Joan Ikonomi

Creative space in virtual reality
Video game designing tools for architecture

IDAUP XXXIV Cycle

Università degli Studi di Ferrara | DA Dipartimento Architettura Ferrara

POLIS UNIVERSITETI

Creative space in virtual reality

Video game designing tools for architecture

Candidate: Joan Ikonomi
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Cycle XXXIV

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Università degli Studi di Ferrara

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UNIVERSITETI POLIS

INTERNATIONAL DOCTORATE IN ARCHITECTURE AND URBAN PLANNING

Cycle XXXIV

IDAUP Coordinator Prof. Roberto Di Giulio

Creative space in virtual reality

Video game designing tools for architecture

PhD. Candidate: JOAN IKONOMI

Curriculum

Architecture / IDAUP Topic 1.2 Inclusive design, design for all, accessibility to spaces, products and services, sustainable design

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"*Technology frequently produces surprises that nobody predicts."*

From "The Metaverse: What It Is, Where to Find it, and Who Will Build It"

Matthew Ball, 2020

"The digital spaces so often frequented by gamers have changed and are changing our notion of space and time, just as film and television did in the 20th century. […] Today we again face the development of new typologies of space –spaces that are emerging from the superimposition of the physical and the virtual. The spaces of the digital games that constitute themselves through the convergence of space, time and play are only the beginning".

Von Borries, F. et al. (2007) in Space time play, computer games, architecture and urbanism: The next

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Contents

Abstract in English

In the last few decades, almost every field has been touched by the new digital state of mind, beginning with commerce, engineering, health studies, education, art, media, and so on. Architecture, traditionally trapped in its physical container, is now being pushed towards the new frontiers of virtual reality with the next generation. The digital age generation values virtual space experiences considerably more than physical environments, resulting in an increasing migration towards virtual reality (Castronova, E, 2007).

According to Marie-Laure Rya`n (2001), virtual reality is *"an immersive, interactive experience generated by a computer, a potential that expands the creation process, opens up the future, and injects a core of meaning beneath the platitude of immediate physical presence*" (MarieLaure Ryan, 2001). This potential applies in various mediums such as films, animation, simulations, videogames, multimedia, software, and applications. However, due to computer limitations, digital worlds in interactive media based on real-time rendering have not been developed to their full potential. The advancement of new media technology (including computer graphics, animation, computer-aided design and real-time 3-dimensional spaces, interactive tools, digital broadcasting, and movie-making) and the increase in computer capacities will broaden the opportunities to create complex and dynamic settings accessible to professionals and users being more user friendly. In this case, virtual space, as opposed to our reality, and influenced by cultural, geographical, and economic factors, can provide different forms of expression to build hybrid and complex realities.

This study will be focused on video game design and architecture to comprehend and investigate the creative and interactive potential of space in a virtual setting. In this thesis, video games were chosen since they are the most popular and advanced virtual reality and interactive media. Video game space will be investigated by examining a series of behavior patterns and tools along with the understanding of a narrative structure such as experience, discovery, interaction, and manipulation, simulation etc. Based on that will be discovered and define a set of processes for storing and manipulating patterns to design complex creative spaces, similar to the human creative process. By investigating the frontier of spatial perception in virtual reality and video games and by exploring design tools, we may liberate imagination and push our comprehension of architecture to the extreme, generating new forms of architecture, the new spaces of our time.

Research methodology is based initially on literature review and the understanding of the current state of art regarding transformation of real and virtual space and architecture in the digital era, elaborating the idea that "architecture is virtual" and that virtual reality is the future of architecture.

Furthermore, architecture will be analyzed from the game/video game prospective. In this regard, theoretical background will focus on video games design aspects of narration and ludology through various authors (Katie Salen and Eric Zimmerman (2003), Juul Jasper (2005), Michael Nitsche (2008), Chris Crawford (2008); Ernest Adam (2010), drawing parallels and discussing the role of game interactivity and narrative in architecture.

In particular, will be discussed the conception of an interactive story structure that enable interactive space in videogames, elements that make up the spatial environment including object, characters and space, interaction and challenges that the space offers to the player via virtual reality.

Following this, qualitative research on game design tools using the "research from design" methodology, will be conducted considering successful game case studies. As result a list of game design tools will be addressed and evaluated with the possibility to be applied in architecture design, architecture visualization, virtual heritage, and urban planning, based on methodology, “research for design”. Analytic tools find out from the theoretical background will be discussed, proposing also a new workflow in the architecture design/visualization process (including virtual heritage and urban planning) and made suggestions with an outlook to further research and applications in architectural practice.

The research seeks for the answers the main characteristics of virtual space that makes them appealing, considering the medium of video games and how they can influence the design process, its representation and architecture in more general terms. The main finding of this research is the definition of a series of behavior patterns that enable more physical interactions between the space and the user. In this sense, the digital interface will be enriched by new architectural perspectives and through a new understanding of object form, navigation, experience, manipulation, interaction etc. These will constitute tools to design virtual interactive spaces, but also can help designers, architects or other professionals dealing with space to develop their creativity.

Keywords: *video game design tools, game space, narration, ludology, virtual architecture, interactivity, representation of VR 3D world, VR Architecture.*

Abstract in italiano (traduzione dal inglese)

Negli ultimi decenni, quasi ogni campo è stato influenzato dal nuovo pensiero digitale, dal economia, ingegneria, ricerca sanitaria, istruzione, arte, media etc.. L'architettura, tradizionalmente confinata nel suo contenitore fisico, viene ora spinta verso nuove frontiere della realtà virtuale con le giovani generazioni. La generazione dell'era digitale preferisce le esperienze virtuali molto più degli ambienti fisici, portando a una crescente emigrazione verso la realtà virtuale (Castronova, E, 2007).

Secondo Marie-Laure Ryan (2001), la realtà virtuale è un'esperienza coinvolgente e interattiva generata dal computer, "un potenziale che espande il processo di creazione, apre il futuro e arrichisce di significati la banalita della presenza fisica immediata " (Marie Laure Ryan, 2001). Questo potenziale e stato applicato in vari mezzi come film, animazione, simulazioni, videogiochi, multimedia, software e applicazioni. Tuttavia, a causa delle limitazioni del computer, i mondi digitali nei media interattivi basati sul rendering in tempo reale non sono stati sviluppati al massimo delle loro potenzialità. Il progresso della tecnologia dei media creativi (computer grafica, progettazione e animazione assistite da computer, ambienti virtuali tridimensionali in tempo reale (RT3D) e progettazione di giochi, trasmissione digitale e produzione di film) e l'aumento delle capacità dei computer stano ampliando le possibilità di creare spazi complessi e dinamici, accessibili a professionisti e utenti essendo molto piu user-friendly. In questo caso, lo spazio virtuale, in opposizione alla nostra realtà fisica che e influenzata da fattori culturali, geografici ed economici, può fornire diverse forme di espressione per costruire realtà ibride e complesse.

Questo studio si concentrerà sulla progettazione e l'architettura di videogiochi per comprendere e indagare il potenziale creativo e interattivo dello spazio virtuale. In questa tesi sono stati scelti i videogiochi come strumenti di analisi, in quanto sono la realtà virtuale e i media interattivi più popolari e avanzati del nostro tempo. Lo spazio dei videogiochi sarà studiato esaminando una serie di modelli e strumenti comportamentali insieme alla comprensione di una struttura narrativa come esperienza, scoperta, interazione e manipolazione, simulazione ecc. Sulla base di ciò verrà scoperto e definito un insieme di processi per immagazzinare e manipolare modelli per progettare spazi creativi complessi, e modelli simili al processo creativo umano. Indagando la frontiera della percezione spaziale nella realtà virtuale e nei videogiochi ed esplorando gli strumenti di progettazione, possiamo liberare l'immaginazione e spingere all'estremo la nostra comprensione dell'architettura, generando nuove forme di architettura, e nuovi spazi rapresentanti del nostro tempo.

La metodologia di ricerca si basa inizialmente sulla revisione della letteratura e sulla comprensione dello stato dell'arte in merito alla trasformazione dello spazio reale e virtuale e dell'architettura nell'era

digitale, elaborando l'idea che "l'architettura è virtuale" e che la realtà virtuale è il futuro dell'architettura.

Inoltre, l'architettura sarà analizzata dal punto di vista del gioco/videogioco. A questo proposito, il background teorico si concentrerà sugli aspetti di progettazione legata ai video game, e cio della narrazione e della ludologia attraverso vari autori (Katie Salen e Eric Zimmerman (2003), Juul Jasper (2005), Michael Nitsche (2008), Chris Crawford (2008); Ernest Adam (2010), tracciando paralleli e discutendo il ruolo dell'interattività del gioco e della narrativa in architettura.

In particolare, verrà discussa la concezione di una struttura narrativa interattiva che abilita lo spazio interattivo nei videogiochi, gli elementi che compongono l'ambiente spaziale tra cui gli oggetti, i personaggi e lo spazio, l'interazione e le sfide che lo spazio offre al giocatore attraverso la realtà virtuale.

Successivamente, sarà condotta una ricerca qualitativa sugli strumenti di progettazione del videogioco utilizzando la metodologia "ricerca dal design", considerando casi di studio di gioco di successo. Di conseguenza, verrà affrontato e valutato un elenco di strumenti di progettazione del gioco con la possibilità di essere applicati nella progettazione dell'architettura, nella visualizzazione dell'architettura, nel patrimonio storico virtuale e nella pianificazione urbana, sulla base della metodologia "ricerca per il design". Saranno discussi gli strumenti analitici ricavati dal background teorico, proponendo anche un nuovo workflow nel processo di progettazione/visualizzazione dell'architettura (inclusi patrimonio virtuale e pianificazione urbana) e verranno forniti suggerimenti con una prospettiva per ulteriori ricerche e applicazioni nella pratica architettonica.

La ricerca si interroga sulle principali caratteristiche dello spazio virtuale dei videogiochi e come possono influenzare il processo di progettazione e rapresentazione dell’architettura e progettazione urbana. Il principale risultato di questa ricerca è la definizione di modelli di comportamento che consentono interazioni fisiche tra lo spazio e l'utente. In questo senso, l'interfaccia digitale sarà arricchita da nuove prospettive architettoniche e da una nuova comprensione della forma dell'oggetto, della navigazione, dell'esperienza, della manipolazione, dell'interazione, ecc. Questi costituiranno strumenti per progettare spazi interattivi virtuali, ma potranno anche aiutare architetti o altri professionisti che si occupano di spazio per sviluppare la loro creatività.

Parole chiave*: strumenti di progettazione di videogiochi, spazio di gioco, narrazione, ludologia, architettura virtuale, interattività, rappresentazione del mondo VR 3D, Architettura VR.*

INTRODUCTION

I. Introduction and problem statement

Over the last decades, virtual reality and virtual space have conquered a central part of our culture. The virtual is occurring in different fields such as art, new media, education, science, health, technology, philosophy, and architecture. Our lives are becoming more and more virtual. Then, who is designing these spaces? Architects appear to be attempting to contribute to the field of immersive and interactive virtual space design by challenging established ways of thinking about space. Still, they consider virtual reality just a tool for communication, not itself a medium. On a contrary, interactive media, and in particular video games, have long been discovered and designed virtual spaces. Since their birth in the late '70s, they have evolved rapidly becoming the major cultural form, changing the face of established media, and becoming a billion-dollar industry and one of the most popular entertainment form, with an increased number of active players worldwide which according to statistics have reached 121 billion dollars in 2017 are expected to reach 180 billion in 2021, with a growing revenue especially in mobile games (Fig.1). The size of the video game marketplace and their popularity especially among the young generation is one of the reasons why video games should be the subject of this study that can contribute to shaping playful architectural spaces in VR.

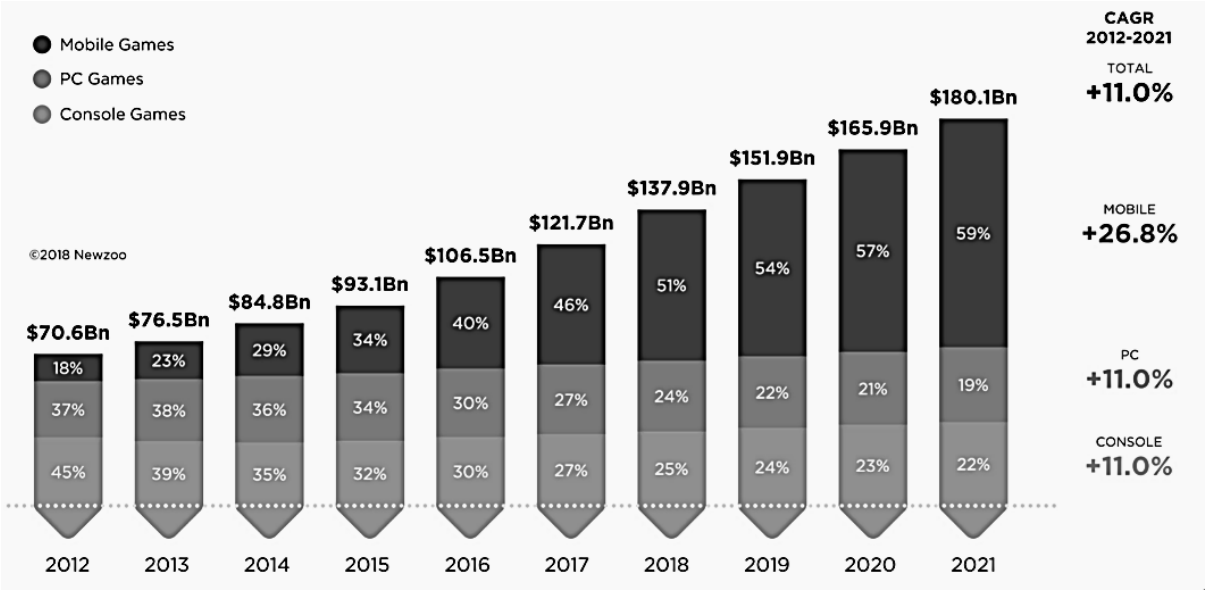


Figure 1 Annual global revenue for video games divided per segment with compound annual growth rates. (source: NewZoo, available online: https://cdn.gamer-network.net/2018/articles/2018-04-30-15-25/segment2.jpg, accessed 20.12.2018)

Today, video games are more than the act of playing. They are primarily viewed as a new media, distinguished by their status as interactive spaces. They permit the user to experience immersive, engaging, and entertaining settings in virtual reality. Furthermore, media scholar Henry Jerkins (2000)

proclaims video games as one of the most dominant art forms in the digital era. They include a dream world, artworks, a narrative, dialogue, and social space. Actually, the primarly role of game designers is to design and sculpt artistic, creative, and interactive spaces. Hence, video game designers are at the frontline of space research. Space in video games is a navigable three-dimensional virtual space experienced visually, either by looking around 360 degrees, navigating to experience and discover space, or using mental abilities to interact and manipulate it based on the creative idea conceptualized in storytelling. In video games, the human obsession of possessing, exploring, and manipulating space, has become possible through the virtual environment and challenges offered. Furthermore, video games have a significant impact on re-modelling communication patterns, social structures, and cultural practices in space. Space is the intersection of digital technology and creativity. As a result, the study of spatially in the video game world in relation to storytelling and gameplay can point out structural patterns and conceptual models of interaction forms, navigation principles of movement within the space which can trigger creative processes of space conception and design in new video games, in cinema, art and most importantly in virtual architecture.

II. Research state of art

The research state of the art is based on two fundamental statements tackling the relationship between architecture, virtual reality, and video games. The first assertion is that architecture is getting more virtual, and the second is that architecture is becoming more like a video game. Architecture, by definition, has always produced fantasy realms and various sorts of utopia, avoiding even the direct confrontation with reality. In this regard, architecture has a long history of designing virtual worlds and exploring new forms of virtuality. Thus, the concept of architecture is not necessarily tied to the real and material but related to immaterial or virtual or to what Emanuel Kant identifies as the phenomena of an "impossibility of architecture" in his “Critique of Pure Reason”[1]. In addition, architecture practices today are getting similar to video games considering the potential that offer the architectonics of game space, the playful character, and the possibility to play with data models and information, to manipulate and manage them, and to create social networks as multi-player’s games.

In the last decades, architecture, VR, and video games share similar design traits on spatiality, visual representation, storytelling, and interaction. They are all based on advanced computer technology that

[1]Kant, Immanuel (1999). *Critique of Pure Reason* (The Cambridge Edition of the Works of Immanuel Kant). *Cambridge University Press.*

includes several technical components as part of the state of arts: 3D graphic adapters / Real-time rendering /Artificial intelligence AI / Networking technologies / Physics simulation/ Human Interaction Devices.

The covid-19 pandemic not only has drawn attention to the virtual environment but has accelerated the virtualization of architecture, acting as a driver for increased use of virtual reality and game design technologies in architectural practices. As result of covid-19, experiments in digital space are becoming cultural practices of being digitally involved into virtual worlds. Virtual reality is gaining ground in architecture and is being used to improve user experience and collaboration among professionals and clients. Architects during the pandemic turned to virtual worlds not only for project design and visualization, but also for collaborating, socializing, and actively participating in shaping their environment. Furthermore, the lockdown period has led to the creation of resilient virtual space largely available to public use, pushing a natural shift towards virtual environments that will never exist in the actual world, such as VR art galleries, museums, collaborative design platforms, and so on. When the pandemic will come to an end, experiences of virtual space will continue to thrive alongside the physical, removing physical barriers to accessing certain spaces and bringing us closer together with different forms of involvements, embodiment, interaction, and social collaboration. As a result, understanding the design process of video games, with its dimension of virtual and playful space, may become an asset value for architecture, historical heritage, and urbanism in the virtual world but also reflected in actual space.

III. Research Questions and Hypotheses

Considering the problem statement, the main research questions are formulated:

- How do video game design aspects like storytelling, ludic, and spatial visualization work in video games? Which are the game tools that can be applied to improve the architectural design process, visualization, and experience in the virtual world? How might video games help architects in improving their design skills?

When aiming to answer the main research question, it is necessary to comprehend how the play space might be designed as well as to investigate the main features and key qualities of video game space, including its morphology, narrative structure, rules, challenges, and the type of interactions offered to the player. What makes the virtual space in video games interactive and what offers more freedom to explore, manipulate and engage the player in the virtual world? Which are the elements that shape or

orient the player's actions/ reactions? This exploratory study aims to investigate how is structured video game space and which are its structural and behavioral patterns. To facilitate the research aim of the thesis this study will explore the fundamentals of video games, their main components, the workflow, and the main process that shapes their design providing challenges for players.

Other research questions ask the relationship between video games, virtual reality, and architecture. This study tries first to conceptualize and interpret the idea of virtual space, its meaning, its evolutionary idea, and the philosophical understanding to explore virtual space in architecture, its features, and if it is distinguished from real/ actual space. In this regard, research will introduce and analyze architecture in cyberspace showing the state of the art and the possibilities to expand the frontiers of spatial design in the virtual world. In addition, research traces parallels between architecture and videogame, suggesting the discussion of play, game, and video game as practices in architecture not only as an activity or pleasurable practice in space but also as an interacting experience and a visualization of space in VR. Lastly, this study questions interpretation mode on the process of gamification or the use of game design tools in the realm of architecture. What have others done; how have they implemented these tools in various fields of architecture; how can that be improved and in which direction could be oriented the architecture practice?

The research hypothesis is that the virtual space of architecture being further enriched by using a set of narrative, representation, and interactive tools found out through the analyses of video games, can become more interactive and creative and expand the limits of traditional space in architecture and urbanism, affecting positively the creative process of architects and designers and the participation process of a larger audience. The implementation of virtual gamified tactics in architecture or urban design will motivate and promote professional, citizen, and student engagement in a more dynamic, interactive, and collaborative environment thanks to the immersive visual technologies found in video games.

IV. Research objectives and limitation

The main objective of the research lies in promoting the use of game design tools to improve the education of future architects and support them to create a professional design in the architecture and urban planning field. **The primary goal of the research** is to demonstrate the affiliation of architecture with virtual reality and video games. Based on these affiliations, the main objective of this research is to explore the spatiality in video games (as one of the most advanced and appreciated mediums that

provide human-space interactivity) by considering a series of tools and behavior patterns in relation to space representation, narrative, and interactive design and to discuss the application of these tools to design complex creative spaces as new forms of architecture related to our time. This study will demonstrate the great impact video games have on changing architecture design practices and workflow in virtual space and the same formal language of architecture space. The goal of this research is to provide video game tools to create an interactive architectural space. Furthermore, will be discussed other video games tools applied in architecture that enhance architecture design processes, as well as communication and collaboration between different stakeholders dealing with the design process. Gamification of architecture and urban scenarios may aid in the formation and professional practice of students and architects by facilitating and offering an effective design process. The creation of serious games dedicated to architecture as a public participation tool and/or as a method of assisted design would significantly improve the understanding of architectural form generation as well as the ability to address and solve architecture and urban design challenges effectively and in a sustainable way while considering all groups involved.

The primary concern of this research is that computational virtuosity that allows sophisticated gamification in architecture, is limited to highly innovative and multidisciplinary academic settings and to experimental or star architecture design firms. Thus, research is limited to a theoretical discussion, exploration, comparison, and critical analyses of current limited applications and the definition of a new workflow which introduces new design tools in the architecture design process, considering in the digital age, the continuous training of architects with game design instruments.

V. Methodology

The research methodology is grounded on a literature review and a knowledge of the current state of the art at the convergence of architecture, virtual reality, and video games, demonstrating that virtual reality and video games are shaping the future of architecture. In this regard, historical and philosophical perspectives on the nature of virtual reality and virtual space and in particular on the transformation of architecture space from real to virtual with be discussed based on various authors from Greek philosophers such as Aristotle and Plato, to a modern philosophical concept of virtuality elaborated by Gilles Deleuze (1991), to the concept of virtual reality in the era of information technology with the cyber theories of Jean Baudrillard (1981), Paul Virilio (1994) and PierreLevy (1999) with the metaphysic conception of virtual reality by Michael Heim (1993) and the virtual bodies of Katherine Hayle's (1999).

An analogous discourse will be held also in the realm of architecture, focusing on various types of "virtual" architectures, ranging from paintings and drawings of utopian visions to architecture in novels, movies, and artwork in video games, up to the nowadays conceptions of Marcos Novak cyber architecture and experimentations of Greg Lynn and Asymptote.

Then, this study will focus on the understanding of play, games, and video games and will explore fundamentals of video game design focusing on the following authors: (Katie Salen and Eric Zimmerman (2003), Juul Jasper (2005), Michael Nitsche (2008), Chris Crawford (2008); Ernest Adam (2010)) (Fig. 2) dealing with conceptual and structural frameworks of video game design.

Figure 2*The book covers of the main books utilised for theoretical background on video game definition and structure.*

In this regard, analogies will be traced with architecture in order to understand aspects of videogames that could be relevant to analyses and discuss in view of their use in architecture. Hence, the theoretical background on architecture considered as a PLAY, GAME, AND VIDEO GAME will be explored based on various authors and multiple design experimentations such as Cedric Price, MVRDV, BIG, Kas Oosterhuis,, etc. Games and video games can be found in architecture in multiple dimensions:

1. ***Interactive architecture/ rule-based architecture/ programmable / generative or compositional architecture*** (a playful approach in architecture creation process)
2. ***Simulation-Based Architectural Design*** (Design for complex urban challenges/ city development)
3. ***Narrative architecture*** (a narrative approach in the architecture creation process)

The methodology is being developed in stages considering the current state of the art. First, a theoretical framework based on the three main structural elements of game design is explored, followed by a literature review based on the authors listed below.

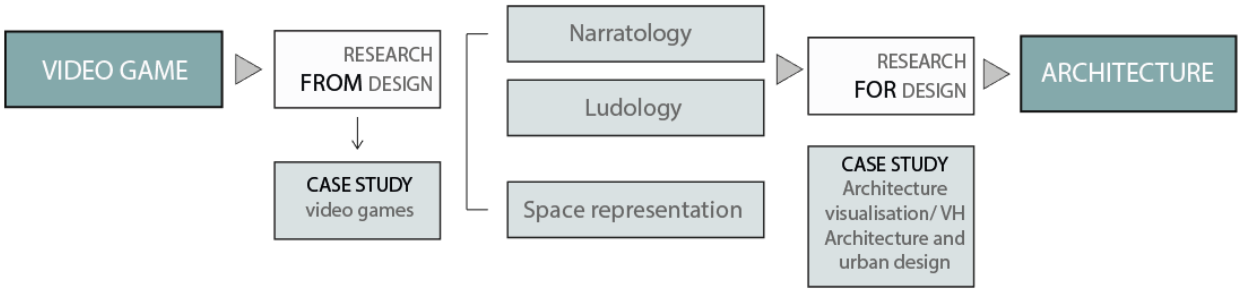


Figure 3 The book covers of the main books utilised for theoretical background on video game definition and structure.

1. Ludology in video game design, particularly interactivity, simulation, and artificial intelligence (Juul, J. 1998, Eskelinen, M. 2001, Frasca, 2003; Aarseth, 2004; Mateas and Stern, 2004. Crawford, C., (2002))
2. Space depiction in video games (Michael Nitsche, 2008)
3. Narrative or storytelling in video games (Janet Murray,1997; Jenkins, 2004)

In addition, theoretical background on the narrative and ludology will be discussed also in architecture. literature review of the following writers (Gordon Cullen (1961), Sophia Psarra (2009), Tschumi (2004), and Nigel Coates (2012)) will be used to understand narrative architecture. In addition, theories from literature and film based on various authors (Aristotle Three Act Structure, Sergei Eisenstein (1938), Sophia Psarra) (2009) will be used to tackle story narrative in architecture. Based on a thorough literature analysis and the following authors: (McMillan (2002), Rafaeli and Ariel (2007), Mitchell (2000), Kronenburg (2007), Novak (1999)), ludological and interaction elements of architecture and space in virtual reality will be examined.

Following the theoretical background, successful video games case studies will be analyzed, in relation to the narrative, ludology, and game space representation or aesthetics. The methodology used in this stage is "**research from design**". Analytic tools find out from the theoretical background and the analyses of case studies of existing video games will constitute the basis for the gamification of architecture, and for the proposal of new spaces not conceptualized before in this field.

Finally, case studies on gamification in virtual architecture, virtual heritage, and urban planning will be addressed and systematically evaluated using various video game technologies to acquire a better knowledge of the existing workflow and identify possible future recommendations. In this sense, the methodology's last section, **"research for design,"** will lead to the development of game design tools for use in virtual architecture.

VI. Implications of the Research and future research

This research envisions possibilities to extend the human interaction in the virtual space beyond video games, providing new possibilities for virtual architecture in terms of virtual space exploration, control and manipulation, interactivity, and social communication, which can completely change the architecture design process, but also the offer large access to architecture in the virtual environment.

Implications of the research are the engagement of architects in the design of the virtual world, as part of the metaverse[2], or contributing in building “digital twins” with information data and gaming rules that can serve to control real-time architecture dynamics, to test performance, and forecast changes by gathering all sort of data through sensors and aiding the field of construction, engineering, energy efficiency, heritage as well as a different aspect of urban planning.

In this sense, architects of the future will need to combine professional expertise from multiple fields and their professional background must require the use of digital media and 3D technologies. In light of this, one of the research's major implications is the incorporation of expertise from digital media and video games into architectural education.

Future research might focus on experimenting with game design tools in architecture practices, which is presently constrained owing to prohibitively high costs. Secondly, future studies can go beyond the visual perception of the virtual space to investigate and engage with it using other senses such as taste, touch, and smell. Most of the architectural innovation is linked to technological advancement.

VII. Stakeholders

The architecture industry nowadays is relying more and more on digital tools of modeling, visualization, interaction, simulation, and performance control. Moreover, advanced technology in VR and the tools used in multiplayer games have the potential to improve communications among different stakeholders, such as professionals, inhabitants, clients, etc. Thus, this research will help various categories of professionals who build real and virtual architecture or virtual reality worlds, like **Visual Artists, 3d**

[2]A term coined by Stephenson in the dystopian novel "Snow Crash" and used in 2021 by Facebook CEO Mark Zuckerberg to rebrand Facebook as a shared virtual environment in which people access and interact using different devices.

Animators, Multimedia Designers, Architects, Urban Planners, etc., to identify and define a set of display, navigation and manipulation patterns that can help them in the design process of creative and interactive spaces which can push further the frontiers of space.

This research can serve particularly **professionals and students of architecture** to be oriented and trained to work with gaming tools to build generative forms and advanced visualizations in architecture, real-time interactive visualization which can be manipulated in an interactive ay by multiple actors and make the design process more open and collaborative. In this regard, the use of gaming tools also facilitates communication with clients and serves **the client** to have a clear idea of architecture and to discuss various options before building it. Moreover, clients, thanks to AR technologies can overlap the design with the real environment and have a more realistic idea of its implementation.

Other stakeholders include **technical or managerial professionals in fields related to architecture, such as engineers, urban planners**, and others, who can benefit from the use of digital twins of real objects, which contain data from the real world and can be used to control the performance of real objects or solve complex problems like those encountered in simulator construction games or resource management games.

People who immerse themselves in a virtual environment, such as architecture, cities, virtual heritage, or museums, are also immediate beneficiaries. They can visit places or buildings that are far away or don't exist at all but are recreated as 3D representations. Furthermore, they may investigate them from multiple angles, which is not feasible in the actual world. Finally, because video games are so prominent in today's media, and VR is becoming part of our daily lives, this search involves a wide range of stakeholders from numerous industries.

VIII. Structure of the thesis

Chapter 1 addresses the nature of virtual space from a philosophical standpoint and investigates "architecture as virtual" through a variety of mediums varying from literature to movies, drawings, video games, and current virtual reality experiences. The purpose of this chapter is to elaborate the idea that architecture is virtual and that virtual reality is the future of architecture.

Chapter 2covers the theoretical background on video games fundamentals, including video game definition, game genre, their main elements of video games related to and the components of game play

and a literature review on architecture comparison with video game. This chapter seeks to draw parallels and analyses analogies between video games and architecture in order to focus the research domains in three primary shared areas: narrative, ludology, and game/architecture spatial representation or visualization.

Chapter 3covers a theoretical background on narrative in video games and architecture, identifying analogies and exploring the importance of narrative in virtual architecture.

Chapter 4 covers a theoretical background on ludology and interaction in video games and architecture, drawing parallels and discussing the role of game interactivity and gaming in an immersive and playful virtual architecture.

In Chapter 5, we conducted qualitative research on game design tools using the "research from design" methodology, beginning with three primary areas of study: narrative, ludology, and aesthetic representation or visualization. As a consequence of the analysis of successful game case studies, a list of game design tools will be addressed.

Chapter 6 analyses and evaluates the use of game design tools in architectural design, architecture visualization, virtual heritage, and urban planning, based on methodology, "research for design". Qualitative feedback and observations are given as findings.

Chapter 7addressed the thesis's findings, `proposed a new workflow in the architecture design/visualization process (including virtual heritage and urban planning) and made suggestions with an outlook to further research and applications in architectural practice.

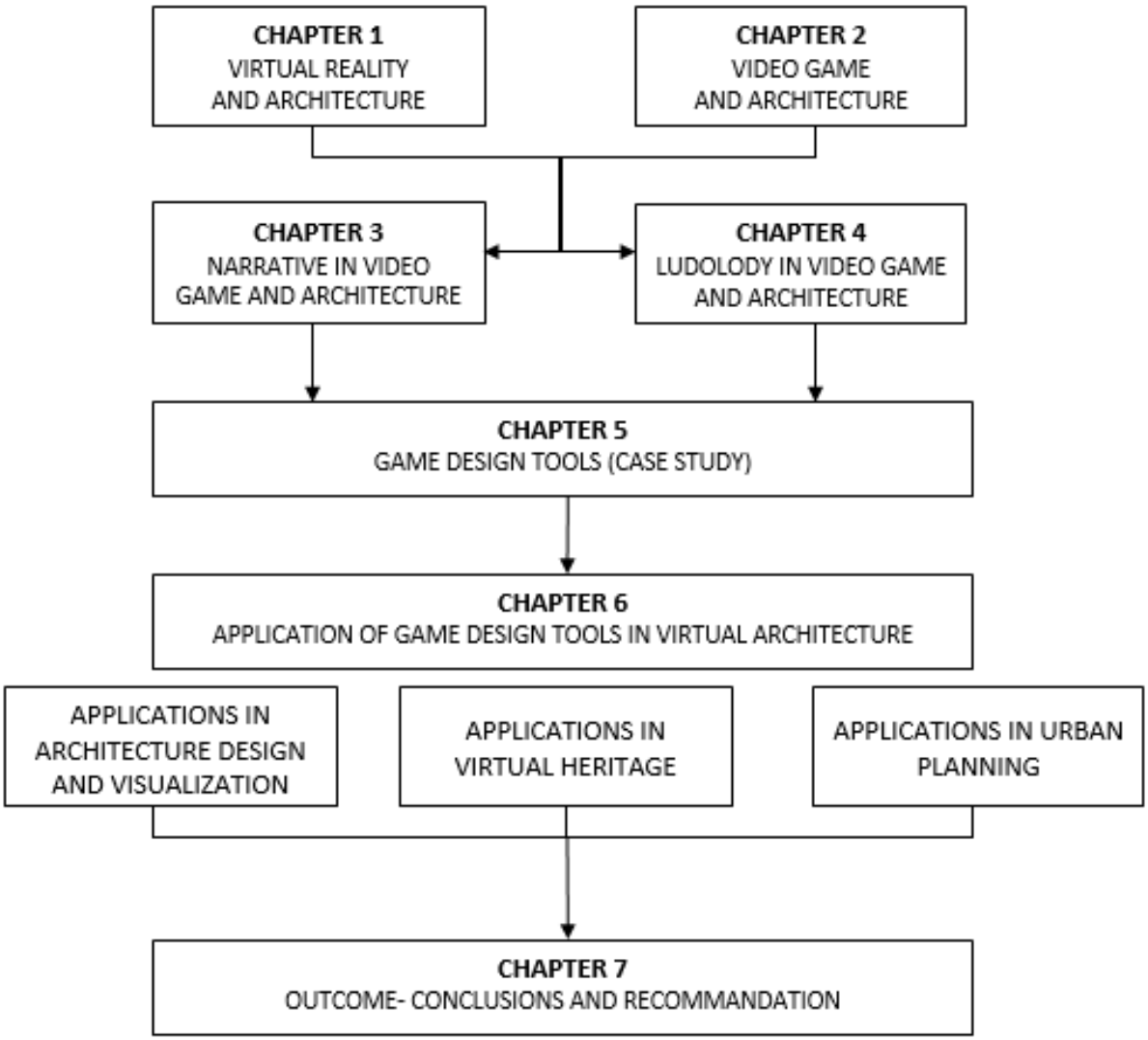


Table 1 Structure of the thesis (source: Authors)

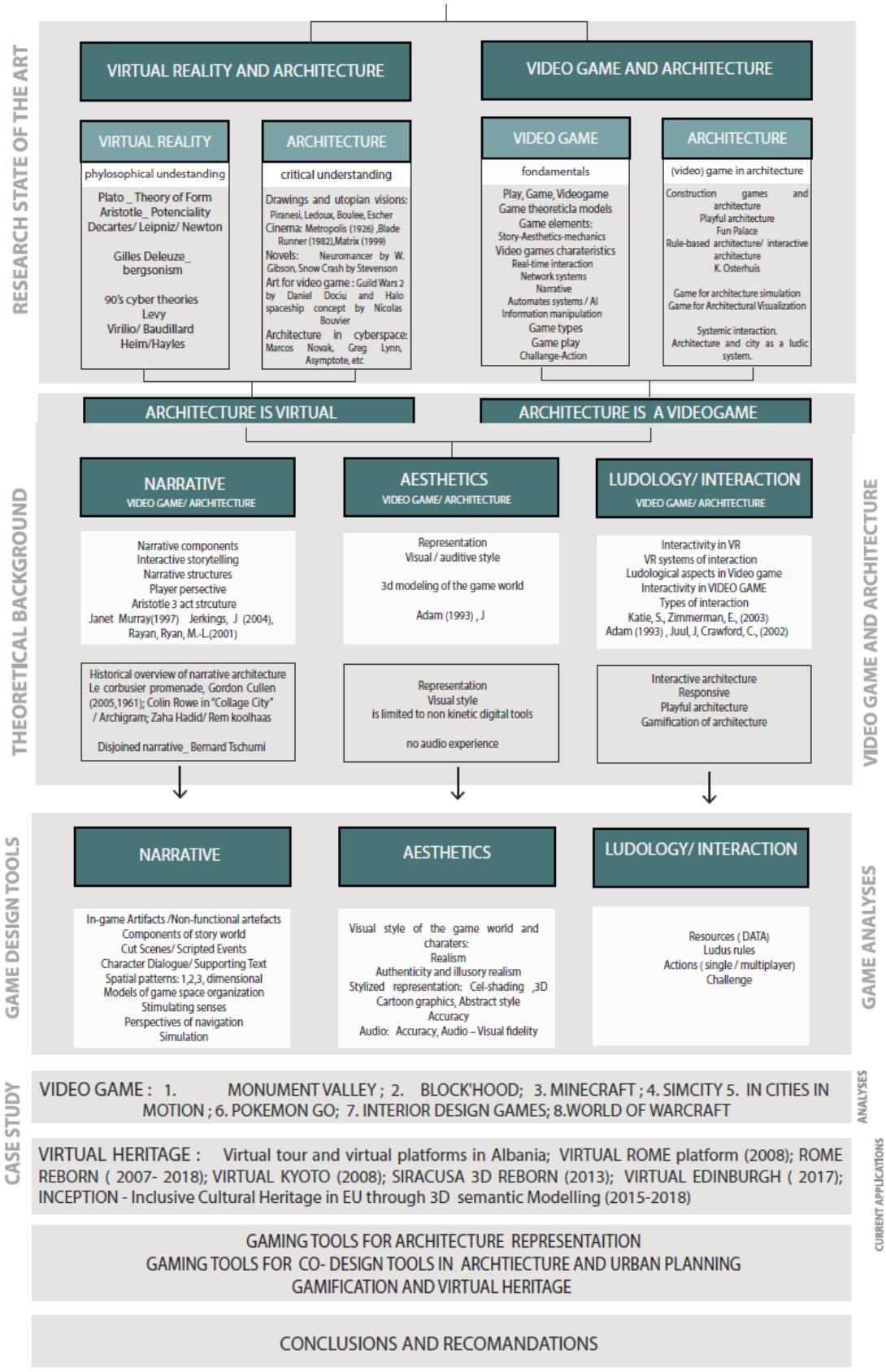


Table 2 Detailed structure of the thesis: Creative space in virtual reality (source: Authors)

CHAPTER 1 – VIRTUAL REALITY AND ARCHITECTURE

"There is no purely actual object. Every actuality surrounds itself with a fog of virtual images."

(Deleuze, *The Actual and the Virtual*, 1997)

1.1 A PHILOSOPHICAL IDEA OF SPACE. ACTUAL, REAL, POSSIBLE AND VIRTUAL.

The ancient and medieval idea of reality and virtuality

Greek philosophers were the first to theorize about reality. Plato theorized the realm of ideas or perfect forms as the sole real space, in his Theory of Ideas (or Theory of Form). According to Plato, ideas are the essence of things, and the physical space is not necessarily real, nor perfect, but a mere representation in the material world of objects that try to imitate the world of ideas. So, while Plato considers the realm of ideas to be the real world, populated by abstract objects, the physical world is the reflected materialized and imperfect representation of it. We all experience Plato's allegory of the man in the cave looking at the shadows created by light reflects the analogy with the illusion of the real word (fig.4). **Plato** as a metaphysical dualist believes that reality exists in two different realms, **the real and the virtual** and can be explained considering two separate substances**: the imperfect material or physical world and the perfect immaterial or mental world of ideas.** As a result, in Plato's view, the reality is recognized primarily via the intellect (from inside), rather than through direct sensory experience. In his view, the world of ideas or the being represents the virtual, and the virtual is more real and perfect than the physical or materialworld, which is the subject of constant change**.**

Figure 4 Plato's allegory of the cave (Source: MatiasEnElMundo, https://www.thoughtco.com/the-allegory-of-the-cave-120330)

Aristotle rejected Plato's world of ideas as a separate entity from the real world, and proposed only one level of reality, although he made a distinction between actuality or reality (things happening in real time) and *dýnamis*, potentiality or virtuality (things which can potentially happen). **Aristotle introduced**

the concept of physics and metaphysics. To him, they cannot be considered as separated realities, but are instead part of every entity of our world, and in individuals are represented through Body and Psyche. Moreover, the potential and the actual are continuously transformed into each other. In contrast to Plato, Aristoteles considered space substantial and dynamic, defining it as a container of objects in continuous motion. Space assumes a variety of possible states, which not being actual are considered as virtual. Theatre, for instance, was considered as a virtual world, in which experience differed from that of real life, and had no direct impact on it. It does, however, have the potential to become real. **That suggests that real and virtual are dynamic and evolve through time, and the virtual is the potentiality of essence to become real.**

Following Aristoteles' stance on potentiality, Thomas Aquinas presents the notion of virtuality as a synonym for potency in the High Middle Ages, although this term had not yet emerged. “Virtuality” and “virtual”, as we know them today, originate from Latin "uirtus" and the deriving nouns and adverbs "uirtualitas", and "uirtualis", etc. In latin "uirtus" assumed different meanings from individual psychological features such as the conformity of life, the living according to natural principles and possessing ethical and moral value, to physical attributes given by nature, "virilitas", such as power, masculinity, bravery, courage, and so on.Thomas Aquinas recognized and emphasized the double meaning of "uirtus" or what he defined as "potency": on one hand the ethical and moral dimension, which he associated with Christian principles, and on the other the actions of violent power. Aquinas placed them in antagonism, giving power a negative connotation that subsequently changed to creative potency or potentiality. In this sense, "uirtualis" as explained by Aquinas refers to two types of contacts: the virtual as characteristic of the state of being and the corporeal, as the quantity of masses, which characterizes physical things. Furthermore, Aquinas asserts that virtual contact may affect and modify the physical condition and considered this as the starting point of action. Similarly, to Aristoteles thought on the dynamic change between virtual and real, Aquinas referring to the human beings, states that the body is virtually inside the semen “*corpus humanum in semine est uirtualiter*” (Aquinas, 1475, De potentia 3,9,9), and has the potentiality to be transformed into a physical being.

By generalizing his notion, we might conclude that any virtual form can potentially be turned into physical reality. It refers to something which without being real, can produce a similar effect. The work of Aquinas definitively established the meaning of virtuality and became a reference point for studies on space and advanced computer technology in the twenty-first century.

The modern concept of real and virtual space

The modern concept of space has its origins in the illumines during the XVII and XVIII centuries, with Descartes, Newton, and Leibniz. Rene Descartes established the notion of expanded substance space in the seventeenth century, with the expansion of Euclidian Space. The corporeal world expands to become infinite, "*something that is expanded in length, width and depth*" (AT VIIIA 46; CSM I 227). Space derives from mind and matter (body), and referring to them, Descartes made a distinction between internal (the volume bounded) and external space (the boundary, the surface surrounding objects or places).Leibniz proposed a metaphysically innovative theory of space and time based on the belief that they are virtual mathematical relationships rather than real and substantial ones. Leibniz viewed space to be divided into parts that may or may not be linked to one another. The "Relacionalism" thesis of Leibniz is concerned with the connection of objects and events in time and space, as well as their relative motility. Similarly, Newton regarded space as non-material, but with a more scientific bent, he distinguished between absolute and relative space. Things in space developed immutable qualities, as well as attributes that change based on the position of the observed objects.

The overcoming of the Cartesian coordinate system, the introduction of space-time dimension, and the concept of inertia emphasized both the rationalist and relativist conceptions of space. Leibniz as Newton considered space to be relative and characterized it as an order of objects in time. Later, Kant investigates the role of human perception in the existence of space and time. Kant related space and time to being and described them as concrete modalities of existence that govern human experience. For this reason, the being is the means by which experience is interpreted.

> "*Space and time are not phenomenal world realities, but rather modes through which we perceive things*." (Kant, 1781, 1999)

To sum up, during the illumines, space was viewed not only as an abstract set of objects and void related to each other in time and space, but also a physical phenomenon characterized by physical features such as dimensions, shape, organization, and connections, etc.

The concept of virtual reality or “virtuality” as a modern philosophical concept, was defined and elaborated by Gilles Deleuze in “Bergsonism” (1991) based on Proust’s understanding of time and memory and centered on Bergson’s philosophy on the notion of virtual. Memories and dreams, according to Proust, were virtual "*real without being actual, ideal without being abstract.*" They cannot be confused with actual experience although they may seem real and have the power to enrich our

experience. Bergson (1988) in his seminal book, "*Matter and Memory*" explains how matter and memory interact with one another and shows how perception is affected by memory.

> *"…the virtual is synonymous with intuition. ... precisely to the fact that our consciousness, which begins by being only memory, prolongs a plurality of moments into each other, contracting them into a single intuition*" (Bergson, 1991, p. 219).

> *"…the virtual image evolves toward the virtual sensation and the virtual sensation toward real movement: this movement, in realizing itself, realizes both the sensation of which it might have been the natural continuation and the image*" (Bergson, 1988, p.131)

Bergson considers memory as virtual[3], since it does not exist under material form in the brain, and hence does not exist in the actual realm. This is an ontological distinction between Matter and Memory.

Deleuze in "Bergsonism" (1991) argues that Bergson considers pure memory as "*the conservation and preservation of the past in the present*". In his view, memory is as an existing entity, an image of the past contained in the present, which exists virtually not actually. In other words, the existing past coexist with the present, as individuals sense its effects as an experience accumulated from the past. We are all bound to the past, which exist virtually, but constitutes also our experience in the present. In this sense, the virtual is not in opposition with the real.

> *"The virtual is opposed not to the real but to the actual. The virtual is fully real in so far as it is virtual. Exactly what Proust said of states of resonance must be said of the virtual: 'Real without being actual, ideal without being abstract'; and symbolic without being fictional."* (Deleuze, 1914, p.208)

In his work, Deleuze emphasized and argued the distinction proposed by Bergson between the virtual, the actual, the real and the possible and in particular emphasized the distinction between the virtual/actual and possible/real (Deleuze, 1994). According to Deleuze, virtual/actual are both real, not opposite to each other, but still are not equivalent, as they represent different ways of being and belong to parallel realms. The virtual tends to become actual through the actualization process, without trying to become material or concrete. On the contrary, the possible is the opposite of reality and only its realization can make it equivalent to the real.

[3] a term rarely used by Bergson

The virtual is a ‘real idealization’ until it is actualized. Deleuze's view, negate the idea that the real is only the actual and concrete, hence the virtual may be described as the domain of real objects and space. However, it is not the mere rephrasing or replication of reality, nor the prospect of becoming real, as virtual is in itself real. Its power lies in the potential drivers of the ideal or possible toward actuality. Deleuze employed Bergson's idea of virtuality as “élan vital” (vital force) and used it to argue to creative aspect actualization. In this approach, Deleuze, sustains a novel conception role of virtuality as part of reality, implying that virtuality might serve as a fertile ground for the creation and genesis of objects, ideas, and new qualities in space.

That constitutes the point of interest of Deleuze's notion of virtuality regarding today's creative virtual space possibilities. Deleuze (2014) in his book “Difference and Repetition” sustains that creation comes out through ‘difference or divergence’, since virtual and the actual are not identical to each other as possible and real are. The actualization of the virtual implies a distinction, typical in the creative process of art.

> *“… the characteristic of virtuality is to exist in such a way that it is actualized by being differentiated and is forced to differentiate itself, to create its lines of differentiation to be actualized*” (Deleuze (2014).

This opens the door to actual creative realms in scholastic philosophy or virtuality.

On the other side realization, the process of bringing the possible into existence is quite different. Deleuze in “*Bergsonism*”, highlighted two elements characterizing realization: resemblance and limitation. The term "resemblance" refers to the fact that the real is supposed to resample the possible that it realizes. As a result, while the real does not resemble the possible, because there are infinite possibilities, "the possible" that goes through the process of realization resembles the real. The process of realization is likewise constrained so that some possibilities are prevented to become real. In short, realization of possible to real eliminates the creative act, not being able to add anything new to the real. In conclusion, virtual reality is conceived by Deleuze as a productive power.

The idea of virtual reality in the age of information technology. 90's cyber theories.

Virtuality will destroy reality. P. Virilio

With the spread of computer technology throughout the previous century, philosophical understanding of the virtual got more incisive. Pierre Lévy is one of the authors who has systematically examined the notion of virtual and virtualization in connection to the IT revolution. Building on Deleuze's (1968) ideas, Pierre Levy (1999) investigates the human condition in the modern information society, researching and analysing four stages of existence (**Possible/ Real/ Actual/ Virtual),** suggesting that the passage from one state to the other has marked human progress. Levy maintains a link between the virtual and the real. The virtual, in his philosophical perspective, is an important facet of reality (Levy, 1999).

> "*The virtual is by no means the opposite of the real. On the contrary, it is a fecund and powerful mode of being that expands the process of creation, opens up the future, injects a core of meaning beneath the platitude of immediate physical presence." (Levy, 1999, p.16)*

With a similar view to Deleuze, Levy considers the virtual as something that embodies the potential to be real, but to him, the virtual is not predetermined. On a contrary, the virtual is seen as a powerful tool for something to be transformed into something new and creative. This change or passage from virtual to real is defined as the actualization process, and set virtual as connected to the actual. In this sense, virtual objects can produce unpredictable effects and a change of identity. Cybernetic theoretician and critic Marie-Laure Ryan defined it as "*a form-giving force*" (Ryan, 1999, 92).

Levy's modes of existence: The Real/ the Possible / The Virtual /The actual

Examining the similarities and differences of its four state of existence, Levy argued that both real and possible are substances and represent ideas. However, they differ from each other, as the real is related to a concrete manifestation while the possible has the potential to be real but is still ephemeral. The possible does not exist, is not present. For instance, two objects differ from each other from the fact that one exists (come into real) and the other not. On the other side virtual and actual are considered as events, which in philosophical view truly exist, and are set as their representation. Virtual is set as a potential, not as an act of realisation. Moreover, Levy's state of existence can be coupled reversely: Real and Actual modes are concrete manifestations while Potential and Virtual are latent. Levy's position is oriented towards the exploration and explanation of possibility and potentiality of the different modes of existing.

	LATENT (ABSTRACT)		MANIFESTATION (CONCRETE)
SUBSTANCE	**Possible/ Potential**	Realisation → ← Potentialization	**Real**
EVENT	**Virtual**	Actualisation → ← Virtualisation	**Actual**

Table 3 Levy's modes of existence and their transformation processes (Levy, 1999)

He distinguishes two types of virtual transformation: actualization and virtualization (Levy, 1999). Actualization is the process of transforming the virtual (as an idea or abstract thing) into concrete form and new quality. Virtualization is defined as the reverse journey from the actual to the virtual, which transforms an entity by redefining the problem to design a new solution. It goes back to the elements that inspire our acts. In this sense, virtualization was seen as a means of creation and is significant to this study in the process of creating realities.

New theories of reality and virtuality in Virilio and Baudrillard

Virtual reality is "*a digital environment generated by a computer that can be interactively experienced as if this environment were real*" (Jerald,J. 2015, p.9)

Before the advent of information technology, communication was direct and visceral. Hereafter, communication became intermediate, rather than directly resulting in a change at the level of perception, having on one side the illusion of non-intermediation, and on the other having the actual feeling of the reality, as if they were truly present and immersed in that reality.

In this evolving reality perception, Paul Virilio develops a new theory of reality and virtuality in his book "The Vision Machine." According to Virilio, technical advancement and the widespread use of computers was a watershed moment that influenced a shift in how we view the world. The shift in perception occurred when the reality or images we see and perceive as instant reality became not merely reproducible, as in the invention of photography, but also displayed, reinvented, and simulated in real-time.

"*The paradoxical logic emerges when the real-time image dominates the thing represented, real time subsequently prevailing over real space, virtuality dominating actuality and turning the very concept of reality on its head. Whence the crisis in traditional forms of representation (graphics,*

photography, cinema…), to the advantage of presentation, of a paradoxical presence, the long-distance telepresence of the object or being which provides their very existence, here and now." (Virilio, 1994, p.63 The Vision Machine)

Virtuality in the age of information technologies, mediated by haptic technologies and advanced computers has become an automated perception or machine–like perception. (Virilio, 1994). Brain activity is substituted by media. In this sense, to Virilio, the distinction between reality and virtual what makes reality is the way we perceive things, and as consequence the machine itself may generated realitites, and things perceived through the machine can be defined as virtually real. In the newly virtual interaction, dictated by machine, Virilio found the disappearance of body and location and the substitution by virtual images and networks. In this sense virtuality takes overcomes materiality.

With highly sophisticated technology and the improvement of computer performance, virtual reality is becoming capable of replacing actual space and object, simulating them at best. In this sense, reality is being recreated artificially simulating the physical environment with the aim to create comfortable interaction. Moreover, Baudrillard (1981) sustain that virtual reality is not simply the reproduction or simulation of existing reality, but it can also provide space for invention, modification and the new reality can result as fake. This ability to retouch or reinvent the world artificially without losing its originality is defined as “hypereality” by Baudrillard.

Baudrillard reality is created by simulactra, or simulation of fake images, objects, and events as they were taking place in a physical form. In this sense reality ceased to exist as a concrete physical form and was replaced by fake reality or hyperreality. While Virilio sustain that reality change because of new forms of perception, which make us reinterpret reality through mediated vision, as an automated virtually different from the factual, Baudrillard added a further dimension of reality sustaining claiming that what changes is the content and meaning, and that there is no direct relation between reality and simulation. This contrasts with Plato's belief that ideas are superior to reality, and in his view, reflection is not directly related to the real.

Digital virtuality in the age of advanced digital technology.

With the advancement of digital and information technology, the term "virtual" has come to signify first "simulated," and it has become an alternate expression of the real. Shield () argues that virtual reality uses technology to replicate reality and to test real conditions avoiding the normal risk. Technology

attempts to replicate sensory information of the physical world and provide better control on it, by building and "information-world" based on the real or "digital twins". In this case the digital twin exceeds and upgradesthe real.

In her essay "Embodied Virtuality," Katherine Hayles (1999) defined the virtual as a duality of material and information,

> "*The perception that material structures are interpenetrated with informational patterns*." (Hayles, 1999, p.6)

Michael Heim gives a wider perspective on virtuality in relation to information technology that is increasingly impacting the contemporary culture.

> "*Virtual reality is a technology that convinces the participant that he or she is actually in another place by substituting the primary sensory input with data received produced by a computer… when the virtual world becomes a workspace, and the user identifies with the virtual body and feels a sense of belonging to a virtual community*." (Heim,1998, p.221)

Heim considers virtual reality as a technology and outlines components of virtual reality in the age of modern digital technology. Full-body immersion, simulation, interactivity, artificiality, telepresence, and networked communications are some of them. (Tab.4)

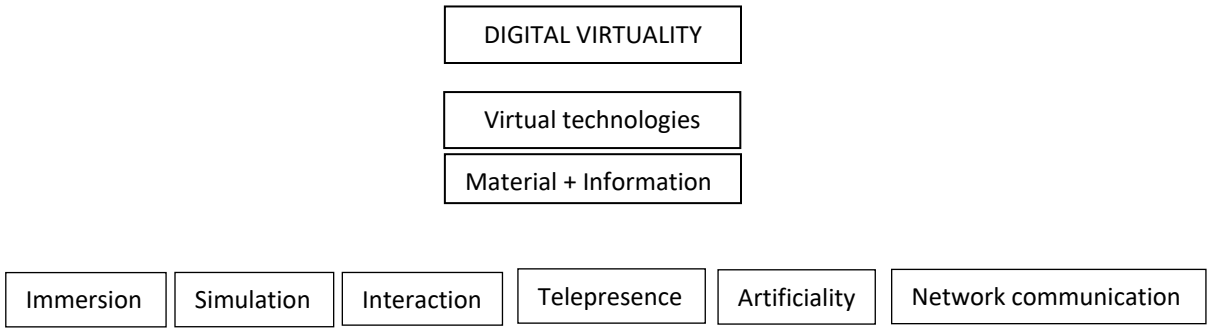


Table 4 Aspects of virtuality in the age of advance information technology

To recapitulate, in the era of modern information technology, virtual space becomes digital virtuality. A computer is used to develop and process objects and information. Users might immerse themselves and engage with this world by using devices that allow them to connect to virtual reality.

1.2 ARCHITECTURE IS VIRTUAL

Architecture in the work of visionary architect and artist

The definition of architecture has evolved throughout time, from real structures to hand-drawn views, to imaginary and utopian spaces, to digital imagery and virtual reality. Otto Ettlinger (2007), a virtual architect, and media theorist, argues that architecture space is a result of visual mediums that have evolved from painting to literature, film, and, in recent decades, virtual reality and video games. Architects cannot construct a physical structure without the virtual filter, which is a communication tool that portrays structures through plans, sections, facades, perspectives, renderings, animations, VR, and so on.

During the Renaissance, the invention of the linear perspective altered the way buildings was portrayed. For the first time in history, during the Renaissance, this type of depiction placed the person at the center of his visual experience. Individuals can view in three dimensions via a window, on a canvas or rectangular screen, which is like virtual reality in many ways (fig.5). Brunelleschi's approach demonstrated the link between space, the spectator, and the space of representation. According to Lev Manovich's digital media theorist, we live already in the screen era. As technology advances, the screen will become part of our bodies, similarly as machines are now attached to us.

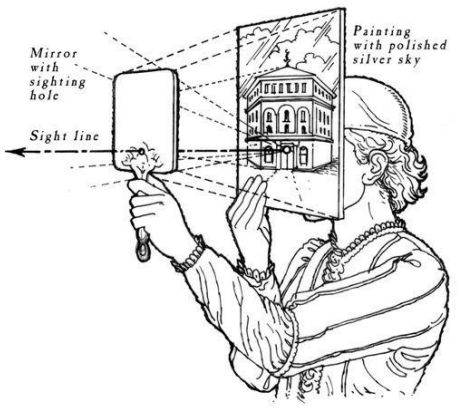


Figure 5 Linear perspective by Brunelleschi

During the XVIII century, architects and artists searched for means to represent utopias, dystopias, fantasies, visions, possibilities. Piranesi created several drawings of rebuilt and reconstructed Rome vistas via monumental ancient structures, like "*Campo Marzio*," which depicts an idealized accumulation of architectures, rich of details integrated innovatively (fig.6.a). Furthermore, he created the well-known

imaginative exploration "*Invenzioni capric de carceri*," a theatrical fantastic portrayal of prisons atmosphere (fig.6,c) .

In Rome, Pannini, one of Piranesi's mentors, created a new type of cityscape or "*veduta*" called "*capriccio*" or architectural fantasy, based on a haphazard arrangement of buildings and sculptures on the canvas (fig.6.b). Murray, 1971. While Pannini is more concerned with a realistic portrayal of fictional ruins emphasizing the scenic and atmospheric nature, Piranesi is more interested in the impact provided by the contrast of light and shadow, deeper lines, and so on. That creates a sense of movement in Piranesi's works. In Piranesi's drawings, this creates a sensation of immersion.

Figure 6, a) Piranesi Campo Marzion, b) Pannini " Caprici", c) Carceri d'invenzione, Plate X: Prisoners on a Projecting Platform. Piranesi. 1750

Other visionary architects and artists whose works can now be considered virtual architectures include Claude Nicholas Ledoux, Etienne-Louis Boullée,Bruno Taut with their Utopian projects, Escher with his impossible world drawings and El Lissitzsky, with his series of paintings "Proun" (fig.8.b) which are considered as 'imaginary space" constructs, among others. Virtual architecture has its deep and profound precedents in these histories of visualization and visionary works.

Étienne-Louis Boullée was the first to challenge Vitruvian notions of architecture as merely the art of construction. Boullée, on the other hand, argued that:

> "*…in order to execute, it is first necessary to conceive. Our earliest ancestors built their huts only when they had a picture of them in their minds. It is this product of the mind, this process of creation that constitutes architecture* …" (Boullée, E.L, 1976, p.83)

In fact, Boullée is almost entirely known for the futuristic and utopian unbuilt projects he made in the last two decades of his life such as "the *grand project*" for the rebuilding of Versailles, a cenotaph dedicated to Isaac Newton, a theatre , a church, etc.. (Fig.7) All these monumental and utopian structures were never built but Boullée's various sketches and models brought them to life. The interior of the church shown a section drawing presents something like three-thousand columns. Boullée's

fantasies offer an extraordinary and yet terrible atmosphere that comes from their scale, stylistic severity, setting, and function. Boullée's drawing create an idea of a desertic world of structures that want to keep their occupant(s) out at the point that it is difficult to even imagine that this world has occupants. Boullée saw architecture as a fantastical setting that, via its formal features and interactions with light, aroused the intellect. The functionalities of his structures become secondary, if not non-existent, compared to aesthetic effect.

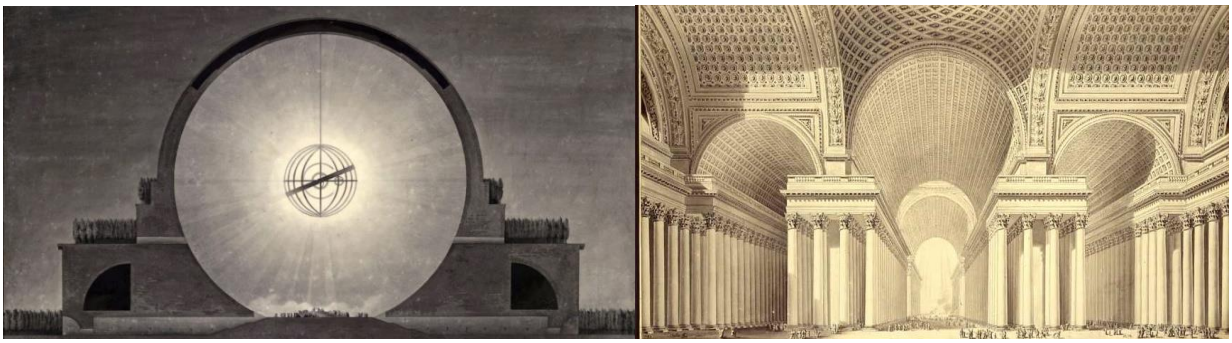


Figure 7 a) An elevation of I. Newton cenotaph

b) An interior view of a church for the "cult of the supreme being"

Imaginary or virtual space can embody characteristics of the physical space or negate them since they are not real constructions. According to Otto Ettlinger, “the characteristics of places in virtual space are based on the characteristics of physical space, which serves as their initial point of reference.” (Ettlinger, 2007). The drawing Relativity by M.C. Escher rejects the rules and in particular the gravity of the physical world, while being close enough to the principles of the physical world to resemble physical realities in certain ways. The similarity can be in terms of functions, forms, representation, events taking place, etc.

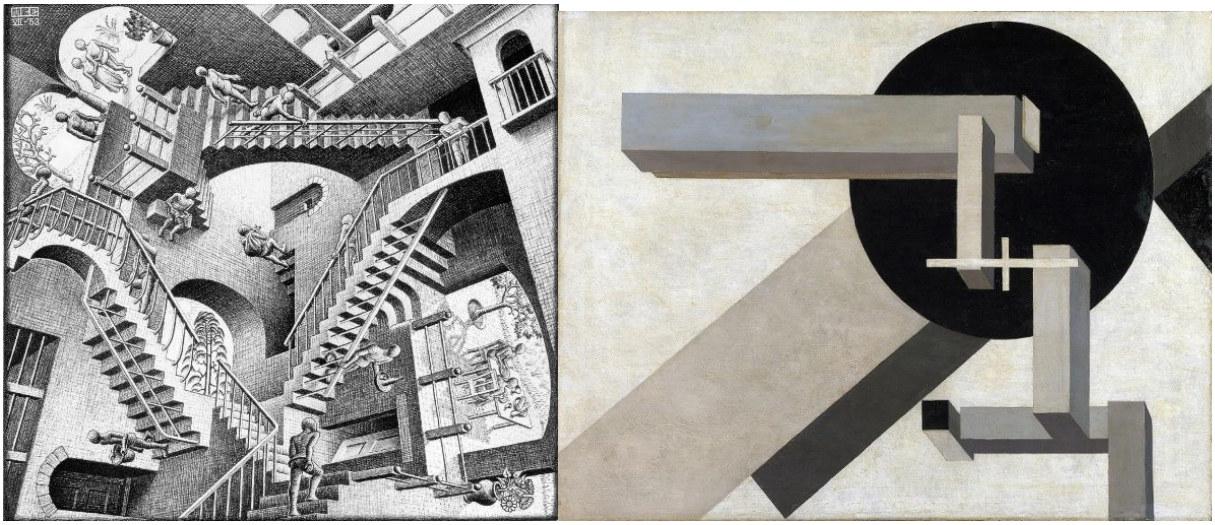


Figure 8 a)Escher’s drawings; b) El Lissinsky Proun

In modern times, American Architect, Lebbeus Woods (1992) present compelling images of radical and visionary architecture on paper on the examples of Steven Holl and Le Corbusier that invented totally new types of buildings and urban conditions. In “Berlin Free Zone” Project (fig.9), Woods proposed a completely new type of space, opposite to the “universal space” of Mies van de Rohe. It represents the extremely regular buildings of Berlin, intersected with a free, organic, jagged forms and voids called “Free Spaces” , which are free, of any predetermined meaning or purpose. These spaces are not suitable to be inhabit because of their complex form and the difficulty to fit with the restriction of livable space. In fact, space was not meant to have a predefined function.

This new landscape is joined by instrumentation of speed of light communications, in changing interactions with inhabitants. It is called free zone because it provides free access to communication and dialogue and to new types of activities, out of political or institutional control. This relationship becomes cybernetic. Spaces are useless and meaningless in physical terms, but they offer devises for interactions and dialogue facilitation through new digital tools that extend the senses and capacities of people communication. Moreover, they have a symbolic value. It is an architectural gesture, almost an act of rebellion to reunited Berlin, and to restore the symbolic centre of the modern German culture. This space represents the idea of intersection of the ordinary forms of space with the new form, and represent a manifesto of where architecture could go in the future with the use of digital tools.

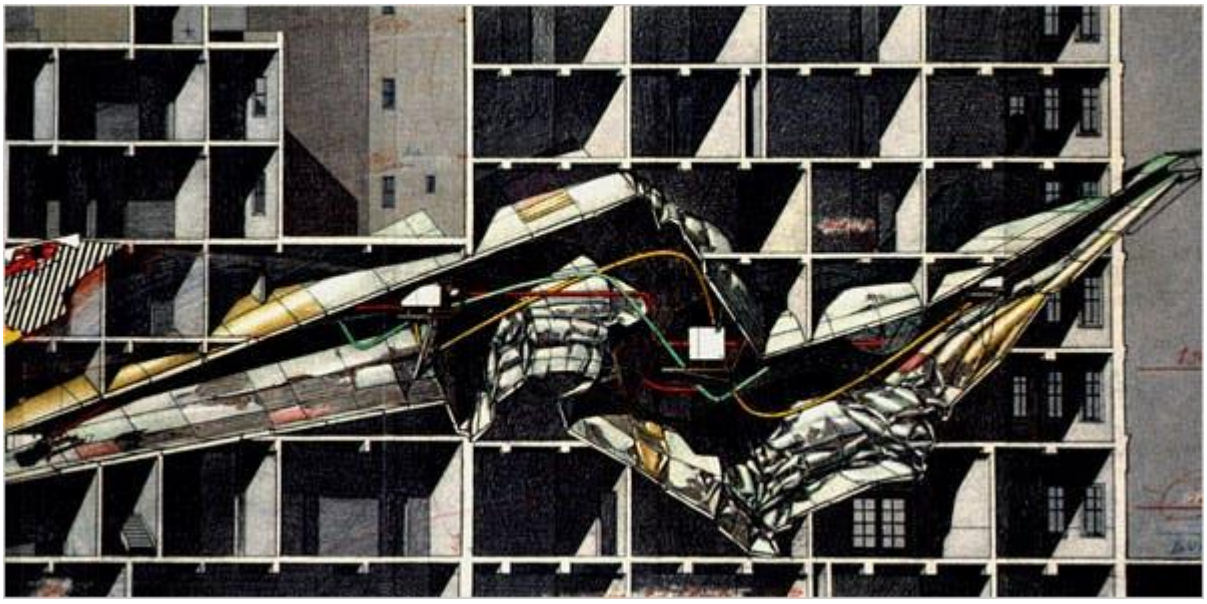


Figure 9 Paper Architect - Berlin Free zone, Lebbeus Woods

Digital tools offer new ways and new rules to design space creating new dimensions to explore. Thus, physical limitations were no longer an issue in the design of space. In fact, this new level of freedom was introduced with the advent of the digital age.

Architecture representation in in sci-fi novels and movies.

Since the early 1900s, many movies portrayed future societies in the age of information technology. Cinema provided an imaginable world, crossing the borders of reality and immersing people in an artificially created reality, which seem real although it's only a technological simulation. Films such as Fritz Lang's Metropolis (1926) envisioned the potential of digital instruments, providing spectators with a window that enabled them to observe in motion a new futuristic dystopian urban world. Fifty years later, other movies like Alien (1979) and Blade Runner (1982) supplied audiences with hypothetical future portrayals of postmodern space as a hyper-real alternative for reality. The cyberpunk film Blade Runner, directed by Ridley Scott and written by sci-fi writer Philip K. Dick, with artwork by Syd Mead, demonstrated how technology carries architecture, not only inside the movie's plot but also in the movies' production.

Figure 10Fritz Lang's Metropolis (1926) and the artwork of Syd Mead for Blade Runner (1982)

The concept of cyberspace was largely introduced in 1984 in William Gibson's novel "Neuromancer".

> "*Cyberspace, a consensual hallucination experienced daily by billions of legitimate operators, in every nation…. A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding….*" (Gibson, W, 1984)

In the novel, the digital space was represented as an abstract landscape characterised by light and color and conceptualised with a dimension of data communication and exchange. Gibson pointed out the

importance of multimedia approach (text, data, animation, video, etc.) in visionary space representation.

> "*Multimedia, in my view, is not an invention but an ongoing discovery of how the mind and the universes it imagines (or vice-versa, depending) fit together and interact. Multimedia is where we have always been going*." (Gibson ,2001)

This idea is fully described in his novel in which, a computer hacker character, named Case, uses a device to connect to his brain and have access to this cyberspace, parallel to the physical space, where he met Wintermute, a superior artificial intelligence. The novel has a multilayer representation and in its cyberspace everything is possible. Moreover, this world that Case navigates, Neuromancer, is free of real world constrains such as cultural, economic, political etc., and is therefore similar to the free-zone proposed by Lebbeus Woods. This world constitutes the basis of the today digital world. However, it was not fully immersive in terms of experience.

Figure 11 a,b) Case in William Gibson's novel "Neuromancer", and c)"Snow Crash" by Stevenson

In Neal Stephenson's 1992 sci-fi novel "**Snow Crash**," the main character, Hiro Protagonist, who delivers pizza for the Mafia, was portrayed also as a freelance hacker. When he is not working, he enters the Metaverse, an alternate networked virtual environment in which people appear as self-created "avatars" and participate in various activities (chat, flirt, fights, espionage etc). The "metaverse," or digital universe in which he is involved, is a communal, participatory endeavor that is always active and beyond the control of any single human. It is a man-made habitat designed as an online simulation that resemble the actual world. The goal is to provide individuals with a virtual environment where they may communicate, purchase, chat, participate in online activities, sell products, and do everything else as they do in real life. The people inhabit and control characters that move in space, just as in a video game.

"**Ender's Game,"** written by Orson Scott Card in 1985, was the first sci-fi novel to investigate the relationship between reality and simulation through video games as a learning aid. The story was set in an undetermined future in which humans and insectoid aliens known as "buggers" have a fight. The earth military academy requites and trains young children, including the protagonist Andrew Wiggin (Ender), in preparation for the invasion. They study military strategy by participating in a series of war game simulations that were part of the military academy's learning curriculum. Instructors made them believe that simulation is a game, for them to approach it easily, without considering wars cost, and distancing them emotional reactions but in fact it was not a game. In this sense, simulation was used as a tool of make believe that obscures the reality of war, but at the same time enhanced the understanding of reality. In the simulated reality, there is no real death as enemies are revived constantly being generated by the computer. War simulations, according to the novel, change the player's view on war by blurring reality, but they also give an insight into the player's interior reality, creating a link between humans and aliens. This is an anticipation of the role of games as virtual reality in bringing people together in the same virtual environment.

*Figure 12 a) Orson Scott card * 1985) novel Ender's Game b) movie inspired by the same novel*

In this period, several movies such as Tron (1982), “The lawnmower Man” (1992), The Matrix (1999) revolved on topics about computers, technology, digital environments and human interaction with them.

The cult sci-fi film of 1982, Tron, was the first animated movie to represent VR as a technology for digital games, by extensively employing computer generated imagery (CGI) through backlit or computer animation techniques and live-action components. These techniques, which up to 1960, were used only in aerospace and scientific research, after Tron were largely used in entertaining industry. The movie features a virtual world inhabited by a man, a computer programmer and video game creator who gets

transported into the software realm of a mainframe computer, taking the form of a video game character interacting with artificial intelligent tyrants and trying to escape and free the program. The game set is a computer-generated synthetic virtual environment, a landscape with buildings, and vehicles serving as backdrops for live-action character, which anticipated the today's virtual space and alternative world of video games. In addition, it anticipated the desire to not only to immerse and participate in virtual reality, but also to have an active role in these alternative realities.

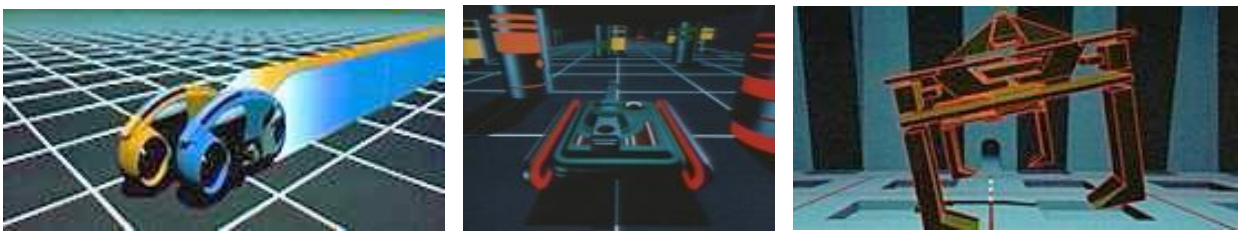


Figure 13 Screenshots from 'Tron" movie of 1982.

In 1992, the concept of virtual reality as a separate space was introduced to the large audience by the sci-fi thriller movie "The lawnmower Man", based on Brett Leonard's screenplay of 1975 titled "*Cyber God*".

Figure 14 "The Lawnmower Man" Movie Poster, and movies screenshot

The film was based on the founder of virtual reality, Jaron Lanier, a scientist played by Pierse Brosnan, who employed VR therapy to boost the intelligence of mentally disabled patients and transform them into geniuses. The use numerous VR equipment's that become popular nowadays to immerse in the new three-dimensional realm of virtual reality and to become virtual beings was anticipated in this film. The movie shows the invasion of virtual reality in people's life at the point that it become the reality. People were connected to computers by wearing helmets with visual displays to immerse themselves in the virtual world, gloves to manipulate virtual objects, touchscreens to control the computer, etc. Hence,

they sense a new reality by being connected to computers with equipment's that allow them also to interact through body motion capture.

The discussion on virtual space was additionally fueled by the 1999 release of **the sci-fi movie "The Matrix"** directed by The Wachowskis that presented a more contemporary picture of virtual space or cyberspace, considered as a software constructed reality which occasionally resembles the real world. In fact, the soft world in which inhabitants are absorbed appears to them to be the actual world, even though it is merely a duplicate of it, a simulated reality. The most significant architectural aspect related to the real environment is the film's setting in Mega City, an expanded virtual city in which the residents of the Matrix dwell. It is a hyper-reality created by a computer with advanced AI machines, that rules this society. This cinematic representation shows the possibility for spatial shift between the two worlds, in order to extend real lives with additional experiences. Hence, it can be argued that it acts as an instrument to define in contemporary architecture spatial theories a space which is not only perceived but also offers the possibility to be created virtually.

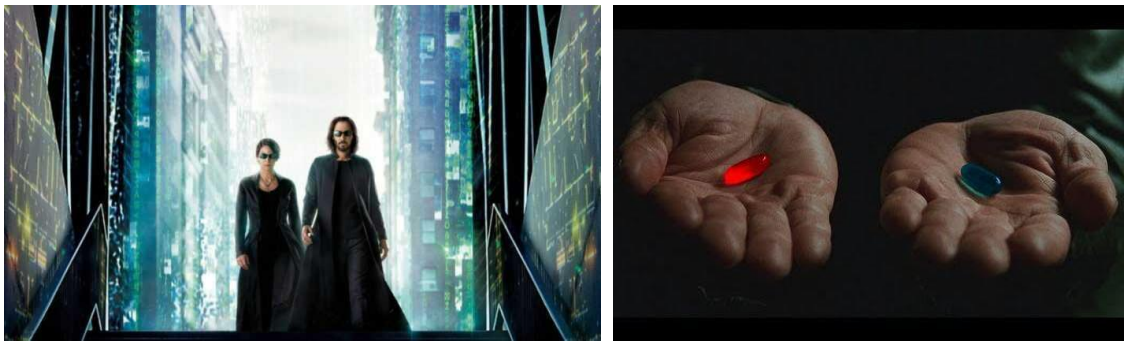


Figure 15 Screenshots from movie Matrix 1999

The metaverse has similar rules as the physical world. Human society needs to impose his rules and culture to the colonized or imagined digital world at the point that is remains globally institutionalized, and lack freedom, and decentralization, as in the case of Woods free world. In his novel Stevenson envisioned the evolution of digital world in the future, which is close to what is happening nowadays. The notion of cyberspace and the integration of data in the virtual world envisaged in science fiction literature, dominated architectural discourse in the 1990s. The use of new electronic technologies and multimedia extended the domain of mainstream architecture to virtual reality and cyberspace.

Architecture and space representation in Video games

Since the earliest video game Tennis for Two which go back to the 1950s, graphics and space representation has become more and more realistic and hyper realistic blurring the line between real and virtual. The first game engine to offer rendered graphics of 3D geometry was "Freescape," which

was developed in 1986 and first used in games like Driller (1987) with full 3D environments in which the player could move and look around in first-person view, and then perfected with the release of “3D Construction Kit”, which allows users to create their own worlds by manipulating objects and geometric shapes in the virtual environment and moving around or flying in this environment. Users may modify the color of objects, scale them, and conduct basic animations. This makes the virtual environment more interactive and engaging. The 3D environment was separated into different rooms to support the processing capacity of existing computers.

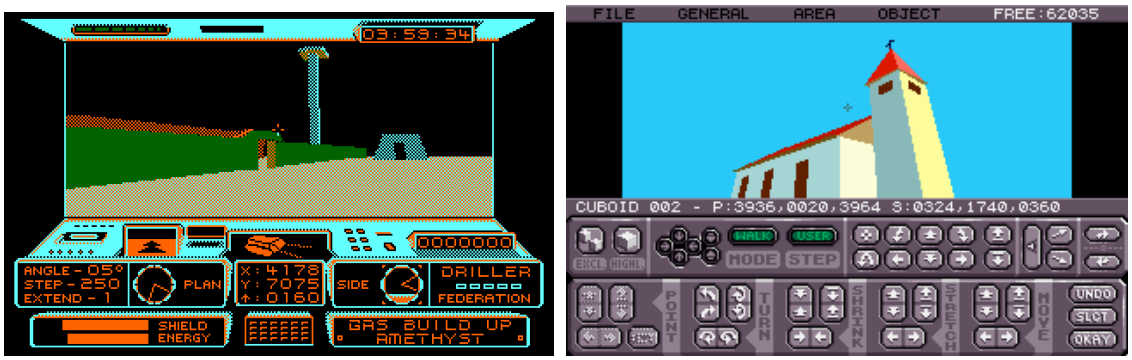


Figure 16 Snapshots from Driller and 3D Construction kit video games.

Another remarkable example of game artwork, "Another World," was created in 1991, with an emphasis on 3D space storytelling rather than gameplay. "Another World" is a cinematic sci-fi action-adventure game with a simple physical environment and no text or dialogue that transports the player to an alien world where he suddenly finds himself. Lester, the protagonist, avoids obstacles by running, jumping, attacking, fighting, and doing particular activities such as swaying a cage back and forth. The game's visuals and animations were designed by Éric Chahi, who used bitmap pictures to save computer storage space and added real-time cinematic effects and cut scenes. The game emphasizes storytelling in this aspect by establishing ambience and a rhythmic pace.

Figure 17 Cover and snapshot of Video game "Another world" (1991)

One of the most important games that changed the video game history was “Doom/ DoomCAD” introduced in 1993, in which were used 3D graphics to create 3d perspective environments with FPS where user moves and take actions. It was a predecessor of AutoCAD. Some years later successors such as Quake (1997) and Half-Life (1998), build on it and improved a lot computer graphics simulating real world physics.

Figure 18 Screenshot from Doom, Screenshot from half-life

Recent game artists, such as Daniel Dociu, Nicolas Bouvier have transformed stunning speculative paintings into 3D game environments using digital technologies. Virtual reality allows to depict and examine the work from an unlimited number of perspectives and forgetting the constrains of physics laws such as gravity, weight, size etc. Daniel Dociu in Guild Wars depicted cities with a dismal atmosphere, big ruined structures, and little humans, conveying the same feeling and dread as our developing cities do. Nicolas Bouvier, a modern French artist is best known for the futuristic 3D settings for video games such as Halo. Halo presented the player to an artificial planet, a massive space with a complicated labyrinth of subterranean tunnels. Later in the series, Assassin's Creed, he will depict 15th-century towns, with their important monuments and historical personalities.

Figure 19 Digital conceptual art for video game Guild Wars 2 by Daniel Dociu and Halo spaceship concept by Nicolas Bouvier

Sublime landscapes, drawing fantasies of Piranesi, Panini, Boulle’s, Woods, and others, the delirious cinematic manifestations of Metropolis and Blade Runner, up to the most recent fantastic video game

landscape representations show where architecture may go if it was freed from the constraints of "reality" and form the foundations for current research in virtual architecture.

Architecture representation in the age of cyberspace

Marcos Novak (1991) in his key essay "Liquid architectures in cyberspace" went beyond the traditional concept of architecture related to perspective, gravity, and physical form and considered and defined a dematerialized architecture in the realm of virtual and cyberspace. Novak considered cyberspace as "***an information space***" (**Novak,1991),** or a data space, a space which form is driven by data not matter.

> *"…Placing the human within the information space, it is an architectural problem; but beyond this, cyberspace has an architecture of its own, and furthermore can contain architecture*…" (Novak, 1991, pg.226)

Herein, he introduced the concept of "liquid architecture", a fluid, imaginative, multimedia landscape characterized by the synthesis of information, art, and technology that exists only in the Digital domain. In this realm, architecture and space becomes mutable depending on the interaction with the user/multiple users. Space become programmable, algorithmic, based on principles and rules and with a variety of manifestations and responsive to viewer's inputs. In Novak, it's evident the idea that multimedia manipulation, based on human-computer interaction is a potential for personal expression and new individual experiences in cyberspace. This approach liberates architecture from physical, functional, and aesthetic constraints, allowing the design of innovative settings and evolving forms of art and communication in cyberspace. In fact, **Novak equated architecture with poetry** and considered cyberspace as a habitat for imagination.

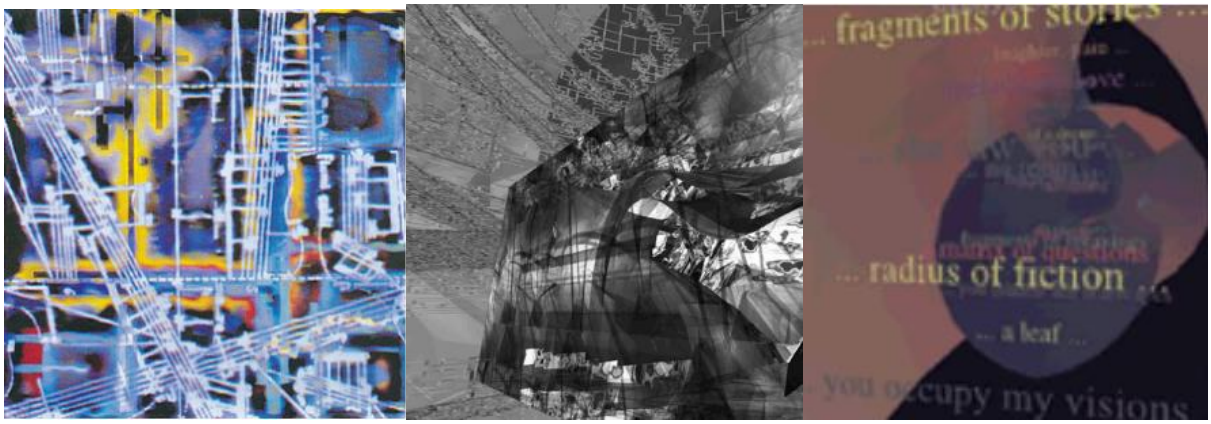


Figure 20 Examples of Liquid Architectures, by Marcos Novak: Algorithmic compositions (Novak, in Cyberspace: First Steps; MathCaveBlockHR (Novak, websiteL CENTRIFUGE);

This habitat has a structure of relationships and connections of data and information involving also the viewer. In this sense architecture is not an object appreciate for its appearance, for the visual qualities and aesthetics, but an interface of information.

In the same period, an innovative designer, **Gregg Lynn**, offered a new perspective of virtual architecture. Lynn challenged conventional concepts of design practise and focused on the creative processes of architecture with design and animation software. Lynn proposed three models to approach the development of architecture in his key text "Animated Form," (Lynn, 1999) based on the utilisation of modern technology and computational processes: 1. via geometrical reproduction of shape; 2. by the construction of an open form that changes due to gradient impacts; 3. by the formlessness / amorphousness of architectural structures. The computer, via its visualisation and transformation processes, **brings building formation/deformation through a range of shaping forces than model form**, or what Lynn refers to as **animated form**. According to Lynn, computational technology enables the execution of a sequence of architectural creation processes in the realm of virtual that is not materially/ physically achievable.

> "It is always more interesting to bring with an inventory of what machines want to do to us before we start asking what we desire from machines". (Lynn, 1999)

In this sense, he achieved dynamic and mutable architecture form in 3D virtual space, similar to the effect that cubist or futurist painters such as Boccioni, Duchamp, etc. express in their 2D representations.

Figure 21 The virtual diagramtic relationships between forms in Lynn become actualised as technical possibilities.

With the introduction of virtual reality in the late 1990s, **Asymptote** architect explored new possibilities in their design practise and produced interactive virtual 3d worlds for numerous projects such as **the New York Stock Exchange** trading area and **the Virtual Guggenheim exhibition space**.

> "*Objects, spaces, buildings, and institutions can now be constructed, navigated, comprehended, experienced, and manipulated across a global network. This is the new architecture of liquidity, flux, and mutability predicated on technological advances and fuelled by a basic human desire to probe the unknown*." Rashi, form Asymptote in (Jodijo 2001)

They developed a completely interactive computer-generated space in VR that demonstrates new methods of communicating and accessing data-rich and complex environments. Even though the experience of virtual reality at the time was obtained presenting moving pictures on displays, these virtually inhabitable spaces comprise unparalleled "architectural environments."

The **Virtual New York Stock Exchange (**1999) was a multidimensional interactive virtual environment designed for the operations department being used as a monitoring tool for stock exchange data and information (such as news, market indicators, etc.). It is conceived as a three-dimensional, manipulable digital interface that help handle large volumes of information in the virtual world. The 3D trading floor is a data driven representation, in which real time market information and statistics are displayed and the can interact with it in real time. In this sense, the virtual architecture is completely different from the virtual building. In virtual architecture, space, time, and information are components that create experience. On a contrary, Virtual buildings are replicas of actual building space.

Figure 22 Virtual Trading Floor. Asymptote, Virtual New York Stock Exchange (1999) by Asymptote

The project of **Guggenheim Virtual Museum (GVM,1999)** was an Internet-based museum committed to the exhibition and promotion of digital art as well as the creation of a digital archive for emerging contemporary media. This virtual museum anticipated new forms of expression that ultimately necessitate new means of exhibition, collection, and appreciation of art. The conventional methods of appreciating museums by moving and seeing, as well as the physical constraints of actual space, do not apply to virtual museums. The GVM embraces new architectural and experiential possibilities like as fluidity, immersion, and replay and interactivity. While the GVM is a multidimensional digital interface

with "visual" clusters in the form of artist-commissioned works, it also proposes a situation in which virtual architecture coexists with the experience of physical architecture.

These two Asymptote studio projects represent a turning point in virtual architectural history and a major step toward a new understanding of architecture. Digital tools offer multiple possibilities to provide architect with new ways to use space, generating forms of abstraction and interaction. Virtual space has definitively broken the barrier in recent decades, allowing users to truly cross its membrane, freely move and interact within the virtual world, particularly in the gaming industry.

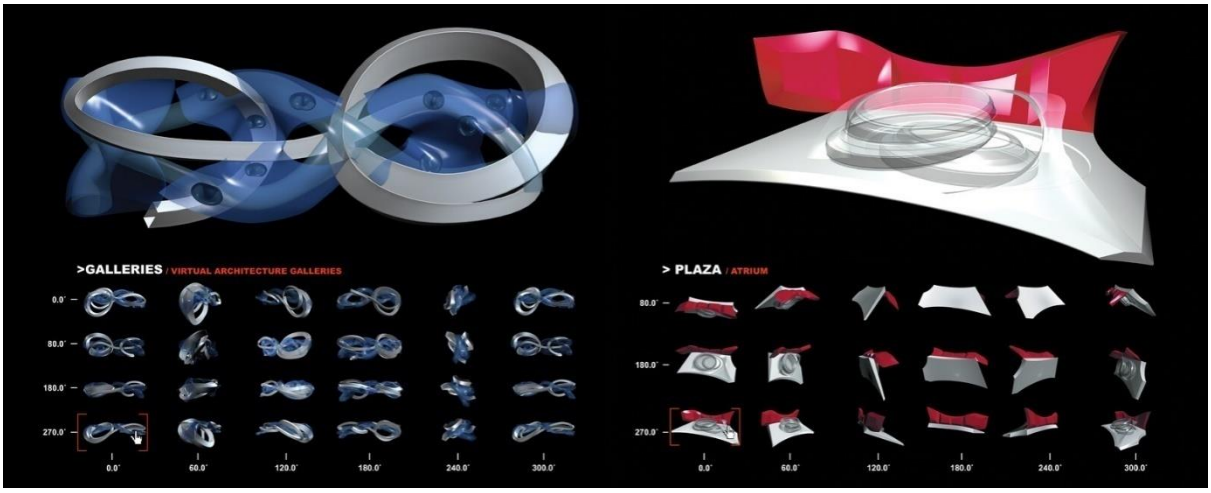


Figure 23 The main navigation interface of Guggenheim Virtual Museum, 1999 by Asymptote

In the future, architecture will probably merge with what is now developing only as virtual architecture, and it will be one of the next radical breakthroughs in design and architectural discourse. In conclusion, in the last decades, virtual architecture based mainly on data and information, undoubtedly influences the ways we now understand space, form, movement, and geometry.

Virtual architecture and adaptation to the COVID-19 pandemic

The pandemic has changed our work culture, prompting businesses to prioritize remote work and to innovate themselves. We are all witnesses to the transition from the real to the digital economy (online shopping, digital wallets, online rentals, digital marketing, gaming), and the worldwide pandemic has accelerated it. As a result, many retail businesses, museums, theatre shuttered their doors in 2020, while online retailers, conferencing firms like Zoom, Google Meet and Teems, virtual museums have achieved great success.

Furthermore, internet connection modes have evolved from a simple 2D collection with hyperlinks to a 3D world to be explored. This has altered the way we work, shop, and live. In this sense architects can

play a role to shape and enrich the virtual space. They can design experience in virtual museums, virtual amusement parks, and learning environments, as well as create digital assets such as cities, buildings, furniture, and artefacts. For architects, it is uncharted world rich of potential to be recreated and free of any physical world constraints.

The act of creation of virtual architecture in which the viewer is involved and call to interact is a new form of art and architecture practice that is evolving fast in our time. Virtual reality constitutes a novel form of experience in space, with the possibility to fully navigate it and interact with object that are part of it. Moreover, this new reality can include also the possibility for multidimensional communication and collaborative art making.

Several architecture firms are now starting to use VR to present the project to their clients including space and various data in 3 dimensions and to propose them in real time changes or design options. Others are using it to explore, reimagine and experience unbuilt spaces such as virtual museums. More innovative firms use it as an innovative design tool that permit to collaborate, review and design in real time and discuss design issues between professionals and clients. Below are shown and explainedseveral case studies of innovative architecture design approaches in the virtual realm.

Architecture firms that use VR today

Ennead Architects, New York

Virtual reality has been employed by the New York-based firm to assist clients in visualising space and data in three dimensions. For instance, in its VR displays, they employ a multicolour block to depict the areas of Shanghai Planetarium that are most exposed to light.

ZGF Architects architecture firm Portland, USA

ZGF Architects firm have used VR to have feedback by various stakeholders on projects, allowing staff to visualize options and make changes to designs in real time on materials, colour, dimensions etc.

"NFTism" byZaha Hadid Architects

At Art Basel Miami, Zaha Hadid Architects created "NFTism," a virtual art gallery that investigates architecture and social interaction. User experience and social connection are prioritized in the design, which is integrated with multiplayer online gaming and interactive technologies. According to ZHA (2021)

> "*Current photo-real, 3D and massively multiplayer online (MMO) video-game creation technologies, combined with high-speed network and cloud technologies, allow cyberspaces to be*

3-dimensional, interaction-rich, socially and sensorially engaging, as well as accessible through a variety of devices using desktop browsers, mobile apps and smart TVs".

The project focuses on a cyberspace that supports human-to-human communication using computer networks based on spatial-web technology.

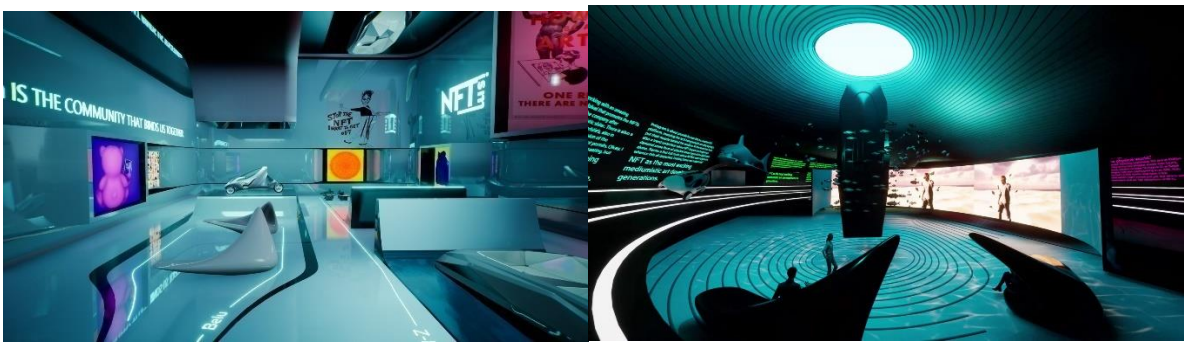


Figure 24 "NFTism" virtual gallery by Zaha Hadid Architects

SpaceForm by UNStudio and BIG architects

UNStudio and BIG architects have collaborated to create "Spaceform", a virtual cloud-based workspace that aids architects, developers and clients in the design, review, and collaboration processes. This innovative virtual platform aims to let architects and other construction professionals to interactand design remotely across multinational teams, minimising the need for travel. Furthermore, it allows clients to review projects remotely, engage more effectively with architects, and enhance decision-making processes. This can be seen as a good opportunity especially in the shift to remote work and in general to the digital world due to Covid-19 pandemic.

The employment of immersive, real-time game technology facilitated exploration and reciprocal participation in the virtual environment. Furthermore, the platform facilitates the visualisation of digital twins as well as data exchange amongst users in order to increase communication and recommended solutions among various stakeholders.

Figure 25 Spaceform platform, by UNStudio and BIG architects (Cutieru, 2021)

Biarke Ingels described the platforms as:

> "*the augmented creative, collaborative environment of the future which will allow an instantaneous confluence of actual and imagined realities – the present and the future fusing in our augmented sense of reality*." (Biarke Ingels in Cutieru, 2021)

In conclusion, architecture space (art space, game space, 3d environment) in a virtual realm has numerous tools of representations. With the advancement of technologies and development of VR/AR/XR forms of architecture visualization have become more immersive. Immersion does not consist only in the drawings representation but also includes the data information and the process of creation. In VR the process of creation can be facilitated by collaborative and review platforms of communication.

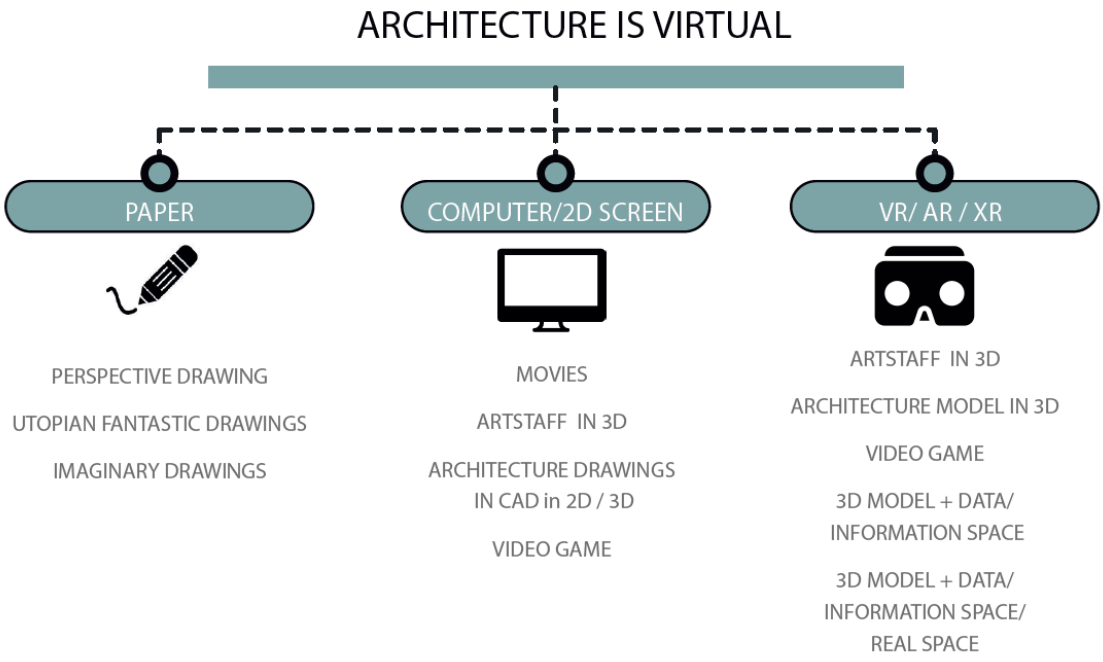


Figure 26 Representation of architecture in the virtual realm (Source: authors)

CHAPTER 2 – VIDEO GAME AND ARCHITECTURE

Games are "architecture's final frontier"
(Wiltshire 2007).

"*Architecture is the art form closest to the gaming experience, not film or fiction, not painting, photography or sculpture. Only architecture completely enfolds us as thoroughly as gaming*." (Gust, 2009).

2.1. THE ACT OF PLAYING. PLAY, GAMES AND VIDEO GAMES.

"What are games? Are they things in the sense of artifacts? Are they behavioral models, or simulations of social situations? Are they vestiges of ancient rituals, or magical rites?" ***E. M. Avedon****, The Structural Elements of Games"*

"Work consists of whatever a body is obliged to do, and . . . Play consists of whatever a body is not obliged to do."
Mark Twain, The Adventures of Tom Sawyer

Play and game definition

Playing activity has been considered since antiquity with Plato and Socrates as a fundamental activity, a form of behavior, and a teaching method central to cultural, artistic, and social development. Ancient Greeks referred to play on one side as children's play or "paida" and on the other side as game activities for adults using the term "agon". Latins intend play as cultural activities in terms of humanitarian studies and used only the word "ludus" to cover all play activities. Ludus or playing mode refers to both children's toys which can be classified as non-play and recreational activities for enjoyment such as drama, music play, dance, religious activities, and so on. All these actions fell within the realm of ludus (alludo), which is an illusion unrelated to reality and free of rules. Toys are not based on specific instructions or rules on how to play, neither they have a goal. On the contrary, play is goal oriented. What differentiates them in relation to play and game according to (Adam, 2010) is the way we engage and the presence or not of rules and goals. Playing can be defined as a recreation, joy expression, or motoric activity and it includes also play or puzzles. Play refers to a single move dictated by a goal, while the game is a more complete, complex, and accurate activity, an outcome somehow measurable. Games are more structured activities and are based essentially on rules and goals.

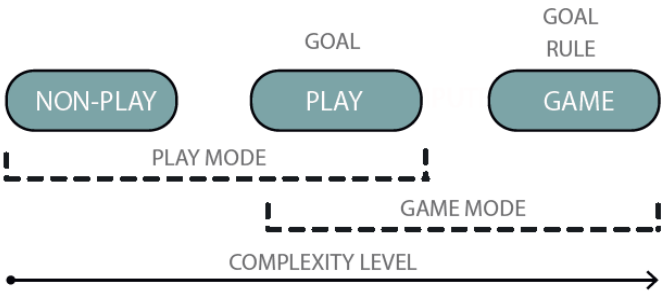


Figure 27 Definition and complexity of Play and game concepts

> *"Play is a voluntary activity or occupation executed within certain fixed limits of time and space, according to rules freely accepted, and outside the sphere of necessity or material utility"* (Huizinga,1938).

Huizinga considered **play activity** as **a more structured activity** based on rules and goals, in which adults entertain themselves. Rules establish the object, meaning of game activities, and challenges offered by the game, while the goals define the objectives of the game. *In addition, Huizinga* points out other attributes of play.

> [*Play is] a free activity standing quite consciously outside "ordinary" life as being "not serious, "but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social groupings, which tend to surround themselves with secrecy and to stress their difference from the common world by disguise or other means.* (Huizinga,1938).

Play activity is considered a rule-based activity, beyond ordinary and serious activities, and is not related to material interest. Still, it is an absorbing activity, outside the boundaries of real-time and space, with the possibility to create a virtual social exchange. Huizinga considers play activity "as separated from ordinary reality" and within what he called "the magic circle". Video games have proven to have broken the limit of the magic circle.

Figure 28 The magic circle as separated from real-world space

In his essay "Man, Play, and Games," published in 1958, French philosopher Roger Callois proposed a distinction between "paidia," an equivalent of the English noun "play," which refers to free games for children based on movement, and "Ludus," an equivalent of the English noun "game," which refers to highly organized and regulated games for adults, such as sport and complex game activities, performed with respect to certain rules. Paidia is defined as:

> "*… physical or mental activity which has no immediate useful objective, and whose only reason to be is based in the pleasure experimented by the player*" (Caillois, 2001)

Ludus is defined as:

> " *an activity organized under a system of rules that defines a victory or a defeat, a gain or a loss*" (Caillois, 2001)

Hence, the main distinction is related to the fact that play activities are simpler and don't need a social component which is typically present in games for adults. Moreover," Ludus" games have a goal and define losers or winners.

Caillois divides ludic activities into four categories:

1. Agon: play activities that depend on the competition: racing, soccer, basketball, physical sports, chess (mind effort), boxing, etc.
2. Alea: games that depend on chance or luck. This is the main game experience parameter. lottery, casino roulette.
3. Mimicry: role-playing games and simulation (imaginary or make-believe game). The ability to play multiple roles is crucial in this game.
4. Ilinx: Activities that alter our common perception and where sometimes there is a risk of life and vertigo: tightrope, bungee jump, skiing, and other extreme sports.

	AGON (Competition)	ALEA (chance)	MIMICRY (simulation)	ILINX (vertigo)
LUDUS	soccer, basketball, chess, boxing	lottery, casino roulette.	Theater, air flight	tightrope, bungee jump, skiing
PAIDA	Racing, athletic	Heads or tail	Children installation Games of illusion	Swinging, waltzing
	ACTIVE	ACTIVE	PASSIVE	PASSIVE

Table 5 Caillois classification of ludic activities

	Terms used for PLAY and GAME	Definitions	Main elements
Johan Huizinga (1938)	Game/ play	"a voluntary within certain limits of time and space, according to rules and outside the sphere of necessity"	Social exchange Rules Inside a magic circle
Roger Caillois (1958)	PAIDA / LUDUS ACTIVE/ PASSIVE	Free play vs organized game with rules.	Rules, make believe Uncertain
David Parlett (1999)	INFORMAL PLAY / FORMAL GAME	Rules/means/ objectives Ends/ means	Rules goals
Bernard Suits (2005)	BOTH PLAY /GAME	an engaging activity, goal-oriented	rules, goals, obstacles
Clark C. Abt (1970)	GAME/ SERIOUS GAME	Activity among decision-maker, which has set objectives and has limitations	Activity Decision-maker Goals limitation
Chris Crawford (2002)	COMPUTER GAME/ DIGITAL GAME	n/a	Representation Interaction Conflict Safety
Greg Costikyan	COMPUTER GAME/ DIGITAL GAME	"a form of art in which participants make the decision to manage resources, earn tokens and to pursuit goals"	Art Decision –Making Resource management Tokens Goals
Elliot Avedon and Brian Sutton-Smith (2015)	GAME	"An exercise of voluntary control systems, with a contest between powers, confined by rules in order to produce a disequilibrium outcome".	Control systems Voluntary and free; The contest between powers: The conflict between players. rules, Disequilibrium outcome

Table 6 Definitions of game and play by different authors

David Parlett made a distinction between play and game as "***formal and informal games***". An informal game is a children's play, while a formal game is a more structured game based on purposes and means or rules.

Bernard Suits in "*Grasshopper: Games, Life, and Utopia"* defined play as:

> "*An engaging activity that orient player toward a specific goal, through rules accepted by the player that make possible such activity".*

To Suits, the main elements that characterize playing activity are rules, goals, and obstacles.

1. In this regard, he traced a distinction between children's play and serious play or deep play.
2. In both cases players are free to perform actions without real and direct consequences.

Clark C. Abt (1970) in Serious games, gave a narrower definition of a game as:

"*an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context*".

He emphasized the need for mutual rules among rivals who make decisions to achieve certain goals. The role and contribution of the numerous players are critical in his definition. He stresses the following game elements: He highlights the following elements of the game: Activities or events; active engagement of players and their decision making, setting goals, and responding to game constraints.

Chris Crawford highlighted four fundamental aspects of games in his classic book "The Art of Computer Game Design": *Representation:* A game is set in a certain setting, and reality is both physical and emotional. *Interaction:* The cause-and-effect relationship that holds things together. *Conflict:* Conflict emerges spontaneously as a result of game engagement. The player is actively working toward a goal. Obstacles keep him from effortlessly accomplishing this aim. Conflict is an inherent component of all games. *Safety:* A game is a safe way to explore reality because the setting is artificial and there are no immediate implications in the physical world.

Game designer **Greg Costikyan**, in his essay "I Have No Words and I Must Design" defined game as

"a form of art in which participants make decisions to manage resources, earn tokens and to pursuit goals".

The key element of games according to **Costikyan** are *Art, Decision-making player's or* player's active participation and choice, *Resource management, earning games tokens, Achieve Goals, or having an o*bjective.

Elliot Avedon and Brian Sutton-Smith, two of the most renowned play and game authorities of the twentieth century, gave an extremely concise definition of game in their book "The Study of Games".

"*Games are an exercise of voluntary control systems, in which there is a contest between powers, confined by rules in order to produce a disequilibrial outcome*." (Avedon, Sutton-Smith,2015)

The key elements of this definition are: systems, Voluntary or free activity, Contest between powers, the conflict between players, rules and limitations, outcome.

These definitions highlight different aspects of the game. Recently, **Katie Salen and Eric Zimmerman** in their reference textbook for game design "Rules of Play", based on the definitions by Johan Huizinga, Roger Caillois, and Brian Sutton-Smith formulated their own synthetic definition.

"*A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome*." (Salen, K., Zimmerman, E (2004).

Two years later, game scholar Jesper Juul in Half-Real formulated a more detailed

> "A game is a rule-based system with a variable and quantifiable outcome, where different outcomes are assigned different values; the player exerts effort in order to influence the outcome, the player feels emotionally attached to the outcome, and the consequences of the activity is negotiable." Juul

From these characteristics Schell comes up with another definition:

> "A game is a problem-solving activity, approached with a playful attitude." This makes them appear closer to serious games.

Theoretical models

Video games can be examined in different perspectives from narrative, simulation, performance, and art education tools, a ground for social interaction and as a medium of entertainment (Wolf, 2005). The various theoretical model that conceptualizes games, in this study can serve to trace parallels with architecture and to understand their significant role in the future development of architecture.

Games as magic circles

Huizinga, a Dutch historian, and anthropologist claimed in his book Homo Ludens that games create a different setting outside of the actual world, which he refers to as "the magic circle" (Huzinga, 1938). The rules of the magical circle do not intersect with the rules of the outer world. The game action within the magical circle constitutes a different realm, disconnected from the actual world. However, this is not completely true because games have real-world implications. Games take time away from our actual lives, teach us, influence our behavior and attitude, and so on. In this way, the notion that the magical circle as separate from reality falls. According to Mia Conslavo's essay "There Is No Magic Circle," gaming activity cannot be separated from real-world activities. Jesper Juul's perspective on games as goal-oriented, experiential activities, and social settings argues that these game tree components are subjective. As a result, the bounds of the magic circle are likewise determined by the player.

Games as cultural and social reflection

Video games are means of entertainment, but this does prevent them to be considered as a creative and expressive medium. Like other media, games are a form of expression and communication. In his book "Understanding Media", Canadian media theorist Marshall McLuhan describes games as "*popular art,*

collective, social reactions to any culture's principal impulse or activity." Games are inextricably linked to the society in which they exist, and are the expression of artistic, political, and social issues of that culture. Moreover, they can be viewed as a form of persuasion based on rules and interaction. Games have a moral character, that makes player reflect on their behavior and decide the type of morals to pursue. Usually, games mimic situations of real-life either working context or social contexts. In these contexts, players can choose how to behave and act, revealing cultural aspects of their context.

Games as education and communication

Video games must change the way we learn and communicate. In his theoretical text Mind, Self, and Society, social psychologist George Herbert Mead highlight the role of playing activity and communication through gaming in the process of education. Games are a medium of communication between children or adults. Layers enter the game world by taking a certain role, a fighter, an adventurer, a city major, etc. This is what Calloise called “make-believe”. Considering what the player pretends to be, he enters the role and learns by integrating himself into the group organization. Games represent excellent models of self-organization. Furthermore, according to British anthropologist Gregory Bateson's metacommunication theory, players transmit and receive information about his statement as well as communicate with other players or computers.While in the real world we communicate through body language and voice tone, in games we communicate through actions. Players expand their communication ability as they become more mature, come to know the game, and get trained on it. Moreover, players start to create online networks with other players, chasing complex clues. Thus, they become able through an advanced form of meta-communication to get outside the magic cycle and educate themselves to solve complex issues related also to the real world. In fact, games can be considered as mirrors in which we can see the way people organize themselves. Players through games learn to take different roles growing themselves but also learn to deal and communicate with others belonging at the same time to different contexts. Thus, games stimulate dynamic communication such as strategic thinking, networking communication and offer contextual knowledge.

The game as a new art form

Professor Henry Jenkins, one of the most famous media studies theorists, believed that video games were a new art form, and that game designers, like painters and architects before them, were the artists of the new century. Nowadays art has assumed new forms, and in particular with the advancement of technology, a new form of kinetic art is considered more appealing. Video games represent a new

kinetic and interactive form of art, appropriate for the digital age. Its potential lies in the exploration of action aesthetic and not mere representation like traditional forms of art.

Games as Play of Experience

Video games offer mainly experience in virtual reality. Players can see, touch, hear, move through the game space, feel emotions, communicate with other players, and change patterns of thinking. Experience is archived within a free movement, manipulation, or active participation in events taking place in the game world. The play of experience means participation in the ludic activity and presence in the game world.

Games as the Play of Pleasure

The various emotions and experiential pleasure derived from game playing can be put under the word "fun". According to Le Blanc (2000) "Fun" is a very general term, so he proposed to structure and categorize the notion of pleasure in eight kinds of experience:

1. Sensation: *Game as sense-pleasure. G*ames offer engagement of senses through memorable audio-visual effects.

2. Fantasy: *Game as make-believe.* Games offer pleasure to stare at a fantastic, imaginary world and allow players to imagine themselves in various roles.

3. Narrative: *Game as drama. The* game has interesting characters and a compelling drama.

4. Challenge: *Game as an obstacle course.* Pleasure is achieved by wining individual confrontations, challenges, or ultimately winning the game.

5. Fellowship: *Game as social networks.* it refers to our constant search for people with whom to interact and create bonds. What we aspire to is to exchange experiences and create relationships, as well as carry out together with other people activities that we consider important.

6. Discovery: *Game as uncharted territory.* Pleasure is provoked by exploring new things, places, and learning new techniques of playing.

7. Expression: *Game as self-discovery.* Pleasure is provided by offering the possibility to explore player creativity

8. Submission: *Game as masochism.* This means the pleasure to submit to a system of rules and follow them blindly.

The Elements of Game

Schell (2008) identified 4 primary elements in games: Aesthetical, Technology, Game mechanics and Story

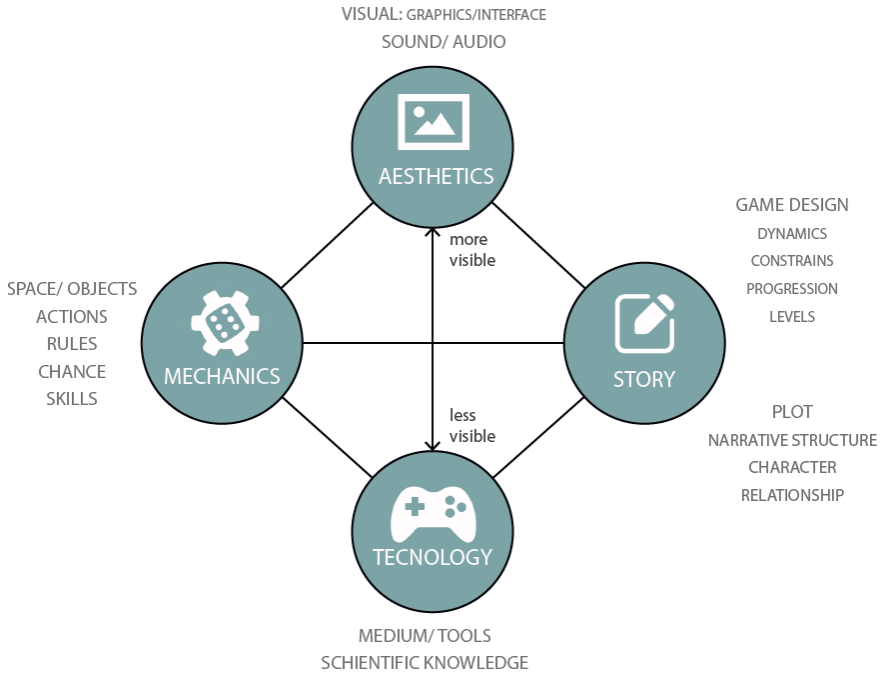


Figure 29The elemental tetrad enriched by the most significant subcomponents of games (Source: authors elaboration, based on (Schell, 2008))

Aesthetics

All aspects of the game that the player experiences are included in game aesthetics. Games are visualized either in 2D or 3D representations by considering a series of subcomponents such as graphics, sound, interface design, sensation portray, animation, etc. The game visual style is chosen in accordance with game mechanics

- **Visual** are the images displayed, including the representation of the game world and character and the possible actions are performed upon them (2D and 3D objects, avatar, data and informational displayed, etc. and anything visible to the player. They include **Graphics and Interface** representation. **The interface** is what the players deal with directly in order to play. It includes all the elements displayed on the screen from the menu, various buttons, navigation bars, controls system, etc.
- **Audio is sound or** music effects that are played during the game as part of the artwork.

Story

The game's plot serves as a backdrop to the game's entertainment. A story is generally included by game designers in order to hold the players' attention and to increase the entertainment value. The story is comprised of all information obtained by the user while playing the game, including information about the game's characters. In this sense, every game contains a story, because the same actions of characters act in a certain context. The story is related both to mechanics and aesthetic elements, as the mechanics and the visual/auditoria language whose should reinforce the idea of the story.

- **The plot.** The plot is the tool that describes the conflict progression of the story. Providing the player, a conflict to resolve makes them motivated and attached to the game. The plot is usually focused on a central theme which allows the audience allowing the audience to immerse themselves in the experience.
- **Narrative.** The narrative is the form in which the game story is told. There are various design forms that can be used to narrate a story: a movie, a cut-scene, informative text, voiceover that introduces the story and explains it step by step, characters monologue, etc.
- **Narrative structure.** The narrative structure can be built on one or more storylines, can be based on a branch structure, or can be totally free. Structuring the events that constitute the story is important in order to merge them with level design and proper ludic aspects of the game. Many games are made up of a series of episodes. They can be self-contained in a story where the plot is presented and resolved, or they can finish on a cliffhanger, with threads overlapping and the plot running continuously.
- **Characters.** Characters that are part of the story. They have physical features, a mental state, and actions or behaviors related to the plot. Characters motivate each other triggering challenges. The main character must develop the motivation to become a hero/ winner or to protect others, and so on depending on the plot.

Mechanics

Mechanics are playing activity players perform again and again throughout a game. They represent the essential activity of players, how they accomplish it, and what are feedbacks he gains as a result.

Hence, game mechanics include **procedure/processes, with rules, actions, and feedbacks**. They constitute a way through which players can reach game goals, take actions, and build strategies in order

to progress. Game mechanics apart from offering the player agency, need also to provide them constraints, in order to challenge and motivate them. Examples of game mechanics are first-person shooter and directional movement in space, jumping, running, conversation in multi-player games, moving, firing, etc.

The rules. Almost all authors (Salen at al, Juul, 2004) define games refer to "rules" as the core component of the game.

> *"A game is a system in which players engage in artificial conflict, defined by rules, that results in a quantifiable outcome"* (Salen, Zimmerman, 2005)
>
> *"A game is a rule-based system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels emotionally attached to the outcome, and the consequences of the activity are negotiable."* (Jesper, 2005)

Games are regulated by rules, which are the main guidelines that participants agree to accept at the moment they actively participate in the game. Every game has its own set of rules, which serve numerous purposes.

They define the purpose of the game as well as the meanings of the many actions and events that occur and can determine when the game is over. They also offer a contextual framework that allows players to understand which behaviors are permitted and which course of action will best help them reach their goals. Furthermore, rules prevent players from committing illegitimate moves/actions and from rapidly reaching the objective. They define the optional movements in the game space.

Different authors (Juul (2005) Salen, and Zimmerman (2005)) proposed a categorization of rules base on the aspects they cover within the game.

Jesper Juul proposed the so-called "interplay rules," which correspond to the physical laws of the gamespace. They determine what can be done or not, including player input and system output.

- *Game state rules:* determine the condition of game elements in a specific place and time.
- *Outcome valorization rules:* determine the positive or negative outcomes of the game.
- *Information rules*: determine the type of information the player receives during the gameplay about the state of the game.

A rather different typology mostly focused on evaluation rules was suggested by Katie Salen and Eric Zimmerman.

- *Operational rules:* These govern game processes and conditions of victory. These include rules regarding the rewarding system or the punishing system.
- *Constitutive rules:* These rules define the basic dynamics.
- *Implicit rules:* These include rules that are taken for granted when we play.

Rules can also be categorized into:

- designer's rules. The designer's rules. These rules define not only the way the game works internally but define also the direction and the shape the game will take.
- player's rules. Players learn designers' rules. They become his rules and he controls how he uses them.
- player's invisible rules.

- **Action/ simulation. Actions are movements of** players to overcome the challenges and reach the game goal. Actions can be run, jump, climb, or make any other movement. Actions can be also a simulation of the real world and set in in a simulated context.
- **Transaction.** Transactions are items gained during the progression of the game and constitute resources. They can be elements collected, harvested, or traded such as money, energy, power, popularity, life energy, etc. Transactions can measure player performance.
- **Progression**. In many games, progression is determined in level design which indicates the way the player moves in the game world. Progression can be controlled by a series of mechanisms (usually specific objects to be found, or difficulty curves) that unlock access to certain levels, , rounds, missions, or specific areas in the game.

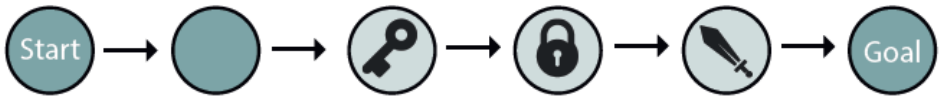


Figure 30Multiple locks and keys to progress towards the goal

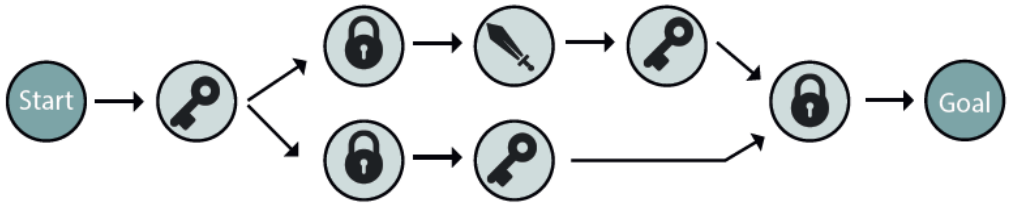


Figure 31Multiple locks and keys to progress followings a mission in a non-linear game space

- **Social interaction.** Social interactions are rules that govern the play-action of characters usually in strategic games or multi-player games with the aim to coordinate actions and alliances.

Video games. Main characteristics.

The history of video games is intertwined with the evolution of computer and information technologies. Spacewar!, created by Russel (1961) at MIT, was the first effort to create a video game. In comparison to other forms of media such as television, film, and the printing press, video games are just roughly 50 years old and became popular in the last few decades as personal computers became more readily available.

According to the Oxford Dictionary video game is:

> "*a game played by electronically manipulating images produced by a computer program on a television screen or other display screen*."

This definition is quite broad and is related mainly to the advanced audiovisual apparatus, which is a device that produces 2 or 3-dimensional images in the video. In fact, video games are games but played in a medium of visual imagery. These devices can be a video game console, a computer, handheld, a mobile, etc. On these devices is possible to have more aesthetically realistic experiences, real-time interaction, and multiple players. This is the main difference between video games and non-electronic games. In this sense, game scholar and designer Gonzago Frasca broadened the definition of video games and claimed that video games are:

> "*any form of computer-based entertainment software, either textual or image-based, using any electronic platform such as personal computers or consoles and involving one or multiple players in a physical or networked environment*". (Frasca 2004)

In addition, Juul (2004) highlights the level of complexity and automated process in video games, which distinguished it from non-electronic games.

> "*computer games add automation and complexity- they can uphold and calculate game rules on their own, thereby allowing for richer game worlds; this also lets them keep pace*". (Juul, 2004)

For the rest, video games are primarily games, and as such, there is no distinction compared to the previous definitions of games.

The history of video games and the specific research on them is relatively short. In the Game studies videogames were viewed in 2 different perspectives: **"the formalist"** or humanistic perspective which is based on ontological analyses and **"situationist**" perspective, which is based on player's analyses, gameplay, and more in general on social interaction in games.

Formalists view two main groups to approach videogames: representation and rules and made a distinction between them considering them first as two contrasting aspects of videogames. The first group is known as "narratologists". **Narratologists**, first of them **Janet Murray** (1997) highlight the potential of video games to tell stories, similarly to movies or novels, but with their visual and representational nature. The second group is known as "ludologists" sustaining the **ludological** character of videogames and the need to study rules. Moreover, they argue that narrative obstructs the game. Ludologists put at the center of their study gameplay and interactivity. According to Rouse (2004)

> "*The gameplay is the component of the computer games that are found in no other art form: interactivity. A game's gameplay is the degree and nature of the interactivity that the game includes*."

As a result, videogames are not only considered as Ludus built of rules but may also feature paideia components that make the player more open to free exploration. In fact, a player can engage in goal-oriented activities while still engaging in free play. This definition of videogames employed in a formalist approach recognizes the importance of both interactive narration and gameplay.

The situationist group is mostly interested in the analyses of specific events and social interactions practices held along with the game.

Building on the fundamentals of game studies, we can identify a series of main features in games: real-time interactivity, multimedia content and information manipulation, automated systems, networks of communication, interactive narratives, etc.

Real-time Interactivity

One of the most appealing aspects of video games is that it involves interaction with a user interface offering feedback on a video device. Video games can offer a quick response to players' input. Digital technology, in fact, enables real-time gameplay and immediate dynamic response to player decisions. However, the kind of interaction depends also on the technological medium used. In PC interaction is usually limited to mouse, keyboard, and screen compared to the possibility that VR offers nowadays.

Multimedia content and Information Manipulation

Digital games can be considered as media for storing and manipulating information of multimedia content such as text, photos, video, sound, animations, 3D models, and other types of data. In particular, video games in order to manipulate information in real-time take up far more computer capabilities compared to other software.

Automated Systems

The most prevalent feature of digital games is their ability to automate complex operations, which otherwise would be too hard to achieve in a non-digital game, facilitating gameplay. Most non-digital games need players to advance the game by manipulating pieces or acting in line with the rules at every stage. In computer games, the software automates these steps and advances the game without the player's direct interaction. Gaming computers handle easily this kind of complexity. Examples of automated complex systems in video games are the management of sustainability in Sim City, the AI used in Thief, etc.

Networked Communication

Another important feature characterizing video games is their possibility to create networks between players and to facilitate their communication. Video games offer different forms of mediated communication including direct text or video chat in the game interface, voice call, email, etc. In particular, multi-player games are networks of communications among players in different locations. Games like Monopoly, Quake, Chess are complex and rich social spaces in which are brought together all participants.

Interactive storytelling

Many games, usually, incorporate a story as part of the entertainment. Videogames, manifest a deeper narrative form and provide a more immersive and interactive experience, due to enhanced advanced technological and representational devices. Furthermore, video games, as a new media, combine narrative entertainment with ludological components, allowing for interactive storytelling. This is one of the distinctions between video games and conventional games. Adventure video games are typically games in which storytelling dominates compared to gameplay and hence they may be regarded as a powerful entertainment genre.

2.3 Video game genre

Given the diversity of games, game theorists (Herz, 1997; Poole, 2000) grouped them based on core characteristics, in the same way, are categorized movies. Some of the most used types of games defined by these authors with their outline features are listed below. Nevertheless, many of them are genre hybrids. Puzzle games for example are included in most of the game genres.

- Puzzle Video Games:

Puzzle video games test players' ability to solve problems and give them reward and make them feel satisfied once they solve the problem. They are based on logic exercises. Ex. Tetris

- Action Video Games

Action video games are games in which the player is involved in a first-person perspective in a physical drama. Player fights, shoots, thrill, and overcome obstacle. These types of games require very quick response and hand-eye coordination. They are usually based on missions. Ex. *Red Dead Redemption, Prince of Persia: The Sands of Time, Gran Turismo,*

- Sport/Racing Video Games

Sports video games are usually based on real-world sports such as racing, tennis, football, baseball, running, boxing, karate, basketball, etc. Some of the most well-known examples are the *FIFA* video game series and *Grand Theft Auto*.

- Adventure Video Games (or platform games)

Adventure video games are mainly narrative games with beautiful scenarios to be explored. The player is usually involved in a plot of mystery and exploration. Ludus aspect is covered by simple puzzle solving which allows the player to unlock levels or continue exploration. These games have usually a central protagonist, a very attractive game space, and a journey from one place to another with an aesthetical visual representation. Ex. The Witness (2016), *Dreamfall: The Longest Journey* (2006), Myst (2005), Legend of Zelda

- Simulation Video Games

Simulation video games have realistic or fictional scenery of real life, which reproduce gestures or instruments. In this kind of game its necessary intelligence or agility to solve problems. Simulation games include two categories: training and management simulation. Training simulations are used for training and learning/ educational purposes simulation real life simulation. (Ex. In-flight simulation the aim is to train the pilot to plane off the ground. These games serve to improve cognitive performance or motor skills. Management simulation improves the management skills of players. EX. *Flight Simulator, Sub Battle Simulator, Sims.)*

- Role Playing

Role-playing games offer the possibility to the player to immerse themselves in the game world. These games present maps of the large gamespace and statistic data related to the game. This category fit also

multiplayer games. In this type of game, storytelling is very important, including the character's detailed features and frequent backstories. EX. World of Warcraft, Legend of Zelda

- Strategy games

Strategy games are usually war games in which the player is not personally on the battlefield but takes the role of the commander. The battlefield is represented through a general map with all necessary details, which the player can view. In this category, there are two main subcategories: RTS (real-time strategy) and TBS (turn-based strategy). RTS doesn't offer the possibility to pause the game while in the other time can be managed by the player. In an RTS game scores depend on the velocity of relation but also on choices and strategy used. EX. Warcraft, Civilization II, Age of Empires.

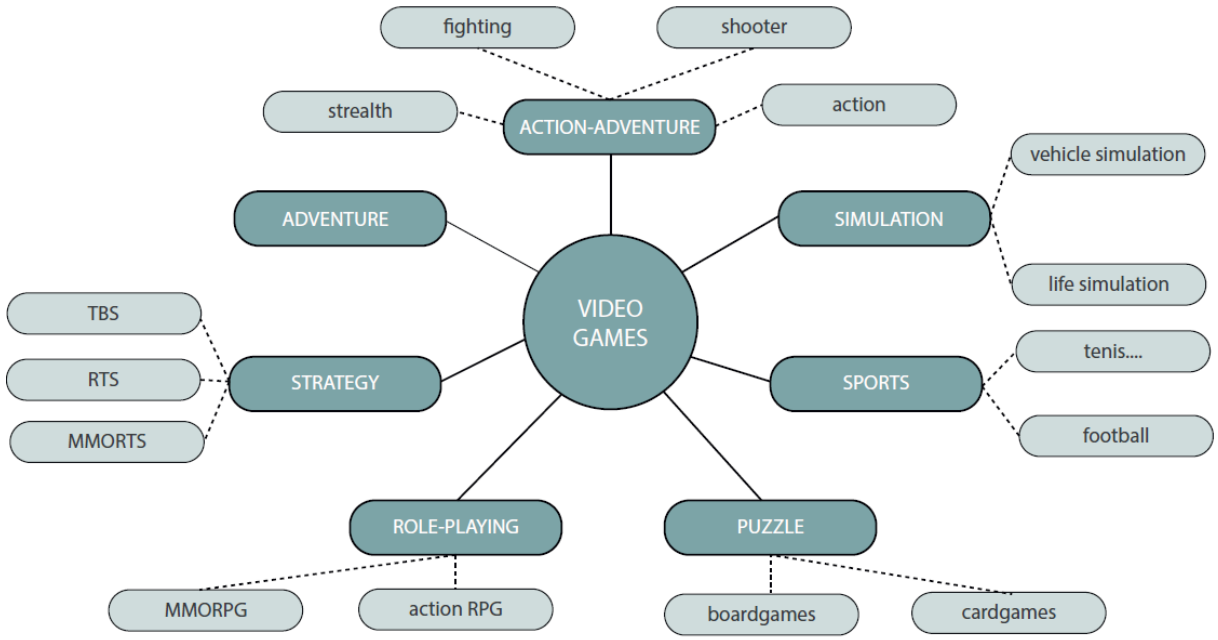


Figure 32 Video game main types. A classification (authors)

Gameplay in video games

Gameplay refers to game dynamics or the emergent rule system of the videogame as well as the possibilities it offers to the player. Gameplay is the emergent behaviors that occur between rules and game space and comprises the full player experience. Game designer Sid Meier defines gameplay as "*a series of interesting choices*" (Rollings and Morris, 2003, p. 61). The game continually challenges the player by a system of risk/rewards prompting frequent actions to overcome challenges. Challenges have an emotional impact on players and force them to interact with game elements. According to game

creator Dino Dini (2004), this type of interaction provides entertainment and experience. In this perspective, games are viewed not just as a kind of entertainment, but also as an immersive activity characterized by constant involvement and participation. In this sense, gameplay simulates sense and maybe regarded what makes the game absorbing, what produces a challenging experience and delivers rewards or compels the player to replay it.

Game theories Ernest Adams (2010) explained the complex relationship between the player and game mechanics, by defining a gameplay mode. Player and game mechanics communicate through the user interface in which the player sends inputs, and the device responds with challenging outputs. Gameplay in fact *consists* of the challenges offered by the game to involve the player and by actions offers to the player, who can choose to perform in order to respond and address the challenges.

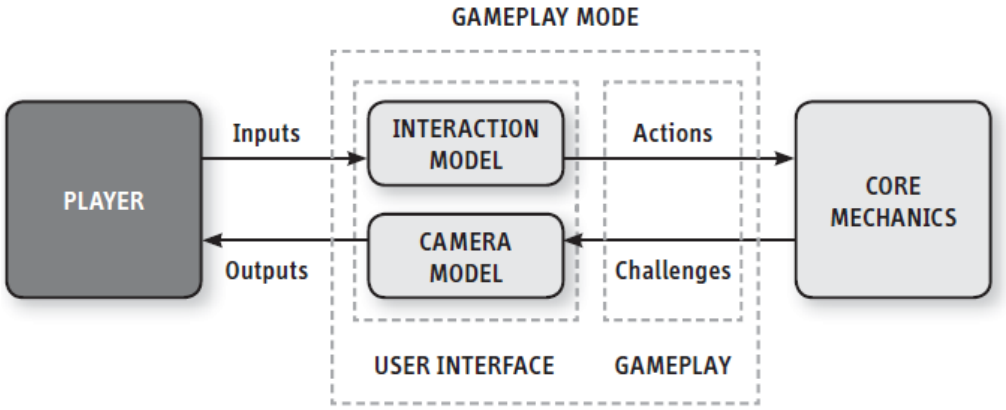


Figure 33 Gameplay mode (Adams, 2010, p.40)

In essence, many scholars (Bartle 2003; Adams and Rollings 2003; Rouse 2004; Adams and Dormans 2012) defined gameplay by the challenge/action relationship. The nature and quality of gameplay depend on the interaction the player interact with the game world and how the world reacts to his choices. Very few players' actions may not directly relate to challenges.

Challenge

Challenges as part of the game encourage users to complete them in order to receive a reward that is not always easily archived. This increases suspense while remaining engaging for the player. Challenges may be addressed with both mental and physical effort. There may be numerous challenges along the way for the wizard, but the most essential is to reach the final goal. Challenges can sometimes act as obstacles to achieving goals. The player can directly be informed about challenges or can discover them by themselves. Challenges are frequently arranged in a hierarchy. In this sense, games offer small challenges as part of sub-mission which are also known as atomic/invisible challenges, mission

challenges, and ultimate game challenges which allow the player to win the game. According to Adam (2010), the most common game challenges can fit into the following categories:

PHYSICAL COORDINATION CHALLENGES. Physical coordination challenges measure players' physical abilities to hand-eye coordination and react quickly to interface outputs.

- **Reaction time:** Players are tested on their ability to react quickly to events
- **Accuracy and precision:** These skills are mostly tested in steering and shooting games.
- **Timing and rhythm:** These qualities are required mostly in music-based games to test the ability of the player to press the right button in relation to the rhythm.
- **Combination moves:** Games need complicated joystick movements and controller button pressing.

LOGIC CHALLENGES: Logic Challenges provide the basis for strategic thinking games in which the player can make logical decisions based on the data given along with the gameplay.

PATTERN RECOGNITION CHALLENGES: Pattern recognition is about the ability of the player to spot visible or audible patterns or patterns of change and behavior.

TIME PRESSURE: These challenges test the ability to accomplish things in time or before other players.

MEMORY AND KNOWLEDGE CHALLENGES include*:*

- ***Factual Knowledge Challenges which are used mainly for*** quiz games. In any other type of game, they risk detracting players from full immersion.
- ***Memory Challenges:*** Many games especially adventure and role-playing games make use of memory challenges. They test the player's ability to remember things seen or heard diring the gameplay.

EXPLORATION OR SPATIAL AWARENESS CHALLENGES: Players are challenged to explore space when they find out obstacles and try to earn their freedom to explore or when they recognize the complexities of space. Thus, in order to challenge the player are required navigation visual clues, spatial relationships, unfamiliar spaces, or hidden objects.

- ***Locket spaces:*** These types of barriers hinder the player from progressing farther in the game unless he player discovers out how to eliminate these restriction.
- ***Traps***: Traps discourages the player from going in a certain way or using the same move again.
- ***Mazes and illogical space***: In this type of space some cues are needed to recognize the location and to find

- the correct path to navigate.
- ***Teleporters:*** They are systems that transport the player from one location to another. Teleporters can be one-way, preventing the player to turn back. To make the exploration challenge, teleporters can be reversible, so the player can return to where he came from.
- ***Search for hidden objects:*** In some games player needs to find hidden objects in their journey in the game world, in difficult-to-reach areas. Sometimes the objects are hidden in obvious places so that the player can guess them from clues, while other times they are located in totally obscured locations.

CONFLICT: A conflict challenge is a confrontation between opposing forces, such as an avatar battling one or more opponents. Strategy, tactics, logistics, and other aspects of conflict can all be divided into the followings categories.

- ***Strategy:*** This means planning considering the opponent's possible moves.
- ***Tactic:*** Tactics involve executing a plan by responding to unexpected events or conditions.
- ***Logistics.*** In video games logistics deals with supporting staff, weapons, food, or fuel for battles to refresh troups. In role-playing games, the player is required also to choose what to carry since he is limited by logistics constraints to take only a few objects.
- ***Survival and reduction of enemy forces:*** Survival and/or the reduction of opposing forces is a fundamental challenge in every conflict-based game.
- ***Defending vulnerable items. (***In chess, all units protect the king.)
- ***Stealth:*** The ability to move undetected. Games occasionally pose challenges in which the victory condition cannot be achieved through combat but must be achieved through stealth.

Economic Challenges: The majority of games are built on an economic system in which resources are moved or transferred, either physically or mentally, from one owner to another. Economic problems arise from resource behavior as outlined by the game's main rules. SimCity, for example, is nearly completely made up of economic challenges.

- ***Accumulating resources:*** Many games challenge the player to accumulate resources such as wealth, points, power items.
- ***Achieving balance:*** In managing games, the challenge to achieve a balance between the various economic resources is more interesting than simply accumulating one resource or point.
- ***Caring for living things***: This means looking after a person or a group of people and improving their development as in The Sims and Spore.

Conceptual Reasoning and Lateral Thinking Puzzles: These kinds of puzzles require extrinsic knowledge, from outside the domain of the challenge itself.

- ***Conceptual reasoning:*** In conceptual reasoning puzzles, the player must utilize his reasoning ability and knowledge to solve a problem.
- ***Lateral thinking:*** Lateral thinking puzzles add a twist. Thus, the player must think of alternatives instead. Provide hints or clues to help a player who gets stuck.

Actions:

Actions are executed by the player as part of the game and in response to interface outputs. They include **walking, running, flying, jumping, shooting, buying, building, fire, etc**. Each game has its own set of actions, although most games share common actions such as walking, running, moving objects, etc. Simple games have very few actions while in complicated games players have a more complex set of actions to perform. Actions depend on the interaction model of the game. In an avatar-based interaction model, actions are performed by an avatar., while in a multi-player game, the player acts indirectly by performing actions as in real-time strategy games, in construction and management simulations, and God games. Actions in the game world are easier to be performed compared to real life. Not all actions are directly tied to specific challenges, so they don't necessarily affect the game outcome. Non-challenge related actions can be categorized in the following categories:

- **Unstructured play**. Some actions can be performed only for fun, not moved by challenges. For example, moving around and sightseeing the game world.
- **Creative play.** In these games, many actions include the creation and customization of objects/ things and avatars in the game world. Typical examples are construction and management simulations. This kind of action is limited only by the game's internal economy.
- **Social play.** In multiplayer games or online games, players perform actions socializing with each other. Typical actions are taking, forming groups, comparing scores, take part in community activities.
- **Influencing narrative.** The player can affect the plot by taking actions that allow him to be part of the story and even orient it.

2.2 ARCHITECTURE IS VIDEO GAME

Play as an experimentation design methodology in architecture. Playing architects.

Architecture has a long history intertwined with play. The notion of play in architectural design is related to the possibilities of the geometrical combination while considering specific spatial, functional, and aesthetic qualities but also to playing theories. Architecture as a design practice plays with forms and volumes and attempt to create order and harmony. The procedural nature of the play activity gives architects the tools they need to organize the rules of their "game" arriving, through task simulation at the eventual outcome of their creative process. The connection of architecture with playing activities and games goes back to the late 19th century.

The first didactic game based on a modular system with distinctly architectural aims was created in 1870 by Gustave and Otto Lilienthal. The construction set is made up of various shaped and colored stone pieces. The instruction manual depicts perspectival views and floor plans of the architectural models to be built. It constitutes the rules of the game. Building blocks can be set on top of each other reproducing the architecture tectonics.

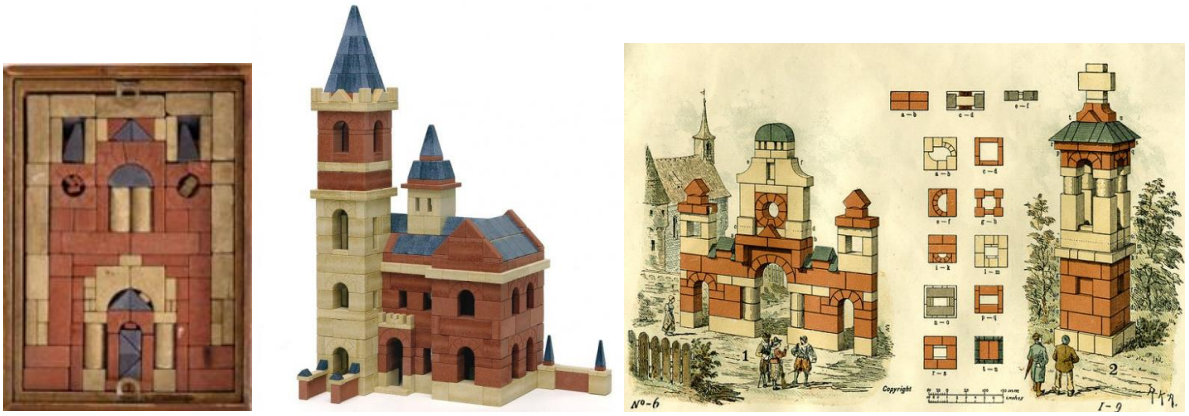


Figure 34 The first didactic architecture game with building blocks. Anker Steibaukasten, 1880

Similarly, Friedrich Froebel, a German educator who is credited with inventing the Lego game, emphasized the importance of educational mechanics for the generation of creative bi or three-dimensional objects and the exploration of the relationship between whole and part through his play gifts (wooden toys made of various prismatic volumes), which allow children to reproduce existing images and to experiment with the composition of new elements of geometric form and structures. These simple toys, offering a large variety of assemblymen, enable children to experiment with shapes, which also constitutes a crucial aspect of architecture. In his biography, Frank Lloyd Wright stated that

the Froebel play gifts had an indelible imprint on his perception of the world and on the understanding of architecture form.

Other construction toys that require intellectual and manual skills were Meccano (1901),Alfred Gilbert's (1911) Erector Set, and Lego construction sets. Compared to Froebel gifts, with were mainly based on the reproduction of proposed images, these games are more creative and offer the opportunity to create a variety of new combinations. However, in some cases, the combinations are still limited, whereas in other cases assemblage is open also to unconventional forms.

Figure 35 Franc Hornby's Meccano (1901) construction set and Alfred Gilbert's (1911) Erector Set

Meccano, invented by Franc Hornby was a wooden toy setfor building miniature constructions which allow users to build variousshapes, styles, or dimensions, using modern architecture principles. The first set contained 16 pieces for construction, which due to the success of the game, rapidly grow in number, complexity, and type of components used. This toy has a significant impact onarchitectural design. The high-tech design of the Centre Pompidou in Paris (1977) and the Lloyd's Bank Building in London were both influenced by Meccano games, according to Richard Rogers and Norman Foster (1986).

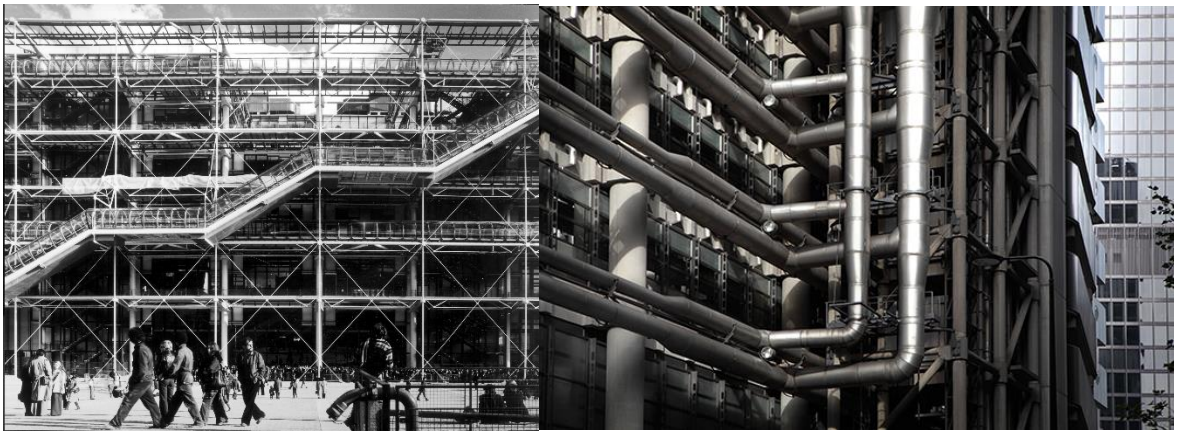


Figure 36 Image of Pompidou Centre by Richard Rogers, Renzo piano, and Particular form Lloyd's Bank by Norman Foster inspired by Meccano construction toys.

Some years later, Alfred Gilbert invented the Erector Set, made of metal construction pieces such as beams, nuts, screws, bolts, etc. to build metal bridges and skyscrapers. In addition to previous toys, this set was made of movable parts and was more flexible and realistic.

The later Lego construction set, firstly developed in 1935 by Danish carpenter Ole Kirk Christiansen, offered absolute freedom for fantasy creations and allow children to create almost everything. Hence, it become the most popular toy that inspired architects. The renowned Danish architectural firm BIG directed by architect Bjarke Ingels was inspired by Lego for the design of the Visitor Center in Billund Denmark. The building is made up of 21 blocks interlocked similarly to the blocks of the famous Lego game.

Figure 37 Visitor centre in Billund, Denmark, by GIB architects and its Lego model

The concept of play in architecture refers to the creative process of the project and is considered as a device that facilitates education and the design process. Le Corbusier in his new manifesto of architecture defined architecture as:

> "*The masterly, correct, and magnificent play of forms brought together in light*" (Le Corbusier, 1931)

The nature of the design process emphasizes the necessity to skillfully combine shapes based on an artful arrangement of rules that are not completely arbitrary.

Design architecture through a guided play is common practice in contemporary works of architects. The Chilean-based studio of Pezo von Ellrichshausen uses the richness of play and assembly in the design process. Combinations are considered part of objects identity and a way to find the right design solution. His methodology of designed in mostly focused on manual combination and generation.

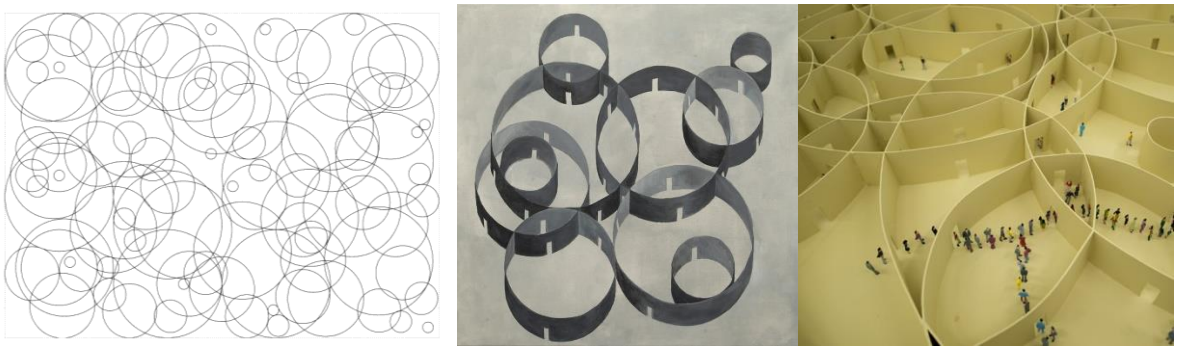


Figure 38 Playful architecture experimentation of Chilean studio Pezo von Ellrichshausen

The procedural aspect of the playactivity provides architects with instrumentations to structure the rules of 'own game' and to reach the outcome of their creative process.

The previously mentioned famous games allow players to not only duplicate real items within the constraints of the pieces but also to expand their creativity and create numerous combinations, resulting in the creation of new models and imaginary worlds. This type of flexibility is made possible by the lightness of the material and the adaptability of the parts. With the advancement of information technology and the creation of digital construction video games such as SimCity (1989), The Sims (2000), Minecraft (2011), Townscaper (2020), the construction process is highly facilitated. In addition, digital construction games are programmed computer applications with defined rules and interactions and provide different options of design carried out in real-time, contributing not much to the construction of a predefined object but in the process of creation and generation of architecture.

Media critic Maaike Lauwaert in his book “The Place of Play” discusses the potential of digital games compared to classical construction toys:

> “*a set of building blocks can be actualized through building and constructing various objects with the individual blocks or bricks. Digital, coded objects take this actualization further because they*

provide the interactor with a string of options to actualize the design, thereby making this actualization into a procedural activity." (Lauwaert, 2009)

In Wright's games, such as SimCity (1989), The Sims (2000), which are open-ended rule-based systems, and in games as Minecraft (2011), and Townscaper (2020), which are essential without rules, the user has an unlimited string of actualizations of design potentials.

The ability to experiment with architecture through guided play is a core idea in the context of video games. Videogames offer a greater potential for experimentation. They invite players to experiment with architecture without physical or economic constraints. Because the computational processing power of many computer systems allows operators to quickly iterateand encourages design through experimentation.Computer games allow players access to new forms of architecture representation which are almost impossible to experiment on paper. In addition, video games give player a virtual agency to act and visualize effect of its actions in real time, visualizing quickly multiple versions.

Figure 39Screenshot from Townscaper and Sim City video games

Complex architecture forms can be organized as Puzzle, Tetris, Lego games. Habitat '67 by Moshe Saftie made of three-dimensional prefabricated units was inspired by Lego, and architecture was the result of experimentation with 2:1 Lego bricks.

"*We bought out all the Legos in Montreal at the time, because we built many, many alternatives*," Moshe Saftie[4]

Video games, offer the possibility to experiment with "voxels" following the rules of Tetris, Lego or similar video games easily and quickly or inventing new rules.

[4]From an interview of Moshe Saftie for Dezeen site (Source: Available online on : https://www.dezeen.com/2014/12/19/moshe-safdie-movie-interview-habitat-67/ , accessed on 12.06.2020)

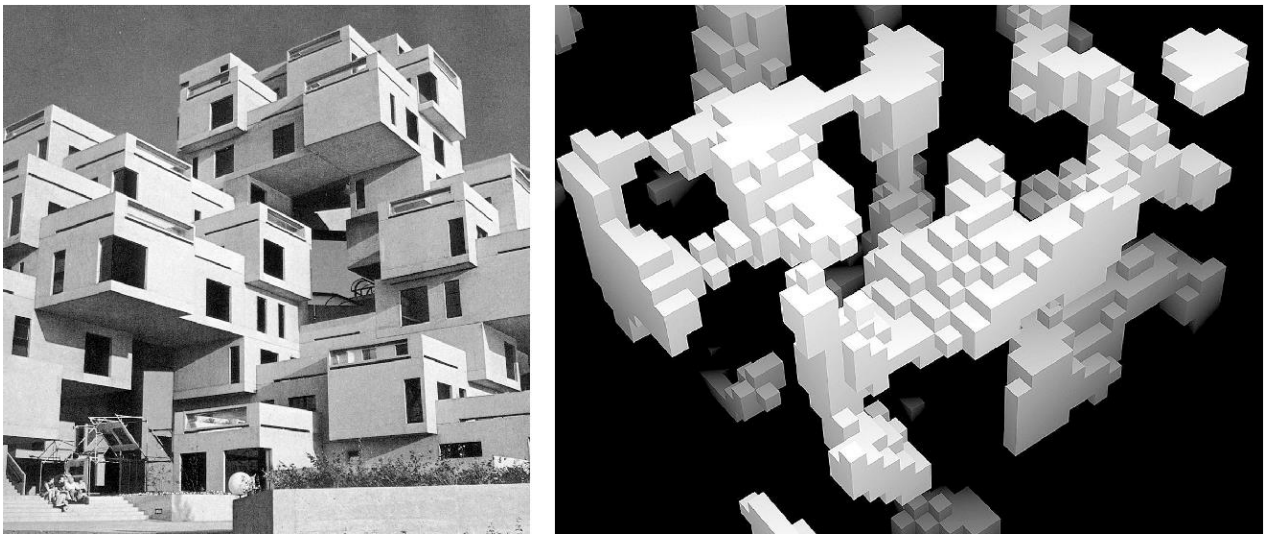


Figure 40 Habitat '67 by Moshe Saftie and computer-based Lego design experimentation

Voxelsare movable, and transformable in size and orientation to allow multiple configuration and creative combinations. Biarke Ingels, inspired by Habitat 67, proposed for King Street in Toronto an architecture made of voxels and designed to suit the plot, fulfil planning restrictions, and provide the best light exposition. As a result, BIG architects' research is centered on "hedonistic sustainability," which they achieve by combining playful design (open to alterations and the creation of various versions) with sustainable design practices.

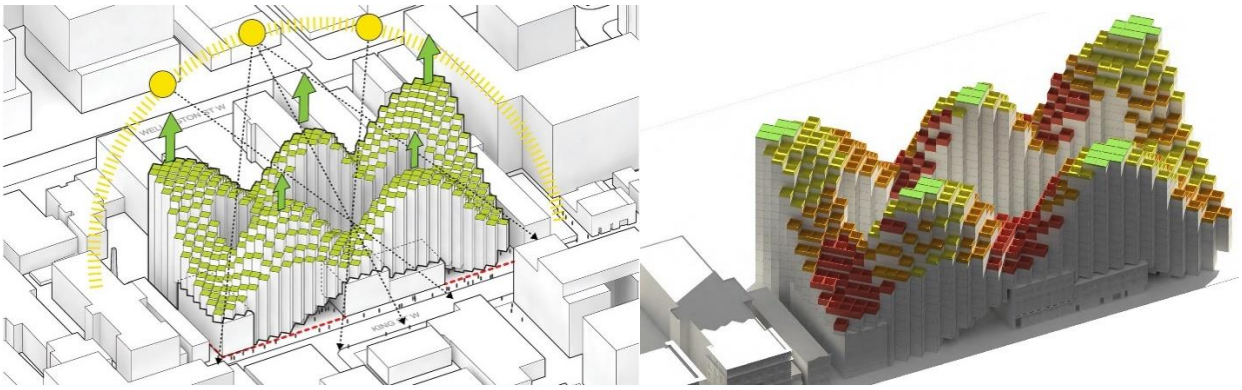


Figure 41 Model of Mountain on King West, Toronto by Biarke Ingles, inspired by Habitat 69 and based on voxel aggregation. Playful design for the generation of the amount of sunlight received, in the upper terraces, (source: Allied and Westbank)

BIG architecture in this case is based on a playing with models in which they have posed specific rules. In this sense, they create constrains, but also playing offers them various possibility to model architecture in respect of the predefined rules. In his Serpentine Gallery Pavilion, the model was defined by simple geometric rules: they took a simple brick, replicate it to create a wall and unzipped the wall following a certain curve. This allow them to generate infinite variations by changing parameter of the components.

"*Building a model by defining rules allows us to change the components of the wall, the height of the bricks, the shape of the curve, in the end generating a new unique Serpentine pavilion without tediously remodelling everything*." Biarke Ingels

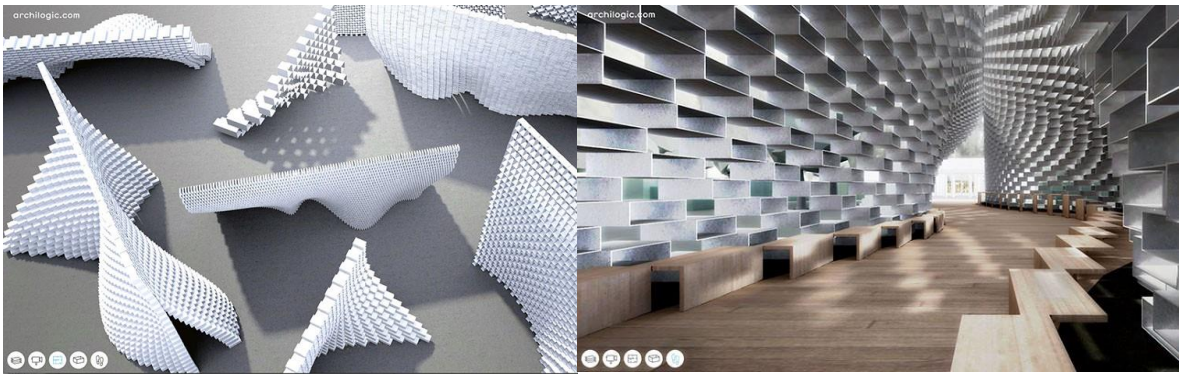


Figure 42 Serpentine gallery pavilion by Biarke Ingels

In this sense architecture is about playing and experimenting with different possible forms, similarly to construction video games which are open ended and that allow infinite compositions.

Video games and cooperative methods in architecture and urban planning.

In the last decade, video games are becoming platforms that support multiple players simultaneously, being part of the same world. With the advancement of internet speed and the introduction of massively multiplayer online games, (MMOGs), new virtual tools for forming social communities and virtual networks have become available. On the other hand, architecture and urban design problems are becoming more and more complex involving different stakeholders, which are asked to develop a shared and feasible strategy of participatory architecture and planning, offering cooperation for a certain project. Moreover, with the online work triggered by covid-19 lock down, the interest on cooperative aspects of video games is growing in the field of architecture and urban design. Multiplayer games, in fact offer not only communication tools between different players, but also the possibility to manipulate the same space, to cooperate with alerts, and provide synergies for the design architecture or urban space. According to Thomas Kvan (2000), the design process in architecture and the possibility of collaboration during the design cycle can be enhanced through the use of different sort of realities. 3D models of architecture are created to mimic physical reality and improve design perception and communication. Similarly, to video game models, they are based on interactivity and information layering that allows user to receive instant input, converse with objects and manipulate them in real time which would otherwise be impossible in the real world. Bradford et al. (1994) coined the phrase "Virtual Design Studio" and recognized communication as a vital aspect for design in new architecture.

A prominent body of research is the work the Bangalore-based research group "Fields of view". They experimented with many participatory architectural and urban planning projects engaging various groups of interest. By providing feedback and presenting alternatives, each group or individual becomes a part of the city game. It was able to experiment with numerous design options using game technology. Players can try out alternative policies and procedures, watch patterns evolve in real time, and contrast different emerging scenarios.

Figure 43 City games of research groups "Fields of view' and "PlayTheCity"

Another Amsterdam-based research group, "PlayTheCity", formed by architect and PhD Game Designer Ekim Tan, draws connections between the video game "Dungeons and Dragons" and engagement and participatory planning, employing numerous rules as tools in the urban game. Cities nowadays are complex settings impacted by a variety of actors. In the "Playthecity" research, different players are asked to play a specific role in modifying their surroundings via negotiating, forging partnerships, and so on. The game help to generate collaborative solutions.

In architecture, Winy Maas, of Dutch MVRDV design studio, in the 2017thDutch Design Week, through an built installation named "(W)ego", reflected on the urban development of the last decades and proposed new forms of habitation that satisfy the desires and egos of each resident in the fairest possible way. (W)ego house is made up of personalized units that can be moves in different configurations similar to Tetris configuration and based on a participatory design process in which each inhabitant present, contest, and negotiate his desire.

This idea was pushed forward by research institute "The Why Factory" (T?F) founded by MVRDV. It investigates development possibilities focusing on the creation of architecture and urban models.

“The Why Factory” explored the topic of density and desires, investigation on the possibility of typological diversity in multifamily housing[5]. On the one hand, they set a high-rise construction envelope as the housing block's development boundary, while on the other hand, individuals claim space based on their desires, discuss, negotiate, and fight with one another to find solutions that meet their needs. Players can conquer space in a variety of ways, go up, down, negotiating, fighting, and so on. They experimented with various rules within this framework. Researchers tested four different urban negotiation video game models: Blind, Strategic, Automanton, and Trading, in which players engage at the same time to achieve their desired objective. In the Automaton model, the conflict takes place without the user's involvement, and the architect loses control of the design since the software entirely takes over and represents your aspirations. In Bling model, the moves of the user are not visible to other users.

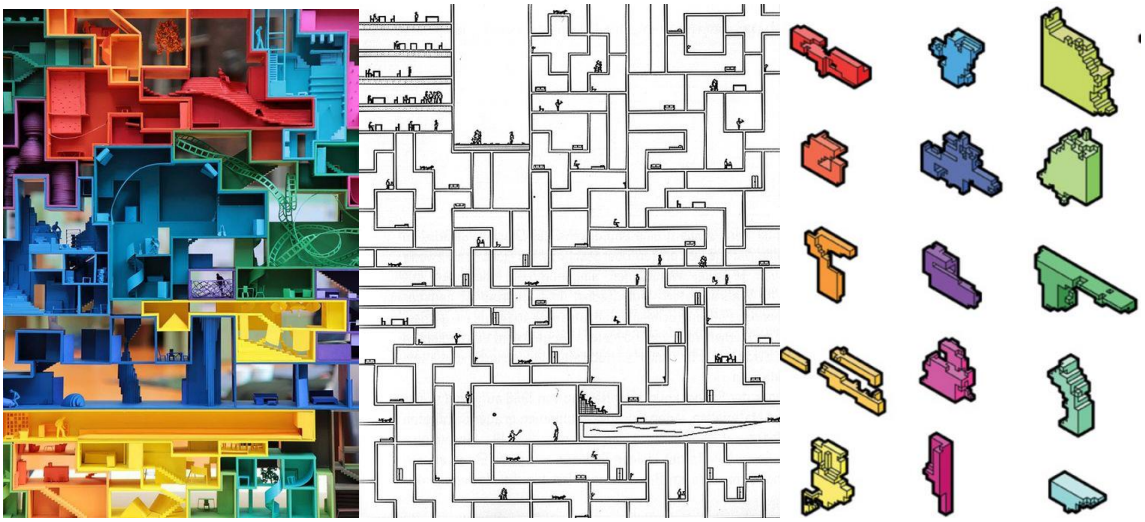


Figure 44 WEgo project, by “The Why Factory”

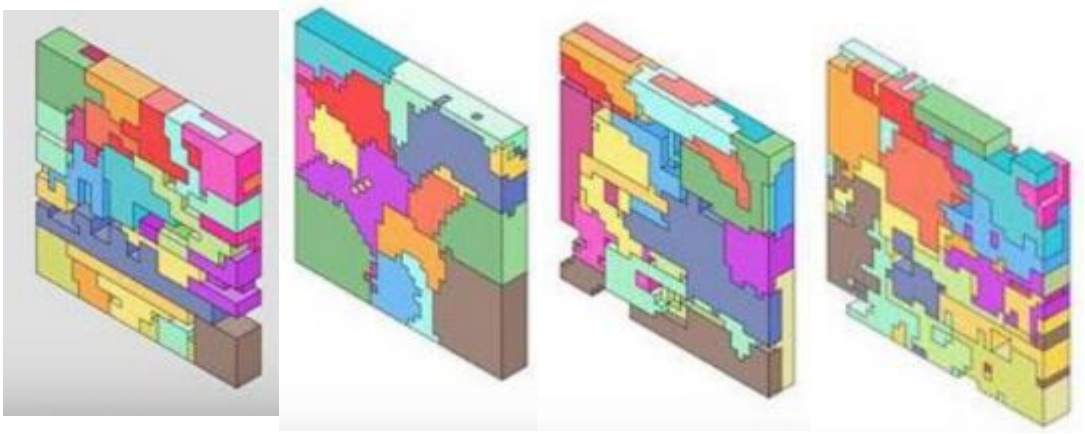


Figure 45 Four urban negotiation games in Wego project: Blind, Strategic, Automanton, Trading

[5]‘Double House’, Wilhelminapark, Utrecht, 1997. MVRDV + de Architectengroep, in Volume 51: Augmented Technology.

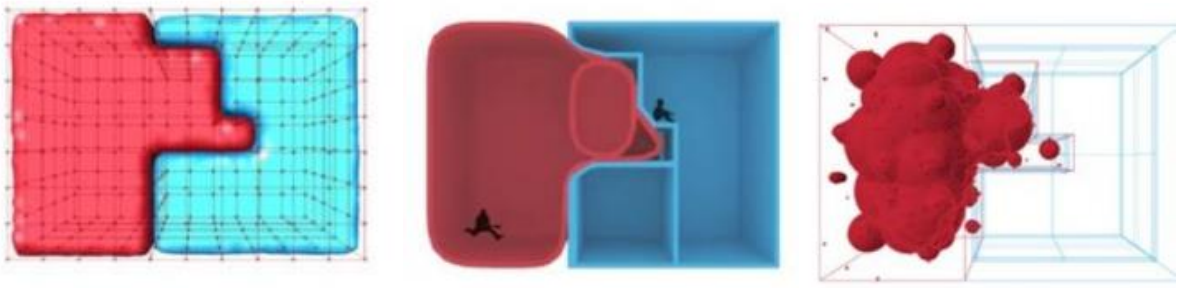


Figure 46 Negotiation between two users to define their limits in Wego Project

The initial experiment was built on a quarrel between only two users, with no way to negotiate and no other option except to rely on their egos until they reached a win-win solution. Another experiment was carried out in Chicago, where the architectural outcomes were ignored in favor of creating a sociological interface that depicted how consumers generate their wish lists. In this example, negotiation yielded unexpected results. Therefore, multiple configurations may be formed based on the rules given to each video game model and the modalities of interaction.

With the advent of technology and the use of MMPOG, city games have shifted in recent years to game engines that provide very realistic 2d and 3d visuals representations of architectural or urban environments, as well as data-driven software simulations in real time. According to Tan (2019), video game technique offers real-time feedback by various participants by providing the possibility to grasp urban complicated datasets through various data processing and simulation. This may be accomplished by not just collecting the various actors face to face, but also by engaging online communities. Indeed, online communities that engage and collaborate in real time, much like MMPOG, may play an important role in the design, testing, and reshaping architecture and the urban environment.

Video Game and Rule-based, interactive architecture

In architecture, game design technologies are seen as instruments for creating environments that can be used not just as playful spaces, but also as architecture virtual spaces that can be displayed to customers or walked through by virtual visitors and interact with. With the advancement of internet speed, architecture is becoming quickly transformable in real time. Video game elements can be found in architecture in a multitude of ways:

1. As approaches for delivering an updated supply of digital technology, computational, and rule-based design during the architectural design process (playing architecture, conceptual

approach). In games with a first-person view, the player to act and react in a 3D virtual environment based on certain rules. In virtual reality, the architect can design, create, and generate a variety of reactive spaces that are predictable or unpredictable; architecture can also design the paradigm of interactivity. Interactive architecture/rule-based architecture/programmable architecture**/ Interactive architecture.**

2. During the design process, as a simulation method. To walkthrough architectural models and visualize them. Realistic, utopian, and dystopian building representations/narratives can all be supported in games. Games can feature activities and transactions that are analogous to those found in the real world.
3. To make the architectural design process more gamified. Architecture with a sense of fun.

Kas Oosterhuis (2006), an experimental and innovative architect who trained at TU Delft, describes architecture as "a complex and dynamic system with movable parts" which are driven by a gaming programming language. He proposes a rule-based, parametrically built architecture capable of changing in real time in reaction to external behaviors and adapting to changing situations at the same time. In this view, he defined architecture as a media akin to a video game that responds to programmable rules with artificial intelligence, due to evolving technologies and based on how players and protagonists move around the game space. Based on these considerations, in the 2000's he builds an installation named Trans-ports at the Architecture Biennale in Venice, in which visitors by moving around activate sensors that bring signals to games running in computers. Signals correspond to game action and they contribute in the change of the geometry of the environment and on the insertion of other visual effects visible on the screen.

Oosterhuis together with his research group "*Hyperbody Research Group"* in Delft, researched on a proactive architecture and on its degree of adaptation and stimulation by using a game design tools. In particular, Oostehuis was interested in the possibility that game engines offer to create new alive, interactive and manipulative worlds.

> "*Architecture becomes a game being played by its users*," who set the parameters of the built environment (Oosterhuis 2006, p.3.)

In addition, Oosterhuis and Jaskiewicz (2007) at Game Set and Match conference in 2007, proposed a "multiplayer design" approach in architecture, considering the possibility to enable the exploration of the architecture design process from different perspectives, not only considering the single-player perspective.

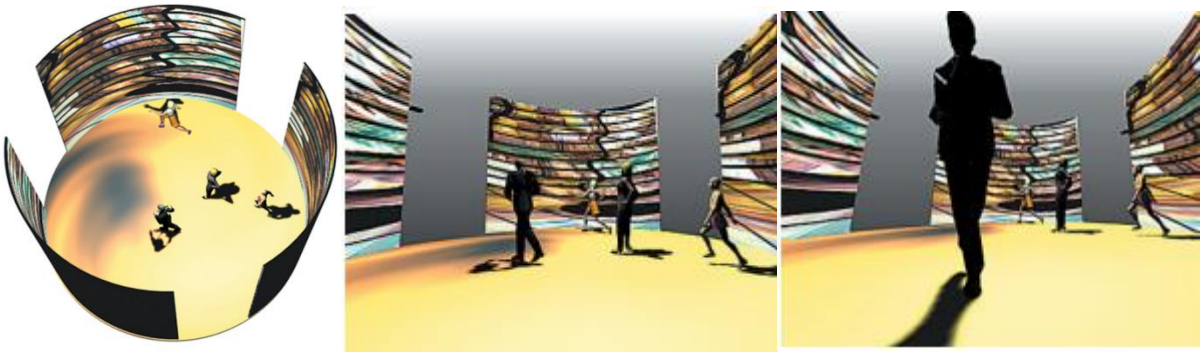


Figure 47 Trans-ports installation for interactive architecture, in Architecture Biennale in Venice, Kas Oosterhuis, 2000

> *"Designing architecture is serious play. It is a game whose goal is to create a great building. It is a game designer's need to play according to the rules of physics, economy, and society. It is by nature a multiplayer game in which many specialists need to work together to increase their prospects to win*" (Oosterhuis and Jaskiewicz 2007, p. 358).

Oosterhuis has pointed out the continuous and progressive gamification of architecture, by the use of game design tools (Oosterhuis, Feireiss, 2006) and claimed the disappearing of substance form in favour an information flow as the primary material of this new architecture. The solid body of architecture becomes a "hyperbody", able to be transformed in real time by exchanging information with the surrounding context. Moreover, Marcos Novac introduced the concept of "neuroarchitecture" envisioning and architecture not made of solid material and not responsive to the laws of gravity, but made of "*intelligent, plastic nanomaterials, keeping the central nervous system of the building informed*" (Markussen, 2005) and able to sense outer inputs and respond to them. In the age of information technology, Novac believes that architecture does not exist only in the physical form but is inevitably the product of technology and therefore is under a liquid form which is in continuous change and transformation and can be accessible and manipulated by all. Hani Rashid of Asymptote Architecture studio pointed out the features of this new liquid architecture.

> "*Objects, spaces, buildings, and institutions can now be constructed, navigated, comprehended, experienced, and manipulated across a global network. This is the new architecture of liquidity, flux, and mutability predicated on technological advances and fueled by a basic human desire to probe the unknown*" (Chang, 2000).

The spatial configuration as in video game is in continuous motion using digital technology. In 1997 Oosterhuis invented and build Saltwaterpavilion, an interactive architecture that depend on the changing the environment conditions. Users experience a changing environment but was also able to

interfere in it by influencing light, color, and sound effect, by adding new information's that could transform the environment. In this sense visitors play with the building.

Based on this idea, later, Oosterhuis proposed a design that responded to real time behaviour of people visiting it. In 1999, Oosterhuis designed a programmable building, call "The muscle" and exhibited it at Centre Georges Pompidou in Paris. This building was not static but was in continuous transformation in response to people movement and actions due to dynamics programed in the design process. The architecture become a videogame; architects offer to the visitors to play it in real time. Visitors make choices similarly as in a video game deciding their movement and actions in the architecture space. Their behavior is recorded and hereby responses are triggered by the environment, which is in continuous interaction mode. In this sense, architecture can become also cooperative enhancing performance as result of people exchange and adaptation to their needs.

Figure 48The interactive architecture of Saltwater Pavilion, ONL 1997
Programmable architecture. Trans_ PORTs:ONL 2001, (Oosterhuis, Lenard 2000)

Gaming architecture visualization.

Gaming technology and in particular the use of gaming engines (GE) is revolutionizing the way architects design and communicate their projects (Indraprastha and Shinozaki 2009). To portray the architecture of game space, the video game industry developed strong 3D modelling tools using software like Computer-Aided Design (CAD) and collaborative platforms based on software of Building Information Modeling (BIM). Today, video games are becoming more realistic or hyper-realistic as technology advances, allowing for a fully immersive experience that is closer to real life, as well as the creation of 3D animations that allow objects to be displayed in a more dynamic way while the user moves through the space. Compared to physical models, architecture created as in game space, allow to better understand space, to enrich user experience and to offer interactivity. The notable video game Assassin's Creed

(fig.49) uses realistic architecture to immerse the player with surrounding environment, recreating historical cities to immerse the player in that particular historical period while playing. Other games use utopian or dystopian environments to immerse the player. In addition, video game engines have the ability to represent architecture semantic information based on BIM geometry processed through gaming engine that allow to work collaboratively. These aspects are highly beneficial in architecture to display the project in a more realistic manner, to allow customers to have a full immersive experience, to understand the feelings it conveys, to provide semantic information about the 3D model and to communicate and review the work with other collaborators in real time. These are valid not only to architecture project to be build, but also for architecture in virtual space. Architects may create these very realistic / hyper realistic / future / utopian and interactive settings in VR employing popular gaming engines like Unreal, Unity, and CryEngine. As engines are becoming more user-friendly, inexpensive, and capable of processing realistic images, architects' interest in employing them for professional purposes to construct software development environments is expanding. Architects solely employ recent programs like Lumion and TwinMotion, combine real-time rendering technology with user-friendly interface.

Figure 49 Assassin's Creed video game is highly photorealistic.

In addition, video games similarly to architecture have the ability, the tools, and a long experience in narrating stories in space. This is very useful also in architecture, to make architecture space more interesting and engaging to client and visitors. As part of narrative, architecture space can for instance be visualized **with different styles, sound and atmospheres** that transport users to another reality, **can be**

viewed in different positions in the environment and by different perspectives, allowing architecture to be viewed from different angles in a dynamic way. **Materials and light** can also be used to provoke feelings. People often associate memories with materials and light fill space or the lack of light brings the player to a deeper immersion. For example, Calvino Noir (2015) video game is built on dark style sustaining the exploratory and adventurous world of 1930s European criminal (fig.50). Game style is inspired by noir movies. In games, architecture is akin to that of a movie set, diverging from real architecture to serve the story. Architecture in video game, as part of the narrative establishes boundaries to avatar movement, and constrains to the influence of his actions. Architecture is made up of obstacles serving the gameplay and architecture space needs to be challenging to encourage exploration. In addition, architecture has also a secondary role to play, to inform and entertain the user. All these elements make architecture closer to video game space visualization.

Figure 50 Video game Calvino Noir (2015) present space narrative through dark style and seen in architecture section.

CHAPTER. 3 NARRATOLOGIES IN VIDEO GAME AND ARCHITECTURE

3.1 VIDEO GAME NARRATIVE. STRUCTURE AND TECHNIQUES.

Stories and video games

Our culture is built on stories. They have an emotional impact on us and influence our thoughts, education, values, and behaviour since childhood. We learn and evolve through stories. Merlin Rebrovic (2014) experienced designer in the field of user experience design defined the story as follows:

> "*The story is the telling of an event, either true or fictional, transferring information, experience, or emotion in such a way that the receiver experience or learn from the story*" (Rebrović 2014).

According to the online Dictionary[6] "a story" is defined as "*a narration that arises interest, amuses, or instructs the reader*", enriching human experience since childhood. People learn better through stories.

Storytelling techniques have evolved throughout time, especially since the emergence of digitization in the previous several decades. Interactive technology has added a new degree of creativity, connection, and immersion to narrative approaches (Murray 1997). Unlike books or movies, where tales are read or viewed visually, video games allow players to experience stories in multiple dimensions and senses: spatial, audio-visual, tactile, and so on. Even though storytelling approaches have evolved, we remain hooked to stories because of the extended experience they provide. According to American neurology professor Robert Morris Sapolsky, the reason we are still attached to them is that the stories are typically told through fragmented events related by cause-and-effect, like how our brain processes information under minor stress (Sapolsky 2010).

In video games, stories are used for various intends including didactic tools, to make the game more appealing, to motivate the player, to help the player feel more involved and immersed in the game and in some cases allowing them to participate, decide on and compose by themselves the stories. However, games are not per definition narrative media. In fact, the game's primary aim is playability. As a result, the story typically plays a supporting role in the video game, however, there are certain so-called narrative games that are largely cantered on storylines. In both cases, the elements of the story in video games are incorporated based on a series of models and techniques of narration. According to video game designer Tadhg Kelly (2011), the story is the structure of all story elements and the way they are

[6] https://www.dictionary.com/

narrated. As a result, it's critical to grasp the notion of narration as well as the numerous models and techniques of designing stories in video games.

Defining narrative in video games

The concept of narrative is related to the story but is not the story itself. It is the plot, or the way story is narrated. The plot and the story are different concepts. The plot is formed only by a few selected interrelated sequences of events explicitly planned by the narrator to be presented to the audience. Narrative, in the Dictionary's (2006) primary definition, is considered as the chronological sequence of stories or the order in which the events occur. The process of narrating is based on interpretation. This creative arrangement of incidents is what makes up the story. Events are dictated by the typology of characters' interaction, collaboration, conflict, etc.

In traditional media (such as literature or cinema) narrative is presented as a series of written or spoken words or moving images, under the classic three-act story structure which is often credited to Aristotle based on his observation that a tragedy must have a beginning, a middle, and an end. Aristotle's plot structure is organized in three acts. The first act, the exposition, is based on defining and describing the setting, background information, the character, and exposing the conflict. It is followed by the second act which is the confrontation of the character, the rise of action, the development of obstacles, and different small crises which progressively rise tension leading to the climax or the major peak of tension. In the third act, the conclusion is related to the final resolution, with a rapid dissipation of the tension after the climax.

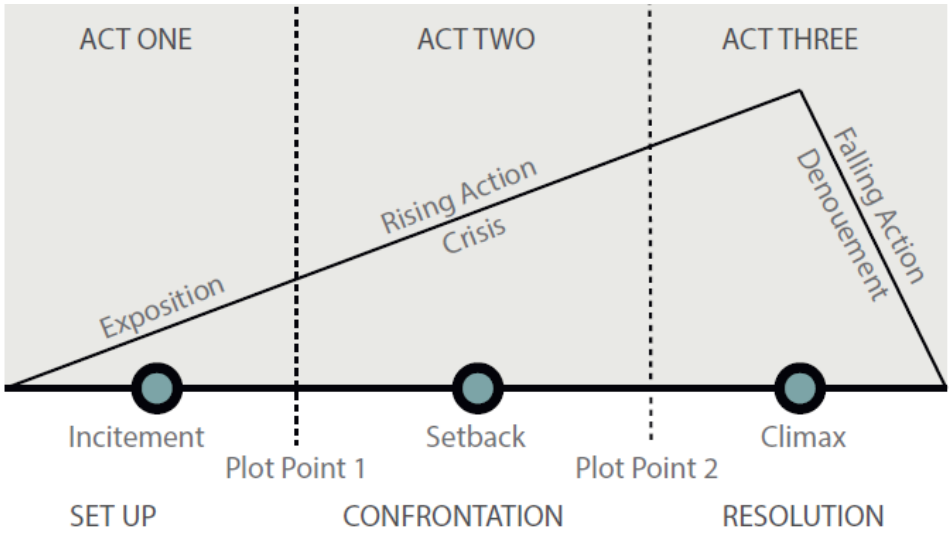


Figure 51 Aristotle Three Act Structure

In cinematography, film theorists David Bordwell and Kristin Thompson (2001) define narrative as "*a chain of events in cause-effect relationship occurring in time and space*". Here, the narrator does not describe all events but instead considers separately the plot and the story. Starting from the story, which is the entire narration, is created the plot. The plot is formed only by a selected interrelated sequence of events carefully planned by the narrator to be presented to the audience. The plot consists of a series of selected events, which can be presented to the audience in a chronological sequence, casually, or in another order decided by the author to create meaning. In movies, the plot should provide enough information for the audience to grasp the cause-and-effect relationship of the chain of events for them to comprehend the entire story. Events in movies are dictated by the type of characters' interaction and the resulting events they cause. According to Jacobs (2007, 26), the plot is an "arrangement of incidents" which make up a story and hold it together. Thus, the narrative is not the story itself, but the way it is told.

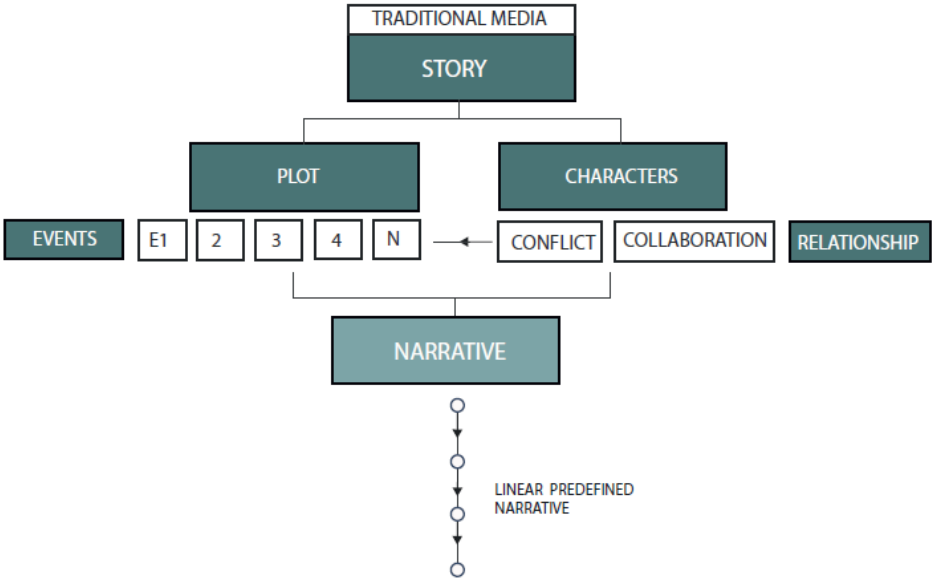


Figure 52 Traditional media narrative (ex. literature, cinema)(by authors)

Building on Aristotle's three-act structure, Todorov defined a basic narrative model and described it as follows:

> *"An "ideal" narrative begins with a stable situation that is disturbed by some power or force. There results in a state of disequilibrium; by the action of a force directed in the opposite direction, the equilibrium is re-established." (*Todorov, 1977, p. 111).

Todorov's theory on narrative structures the different stages in a continuous circular model starting from an equilibrium state to the disruption of equilibrium, the recognition of the disruption from the character, its actions to respond to change, and the new equilibrium state gained. Toronto's definition

seems to fit better to the video game narrative. The disturbance of a quiet state, in fact, is fundamental in all games to give the player the purpose of the game (the sensation of a beginning) and the general or partial objectives and challenges that bring the player step by step toward the conclusion (the end) of the game. While in literature and in the cinema the reader/ spectators is excluded from the production process, respectively, in computer games players participate in the game by acting. As a result, the story is delivered the moment players act and interact in the game world.

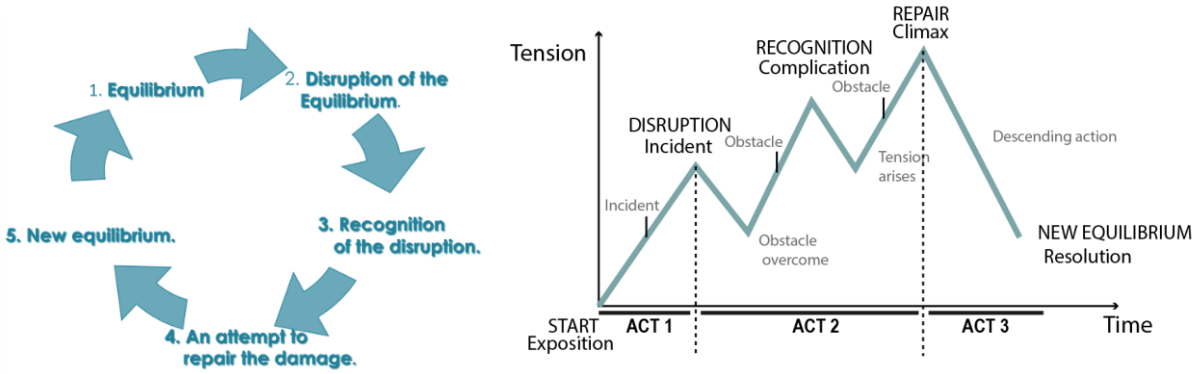


Figure 53 Torodov's model of narrative; Authors reinterpretation of Aristotle and Torodov model of video game narrative considering the role of players action in the narrative structure

Hereupon, video games, although are based on traditional storytelling techniques, have changed the way stories are told. In video games, players are turned from passive observers (described as the audience in conventional media) to active participants (players) and influencers in the way the story is told. People can interact with stories. In video games, players are not only readers or viewers. According to game scholar Gonzalo Frasca (2003), a player's performance is crucial in video games. Without a player's performance, the game cannot progress and reveal itself, be it narrative or non-narrative. As a result of the game nature, the narrative is based on gameplay characteristics such as challenge and choice which are reflected by the player's action. The game plot as an organized experience, according to game writers Dille & Zuur Platten (2007), is *"created by a conflict and experienced because of the existence of challenge"* Furthermore, game designer Sid Meier describes a successful game as "*a series of interesting choices*" (in Rollings and Morris 2004, 200), that arouses players' interest and engagement, emphasizing the role of the challenges as part of the narrative in the game enjoyment. As a result, it's more than just a game as players seek a meaningful continuity of choices that result in meaningful stories from which they may learn.

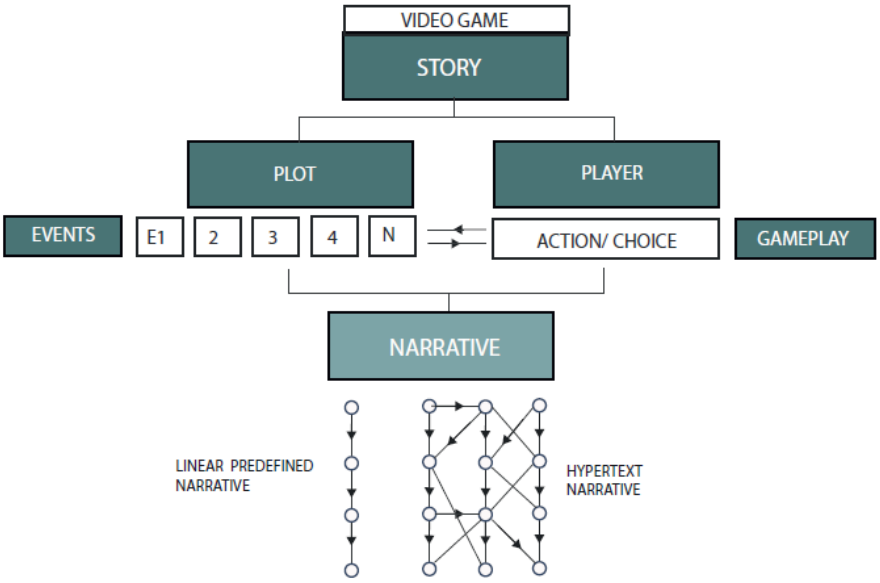


Figure 54 Narrative in Video game (by author)

Raph Koster (2005, 36) another well-known game designer, considers games as learning tools. To him, a good game should give the possibility to learn and to engage to the game world. This is conceptualized in the storyline for the various action to make sense or be comprehensive and is detailed in the game narrative structure. However, similarly to traditional narrative forms, in video games, the reader/player imagines and recreates by himself various elements not explained by the creator. So, in game design, the role of the player becomes active not only as performer, but also as a narrator and the quality of the game depend on the way players interact and give birth to different experiences. Koster (2005) proposed two models of narration in the realm of video games: imposed narrative and expressive narrative. The imposed narrative is decided by the designer and imposed on the player by deciding the elements of the plot, the characters' identity, and its behavior, while the expressive narrative is free to be decided by the player, to whom are given tools to determine his character identity and his behavior.

In this sense, the game narration is not singular and rigidly defined as books or cinema. Because of the freedom of actions and choices, the game can have "a cybertext narrative" (Aarseth, 1997), based on different railroads and destinations and open to produce a variety of expression. According to Aarseth (1997), this text is more challenging than the structure of traditional media narrative as it set the reader in a more active position. In video games, "the reader" requires significant effort to navigate the structure or narrative of the text.

> *"A reader, however strongly engaged in the unfolding of a narrative, is powerless. . . . He cannot have the player's pleasure of influence: "Let's see what happens when I do this. The reader's*

pleasure is the pleasure of the voyeur. Safe, but impotent. . . . The cybertext puts the would-be reader at risk: the risk of rejection.. . . The tensions at work in a cybertext, while not incompatible with those of narrative desire, are also something more: a struggle not merely for interpretive insight but also for narrative control: "I want this text to tell my story; the story that could not be without me." (Aarseth, 1997)

"The *cybertext reader is a player, a gambler; the cybertext is a game-world or world-game; it is possible to explore, get lost, and discover secret paths in these texts, not metaphorically, but through the topological structures of the textual machinery."* (Aarseth, 1997)

The reader of video games becomes an active participant powerful to control the narrative. Thus, narratives in video games are influenced by the agential work of the player. Game scholar, Janet Murray (1997) argues that the transformation of the digital texts is assigned to the player through the freedom of action and interaction that is given to him.

In conclusion, while the narrative is traditionally defined in a linear way based on Aristotle's (1995), three-act structure, with a beginning, a middle, and an end, narrative in video games is considered as hypertext is based on the creation of a frame for players action, which offers them motivation to continue playing or it's developed through the same actions carried out by the player.

Story-playing. Ludologist approach in video game narrative.

Since narrative in video games is strongly related to the gameplay and dictated by player's agency, it's important to explore games not only as narrative mediums but most importantly considering their lugological aspect, which defines them since the origin.

The ludological aspects of video games go under game studies on Ludology, which were coined by Espen Aarseth (2007) as a discipline focused on the study of gameplay. According to ludologists a game is primarily a competitive activity, goal-oriented, and conducted under certain rules. Furthermore, Gonzalo Frasca, a game designer, and academic researcher introduced a similar understanding of the term ludology in 1999, derived from "ludus," the Latin word for "game," to refer to games and play activities. Ludology views gamesas a form of play that has nothing to do with the narrative, fictional content in games, or games as a visual medium.

Initially, ludologistsignore totally narrative analyses, thereby rejecting the existence of a link between narrative and gameplay, and instead focused on a formal analysis of the game and its mechanics. The same Aarseth (2004, 52) considered gameplay and interactivity as a key component in video games,

ignoring narrative, space, and visual representation aspects or considering them as secondary. Other scholars (Kelly 2011; Juul 1998) sustained that stories and games contradict each other. Eskelinen (2001) went further claiming that games shouldn't have a narrative at all, as the narrative is a necessary element in games, since it does not constitute their essence. Similarly, Mateas and Stern in "Interaction and Narrative" (2004) defined ludology as the result of gameplay and interactivity, in contrast to the narrative which is understood as something related to a predefined path. Their approaches were oriented towards gameplay as the essence of video games.

The legitimization of narration in video game studies was first sustained by other scholars of game studies including Jesper Juul (1998), having a more comprehensive approach. Juul, who is often considered a ludologist, questioning the notion of narrative in games, suggested that the ***computer game is not a narrative medium*** but is primarily a rule-based medium. Nevertheless, it incorporates narrative elements. (Juul, 1998). This means that the Ludological approach can be open to narrative and does not essentially contradict it. Secondly, ignoring the games as a visual medium, the pure ludological approach neglects the role of the spatial environment in the video games as a visual narrator and as a space for interactivity. Thirdly, this approach is based primarily on establishing rules and defining what a player can or cannot do and predicting the consequences of his actions in the game world.

To summarize, ludological scholars believe that the primary goal of video games players is to obtain pleasure from action/ interaction which permit them to continue the game and face the challenges it offers. This is not directly related to video game narrative and is not a representational feature of video games. A similar believe has also James Newman who definedin his book "*The Myth of the Ergodic Videogame: Some Thoughts on Player-Character Relationships in Videogames*" pleasure related to the action of players:

> *"the pleasures of a video game are not principally visual, but rather kinesthetic" (Newman 2002, p.2).*

Frasca (2003) also pointed out the fact that video games have different characteristics compared to traditional media (novels and movies) as they are primarily based on simulation. So, narration, when is part of the game can be easily manipulated and influenced by the player or the mechanics of the gameplay. In this regard, Frasca suggested that the ludological approach in game studies

> "*focus[es] on the understanding of game structure and elements—particularly [their] rules—as well as creating typologies and models for explaining the mechanics of the games*" (Frasca 2003, p. 222).

Most of them eventually realized that gaming and narrative could not be tightly separated, and that the narration framework could not contain gameplay. While narrative representations describe the paths or events to be followed in a linear sequence, video games based on simulation, according to Frasca, cannot be slaves to preset paths since they follow models of behavior that reacts to certain stimuli normally provided by the gameplay (Frasca, 2003b).

In conclusion, the pure ludological approach limits its scope of study to game mechanics and ludological elements (such as rules, objectives, items, and gameplay), emphasizing the role of a model of behavior based on the game's given stimuli while ignoring representational elements, even though games include "narration" and its representation, which was considered a secondary and, in some cases, conflicting element in this approach. Nonetheless, because the physical, psychological, and cultural features of the narration impact the rules and simulations developed by the game designer, the model of behavior (or rule-based model) and narrative representation are strongly linked.

From traditional narrative to videogame interactive storytelling.

Early video games typically consist of a sequence of levels with increasing complexity and include basic mechanics of play without a narrative or characters. Later, narrative was seen as a secondary component in video games. Some video games even lack a narrative structure, although many scholars sustain that a lot of games have a prominence of storyline. The conflict between narrative and gameplay derives from the fact that playing activity and enjoying the story differ from each other. The first is interactive and open to changes, while the second is predefined. In recent decades, the classic linear narrative seen in literature and film has been challenged by interactive storytelling in video games.

In video game design discipline, there have been a long-lasting debate between the narrativist and ludological approaches who sought to dominate game design field. Narrativist approach supporter, **Janet Murray (1999) claim that games are based on a story and envisioned new ways of storytelling,**while ludologists supporter **Jesper Juul** have questioned the notion of narrative in games, suggesting that **narrative and gameplay are conflicting things and that** the computer game is not a narrative medium, although it includes narrative elements (Juul, 1998). Lindley (2005), defends this idea, arguing that videogames per definition demand interaction and gameplay, while predefined narration make them more rigid and weaken interactivity. Game highly characterized by narrative are less game-like and therefore less interesting compared to interactive games. This is not always valid, as there are lots of qualitative games that integrate narrative and gameplay.

Extreme positions, such as that of Eskelinen (2001) sustain that game shouldn't have narrative at all. The traditional media theory is based on the classical predefined narrative structure which restrict user's freedom, while new insights today are more open and offer more elements of interaction which are typical for gameplay. However, many authors (Aarseth 1997, Juul1998, Eskelinen 2001) who sustain the overcome of certain games of narration over interactivity and game rules admit that they are both part of the games. Another interesting position is that of Henry Jenkins (2002), how sustain that there is another dimension of narration present in video games, and it has to do with the spatial exploration. All of them are reconciled with game play.

Considering the dual nature of videogames, Marie-Laure Ryan (2006) proposed a "*functional ludo-narrativism*" model, defining video games as "*a combination of the imaginative experience in a fictional world" and "the dimension of gameplay*". So, video games, unlike traditional media which rely on textual and audio-visual description and representation methods, also use action/ interaction as techniques to involve the player in the storytelling process. In this sense, interactivity in video games has encouraged the evolution of narrative (FIG. 3). Rather that description and representation, game narration is based on agency (action/interaction/simulation). In the recent years, video game narrative could be seen as a new way of storytelling that uses and combines the element of the traditional narrative structure with ludic components and elements of simulation provided by the game.

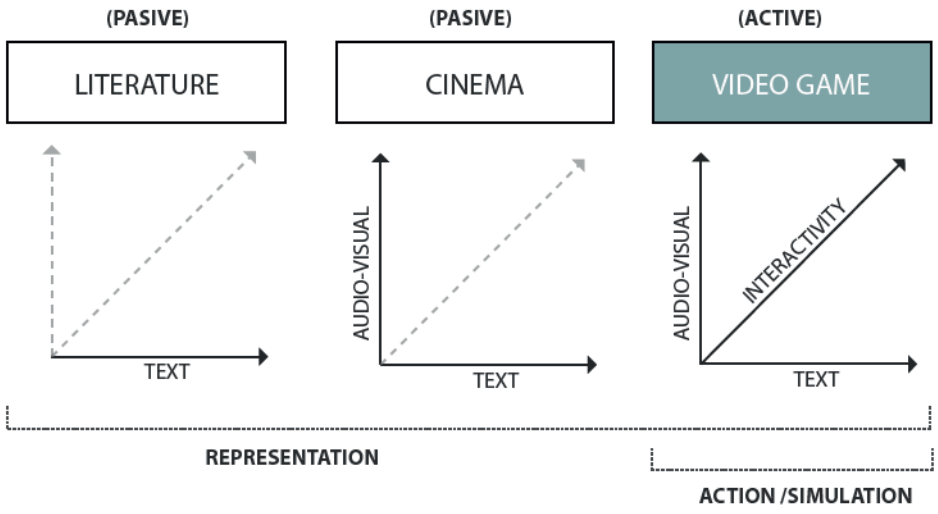


Figure 55 Evolving types of narratives (source: authors interpretation based on https://hitboxteam.com/designing-game-narrative)

Interactive narrative as defined by Meadows (2003) is:

> "*a time-based representation of character and action in which a reader can affect, choose, or change the plot*" (Meadows, 2003)

In video games, as entertaining media, the reader (the user or player in this case) is intentionally allowed to influence the narrative as he has the freedom to act and choose to enjoy the game. Part of the enjoyment is also the feeling that his action trigger events, and the things that happen inside the game are the result of his actions. Nevertheless, players are not set totally free to manipulate the game. They are posed under certain limits and restrictions, but also possibilities and choices are offered to them in the framework of gameplay. This specific behavior of the system is enabled through simulation, which activates a dynamic response as result of a certain behaviour of the user.

Simulation in interactive storytelling

Storytelling in video games apart from the representation as a form of traditional narration and gameplay or the orientation of game mechanic rules also includes simulation, to offer a high degree of interactivity, entertainment and the possibility to manipulate video game space. According to Frasca (2003), simulation in video game does not simply replicate objects feature, but also includes their behavior model, or the way objects reacts to certain stimuli or inputs, under certain condition. It provides realistic and uninterrupted modalities of interaction which are the basis for immersive and compelling experience ein the game world.

"*The player does not act so much as he reacts to what the game presents to him [sic], and similarly, the game reacts to his input*" (Arsenault, Perron, 2009, pp. 119–120).

Simulation enables agency (action or reaction) which produces through interaction, changes, and transformations in reality. Agency has an open character and includes a multiplicity of human and non-human actions. Thus, the actor can be the player, an abstract entity, a person, or an object part of the game. Everything inside the game can be mobile and transformable. Interactive Narrative allows the user to make decisions that directly impact the narrative experience.

In video games, agency is enabled and delimited at the same time by the system, the technology, the developers, or other players. It is the result of a highly complex mathematical process that puts together the object representation (narrative) and its purpose or the role that it assumes in game(gameplay). This process or function is defined as simulation. Simulations provide an compelling experience for players because of a realistic mode of interaction. The realism of simulation is also advantageous in the visualization and design process of architecture and urban design, since it provides a realistic experience in several dimensions.

Lindley (2005) offers a classification plane of ludic systems based on three components:

1. Narrative. In narrative based game, players experience is highly defined. Adventure sport games, for example, are mainly narrative games, being non-competitive. They have limited rules, primary defining the limits of the game.
2. Gameplay (ludic). Pure games have a week narrative structure and are based mainly on rules. Game genres such as matches(ex.football, chess), and competitions have a defined structure based on interconnected rules. In case lack any kind of fiction.
3. Simulation. In simulation games, narrative and gameplay are set together in a dynamic process. Narrative integrates to game play offering simulation.

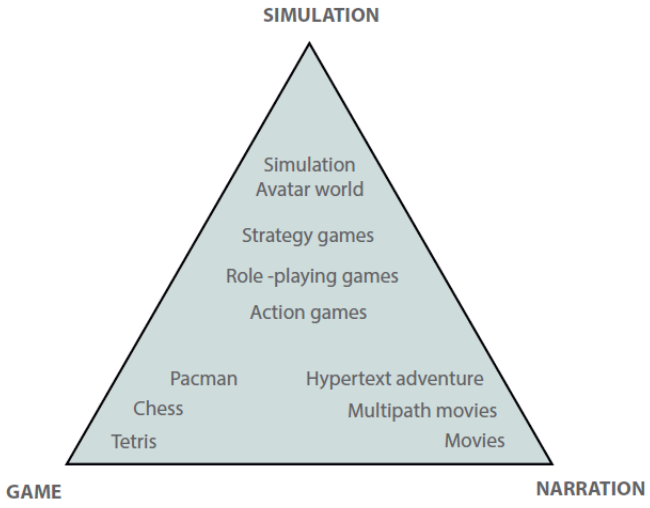


Figure 56 A classification plane of ludic systems (Lindley 2005)

Nowadays, video games largely rely on simulation, especially in terms of the representation of game space, objects inside it, and their behavior or interaction with the player or other game components. A rich ludic component in video games is the synonym of a simulation that has the capacity to include player's will. In this sense according to the classification plane of ludic systems (Lindley 2005), there are various levels of simulation depending on the game category:

1. Action and adventure games rely less on simulation. In this type of games simulation is limited to objects physics, weapon effects, characters movements, etc. However, the player is constraint to experience a defined /almost defined narrative path because of the game story.
2. Role playing games assign to the participant a role and let him free to explore in a spontaneous way the environment. ….
3. Strategy games, which initially were used for military training, are based on combat simulation.
4. In gaming-simulations (ex. The Sim, SimCity), the role assigned to the player is not definitively assigned but is the result of an interacting systems. Thus, in this case, simulation model

constitutes the terrain for dynamic interaction, and includes various rules and manuals, such as constraints, limits, rewards, etc. (Greenblat 1988).

Video games from player perspective

There are a lot of theories regarding player'sbehaviour within the game spaces. French sociologist,Roger Caillois(1961)defined a series of human needs which could be fulfilled by playing: agon (competition), alea (chance), ilinx (vertigo), and mimesis (mimicry). However, different players prefer different kind of experience from a game. While they play, they often have certain freedom to choose which goal to achieve and the game style to play, which personalizes game experience. Richard Bartle[7] has categorized play styles based on four player's personality types:

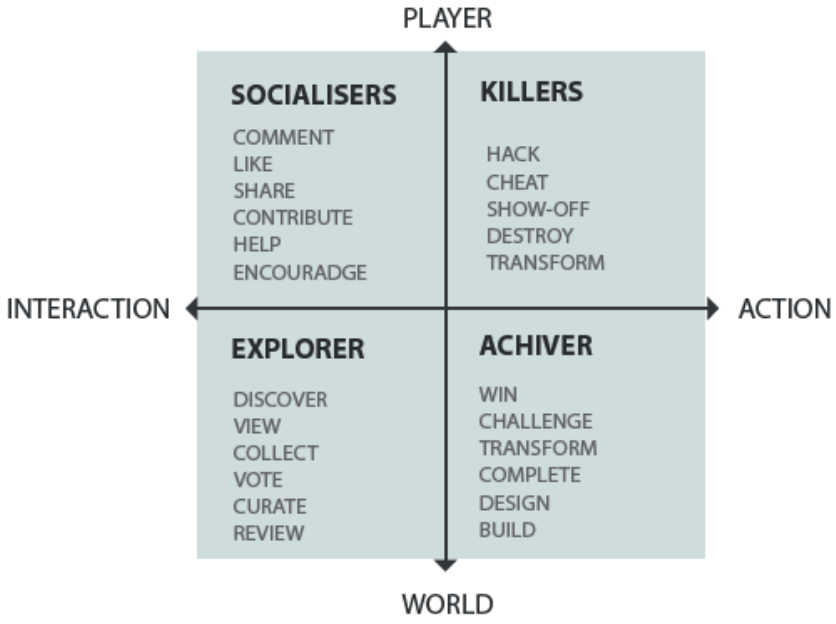


Figure 57 Bartle's (1996) categories of play types

- *Socializers* use the virtual world to interact with other game players.
- Killers are driven by the desire to hurt other players, inflicting pain in the virtual environment.
- Achievers. Achievers are driven by goals to accomplish such as gathering points, complete levels, or earn money and rewards). They are always in a competitive position and want their achievements to be measured and shown in the game.

- Explorers. Explorers are driven to understand and learn from the virtual environment, including space features and game mechanics. They look at the game more as a journey, than as an achievement or final destination.

Considering these four categories, Bartle (1996) distinguished 4 categories based on game elements:

- Acting upon (killers and achievers) In this category fit killers and achievers, as they represent players who act with the aim to have rewards or cause distress.
- Interacting with (explorers and socializers) In this category, fit explorers who interact with the game world and its objects or characters and socializers who interact with other players.
- Players (Killers and socializers) In this category fit players who want to socialize with other players (ex. in multi-player games) or to be recognized as leaders.
- The world (achievers and explorers). In this category fit explorers and achievers who reach their goals by acting or interacting with the game environment.

Based on these categories and on the analyses of various type of games, a series of actions can be defined.

- Socializers prefer to comment, to like, to share, to help and to contribute in relation to other players.

- Killers prefer to negatively transform, to destroy, to harm, and to hack in relation to other players.

- Achievers want to design, transform, build, complete or win by action upon the game world.

- Explorers prefer view, to discover, to learn and to understand, to collect things related to the game world.

These typologies of action/interaction are valid in other form of complex and creative space visualization, which not necessary are game forms. This is because people like to interact in a “playful” way, especially when referring to the digital world.

Narrative structure in video game

As it was previously defined, narration is the structuring of the story based on the plot (made of a chain of selected events) and characters relationship. According to Genette (1980), every narrative implies a narrator, a narrate and functions throw-out a series of events in time. Narration in video games which are an active media is related to plot, but also actions are demanded, which somehow define the plot in real time. In games, in fact, events are narrated as they happen. Thus, the story content is organized

based on the relation with the narrate or player. The player assumes the control of the game, performing actions and causing transformation of the fictional world. As accepted by ludologist (Murray 2004), narrative in games is necessary up to a certain level, to drive the play, otherwise the play dimension get lost and games become like literature.

A typical example of a narrative driven video game is Dear Esther (2012), by Dan Pinchbeck. *Dear Esther* invades the player to freely explore un uninhabited island. There are no game rules and restriction, no objectives to complete, no assignments, no rewards, no enemies to defeat. The emphasis is placed on the environment exploration and the player follows a guiding voice who orient him in his journey, but have no way to influence the narrative, which is predetermined.

In interactive games, on a contrary narrative should be able to allow the player to influence the story. Thus, highly interactive games are characterized by a weak predefined or linear narrative. Interactive games are therefore defined by gameplay (interactive, action-centred) and by cutscenes (non-interactive, narrative-centred) sequences which create branching narratives that are more interactive.

Story techniques for games include different narrative models which go under different categories of narrative from interactive story structure, to environmental storytelling up to emergent storytelling in which the player is free to determine the story by himself. Below, will be analysed the main game narrative structural models to comprehend the relationship between story and game space, as well as understand how it affects virtual architecture.

Narrative Structural models

Narrative structure is very important especially in video games that incorporate plot and interactive elements, strengthening player engagement and immersion in the game world. Narrative can be considered as a structure or a framework in which convert all the narrative and ludic components. The narrative components in the video game are the plot, sounds, music, atmosphere, dialogues, player choices, and game rules. They can be categorized essentially into two main groups:

- **linear stories** which are predefined, and the player cannot change; and
- **non-linear stories** which can be influenced by the player.

Non-linear stories include Discovery, Sandbox, Computer-based, and Emergent narrative. They are almost typical for video games compared to other narrative media.

Pre-established narratives

Pre-designed video game narrative assumes are three basic structures: **1. the classical structure linear and a string of pearls model 2. the minimalist structure (branching narrative), and the anti-structure (the amusement park approach**). They are defined based on the degree of interactivity and on the player's ability to influence the story or to endure the pre-designed narrative.

Linear narrative /String of pearl model

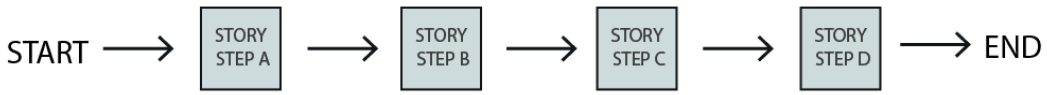


Figure 58 Linear narrative structure

The linear narrative or rail narrative is the most common, simple, and easy to design storytelling architecture because gameplay and narrative are separated. The story is revealed step by step, between gameplay, as the main plot is divided into predefined stages. When the story is delivered, players have no choice. He starts acting once gameplay is activated. This type of structure offers a pre-established sequence of events that result as highly controlled. The interactive parts of this narrative are the user's actions following the completion of the game quest. When the player reaches certain checkpoints, a new step is triggered, and the game is built as a chain of events from start to end. In this straight line of events there is no possibility to insert side-events. This succession of fixed predefined pieces inflicts a low degree of freedom for the player, who is not able to choose which event to explore and be part of but is obliged to discover stories as ordered and offered by the narrator. Players progress the story without exercising control over it. Juul defines it as a '*narrative of progression*' (2005, pp. 72-73) because the story starts with an introductory sequence, the presentation of the main settings of the game, and an event that disrupts the initial equilibrium by creating challenge. The first act introduces the environment and the main character that inhabits it. In this step, players are posed in front of events that create imbalance and challenge them. This forces them to understand their role by starting to interact as a protagonist and restore the balance. The story progresses through the player's actions. The following steps can progress by entering in separate units, with different locations and thematic. Nevertheless, they are part of the same logic understood in the first step, but the player can jump to these steps once the level is completed. If he doesn't complete the level, the story does not progress. The passage from one level to the other is released by means of cut-scene, in which the story fragments are delivered as rewards for completing a certain section. This type of narrative has only one predefined ending. The video game *Call of Duty* (2003-2022) is based on linear narration form. The gameplay is

occasionally interrupted to insert story content of memory as part of the main story. Other examples of games with a linear narrative are *Battlefiel*d (2002-2021) and *Killzone* (Guerrilla Games, 2004).

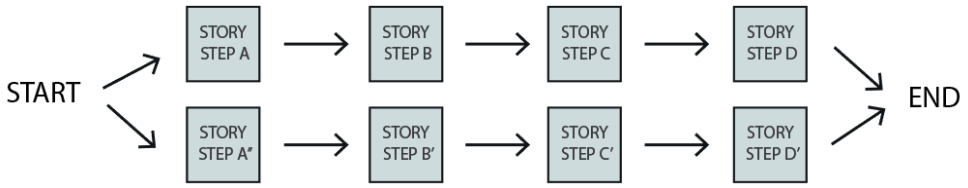


Figure 59 Paralel linear narrative structure

The string of pearls model (Pseudo-Linear)

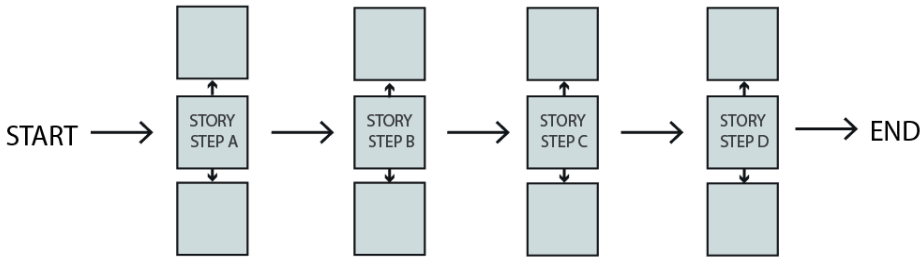


Figure 60 The string of pearls narrative structure

The string of pearls model is the simplest form of interactive video game narrative. It is like the pure linear narrative, but it embodies the illusion of interactivity. This model is still pre-established, but the player perceives more interactivity, due to possibilities to explore parallel events that are offered in different stages. The players are given a wider amount of freedom within one level or stage to explore pearls. Once they explore peals they are obliged to pass through strings. The narrative sequences, that define their progression towards the outcome and the end are built from one level to the other through cut scenes and are strictly controlled. In this model, in fact, there is only one end. According to game designer Jane Jensen (2002), this model starting from each main plot point can be vconceptualized as the starting pearl of the string. The player then spread in a larger section in the middle of the string, where he is free to choose various events, thus resulting in a degree of non-linearity. Nevertheless, as the player progresses through the stages or missions, the number of alternatives available decreases, and the plot narrows to a single conclusion. Players have no alternative conclusion and the along with the play they have just one way to proceed. This does not mean that games with this kind of structure are less interesting. Indeed, interactive games with a poor narrative operate well with this kind of structure. **The string of pearls model** is ideal for adventure games with a strong focus on the plot.

An example of pseudo-linear narrative structure is adventure game such as ***Indiana Jones and the Last Crusade*** (1990). The game takes place in different locations, cities like New York, Venice, Iskenderun, and multiple locations in Germany. The player can move around in each location in a non-linear order and solve puzzles. To move from one location to the other, the player must complete several tasks. The storyline is defined and there is only one single conclusion. The plot in ***Doom (2005)*** video game is split into three episodes, each containing nine levels. Within a level, the player has the freedom to tackle different areas of the level in any order he chooses. However, because each level can only be completed in one way, the game's narrative can only follow one path.

The branching narrative model

The branching narrative aim to give more freedom to the player compared to a linear or string of pearl model, by allowing the player occasionally to influence the storyline. In this model, the story Instead of being linear, unfolds through numerous pre-planned narrative lines, yet nevertheless leads to a single conclusion. The trunk constitutes the spine of the story, while events can happen in different direction along the journey. Dissecting the plot in several directions and offering the possibility of multiple endings create more variation for the player.

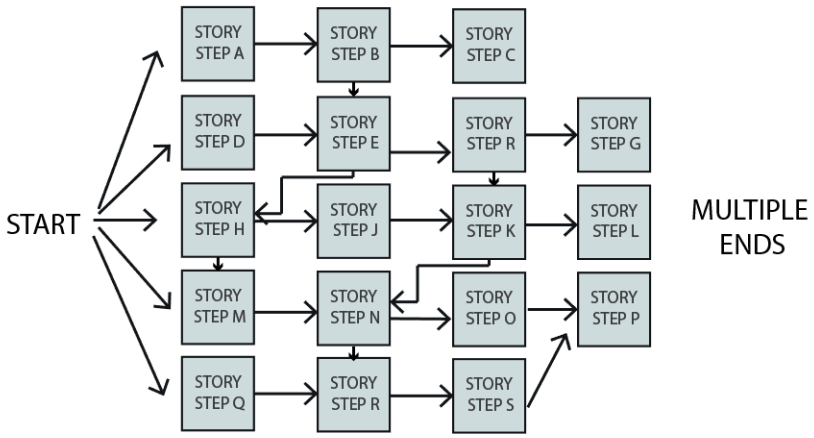


Figure 61 A Typical branching narrative structure

Branching can be achieved through cut scene and gameplay sequences. Due to the hyper textual nature (assuggested by Aarseth, 1997),and the proceduralcharter of video games, it tends to have a progression structure (Juul, 2002)requiring the player to occasionally make choices. Choice and option provided to the player can bring him in various paths and solution that lead him towardsthe single end of the game. The choice of a path instead of another can make the game simple or harder, or can affect the story, by

allowing the player in some cases also different ends (in which one is the best option). Other options can lead player to failure, which orient him toward the main conclusion line. Currently, the branching narrative model is rarely used by game developers, due to high development costs increased by the extensive branching structure. Therefore, when adopted for certain video games, this narrative model is limited few branches. Nevertheless, this model developing a more complex narrative can offer to the player more power and is perceived as consequence as more interactive.

Ex. Video game Prince of Persia (1989). This game uses both string of pearls and branching narrative models. From each of the twelve levels there is only one exit. The player only has limited time to complete the game, and failing to do so will result in a different tale ending.
In Maniac Mansion (1987) narrative is depict through a combination of text and abstract style graphics. The player was able to choose a characters out of a total of six. Characters have their own features and skills, and consequently, the choice of characters at the start of the game is related to the first branching point of the narrative.
In Odyssey: The Legend of Nemesis (1995), by Richard Rouse, narrative is based on the selection of multiple challenges or activities to perform inside the game.
In The Elder Scrolls III: Morrowind player (2002) has the possibility to choose the character and to define its features which can be improved along the game.

The main models of branching structures are:

- Parallel branching narrative
- Branching story with linear gameplay
- The amusement park model or web narrative as a controlled branching
- Open-ended branching

- **Parallel narrative**

Branching narrative can be simplified to a limited parallel narrative when the player has only one early choice to follow up to the end of the story.

- **Branching story with linear gameplay**

Explorative narration can be delivered also without affecting the game play, with pure explorative branches that always lead to the trunk, or to the main story line.

- **The amusement park model or web narrative as a controlled branching**

Controlled branching is another way to create complex exploratory narrative, but in a more structured and controlled way. According to Ince (2005), narrative and gameplay coexist along the game experience. In this model, player have the freedom of some agency, still the narrative is under control, drawing the player towards a predefined destination and story path. Even in this case it's possible to have one or multiple endings. In a single ending narrative, the story will not be affected by player's choice, as all their choices or the different paths players take, will bring him to the same ending, with different type of interactions.

- **Open-ended branching**

Open-ended branching is the most complex and expensive narrative branching structure due to the multiplicity of story steps and to their different content. In fact, players face potentially infinite story steps with multiple storylines. This makes it more a theoretical approach since most of the video games have limited storylines.

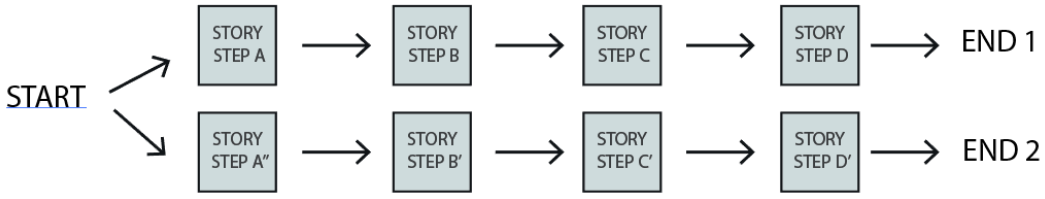


Figure 62 Parallel branching narrative

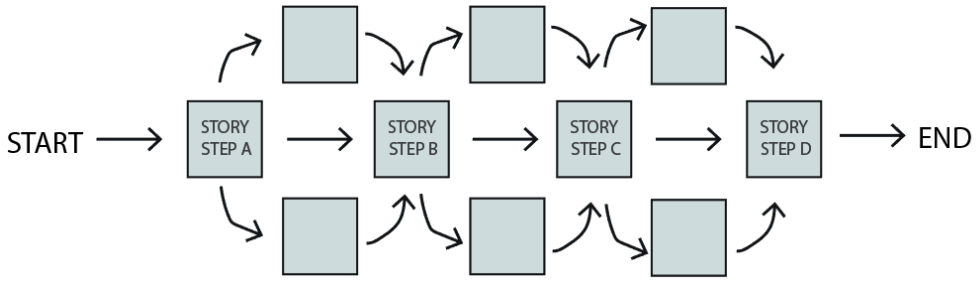


Figure 63 Branching story with linear gameplay

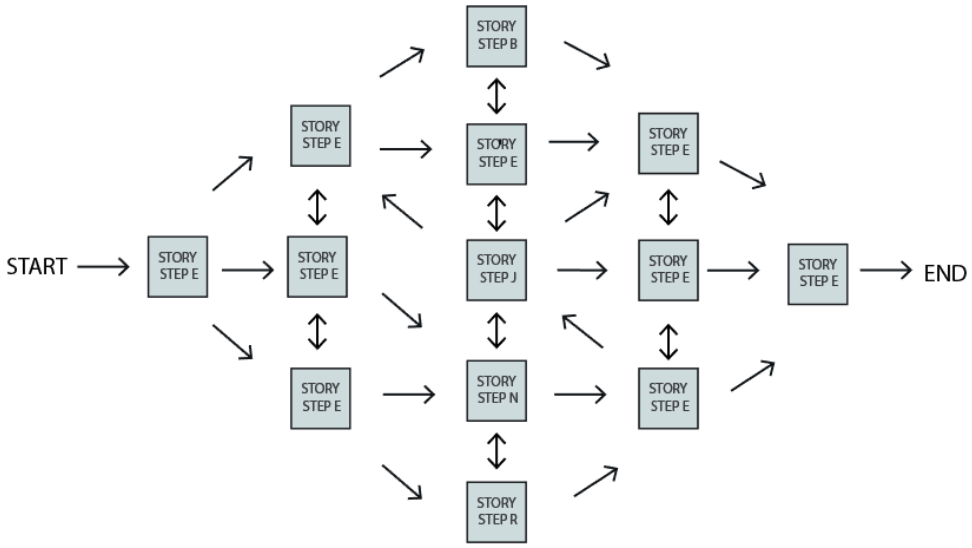


Figure 64 The amusement park model or web narrative as a controlled branching

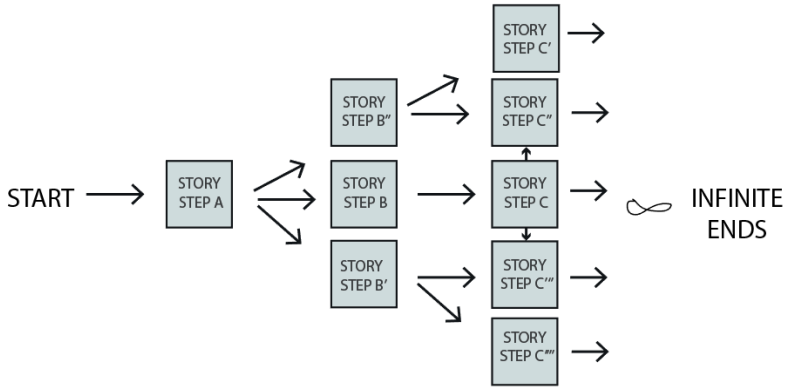


Figure 65 Open-ended branching

Discovery narratives

Discovery narration offer a lot of freedom to the player to explore the game world and to discover information on it. The narration structure is open to be explored by the player and therefore it present branching stories and results as less linear. These models are based on multiple options to access side story information. Moreover, the player has the control to choose and define side stories order. In this sense discovery narrative is unstructured and it the player who tries to restructure the story and recreate the main plot based on his choices. This depends also on how deep they want to explore the game world and to create a game map within an open ended environment.

Modular narrative - The building blocks model

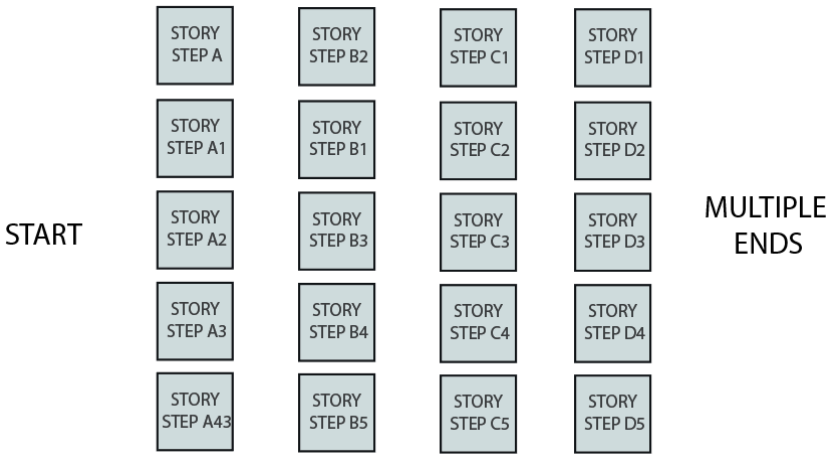


Figure 66 Building block model of narrative structure

The modular or the building blocks narrative model is based on episodic events that constitute a system of parts. Every event becomes a story module and users are not forced to follow a certain direction. Thus, in this model the player freedom is almost total and he becomes the creator of the story, having control over it. Moreover, on multi-player games, it's difficult to tell the real actor, as both player contribute in the creation of the story. Ryan (2006) and Jenkins (2004) consider this model as "*relatively unstructured and controlled by the player as they explore the game space and unlock its secrets*" (Jenkins, 2004, p.126). The game designer provides to the player "an open map" made of different stories. The player is free to reconstruct the narrative as he wishes, choosing depending on his interest and desire to explore deeply the game world and without time or space restrictions. Hence, the storytelling is an act of narrative creation assigned to the player and what happens its entirely in his hands.

This model presents different ways to explore open maps: in case the map is available from the beginning, the player chooses since the start what and when to explore (The Elder Scrolls V: Skyrim; otherwise the player is free to explore only in certain portions of the map as defined by the game designer (Final Fantasy XIII).

In *Civilization game* according to its game designer Sid Meier few important decisions are made by the designer, the rest is left for the player. In *The Sims* (2000), the player creates by himself the city. (Will Wright, in ibid., pp. 464-465). Likewise, *Tomb Raider (Crystal Dynamics, 2012)* is an open world game that allows players to explore much of the Yamatai Island where the tale takes place. Because there are no level transitions, players can freely roam the island. On th4e other hand, *Assassin's Creed (Ubisoft, 2007-2014)* is designed in such a way that numerous secondary plot aspects appear by accident as

players explore the game world. At a particular point in the game, players are able to leave the main plot and explore the environment.

Open world or sandbox narrative

Sandbox narratives are discovery and exploratory narratives of an open environment with a higher level of interactivity. In games such as *GTA IV,* the world to explore is the city. In *Red Dead Redemption* is the wild West. In this type of narrative, designer provide the players with an vast map of the world filled with elements to interact with. Breslin (2009) highlight the high level of freedom enabled which give the player he possibility to exercise creativity and decide the story to experience: "*Give them a sandbox, and they will build castles*". In fact, during the exploration occur several random events, which increase the level of interactivity of the player.

Figure 67 Sandbox narrative model in video game (interpretation by author)

According to Ryan, in this model of narrative "*players write through their actions…within the range of possibilities offered by the built-in scr*ipt" (2006, p.201). As part of sand box is also the hub world structure. A classic example is *Red Dead Redemption* (Rockstar, 2010). This game has both expansive narrative and interactive relationships. In this game player can spend a lot of time learning about the game world and its characters because of very interactive environments. After entering in one scene, player can verbally interact, asking things, can move, sit, act, and participate in events. Players have almost full autonomy to control to make decisions within the game's rules.

Figure 68 Map and screenshot of GTA open game world

Computer-generated narrative

Computer generated narrative is a deterministic narrative based on AI techniques. This narrative model is typical in simulation game genre. Similarly, to the sand box narrative, it is based on a high level of interactivity with an increased level of randomness and computer-generated events. The game suggests to the player possible actions that can be based on their needs. In this sense, narrative is not prefigurated, neither its totally up to the player. According to Newman, in this model of narrative players have "*considerable control and influence over the game world*" (Newman, 2004, p.116). The computer-generated narrative is the result of players' choice and multiple variables related to the simulation of real-life events.

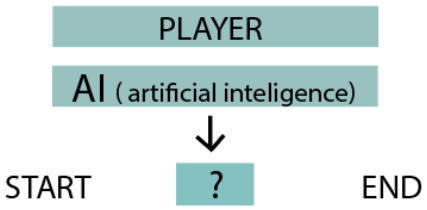


Figure 69 Computer generated narrative in video game (interpretation by author)

Figure 70 Screenshot from The sim

Video game The Sims by Will Wright (Maxis, 2000-2013) simulate real life activities of a human household. Player has the ability to personalize his look and profile and his living space. Sim family members have their physical, mental, and social needs. These needs orient their actions, which are related also to their personality. Many variables are set. Hence, their decision and actions are governed by AI, based on their needs. Then the system is enabled to predict their behavior. This kind of narrative is considered as computer-generated narrative, as events are generated thanks to the combination of variables deriving from game AI.

Emergent narrative

Emergent narrative allows stories to emerge spontaneously, so that each player create his only story by his experience. These stories are not predefined by the designer. They are only made possible, through non-predictable game AI technique. They are based on Artificial Neural Networks (ANN) and Genetic

Algorithms. In this framework, actions can have different behavioral responses. They focus on an emergent content that is the result of player's experience. (Lebowitz, Klug 2011).

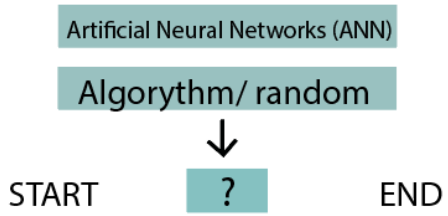


Figure 71 Emergent narrative in video game (interpretation by author)

One of the best examples of emergent narrative in game design is BioShock (2010-2016) video game. *BioShock is well-known for its* narrative and the representation of the story world. Narrative is based on unexpected twists, and even subverts, which make the gameplay a unique experience.

In conclusion, narrative models show the way narrative is incorporated in video games and in particular how they impact the architectonics of game space.

3.2 AN ARCHITECTURAL APPROACH IN NARRATING STORIES

Narration is not only a matter of telling stories through world. In architecture terms it has to do with the creation of spaces and the arrangement of elements where players quest take place.

> *"(...) what makes a story a story is not the bricks it's the arrangement of those bricks into a specific structure which conveys more than the sum of its parts."* (Kelly, 2011)

Tadgh Kelly, a renowned game designer considers games not only a storytelling medium but mostly a sensing medium, in which the story is perceived experiencing the space. Moreover, he considers game designer not storyteller, but mostly visual artists (Kelly, 2011). According to Jerkins (2003) player is asked to explore, map and master video game space.

> *"Games should be examined less as stories than as spaces ripe with narrative possibility."* (Jenkins, 2003, p. 119)

> *"Designers don't simply tell stories; they design worlds and sculpt spaces." (Jenkins, 2004)*

These spaces cannot be dissociated from the events taking place. Thus, game space should be conceived considering player's movement, experience and facilitating the discovery of the story elements. Walt Disney designer Don Carson (2000) suggested game designers to use the same techniques of

environmental storytelling used to design Disney amusement parks, because in this case it's the space itself that tell stories. Space does not reproduce the story, but narratives evoke the atmosphere. Media scholar Jenkins (2003) suggested four environmental storytelling space typologies: evocative spaces, enacted stories, embedded stories, and emergent narratives. These typologies are very important in the design of architecture space in the virtual realm.

Evocative stories and space

The most compelling spaces in video games are spaces that evoke player's stories, or an atmosphere previously experience or that they have been familiar within their fantasies. In these spaces people feel safe and familiar and they can easily take control of space and recreate the story it by themselves. Evocative spaces play with player's memory and images, immersing them in an environment to interact with, but avoiding details which the audience is expected to know. Amusement parks uses this king of technique. They usually use an existing story for the design of the environment, and the space evokes the story to the visitor. As a result, the game enriches existing already known stories and enhance players sense of immersion. Thus, the game does not tell the whole story, but reconstruct it through the players selected exploration of worlds and characters.

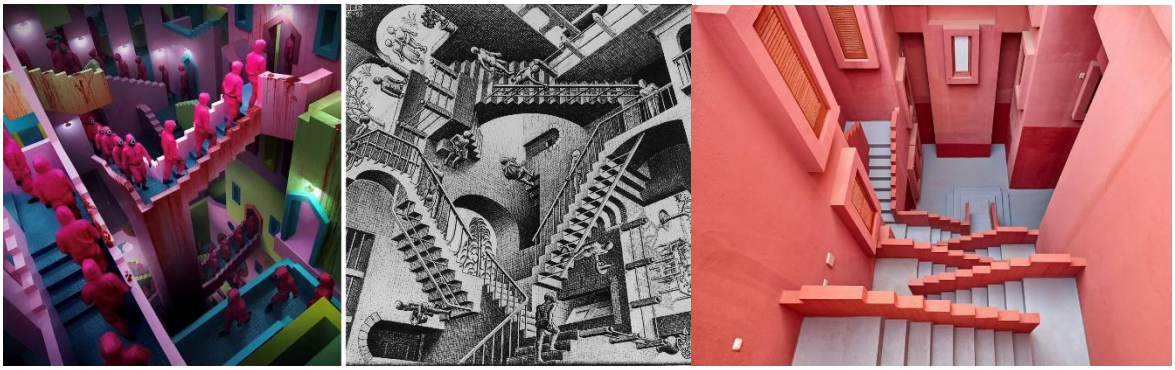


Figure 72 Evocative space: Suite game movie, Escher drawing, Bofill architecture

Enacting stories in staging geographies

Stories in video games are connected to the player as a witness to narrative events on the one hand, and the player as a performer or influencer of the game narrative by his actions on the other hand. In this kind of narrative, the player assumes the role of an avatar with special skills that affect the gameplay. Game designers define conflicts and localize incidents creating stages through which the game narrative is understood and conveyed in this way. The plot development may be slowed or sped up depending on what the player/character encounters while navigating through space. The events are offered as single

episodes in which activities take place but do not have a significant impact on the overall experience. As a result, they can be recorded in any sequence. Micronarrative, or localized incident and barriers are what these refer to as. They offer a stage for events to occur. Instead of predetermined narrative developments and episodic sequencing, enacted narratives are produced via spatial exploration and character movement in the game environment with the goal of getting to the end destination.

In comparison to plot development, enacting stories prioritize space exploration through different steps. According to Jenkins (2004), a narrative is a designed geography of an imagined world with enigmas to solve, conflicts to resolve, and obstacles to overcome that encourage characters to progress towards the end goal, with conflicts and obstacles being resolved. As a result, interaction plays a significant role in the story. Nonetheless, a balance must be struck between an engaging plot and the player's ability to act freely.

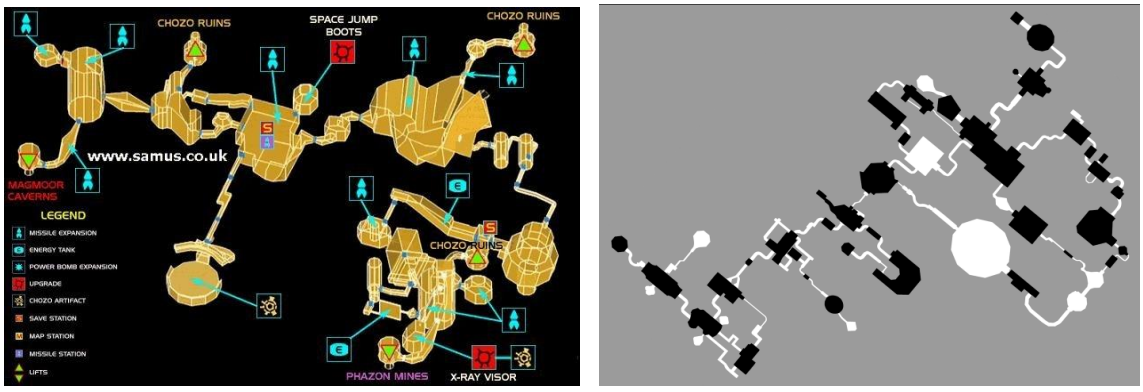


Figure 73 a) 3D Metroid Prime (2003) Maps of game staging geographies (from Samus.co.uk); and b) its interpretation in using Nolli-s figure-ground technique. (Source: http://www.jonathan-sun.com/gaming-urbanism)

Embedded narratives

In narratives plot and story are slightly different. While story is the about structuring events as they will be presented to the audience, the plot is the conceptual construction of the story with the chronological order in which events occur. In video games, when the story is revealed in a non-chronological order, narrative is actively understood by the player, based on information reveled step by step and by noticing and examining clues that are present in the game world, which to consider various assemblage options and hypothesis of the story development. Player can deduce his own understanding the story's flashback chronology. Players reformulate their mental maps of the narrative action and story space as they navigate and experience the game world. In games, players are compelled to act on their mental maps, putting them to the test against the game environment. In this respect, the story is more of a body of information dispersed across the game than a chronological timeline of events. The designer has the

power to determine when, where, and how players get information. Aside from the structured, embedded and narrative that is provided to the player through level design, a structured narrative is also explicitly conveyed to the player by the game designer, to explore game space and unlock the various levels.

Emergent narratives

Emergent narratives are gaming environments that are intended to be enhanced with narrative possibilities from the players. They aren't pre-structured or pre-programmed, but they aren't chaotic either. They do have an introducing narrative. The sandbox video game "The Sim" by Will Wright is a classic example of emergent narrative. Game space refers to a player's setting in which he can set his own goals and write his own narrative. This game is not played on a white sheet. Wright has designed a world, rich with narrative potential, with every design decision aimed at raising the chances of interpersonal romance or conflict. The ability to construct players "skins" invites them to develop emotional avatars, practice their own interactions with friends, family, and coworkers, and transplant characters from other fictional worlds onto The Sims.Characters have their own wills and don't always surrender to the player's control easily.Characters are given desires, urges, and needs, which might fight with one another, resulting in dramatic interactions. The designers have decided what behaviors are and are not allowed in this reality. The use of emerging narrative is incentivized by the presence of interactive elements or other dominant special elements such as landmark, edges (see. K. Lynch 1960)

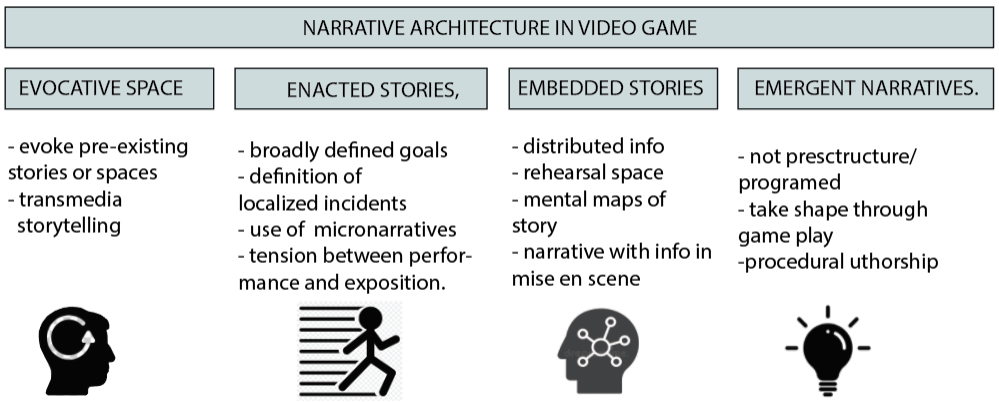


Figure 74 Elements of environmental storytelling in video game space

3.3 NARRATIVE AND ARCHITECTURE

Since the 1960s cultural studies considered narrative as a fundamental form of human expression that has enabled societies to preserve their knowledge and transmit their experiences across time. As a mean of communication, narrative aids in the comprehension, sharing, and transmission of knowledge and culture. Roland Barthes points out its role of civilization, and its presence throughout human history

> *"…under this almost infinite diversity of forms, narrative is present in every age, in every place in every society; it begins with the very history of mankind and there nowhere is, nor has been, a people without narrative"* (Gee 2005, p.75).

Moreover, narrative as described by Gee, have and education role as it serves also to predict actions and their consequences by using simulation. Narrative as simulation *"help us prepare for action in the world… before we act in the real world*" (Gee 2005, p.75).

In relation to the idea of culture, the narrative is subjective as it represents reality from the narrator's perspective. Reality is presented as a subjective reconfiguration that produces meaning. Subjectivity, in this sense, is defined by the choice of events and the defining of their sequence. The sequence of events and their unique effects, as well as the actions, were foreseen that involve people constitute the unicity of narrative. Nevertheless, the conception of the narrative is not totally free. Every type of narrative follows the Aristoteles three-act structure: beginning, culmination, and resolution. This is a simplified generalization, to highlight the necessity of selection and sequencing in all type of narrative.

In architecture conception and space configuration, the creation of a narrative is considered as an important space formation tool that allows creating interesting, meaningful, and memorable space. Narrative attributes meaning to the space in architecture, by projecting stories in the architectural space and defining the way we as users can move along and perceive them. In comparison to the oral and written tradition, architecture narration characterized by the positioning of objects in space seem to be more powerful as it engages all human senses. People move through the space, see, hear, smell, and feel it along the architectural journey. Thus, the quality of architectonical space is measured beyond the practical aspects, in relation to the way of exploration and experience and to the meaning it conveys. The intent is to create significant meaning and transmit positive emotions and sensations to the user. These elements that enable a qualitative exploration of space are related on one side to the visual messages through symbols and signs that are set inside the space, and on the other side by the spatial structure of events and the way movement across them is conceptualized in sequences (fig. 75) .

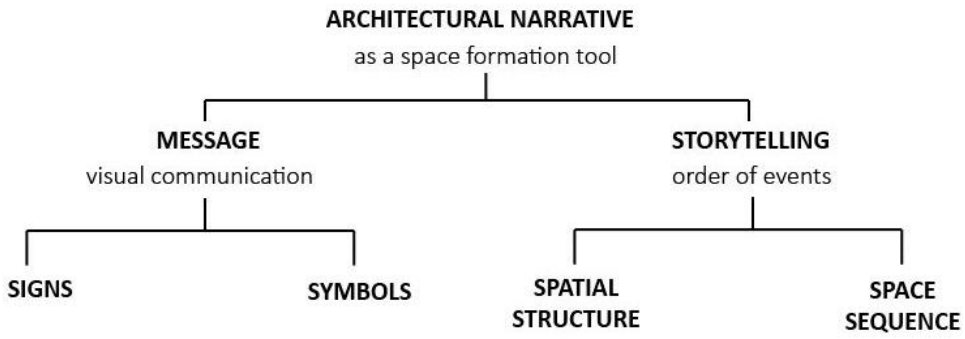


Figure 75 Architecture narration components

This was also highlighted by Cobley (2001: 3) who defined narrative as form of representation in which are implemented "signs bound up with sequence, space, and time". This form of representation and space organisation used in architecture is used also in cinema.

Cinematographic, similarly to architecture, is the art of emotional space sequence of space that follow the context of the story. The way space is focused and experienced and the order of events trace the quality of the movie. Film writer Jacques Aumont highlights three tools used in cinematographic narration:

1. Multiple of viewpoints,
2. the variation of the scale of the plane,
3. Playing with the viewer's gazes. (Aumont,1996)

Multiple viewpoints allow for the manipulation of the frames and the creation of plane hierarchy in terms of scale, duration, and composition. Architect Rem Koolhaas, which originally has been a filmmaker sustain that that in cinematographic, the sequences of episodes and actions should be built to create suspense and to provoke a cerebral emotion. This is valid also for architecture, but in traditional architecture, narration is materialized through the arrangement of objects, space, social relationships, and cultural patterns, not with the same tools used in cinematographic. When considering the virtual dimension of architecture, the comparison with cinema is similar in terms of narration tools used.

Research scholar Sophia Psarra in her study "Architecture and Narrative" (2009), defines narrative in architecture as a form of representation that organizes events in space based on an idea of space that attribute meaning to this sequential organization. Space narrative traditionally was built similarly to other types of narrative, based on the classical three-act structure, which is translated in space as: beginning (entrance, culmination (centre), and conclusion (exit) (Parsons, 2009). However, within this general view, the arrangement and the revelation of architecture space is more complex, as it's dictated by the story.

Narrative according to Psarra (2009) has dual use: on one side it contributes in the representation of an architectonical idea, through drawings, models, 3d models etc., and on the other side contributes in the construction of meaning and experience through the ordering of space and the provision with a dynamic network of relationships. The first is related to the representation of the conceptual structure, while the second to the perceptual experience related to formal and social dimensions. In this regard, narration can reveal the various aspects of architecture space, to see it in different viewpoints, to represent its essential idea or immaterial concept, and to also consider the events and possible actions that move senses and offer experience. The importance of the phenomenological aspect in architecture narration was emphasized also by Nigel Coates (2012), in "*Narrative Architecture"*, pointing up the sequence of experience as an important tool in architecture storytelling. On the other side, architecture can narrate stories manipulating the geometrical form of space. Considering both aspects, architecture comes closer to filmic space.

In architecture, since antiquity, important buildings such as the Parthenon of Athens, had a narrative behind. Symbols, signs and other communication messages, such as sculptural relief, part of the narrative were essential tools that contribute to the significance of the monuments.

The Parthenon's frieze relief paid homage to the democracy and to the political power of classical Athens during the Periclean system. This narrative is related to the morphological order of architecture and the sculptural decorations which integrates contents of history, politics, myths, and struggles(fig.76). In the Parthenon, according to Psarra (2009), architecture is "the semantic expression of narrative", as the narrative consist mainly in symbolic sculptural decorations.

Figure 76 Parthenon sculptural decoration narrating Periclean political system

With the invention of baroque, "dynamic movement" was introduced in urban space. A typical example is the monumental sequence of space Place Royal in Nancy (fig.77), which represent one of the most beautiful examples of baroque urbanism. Space sequenceorganized with different squares, produce different spatial sensations. This series of episodes constitutes a complex articulation in rooms with

different spatial proportions, high and building facades characteristics. Still, they are connected and harmonized by the presence of a linear continuity and symmetry. This is the simplest form of architecture narration. This linear structure orients the user from the beginning to the ending point, by facing him along this itinerary with different views and situations that moves him emotionally.

Western architecture, prior to the industrial revolution uses mostly a geometric organizing of space along carefully regulated axial patterns. The neoclassical symmetry limited the possibilities of dynamic space arrangement. The rigid structure shaded the space sequences. Space was explored through the linear narration, from one room to the other, unidirectional. Nevertheless, the sequence of rooms presented always surprising new configurations.

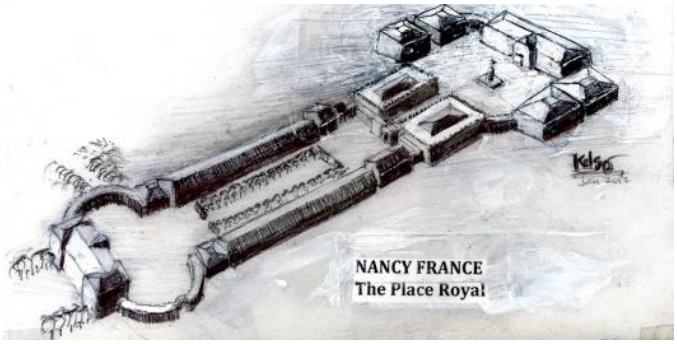


Figure 77 Linear spatial sequence of squares in Royal Square, Nancy

With the advent of the modern movement, and with the invention of cubism in the beginning of the 20 centuries, objects stared to be visualized from different viewpoints.

> *"The Cubists did not seek to reproduce the appearance of objects from one vantage point; they went around them, tried to lay hold of their internal constitution. They sought to extend the scale of feeling; just as contemporary science extends its descriptions to cover new levels of material phenomenon." (Giedion 1980, p.436)*

The modern movement rejected symmetric space, regular geometry, axiality, which gave rise to unexpected spatiality. Novel approaches to spatial sequencing brought to the formation of new spatial structures. Human perception and in particular, movement of the body and eyes became essential elements for architectural design. Thus, this new asymmetric ordering systems exploring new spatial configurations according to Giedion (1980) is based on the modern principle of "simultaneity".

A classic example in architecture history that connects human perception with the design of space is the architectural promenade shaped by Le Corbusier, in Villa Savoya. Le Corbusier conceptualize a story and set it along a linear narrative path, which represents a metaphorical representation of movement describing a journey from outside in and again out in the roof of villa Savoya. The architectural

promenade is a physical route in which the user walks through. Le Corbusier frame the space and define it by using a series of space sequences, ramps, scales, passages from light to dark etc., all architectural means that, generating a complete embodied experience creating an exciting experience of space.

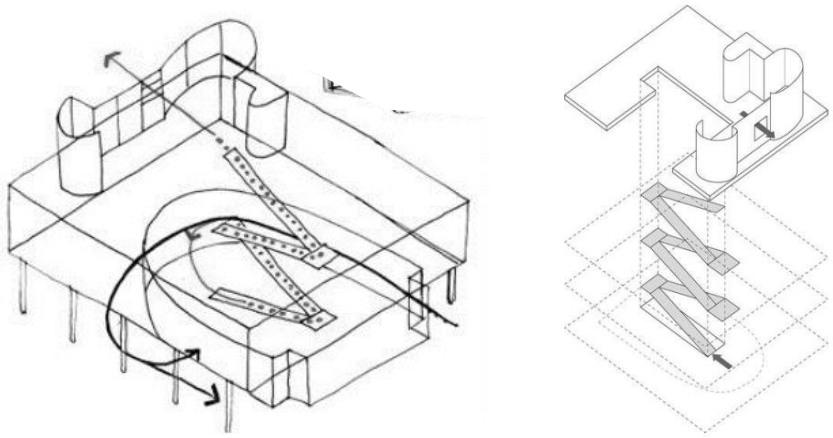


Figure 78 Architecture promenade in Villa Savoya, by Le Corbusier

The tale is a metaphor of a progression intended as a rich spatial experience, but also to stir curiosity. In this sense the concept of promenade had double significance: moving through space, but also a conceptualized space that forces you to move forward and to explore it. In this sense, architectural design emphasis movement. The promenade architectural is a programed itinerary of movement along a continues set of frames, which offers multiple vistas and engagement in the spatial experience. This path is necessary to navigation, as it orients the observer to advance gradually through space. However, in Villa Sovaya, it is rigidly defined as single predetermined path.

In his theoretical book "***Vers un architecture***", Le Corbusier overpassed the rigid path of the promenade architectural inspired by the visit in the Acropolis and the description done of the walk through the Acropolis of the French architectural historian Auguste Choisy. Le Corbusier highlighted a picturesque quality in its composition perceived while traveling through it, rather than its classical order and symmetry.

> *"The whole thing, being out of square, provides richly varied vistas of a subtle kind; the different masses of the buildings, being asymmetrically arranged, create an intense rhythm." (Le Corbusier 1980, p.43)*

This constitutes a reference point for cinematic space or filmic space conception, based on narrative, movement multi-perspective mobile character and simultaneity.

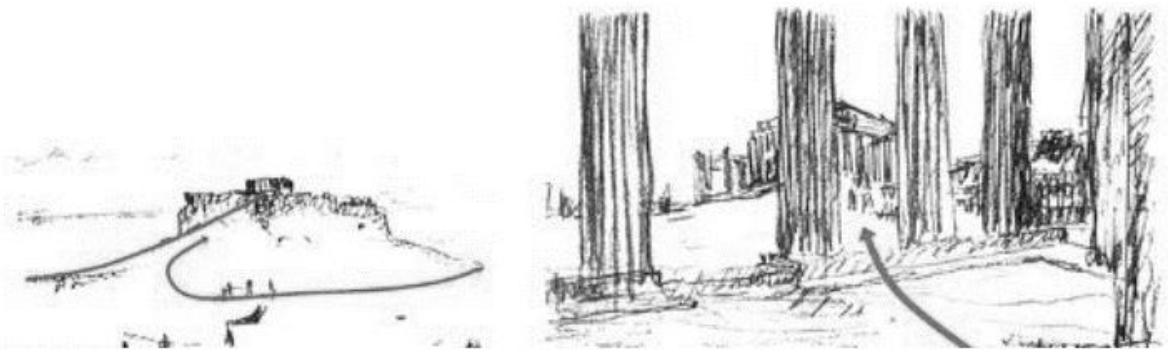


Figure 79 Acropolis dynamic promenade illustrated in Le Corbusier sketch (Kostoff, 1995)

The importance of architecture cinematic path in movies was pointed out also by film director and theorist Sergei Eisenstein (1989) comparing it with the sensation of moving through an architectural space. He refers to the sensation of entering the Acropolis and walking among its buildings posed asymmetrically. Cinematic space is more engaging compared to real architecture space.

A similar cinematic method was employed by Gordon Cullen (2005,1961) in his book "*The Concise Townscape*" to represent the complexity and picturesque character of urban space developing the concept of serial vision. In the serial vision the urban form perceived in movement is seen in continuous transformation as a series of framed spatial experiences. He represents it as a storyboard, shot by shot. The visual frames of a walking character can be compared to the shots of a movie camera in movement. Cullen selected and represented interesting and thrilling narrative paths in historical cities. Still his narrative similarly to that of Le Corbusier is linear and guided.

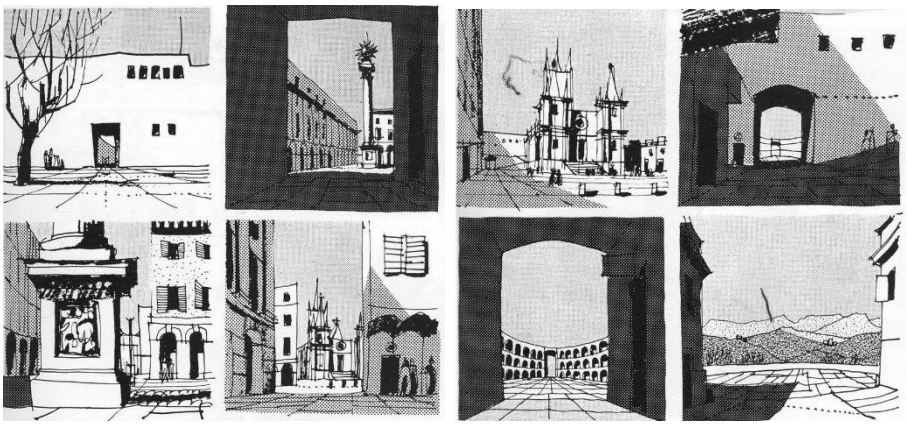


Figure 80 Gordon Cullen's cinematic urban space representation (Cullen, 1961)

Later, Colin Rowe (1983) in *"Collage City*" pointed out "*the composite and ambiguous*" character of buildings which create a disintegrated and fragmented image of the city or what he defined collage city.

Archigram architects, also, communicate their architecture through dynamic drawings of the urban environment such as Living City, Walking City, and Instant City, which are set up as a composition of fragments. These radical images of architecture have inspired the work of vanguard architects such as Hadid, Koolhaas and Tschumi. They all turn to cinema to represent their architecture.

Zaha Hadid early drawings represent virtual reality experiences on paper, which later were presented using digital tools. Her digital drawings are characterized by dynamism, fluidity, movement. They differ from image-based tradition, as the digital overcomes the restriction of the view and allow user to have not only different perspectives on objects, but also an interactive experience in VR.

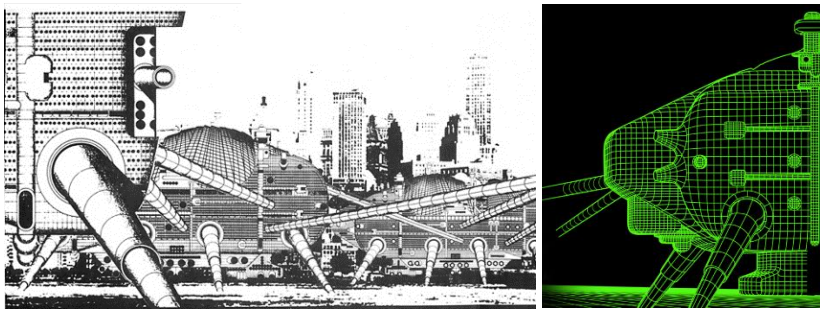


Figure 81 Walking City, Archigram

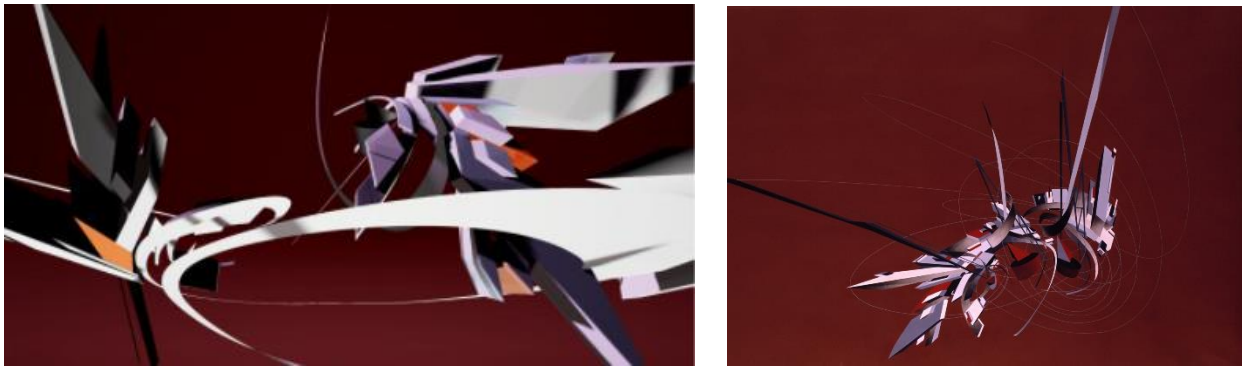


Figure 82 Zaha Hadid early drawings on virtual reality experience

Rem Koolhaas used montage images to represent visually his tale. In his early projects, oriented by a phenomenological and hermeneutic philosophy, he consideredthe possibility of an open exploration of space and a free interpretation of space experience, and examined the method of montage in architecture. In Seattle public Library, focusing on the idea of program flexibility and its transformation over time, he introduced the notion of “programmatic indeterminacy” as a changing condition of the building, grouping space in compartments according to their function. Considering this primarily aspect, he traces similarities between architecture storytelling with the cinematic screenplay, as in both cases the narrative technique of editing and cut scenes offer suspense, engage individuals, and creates exiting

experiences of space. Editing and cut scene happen between flexible compartments with consolidated programs. Activities are overlapped to create dynamism, mutual interrelation between different events and a level of complexity that is produces a rich experience of accidental and unpredicted events. But one of the most important contributions related to architecture narration is that of Bernard Tschumi.

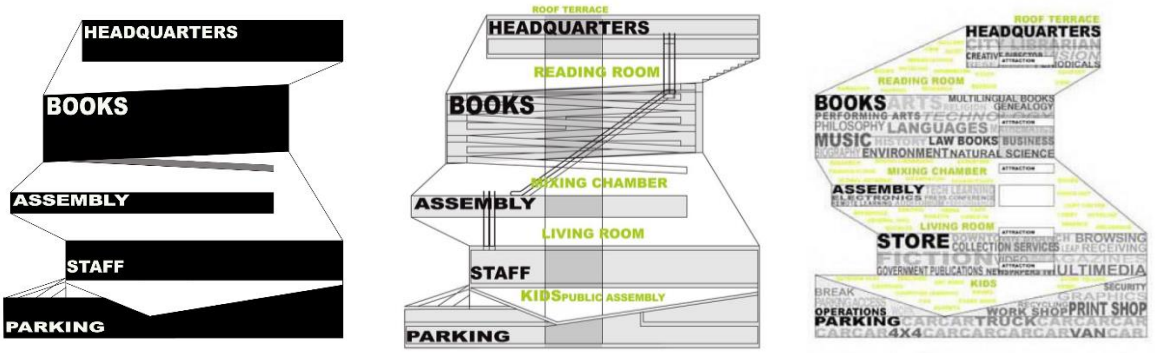


Figure 83 Diagrams, the use of montage technique in the Seattle Public Library, by R. Koolhaas

A disjoined narrative in Bernard Tschumi work.

Architecture theorist Bernard Tschumi set out a new innovative approach related to architectural narration, which is based on space experience and on the intercourse between building, space and its user. In the late ’80, one of the most important physiologists contributing in the field of visual perception, James Gibson (1979), sustained that perception was not a passive reception of inputs from the environment, but a dynamic and collaborative process based on direct experience in which individuals act and detect structures. In this sense, visual experience is related to body movement in space and is revealed by acting in the environment. This was highlighted also by Psarra in Architecture and Narrative (2009), noting the intellectual and sensorial dimension of space in movement instead of the real physical dimension we perceive moving with our body.

> "*When architects refer to design, they cast it as a mental activity that is concerned with arranging forms, spaces, program and materials. When they speak about a building, they often describe it as narrative invoking a hypothetical viewer and a journey through space. Thus, while design is portrayed as an activity of the mind, a building is seen as something to be experienced”* (Psarra, 2009).

In accordance, Tschumi designed space and developed a meaningful narrative based on events and movements of individuals which create nonlinear sequences of space. Similarly, to the cinema montage technique, architecture significance is based on the way sequences of space and events are combined

and juxtaposed. "*The architect designs the set, writes the script, and directs the actors*" (Tschumi, 1976). On a contrary, in architecture user is not passive, but has the power to challenge the space proposed by the architect.

In Manhattan Transcript project (1994), Tschumi photographed, recorded, and draw people's movement in the city of New York, creating a "storyboard", with the intent to use it as a blueprint for architecture design. Manhattan Transcripts are theoretical drawings made of cumulative photographed or drawing sequences that interpret the city in an innovative way and explore the complex relationship between the physical form of space and activities taking place. They serve as organization tools to understand the formula that led from one sequence/ event to the other. The traditional tools of architecture such as the relationship between space and function, set and script, and objects and event are here broken down and recomposed with another order, based on the disjunction of space, form, and social meaning. His ideas overcome the pragmatic and rational approach in architecture design, opening the possibility for the unexpected, irrational and symbolic use of space. Moreover, he gets over the idea of solid and unchangeable architecture, not only in physical terms of concrete space, but also in terms of program and event, which are in continuous change.

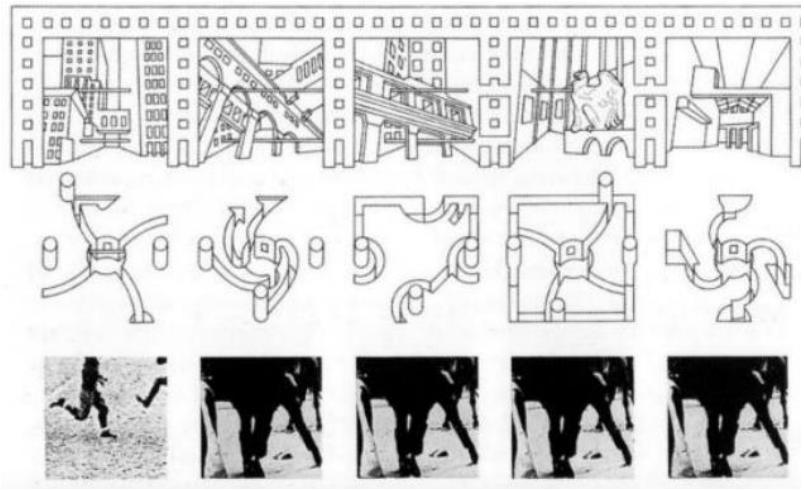


Figure 84 Frame and sequences in Manhattan Transcript, Bernard Tschumi (Manhattan transcript, 1994)

Manhattan Transcript drawingsdo not correspond to real project ideas or defined forms, nor to mere fantasies. Tschumi uses at once a structured and an imaginative language of play to present and idea of instable architecture. In fact, this idea of ephemeral space, events and program is typical in game narrative as it is under continuous change by the player. This narrative of play in Tschumi is based on three main systems: space /or objects represented through abstract buildings, movement and events/actions. In the background, there is a strong structural logic that tight these systems together.

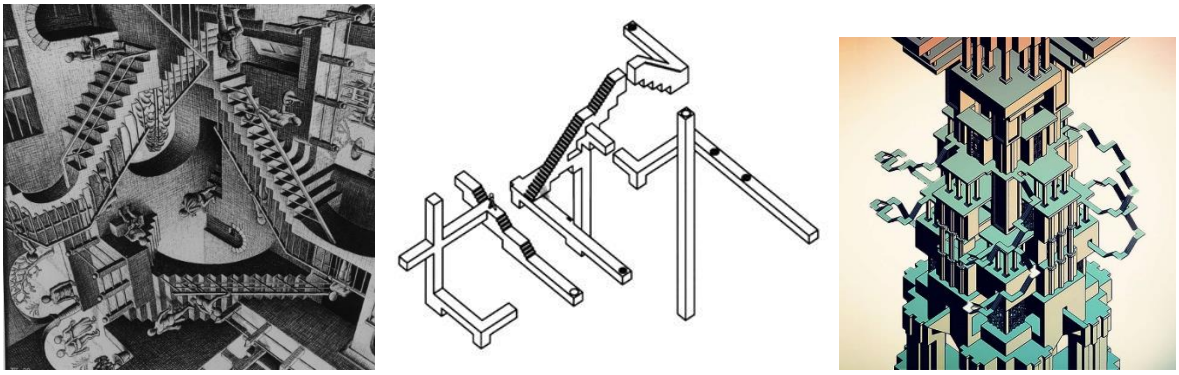


Figure 85 Escher's drawings of disjoined narrative of space and events; Video Game Echochrome II, 2010 by Japan Studio is a puzzle game in which user travers a rotatable world with a changing perspective made of impossible constructions similar to M. C. Escher's

Events are occurrences in space or independent activities. Although architecture traditionally has been prisoner to functional restrictions, Tschumi ideas can more easily be conceptualised in the realm of virtual space and video game, where these restrictions are not posed, as the level of freedom, irrationality and fantasy is higher. In fact, in Tschumi as in most nowadays VR representations, events or actions are independent of space characteristics and inputs coming from outside. They depend on the narrative flow or come out from the logic of narration and represent turning points of the story.

As opposed to transitional architecture, which is fixes and univocally defined, Tschumi sustain that the future architecture will be defined as a sequencing of events. A similar concept has been proposed also by Derrida using the term "eventualized architecture".

Space (or object)as an independent mental construction has its own logic and is revealed to the observer through its journey. While in the promenade architectural space is presented as a cinematic element, organized as a series of frames set in a defined sequence to frame users' journey, in Tschumi, space is distorted by the time which opens the possibility to enfold different narrative orders. In fact, Tschumi space is fragmented, occasionally compressed, distorted in a disjoined narrative.

Movement is the act ofprogressing or developing in narrative. In architecture, it comprises the involvement of the body either to move physically or to perceive continuous changes of the surrounding.This process is exposed to changing perspectives, overlapping orientations, juxtapositions, different visual angle, transition, culminated elements which provide a dramatic effect.

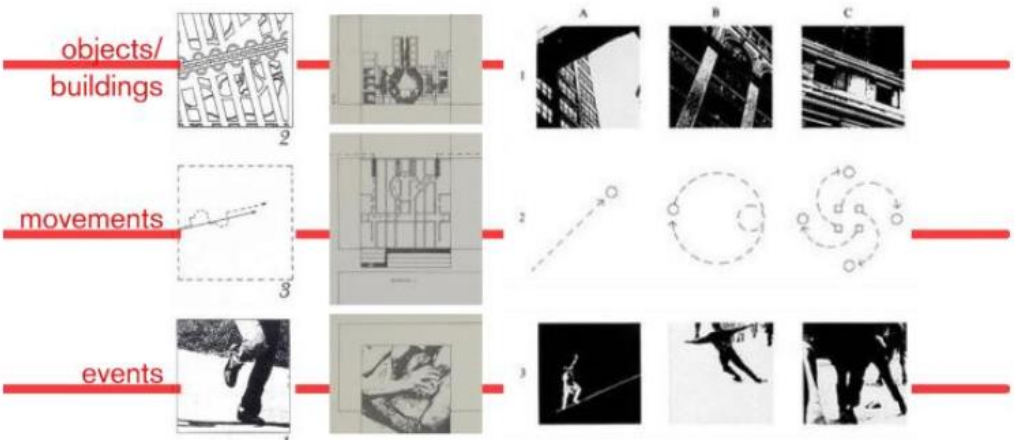


Figure 86 Figure 5 Objects, events, movement in Bernard Tschumi representations (Manhattan transcript, 1994)

Dynamic architectural sequences are based on tree type of narrative relations:

1. SPATIAL NARRATIVE which means the juxtaposition of physical manifestation of space, objects or buildings embodying meanings or significance.
2. SEQUENTIAL NARRATIVES include movement and progression, which lead to transformations. Sequential patterns are transitory paths that lead to programmed events or actions. Some of these transformation patterns can be rotation, insertion, fusion, inversion, substitution, dissolution etc.
3. PROGRAMATIC NARRATIVE includes the presence of events and actions.

In Parc dela Villete, Tschumi let individuals move along paths that intersect and collide to each other offering a surprising experience based on kinematics. Visitors get from one space to the other changing the perception of the surrounding environment at the point to lose the sense of orientation because of the open plan proposed and they arrive each time at the “follies” some points of intensity, which are strange and ambiguous spotswithoutprogram function, set in the intersections point. Folliesare abstract-childlike forms, without any kind of symbolism. They are open to take on meaning given by the visitor. Removing the program function, this architecture highlights the importance of exploration and an individual way of interaction with space and objects, instead of arriving at a specific point and performing specific obvious actions. Space, events, and movements are abstracted in surface, points and lines in order to create a more comprehensive structure.

Point which are intended to be follies are structured based on a regular grid creating a comprehensive image that enables an easier orientation. The line system intersects the grid in various points creating

unexpected views. In the surface layer are placed freely all activities, without a specific program. The combination and superimposition of these three systems suggest various exploratory paths, rich in episodes, events, and fictions.

This kind of space so typical in pure narrative games and adventure games, make architecture design process conceptually like that of video game. Therefore, in architecture can be applied similar narration tools as in video game to design advanced forms and creative spaces.

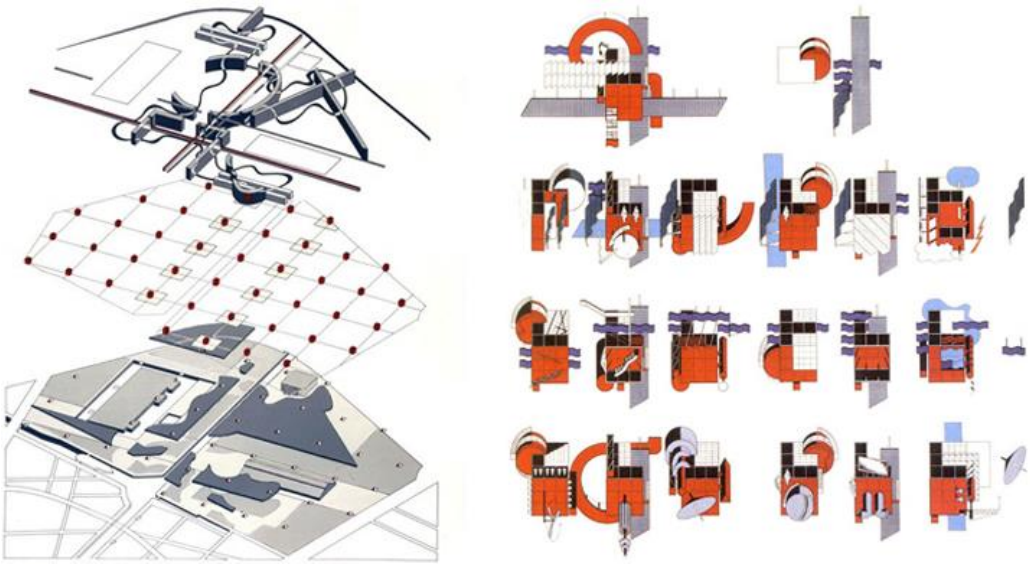


Figure 87Figure 5 The structure of space in Parc de la Vilette, by Bernard Tschumi (Tschumi , 1994)

In conclusion, these approaches to architecture narration are based on the kinetics of space, either individual movement or actions towards the environment and are based on a process of fragmentation and reassembling. This approach is being used in video games, due to the nature of the media which is based mainly on movement, action, and interaction in space, and therefore can serve as a tool for architecture narration in virtual reality.

CHAPTER 4 – INTERACTIVITY IN VR, VIDEO GAME AND ARCHITECTURE

4.1 The concept of interactivity and interactive communication

The definition of interaction depends on the study domains. The word is employed variously in the two primary fields of social science and computer science. The essence is, nevertheless, the same. The term interactivity according to Oxford Dictionary means:

> "*to allow information to be passed continuously and in both directions between a computer or other device and the person who uses it*".

Interactivity is a two-way flow and an exchange of information between a device and its user or between two users. Both parts have the ability to act and react. 'Exchange', 'interplay', 'mutual influence" are all synonyms for interactivity. Collins's dictionary outlines three types of interaction.

> 1) When individuals engage with one another while working or spending time together, they communicate.
>
> 2) when individuals interact with machines, by exchanging information of giving and receiving instructions,
>
> 3) when one thing interacts with another, they affect each other's behavior or state.[8]

With the development of computer science and digital communication technologies in the late 1980s, communication and information transfer became much more interactive. During this time, several articles on communication described interactivity as mediated communication based on engagement and involvement, which was still a standard concept tied to social science at the time. Interactivity is a part of the communication process for them. Human-computer interaction (HCI) is a technical feature defined by computer science, which is mainly focused on improving the dialog between man and machine (McMillan, 2002). While conventional media facilitate "interaction" primarily in a social sense emerging computer-based communication facilitates interactivity in terms of machine communication.

In this view, "interaction" refers to face-to-face communication and an exchange of meaning, whereas "interactivity" refers to mediated communication via technical devices (mouse, joystick, keyboard, etc.) and consists of actual "actions" toward the system. While the term "interactivity" is not commonly used in social science, both terms appear to be synonymous in informatics and media studies.

[8] https://www.collinsdictionary.com/

When personal computers became popular in the 1980s, the terms interaction and interactivity became popularized. As a result, interactivity and interaction became integral to digital communication.

According to many scholars (McMillan,2002, Rafaeli and Ariel, 2007), three forms of interaction may be distinguished:

- **User-to-user interaction** occurs when two or more individuals communicate using a technological system (ex. email, chat, video conference, online games with multiple users etc.). Interactivity refers to how people interact with one another.
- **User-system interaction** occurs when a person interacts with a media system that responds to the user's input (for example, playing single-player games or painting on a computer). In this instance, exchange is not good communication since the user is dealing with a technical system rather than a human. As a result, the engagement is computer-assisted.
- When people interact with documents and customize their contents, it's called **user-content/document-based.**

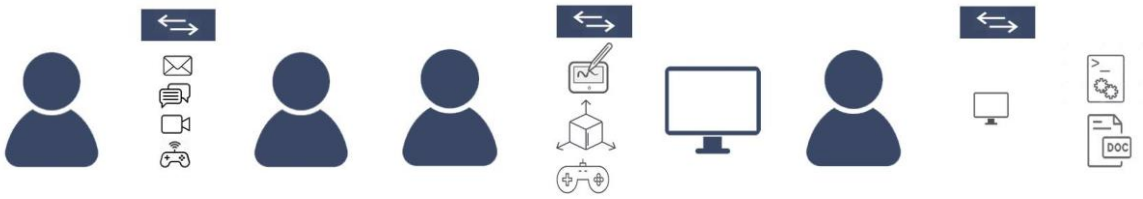


Figure 88Figure 1 Three types of Interactivities 1. User- user ;2. User- computer, 3. User –content based (by author, based on (McMillan,2002, Rafaeli and Ariel, 2007))

Although interactivity is defined as *two-way communication between user and source (other use, data or computer), in fact it is much broader, and it can be extended to a multidirectional communication between a large number of users and sources (ex. Multiplayer games)*. In fact, user and system can be multiple, and interactivity can occur in various dimensions.

Based on the theoretical background so far, the degree of interactivity depends on three elements: *Systems features*, *User perception and experience* (McMillan & Hwang, 2002), *Communication processes* (Rafaeli, Ariel, 2007).

1. *System features* include a variety of modification options, hyperlinks, audio-visual content, feedback and contact options, and avatars that talk to users. Interactivity, in this sense, is a technological aspect of mediates environments that allow for reciprocal communication or information exchange, as well as interaction between communication technology and users or between users via technology.

2. *User perception and experience.* Users realize the level of interactivity when they take actions toward the system (e.g., typing text, selecting links, manipulating space). As a result, interactivity is measured based on the degree to which users may alter the virtual environment in real time. This element is crucial to this study since it is directly tied to the ludological characteristics of video games.

3. *Communication processes.* Communication processes become interactive when users recognize the system's interactive potential and make proper use of it. Rather than being thought of as a media property, interactivity is viewed as a quality of the communication process and the way information is communicated.

Quiring and Schweiger (2008) discussing on interactivity, explored in depth the function of systems, user perception, and communication processes in facilitating interactivity by evaluating the complex co-action between the system and the user:

1. *Systems features depend o*n the level of control and transfer in the actions of the system. The control dimension is linked to the selection and modification options, to the speed of the system, synchronicity, and to time flexibility to integrate system response to the user. With the advancement of real-time processing, a more interactive system was created. Furthermore, the amount of interaction is determined by the transfer dimension of the user's and system's activities in relation to sensory complexity (aural, tactilely, olfactory, gustatory, visual).

2. *User perception***.**Users' assessments of interactive processes are partly subjective, but they are also influenced by the same criteria mentioned above, namely the level of control and transfer in the user's actions, which means that the more interactive the system is seen to be, the more control the user obtains. Perception-related criteria are based on an examination of how these aspects impact how customers perceive or experience the degree of interaction, because of prior experiences and expectations.

3. *Communication processes*. Communication processes focus on the process of massage transition or in the way users transmit information and are centered on responsiveness and interchange. (McMillan 2002; Rafaeli, 1988). To facilitate information exchange and to make the system more interactive, processes should be optimized in relation to usability and easy handling. (For instance, the encoding and decoding messages between the user and the system could be more intuitive.)

Indeed, Rafaeli & Ariel (2007) sum up some of the parameters that influence interactivity such as real time processing, speed, control, multiple choices, hyper textuality, participation, variety directionality, connectedness, experience, and responsiveness.

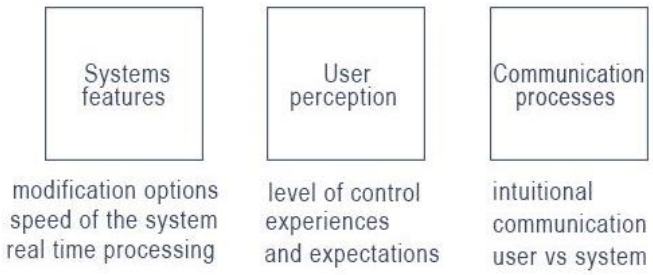


Figure 89Factors affecting interactivity (by the author based on various authors consideration (McMillan,2002, Rafaeli and Ariel, 2007),

Rafaeli (1988) proposed an interactivity model in which are identified three forms of responses:

1. **non-interactive responses**: one-directional messages between a sender and a receiver.
2. **reactive responses**: two-directional messages between the sender and receiver who react to previous messages. In this case, communication is focused on specifically requested information.
3. **interactive responses:** continuous two-way messages between a sender and receiver. Messages respond to a wide range of exchanging information and stimulate further the flow of communication. In this case, there is a highly responsive exchange.

New VR technologies permitted a different revolutionary interactive communication and consuming experience in the previous few decades, to the point that interactive media services are attempting to mimic face-to-face engagement creating a sense of presence and immersion. The experience of presence refers to the perception of virtual items as real ones. This sensation is founded on the illusion of being in a real environment. Immersion, on the other hand, is the condition of being completely immersed in the virtual world and completely disconnected from the real world. Both are highly dependent on the level of interactivity.

With today's rapid technological evolution, it's hard to fully describe the potential of these three indicators on the degree of interaction (for example, all technological systems can now react in real time). As a result, interactivity relies on new technological features, users, and creative communication procedures.

To summarize, the notion of interactivity has profoundly changed the methods we communicate, as well as user expectation and experience, because of rapidly evolving technologies. This may be seen in a variety of industries, including architecture and video games.

4.2 INTERACTIVITY IN VIRTUAL REALITY (VR, AR, MR, LIVE)

Virtual reality (VR) as an interactive media

The concept of Virtual reality was first introduced in 1963 by computer graphics pioneer Ivan Sutherland, in his Ph.D. dissertation, where he proposed a head-mounted display (HMD) to view the virtual world. However, the term was coined and popularized by Jaron Lanier in 1987 when he set up the research lab VLP "Visual Programming Language" and start an extensive research activity on virtual reality and 3D graphics.

Since then, several definitions of virtual reality have emerged throughout the previous few decades. In a technical sense, Adam (1993) described it as "a *combination of various interface technologies that enables a user to intuitively interact with an immersive and dynamic computer-generated environment"*. Similarly, other authors, (Barfield and Furness, 1995), considered it as an immersive and interactive, three-dimensional computer-generated environment (CGE), simplifying the concept. This 3D virtual environment can imitate the real environment or can be imaginary. Other definitions refer to specific aspects of VR as interactive media related to the degree of interactivity: immersion, augmented reality, presence or telepresence or to real-time simulation and multi-sensorial experience and to the experience of being immersed in a responsive virtual world to which the user can control the viewpoints. With the technological evolution and innovative devices, virtual reality has become more and more immersive. Audience is not any more passive viewer but actively participate in real time. Recent definitions, describe **virtual reality** as an interactive medium based on interactive computer simulations.

> "*A medium composed of interactive computer simulations that sense the participant's position and actions and replace or augment the feedback to one or more senses, giving the feeling of being mentally immersed or present in the simulation (a virtual world)*" (Sherman and Craig, 2003)

This definition describes virtual reality as a combination of many elements. Sherman and Craig's (2003) highlight four key elements of **VR**: **virtual world, immersion, sensory feedback, and interactivity,** which are valid not only for video games.

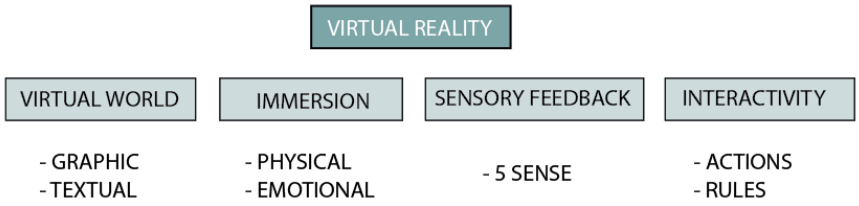


Figure 90 Virtual reality key elements and sub-components (authors, based on Sherman and Craig (2003) interpretation.

i. ***Virtual World*** according to Sherman and Craig (2003) is a collection of objects in a digital realm organized by rules and connections. Virtual world is based on 2d or 3D graphic, and avatars which interact with one another or with the virtual world.

ii. ***Immersion,*** as a feeling of being engaged with the medium at the point to be separated from real life and to have a sense of belonging to the non-physical world. The sense of involvement in virtual reality experience or this high level of understanding of the environment according to some authors mean that the user is fully present in this environment. In this sense, immersion and presence are synonyms and depend on the degree of interactivity, and inner cues. In reality is possible to identify two main types of **immersion depending of the type of involvement:**

- **Mental / Imaginative / Emotional Immersion** - mean a mental state of engagement similar to what happened when reading a novel. This kind of immersion is not typical in virtual space, apart from video games in which players are absorbed by game narrative. Mental immersion, is a *passive immersion*, as the user just receive information, without interacting as in the case of watching a movie.
- **Physical / Spatial Immersion -** mean a physical engagement or participation in a virtual environment at the point to sense it as real (ex. flight simulation). In this case, user *actively* participate in the virtual environment. The virtual environment can present different levels of immersion:

Low level of immersion or non–immersive virtual environment Non immersive virtual environments are usually basic virtual reality systems which are based on 3d graphics and can be experiences at least, through screen based visualization or pointer such as mouse.

Enhanced virtual reality systems are:

a. Semi-immersive virtual environment
b. Fully immersive virtual environment

The projection of the virtual world on the screen through enhanced projectors is a semi-immersive virtual reality system. **Infinity Wall, ImmersaDesk and head-mounted** projection-based virtual reality display are semi-immersive systems.

In Infinity Wall projection, the system track parts of the body and requires the use of gloves which are connected through cable with the projected wall.

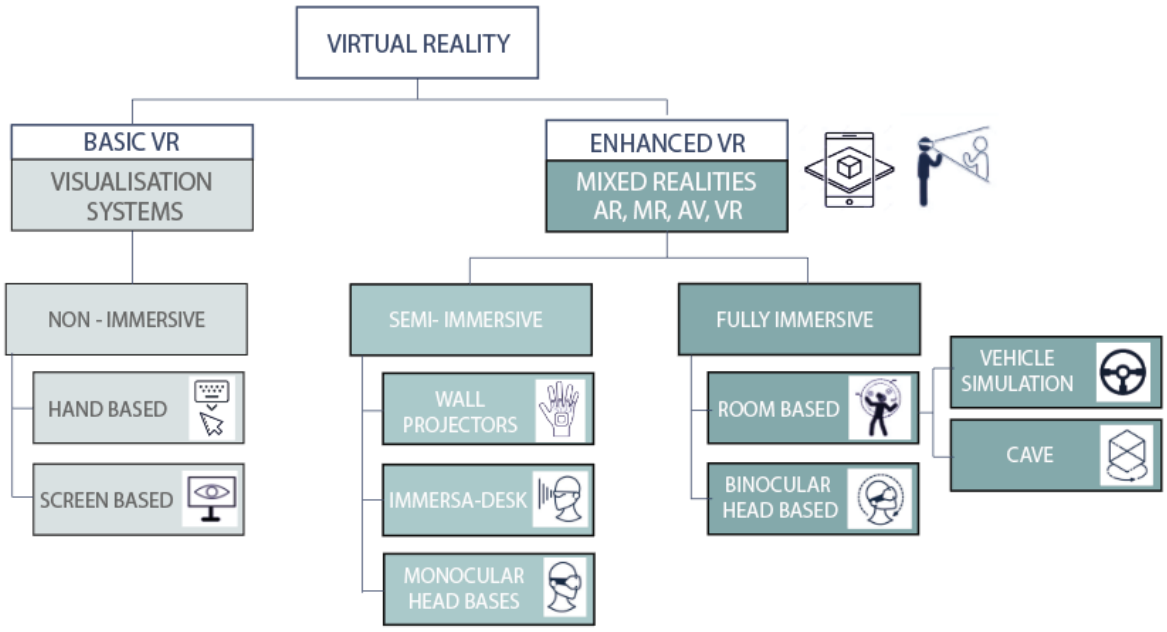


Figure 91Classification of VR types based on the level of immersion

ImmersaDesk is a VR display in table format. It requires shutter glasses to see 3d images. This system is based on 2 overlapping pictures so that the user can have the feeling of the third dimension coming out of the screen.

The monocular head-mounted display (HMD) is a display device, to worn on the head. It provides visual and aural feedback, that augment the reality system. Both real and virtual images are combined on a transparent screen

The binocular head-mounted display (HMD) and **room based systems** are fully immersive systems.

- **The binocular head-mounted display (HMD**) is a fully immersive display device. In this case, the virtual scene displayed in each eye of the user is different so the user does not only perceive a three dimensional effect, but has also a large field of view.
- **Room based system** is a fully immersive experience achieved inside a room. The CAVE (Cave Automated Virtual Environment) and vehicle (flight, car) simulations are typical examples of room based systems.

iii. ***Sensory Feedback.*** VR, in order to fully transmit a sense of immersion, requires to simulate all senses and provide sensory feedback from actions. Adequate stimuli such as a proper sound can stimulate certain responses or feedbacks.

iv. **Interactivity.** Interactivity refers to the degree of information and data exchange in the virtual world and to the amount of involvement of the user in experiencing and exchanging in the virtual world. Involvement is related to the ability to act and transform the environment which enhance the virtual experience. In virtual reality, audience can navigate through space, travel the virtual world, change the point of view, communicate and exchange information but also interact with objects found in the environment, selecting them, move and manipulate their state.

Figure 92 Factors that create a vivid virtual experience

The expansion to extended reality (XR)

Virtual reality systems are categorized based on three main characteristics: Interactivity, 3d spatial model, real-time – feedback. In the recent years, due to the increase of computer graphics processing performance, VR is moving to an extended reality form such as virtual reality (VR), mixed reality (MR) and augmented reality (AR), augmented vitality (AV) etc. They are exploring the frontiers of innovation regarding the interactive level. In fact, in addition to the basic forms of VR, they combine together the virtual and the real environment and develop response, which mean that the system either virtual or real responds to the user. Mobile location-based devices for example can show people bus timetables in real time. The most basic virtual reality representations were linked to 360-degree video. These are video recordings with a spherical camera that allows a view in multiple directions. 360 videos can be videos on the real environment (cinematography or videography), or animation captures from a 3D model), or both. They can run on game engines and can be seen through headset. Nowadays virtual space can be rebuilding through detailed 3D models and explored in a variety of forms, being connected also to the real world. In this regard, Milgram et al, (1994) claimed a Reality-Virtuality Continuum and identifies different types of virtual reality such as: AR, AV, VR, XR.

- **Augmented reality AR**

Augmented reality is a semi-immersive experience that allows to overlay virtual objects over the physical environment (Fischer et al., 2006) delivered via technical device such as a mobile phone, live camera or AR glasses. This data can be 2D images, 3D graphics/models, text, information etc. Technology allows to sense proprieties and data from the virtual world and to use them in real-time, enriching the real world experience. In AR, the system provides information or data to the user in real time, meaning that it is related directly with his current experience. Azumaet al. (2001) highlighted three main characteristics of an augmented reality (AR):

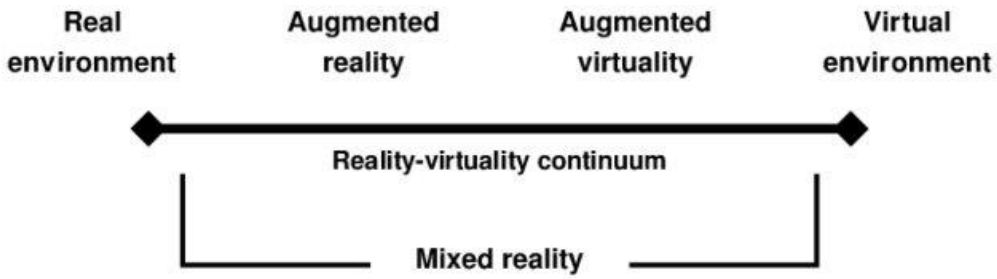


Figure 93 Milgram's Reality-Virtuality Continuum concept (Milgram and Kishino, 1994)

1. the combination of real and virtual objects in a real world;
2. real time processing,
3. the align of real and virtual objects with each other.

A classic example is the train timetable updated by tracking user's location. Augmented reality is based on real environment elements tracking, which are than synchronised with a model or data in 3D virtual environment.

Moreover, multisensory interactions are possible through devicesattached to the body (helmets, gloves, sensors, chips, Force Balls/Tracking Balls, Controller Wands, Trackpads, Motion Trackers/Bodysuits, smart lenses, AR glasses, Motion Platforms etc.) and the room or CAVE(Cave Automated Virtual Environment.

- **Mixed-reality**

Mixed – reality is a combination of Virtual Environment, virtual reality and Real World. According to Milgram & Kishino (1994), mix reality incorporates AR in terms of a "mix of real and virtual objects within a single display." It lets you to see the real world on one side and an imaginary environment on the other, linking the two worlds. However, it differs as AR is a navigation environment while MR has the possibility to manipulate the environment in real time. Milgram et al. (1995) proposed the concept of Reality-Virtuality Continuum. The five senses of reality can be included in MR in order to make it more

interactive and similar to the real word: 1. Audio; 2. Motion (application of motion capture on 3D virtual objects); 3. Touch that allow to touch and feel virtual objects. 4. Taste/Flavor. 5. Smell.

- **Extended reality**

XR encompasses all the previous 360-degree video, augmented and mixed realities. XR enables real interaction although objects and virtual environment. XR synchronizes VR and MR by bringing real-time data to them.

Interaction forms in VR

Interactivity is crucial in the virtual reality. With continual advancement in computer, virtual environments have the potential to provide a natural form of human-computer interaction in which user uses his eyes, ears, and hands almost similarly to the real word. Virtual world will perfectly simulate in a realistic view interactivities from the physical world. The main forms of interaction in virtual environments according to Mine (1995) are gaze interaction, experience (moving/navigating), selection and manipulation or acting (scaling, transforming).

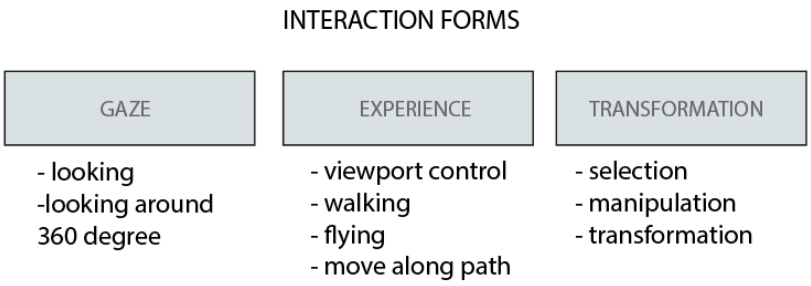


Figure 94 Interaction forms in VR (authors interpretation based on Mine (1995))

1. *Gaze interaction*.

Gaze interaction mean that interaction with things happen only by looking at objects in the environment. It includes looking around in the virtual environment whether it could be a text, an image, a 3D model or a moving image based, exploring its content, without being able to manipulate it. The user remains still while seeing a 360-degree picture. Because there is no reaction to user inputs, this is considered a low degree of interactivity. In this category of experience engagement, a somewhat greater degree of gaze interaction may be obtained using real-time sound and tactile feedbacks. The tool use d for navigation is “360 VR video”, a rotational tool that allows the user to look around.

Advanced gaze interactions include not only passively glancing at the virtual world, but also displaying desire to pick digital material, handle particular items, or move the cursor by gaze (Lee et al., 2014). Gazing interaction in this case also involves movement through space and selection of objects.

2. *Experience interactivity*

Experience interactivity mean to move or to navigate in the virtual environment whether it could be a text, an image, a 3D model or a moving image based, exploring its content, again without being able to manipulate it. In virtual space, users can get around in different viewpoints of the scene. In VR, they are not limited to have real space points of view, but are free to explore the environment through infinite viewpoint, though having a more comprehensive understanding of space. The process of getting navigating the environment while recording details of space and activities is tight to an architecture approach in space relate to rules of wayfinding, viewpoints control and navigation and camera tools. The virtual environment used for navigation can be both ***camera-based VR*** and ***model-based VR. Considering both of them,*** Mackinlay et al. (1990) distinguish four types of viewpoint movement for interactive virtual environment.

- **Movement**. Movement to explore space, such as walking through an architecture space, without any specific goal, flying through the environment or driving by using vehicles. They can include tools similar to architectural design programs such as: modify camera position through the use of arrows or mouse control, rotate, zoom, pan, in order to explore and inspect objects in the virtual environment. Usually movement is viewed from user perspective, which is video game is defined as first person perspective (FPP).
- **Targeted movement.** Movement towards a target, to examine it in detail.
- **Position movement.** Movement to a precise position in the model/ virtual space. Hence, the viewpoint flies directly to a target which might be a point of interest.
- **Trajectory movement.** Movement along a specific path as in cinematography or guided navigation. This technique allow user to project a walking camera through a certain path, defined or designed by the user providing better views or guided views in order to avoid disorientation.

3. *Transformational Interactivity. Actions:* Selection, Manipulation and transformation

Transformational interactivity allows users not only to move and look around the environment but also to engage with the environment, to perform tasks and to transform it (ex. selecting, moving, opening, holding, closing, rotating and placing objects).

- Selection. Interactivity consist in clicking on objects, pointing it, selecting on a list or selecting objects directly. Selection can be performed by patterns such as pointer - controllers, gaze or headsets that captures hand gestures, Image-Plane and Volume-Based Selection Pattern.
- Manipulation. When working on a scene, user can be able to manipulate multiple objects. When operating in a scene with multiple objects, manipulating means to continuously moving, rotating objects or different parts of them. User can have different controls available to manipulate objects, or touch based manipulation tools including Direct Hand Manipulation, Proxy Pattern, and 3D Tool.
- Transformation. Transformation include making changes to object in particular and to the virtual environment, changing scale, shape, colour and texture. The same patterns of manipulation can be used also to change attributes of objects.

Interaction modes and patterns in VR

In real life, there are four types of interaction with objects and people in the world (Robinett, 1998)

1) looking (people are able to look at objects or other people in the environment),
2) moving (people are able to move in space in order to look at different things)
3) acting (people can act transforming the environment)
4) talking (people can verbally communicate with other people).

In *virtual reality,* there are similar forms of interaction including **instructing, conversing, manipulating, and exploring** (Preece et al., 2018), **responding** Christopher Lueg et al. (2019) These concepts are parallel to the real world interaction forms. Nowadays with video games, other form of interaction related to **direct communication** can be introduced such **as socializing, working, decision making, solving problems, etc**. Below are illustrated and discussed in detail the various forms of interaction.

- Exploring

Exploring interaction occur where user navigate in a virtual space. Exploring interaction comprehend both, the virtual environment and augmented reality. User start understanding and exploiting their knowledge of the environment by physically moving around or looking around. For example, the user can explore the interior of a room, a complex of buildings, a park, a museum, a city. Exploring interaction is widely used in realistic architecture visualisation, in virtual tours (where people in order to learn about certain space, navigate virtually through them) and in video games world which are 3d environments (or

fantasy worlds). Whether it is real or virtual environment, it allows people to virtually navigate through. In architecture design it's possible to build highly realistic representations that allows client or customer to better perceive the project. Exploration consist in:

- Wayfinding, that is about orienting user movement in the virtual reality to find his position and to find specific spaces to explore.

  - Travel is the act of exploring a virtual world without a clear goal, using equipment that allow you to not only walk but also change perspectives, rotate them, adjust your eye level, and so on.

- Instructing

Instructing interaction occur when user **give instructions to a system** in different ways such as: by typing commands or pressing buttons, selecting options from menus, giving voice commands, gesturing. In this type of interaction users tell the system the task to perform. Usually users in order to perform commands are supported by additional devises such as: keyboard, a mouse, touch screen etc.

- Conversing

Conversing interaction occur when users dialog with a system. Users **speak and give inputs to the system via an interface** and the system is instructed to respond as it was a human but via text, text-to-speech or audio output. In this case the system is not instructed as a machine to respond to orders, but is based on artificial intelligence. This kind of interaction based on dialog is supported by voice recognition menu-driven, menu system, and complex inquiries that aim to respond to the user request. It works well with different application such as Siri, Cortana, AIVC (Alice) etc. This kind of interaction is used from banking to ticket booking, to queries of different topics, helps system. Nevertheless, it is still limited, and in many cases queries can be misunderstood.

- Manipulating

Manipulating interaction occur when users act upon objects in virtual reality or in the physical space by manipulating them (ex, drag, select, open-close, hold, move and place, change proprieties etc.). According to Sherman et al (2003) manipulation is the ability "*to treat or operate with the hands or by mechanical means especially*". This actions depend if we are acting in a real or virtual world. In fact, some of the actions such as cut, zoom, stretch, shrink cannot be performed in real world and are advantage of virtual reality. Technology today allows to perform human actions using physical controllers that control the movement of a screen avatar. This way humans perform instantly physical actions upon objects on the screen. Video games are the classical example of direct manipulation. Other

applications are, image editing and drawing apps, etc. Schneiderman (1983) coined the term DM (direct manipulation) from studying video games. In Virtual reality manipulation can be performed through:

- direct user control, when user in the virtual world mimic real world gestures in the interface
- physical control, when user control touch based devices (ex. Joystick)
- virtual control, when user controls virtual based devices. Most of them are based on real life simulation.

- Responding.

Responding interaction occur when the system respond to user action, involving and alerting the user to respond. In particular, the proactive mobile location-based technology can alert people of the presence of interesting things happening nearby. Users on their side are free to respond or to ignore it.

- Communication

Communication is the ability of the virtual reality to allow interaction with other users of the same space. This form of interaction is very popular recently in multiplayer online games. In this research communication is viewed in terms of learning, Problem-Solving, Planning, Arguing and Decision-Making. They include option thinking, building various scenarios and consequences, building pros and cons models, deciding best option. In this sense they are complex systems based on multi-criteria decision making.

In conclusion, interaction modes in VR are essential tools to trace parallels between VR and video games and to discuss the possibility to adopt them in architecture visualization and aiding the design process.

4.3 VIDEO GAME INTERACTIVITY

"The word interactivity isn't just about giving players choices; it pretty much completely defines the game medium" ***Warren Spector in*** *RE:PLAY: Game Design + Game Culture*

Interactivity is an important part of the games, especially video games. This was an argument used by ludologiests in the dispute over whether or not games should be considered narrative medium. Thus, as part of the gameplay and its ludological character, games imply interactivity. Stéphane Natkin (2006) in her book "Video Game and Interactive Media: A Glimpse at New Digital Entertainment" sustain that videogames are the most advanced "interactive media."In video games, players have the power to performs actions. They must engage being active in order to complete game tasks and enjoy the game. According to Murray (1997) agency is one of the most appealing aspects of games, since it turns the user

from a passive observer to an active participant. In his book "*Dissimulations: Illusions of Interactivity*," interactive designer Andy Cameron emphasized the concept of interactivity in relation to player's experience. Interactivity refers to the player's direct action or participation in response to game challenges and to computer AI as response. Interactivity is tied to the rules of play, or what is known as the ludological components of video games, in this respect. As a result, the gameplay encourages user engagement to determine space of possibilities. Katie and Zimmermam (2003) asserted that video games provide many levels of interaction, including interactions with objects in the game environment, social contact among players, and cultural interaction, when playing goes beyond the game context. In this sense, interactivity in video games is seen as a communication process similar to that of the physical space and in VR. Game designer Chris Crawford, who outlined the necessity of reciprocal reaction in maintaining the quality of communication in time, emphasized this component of interaction as a form of dialog, reflection on the input, and exchange or response that feeds the past inputs. Interactivity, according to Crawford, is defined as:

> "*a cyclical process in which two actors alternately listen, think, and speak. The quality of interaction depends on the quality of each of the subtasks (listening, thinking, and speaking)." (Crawford, 2002, p.6)*

Other researchers looked at how interaction in video games corresponds to gameplay. In his book "*Game Design: Theory and Practice*," Richard Rouse (2001, p. xviii) claims that gaming is "directly tied to the degree and nature of interactivity". This emergent feature of interaction between the game system and the player's strategies and problem-solving processes was also highlighted by Jørgensen (2008). Thus, gaming refers to how the game is played, which is determined by how the player approaches the rules and decides how to interact with them.

Based on the above definitions, in this research, interactivity is approached more as a product of CMC that as an attribute of technology, emphasizing on one side the process of interchange and response through CMC and on the other side focusing on player's participation, activity and behavior in the game world. In this regard, Rafaeli (1988) emphasized the role of player's action, choice and reaction in the development of the game and in the level of interactivity. Steuer, put into evidence three main components that determine the depth of interactivity in games: speed and mapping that are technological variables and range (number to choices available) are variables related to the player and its performance. They can vary from the choice of players personal attributes to the various actions that he performs along with the gameplay. In this sense, in video games we can identify different dimensions of interactivity such as: player personal, social and environmental interactivity.

Figure 95 Dimensions of interactivity in video game

Players Personal Interactivity

Video game offer player the possibility to sense themselves physically in the game world and. In video games players have an avatar or a physical representation of themselves as the main protagonist of the game story. This character can have various attributes, such as a specific profile representation, body language such as facial expression, gestures, postures and kinetics, body movements, abilities (skills such as jumping, fighting, etc.) and tools and equipment's such as (cloths, weapons, etc.). Thus, physical interaction can be analyzed based on the attributes of the avatar or player.

Social Interactivity

Social interactivity consists in player interaction with other players or inhabitants who can be geographically distant. Virtual inhabitants can be characters populating the virtual environment, or having a key role in the story, or be support characters that travel with the player and help him/her. They both share information, resources, help and support each other or act as enemies. According to Bartle (2004) there are different inhabitants of the virtual world: players, non-player characters and monsters. Players have the opportunity to interact with each other through their avatar in MMOGs. Interaction is mediated through the use of their representation forms. They can be part of tasks or quests to be solved together and need different skills, Thus, players of MMOG interact socially in the game environment with other gamers, creating relationships, collaborations, alliances in order to accomplish common tasks (Cole & Griffiths, 2007). Non-player characters are usually supporting characters that serve to buy, sell, provide services, information for the player.

Environmental Interactivity

The player also interacts with items in the virtual environment that he or she may control or affect. It involves spatial and temporal changes in the virtual environment relative to moveable items, destructible objects, constructive stuff, and upgradable objects. Interactions with these things follow the physics principles established by the designers. The environment may interact also with itself without concern for player activities, yet this may have an impact on the user's gaming experience.

In conclusion, the depth of interaction in video game is determine by the realism, playability, and believability of the player and its actions. Interactivity can be defined in relation to the player's freedom and possibility to modify his avatar, as well as other characters and objects that make up the virtual environment so that his choices impact the game progress. These three dimension of interactivity are not exhaustive, but are related to our definition of interactivity concerning game play.

4.3 GAME INTERACTIVITY IN ARCHITECTURE

From Fun Palace to a ludic interactive virtual architecture

Prior to architecture, the earliest experimentations on interactivity were carried out in the sphere of art. During the 1970s, the "Groupe de Recherche d'Art Visuel" GRAV, a Paris-based group of artists, focused their study and experimentation on kinetic art and interactivity, producing collaborative events called Labyrinth. They engaged the audience in kinetic activities such as walking on uneven slabs of wood, movable bridges, light displays, and/or seeing a distorted reality in order to influence their behavior and provoke varied emotions. GRAV recorded a variety of audience responses, including simple contemplation, visual activation, active involuntary engagement, voluntary participation, and active spectatorship. As a result, they claim that audiences do not receive art passively, but rather actively engage and respond to it. GRAV labyrinth installation are seen as the first interactive art form anticipating architecture.

Figure 96 Interactive art as part of "Labyrinth" research by GRAV (source: http://julioleparc.org/g.r.a.v.html)

The earliest example of game theory in a ludic and interactive architecture design was probably "Fun palace" by Cedric Price and Gordon Pask. Inspired by game theory, Fun Palace, in London (1961) was an innovative leisure center project designed as a ludic architecture to offer space of play and improvisation adaptable to user needs, social interactivity, and performance space. It soon became a manifesto of an

evolving and ephemeral architecture based on mutability of programs and possibility of expanding spaces. It promoted responsive and flexible architecture based on users need. Its linear configuration was not based on perspective laws of traditional architecture rather than on a systemic approach based on parts that people can assembly by themselves. In this sense, its design was based on methods of interaction kinetic element and flexible space conceived as an algorithm accompanied by a set of diagrams exhibiting kinetic elements (Standley, 2006).

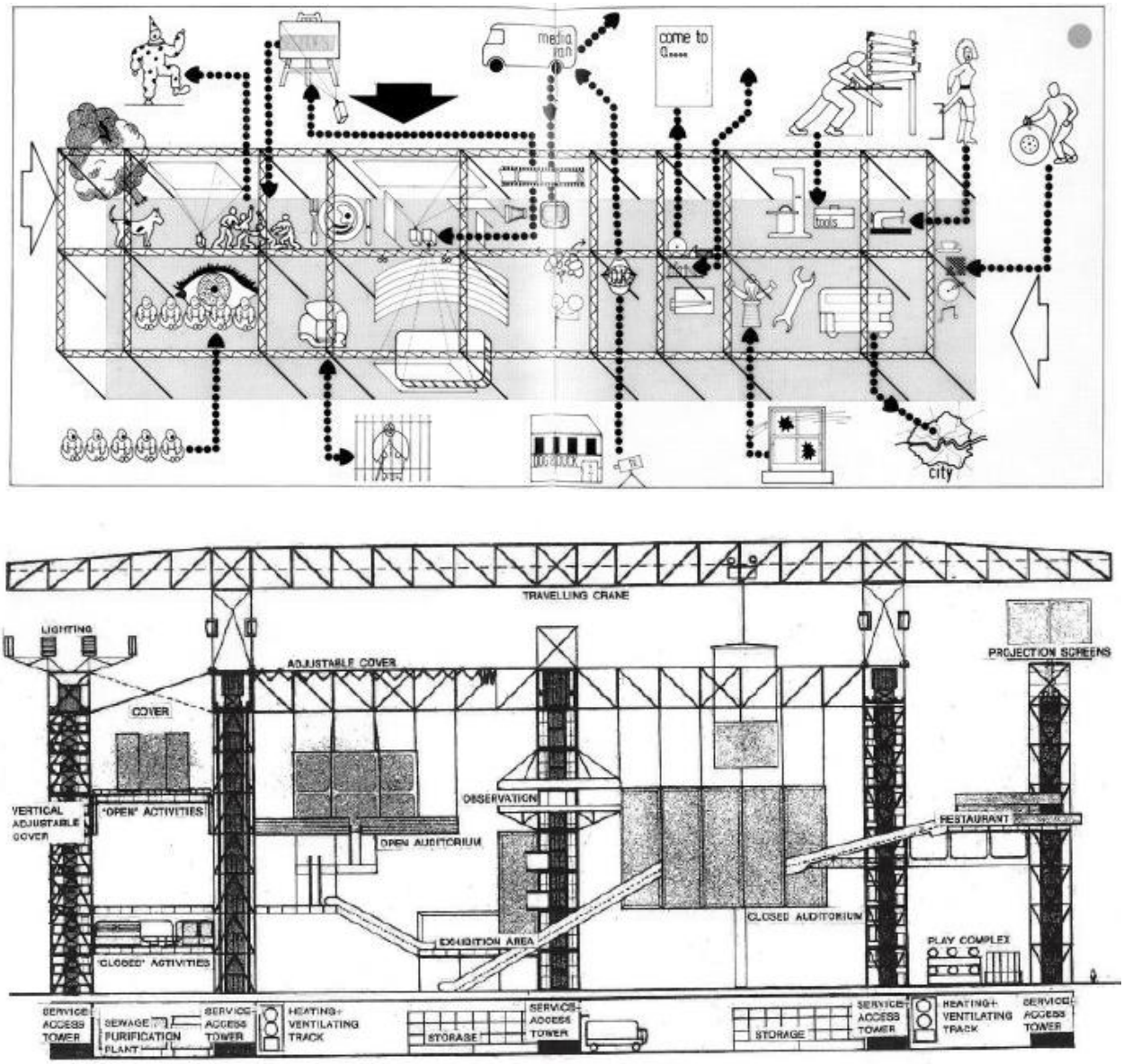


Figure 97 Drawing of Fun Palace in Price, Cedric The Square Book (Chichester: Wiley- Academy, 2003)

Gordon Pask was involved in the development of intelligent cibernetian settings that interact with people and can change their behavior, resulting in a societal impact. He suggested a "Conversation Theory" based on the concept that user activities have an influence on the environment, which leads to

environmental modification. Pask believed that human-architecture interaction had a conversation character. In this aspect, architecture has the ability to understand and respond to participants, as well as learn their behavior. The inhabitants and architecture collaborate to achieve a common goal for the environment via interaction. Goals adapt in response to user demands and learn from previous interactions, resulting in what is now known as artificial intelligence (AI) and machine learning. These objectives are not set in stone, but are continually established by the actions of the users. As a result, such systems can adapt to complex and unusual environments without being restricted or authoritarian.

To determine the behavior of Fun Palace, Pask's Cybernetics works in tandem with game theory. Game theory was mostly used in long-term performative tactics, taking into consideration interaction characteristics that control behavior dynamics. As a result, Fun Palace not only reacts quickly to user actions, but also learns from them, anticipates their requirements, and adapts accordingly (Standley, 2006). The design of Fun Palace began with cause-and-effect flow charts and diagrams of interctivity and dynamics which would reflect on architecture. Sensors would collect data and assist architecture in responding to people's needs. This information might potentially be used in game theory to establish trends that could be used to determine long-term transformations. The system is designed to learn users' behavior and anticipate their needs in the long run, allowing it to adapt to future activity. Based on this information, the walls, pathways, and other dynamic elements shift, modifying the Fun Palace space. Fun Palace was never built, but its revolutionary concept is today regarded as a classic example of how a virtual environment may be playful, interactive, and creative via the use of ludological principles of game theory.

Nowadays, architecture as an interactive design field is concerned not only with the physical features of our surrounds, but also with how built objects facilitate activities, people movement, information, communication, and interaction. Different variables are considered while creating architecture, ranging from aesthetic expression to functional, educational, and inspirational spatial experiences. In this regard, there is synergy between architecture, urbanism and computer games, and its reflected in the similarity of the attributes of space. Architects may use interactive gaming technologies to reimagine and dynamically repurpose architectural space and the built environment in their virtual architecture representations and speculations during the design process. The interaction processes connected with video games have crept into our daily lives to the point that they are now used to grow not just interaction and recreational activities in space, but also social groups extended into "real" life.

Ludic Interactive Architecture research in relation to ludic aspect of game theory investigates not only the ways to represent space, gaze and navigate through it for fun, but also how to transform it by

adopting, and allowing user to take actions that will find a response in real time. In technological terms, interactive architecture present an additional technological layer related to the computer systems which facilitates interaction. Thus, an interactive space is more dynamic and according to Kronenburg (2007) make people more proactive to adapt it to their needs.

Interactive Architecture being driven by digital technology needs large technological competences from architects to create creative spaces. William Mitchell, one of the most influential intellectual thinker invite architects to have a proactive role in this technical revolution in order to be able to create

> "*smart places from electronic hardware as well as traditional architectural elements, and develop the software that activates those places and makes them useful..."* (Mitchell 2000).

Mitchell observing since the late 90s, the proliferation of tags and sensors augmenting real space and describe this mediated environment as "the urban infrastructure of experience". He considers it an overlapping layer that enriches the real world experience. In these spaces, people are able to move freely and make changes to the environment. In architecture space, they can place furniture, change color, place lighting. Moreover, they can transform spaces based on their need, or can let the computer to transform it based on their behavior. In urban planning various actors involved in urban transformations process, can be part of dialogue platform, discussing, proposing changes and collaborating with each other in real time. The field of Interactive Architecture technology allows the creation of dynamic, transforming places which respond and adapt to the complexities of life (MIT 2005). Currently, architectural scholar Kronenburg (2007) consider "Interactive Architecture" in relation to automation or intelligent automation in buildings in which "*an action that is carried out towards a predetermined result though the process may be changed along the way*". Its shows the reactive quality of architecture. In fact, these systems have the ability to respond to the user's input. From this perspective, architecture goal is to integrate sensor systems that assess and manipulate data from the internal and external environment and building's systems conditions, and processing those data, react to achieve the best operational performance and control level.

According to game programmer Chris Crawford, interaction is the process listening, thinking, and speaking between two or more people. In technological terms **interaction process** can be translated to: input, processing, and output.

1. **Input technology.** Inputs are provided through ordinary devices such as keyboard and mouse, while evolved technology offers sensor, cameras and tangible user interfaces. Sensors measure certain proprieties of objects or space such as: sound, temperature, light features, pressure, movement, etc. Tangible user interfaces embody digital information from objects.

2. **Output technology.** Actually, there are various type of output technology, but the most common are **display and kinetic based**. In Architecture real projects such as Bix project,in Kunsthaus in Graz have used as output a display. In Living New York (Benjamin and Yang 2006) the output responds to internal or external conditions with movement, change the shape depending on the temperature.

Figure 98Interactive screen of Bix project, in Kunsthaus in Graz

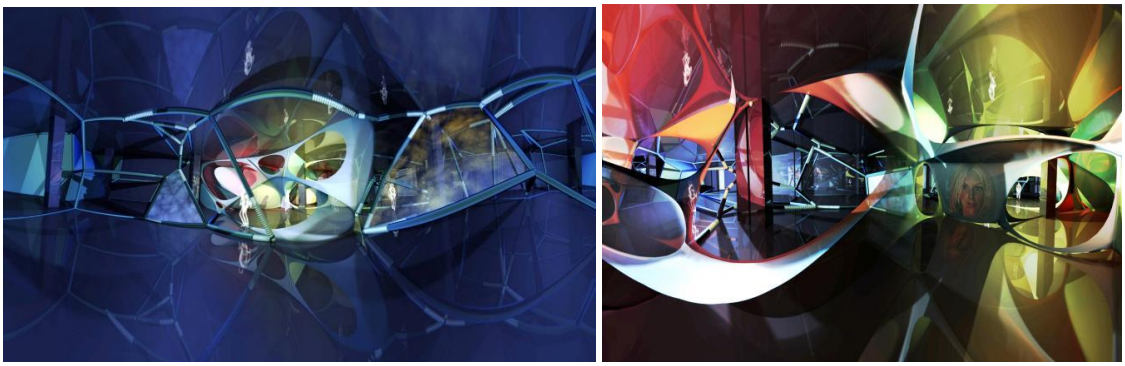


Figure 99 Digital Pavilion by ONL, Kas Oosterhuis in Seoul South-Korea

3. **Processing.** Interactive architecture not a final product but a process-oriented system that aims to create dynamic spaces. It includes on one side the computational aspect and on the other the physics and the kinetics. Memory Wall by Jason Bruges in Jean Nouvel's Puerta America Hotel in Madridis an interactive lighting installations that involve individuals passing by. Motion and body mass are captured, filtered and displayed through a computational process as shadows in the wall. ONL architectural office designed an interior space for Seul Digital Pavilion, where visitors were invited to experience a living installation. The pavilion contains multiple intelligent technologies not only applied in conception and building processes, but also for the creation of interactive engagement with visitors. The Digital Pavilion's parametric geometry is developed based on user behavior and can only be built algorithmically. Visitors use special handheld interactive game device through which they define personal details used then to configure contents. In fact, the installation is never the same in terms of shape or content offering each

time unique experience because it is updated in real time by public movement and streaming content. The physical and the virtual reality come together in real time.

Rule-based Interaction design. Gamification of the architecture design process.

According to Deterdinget al (2011), gamification means using game design tools in non-game disciplines. Tools refer to “the process of game thinking and game mechanics that engage users and solve problems.” (Zichermann and Cunningham, 2011). Game theory is the study of mathematical models of strategic interaction among rational decision makers. Gamification includes a set of activities, rules and processes to solve problems by using or applying tools and instruments from games. Gamification seeks to enhance user engagement in whatever activity to which it is applied. Thus, for serious games, the goal of game theory is to formulate mathematical rules, whereas gamification aims to apply rule-following games in a non-game environment. For that reason, the main objective of applying gamification is to improve the involvement and motivation of users and to ensure the experience needed in certain areas.
In the design process, rules of interaction allow to generate different configurations of architectonical form.

Patrik Schumacher, from Zaha Hadid Architects, uses interactive design as a creative process**; Marcus Novak** defines form through algorithmic techniques, **Kas Oosterhuis** (Oosterhuis et al. 2010), sees architecture more as process oriented, that reflects dynamics of changes; **Greg Lyn** uses animation software to generate geometric forms, controlled by computer software, not by the designer. A similar example is BMW Pavilion by Bernhard Franken & ABB Architekten. In the interior, they have simulated air movement from air condition and acoustics visualization building rules of physics based on real data.
These rule-based design methodologies enable an interactive architecture generation and space experiencing.

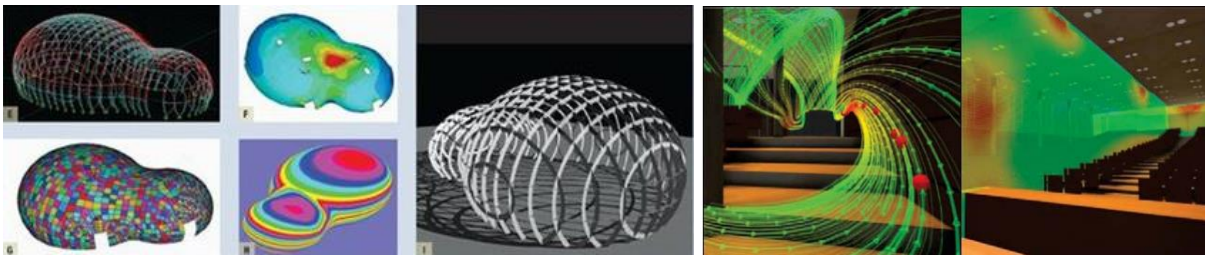


Figure 100 Simulation in BMW Pavilion by Bernhard Franken & ABB Architekten.

Systemic interaction. Architecture and city as a ludic system.

Architecture, like video games, may be thought of as a system. In his essay "The city is not a tree" (Alexander, 1965), architectural theorist Christopher Alexander claims that architecture is a complex

structure, specifically a "semi-lattice," in which parts of various scales interact and connect to one another in an open system. As a result, the city cannot function in isolated sections, but rather as a complex and interconnected whole that supports and enhances the different pieces. In the context of networked society, architecture and urban design is a collection of spatial regions that interact and enhance each other in a broader whole, rather than a collection of individual elements operating in concert. Today, architecture and cities are viewed from a holistic perspective, as natural systems. In this regard, architecture and urban design space is not univocally defined, but is the result of a network of cooperation and an open source for different actors or users and their contestation. It is viewed as a networked participatory design system. Nowadays, architects and urban designers are shifting from the design of objects or urban plans to programming processes of interaction with users or people involved. It consists in a democratization process from centralized to participatory systems that involve users. This system is typical in construction, management and multiplayer games.

Between the 60s and the70s professor from Michigan University, Richard Duke introduced games in the urban planning practice. Richard Duke (1974) in his book “Gaming: The Future’s Language” did a classification of games in relation to urban planning and build a theoretical framework for the use of game design tools in complex environments to manage and take decisions. Based on his definitions, games are seen today as tools for citizen, architects or various stakeholder’s participation, and as tools for design and research (Greenblat and Duke, 1981).

Game through the introduction of a set of game playing rules involve multiple actors disputing their own interests on space, define architecture and urban planning as a ludic system, in which interaction is played in a contested space. In contested spaces architecture and the city worked as a setting for conflict against other opponents and negociation. The city is a battlefield of different interests.

Figure 101 Urban planning as a system in The Maritime Spatial Planning Game with Wilco Boode and Harald Warmelink and Redesire with ReZone

In MVRDW Wego city, contested space is the residential block in which each family desires to realize its ego. In urban planning, the city is an arena of conflict between different actor's interest. In both cases, intentions of one actor influence the whole environment, because it functions as a whole.

Another significant example is **Hybrid Space Lab** led by Professors Elizabeth Sikiaridi and Frans Vogelaar who developed digital gaming tool to improve community space. Residents and professionals utilized the Make Shift Kit and City Kit developed by the Lab, to co-create and develop their neigboorhood based on their needs. The kit was made up of moveable modular construction components that could be placed and installed in various locations across the area. Users might construct theaters, pools, and leisure centers to improve their neighborhood's quality of life. The kit consists not only in using basic needs but also the consideration of the symbolic and the emotional dimension of place. This tool assists users in assessing their immediate surroundings and incorporating new, innovative layers into their neighborhood. This is an open source platform that allows inhabitants to play the game online and change their surroundings by suggesting modifications in the digital realm.

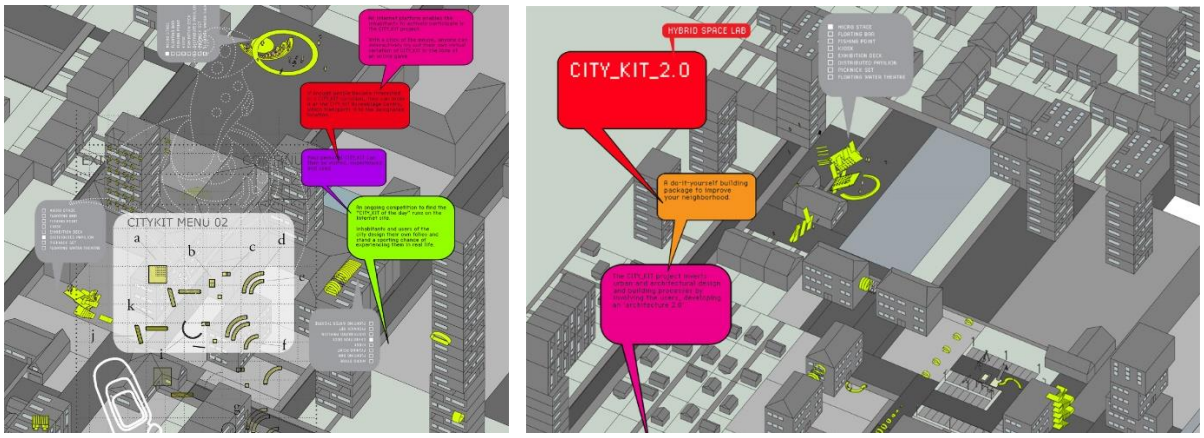


Figure 102 CITY KIT by Hybrid Space Lab (source: https://ecosistemaurbano.org/tag/hybrid/)

Various labs and research groups are developing game-based projects to support qualitative and participatory urban planning design processes, such as " Play the city", a game for collaborative spatial planning, the "Urban Ideas Bakery," which assists local stakeholders in creating and implementing innovative design solutions to social challenges in their city, "Building Futures Game" which is a scenario planning tool that assists residents in exploring, anticipating, and managing changes in urban areas to develop and enhance the quality of sustainable environments, Future City game which is a team-based endeavor that aims to improve community quality of life.

Finally, gaming tools in urban planning have the ability to assist communities in improving their surroundings while also fostering social cohesiveness.

CHAPTER 5 – CASE STUDY: VIDEO GAME ANALYSES. REPRESENTATION, EXPERIENCE DESING AND INTERACTION TOOLS

5.1 MONUMENT VALLEY (2014)

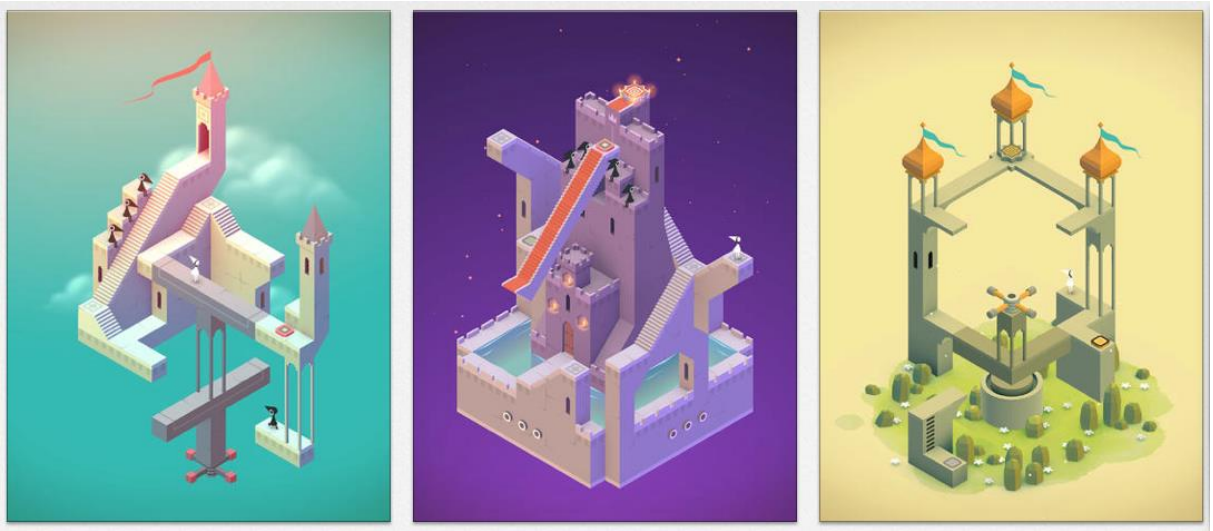


Figure 103 Screenshots from Monument valley video game

Monument Valley (by USTWO and main game designer Ken Wong) is a virtual space adventure told through the eyes of Princess Ida. The virtual realm is a surreal architecture space that relies on visual deception with bizarre landscapes built of spiralling steps and mysterious thresholds and illusion inspired by Escher's artworks. While leading the avatar around the floating terrain and blocking platforms where geometrical rules are absent, the avatar moves and interacts with items in space, encountering challenges and obstacles in a completely immersive experience. Princess must create various building configurations in front of fragmented ruins that obstruct her path to continue her journey. While walking through the objects, the protagonist keeps gazing at doors, buttons, and handles that can be twisted to flip and modify mechanisms that change the arrangement of the objects and open new passageways. Monument Valley is a puzzle game in which you must navigate Ida around the virtual world in search of her lost crown by twisting and pulling geometrically impossible things. Compared to other games where architecture is in background, here architecture and space take the center of the game. The game is all the experience of traveling through monuments.

The player's perspective can be rotated, moved in and out, and zoomed in, but the camera perspective does not change. It was vital to offer a certain amount of illusion in this type of game, thus designers employed isometric perspective representation. In addition, the game offers other presences in higher levels, which the protagonist must avoid as they begin to weep as if insane.

Representation

The visual style of the game is minimalist abstract stylized. Objects are inspired in different architecture styles, starting from Arabic, Moroccan architecture, Japanese prints, to Escher drawings, to Scottish medieval fortresses, Indian temples, Islamic minarets, and domes, etc, and reflect some detail patterns. Each level has its own theme, his storyline, and different artwork with a different colour palette, in order to challenge the player to accomplish different levels.

Design experience

The game is about princess Ida moving swiftly from place to place, through mazes of optical illusions and impossible objects while manipulating the world around her to find her lost crown. The narrative is intricate, and categorized as an open-ended branching model. It suggests an enacted story and an absolutely beautiful space exploration, urged by the challenge to find the way out. Ida's character is memorable. In fact, since the beginning the designer used the world explore instead of Start to start the adventure. The story is made up of challenges like swiping a finger to spin sidewalks or swiping a swipe to lower and elevate structures. By flipping the earth upside down, we were able to quickly capture enemies that were blocking our route. Because each level is developed in a completely different mood and setting, they are all memorable.

Design interaction

The player in each level experiences have different types of interaction because the manipulative tools change and he has always to try and figure out the way objects can be transformed, platforms can rotate. As the game proceeds, the complexity rises, but with each new challenge comes a new and equally speechless way in which the universe moves or can be altered by the player. Player starts to reposition entire stairways and passageways, as well as spin entire buildings, for walkways to intersect due to shifting viewpoints. Interactivity is based on exploration and manipulation of the environment as part of the game challenge to proceed in the space exploration and save the princess. Player does not have instruction, but learn to interact by himself progressing the game. In addition, other elements which he discovers gradually are hidden in order to surprise and delight him. The virtual space is visualized in a 30-degree isometric perspective because the optical illusion that the bridges or roads create is better perceived by the player. Player navigates space in first-person.

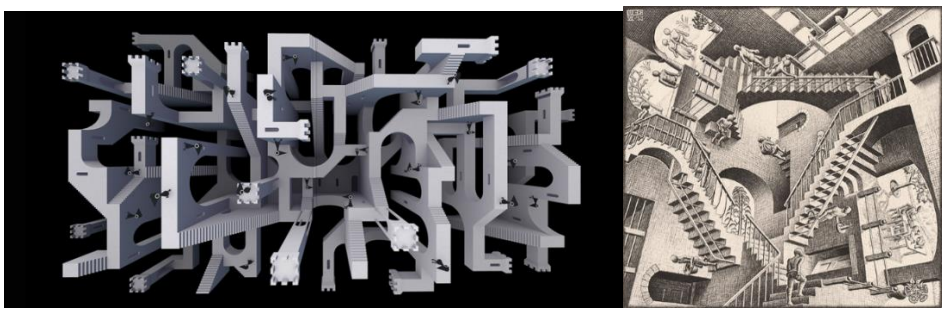


Figure 104 Monument Valley inspired by Escher drawing

5.2 BLOCK'HOOD (2017)

BLOCK'HOOD is an architectural and urban construction and simulation game based on ideas of ecology, entropy, and sustainable design, and urbanism, with an emphasis on the interdependence of programming components. This game allows the player to build a city district out of pre-defined blocks while considering aesthetical aspects and environmental, social, and economic factors. Because they imitate real components, blocks are modelled after real-world data. They demand resources to function and inputs to survive, prevent decant and structural abandonment, and produce outputs that contribute to the creation of an efficient pattern for a sustainable neighbourhood. While a tree needs water, an apartment requires power, water, and a community realm. A player can arrange them in a variety of configurations, grasping the complex interrelationship among city units by managing and balancing the inputs and outputs of blocks in the game in real-time. Blocks arrangement is not just compositional like in the case of Minecraft but is based on the alignment of inputs and outputs to optimize resources, production, and generate abundant resources while creating good relationships and avoiding negative interactions.

Block'hood provides the player with a set of 96 interconnected blocks with which to build their own neighbourhood. Blocks include various architectural functions such as apartments and shops, and natural features including trees, food production, and power sources such as wind turbines and photovoltaic panels.

The simulation of Block'hood is based on two components:

1. a rectangular grid for voxels that allows the player to place these blocks, which represent a simulation unit.
2. The use of mobile units that can circulate throughout the voxel. These agents represent the simulated population of the voxel aggregation. The agents are modelled with a series of criteria as requirements allowing them to become the analysis tool for the voxel arrangement. The

degree of 'happiness' or 'success' of an agent is based on conditions of accessibility, circulation, and overall quality of the voxel arrangement.

This game is more than just for fun and entertainment. It features an engaging and realistic story that encourages players to immerse themselves in the virtual world and encourages collective thinking through virtual collaborative communities. Video games, according to game designer Jose Sanchez (2015), will become effective tools for understanding complex urban design concerns and encouraging collaboration between experts and communities. In this sense, the use of video games in architecture and urbanism can potentially democratize the design process and stimulate systems thinking from the starting point of the design process. This type of game is based on crowdsource design.

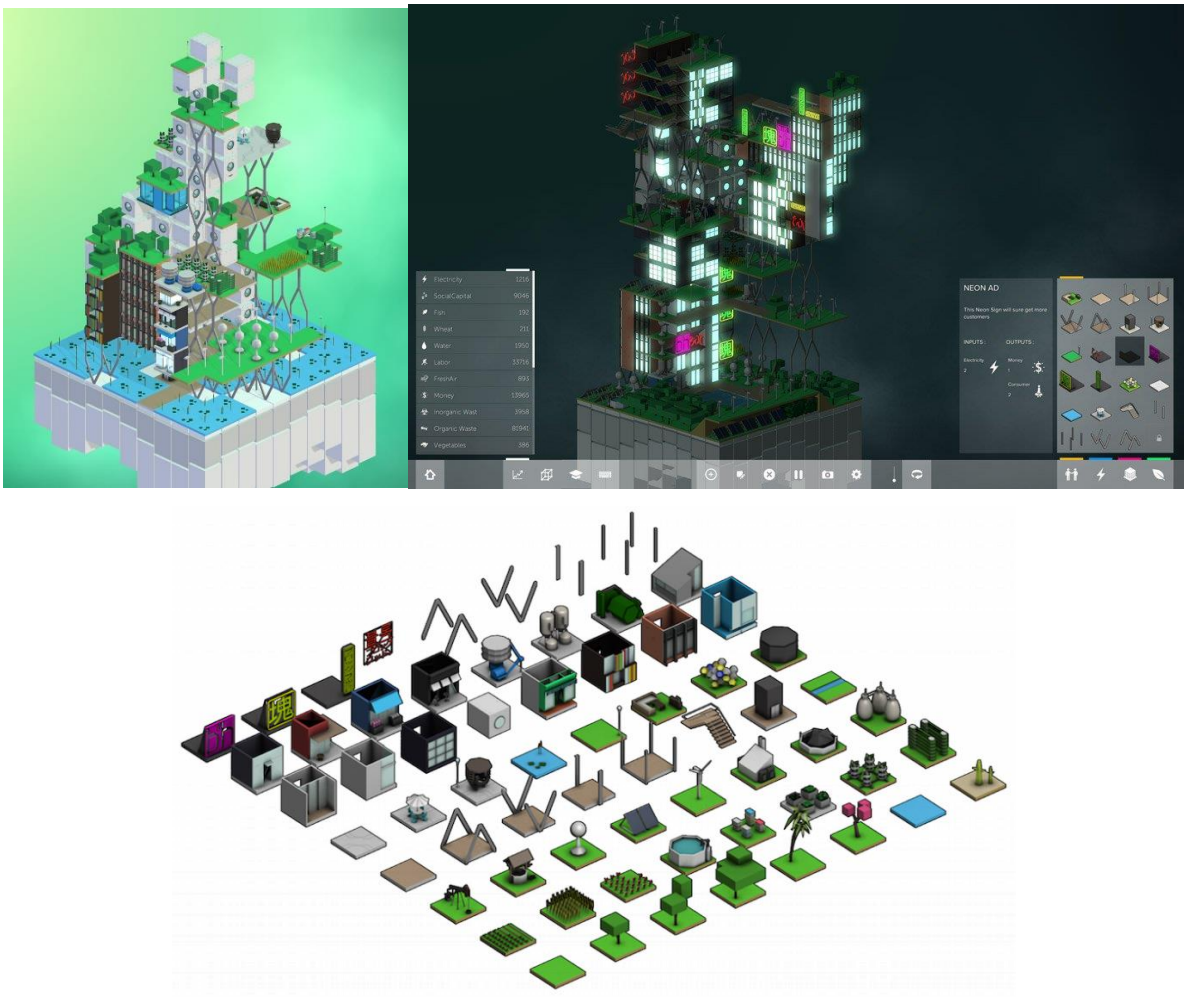


Figure 105 Screenshot from Block Hood video game (source: https://www.plethora-project.com/blockhood)

As architects, we are taught to think on multiple scales. Today, more than ever, we must confront global issues that, due to their complexity, require a more comprehensive approach to overcome. This type of game based on crowdsource design, appeal to a broader audience and therefore can serve as

collaborative instruments in design, while also assisting in the resolution of difficult problems. Games can be considered as an important instrument through which to understand complex systems because they stimulate interaction.

The current methods of participation place the architect as a filter to community needs offering them ready made ideas. Hence, they do not contribute in education community to face new challenges and implement new ideas. In video game, users can grasp the complex interplay of aspects involved in city planning by letting them engage with the variables of a system. In this way, the architect and the game designer become closer disciplines. Architecture, similarly, to multiplayer strategic games will be based on mass customization involving citizens with architects in the design of the city.

Current participation approaches place the architect as a filter for what communities may express as needs, but they frequently fail to educate a community about the problems that come with adopting a new idea.

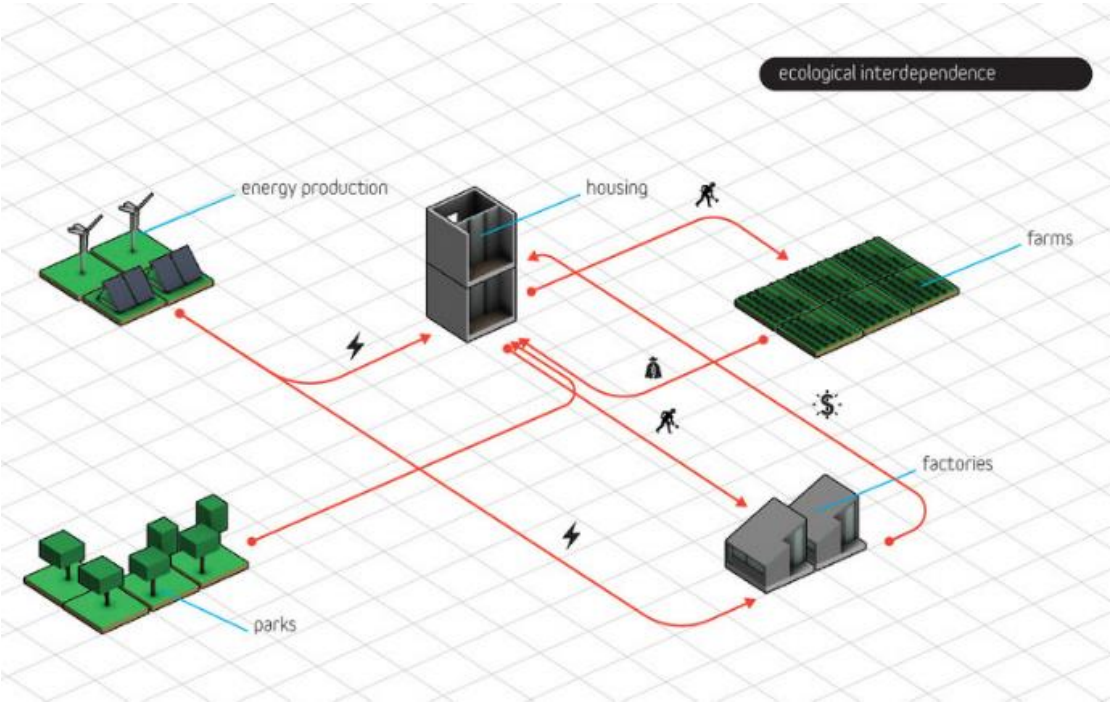


Figure 106 Ecological interdependency in Block n Hood video game (source: https://www.plethora-project.com/blockhood)

Representation

The visual style of the game is stylised and iconographic and is inspired by Metabolist capsule architecture. Background changes in relation to day and night, and environmental conditions. Architecture is made from pixelated modules which can be found in the main menu and can easily be introduced and combined in the scene similar to most common drawing softwares. The interface

features stirring graphics from an axonometric view, which is appropriate to understand the systems behind urbanism, and the rules that govern urban design.

Design experience

Since it is a strategic game, narrative and storyline is free and up to the player. In fact, the player by combining blocks and managing them as resources are asked to design the city based on aesthetical and technical criteria. The visual style suggests an evocative narrative about eco-architecture, which is then reinforced through game rules. Player navigation is limited as he views the city always in a 3d isometric perspective, so it is easier to control the composition of blocks and manipulate them.

Design interaction

The interaction design is based on game space manipulation through the use of various building blocks, inputs and outputs assigned to individual blocks, as well as resource management and a balance between different building blocks, that player learn along the playing process. The efficiency of a building is influenced by its proximity to other types of blocks. In this game, interaction is about world manipulation, mutual response between player and the system, strategic thinking and efficient recourse management.

5.3 MINECRAFT (2009 2013)

Minecraft is a first-person sandbox video game that allows users to build objects in the virtual world using 3D textured cubes with different materials and styles. Users can combine various materials and create houses, cities, and pixelated landscapes free of choice and out of simple rules. The player can build or demolish cubes of 1x1x1 meters. Cubes are obtained by exploring caves and mining materials spread in the game world. Minecraft despite the need to survive is a creative game, in which player can build their own fantasy structures. It may be seen of as an updated version of the popular children's construction game LEGo. Furthermore, it is built on earth ecological principles to create and build an in-game world. As a result, the game needs both imagination and rationality in order to progress, despite the game's addicting gameplay.

The game is presented into four modes: survive, create, adventure, spectator (Smith 2012) in which there is different access to the resource, the challenges are different and the modularity of interaction in a large space with other players is different. In survivor mode, the player is entangled in the world and mine limited resources to build structures to protect themselves, as they try to avoid monsters and survive. In creative mode, the player has access to unlimited items used to create beautiful objects and

does not worry about anything else, having no constraints. In adventure mode elements of survival are present as a form of challenge to exploration, but moreover, the player has the possibility to interact with other players. Spectator mode allows the player to observe gameplay of other players without interacting with them, just watching what other players have done.

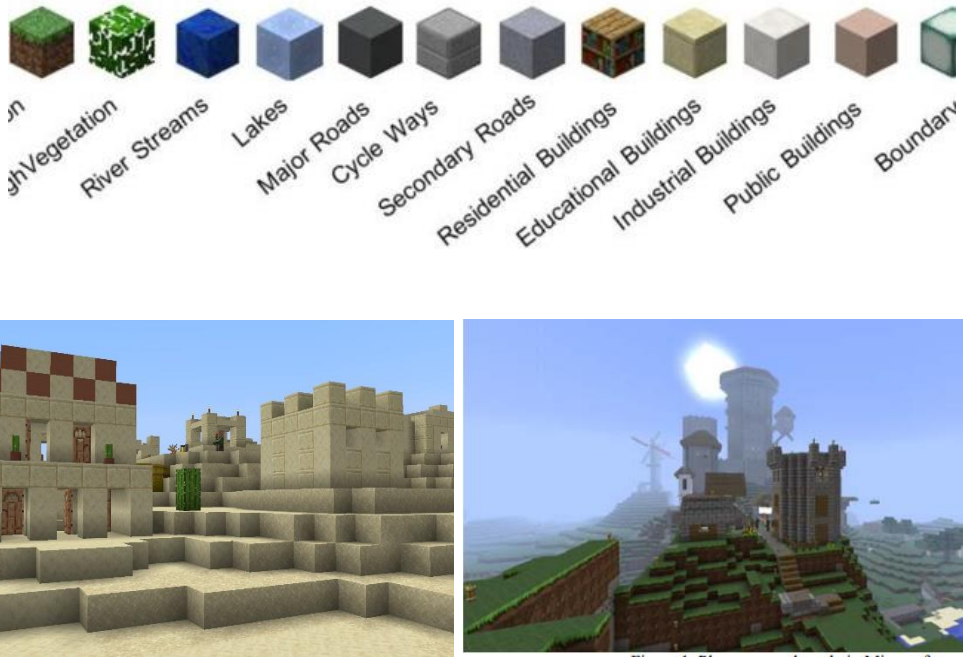


Figure 107 Partial set of materials used to build in Minecraft; Screen shot from Minecraft constructions

Hence, the various modes offer also the possibility to play the game either singularly or as multiplayer on server connections. Each Minecraft creation, in updated versions of the game, can be loaded on a server and made available for online access to other players. In this sense, Minecraft is designed not only as a creative related to form creation and entertaining tool related to fun but also as a collaborative platform in which different people can contribute in real-time. Today players, use to share online their creations and achievements. This culture of sharing 3D creations is very important for maintaining a productive creative community. Therefore, Minecraft can be used as an exchange platform. Minecraft, in essence may promote a more democratic, populist approach to design. This is a great example of how games are starting to influence decision-making and allow user participation in the architecture and urban design process.

Representation

The visual style of the game is simple, with pixelated texturing of blocks made of different materials, offering the possibility to create multiple structures in the city and architectonic scale, but in the case of

creative mode is possible to design objects. The interface is based on a first-person perspective, which is appropriate to understand architecture practice and everyday interactions.

Design experience

Since it is a construction sandbox game, narrative and storyline are free and up to the player, with limited rules and constraints. The constraints are the limitation of resources and the need to be protected by hazards. However, this is true only for the surviving mode, while the creative mode version of the game is freer and is up to the player/ players to be created and maintained. Users create their own narratives.

Design interaction

The game encourages user engagement in agriculture and natural resource mining. Despite the difficulty of surviving against imaginative enemies, the game presents a variety of animals and assigns them crucial roles, such as giving food, protection, transportation, or other materials essential for crafting. Furthermore, because it is an open-ended game, the gameplay challenges players and allows them to be creative. The game is about construction and manipulating game world, but also walking, gazing and exploring it. Constructions are the resort of experimentation with the tools in the game environment. Moreover, it is based on communication through converting and taking inputs by the various players participating in the design process or looking at their design. In fact, the game can be played alone or in servers with multiple users. The advantage of *Minecraft* is that it can be played online, and players can exchange their work in real-time. Interaction is based on conversing and communication which enable exchange of knowledge and collaboration.

5.4 SIMCITY (1989)

SimCity is another city-building, open-end game that focuses on the creation of space and the actions that take place inside it. The player takes on the role of a major or chief city planner, who makes decisions on the city's growth and changes. SimCity is based on a rationalistic approach to urban expansion rather than aesthetic criteria for urban design. It is based on the CIAM idea of separating the city into zoning areas based on functional differentiation and a set of standard services and amenities such as power, garbage collection, firefighting, infrastructure, and so on, depending on the district's surface area and population.

The city's players and management collect taxes based on residents' satisfaction with the reasonable criteria and the need to strike a balance between expenses and the requirement to meet the standards.

Meanwhile, players encounter catastrophes and perils while delivering these services and expanding the city. Like the “Block n hood” game, SimCity conveys or make player produce various elements needed to build a city and focuses on the idea of interdependence and decay between the various components.

Game management is based on a set of predefined rules, such as maintaining a balance between residential and industrial sectors, as the former generates taxes, and the latter provides services to inhabitants. Major can also support community initiatives in areas like education, health, safety, tourism, and others, which help to offset growing taxes and enhance the quality of services provided. All these services are linked to nearby cells and alter as a result of inputs from them. SimCity uses multi-level interactions to model self-organization and emergent traits including a hierarchical structure of inhabitants and production, functional differentiation, while avoiding social segregation.

Figure 108 Screenshot from Sim City video game

Sim City may be viewed as a modelling tool in this respect. In fact, it represents a model of urban life, in which most of the player’s actions can be visible in real-time and others take time to become visible. This means that games can be used to understand and solve urban issues related to complex urban systems, with different variable to be analyzed contemporary. Therefore, Sim City has been largely used by city planners to explore and to predict the effects of urban decision, budget choices, public policies, various projects and to adjust these interventions accordingly.

Representation

The visual style of the game is a close to realistic representation inspired by American cities grid and some of the buildings resemble American buildings reproduction. The graphic representation of SimCity 2000 reconstructs realistically the way cities are built from the plots of land including road patterns, buildings construction and decay. Many elements in the game world simulate the real world like fire, traffic jams, pollution effects, etc. The interface is based on a god-like view or birds-eye view, in which the player can monitor a large area. This representation is typical for management and strategic games.

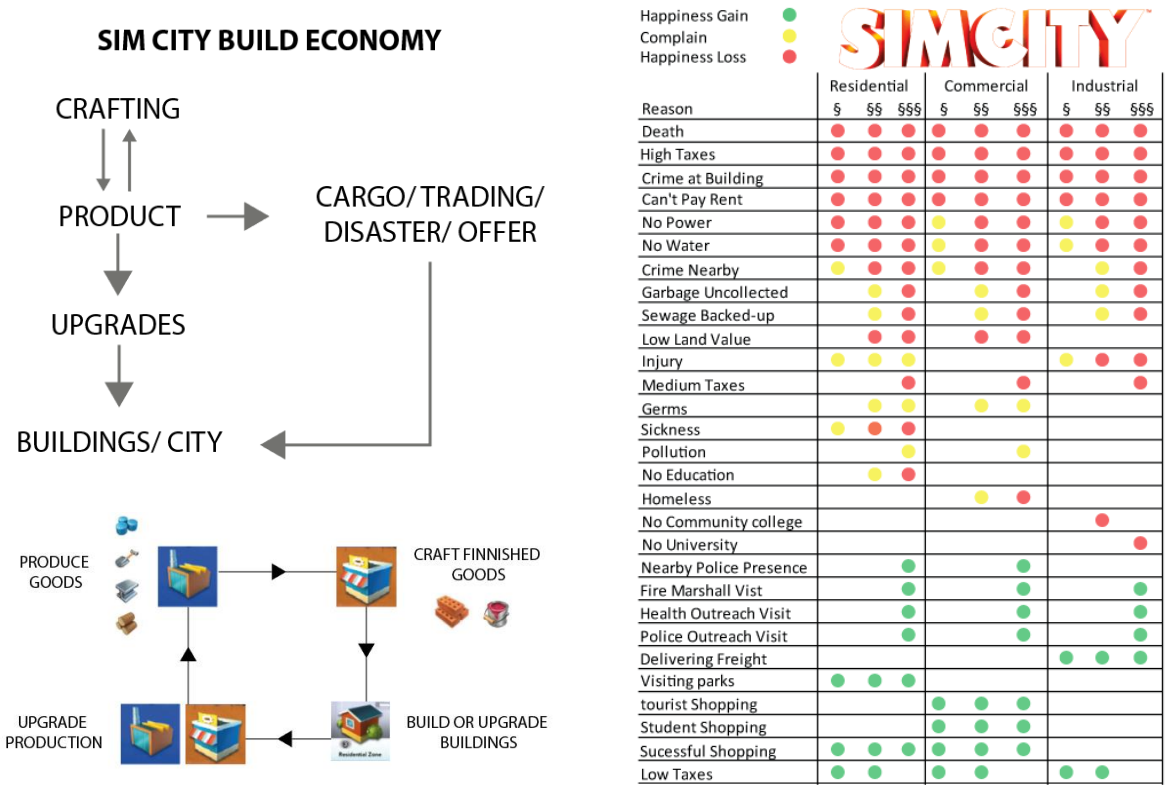


Figure 109 Sim City build economy scheme; Relation of economy and services with inhabitants happiness.

Design experience

Sim city is a construction sandbox game and therefore narrative and the storyline is partially free and up to the player, who gradually build up the city, in the limits of given rules and constraints which he learns by playing. The story is set in modern times in a predefined geographical location. However, due to the godlike interface, the player explores only from above the city, having mainly an experience of data visualisation and management rather than spatial and perceptual. Game experience is enriched by textual communication messages inhabitants or public authorities send to the player, and by cut-scenes which bring the player in different game world.

Design interaction

Player in god-eye view gaze the environment to build and transform. All player actions in Sim City are reflected in real-time in the city transformation. The game progression is based on unlocking new demands (ex. upgrade of houses, services, parks etc.) in order to made inhabitants happy. Thus, the system work together on numerous levels to make game advancement: producing materials, crafting

objects from materials, producing currency sources by selling or exporting products, designing the city layout, etc.). In this case, the player reacts to computer outputs in a continual interaction and engagement, depending on whether the effect is short or long-term. Furthermore, by visiting other players' cities, the player can interact with them.

5.5 CITIES IN MOTION (2011)

Cities in Motion is a 3D simulation game that is based on public transport implementation and the management of realistic traffic flow. The game takes place in four major European cities throughout the course of 100 years of transportation history, encompassing four eras from 1920 to 2020. Players can choose a city where to shuffle commuters and the starting year of play. They will have at their disposal 30 different transportation vehicles such as metro, trains, trams, boats, buses, water buses, helicopters, and in particular means that were used in that period to create the perfect network line for customers. Since technology changes as the years go by, the city also changes in one hundred years, and commuters gain access to better transportation means such as updated buses, more subway lines, modern cars, and helicopter taxis. In a God's-eye perspective, the player takes the task of sustaining population mobility through the city space.

Figure 110 Screen shoot from Cities in Motion video game

As part of the gameplay, is possible apart from maps to call up graphs and statistics which reveal detailed information related to traffic management, such as commuter satisfaction, the waiting time, the price of fuel, and so on. The player can decide bus stops, tram stations, tram stops, subway stations, timetables, ticket prices, instructing drivers where to stop to pick up passengers. Passengers on their side are divided into different target groups based on their needs. In deciding the routes and the webs of transit, the player has to take into account the cost efficiency of his actions. In this sense, gameplay resembles challenges of real transportation management in the city.

Representation

The user interface is highly realistic. Four of the biggest cities in Europe Vienna, Helsinki, Berlin, and Amsterdam are rendered in detail, including many unique buildings, await the steady hand of a planner to manage their transportation needs in “Cities in Motion”. Realism is at a point that even for transportation specialist would be difficult to understand the difference between real cities and virtual ones because of the realistic traffic patterns presented by the game and realistic commuter demands. The interface is based on a god-like view (or birds-eye view, in which the player can monitor a large area.

Design experience

The story is set in a precise period and place. The player is asked to orchestrate the transportation system. Hence, his perception of the city is based on an eye view and his task is to provide good service to travellers, considering the accumulated budget. In this sense, various in-game artefacts such as text, graphs, characters suggestions are posed as challenging elements that serve to move on the narrative. Cities are experienced in 3D in a birds-eye view, as third-person navigation. Using navigation, maps are possible to fly from one part to another, without any restriction as the topography of the game is open, continuous, and free to be explored. However, game space in part is static as the player cannot manipulate the landscape and buildings but is enabled only to intervene in the transportation system, by deciding trails and stops and active transportation means. The cities are dynamic, which mean that they change based on the decisions and interventions that the player makes.

Design interaction

The main elements and resources on which the game is built are 30 transportation means, cities maps, 4 types of commuters with their specific needs simulated by computer, and a budget depending on the use of transportation means. Players are asked to build roads and create transportation networks in a pre-build city. In Cities in Motion, players’ actions are reflected in real-time in the dynamics of the transportation system. Due to the computer outputs, based on simulation, the player is in a constant state of interaction and engagement to respond to the challenges simulation offers in real-time.

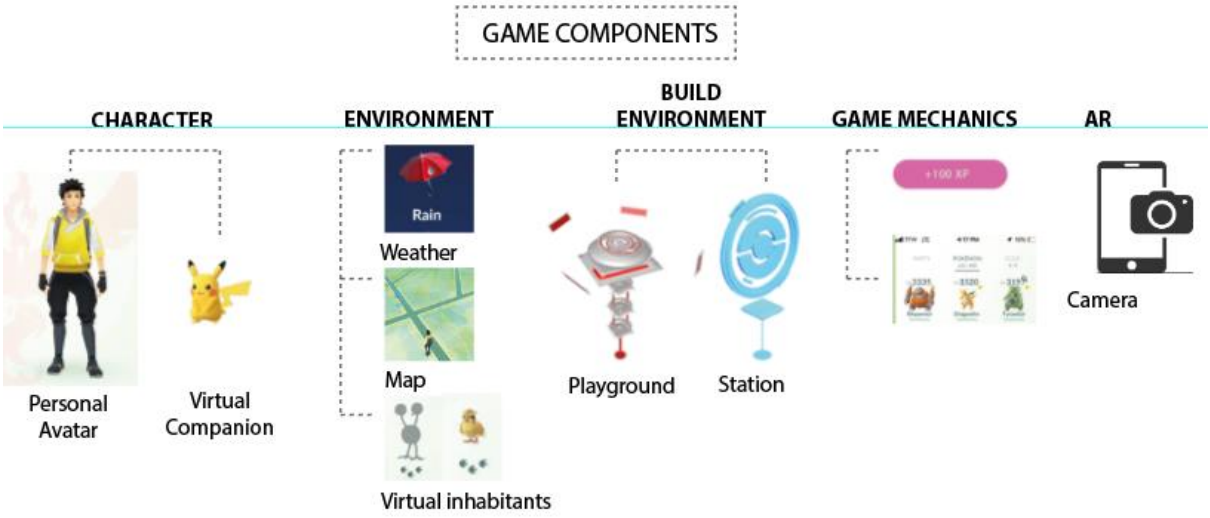
The game can be played in three modes: campaign, multiplayer, and sandbox responding to different type of demands and from game genre relate to a feeling of progression, to cooperatively and competitively game genre up to a sandbox mode in which player chooses a map and play worrying about meeting deadlines. In this case player is free from limited funds, dictated tasks, city growth, etc, giving them full control over the game experience.

5.6 POKEMON GO (2016)

Pokémon GO is a location-based augmented reality online videogame that blurs the barriers between virtual and physical environment. This game is built on digital maps of the actual world and relies on location data gathered by a single player or multiplayer in the present day. It allows users to influence the game world. User identifies and catches virtual creatures in the real world by utilizing GPS capabilities supplied by most smartphones on which the game is played. The appearance of these creatures is determined by the user's geographical location and the sort of pokémon met. The game takes place on a simplified map that represents the buildings and streets in the proximity of the user's geographical location. To discover pokémons, players go outside and roam about. When a user is near a wild pokémon, the creature's picture shows on the map. After that, the user can select the picture to encounter the pokémon.

Pokémon GO employs two in-game elements: Pokémon gyms and pokéstops, for the sake of game play and engagement. Pokéstops are rewards represented by the shorter markers with either a cube or circular top. They provide pokémon trainers with items such as pokéballs, potions, raspberries, incense, pokémon eggs, and lure modules that attract pokémons to that location, while Pokémon gyms allow trainers to battle for control of the gym. All pokémon trainers in the vicinity benefit from this effect. As a result, by planting a lure module on a pokéstop, a user will likely attract not just pokémon, but also other trainers. Users can connect with one another at pokéstops, gyms, or when searching for pokémon, which adds an intriguing social component to the game.

*Screenshots from the Pokémon GO game. a) Creatures on the map; (**b** Pokémon in the physical world. (**a** Pokémon gym; (**b** Pokéstops.*



Main Game components in Pokemon Go (source: authors)

Representation

Pokemon go interface is both real and virtual. The real environment is the environment caught by the camera of the mobile. Based on the real environment the device offers a map in which are placed the main game components: virtual characters, virtual inhabitants, weather conditions and virtual elements of the build environment. Game world is experienced on first person perspective or by god's eye view in the overall maps. The weather conditions mimic real weather in real location. Other components are fictional such as virtual inhabitants, stations, playground etc.

Design experience

Player moves in the real environment and orient himself through a digital map in order to find and catch virtual creatures and to capture them through camera in an Augmented reality gameplay, where the virtual and the real are interconnected. Player can choose a personal avatar, to represent him in the virtual map. The avatar follows user movements as it connected to the geo-located devise. In addition, a companion avatar is provided. Companions offer a walkable company that imitates players movement and reflects its personal choice. They allow users to compete in the game.

Design interaction

Pokemon go introduced augmented play, offering the possibility to interact with real-life monuments. Player interacts in three different levels: a reality layer, in the environment in which he is moving, a virtual reality (VR layer) through mobile device and an augmented reality (AR) layer that mix both realities. The reality layer is the built environment in which player is moving physically. The virtual reality layer represents the virtual map, characters and the gaming mechanics. The AR layer I achived through

the use of the different devices such as camera set at certain places in the game. Pokemos go mechanics is based on a collection system of objects in space and a rewarding system. The collection system allows the users to collect virtual pets and items that allow the advancement in the game. The rewarding system, based on experience points (XP, rewards the users with extra perks and unlocks new achievements which add to their collection.

5.7 INTERIOR DESIGN GAME

Interior Design game is a game based on the arrangement of furniture in a room. The players can select furniture from real-life brands to decorate virtual space and compete with/ or without friends to find out who comes up with the most unique decor designs. Game becomes challenging because of the various option it offers and due to the competition with other players who can vote and decide the best design. Similarly, many apps, based on this game tools, through the use of AR technology, in the resent years are integrating virtual objects from various brands library with real environments, assisting architect in designing interior spaces, but also clients to involve them in real time to give his opinion and decide on the project.

Figure 111 Screenshot from interior design apps

5.8 WORLD OF WARCRAFT (2004)

World of Warcraft is a multiplayer online role-playing game (MMORPG) that allows players to collaborate and engage in innovative ways. WoW provides alternate worlds in which social skill development may be exercised in a virtual setting (Davidson and Goldberg, 2009). In World of Warcraft, a player takes on the role of a hero as he explores this virtual world and engage in social and strategic interactions. Player can establish friendships, alliances, fight and compete against enemies (Blizzard,

2010). People can only engage with players from their own faction in a pleasant manner (talking, trading, sharing guilds, etc.. As a result, players have fun while completing the game's objectives.

WOW offers different types of interaction:

- **Player versus Environment (PvE)** where players cannot kill other players,
- **Player versus Player (PvP)** where players can kill each other.
- **Players group into guilds**. World of Warcraft provides also a collaborative system where players group together ingroup. Guilds are groups of players that have common interests within one of the two in-game factions, and they offer quest aid, social connections, collaborate with each other and protect each other against other factions.

Moreover, there are other types of interaction obtained by the combination of the above types with role-playing. The basic motivation is to create an immersive world that are faithful to the game plot. that Game narrative is crucial for the immersive experience at the point that the game instead of fighting offers you the possibility to live and explore the game world.

Representation

Interface in World of Warcraft has a conventional three-dimensional game space. The player moves the avatar either by using the mouse or arrow keys. The camera follows the movement of the avatar automatically. In World of Warcraft navigating is much closer to the real-life experience. The interface is a mix of game space, information bars and function buttons, a map displaying the surrounding area.

Figure 112 Interface is very flexible to be changed by user.

Design experience

In World of Warcraft the avatar development is achieved by distributing the areas, monsters and items according to a thoroughly designed level regime. As the player's skills improve, in order to keep the player in the same state of mind, the game has to provide the player with more challenging tasks. In

World of Warcraft every skill and ability of the avatar, as well as items, quests, monsters and areas, are shaped around this escalating level structure.

Design interaction

Gameplay in WoW is based on social interaction and player's patterns of behave. WOW provides three types of interaction: Player versus Environment (PvE), Player versus Player (PvP) and just the exploration of the game world, while players can have different attitudes: be cautious, attacking only one enemy at the time; attack multiple enemies, be more aggressive, etc. Nardi et al. (2007) sustain that player understand how to play the game through chat conversations with players to devise tactics and strategies for game play. Wow have a progressive rule structure. Nevertheless, player has the possibility to break the rules (e.g. farm gold illegally). Interface interaction is open and changeable by user, to whom is given lots of flexibility.

GAME	TYPE	REPRESENTATION TOOLS	DESIGN EXPEREINCE TOOLS (Story and its visualization)	DESIGN INTERACTION (Gameplay) TOOLS
MONUMENT VALLEY	▪ Adventure	▪ Abstract-stylized ▪ Multiple scenes	▪ Avatar anvigation ▪ 30-degree isometric perspective ▪ Use of Avatar ▪ VR ▪ Open branching enacted narrative	▪ Walking and exploring space ▪ Manipulation of the game objects ▪ Move, rotate, take actions
BLOCK'HOOD	▪ Architecture and urban construction ▪ Simulation game	▪ Stylized and iconographic; ▪ Pixelated image; ▪ Transformable background	▪ Axonometric view; ▪ Ecological design ▪ Evocative narrative ▪ Emergent narrative	▪ Manipulate the world; ▪ Responsive to game inputs ▪ Simulation; ▪ real time interaction; ▪ management of data; ▪ strategic thinking
MINECRAFT	▪ first-person sandbox video game ▪ Construction game ▪ Open–end game	▪ pixelated texturing blocks, ▪ Material simulation / resemblance ▪ First person	▪ a first-person perspective ▪ Open ended narrative ▪ Emergent narrative ▪ Various play	▪ Walking, gazing and exploring space ▪ Manipulate the world ▪ Converse and communicate

		perspective	modes: surviving; creative	▪ Collaboration and exchange of work in real-time.
SIMCITY	▪ city-building, ▪ open-end game ▪ construction game ▪ sandbox game	▪ close to realistic representation ▪ real world simulation: visual characteristics and dynamic features like building parameters, traffic jams, etc.	▪ a god-like view (or birds-eye view ▪ storyline is partially free ▪ Gaze ▪ Explore ▪ Transform ▪ Textual messages ▪ Cut-scene	▪ Manipulate ▪ Simulation ▪ Game progress cause player reaction to computer outputs ▪ Communication and interaction between players ▪ management of data;
CITIES IN MOTION	▪ 3D simulation game	▪ realistic traffic flow ▪ highly realistic cities maps ▪ Traffic simulation	▪ a god-like view ▪ Gaze ▪ Transform	▪ management of data decision-making, simulation ▪ manipulation ▪ construction
POKEMON GO	▪ a location-based augmented reality online videogame	▪ Real world and stylized characters.	▪ AR ▪ Gaze ▪ Explore	▪ Movement, select objects ▪ manipulate real world
INTERIOR DESIGN	▪ Simulation game	▪ Highly realistic or slightly stylized representation ’s ▪ Multiple perspective exploration ▪ Lack of narrative	▪ First person view ▪ Gaze ▪ Transform	▪ Manipulate space; simulation of real environment; ▪ AR, XR ▪ Changing options of items inserted in the environment
WORLD OF WARCRAFT	▪ a multiplayer online role-playing game (MMORPG)	▪ Stylized representation	▪ Axonometric on Avatar representation ▪ Gaze, ▪ Explore, ▪ Transfroms ▪ In game artefacts ▪ Cut scenes	▪ Player versus Environment, Player versus Player ▪ Exploration and gaze of the game world. ▪ Collaboration ▪ Negotiation ▪ Strategic thinking/ acting ▪ Social **networks**

Table 7 Analysed of a series of video games based on game genre, representation features, design experience and interactivity. (source: authors)

5.9 CONCLUSION

The above selected video games have a pronounced ludological character, with the narrative as a background or with an open-end narrative. Each of them has different visualization stiles, and experiences of space and different type of gameplay or interaction. Nevertheless, both of them in some aspects are related to aspects of architecture and urban planning.

In terms of representation, architecture in the virtual environment compared to the real architecture can develop multiple modes of visualization, expanding the limits of traditions representation of architecture using game digital tools with includes highly sophisticated graphic representation but also kinetics character and auditee characteristics.

Considering the story and the way it is experienced through space, this video games offer variety of navigation and interaction modes. Navigation modes vary from 360-degree gaze, to first person navigation to the possibility of multiple perspective, up to bird eye view which allows to explore virtual environment prom multiple perspectives not possible in the real world. Narrative is usually free or open and its defined by the player. In some examples, game space evokes a certain kind of narrative. Regarding interaction modes, they offer not only the possibility to gaze, navigate and simulate the 3D environment, but also to manipulate it, to build or destroy or transform it in real time, to manage different data and components constituting it and also to create social networks of collaboration / discussion / dialogue / exchange / negotiation.

These aspects relate to architectural representation and experience, as well as the architectural design process and collaborative urban planning. Experimentation with the employment of game design tools has accelerated in recent years, notably as a result of covid-19, and has now expanded to cover the field of virtual heritage. Especially in Albanian context, where experimenting in architectural and urban design processes appears to be particularly challenging when faced with current lack of human capacities and a lack of funding, in the heritage field these experimentations are more likely to be possible.

CHAPTER 6 - GAME DESIGN TOOLS

6.1 AUDIO-VISUAL REPRESENTATIONAL TOOLS

Visual style

As a visual medium, video games rely primarily on visuals and representation. Quality and style of representation are significant aspects of the story. A good appearance may help to improve the player's experience and immerse them in the game world. Pixelated "Minecraft" has a different style compared to the colorful "Townscape" and “Call of Duty's” war scenario. Thus, completely distinct sceneries and story worlds emerge. "Minecraft" has an abstract visual design based on blocks (akin to the classic Tetris game) that are part of gameplay with modular construction aspects. Despite having similar gameplay, "Townscaper" features a colorful and stylized cartoonish style that is linked to the romantic notion of the townscape. On the other side, "Call for Duty" was given a photorealistic graphics style that succeeds in immersing the player in the most realistic war game.

Figure 113 Representation style of Minecraft, Townscape and Call of Duty video games (snapshots).

Because it is intimately tied to the game plot and acts as a bridge to better grasp it, the visual style in video games plays a significant part in communication. As a result, a game designer's choice of visual style will have an impact on the sort of game he designs. Visual components are a nonverbal way of communicating story and meaning, and they're employed to provide the player a background information on the story that he may understand by noticing visual characteristics. Virtual space's aesthetic design has the ability to support narrative. Similarly, to the cinematic media, a video game location that the player is required to visit narrates the story to the user without text or dialogue, rather by interpreting images Furthermore, according to Brown and Cairns (2004), if the audio-visual representation of virtual environment is artistic, the player can be immersed in virtual reality. It depends not only on the audio-visual quality, but also on the artistic idea and creativity, as well as the arrangement of objects in the VR environment, lighting, textures, characters, and objects that make up

the game world. In this way, the improved quality of representation made possible by technology in recent years may help artists develop and better portray their ideas.

In fact, as computer graphics evolve, virtual space in video game has become more detailed and, in many cases, more realistic. In reference to the visual style, what is important is that the artwork is eye-catching and contribute to impress user and to arouse its interest, so that the user can fully immerse and feel the presence in the virtual space. In the realm of video game representation different visual styles can be employed.

According to game scholar Aki Järvinen (2008) there are three categories of graphical style that have dominated game industry for years:

1. Realism or photorealistic style.
2. Caricaturism or stylized
3. Abstract style or abstractionism.

Realism

Realistic depiction has been used extensively in several creative forms, including architecture. It was often utilized in art until the eighteenth century to authentically depict reality. Realistic visualizations have been increasingly popular in architecture in recent decades, not only to communicate with clients and to exhibit architecture and details, but also to visualize the impact of buildings in real-world settings.

Since their creation, video games have strived to portray the game world as closely as possible to the actual world. In the game environment, realistic representation implies accurate proportions, scaling, physics, and precise portrayal of surfaces and materials. Because the quality of graphical representation is determined by technical innovation and computer performance, it has only been feasible in recent decades to add more and more details to the game world and obtain a deeper level of realism thanks to technological advancements. The amount of polygons, texture, lighting, and animation are four primary components of realism in video games (Guide to Realistic Game Art, 2015), all of which are a direct result of advanced technologies.

Most modern 3D video games employ the rasterization approach, however in order to generate highly realistic or photorealistic settings, the game industry has lately shifted to the ray tracing technique, which necessitates the use of increasingly powerful computer processors. From a technical standpoint, realism necessitates technological innovation and high-performance devices in areas such as highly detailed environment representation or factual representations (by employing photogrammetry, which records detailed information about objects), as well as character mechanics, object dynamics, and decision-making. In this view, realism is multifaceted, including the following subcategories:

1. Representational realism related to the characters, objects and environments emulated from the real world and; it includes details, textures, ambient lighting, atmosphere, weather elements, sounds, wind effects etc.
2. Behavioral realism relates to actions, motions, dynamics, and behavior simulated based on real life.

Representational realism includes graphics (texture, light, dynamics of the virtually build environments sound and physics simulation. Behavioral realism is concerned with the player's interactions with the game world and the consequences of those interactions. Both of these aspects are linked to simulation and artificial intelligence.

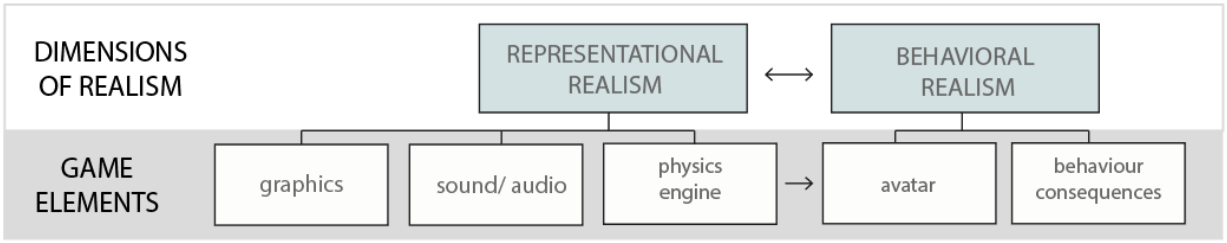


Figure 114 Dimensions of realism and game elements

Since video games are not static 3d word representations, the mechanics of action and objects dynamics (including ambient simulation are very important as they mirror actions and dynamics of the real world. By doing so, they import animated details of the real-word (character expressions, character movements such as walking, combating, running, hunting, etc. in the game world. In action game genre's players prefer realistic representation that replicate actions or objects motion in the real world using simulation techniques (ex. Flight simulation; hunting challenge in *Red Dead Redemption, etc.*

Figure 115 Representational phases of characters visual realism

Figure 116 Behavioral realismin Kingdom Come: Deliverance (2018); and in Red Dead Redemption (2018)

Authenticity and illusory realism

Video games' realism Despite the fact that it is not always employed literally, it is an important tool that allows the player to be immersed in the world view. To raise the degree of reliability, several video game genres, such as third-person adventure games, simulations, racing games, sports games, and so on, require very realistic representations. They show a direct correspondence between the actual world and the virtual world of video games. This indicates that the virtual environment is authentic and faithful to the real world. Authenticity is defined as the capacity to convey the impression of being real. According to Shapiro et al. (2006), this impression may be generated not just by including video game design, a realistic atmosphere, and mechanics, but also by incorporating ordinary activities or objects. As a result, while the overall image of the game world may not always be accurate, these features might help to create the illusion of realism. This is most commonly seen in sports, when the game designer gives a real-world setting for certain sports activity. In the case of science fiction videogames representation is illusory. However, in sci-fi videogames, realism is used to depict the actual world or to portray the illusory reality, which must be extremely realistic in order to be credible.

Illusory realism is most commonly encountered in the illusionistic fantasy or science fiction gaming genres. Semi-realism (or stylized realism) is a style that combines realism with a caricaturist style based on cartoon design and photorealistic graphics. Idealized people, items, sceneries, and the game's overall setting can all be included in a cartoon or stylized design. The game world's objects and characters are portrayed with realistic material, texture, and lighting.

Stylized representation

Stylized video games graphics are a very popular style in video game and provide an alternative to realistic representation. Stylized graphics are based on caricatures or cartoon artistic style through which

the essence of a person or an object is presented by exaggerating its most prominent features. Characters and environment are designed with fewer details, but considering essential the graphic components such as the form, shape, lines, patterns and color palette and overall composition, through with its represented artistically. Usually, stylized games are unrealistic or semi-abstract, and belong mostly to the sphere of fantasy which works well in most of game genre and audience.

Figure 117 Authenticity in video game Fifa; 2. Semi-realism in video game Final Fantasy XIII-2

Figure 118 Stylized realism representation vs stylized representation in Super Mario

Technically, stylized representation is less demanding in terms of computational processing compared to realistic representations, and fits well in less powerful devices. Moreover, stylized graphics, offering a simpler and stylized interface permit to focus on game aim either gameplay or permit the player to follow the game narrative. However, with the allowance of technology, today stylized game is becoming more and more realistic in visual qualitative terms, although these reality does not belong to our world.

In this regard stylized representation can offer a spectrum from minimal to over exaggerated stylization. Minimalistic stylization is based on conveying video game characters and environment a role and function through few details based mostly on color and larger shapes or silhouettes. On a contrary, highly detailed stylization focuses on larger detail. Objects or characters shape is exaggerated, and very few details are putted into evidence.

In *Ratchet and Clank* video game characters and environment are over stylized while in *Firewatch or Yourney (2012)* there are very few details and main contour shapes.

Minimal stylization by Thiago Klafke vs over exaggerated stylization in Journey (2012)

In video game design, 3D stylized representation can be divided in 3 sub-categories: cel-shading, cartoon and semi-realistic.

Cel-shading

Cel-shadingis a 3D technique that cast shadow to 3d objects and make them appear flat as hand-drawn by using a single shading color instead of a gradient. This technique is appropriate for exaggerated cartoon style representations. Successful game that utilized cel-shading in stylized representation is *"The Legend of Zelda: Wind* Waker", "*Jet Set Radio*". Nevertheless, with today graphical standards, this technique is not very common.

3D Cartoon graphics

Cartoon graphics are exaggerated comics of game characters and environments rendered in 3D. They are made of more polygons, complex shapes, textures, shadows and offer a more realistic image compared to cel-shading technique. Super Mario 64, the first Mario game in 3D, has been one of the most influential game in terms of 3D representation style. It set the standard for character design in 3D.

Abstract style

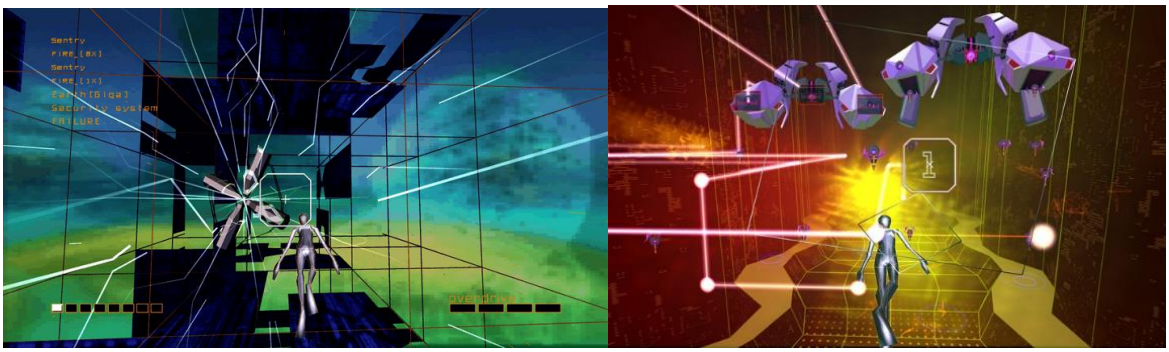
Abstract style focuses on basic elements, colors and shapes that produce pure forms instead of a detailed realistic design. Abstractionism does not reproduce the existing visual reality, nor stimulate the recognition of living places and characters. It is based on free-forms and is related to a more visceral experience. Therefore, is not very suitable for videogames that contain a narrative. In fact, only videogames based purely in gameplay that lack narrative can be highly abstract.

In the '70, the majority of games were minimalistic and abstract, because of limited technology in image processing. Tetris was one of the most famous games with an abstract style. Two decades later

technology allowed more detailed representations. However abstract style continued to be used as an artistic choice instead of mere technical default (Wolf, 2004.

In the recent history of games, as graphics have significantly improved, abstract video games are not being commonly produced any more, as narrative aspects are becoming more and more important at the equal to ludic aspects. Players need to move and explore a familiar environment, recognize objects, characters, and environment, through which game narration is materialized. Today there are very few purely abstract games.

Rez (PS2 and Dreamcast, Sega 2001 is an example of an abstract musical rail shooter game. The game was inspired by abstract painting of Kandinsky and is built on abstract lines and shapes. Its gameplay is based on a hacker who navigate in virtual space inside the computer, shooting enemies and computer viruses. Virtual space is made of lines, shapes, neon colors, vibration, beats, rhythm, etc. which create a multi-sensory experience. Game world is represented with wireframe forms, but many effects and explosions of particels, colors and light appear when enemies come close together with sound effects.



Abstract representation of Rez (2001 video game

Rezis based on traditional shooting game, which take place in an abstract digital landscape. Moreover, it presents n responsive audio which creates an innovative soundscape that fully immerse the player in a unitary sensation. For example, when you shoot enemies they produce a sound, which becomes more complex when you shoot multiple enemies.

Herein, Rez video game does not aim to reproduce real architectural space, but to create a dramatic sensation of space in virtual reality.

Accuracy

Visual elements in game space depend on the type and purpose of the game and in many casesrepresentationneeds to be accurate in order to have the power to immerse the viewer. Accuracyrefer to the degree of fidelity compared to absolute and in video games is related to texture, objects or characters proportions, motility of characters or physics dynamic, as well as natural

phenomena such as time, day-night, light, weather, etc. Accuracy means usually a detailed representation.

Accuracy is particularly important in historical and educational games. They include both historical characters and setting. *The Assassins Creed Series* is a classic example of accuracy representation in video game. In this game, players are taken to significant historical periods and locations worldwide, recreating the historical political, familiar and social atmosphere. In the game world are described also historical characters, ordinary people with their characteristic and role in society, historical buildings, artefacts such as weapons, costumes, crafts, vintage objects, raw materials etc., Moreover, the game offers a large database of information which can be useful to educate the player on the historic period he is experiencing. However, for the sake of gameplay and game narrative not everything in this videogame is historically accurate and entirely faithful to the historical period. Many fictional and imaginative elements (like magical, monsters, mythological creatures etc. are introduced in order to make the game more appetizing and attractive.

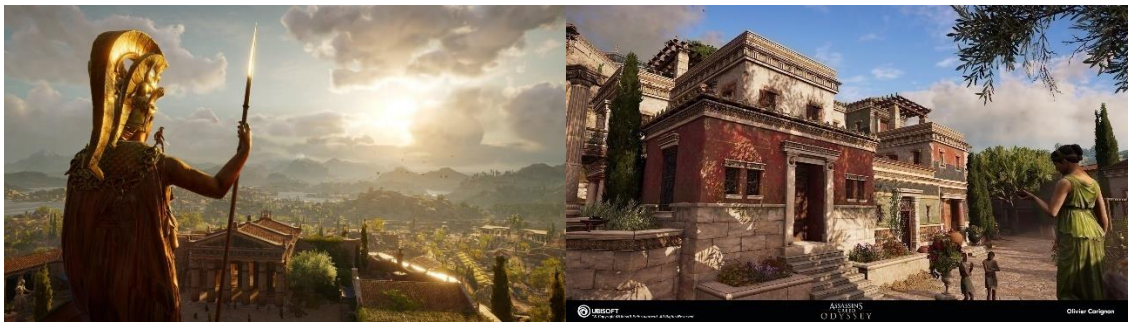


Figure 119 Snapshot from The Assassins Creed Series, accuracy in historical representations of historical buildings, characters, costumes and other artefacts

Figure 120 Cut-scene from "Valiant Hearts: The Great War" (2014), stylized representation of historical soldier and gods used during the war; Snapshot from "Valiant Hearts: The Great War" (2014) facts section, which show details about war dogs.

Another video game which have a high degree of historical accuracy is "Valiant *Hearts: The Great War"* (2014) puzzle adventure game. Its aim is to teach players about the First war world history through

the use of puzzle solving gameplay learning method. The story is set during the first world war, and is based on one side on a high level of simplified stylized representation of environment, characters and events, nevertheless highly accurate which makes it more attractive to young audience, and on the other side specific menus contain historical facts and objects described with high historical accuracy. Factual tangible and intangible historical content based on photographs and textual means of manifestation are unlocked across gameplay, and the player can learn about them getting through the game narrative. Each time player solves a puzzle, he is rewarded by the appearance of a fact sheet. Artifacts can be collected along the gameplay, which hereafter display detailed image and description. All artefacts and other contents represented in the fact sheets or displayed along the game world are real objects of that time, (ex. cloths are detailed representations of the war period fashion or real events. In this game history is taught based on specific facts.

In video games, absolute accuracy does not exist since it interferes with gameplay and game space experience. In this sense accuracy is a balancing act and it can be presented in different forms and content intertwined with gameplay and narrative.

Audio Accuracy

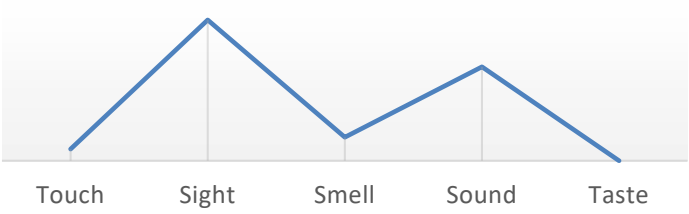
Audio is an important tool to add realism to video games although it does not have the same weight as graphics. It is related to environment perception and through audio game experience can be enhanced. It carries emotional content and can serve therefore to trigger feelings that describe game narrative in a more realistic way. Different type of audio (noise, ambience and domestic, sounds, music, machines, mechanical, speech, voices, human sound and sound effects upon interaction with objects, interfaces, contribute to immerse in the game word and make it closer to real world feeling. Its highly important the accuracy of audio in game environment as it must fit game narrative.

Noise, ambience, domestic sounds, interface sound, as well as music carries an emotional aspect relate to game story or gameplay reactions. They cover a large typology of feelings like sadness, happiness, courage, warning, alert etc. Machines and mechanical audio effects enhance fidelity in real world objects representation. Speeches, voices and dialogue between human-like characters in the game world used to entertain player or to give him gameplay information contribute in real world resemblance. Moreover, sound is related to game feedbacks.

In conclusion audio accuracy is mostly a reaction of objects, environment and story rather than provoke interaction from player's side. It is becoming a more and more important element in game design on which designers are investing a high percentage of the budget.

Audio – Visual fidelity

In video game space, players have a sensation of being present. According to Brown & Cairns (2004), in order to completely immerse themselves in the environment, players must identify with the character or avatar being played and navigate using their own senses, directed by the avatar. This necessitates sensory fidelity, which is defined as a multimodal experience in virtual space that closely resembles how you feel in real life. It is mostly accomplished by the use of audiovisual components such as music, texture, and light. Sight and sound are the two senses that have the most impact on a video game's sensory experience.



Graph 1 Five senses impact in video games

In this regard, McMahan (2003) sustain that fully immersion in game world is achieved by replacing sensory information from the real world with audio-visual tools that create the same effect and make the visual space more interactive. Virtual world sensory experience need to be closer to real experience or at least believable to be the same (Ermi, Mäyrä, 2005). The level of believability is directly related to the level of immersion. In addition, characters body image and movement sustain that player should identify a certain character because of kinesthetic-visual matching. Hence player must find out similarities of image, action, movement stimuli. In this sense, sensory fidelity must reflect not only objects and environment including their physics, and but also a psychological fidelity.

Objects and environment fidelity is related to graphic and additive aspects of the real world. Objects physics and characters motion fidelity refers to the way simulation mimics the actions of objects and environment. Psychological fidelity is related to the way the program simulates the real-world situation.

6.2 DESIGN EXPERIENCE TOOLS OR NARRATIVE TOOLS

In-game Artifacts

Stories can be told in different ways. In-game artifacts are objects that can be incorporated in game space and serve to deepen the story and advance narrative. Artefacts can have story related contend and but can also serve to move the play. In- game artifacts depending on the purpose can be functional

and non-functional. They also have different nature of content and presentation form in the game world: text, documents, recordings, objects etc. Player is not obliged to deal with them, but in case they want to deepen narrative or extend it they can collect and use this artifacts, or just by perceiving them, in some cases they can gain more information on the story.

- Functional artefacts

The functional artifacts are object used to enhancing game play by attributing rewards to the player. According to Bartle (1996), achievers expect to gain rewards as they rise in levels. Achievers claim artifacts as they precede the game in order to acknowledge game progression and set up their interest. In some cases, they can serve to upgrade player's game performance and avatars skills. In "Middle-Earth: Shadow of Mordor" (2014) video game, players reward artefacts which enhance its attributes and performance. Similarly, in The Last of Us (2013, artifacts can be used to upgrade weapons performance.

- Non-functional artefacts

Non-functional artefacts are mostly related to the story. They hold information that can offer players the pleasure to explore and give him motivation. According to Bartle (1996), explorer players want to find out what the game world can offer while interacting with the world. In "Uncharted: Drakes Fortune" (2007) player collect hidden treasures as artefacts. In Assassin's Creed (2007) player collect flags to show the advancement in the game world. "Flags" are artifact which can be found in various locations of the game world. They do not give player any reward.

Figure 121 Functional in-game artefacts in Middle-Earth: Shadow of Mordor" (2014)

Figure 122 Flag as non-functional artefact in Assassin's Creed (2007)

Supporting Text

Ordinary textual narration is the most simples and easiest form of narration for video games, where player is seen as a reader. Text (or codex text (Aarseth, E J. 1997) contains information that can contribute in unfolding narration. It can be presented as static or dynamic in the video game interface,

but lacking hyper textual linkages. Text can be incorporated in different categories of games and as single components of certain scene:

1. Text can be used in narration-based games with a low budget which does not permit environmental story-telling due to graphics high costs.
2. Text based artefacts such as letters, files, messages, newspapers, diaries etc. However, they can be occasionally used, because player can be disturbed by reading extended text material. Text is usually used as an extension of the story, not as the presentation main storyline.
3. Some games use **text as subtitle or as form of conversation** for artistic reasons, instead of recorded dialog, such as The Legend of Zelda. Game designers and producers refuse to use recorded voice, even though it is technologically possible, in order to maintain a naïve tone of the game and not restrain player's imagination. Kind World (2019) video game player is based on the exchange of letters with other players around the world. Game narrative as defined by game designer is limited, and it open to user interaction.

Figure 123 Letter exchange in Kind World (2019)

Figure 124 Text as subtitle/ dialog transcription in The Legend of Zelda

Components of story world (characters, weapons, vehicles)

Digital characters, weapons, vehicles, etc. gives the players opportunity to play the game in their own way. For example, adding different kind of weapons in a game gives the player the opportunity to select the weapons of their own choice, which motivates them playing game repeatedly. All the components which are in a game should define properly their roles and purpose of existence. Meaningless components that have no purpose in a game play should be avoided as much as possible.

Cut Scenes

Cut scene is a narration tool borrowed from cinematic and largely used in video game design. It's a short intermission of cinematographic space in video games that suspend player action and introduce him in

the film world, realizing hi from action. Different scholars (Hanckock, 2002; Salen, Zimmermann, 2004) sustain that cut scenes serve to specify gameplay functions, give information to the player and orient him for upcoming events. In many cases they present instruction on game rules, goals and awards. These are presented to the player after performing important tasks, actions or after having accomplished rewards. In other cases, they are set in branching points to deliver essential information to proceed the game. Today most of video game developers create visual interruptions between game levels or sections and introduce cinematics. In Cinematic cut-scenes, camera movement is similar to film techniques and is camera movement assumes and expressive role. Moreover, editing techniques enable the viewer to perceive imagined space made of characters and stories.

In this view, these selected sequence of events (or cinematic spaces convey the plot and contribute to structure the story quickly and in a better way, by interrupting game continuity. This was appointed by theorist J. Majewsky (2003), who sustain that cut-scene interrupt playability and players control on game. They constitute a parallel space which is not accessible to the player.

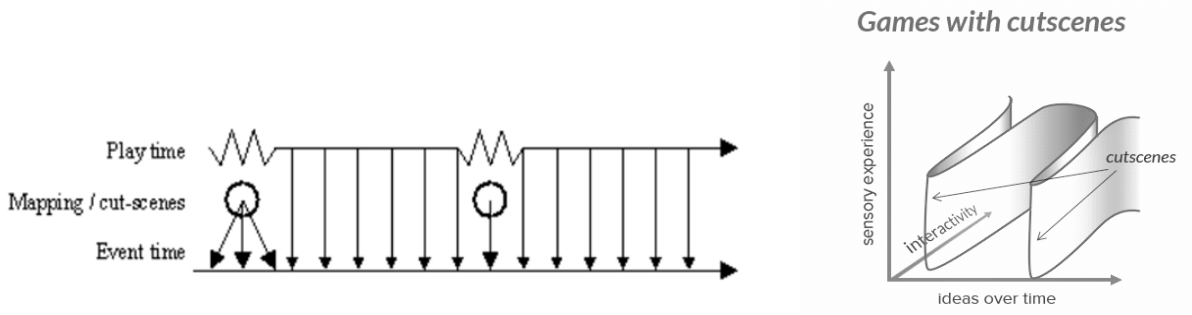


Figure 125 Scheme of cut-scene application in video games (source: Juul, 2004)

As regarding representation, cut scenes in order to be distinguishable, compared to the game flow should use different graphics and visual perspectives. They can be classified based on their quality compared to game environment.

- Cut-scene with similar quality of graphics as the first video games.
- Cut-scene with better quality of graphics or pre-rendered/ visual realistic cut-scene, (Final Fantasy VII, 1997)
- Cut scene in Full Motion Videos (filmed Movie)

In the recent decades, with advanced computer graphics, cut-scene visual quality has improved considerably and present a visual continuity with the gameplay, with reduced costs, as they use the same computer graphics and don't need additional graphics. Video game "Heavy Rain" (2010) is played in real-time graphics and is based on 3D real-time navigation. Similarly, cut-scenes are played in real time and

blended with game graphics. Now, this has become the standard for video games. Developers are leaning to use cinematic storytelling techniques that merge film and game.

Cut scene recently are becoming essential and are growing in number within the same game. Many micro-cut-scenes are introduced along the play, so that the player slightly stumble while playing, but regains control of the game play quickly. They need to preserve a characteristic rhythm in order to be always expected from player side. Moreover, in the last decade there is a tendency to introduce action in cut scenes and make them more interactive. Game developers have introduced "quick time events", in which the player can decide the way a certain scene unfolds.

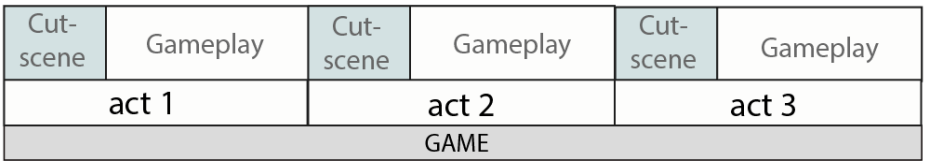


Figure 126 Integration of cut-scenes with gameplay in video games development.

According to Jenkins, cut scene have an important role in supporting narrative meaning. In contrast Paul Cheng (2007) sustain that cut-scene have contributed in defining video games as a trans-medial narrative category. In the focal points defined by cut scenes, designers create a unique expression that trigger tension, because of the interruption of playing activity and a passive watching of cinematics. In this sense as argues by Cheng (2007), cut-scenes contribute to frame narrative in a creative way, similarly as in movies and offer interesting shots. However, the main role of cut-scenes is not primarily on plot definition, but to contextualize events in view of this particular genre. In conclusion, cut-scenes in video games are a unique form of narrative framing which expand the possibility of artistic expression.

Scripted Events

Scripted events in video game are created by game designer as part of a scenario in which they define a series of things that will happen while playing such as determining when and where game elements can appear in order to trigger player's attention and make them act. Scripted events are defined by game designer and player has no control on them. The different events are used in specific points in the game to move the story and the game play forward. By causing players different type of emotions such as frightens or surprises, or moving objects in the screen, they involve and make them continue the game play or the exploration of the game world. On a contrary to cut-scene, a scripted event doesn't interrupt game play. Thus, players are free to act and continue playing.

Character Dialogue

Character dialog is another tool used in video game to convey story, to communicate game rules, or to set information about quests player will face or to collaborate with other players. Dialogues can be presented to the player either with text or voice-over. Dialogue can be used directly from characters (players or non-players or through cut-scenes along the game. Dialogue can be performed in different ways from the simplest form of option and choice to the ore complex branching dialogue.

- Simple Choice. The first form of dialogue provides player with options which player has to select.
- Linear Dialogue. This is the simplest form of interactive dialogue, usually with NPC who respond with a scripted dialogue from his side. It is a linear bidirectional dialogue and it is limited in the field of response and quantity of information revealed and consequently the player does not always have choice. Nevertheless, although it is not highly interactive, it is easy and simple to be implemented. Linear dialogue can happen also between two NPC advancing the story flow.
- Branching Dialogue. This is a more advanced dialogue tool. It offers tree options and therefore provides the possibility for more in depth information. Players acknowledge additional information by selecting step by step a set of option. Tree dialogue structures are more interactive and give the player the feeling of action.

Dialogue is usually a game to player communication or a player to player communication. Technically this can happen through option choose, chat or voice over.

Game play spatial patterns

The basic propriety of video game is spatiality (Murray 1997). Video game space is a virtual, navigable space which the player is invited to exploration and where game activities take place. It is an essential element of the virtual environment. In video games, space does not have a material dimension, although it's a space build in 3D. Similarly, to the real space of architecture game space is defined by objects and their reciprocal relationship and rules. Moreover, video games create space (virtual environments to navigate, explore, and manipulate for the sake of the game or in the perspective of storytelling. In this sense space is structured into stages or levels which are explored step by step as player progress through the game world. Hence game space is revealed in its shape while player move within it.

Narrative shape game space influence player's engagement. King and Krzywinska (2003) classify games in relation to the dimension of game space exploration, highlighting three spatial configurations related to player's **degree of freedom to perform movement** along X, Y and Z axes.

- One-Dimensional,
- Two-Dimensional,
- Three-Dimensional game play

In Architecture this kind of exploration is possible only in the virtual word.

Player movement in 3D space.

3d Space gameplay can be one, two, or three dimensional, which means that player can move within these constrains.

Figure 127 One, two and three dimensional space patterns indicating the level of constrains in space movement.

One-Dimensional gameplay in 3D space.

One-Dimensional gameplay space scroll in one direction. Typical examples are race video games such as Gran Turismo 7(2021, which have a focused point of view of the player. Players moves along a rail or track represented through a 2D map which is shown to him continuously as navigation bar in the screen. It is used to facilitate players orientation and to show him its real time location.

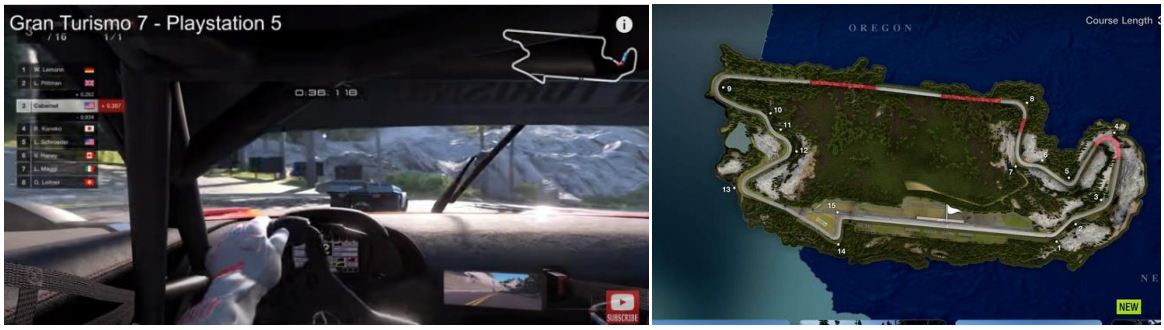


Figure 128 One dimentional play in Gran Turismo 7 (2021). View from avatar and map of the path in which player navigates.

Two-Dimensional game play in 3D space

Player moves at least in two directions within the 3D real time environment. This spatial configuration is typical in first-person shooter game genre such as Myst III: Exile (2001, Wolfenstein (2009). In this games player can move back and forth and right and left shooting enemies, which do similar movements in the 3D space. In this type of game configuration movement is bidirectional.

Figure 129 Bi-dimensional movement in Wolfenstein (2009) : snapshot from game and map of game space

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Three-Dimensional gameplay *in 3D space*

When the cardinality of the game world and game play are both in 3 orthogonal axes player have freedom of movement and action in three directions. They can walk, jump in vertical, look around in every direction and in some cases depending on the game, even fly.

Figure 130 3-dimentional gameplay in Final Fantasy and Elder scrolls: Oblivion (2009)

Topological models of game space organization

According to Squire and Jenkins game space is organized in the way that player is guided in the game world, to meet game challenges, keep player engaged in the game world and make the story unfold beforehand. Therefore, gam*e space* depends on the narrative structure. It can be perceived as a mental map in which the player traces relationships between his location and the surrounding pattern and can include also significant features that mark important locations. In this regard game space is similar to architectonic and urban space as read by Kevin Lynch (1960), in which there are always some hints to orientation and wayfinding. According to Nitsche (2008), game space can be classified based on the layout in three basic models of game space: **rail and track; labyrinth and maze and playground or arena space.**

- **Linear or rail and track space**. Linear space is the simplest of video game space based on an axial development, along which the player is guided.
- **Labyrinth or maze space**. Labyrinth and maze space are metaphor of spaces difficult to traverse, with meandering paths. The lack of visual hints in these models of space create confusion and disorientation and make user hard to get out toward exit point. Nevertheless, there are forms of labyrinth which trigger interest such as maze, which is more open to be traversed and discovered in different ways compared to single path labyrinth and *rhizomatic* structures based on branching paths which are more dynamic. Linear labyrinths are mostly considered as tour space while complex labyrinth created mapped spaces. In both cases player's movement is restrained within certain limits. In a complex maze, moreover, movement in space is constrained within certain limits as the space present different barriers and there is limited visibility of the player. It makes it difficult to be understood so in many cases labyrinth spaces present orientation maps. Otherwise they must have few orientation points as part of the chaotic structure through which the memorizing the path.

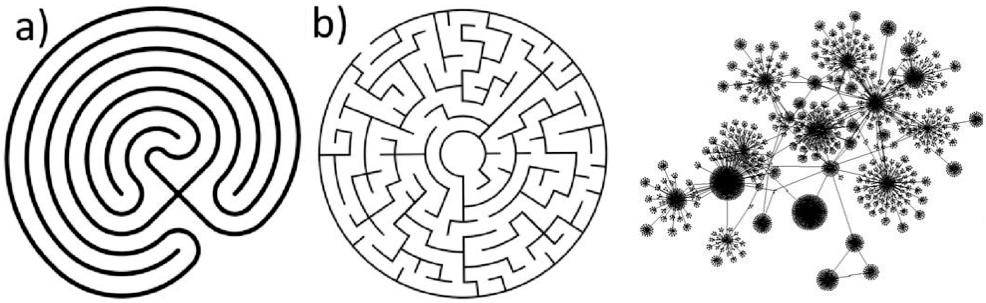


Figure 131Friedrich von Borries, Steffen P. Walz, Matthias Böttger, (2007) Space Time Play Computer Games, Architecture and Urbanis 7 Birkhäuser Verlag AG

- **Playground/ Arena space**. Playground space or arena is an open space defined by free narrative, where clues are not important since the space is free to be explored and has high visibility. It is usually used in case of battles, football games etc. Arena space due to its high visibility is less explorative space, as it does not trigger surprise and the desire to discover it.

Schell and Adams (2009) detailed these models in other specific spatial layouts: a **linear model, grid, web, divided space and points in space**. Models defined by Schnell are the following:

- Linear model is based on the same concept of Nitsche's "rail and track" model of game space, in which the player moves along one corridor and follows a fixed sequence of events, with no possibility of branching. (ex. "Candyland", "Super Mario Bros". However, this does not mean that space is arranged in one direction, but only that it is limited in terms of choice.

Adams (2009 proposed also a parallel layout model and a ring or loop layout as a variant of the linear model. The Parallel linear model enables the possibility to switch from one line to the other, in parallel tracks, while in the ring model the starting point returns to the ending point forming a loop and in some cases include the possibility of parallel shortcuts.

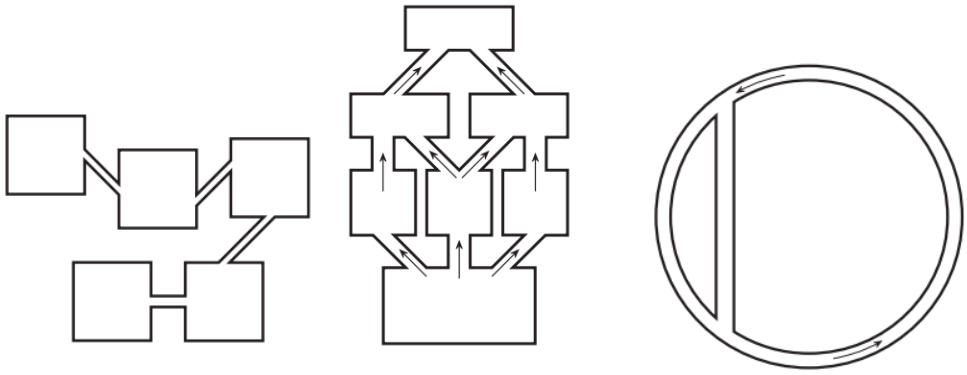


Figure 132 Linear, parallel and ring layout of game space (Adams, 2009, p.366)

- Grid model is commonly arranged within a discrete space and movement depends on space shapes. (ex. Chess)
- Web or network model is based on the possibility multiple movement on different points on map forming itineraries from one space to the other. This model gives the player the possibility to choose the path to take, so the sequence of events is not fixing. This mean that the story should take into account any sequence of events enabled by the space structure.
- A combination model is based on the use of two or more models (for example the linear and the network model. In this case, the model is based on a hierarchy and layered space organization and the player can explore a certain space and then move on a different level of space.

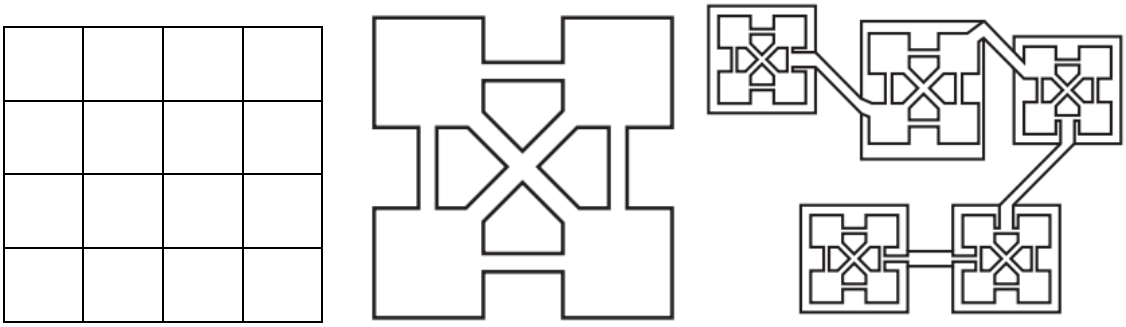


Figure 133 Grid, Network and Combined layout of game space (Adams, 2009, p.366)

- A hub-and-spoke layout is based on a central space in which the player feels in a comfort zone, and additional spaces in which he gets out to explore, which not always are accessible from the beginning of the game.

This layout gives the player some choice about where he goes, which many players appreciate. You need not offer the player access to all the spokes at the beginning of the level; to make sure that the player doesn't try the harder challenges too soon, you can lock off some areas until the player tries the easier challenges available in other spokes. Note that if you unlock the spokes only one at a time, you effectively change the hub-and-spoke layout into a linear layout.

- Divide space models are separated spaces or replication game spaces.
- Point space. Space is seldom represented in points, but Final Fantasy (Square, Nintendo, 1987-2018 uses this arrangement.
- An open model is representing the environment in which the player is free to navigate and experience.

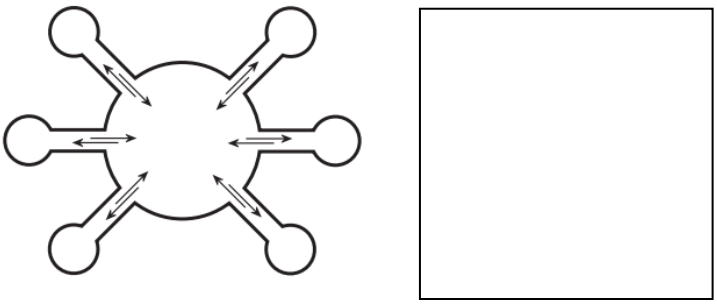


Figure 134 A hub-and-spoke, Network and open layout of game space (Adams, 2009, p.366; Schell ,2020)

In video game these models are part of level design.

Game space dimensions

- **Discrete and continuous space**

Game space can also classify based on the limits of space in **discrete or continuous space**. In discrete space, movement and action take place in specific positions in space and the space itself is limited while in continuous space action is freer and occurs everywhere. Continuous space is larger and offer the possibility for exploration.

- **Static and dynamic space**

According to Aarseth (2003), space in video game can be classified according to the possibility of transformation to static and dynamic space. The first remains unchangeable (Ex. "Chess") and actions happen in one viewpoint, while the second is subject to player's manipulation (Ex. "Minecraft", "Sim

City", "Battlefield"). "Minecraft" and "Sim City" as construction games, offer the possibility to the player do build objects based specific tools offered by the game or to build a city and its infrastructure, while in Battlefield, player destroys environmental elements such as walls, buildings, fences etc. Space is dynamic and is subject to constant change.

Figure 135 Dynamic space : build in Minecraft and destroy in Battlefield

Perspectives of navigation

Game space is experienced and understood through player's movement and the perspectives of navigation. The perspective of navigation and the experience gained in the game world contribute in shaping space. It defines the vantage point in which actions and events are experienced in a disjoined way. In videogames there are different perspective of navigation, depending on the game type and the effect produced to the player. The following view perspectives refer to 3-dimensional space.

1. **God view perspective.** This perspective of navigation sees the player as an all-seeing force in the game world. It is usually used in simulation and management games like SIMCITY, Cities in motion, strategy games like Civilization, Black and White or puzzle games with static environment such as Chess or Tetris. In these type of game space, player do not act directly as an avatar, but as a force that control and act on multiple levels. This point of view, impossible in real life, offers a large perspective, being distant from the field of the game space. It has control over large space and data. Player look into the game space, but is not present in the field. This occurs also in partly system games, in which the player takes control of different characters at the same time. Player has an overview of the whole environment and is able to transform multiple things at the same time, understanding the impact on the whole. This approach is typically used in collaborative urban planning in which multiple actor need to have an overview of the city, impossible from personal first person perspective.
2. **First-person navigation.** In this case, the scene is shown through the first-person of the main player-character as he is walking. The scene is explored as in the real physical situation and show

the world from characters' perspective. Player controls the camera so he can change its relative position in the game space or its avatar and gaze on 360 degrees. It contributes in the sense of immersion as it is similar to the habitual perspective people are used to. Player tend to do limited actions related to his perspective of view and in comparison to god's view, he has not the potential to change and transform large part of the environment. Hence, this navigation perspective is used for Shooter, Action, and explorative Open-World games interacting only in first person within the surrounding environment.

3. **Third–Person Navigation.** Third-person perspective refers to the viewpoint of an avatar or gaming character that the user encounters on the screen, controls, and has a sense of belonging to. In this viewpoint is typically cinematic, with extensive cut scenes, and several characters participating in the game. This view point allows characters to have a wide range of movement options such as to flip, roll, kick, and other actions that are impossible to attempt in first-person.

6.3 DESIGN LUDIC SPACE

Rule space

The relevance and quality of video games is determined by the degree and modality of interaction with the game world. The sort of rules that govern interaction in the game world influence the nature of space. These rules often tend to make reference and simulate the real-world and reproduce similar events.

> "*A building or a town is given its character, essentially, by those events which keep on happening there most often*" Ch. Alexander observes (1979, 66).

Rule space and events triggered from them are important both for game developer and player. Developers must provide a challenge that can be mastered by honing the player's abilities and providing options for action. Players must be encouraged to conquer the obstacles imposed by the rules and to devise their own techniques and methods in order to take control of the virtual space. The environment in which we live is guided by agreements and dependencies between functional, physical, geographical, cultural, economic and social rules. Its designs is similar to the design of the game world, and takes into account simultaneously cultural, social and economical and other rules which sometime are also in conflict with each other.

According to game researcher Michael Nitsche (2008), there are five basic conceptual layers for analyzing game spaces: rule-based, mediated, fictional, play and social space.

Rule-based space, is a space defined by explicit mathematical rules such as physics, sounds, artificial intelligence, data etc. **M*ediated space*** or **representation space** refer to the way game space is presented in an audiovisual plane, using cinematic presentation techniques. The first two refer to the way space is represented. **F*ictional space***, on the other side is not a represented space as it exists only in the player's mind, or is imagined by player based on their understanding of available images. It is a conceived image in mind. **P*lay space***, is the way space is used. In this space come together player and game mechanics. ***Social space*** is characterized by social interaction, implying that the game space is influenced by several players interacting with each other. In this sense, it is considered as a space of representation, in which various actors or players can communicate and share their experience. Each layer of space has specific patterns of interaction which can be seen also in architectural terms separately.

Performative patterns

Videogames mimic real-world spatial use patterns. Games as spatial constructs are architectural (Espen Aarseth, Henry Jenkins and Bernadette Flynn). Because the relationship between architecture and games is reciprocal, the spatial conditions of architecture that are true for video games may also be understood in virtual reality architecture. Not only are videogames architectonic spaces to explore, but they are also performative mediums. Alexander Galloway (2006) emphasizes this character of video games:

"*…games are actions, enacted in a cybernetic relationship between the player and hardware*." (Galloway, 2006)

This feature of video games is part of gameplay, and is manifested through actions, reactions and interactions of player and game. In this sense, game space is tied to gameplay and can be interpreted only by the way it affects gameplay. Ulf Wilhelmsson, professor in game development, sustain that "*there is a strong relationship between where we play and what we play, that game environments constrict and afford what it is possible to do"*. The qualities of architecture and landscape dictate how the player can interact with them and what gameplay is possible. Similarly, based on Robert Venturi assertion referring to architecture that, *"the activities of people in cities and buildings can be seen as patterns*", it's evident the impact of user in the spatial patterns. The following type of patterns embedded in real space manifest as archetypes of spatial use in game space:

- **Challenge space** – Gameplay is offered by directly challenging the player through physical challenges. Playgrounds, road obstacles, ramps, and racetracks are examples of discrete units that are intentionally designed for physical challenge. Architecture is considered as an enemy or an opponent in challenge space. In subtler ways, challenge spaces are becoming increasingly prevalent in the everyday world. A city poses a variety of navigating challenges for which there

are several aiding tools, such as maps, street directories, and GPS devices. Similarly, in games, complex settings frequently provide the same sorts of aid, and maps are a common component. Many games include environmental challenges such as navigation and wayfinding. The player must negotiate and memorize spatial configurations due to several passageways, wide vistas, and intricate patterns.

- **Contested space** – Gameplay often creates an arena for conflict in game space. Contested space is an environment contested between different players or users. Contested spaces are completion spaces, battlefields, spaces of disputes, football fields etc. Some of them are highly regulated contests, formalized space based on precise rules, others present aggressive and informal conflict. Contested spaces appear in videogames on a variety of levels. Games present various type of contestations: contest for land, contests for resource control, where players compete for control of a limited number of resources required for gameplay, contest for the way to design. Contested space are part of architecture and urban planning design processes when dealing with decision making of multiple actors on the same space.
- **Nodal space** – Game space is governed by social layout, which adds structure and intelligibility to the game by imposing social patterns on the game environment. The nodal space is an event space in which are concentrated various activities. These spaces show a direct link between the activities we do perform in games without affecting the outcome of those activities. Nodal architecture has no direct influence on gameplay, but it can define activity boundaries, making gaming more location-specific. Specialization of activity through architecture and landscape is familiar and easily understood by players.
- **Codified space** – Codified space are about interface and information objects which are non-spatial game components, but are valuable for gameplay. Codified Space is about the connection to information that is in itself not spatial. Architecture acts as a simplifier that reduces complex information layers to a comprehensible and localized icon. Strategy games, which require management of large amounts of complex information, are the biggest employers of codified spaces. In architecture codified space is about the user interface and information that can be accessed on object parameter, data, information.
- **Creation Space** – Game space is creatable and transformable and gameplay is about building up space or objects. Architecture is something that is constructed and then continuously transformed, refurbished, and reused by its inhabitants. For instance, in Sim-City the player builds up and manages a city, through zoning land, creating transportation networks and providing services and leisure activities. The city is the result of its architectural and urban fabric.

- **Backdrops** – Game space as non-interactive – Not part of gameplay: where there is no direct interaction between the game space and the player. Game space serves solely background to the gameplay since its architecture does not affect gameplay.

Multilayer Space Access

Multilayered space access refers to the use of many spatial tools in video games at the same time in order to emulate real-world behaviors and improve performance. Artificial intelligence (AI), complicated rule systems, and interface design may all be used to add functionality. Interaction in three-dimensional virtual environments gets richer and more challenging. In the game space, the player must complete a many tasks at the simultaneously.

REPRESENTATION	VISUAL STYLE	Realism/
		Stylised
		Abstract
	ACCURENCY	
	FIDELTY	
DESIGN EXPEREINCE TOOLS	IN GAME ARTEFACTS	
	SUPPORTING TEXT	
	COMPOENENTS OF THE STORY WORLD	
	CUT-SCENE	
	SCRIPTED EVENTS	
	CHARACTER DIALOGUE	
	SPATIAL PATTERNS	1-dimentional
		2-dimentional
		3-dimentional
	TOPOGRAPHICAL MODELS	linear
		maze
		arena
	SPACE DIMENTIONS	discrete/ continuous
		static/ dynamic
	PERSPECTIVES OF NAVIGATION	god-view
		first-person
		third-person
DESIGN INTERACTION	SPACE RULES	rule space
		mediated space
		fictional space
		playspace
		social space
	PERFORMATIVE PATTERNS	challenge space
		contested space
		nodal space
		codified space
		creation space
		backdrops
	MULTILAYERED SPACE	

Chapter 7 – GAMIFICATION OF VISUALISATION AND DESIGN PROCESS

7.1 GAMIFICATION AND ARCHITECTURE REPRESENTATION

Traditional architectural representation tools such as orthographic drawings in plan and section or the realistic rendering style do not fully express the feeling of a project or a sense of scale. Virtual reality combined with gamification methods, on the other hand, can offer architects new ways to depict buildings, such as a 3D immersive view of the building and a lifelike simulation of walking around it. They show not only a conceptual idea and speculative design forms as the heights form of thought, using VR, Ar, digital modeling and simulation, but also a social space which can be shared in real time with clients and colleagues, and a playful interactive space which can be manipulated simultaneously giving users the control over this reality. This will give clients and architects a clearer concept of how the building will appear after it's finished, as well as a stronger sense of belonging over the project. VR gives the customer a greater sense of space, the sensation of being there. Simulations aid in the testing of theories by visualizing them in a simple and understandable way for users. Users can be immersed in a virtual reality environment that provides visual, audio, and tactile feedback, making the space feel realistic and allowing the body to move as if it were in the physical space, as well as vividly seeing the implications of their decisions. This make it simpler to discuss issues, solve needs, provide feedback, analyse the project, and make better design decisions faster. This new form of representation and platforms gives a multidimensional vision of the world.

7.2 GAMIFICATION IN ARCHITECTURE DESIGN

Architecture is more than representation, it is the conception of space, a vision and the way it is perceived. In virtual reality, architecture is generated by computer. According to Marcos Novak (1993), virtual reality is in itself an architecture. Thus it’s not important that space becomes buildable in order to be real and to offer experience to the users. In addition, virtual space can be considered as an educative space. According to Novak (1993), it “can be seen as a vast virtual laboratory for the continuous production of new architectural visions". This kind of architecture has no limitations. It’s all about speculation in 3d virtual environment. The essential component in which architecture as a field is engaged is the manipulation of form, as Plowright asserts in his book "Revealing Architectural Design. Methods, Frameworks, and Tools" (Plowright, 2014) This means that direct development of architectural forms in virtual space allows designers to be more creative with computer technology in the design process. The architect designs fully immersed into the environment, manipulation forms and plays with them in the Virtual space. For architects, virtual reality artificiality can be both a playground for play and

creation and a testing grounds for real life simulation. In virtual reality, objects in space have a visual not a material character. Space is a virtual contrition and architects must invent their own rule and logic for how things work, freed the constrains of the real world.

Yu Qi and Ziyi Yang of Bartlett University created Kintsugi City, an experimental virtual reality video game. They're making a utopian metropolis out of video games that explores elastic design and questions real-world boundaries. The idea was inspired by "Kintsugi," an ancient Japanese practice of repairing broken ceramics by highlighting and mending gaps rather than covering them. The videogame is a mix of metaphor (based on a certain narrative) and algorithm (computational instruction). The player rotates, scales, and distorts a set of architectural elements as they walk through a vision of Tokyo. It presents the Japanese metropolis as a continually changing set of experiences patched together by the spectator at ground level, rather than as a unified totality. This utopic metropolis is more than simply a picture; it also has quantitative substance, implying that the city's future depends on data interchange and movement. In fact, today's quantitative utopias are videogame environments with encoded interactions between objects, users, and the environment.

Figure 136 Kintsugi City by Yu Qi and Ziyi Yang, Bartlett University.

Architects can use video game tools to create both virtual space and the rules that govern how people interact in it. In this way, they serve as a crossroads for art, digital culture, and video games. They provide us with a platform for bringing livable ideas to life without the cost and space constraints of physical construction.

7.3 GAMES AS CO-DESIGN TOOLS IN URBAN DESIGN AND PLANNING PRACTICES

There are several interactive video game models used in urban planning. As a sociotechnical and political decision-making process, urban planning necessitates communication and engagement from a wide range of stakeholders, including the general public, legislators, planners, architects, and others. In addition, urban planning has a significant impact on urban landscape and aesthetics. Thus, planning becomes a systematic activity, resembling resource management video games, construction games, and multiplayer online games in certain ways.

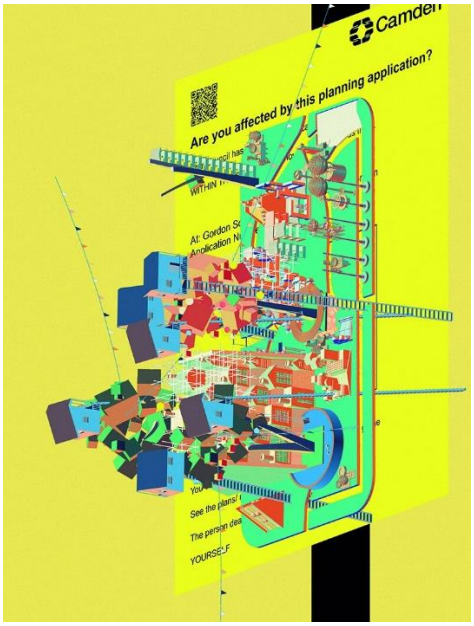
In this regard one of the most recent and updated implementation of game design tools in urban planning was that of the city of London, which developed a VR 3D map to support planning methodologies and to help future development. It was created during the Covid-19 period, prompted by the need to shift to working from home. The city of London was the first to produce a virtual reality map with detailed reproduced buildings, including facades, streets, and traffic lights, among other features. It's a "digital twin" of the real city that facilitates decision-making in the Square Mile, London's city center. People and decision-makers may use the VR Model to see the impact of new buildings before they decide to build them. Furthermore, it allows various stakeholders to experiment with alternative designs, see visually the impact, and make the best decision.

Figure 137 City of London virtual reality map

Recently, in the city center was approved a building at Fenchurch Street, which is possible to be explored in VR and to understand the impact not only in bird eye view, but also from the human scale perspective. The Virtual Reality (VR) of the City of London is a tool that administrators and developers may use to deal with participatory decision-making. Typically, ordinary people are unaware of the environmental consequences of architecture projects and new proposals. As a result, this technology enables people to observe and better appreciate their impact not just on a human scale, but also on the city's skyline. The

use of game tools and augmented and immersive visual technologies in urban planning in the case of London create a more dynamic, real, flexible collaborative environment.

Today a lot of research is done on the use of video game tools and technologies to conceptualize and realize urban design projects. A collective of architects You+Pea (founded by Sandra Youkhana and Luke Caspar Pearson) in the last yeas established “Videogame Urbanism” studio as part of Urban Design master at the Bartlett School of Architecture, UCL. The aim of the studio was to research the interactive nature of video games and to use it as a tool in architecture and urbanism practice. They research on the way architecture and urban planning processes can be communicated to large audience, on how to incorporate narrative in their representation in order to offer alternative ways to vie the city, to give voice to different stakeholders. In addition, they research on how put into evidence architecture qualities at a structural and cultural level, to embrace relationships between rules, interactive actions, and audiovisual representation and to investigate on their application in complex urban and architectonic systems.



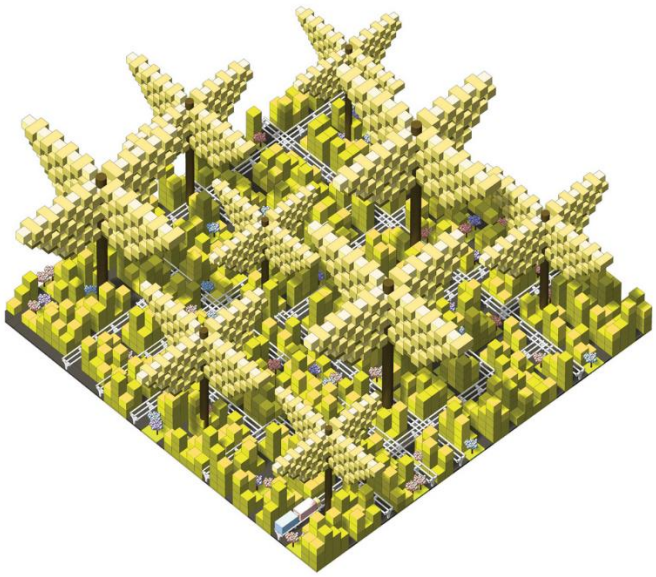


Figure 138 The Playable Planning Notice, 2017. Digital screenshot drawing from game. Zhibei Li, Shenghan Wu, Meiwen , Zhang, Bartlett School of Architecture, UCL (source: in (Pearson, Youkhana, 2020).
Figure 139 Playable city, experimentation in Video game urbanism studio by you + pea (source: https://washmagazine.com/Videogame-Urbanism)

Complex urban systems are viewed as games, and are turned into games, allowing for a better understanding of how cities are shaped and offer new methods to interact with these dynamics (Pearson, Youkhana, 2020). These games can provide direct feedback for designers and can be easily accessible for people. Kars Alfrink (2015) viewed the use of game technologies in urbanism as a “***playful***

soft urbanism" which promises an increased level of autonomy, participation and influence of individuals and groups of interest, consequently offering alternatives to the current system of governance in urban planning.

6.2 GAMIFICATION AND VIRTUAL HERITAGE

Digitalization of architectural heritage

Digital technologies are becoming more and more important in architectonical heritage research and education, and their use and research has been further accelerated due to covid-19 and the impossibility to access historical sites or museums. Digitization of heritage and the creation of open digital archive contribute in a large scale dissemination of history and culture. Architectural heritage as a disseminative human activity is related to the recovery and representation of the physical remains of historical objects and serves to communicate knowledge and transmit ideas and values. It includes three main domains *documentation*, *representation* and *dissemination* (Addison, 2000.

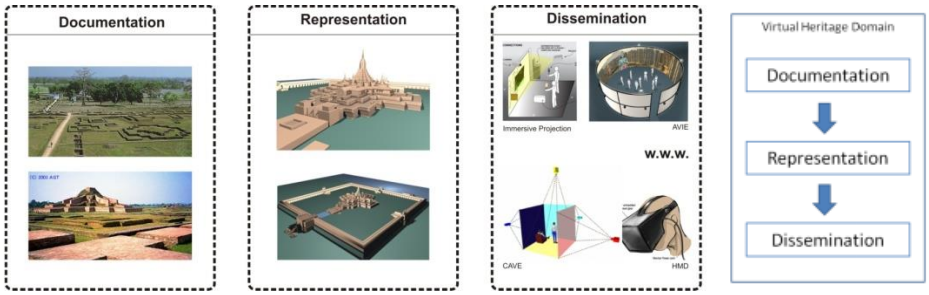


Figure 140 Three main steps of Digital heritage (source: Addison, 2000)

Documentation means data collection regarding the study objects which serve for object 3D representation and as a "deposit "of information for the object.

3D Representation is the 3D model of existing heritage object, or the representation of the supposed object which is no more existent. In this step, research deal mostly with the 3D modelling techniques, texture, polygons and real time rendering.

Dissemination of virtual heritage refers to the way the 3D content is offered to the user based on a purpose of use. VH can be used for excavation, documenting, data analyses and publications, education, display, digital reprocessing, tourism and serious games.

Nowadays, technology allows us not only to easily access information on heritage and view 3D models of buildings or artefacts, but also to experience virtually historic sites or historic object, by representing them accurately, either referring to the recreation of exiting objects or rebuilding models of objects as they may have appeared in the past (Roussou, 2002.Herein, UNESCO in 2003 introduced the term 'Digital

heritage' referring to the recourses "created digitally or converted into digital-form from existing analogue resources". This means that architectonical heritage can be scanned and 3D models can be produced. Architectural heritage recorded digitally has contributed in preserving it but has also significantly increases their accessibility to larger audience (Tonta, 2008. Moreover, digital heritage platforms allow visitors to navigate through virtual spaces and access information data, but still provide a low level of interactivity and immersion (Champion, 2008.Researchers in this field agree that the level of Interactivity in virtual heritage is still very low. (Sanders, 2012, Champion, 2002 sustain that heritage dissemination should encompass also the cultural and artistic evidences and narratives. Although, digital models today are becoming more and more realistic representation of the physical objects and in general of the environment, they still lack a narrative which describes the intangible elements of cultural heritage, human attitude in this environment and simulates thecultural context.According to Yang et al. (2006, the lack of human interaction and the limited cultural content in these kinds of representations make them more technical and limit people engagement with heritage.

In order to guarantee an effective engagement with learning experience and offer better entertainment to a larger audience, other than conservators, historians and archaeologists, its essential to introduce an interactive and immersive approach in heritage 3D platforms. 3d reconstruction and data availability is not enough to explore the socio- cultural context as it could be done through the use of narration techniques or the exploration through motion and interaction. Advanced digital technologies and interaction techniques on one side facilitate interaction modes, but still other motivation and entertaining elements are needed.

Historical overview on virtual heritage

Virtual heritage can be considered as a sub-category of digital heritage as it is related with VR technology and a real-time navigation through a computer-generated three-dimensional space.

> "*Virtual heritage (VH) is a term used to describe works that deals with virtual-reality and cultural-heritage"* (Roussou, 2002).

The role of role of virtual reality in this case is not only to reproduce digitally historical content and data, but also to process and display heritage through the use of VR technology. It means that heritage content becomes digital or through the use of computer VR technologies it's possible to simulate it, if it is lost and deliver it openly to the global audience. VR technologies such as Mixed Reality and Augmented Reality are being used recently to rebuild digitally historical sites, visualize it to the audience by improving user's experience. Nevertheless, the role of virtual reality is not just to visualize existing or lost objects and other type of historical content, but also to attribute them significance, through the use

of interactive media. According to Stone and Ojika, as cited by Champion (2016 virtual heritage is defined as "*the use of computer-based interactive technologies to record, preserve, or create artefacts, sites and factors of historic, artistic, religious, and cultural significance and to deliver the results openly to a global audience in such a way as to provide formative educational experiences through electronic manipulations of time and space*." In this study Virtual Heritage is considered not just as 3D modelling and animation of historical objects but refers to a fully immersive 3D virtual space where a user is able to navigate interactively (Champion, 2008; Sanders, 2012. Moreover, Addison (2001 apart from the use of technology to *record, model, visualize* highlighted also its role to c*ommunicate* cultural and natural heritage. Herein, virtual heritage is more complex than just the realistic reconstruction of objects in VR, and information about them, but it includes also the story and context that give meaning to this representation, and offer engagement and entertainment for people. According to Champion (2008interaction is crucial for virtual heritage to communicate and transmit significance to the user.

Virtual reality was first used in heritage visualization in 1994, with a brief 'walk-through' 3D reconstruction of Dudley Castle in England. It can be considered as the genesis of virtual tours. Since then, archaeologist start to experiment with virtual reality in research projects demonstrating time by time the power of the new technological systems.

Figure 141The 'walk-through' 3D reconstruction of Dudley Castle in England and an image of Dudley Castle

In 1995, in the first virtual heritage conference held in England, were presented interactive models of historical objects and hereafter was created VRML programming language (Virtual Reality Markup Language, which allowed highly detailed and fast performing virtual worlds from personal computers. This opens up the possibility of large use of VR in heritage for education. The first interactive models proposed were the ancient sites of Olympia, Epidaurus, and Miletus (Refsland 1998 in Sanders 2012. At the time, these models presented poor graphics and textures and had a low navigation performance which started to be improved in the late 1990s with the development of Alpha world, an online immersive and collaborative virtual environment populated by virtual pedestrian who explore and walk through the 3D space. This has anticipated adventure videogames (such as Myst and the sequel Riven

with high performance of computer graphics and real world simulation where players explore the large set of game world and manipulate surrounding objects (Cyan, 1997. Still during the 1990s, virtual heritage was not fully embraced by archaeologist and compared to video games, this field was left behind. Only few projects (ex. Nemrud Dagi virtual world, Turkey tried advanced virtual environments with detailed 3d reconstruction models and interactive data linked to object in the virtual world.

During the 2000s, virtual heritage become the primary technology for the dissemination of architectonical heritage. Technological achievements such as faster graphic cards and higher hardware performance, high-resolution laser scanners, megapixel photography, GPS, etc. enable large access not only to professionals but also to public for teaching and education use. Moreover, they urge complex and accurate virtual environments (with high-polygon-count, with highly realistic textures and an increased level of interactivity. Nevertheless, when considering real time rendering, visualization performance was still low.

An interesting project developed during these years was the interactive 3D model of the battle monument of Octavian at Actium. Through navigation in virtual reality and interaction with object pieces was possible to understand the complex construction methods of this object, which not only was not possible to do in 2d representation, either with the real object, which could be damaged by manual use. Hence, VR in this case was used as a mean to offer new visualization and interaction modes to relate to the historical objects or constructions. In other projects (ex. the ancient shipwreck found in Cyprus coast VR was used to put together separate pieces of objects found, and to work on hypothesis of assembly. This model evaluation practice is standard in architecture schools and is used as a mean to check the visual impact of real object or objects that are projected in mind. In architectural heritage they constitute an instrument to test hypotheses about the past. In the historical reconstruction of Athens Acropolis, this practice was used to test the reconstruction and the visual impact of the old Athena Temple upon the classical structure of the Acropolis.

In the last decade, virtual heritage projects are employing advanced communication means such as interaction based on artificial intelligent communication between user or avatar and virtual characters, advanced manipulation of objects in VR, collaboration platforms that link models instantly and give access to users worldwide in real time.

In the VR reconstruction of Assyrian Northwest Palace was introduced interaction between users and virtual characters based on artificial intelligence. Visitors navigate inside the palace and background information’s are provided to them depending on the various locations. Moreover, they meat virtual characters and can interact with them. Communication interactivity between them is based dialog stimulated by artificial intelligence. In this regard, research is going further. Interactivity based on the

capacity to manipulate objects in 3d space was used in the case of digital reconstruction of historical objects made of separate pieces which needed to be put together (ex. an Egyptian wooden model of ship. This allows object verification, and makes possible various interpretations.

Year 1990's	Year2000's	Year 2010's
Simple 3d models	Advanced/ realistic 3d models	Realistic /Accurate 3d models/
Low polygons	Higher polygons	Very high polygons
	BIM (Building Information Model	BIM (Building Information Model
Navigation in VR , limited viewpoints	Better Navigation in VR, Different viewpoints	Advanced Navigation in VR infinite number of viewpoints
Low interactivity	Better interactivity	Higher interactivity
		Simulation
		Manipulation and contribution of VE
		Collaboration
		Artificial intelligence

Virtual heritage characteristics in time (Source: author's)

In the last decade, digital technology and in particular VR has been highly evolving allowing not only highly realistic visualization, but also the possibility to developing interactive narrative of architectural objects or sites (interactive 3D story space. This makes it a highly useful tool to analyze and disseminate data in clear way, to visualize objects in an accurately and in a realistic way and introduce highly engaging environments. So actually, the challenge of interactive virtual environments for cultural heritage and not only, has become the design of virtual "experience".

According to Sanders(2012), there are five main group of users of Virtual heritage: 1.Historians of architecture, archaeology and conservation experts who are interested in understanding the past; 2. Visitors of museums 3. Students and education professionals 4.Researchers 5. Players.

Game elements for engaging virtual heritage environments

People learn about culture from observation, action and conversation (Champion 2006) ,which in virtual heritage can be translated in visualization or representation, experience and interaction. According to Roussou (2007, these are the main components of virtual heritage environments and they represent also the principal video game components. That's why, video games as an interactive and dynamic visual

media are a relevant tool to incorporate narration and ludic aspects and make the dissemination of virtual heritage more interactive and immersive. Having a different aim and utility compared to games/ video games, these virtual spaces are often known as serious games and serve as learning platforms/applications for research, education, entertainment and marketing. The application of game design elements in architectural heritage such as historic structures, monuments, cities, landscapes can offer a high level of user engagement. Below are listed and discussed the main game elements and their role in an engaging VH.

- *Representation*

The representation of the architectural heritage in virtual reality usually tent to resemble or be faithful to the real world building. Nevertheless, depending on the target groups and purpose, in order to offer a compressible representation, the visualization can be subject of artistic interpretation (ex. in children education, video games. Nowadays technological achievements allow designers to achieve highly realistic representations.

Highly engaging environments are influenced especially by the last two components experience design or storytelling and interaction, which contribute in creating an interactive experience in virtual reality. Other elements that make representation engaging are 3D models seen as information systems, which embody data of different nature (architectonical, material, constructive, economic and environmental and offer the possibility to access then in real time.

- *Design Experience through storytelling*

An engaging virtual environment is an entertaining space that triggers interest and offers experience to the visitor. Experience is expressed through storytelling or the way the story is narrated. Various scholars (Nitsche and Roudavski 2003 sustain that “narrative” plays an important role in driving the virtual world and consequently in the success of virtual heritage projects. Stories in virtual heritage connect architectural historical objects to human experiences. In virtual heritage, narrative is not just the story you hear or watch walking through the space, but the events andthe same spaces you see and discover and the way you are involved to interact with them. The Dissemination of heritage in VR is based on a story driven approach which grounded on collection, selection and display in a meaningful way of objects and information. They can specifically be multimedia elements such as image, sound or video narrative, *miseen scene* that immerse the user. In video games there are different type of storytelling lines which can serve as a tool to design a narrative based experience of virtual heritage. However, the story does

not represent faithfully the historical content, but is an interpretative process. Moreover, it gives an insight on the virtual reality historical content and as a learning tool that engages actively the audience.

-Design experience by introducing digital characters

Designers should include digital characters to enhance visitors experience in virtual heritage environment. According to professor and media artists Margaret Morse, virtual heritage without characters populating the story is like a kind of "Natura Morta" (Morse 1996. Virtual space becomes more engaging when user can see and interact with virtual characters, similarly as in real life.Although the focus of architectural virtual heritage is the object and space, the emphasis on the characters populating the space (virtual humans is important not only to create the historical, social and cultural context and a sense of inhabitation of the space by adding significant value to architecture object but also to increase user motivation and engagement. Characters can help drawing attention and can be useful providing motivation to explore the virtual environment.They can be conversational agents thatprovide specific information or feedback on particular objects or sites. Moreover,the same user can become an avatar or role-play(Cruz-Neira, 2003 and perform actions inside the virtual space, or became actor/narrator effecting an interpretation of the story. Similarly, as in videogame, avatar can be personalized by choosing gender, body and physical features, style, clothing or character type. In both cases they learn about the environment by experiencing it as they were real citizens.

-Design experience by stimulating senses

An engaging virtual environment needs to be multisensory to fully immerse the user into the environment. User for example can have a physical contact with the objects, can touch them and have a feeling of the materiality. In architecture seeing and touching can help to have a full perception of the objects. Hearing can also help to interact with digital characters or interactive media present in the VR. McLuhan in the '70 predicted that the age of visual is overpasses and we are now l into the age of the aural and tactile (McLuhan 1964.

Interaction: from navigation to manipulation and contributive interactivity

Engaging virtual heritage environments are not virtual space that resemble exactly to the real world. The component of interactivity usually offers a new, interpretative point of view that provides an escape from reality. Various authors (Jacobsen and Holden, 2007, Champion 2008 suggest that virtual heritage aim is to convey information and communicate cultural significance of historical objects or sites, and interactivity and simulation are powerful means to achieve this. Interactivity is the ability to interact with

objects or characters in a digital or virtual environment. It includes exploration of virtual space through navigation, acting and completing tasks, communication between users or virtual characters, performing quizzes or queries, and real time collaborating.

Interactivity as navigation is visualization-based

Initially, interactivity in VH was limited to spatial exploration, the basic form of interactivity, which consists of walking, flying and examining objects in VR in a different perspective. Exploration depends on the possibilities of navigation, the amount of explorable area, navigation options and the possibility to experience a live experience of the site through augmented reality- mix reality.

.Interactive navigation interfaces include additional options such as moving the head, focus on point of interest, go ahead or backwards zoom in and out, pan, change viewpoints etc. which are not always possible in the real world. Navigation could be either guided (passive or person control movement (active. In both cases, user has different point of view and the freedom to move, but the environment is not interactive at all, as he cannot modify it.

Interactivity as manipulation and contribution is activity/ task based

In video game design, actions and tasks are related to the need to complete or succeed a game goal. In virtual heritage, tasks are used to improve technical and historical knowledge, by involving in first person the user to learn by acting in VR. This can encourage users interest and consequently his level of engagement.

Last decades, advanced interactivity offers to the user the ability to change the environment (Ryan 2001 which include manipulative and contributive interaction (Pares and Pares, 2001. Manipulative interaction resides in the ability of the user to manipulate objects in VE and modify the virtual world, while contributive interaction transforms the environment by adding elements. Both of them are determined by the creator when designing interactive narration of VE and by the freedom of the user to transform the environment.

Interactivity as ludic activity

Ludic activity related to cultural heritage can engage users in the learning process. Bellotti et al. (2012 suggested quizzes, puzzles, etc. to be incorporated in virtual heritage applications as a way to learn similarly to the tests in books. EX. museum games are ‘Virtual Egyptian Temple’, ‘Olympic Pottery Puzzle’

Interactivity as dialog and collaboration

The dissemination of architectonical heritage need to be seen not as a closed scientific activity reserve only to professionals, but as a communication medium that shares information between professionals, public and gathers feedback from them. Collaboration of virtual heritage communities refers to communication and shared experience between multiple users who share the same virtualspace. It can be either by sharing materials (images, drawings, photographs, information, etc ,space or to take part in a dialogue with a real /virtual character. Dialog happens through artificial intelligence or pre-programmed character. Pre-programmed character can only respond to limited topics as predicted by narrator.

Different authors (Cruz-Neira, 2003; Jacobsen and Holden, 2007, consider dialog and in general communication as an element to use in learningvirtual heritage applications in order to involve students to be active members of that society. Similarly to multiplayer games which allow collaboration of confliction relationship between players, virtual heritage can be a shared space where user is a role-play member and they can collaborate with each other.

ELEMENTS	Sub- Elements	Details
REPRESENTATION	Realism and accuracy	Level of polygons, level of detail, texture, light
	Representation of the intangible	Cultural, historical , visual, behavioral values
	Visual and Environmental	Visual style
	Sensorial reality	Environmental effects, sound effects, etc.
DESIGN EXPERIENCE	Narrative / Storytelling	Voice over narration/ Story design / Branching design/ Interactive design
	Digital characters	Avatar/ Personalized Avatar/ Role-play/ Multiplayer
	Stimulating senses	Five senses
DESIGN INTERACTION	Navigation	Moderate motion: walk, fly, examine, turn head, rotate object of interest, go ahead/back, pan, change camera optics, jump to another viewpoint, etc. Location Reference: Time and space
	Manipulation and contribution	Move, add, change, edit etc.
	Ludic activity	Quiz, challenges, missions, achievement , levels
	Dialog and collaboration	Multiplayer in virtual social space

Elements of Game design for an engaging virtual environment (source: authors

Type of virtual heritage

The virtual heritage environments can be divided in two types:

- ***Serious Games for Heritage***

1. Virtual museum or virtual tour – Exploration of virtual heritage is made through navigation, access to data and information, digitalized archive etc.Exploration can occur through VR a 360 grade photographic exploration or 3D reconstruction in which visitor can navigate. Ex:Walk through Ancient Myletus; The Virtual Egyptian Museum etc.
2. 3D model prototypes – that simulate architectonical heritage, but have also an interactive content on historical buildings or sites given in some cases also by virtual characters (Ex.Historical video game "Pompei: The Legend of Vesuvius"; Serious game 'Roma Nova'. They aim is to teach notions of history by providing not only realistic and historical fidelity exploration but also political, religious and artistic living background andvirtual characters that act within the virtual environment and offer interactive communication to the user.

- ***Entertainment Video Games for Heritage***

3. Entertainment Video Games for Heritage are fun games that provide players knowledge of historical content by offering them the possibility to engage with the past. Players are invited to be part of events such as battles, construction processes, rituals etc. and to learn about people, objects and history. (ex. Napoleon: Total War (2010,is a strategic and tactic video game set during the napoleon period. Player immersed in this historical setting learns about

Below a series of virtual heritage will be analyzed considering the methods, techniques and outcomes related to the purpose of the project.

Serious game for Virtual heritage analyses

Virtual tour and virtual platforms in Albania.

In the last years, in Albania have been implemented a series of projects related to virtual heritage. Most of them were virtual tours on museums, art galleries and historical buildings or platforms based on 360 VR technologies. Actually a number of museums such as: Museum House of Leaves, in Tirana, Onufri Museum in Berat, etc[9], art galleries such as Marubi National Photography Museum[10] , historical objects

[9] Other virtual museums: The Archeological Museum in Durres, The Archeological Museum in Apollonia, The Archeological Museum of Butrint The National Ethnographic Museum in Berat The National Museum of Medieval Art in Korca Gjergj Kastrioti National Museum in Kruja The Ethnographic Museum of Kruja

[10]Other virtual art galleries: Gjon Mili Museum in Korca National Gallery of art Exhibition at PM's Office Gallery, Tirana

such as Saint Nicolas Church in Voskopoja[11] were turned in virtual experiences. A platform for cultural heritage developed in collaboration with Italy and Montenegro, as part as cross border projects, providing virtual experience and open access to archive materials of each monument. The virtual platform part of the project 3Dimpact is an online documentation platform on historical castles and provides digitalized archive with large information (textual, web-GIS maps, 3d scanned model of monuments, 360 VR about selected castles in both countries. Hyperlinks are used as navigation tools in the navigation map in the top right part of the interface. These virtual tours can be experience only through 360 photographic VR, and visitors can only take measurements of the space and access text basic information on particular objects inside the space. In these examples the level of interactivity is very low. They have been used only basic game tools, mostly related to navigation map and basic blueprints used for detailed information about specific elements in the visual frame.

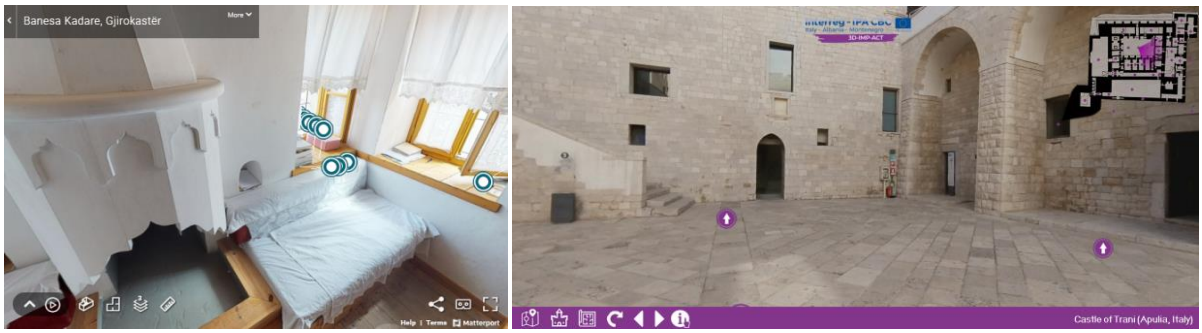


Figure 142 Virtual heritage in Albania: Screenshot of Virtual museum of Kadare House (source: https://kultura.gov.al/3dsite/banesa-kadare-gjirokaster/; Screenshot of virtual platform " 3D impact" for castles of Albania, Italy and Montenegro (source: https://3dimpact.poliba.it/

Virtual heritage and virtual platforms worldwide.

- **VIRTUAL ROME platform (2008)**

Virtual Rome is an online platform created by the ITABC-Virtual CNR's Heritage Lab in partnership with CINECA. This application was created to allow users to view and explore the archaeological landscape of Rome in the second century AD in real time (Pescarini et al, 2008). It also incorporates open source technical information, data, and 3D models, resulting in a collaborative environment in which many professions collaborate on the interactive reproduction of Rome.

The steps in the project workflow are as follows:

[11] Other historical objects turned to VR: Kadare House in Gjirokastra Saint Nicolas Monastery in Mesopotam Saint Nicolas Church in Voskopoja Saint Mary Church in Voskopoja Saint Mary Church in Gjirokastra The Lead Mosque of Shkodra Iljaz Bej Mihrahori Mosque in Korca Muradie Mosque in Vlora Saint Mary Monastery in Apollonia Dollma Tekke in Kruja

- the creation of an Internet Explorer and Mozilla Firefox plug-in; 3 OSG4WEB PLUGIN creates 2D and 3D content (detailed 3D terrains, vegetation, optimized 3D models, multimedia linkages, and a 3D Internet site).
- 3D content reduction and optimization for interactive web deployment
- the creation of a 3D space navigation plug-in: OpenSceneGraph,1
- the development of a 3D interactive front-end platform for online exploration of huge archaeological sites. User can explore the landscape, collect data (such as orientation, height, speed, and location) for quick feedback, and interact by switching to different terrain models.
- the development of the plug-in for Internet Explorer and Mozilla Firefox; 3 OSG4WEB PLUGIN
- the development of 2D and 3D contents (Highly detailed 3D terrains, vegetation, optimized 3D models, multimedia hyperlinks, a 3D Internet site.
- The development of ViRo, and simple, functional and user-friendly tool for navigation system that provides
- virtual world exploration. Users can walk inside the monument and fly up to different historical periods. Advanced collision detection and obstacle avoidance algorithms, joined with different exploration modes, are provided together with the walk mode, using basic physical effects such as gravity and surface adaptation.
- The development of a BACK-END collaborative system (VR web LAB in order to enable the integration of the constructed 3D terrain dataset, high resolution 3Dmodels, vectors, vegetation information, and metadata edited dynamically.

Figure 143 Screenshots from Virtual Rome (source: Pescarin, et al 2009)

❖ **ROME REBORN (2007- 2018)**

"Rome Reborn" is the 3D digital reconstruction of ancient Rome, enriched with historical and architectonical information on the urban development of ancient Rome in 320a.c. The model presents an accurate visualization of 250 buildings belonging to Class I monuments, including information about their

design, location and history. Other Class II buildings, lacking detailed information, have a very schematic representation, relying mainly on textures instead of geometry for architectural details and decorations. The overall image is based on realistic environment with interactive lighting.

This platform was intended for education purposes, since it provides knowledge about the urban topography, infrastructure and monuments of ancient Rome at various periods of time. The model has data regarding urban patterns, buildings height and topography which can be used for urban or architectural research regarding urban and building performance in relation to energy, urban ventilation, sunlight exposure, people circulation, and use of space etc. Its purpose was to present to students or public the image of the city and the main architectural monuments of a particular period and to create a collaborative platform for professionals to discuss theories and ideas regarding the urban history of ancient Rome and its hypothesis of reconstruction.

The first version of Rome Reborn was shown on PCs as a real-time interactive urban model using Open Scene Graph. In the new version 2.2 were added animations of humans moving on the city streets (Dylla, et al 2010. This digital characters, although are passive, contribute in giving the model a sense of scale.

As regarding interactivity design, this platform offers a smooth walking and flying navigation from ground level to bird's-eye view of the city. While moving in VR and come up against monuments, user can listen to the story of that particular object. Still the level of interactivity is limited to ordinary type of navigation and audio interactivity.

Figure 144 Snapshot of Rome Reborn bird eye view of the 3D model (source: https://www.romereborn.org/

- **VIRTUAL KYOTO** (2008)

Virtual Kyoto is a virtual representation of the historical development of the city of Kyoto in Japan. The platform displays first a 3D modelling of the city reconstructed referring to the main historical periods of development. It includes also an organized archive of materials of the development phases of the city: different type of maps (historical, topographic, cadastral maps, aerial photographs, historical landscape painting and photographs, historical documents, street and buildings photographs. Moreover, it provides a digital infrastructure which contains a database of all existing buildings and historical or cultural

heritage archive, in particular numerous temples and shrines which were also created in 3D. The 3D models were not detailed and therefore the overall reconstruction and visualization of the city is in low quality

The aim of the platform is to simulate the land use and landscape changes in the different development periods and to disseminate the cultural and historical heritage of the city.

The system provides a user friendly interface and allows users flying-through city, viewing detailed building models and access associated information on each of them. User, by walking through the city, in real time, to have the possibility to change the configuration of the city at the same viewpoint turning from present to past.

Figure 145 Fly through and walk through Virtual Kyoto (source: Takase at al, 2012)

Figure 146 Changes in urban landscape of Kyoto- Virtual Time-Space of Kyoto (source: Takase at al, 2012)

- **SIRACUSA 3D REBORN (2013)**

Syracuse 3D Reborn is 3d documentary that described and analyzed monuments of Syracuse and war mechanism and devised conceived and designed by Archimedes in that context, offering the opportunity to learn about history. The whole context has been reconstructed digitally including the main buildings. After building accurate 3D models and rendering them, all scenes were processed in with “Adobe After Effects” program in order to create realistic effects of smoke, fire, sea foam etc.

Since the Virtual reality in this project was used in the context of cinematographic, a narrative was incorporated, divided in two themes which represent the two historical phases of the site development. The first phase was illustrated through the road network, houses blocks and the public area configuration including the main temples. The second phase was based on the transformation and destruction of part of the city and the construction of new buildings, fortifications and monuments. Narration was conceptualized and visualized through storyboard, in which was given particular emphasis to the detailed recreation of artefacts and digital characters animating space which through their acting provide knowledge about the historical and social context.

Images and 3D reconstruction of site was overlapped by illustrative texts and audio. In this case, documentary aim was didactic and the story as based on the historic urban development and the main events happening in Syracuse during that period. For this purpose, initially was the interpretation of historical context. Therefore, an intentionally didactic narrative was translated into a storyboard in which was chosen to provide passive cognitive tools (typical of documentaries to transmit knowledge without diminishing the emotional aspects.

Figure 147 Snapshots from Siracusa Reborn documentary (source: http://www.archeotour.eu/en.html

VIRTUAL TIME TRAVEL OF PRE-REFORMATION EDINBURGH (2017)

Figure 148 Snapshots from Virtual time travel of pre-reformation Edinburgh

The virtual reconstruction of pre-reformation Edinburgh is a project that offers the opportunity to see the old city of Edinburgh as it was prior to the reform and to move along houses, marketplaces, and streets connecting the virtual with the real. This platform offers the possibility to experience dual

realities (virtual and real on the same space by using digital time travel binoculars. Visitor are considered as virtual-time travelers as they can contemporary see the various historic layers while moving along the city streets. Position and orientation within the two worlds are synchronized enabling intuitive exploration of both worlds through movement in the real world. Moreover, visitors can navigate inside important historical buildings.

This project is based on 360 photographs of a reconstructed historic model developed in the UNREAL Game Engine. This offers also a friendly interface, and an interactive navigation with video fly-throughout the city and interactive map.

- **INCEPTION - Inclusive Cultural Heritage in Europe through 3D Semantic Modelling (2015-2018)**

Inception is a platform for cultural heritage documentation and dissemination among different stakeholders such as scholars, professionals, authorities and visitors or non-expert users in order to promote the accessibility and spread the knowledge of European heritage. The platform is based on the development of time-dynamic 3D models of buildings, sites and artefacts, which are semantically enriched in the digital content with documentation, analysis and management tools. It includes different categories of data recording such as historic material, geometric and architectural model, building materials, structure and structural analyses, external condition assessment, risk definition and conservation interventions that contribute in creating a library of parametric objects. These objects (BIM models contain geometric information in order to be updatable for professionals and useful for conservation purpose. The platform in itself contains not only a digital representation of object in H-BIM, but includes also the management of data from different disciplines. Every user was enabled to upload data, materials and information in relation to BIM models, updating a single file in real time. (Maietti et al 2018). Herein, the platform is open and interactive, and allows experts of various disciplines to give a contribution and actively collaborate with each other sharing updated content and facilitating cross-disciplinary researches and public users for education purpose. The dissemination of content was based on in situ applications for tourists and professionals and remote applications for audience that is interest in accessing knowledge about cultural heritage.

This platform has structured a methodology for data acquisition based on Heritage Building Information Modelling (H-BIM which facilitates time-dynamic update and online collaboration. However, referring to an engaging virtual heritage the platform is not highly immersive.

First, interactivity is limited, because real time navigation is slow and the navigation tools used are zooming, clipping planes, change shades, walkthrough, pan, rotate, filter elements, etc. (Maietti et al 2018. Changing viewpoints, fly-modes and other type of navigation that offer new insight of the buildings

or site are not used. Moreover, it there is limited interaction with objects. Users can perform action on the model, “such as visualize and download videos and images, select elements of the model, measure distances or surfaces or move within the model.” (Maietti et al 2018. In addition, objects and their components can be visualized separately based on filters, but they cannot be manipulated, moved or transformed. Moreover, there is no ludic activity included, as the platform is mainly for professional use. Referring to experiencing of virtual heritage, there is only the possibility to be engaged by running virtual guides (Maietti et al 2018. For the rest users cannot really immerse themselves in virtual heritage, since there is no narrative and non-tangible cultural aspects of historical buildings and sites are not covered. As regarding representation, the visualization of historical buildings is low quality texture resolution.

Figure 149 Inception Platform interface.3D model and possible interactions (BIM model, point cloud, images, documents, videos, etc.) (source: Maietti, F et al(2018))

GAME ELEMENTS	Sub- Elements	Virtual Rome	Rome Reborn	Virtual Kyoto	Siracusa 3D reborn	Edinburgh	Inception Platform
REPRESENTATION	Realism and accuracy	Yes and no	Yes and no	no	yes	yes	Yes and no
	Interpretation of visual and auditoria reality	no	no	no	yes	Yes	no
DESIGN EXPERIENCE	Narrative / Storytelling	no	no	no	yes	no	Yes and no
	Digital characters	no	yes	no	yes	no	no
	Stimulating senses	limited	limited	no	no	no	no
DESIGN INTERACTION	Navigation	yes	Yes bird eye,	yes	predefined	Yes Time and space	Yes, limited

			human				
	Manipulation and contribution	no	no	no	no	no	Yes and no
	Ludic activity	no	no	no	no	no	no
	Dialog and collaboration	yes	yes	no	no	no	yes

Table 8 Analyses of game elements in Virtual heritage museum or platforms (source: Authors)

Entertainment Video Games for Heritage

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- **ASSASSIN’S CREED”(Ubisoft Montreal, 2009-2020**

Figure 150 Snapshot from Assassin Creed Video game. Reconstruction of Notre Dame Paris and Reconstruction of Renascence Florence.

Assassin’s Creed is a 3D action adventure game set in different historical contexts such as the Renaissance epoch in Italy, the Revolutionary Paris of 1798, the Victorian London of 1868; the Ancient Greece and Egypt, etc... The games recreate digitally famous historical sites and characters with great cultural, visual and behavior fidelity and accuracy based on historical documents, in order to transit realistically the spirit of that epoch. In this way it serves players t learn about that epoch but can serve also the scientific community as the reconstruction of historical sites or buildings for this game were high accurate. However, some alterations to historical facts or material evidences were made for the sake of the game.

For virtual heritage this game becomes important, not only because of the 3D VR representation of particular sites in time and place, but also because of the incorporation of database, in particular in the latest series. The game database means detailed information about characters, objects or locations which the player meet during his adventure journey in the game world. Moreover, as a video game, it presents high interactivity, in terms of navigation possibilities, manipulation of the game world. Objects and characters part of the game world are movable within certain limits. (ex. houses can be taken and used to speed up the player and to accomplish the game challenges. In advanced series, Assassin’s Creed

presents dialog choices with text options. Navigation mode is also more flexible, with the possibility of scaling viewpoints.

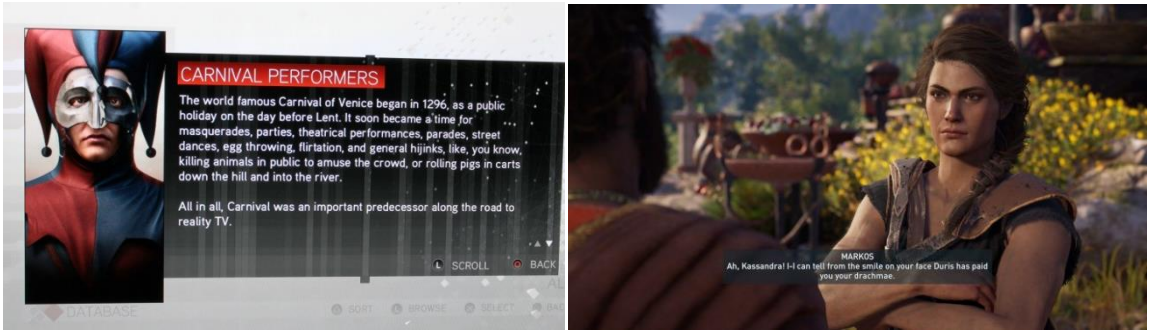

Figure 151 Snapshot from Assassin's Creed Video game. Database on characters and dialog choice.

- **"RED DEAD REDEMPTION" (Rockstar San Diego, 2010.**

'Red Dead Redemption' is a 3D action adventure game set in American-Mexican border at the turn of the 20th century. The geography of the site mirrors highly realistic and sublime landscape in the United States. Redemption is built on third-person perspective, following protagonist John Marston, who plays the role of an historical character, the cowboy archetype. The introductory sequence of the game is based on a dialog between virtual characters which introduce the protagonist, the story and set the historical background. Along the way, the player meets different characters, learn about their backgrounds and their life's. The development of the narrative structure offers the player high degree of freedom and allows emergent game narrative. The player can choose between different characters and different activities to do like free exploration, hunting treasures or animals, etc. In addition, there are multiplayer options available, which make the game a collaborative platform.

Figure 152 Screenshot from Red Dead Redemption: protagonist in the realistic game world (on the left the interactive map; on the right weapon options and information wheel

GAME ELEMENTS	Sub- Elements	Assassin's Creed	Red Dead Redemption
REPRESENTATION	Realism and accuracy	Yes and no	Yes

	Interpretation of visual and auditoria reality	yes	yes
DESIGN EXPERIENCE	Narrative / Storytelling	yes	yes
	Digital characters	yes	yes
	Stimulating senses	limited	yes
DESIGN INTERACTION	Navigation	yes	Yes bird eye, human
	Manipulation and contribution	yes	yes
	Ludic activity	yes	yes
	Dialog and collaboration	yes	yes

Table 9 Game elements used in highly engaging video games (source: Authors)

Conclusions

Virtual reconstructions and interpretations of history and culture is becoming increasilly important in shaping our perception of the past. In the past, virtual heritage was limited to the accurate and realistic visualization of objects and sites.

The above case studies of 3D, virtual tours or interactive platforms as virtual representations of historical heritage, area tentative to enable people to relive historical space, to understand it and learn about the past in an engaging and entertaining way. They open up to the opportunity to create interactive storytelling experiences by combining interactivity with narratives in virtual environments. In entertainment Video Games for Heritage, it's evident that the level of representation, design experience and interaction is higher and complete in all elements that guarantee engaging space in virtual reality.

As a result, game design tools need to be taken into account when designing virtual heritage. Game engines supporting highly detailed game worlds and being equipped with artificial intelligence, are able to offer interaction while being guided by a story model.

CONCLUSIONS

The similarities between architecture and video games explain the relevance of games tools in architecture (both real and virtual). Many video game features, such as space, visual and auditory representation, story, interactivity, and rules, are also characteristics of architecture. The implementation of video game design tools in architectural design is a direct result of these common features. The architectural design process is highly complex both in term of composition, design, relation with clients, actors, and multiple requirements and restrictions. In this regard, the abstract character of game mechanics is critical to response of these issues since it reformulates the design challenge in simpler terms creating rule patterns. Video Games simplify complex systems, make them visualized in a simple manner and provide worlds in which players and viewers may engage to prototype new futures. Games can contribute in multiple direction in designing creative space in VR:

1. Interactive experiencing of architectural design and urban landscape.

Gamification can contribute in interactive experience of architecture in virtual reality. Architect are not only sculptor of form, instead they design stories in space and offer interactive experiences of space. 3d modeling software's largely used by architect offer a volumetric analyses and visualization of buildings. This provides the user with a sense of scale, which is crucial when designing a built environment. A scale is the relationship between objects in space. In architecture this is fundamental. Gaming tools offer an alternative way of scale perception. They provide walking through experience, which allow user to control their design detail, perceive the atmosphere, have a sense of presence and have a close to real-life sensation. This will help them to enhance the design project.

In reference to the urban design, it allows user to view the landscape in different perspective and different conditions not possible in real life. Virtual cities reconstruction, for example allow user to experience lost cities, which is useful for education. User can interact not only through navigation, but also enhance the design by using manipulative tools that transform existing space, in order to have a better experience.

2. Game space experience increase imagination

Video games contribute in experimentations in representation, in the creation of synthetic world and utopian spaces, which before were represented on paper or through collage techniques. Games combine different media such as 3d models, 2d graphics, animations, various form of narrative, behavior patterns,

rules and control systems, physics, and artificial intelligence protocols, expanding the possibilities of creative spaces in VR.

Experiencing architecturally significant gaming spaces, ranging from historical to cultural to technological, aids in the development of a distinct knowledge of architecture. It allows users to move through time and space at their own pace, experiencing historical buildings and real-world environments.

3. Gaming tools to create stories through space.

Architecture is the art of using space to communicate stories. Objects' shapes, materials, visual quality, and style provide a nonverbal communication method for telling stories. Architects may construct great visual tales, packed with characters and artefacts, using game storytelling techniques to tell stories about people, culture, time, and location. This is extremely handy for re-creating old towns or monuments. Users may engage in ultra-sensory interaction with the built environment and immerse themselves in virtual environment portrait historical, real or fictional environments.

4. Gaming tools to test architecture and interior design

Architecture design and interior design deals with multiple volumes composition or furniture's, materials, fabrics combination. Architect need to test multiple option and visually understand the effect and qualities of space, functionality and aesthetics in order to choose the most suitable solution. Gaming tools allow them to make composition by using already made blocks, or design interiors by picking furniture and decorative elements, make multiple combinations and test their visual effect. Various applications allow to compare compositions with other users.

Video games, as playful spaces, may improve the representation of interior, architectural and urban design projects, not only for visualization of purposes, but also for exchanging ideas, receiving feedbacks and evaluating different options in real time. New virtual reality (VR) and augmented reality (AR) representation and visualization techniques, as well as new game tools that allow users to play with variants, colors, textures, human scale, environment impact of objects etc. in real time, allow professionals to troubleshoot problems before design is completed, and clients to have a friendly user experience in a way they have never had before.

Game tools contribute also to the creation of "digital twins" or virtual prototypes (VP) simulating real objects, architecture or urban systems. This means not only the physical reproduction in 3D, but also interactive tools, parameters, data which can be tested in real time.

5. Gaming tools for strategic management

Architects needs to predict and anticipate future developments for effective urban design and urban planning. Gaming tools for strategic thinking and management are typically used in many simulation and strategy games like sim City, Cities in Motion. These are rules to balance different factor or variables of scientific disciplines such as energy, transportation, infrastructure, waste, traffic management, control of economic growth and population, guarantee a sustainable development. Through these gaming tools is possible to manage various categories of indicators. The strategy to follow is oriented in response of the indicators.

6. Game tools for collaboration and remote work.

Video games as social space and contested space allows for an increased level of engagement discussion and collaboration between designers and the public. They offer a tool for social engagement that facilitates the design phase. As part of the rules, for participant can be created a hierarchical model with competences and behavior patterns so that each actor knows his role in the design. It is a sort of collaboration diagram, that represents the way participants share ideas and interact with each other.

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