

GAMITECTURE: REPRESENTING ARCHITECTURE AS A DESIGN TOOL

by
Orhan Çeliktürk

Submitted to Graduate School of Natural and Applied Sciences
in Partial Fulfillment of the Requirements
for the Degree of Master of Science in
Architecture

Yeditepe University

2021

GAMITECTURE: REPRESENTING ARCHITECTURE AS A DESIGN TOOL

APPROVED BY:

Assist. Prof. Dr. Aslı Can Varon

(Thesis Supervisor)

(Yeditepe University)

.....

Prof. Dr. Ece Ceylan Baba

(Yeditepe University)

.....

Assist. Prof. Dr. Güven Çatak

(Bahçeşehir University)

.....

DATE OF APPROVAL:/....../2021

I hereby declare that this thesis is my own work and that all information in this thesis has been obtained and presented in accordance with academic rules and ethical conduct. I have fully cited and referenced all material and results as required by these rules and conduct, and this thesis study does not contain any plagiarism. If any material used in the thesis requires copyright, the necessary permissions have been obtained. No material from this thesis has been used for the award of another degree.

I accept all kinds of legal liability that may arise in case contrary to these situations.

Name, Last name

Orhan Çeliktürk

Signature

.....

ACKNOWLEDGEMENTS

I would like to thank one of the academicians I value most, also my precious friend in my life and my thesis supervisor, Assist. Prof. Dr. Aslı Can Varon for her continuous support, motivation and worthwhile references during my MSc study and dissertation. In addition to taking part in this research, working and attending with her valuable master courses provided me reputable experiences and courage to work harder for further achievements.

I would like to specially thank Prof. Dr. Ece Ceylan Baba, our head of department for being a pioneer for my videogame and architecture studies, by participating Workshop I course that, encouraged me to write an interdisciplinary research and let me to believe in independently.

I also would like to express my gratitude and special thank for Assist Prof. Dr. Burçin Başyazıcı, for her respected academic knowledge and skills which I have gained from the course Psychology for Architects and also during my graduate education for her academic approach, the way she thinks, supports and ideal ethical understanding that I respect.

Another thanks to my dear professors and academic staff in the Department of Architecture Assist. Prof. Dr. Pınar Çalışır Adem, Assist Prof. Dr. Moira Valeri, Assist. Prof. Dr. Cem Topçu, Assist. Prof. Dr. Faruk Can Ünal, Research Assist. Şafak Cudi İnce and Research Assist. Erdal Kondakcı, for supporting me during my teaching assistant, for being with me and for reflecting their good approach to me.

At the same time, which they inspired me everywhere during my graduate education; I would like to express my gratitude to my spiritual colleague and favorite friends, Gizem Hatipoğlu, Merve Cengiz, Yiğit Kayış, Şan Yalçın Şarabil, Sinan Yasan, Research Assist. Pınar Lütfiye Alkan, Ezgi Özkoç, Tansu Doğan, Esra Nur Pelen, Mehmet Berkay Sülek, Ozan Yavuzarslan, Cem Konukman, Ceren Konukman and Can Şaylıman who listened my thesis and supported me.

Also, I sincerely thank to Game designer Emir Yardımcı and Scriptwriter Can Kantarcı for their precious contributions. Finally, I would like to thank my family for their lifetime support.

ABSTRACT

GAMITECTURE: REPRESENTING ARCHITECTURE AS A DESIGN TOOL

Architecture has been growing, refreshing, and be in charge of adapting itself of the 21st centuries necessities day by day by following up to date with some significant applications, tools, and technological improvements. Especially, architecture and digital world combination that designers used in representation for their architectural projects have been knitting up, integrating through all art and architectural studies. Architecture started to prepare itself for the upcoming future of other disciplines like computer science, videogames, and virtual reality. Especially, videogames have conquered us and make a huge market of entertainment and economy sector all over the globe. With the development of technology and advancement of representing spatiality of video games, the space of a game comes from the act of playing, from the gameplay which is seen on screen that the way gamers play videogames itself. The spaces of the digital games that contribute themselves through "space" "time" and "play" are the only beginning.

In this thesis, it is tried to reveal that, the video game elements may improve some new perspectives, knowledge and questing the representation of architecture as a next generation design medium because its technological possibilities. This study tries to focus on game engines and game theory by examining and explaining the possible representation and applications of new design mediums for architecture.

Another promoting methodology of the thesis is based on playtesting, which offers architecture as a new potential medium of designing architecture. "Assassin's Creed: Syndicate" video game is determined as a case study located in London's Victorian Period will provide to examine the spatiality of Victorian England. The research also contains supporting qualitative and quantitative scientific methodologies such as surveys, interviews, experiments, playtesting, literature review, media studies and scientific articles.

ÖZET

GAMITECTURE: MİMARLIĞI BİR TASARIM ARACI OLARAK TEMSİL ETMEK

Mimarlık, bazı önemli uygulamaları, araçları ve teknolojik gelişmeleri takip ederek 21. yüzyılın ihtiyaçlarını günden güne geliştiriyor, yeniliyor ve uyarlamaktan sorumlu olmakla yükümlü. Özellikle, tasarımcıların mimari projeleri için temsilde kullandıkları mimari ve dijital dünya kombinasyonu, tüm sanat ve mimari çalışmalarla bütünleşerek örülmüştür. Mimarlık, bilgisayar bilimi, video oyunları ve sanal gerçeklik gibi diğer disiplinlerin geleceği için kendisini de beraber katarak kendini hazırlamaya başladı. Özellikle, video oyunları insanlığı fethetti ve tüm dünyada eğlence ve ekonomi sektörünün de büyük bir pazar yaptı. Teknolojinin gelişmesi ve video oyunlarının uzamsallığını temsil etmenin ilerlemesiyle birlikte, bir oyunun alanı, oyuncuların video oyunlarını oynama şeklinin ekranda görüldüğü oyundan, oyun oynama eyleminden gelir. Dijital oyunların "uzay", "zaman" ve "oyun" yoluyla kendilerine katkıda bulunan alanları sadece bir başlangıçtır.

Bu tezde, video oyun öğelerinin bazı yeni bakış açılarını geliştirebileceğini ve mimarlığın yeni nesil bir tasarım aracı olarak temsil edilmesini teknolojik olanakları nedeniyle sorgulayabileceğini ortaya koymaya çalışmıştır. Bu çalışma, mimarlık için yeni tasarım ortamlarının olası temsilini ve uygulamalarını inceleyerek ve açıklayarak, oyun teorisi ve oyun motorlarına odaklanmaya çalışmaktadır.

Tezin bir başka teşvik edici metodolojisi, mimariyi yeni bir potansiyel mimari tasarım aracı olarak destekleyen playtesting'e dayanmaktadır. "Assassin's Creed: Syndicate" video oyunu, Londra Viktorya döneminde yer alan bir vaka çalışması olarak belirlendi ve Viktorya dönemi İngiltere'nin mekansallığını incelemeyi sağlayacak. Araştırma ayrıca anketler, röportajlar, deneyler, oyun testi, literatür taraması, medya çalışmaları ve bilimsel makaleler gibi nitel ve nicel bilimsel metodolojiler ile desteklemektedir.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	iv
ABSTRACT.....	v
ÖZET	vi
LIST OF FIGURES	x
LIST OF TABLES.....	xvii
LIST OF SYMBOLS/ABBREVIATIONS.....	xviii
1. INTRODUCTION.....	19
1.1. AIM OF THE THESIS	20
1.2. SCOPE OF THE THESIS	20
1.3. METHODOLOGY OF THE THESIS.....	20
2. REPRESENTATION OF ARCHITECTURE.....	22
2.1. GAMES: A VISUAL METAPHOR OF ARCHITECTURAL REPRESENTATION.....	22
2.2. GEOMETRY, GRAVITY AND SPATIALITY: SPATIALITY AND GEOMETRY OF VIDEO-GAMES.....	26
2.2.1. The Architecture and His Shadow	26
2.2.2. Gravity and Geometry and Natural Rules of Spatiality	27
2.3. ARCHITECT AS A PLAYER OF THE SPACE.....	28
2.3.1. The Architect as Game Designer	28
2.3.2. Top-Down vs. Bottom-up Approach	29
2.4. SCENARIO OF VIDEO-GAMES	31
2.4.1. Decisions Determine Scenario of Games	32
2.4.2. Level Design and Scenario Collaboration	34
2.4.3. Game Design Document - Demand List of Architectural Projects	34
2.5. THE GAME ENGINES.....	35

2.5.1. What is a Game Engine?.....	35
2.5.2. Key Game Engines	36
2.5.2.1. Unreal Engine	36
2.5.2.2. Unity	38
2.5.2.3. Cry Engine.....	39
2.5.2.4. Motion Effects and Graphics on Game Engines	40
2.5.3. Materiality and Lighting	43
2.5.4. Sound of Games and Effect on Spatiality	45
2.5.5. Graphic Impact	46
2.5.6. Game Engines as Architectural Spaces, Applications	49
2.6. ARCHITECTURAL DESIGN PROCESS	52
2.6.1. Design Problem.....	52
2.6.2. Objectives, Rules and Limitations of Solving Architectural Design Problems.	53
2.7. VIDEO-GAME DESIGN PROCESS.....	56
2.7.1. Objectives, Rules and Limitations of Designing Video Game Process.....	56
2.7.2. Comparing and Similarities of Games and Architectural Design.....	60
2.8. GAME ENGINES FOR ARCHITECTURAL DESIGN BENEFITS	61
2.8.1. Free to Design and Functional User Interface	61
2.8.2. User Friendly	62
2.8.3. Integrate with CAD and BIM Software	62
2.8.4. Experience of Spatiality in a Walk Through	63
2.9. HISTORY AND GENRES OF VIDEO- GAMES	65
2.9.1. M.M.O.R.P.G.....	69

2.9.2. Real-Time Strategy (RTS)	70
2.9.3. Simulation.....	71
2.9.4. Arcade.....	74
2.9.5. Sports and Competition	76
2.10. CAMERAS OF VIDEO GAMES	77
2.10.1. Perceive the Game	77
2.10.2. Perceive via the First Person.....	79
2.10.3. Perceiving via Third Person.....	81
2.10.4. Perceive via Top-Down Plan, Isometric Perspective and "God Effect"	82
3. LITERATURE REVIEWS OF REPRESENTING ARCHITECTURE VIA VIDEO GAMES	90
3.1. VIDEO-GAMES AS ARCHITECTURAL HERITAGE	90
3.1.1. Assassin's Creed: Unity.....	91
3.1.2. Ubisoft made it: Revival of Notre Dame Church after Fire	92
3.1.3. Tom Clancy's The Division.....	93
4. REPRESENTING ARCHITECTURE VIA VIDEO GAME: ASSASIN'S CREED: SYNDICATE AS CASE-STUDY	94
4.1. REPRESENTING OF SIGNIFICANT BUILDINGS AND ARCHITECTURAL STYLES OF THE PERIOD	95
4.1.1. Factories and Mills.....	95
4.1.2. Landmarks of London City.....	100
4.1.3. Landscape and Orientalism.....	102
5. CONCLUSION	105
REFERENCES	108

LIST OF FIGURES

Figure 2.1. On the (left) demonstrates that Top-Down approach of Architectural Representation studies Architect/Designer creating abstract planning; On (right) Bottom-up approach of the Video Game approach that conducts directly user's experience of the building [4].	31
Figure 2.2. (a) Unreal Engine 4 can used as a representation of architectural visualization as indicated from the rendered image. (b) It also may use as a 2D game design as Tappy Chicken (2014) with the regeneration of Flappy Bird (2013) created by a single artist [4],[24],[25].	37
Figure 2.3. (a), (b) The footages from the scenes that used Unreal Engine for Star Wars: Mandalorian tv series by supplying the virtual exterior and interior spaces [26].....	38
Figure 2.4. (a) Unity 5 advanced rendering technologies. (b) The game engine used for mobile gaming such as Monument Valley [4],[27],[28].	39
Figure 2.5. Cry Engine created Crysis 3 (2013) with stunning graphics and representing architecture in a realistic graphics with powerful level designs [4],[33]......	40
Figure 2.6. Footage from Devil May Cry5 experiencing spatiality in RE game engine [34].	41
Figure 2.7. The footage from Combat Motion graphic from Devil May Cry5 [35]......	41
Figure 2.8. (a) The videogame was inspired from the ceiling and structural system of Galleria Vittorio Emanuele II. (b) Devil May Cry 5 scenes the anticipation of Passages and stores of Galleria Vittorio Emanuele [36].	42
Figure 2.9. The floors reflecting on lighting and the concrete material of the building may be seen in a realistic with Ray Tracing on Control, Screenshot on gameplay [40].	44

Figure 2.10. The scene from game presenting lighting and materiality when the Ray-Tracing Technology is switched on [40].	44
Figure 2.11. (a) On the left image, it may be seen that the ray tracing is switched on. The reflections, shadows, lightning, textures and the finished materials may be more realistic. (b) On the right image indicates that, ray-tracing feature is switched off and the reflections, material details, lighting and shadow details seen blurred [41].	45
Figure 2.12. The screenshot from Rayman Game launched on PS1 [43].	46
Figure 2.13. (a) Arc the Lad's characters. (b) A scene that providing changeable camera perspective, first the game presents an axonometric perspective that perceiving the spatiality with zooming-out. (c) Then, the camera zooms in and able to see the gameplay in more detailed way [43].	47
Figure 2.14. (a) On the left, footage from Seattle Public Library designed by Rem Koolhaas physical building. (b) On the right, footage from the virtual representation of Seattle Public Library from the Last of Us Part:2 video-game rendering with advanced environment elements such as texture, shadow, geometrical process [46].	48
Figure 2.15. Objects refer as ArchiCAD's models that used B objects are used the same modelling at Unity [48].	50
Figure 2.16. (a) On the left the rendering image was taken from ArchiCAD software may seem the building in less detail. (b) On the right rendering image was taken from Unity game with an advanced detailing spatiality engine [48].	52
Figure 2.17. The image of the Bauhaus, the first school of architecture located in Dessau, Germany presented the first architectural design studio culture and spread all over globally [57].	54
Figure 2.18. Cyberpunk videogame and Cyberpunk Dystopian City concept drawing, Illustrated by Emir Yardımcı [71].	56

- Figure 2.19. (a) Cyberpunk video-game concept, architectural building templates. (b) Vehicle concept drawing, Illustrated by Game Designer Emir Yardımcı [71].57
- Figure 2.20. The first concepts of the "Toe&Jam" video-game characters. (a) On the left illustrates "Toe&Jam" [68],[72]. (b) On the right image shows "Earl" character [68],[72].57
- Figure 2.21. Cyberpunk game sketches of story-telling architectural building and vehicle concept drawing, Illustrated by Emir Yardımcı [71].58
- Figure 2.22. (a) Cyberpunk video-game sketches and character drawings. (b) A detailed outfit design concept drawing, Illustrated by Emir Yardımcı [71].59
- Figure 2.23. The first videogame, Space War created for Military purposes [91] 67
- Figure 2.24. The footage from the "Pong" game that chasing the dot with the bar that given to you [94]. 68
- Figure 2.25. Footage taken from Wolfenstein; the first FPS (First Person Shooter) Game created with Wolfenstein 3D Game Engine [95]. 68
- Figure 2.26. The Footage from M.M.O.R.P.G. Game: New World [96]. 69
- Figure 2.27. The footage from the Sim-city videogame that may observe to design a virtual city that designed and constructed according to the ideas of the player with becoming a "virtual mayor" [99]. 72
- Figure 2.28. The footage from The Sims 4 game representing an ideal, designed house creation made by players by providing to become "virtual architect" [100]. 72
- Figure 2.29. (a) On the left, footage from House Designer videogame that presents a scene of the construction phase of a single house, foundation phase of the single house. taken screenshot from [104]. (b) On the right House Designer videogame showing the exterior and interior walls building and continue to build it [104]. 73

- Figure 2.30. (a) On the left, footage from House Designer videogame showing a worker building a wall for interior architectural organizations constructed and designed single family house project in. (b) On the right, 3D perspective camera that illustrates all the finishing, windows with landscape design [104]. 74
- Figure 2.31. The pong game with a physical Atari mini arcade gaming. 75
- Figure 2.32. The footage from the Can you see me now? videogame that represents the virtual players can be detected [106]. 76
- Figure 2.33. The Footage from NBA 2k 2020 Los Angeles Lakers vs Los Angeles Clippers basketball match interior space represented Staples Center, Los Angeles, California [107]. 77
- Figure 2.34. The footage from Cyberpunk 2077, the F.P.S (First Person Shooter) game that the player is riding a motorcycle that enable to experience the dystopian city and its architectural design with human-eye perception. [114]. 80
- Figure 2.35. The footage from Silent Hill-4 video-game that perceive in First Person Game Camera interacting with Henry's apartment [116]. 80
- Figure 2.36. The footage from the gameplay of the videogame "Minecraft" creating, extracting and building the site depend on your sources. [119]. 81
- Figure 2.37. The footage from the gameplay of the Star Wars: Jedi Fallen that experiencing the game and virtual space with third-person perspective by observing and experiencing of the character's movement [121]. 82
- Figure 2.38. The videogame "Greatest Grids" represents the New York's Manhattan as perceiving top-down plan projection by experiencing and interacting with the city [118],[122],[123]. 83
- Figure 2.39. The image from Cities: Skyline (2015) videogame that represents the desired city that observing in an isometrical perspective camera [124]. 84

- Figure 2.40. The image from Cities: Skyline (2015) videogame that playing the desired city as a "God" observing in a top-down perspective camera [124]. 84
- Figure 2.41. The footage from Netflix's Black Mirror: Bandersnatch that allows watchers providing to select and manipulate the scenario by making a decision through duration for the game designer Stefan Butler acted as Fionn Whitehead, game designer [126]. 85
- Figure 2.42. The footage from Netflix's Black Mirror: Bandersnatch videogame provides a mazing by unlocking the spaces and make some decisions according to game structure [127]. 86
- Figure 2.43. Disneyland California, Anaheim represents a Simulacrum that replacing the reality and presenting a substitute hyper-real spaces [129]. 88
- Figure 2.44. The map that represent the area of Disneyland California, Anaheim represents the theme-park area that takes place on a territory [129]. 88
- Figure 3.1. The footage from the representation and reconstruction of the Eiffel Tower as virtually in Assassin's Creed: Unity (2014) [137]. 91
- Figure 3.2. The Notre Dame Cathedral from Assassin's Creed: Unity reproduction for the videogame refers the representing precisely [140]. 92
- Figure 3.3. The footage from the screenshot showing the Manhattan Bridge reproduction at Tom Clancy's: The Division's virtual New York City [141]. 93
- Figure 4.1. The representation of interior design of a coal-mining factory that structured in wood, steel and cast-iron materials [149]. 96
- Figure 4.2. The truss structural elements were constructed for the building and represented by the videogame [149]. 96
- Figure 4.3. A scene with acting child labor that children are working and gathering around in a bowl [149]. 97

Figure 4.4. Whitechapel Sawmill designed faithfully to the history for the videogame [149].	97
Figure 4.5. The footage from a brewing company building designed as a British style that revival of the romantic Gothic style [149]......	98
Figure 4.6. Greenhouse was constructed for the videogame with iron and steel materials [149]......	99
Figure 4.7. The interior space of a fabric building that the finishing of floor, ceiling and door was made from wood [149].	99
Figure 4.8. The realistic height and proportion of Big Ben may be observable in videogame [149]......	100
Figure 4.9. The details of Big-Ben in videogame [149].	101
Figure 4.10. Virtual Westminster Abbey designed in all the construction and architectural details presented [149].	101
Figure 4.11. The character is traversing with the rope at the top of the Westminster Palace, seen its proportional symmetrical courtyard [149].	102
Figure 4.12. The rosace detail of the Westminster Abbey from the gameplay, indicates from the material detail, gold finishes and ornament details from Assassin's Creed: Syndicate [149]......	102
Figure 4.13. Footage from the screenshot of the landscape garden near the Westminster Palace that may be seen with the symmetrical garden design with a tiny pool and oriental streetlights [149].	103
Figure 4.14. Footage from the videogame created an arbor, which is a kind of a landscape artifact may see ornamentation and orientalism in structural details [149]......	104

Figure 4.15. Footage from the structural system of virtual space made from iron and its ornament details [149].	104
---	-----



LIST OF TABLES

Table 2.1. Comparison of the results timing that taken from ArchiCAD render and Unity rendering outcomes. Time presented in: HH: Hours, MM: Minutes; SS: Seconds, Milliseconds: 00.Taken Screenshot [48].	51
Table 2.2. The slices that attained the survey and 63.2 percent answered absolutely yes for the question: "Does the additional interaction (e.g., Open doors, walk through) benefit the visualization?" [66].	64
Table 2.3. The slices that attained the survey and 78.9 percent answered yes for the question: "Did you prefer the video presentation over the interactive walk through?" [66].	64
Table 2.4. The slices that attained the survey and 89.5 percent answered yes for the question: "Do you think interactive walk through's have a place in the future?" [66].	65
Table 2.5. The graph illustrates the one of the key elements to fulfill the Eudaimonic experience for the players and users' audiovisual aspects including camera perspectives [108].	78

LIST OF SYMBOLS/ABBREVIATIONS

ANL	Astana national library
BAFTA	British academy of film and television arts
BC	Before century
BIG	Bjarke Ingels Group
FPS	First-person shooter
GB	Gigabyte
GDD	Game design document
GFx	Graphics card
GUF	Graphically user interface
iOS	iPhone operating system
MIT	Massachusetts Institute of Technology
MMORPG	Massively multiplayer online role-playing games
PC	Personal computer
RAM	Random access memory
RPG	Role playing games
SSD	Solid state drive
USA	United States of America
UDK	Unreal development kit
US	United States
VR	Virtual reality
XR	Extended reality
2D	Two dimensional
3D	Three dimensional

1. INTRODUCTION

We are obsessed and love with video games so much. Do we? Why? What features of Games that fascinate people so much? How can video games captivate so many gamers?

Videogames endow to people experience in a full of fantasy, stirring immersive spaces that people can interact and witness since it has launched on the world, for the first time. Games let us to turn into any avatar, character, genders that customize on games and provide freedom on the user with a full open-world area. Despite, gaming market, provide freedom, experience architecture by exploring the virtual space and customization, game corporation and game designers ought to integrate the game engines through with architectural offices and corporations. When 21st century come up with the advancement of technology, the representation and experimentation of architecture updating, people are demanding more visuals, advance renders and even also experience almost real or realistic graphics. In this research, it is tried to aim with this hypothesis that video game engines and video game theory may open up a new era for the architectural representation that, game engine software provides navigating the spatiality with human eye perception on architectural design, presenting an advanced renders and visual with lighting, texture, shadow, reflection and graphically advanced spatiality, representing the historical periods of cities in architectural manner with detailed by feeding from game theory. To reveal this hypothesis as much as possible, the research opens and tells first the theoretical approach of how representation of architecture update from past to future, and how game designers and architects tries to represent their spatiality. Then, this master thesis asserts about the video- game engines and its potential features for architectural representation. After that, the dissertation briefly examines about the game theory with bounded with how videogames represent architectural space with different perspectives Finally, the research examines the case study video game: Assassin's Creed: Syndicate by focusing on the Industrial Revolution spatiality created from game engine that, how the video-game engine represents the spatiality with concrete reference. The research uses some methodology as reviewing literature with connected video-game engines and architectural spaces, experiments, charts, and some render outcomes for one building created by C.A.D. and video-game engine software, playing some videogames such as Control, Devil May Cry 5 Assassin's Creed: Syndicate to experience

the ray tracing technology and held some interviews with professional game designers to process the gaming sector, video games and architecture relation.

1.1. AIM OF THE THESIS

Video Games have a huge visual and conceptual impact as a generous entertaining medium for decades. Competition, splitting the screen and playing with someone who interests playing computer games are always attracting for the players. From racing, RPB (Role Playing Games) to simulation would have liked to play a huge genre of computer games with friends. PlayStation and Xbox gaming consoles have been placing almost every house in the world. Interacting with the architectural space and environment of the game and also scenario might connect you to the game. This thesis aims to research and examine the potential role of video games and video game engines on how to represent the architecture and potential benefits on architectural design.

1.2. SCOPE OF THE THESIS

Because of the century that developing technology and shifting architectural approaches and representations, architects and architectural studios may struggle with the common C.A.D. (Computer Aided Design) and B.I.M. (Building Information Modelling) software to extract outcomes for their design studio. The research may open to examining the spatiality of video games impact of architectural renders and footages on video-game engines by researching and examining them as a new next generation representation and design medium of Architecture. In addition, the thesis takes a closer look on the benefits and functionality of video-game engines with the aspects of rendering outcomes as timing and visual quality to provide design freely and navigating the virtual spaces by walkthrough.

1.3. METHODOLOGY OF THE THESIS

The thesis is tried to brace the research with game engines as a tool for designing architectural design simultaneously real-time design environment with claiming qualitative and quantitative scientific methodologies such as: surveys, experiments, doing interviews with game designers, media studies and reviewing recognized scientific articles. Examining

of the features and some noteworthy benefits of game engines with supporting surveys for application to architecture is asserted strictly. In addition, the research will take a look on game theory and some significant video games graphics to promote the dissertation. Some experiments that studied is presented as comparison of rendering results between game engines and Cad based software. Finally, the thesis will take a closer look at "Assassin's Creed: Syndicate" as a case study game to promote the investigation as play-testing method.



2. REPRESENTATION OF ARCHITECTURE

2.1. GAMES: A VISUAL METAPHOR OF ARCHITECTURAL REPRESENTATION

As first chapter mention about how video-game engines and video game theory has a potential technological strength about representing architecture. In this part, the research will conduct the architecture and technology relation and why architecture need to adaptation of 21st century representation skills. Firstly, video-game engines may empower the architectural buildings and environments with all realistic visuals and renders. Video- game engines may let player/customer free to experience the spatiality with exploring and experiencing in an immersive outcome. Thanks to game engines and gaming theoretical background, architects and game designers may present their spatiality by integrating next generation advanced spaces.

Architectural Representation has been generating and transforming day by day as parallel to our technology and our demands of what we expect from architecture. The world has been facing rapid digital visual communication that reveals graphically advanced point of view. Technological and scientific advancements may support this everchanging representation in architecture. The traditional representation of Architecture is becoming non-sufficient for the demands of the 21st century. Architecture and Architectural Representation has to evolve, adapt and support with more digital instruments as visual and audiovisual aspects to represent itself [1].

"Architecture is a game". While this statement might seem bold, the two do have a lot in common, as American architect and Professor Wes Jones observes:

Like so much else today, the discipline of architecture has come to be taken less seriously by itself and by others. Architecture has been exposed, frankly, as a game. Both seem to demand a surprising amount of attention for (mere) diversions, perhaps because both are concentrated versions of their respective worlds: the game is a reduced slice of life, and architecture is an intensified version of the building [2].

It emphasized that the digital and virtual spaces make importance for the next generation architecture and spatiality. It also refers the video games and digital spaces will integrate deeply on architecture and design with promoting these quotes:

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 [3].

Videogames generally integrate space intensely and architecture may feed on this spatiality of games. Video games may become more trustable medium than any other traditional games concerning with the spatiality and architectural environment aspects. Spatiality may be reviewed from any videogames even it is two or three dimensional. From RPG (Role Playing Games) to simulation, strategy to FPS (First-person Shooter) titanic genres of games representing the environment of the scenario, also for the architectural design process when it experiences, the architectural spaces of video games and it may make a significant factor for the real architectural spaces [4].

Architecture may define as "art of designing buildings, or the style of a building and its connection with a specific period, place, or culture" [5]. The famous Roman Architect Vitruvius defined a good building is durable, useful and beautiful (*firmitas, utilitas, venustas*). After 2000 years, digital spaces created this principle might apply with Brouchoud's quotes:

Durability will be assured when poly count and mesh topology are carried out wisely and appropriate shaders are selected; convenience, when the arrangement of the levels is faultless and presents no hinderance to player navigation, and when each level is assigned to its suitable and appropriate user experience; and beauty, when the appearance of the work is pleasing and in good taste and looks fascinating [5].

The trends and methods of thinking, designing and creating spaces have been changing day by day to represent architecture. By developing technology and interrogation of architecture with virtual space phenomenology, visual perception of architecture, for the aspect of graphics concentrate the meaning and representation as spatiality. In addition, architects/designers begin to collaborate with some interdisciplinary sciences and techniques such as videogames, software engineering, computer science, visual communication etc. The upcoming outcome may be referred to as a mosaic knowledge that brings together as an abstract system for creating a vision. Vesely points out that, before it may be referred to how the modern visions, communications and video games promote architecture, the research may examine the principles effectuate visual of architecture [1].

Humankind has the innate ability to think, dream and critically criticized. By the advancement of technology, trends, thinking methods, lifestyles and demands have been shaping and changing. The traditional representation tools that preferred so far may insufficient and no longer updated enough for the 21st century. People are accessing an electronic era that interacting with the intersection with physical and virtual spaces that connect with telepresence of altered architectural spaces and graphics. Telepresence defines as a transformation of traditional fabric of architecture a new kind of reality structured by electronic media in which computers will weld seamlessly into the fabric of buildings and buildings themselves will become computers. It is the outcome of a long evolution [1].

By this changing, the forms may be reproduced, recombination of new types of cities, buildings, materials that comparing with the current engineering system.

Mies Van der Rohe claims that technology brings into open explicit in architecture and construction. He also adds it reveals "something" else and a "powerful" form. He asserts that architecture will be outdated and give place to technology [1]. Technology has been developing rapidly and will predominate into architecture. Materials may be developed and transformed with the development of material techniques according to the idea of Friedrich Schinkel. Mies van Der Rohe mentions the relation of architecture and technology with these quotes:

Architecture depends on its time. It is the crystallization of inner structure the slow unfolding of its form. A true symbol of our time [1].

Video games are significant factors that may be located in how architecture might be usable as a visual metaphor for the architectural design.

Second level of "Space Time Play" called "Make Believe Urbanism" focus on the game generated spaces that creating of digital cities for how the public spaces could be red occurred from and what may reproduce and present for near future. The part of this book commonly examines the representation of the city in videogames and the city as a metaphor for the vision of a socially metaphorical situation. How can be "played out?" and how the identity, culture, economy and social and private spaces could make a template, form and shape from this simulation [3].

It may be asserted that, this development does refer to 21st century. It can be seen that the architects and designers have changed the 50's of culture, lifestyle and also architecture with this statement:

When the modernist functionalist approach to architecture revealed itself as no longer useful for addressing contemporary artistic crises. For these "new" architects of the 50s, architecture had to relate to a kind of new humanism to which the physical and psychological presence of man in space was integral [6].

As it seems that the architects refer as a "player" to change the rules of the game and affect (users) people on its lifestyles, cultures as well. This situation represents us that the world is a "playful" world that every decade and anniversary changing and manipulating by the "player-architects".

With the support of video game engines, it let designers and architects may let free to design the architectural spaces from this kind of complexity [4]. Another significant factor that it might consider, the architect or designer is struggling with the use of representation with sketches, diagrams, graphics or physical models to present his/her design. Because of this reason, the architects refer as a "player" of his/her design he/she doesn't play just a game he/she plays as a "metagame" which symbolizes actual game itself.

The term "metagame" contains the Greek word for "after" or "beyond" meta, means that the traditional limits of the games are beyond, and was first declared in 1971 by Nigel Howard. Pencil lines represent only the physical doors, windows and other real architectural. Therefore, the design problems are fixed, translated and completed somehow by the architects and designers. On the other hand, by using the metagame; it creates some rules with applying naturally, while other new ones are introduced.

The designer sets and creates his/her rules externally and reformulates the rules of the "game". A critique of player and game metaphor that supports fort his phenomenological aspect may refer by Chris Totten. Totten suggests that the architect is not a player, but a designer of games, which others (the building's users) play. He also points out that, video games may use as a new architectural design instrument by making less effect of the traditional top-down design process. The video game engines may use as a design tool for the next generation of the architectural design process [4].

As a becoming trend, the video game engines have become more wide range of interactivity, user friendly and ease of accessibility and affordability makes one of the most attractive design tools for architecture design. Video game engines also provide designers to interact with the multiple varieties of designer video games, exclusive contents and represent a multiplicity of media rather than one side and let us professionally interact opportunities.

2.2. GEOMETRY, GRAVITY AND SPATIALITY: SPATIALITY AND GEOMETRY OF VIDEO-GAMES

2.2.1. The Architecture and His Shadow

For the understanding, the ontology of architectural space, the structured geometry and reflection of light must be examined. In the Renaissance period, geometry and light take an important role in architectural representation. This instrument reveals the transformation of geometry and science to building and space, it is as a pure conceptual structural element of architecture. When it comes to our modern times, architecture also discusses the geometrical representation of real and imaginary spaces. If it has to be added an instance, Daniel Libeskind's Drawing, "The Architecture and His Shadow" tries to reveal the possibilities of the representation of geometry and also tries to find out architectural relation between real and imaginary space. Libeskind's drawing generally refers as "deconstructive construction" and represents as its spaces as pre-sense of geometric structure, in a pre-objective phase of experience and come up with the formalizing the objects in a universe. The drawings take significance for the transition from actual to imaginary spaces by revealing geometrical representation to spatial relationships. It may be referred to as "the autonomy of geometrical representation". The fluidity of all the forms and shapes that combine with flashes through real to imaginary space. It may be compared and interpret with "Atopia" term with Libeskind's Drawing. Atopia is the connection between paper projects and virtual spaces bring utopian thought into the present. McKenzie Wark describes virtual game spaces as "atopian" which is the quantitative utopia by any other name [1].

The drawing alternatively might be assumed as a machine that constructive possibilities on the boundary of actual and imaginary spaces. This representation as a transition from space of real possibilities to space of possible realities. This approach brings imaginary spaces to

the transformation itself by the meaning of the process itself. Hereby, it may stir up transformation of flow, spirit and all the humanistic issues that bring the architectural representation.

2.2.2. Gravity and Geometry and Natural Rules of Spatiality

Evans asserts that drawing is a medium of architectural spaces. Vectors and pixels for digital drawing also refer to relative autonomy. Indeed, Architectural spaces that built at zero gravity or gravity depend on may represent itself and be named as a visual work of art [7].

Afterwards, the thesis will show up and reveal the possible design rules of architecture and video games also for geometry and spatiality in games and architecture, Jones emphasizes about the relation between architecture and its game rules as criticizing with their common design rules:

This basic activity of architecture is linked to the idea of rules in general at a "deep" level, where architecture becomes a metaphor for "organization" generally. Here the "natural" rules of architecture spillover from the building's concerns with gravity and geometry into the realm of logic. The two go together: value cannot exist, much less be "added" or appreciated, unless it can be recognized and described that is unless there are some "rules" by which it might be identified, measured judged [2],[4].

Cook also believes that architecture has a mission to reflective and representative feature for revealing spatiality and asserts with his quotes:

Drawings are therefore both creative and reflective. They shape their reality while representing another [8].

This phenomenal approach also two-dimensional projects of the paper plane and orthogonal projection that is used to three dimensional objects encourages of the frontality of architecture. In the next chapters, the thesis will examine deeply about the phenomenological aspect of architects and designers as a "player" of the buildings and examine the game engines as a possible design medium, also adverting architectural and video games design process, methodologies of design principles, rules and narratives of both interdisciplinary departments.

2.3. ARCHITECT AS A PLAYER OF THE SPACE

2.3.1. The Architect as Game Designer

The idea of architecture as game approach comes from the similarities of designing architecture or creating the environment itself as playing a game. By playing the game, which the player can experience the architectural design may be the assessment of using and experiencing the buildings itself. American architect and professor Richard Bender noticed this conceptual shortcoming, stating that:

What has become equally important to me is the understanding that, as architects, we not only play in this way (using the moves and the rules of the game), but we design games which others play [9].

This approach may give authority for architects on "architect as a game designer" approach that inventing scenarios, manipulating buildings and spaces as a "creator-player" effect and some frameworks which he/she can play in his/her design process. Bender also emphasizes that; architecture is a kind of a "game" those architects create a scenario of our built environment and settle us with a range of different open-world public/private spaces just like video games represent to players.

Besides, there have been some experiments that thinking and playing video games as architects may develop design and develop the design language and knowledge. The experimental study was conducted by Taiwanese PhD. researcher Sheng-Fen Chien is expected from students to analyze designs of a particular style or by a particular architect and develop (board and web-based) games that when played, it could produce designs of the style of the architect. While Chien was observing the stages and process of the experiment, he figured out that:

It enables students to gain design knowledge as well as to be able to view design constraints constructively [10].

The experiment may also assert that video games could possibly apply the essential rules and design parameters of video games to the discipline of architecture. This experimental study also locates on game designer and an architect student Chris Totten's master thesis "Game Design and Architecture" that he examines the strong and powerful design method of video games can easily be used to get rid of the traditional design methods of architectural

design. Even video games and architecture may differ fundamentally, they are both fields of design. Both tries to deal with the connect and assemble of the parts of the whole finish product and let user-experience valuable and interesting spaces. The next chapter reveals about the comparing the one of the traditional design perspectives of architecture and design perspective of videogames as refer top-down vs bottom-up approach.

2.3.2. Top-Down vs. Bottom-up Approach

The idea of designing and planning any building might be similar to designing a videogame. Experiencing and interacting with spaces may reference also simulation games. Both Game designers and architects also shape our habits, lifestyles and the way people meant to be "played" for their life.

Some experimental research claim that architectural designing and planning process represents the spatial elements of the building by using a top-down approach that provides the building by observing and analyzing on a site plan and layout the general plan of the space that shows up all the building elements, context, territory, technical information that architect/designer may show on 2d projection. Then, the architect can show and represent the details of the space by using length and width sections that reveal all the constructional and other architectural elements. Finally, by that architect may show up the potential architectural outputs by using some 3D software like 3DsMax, Revit and Sketch-up by supporting of the basic three-dimensional design medium of videogames and experiencing some perspectives, volumes and heights of the building itself.

However, for video games, firstly, game designers experience and interact of bottom-up approach opposite of the architectural design medium approach that, interact generally human eye perspective. This method starts from understanding and conducting of the basic experience of the user and different possible scenario and spatiality that how the character or a person can perform, move, interact and experience from that built environment. These actions refer as a "core mechanics" and respected as a natural rule of the game world [4].

If one of the significant architects Mies Van Der Rohe protests Architecture: "form follows function" for the videogames may be: "pixels follow core mechanics".

Generally, architects' control and adjust their architectural projects and test their scenarios by user's demands, context and value of the spatiality according to the territory and layouts. This approach might be as a "playtesting" of the game that let architects/designers see and observe what will happen and what possibilities will occur in the next decades. Both game designers and architects place a dramatical situation of creating and setting up future spaces and rules of our built environment. The architects and designers create and design their projects and plan to simultaneously may "control" and "simulate" the scenarios of users' life and lifestyles.

Besides, video game engines have a chance to test and play the video-game design at the same time and this approach might be beneficial on architectural representation to reduce the disadvantages of a top-down process. Totten supports this phenomenological approach with this quote:

"This eventually results in the final, more meaningful product. As a generator for architectural designs this is where the true potential of the core mechanic lies: in the ability of the designer to prototype a design for an audience and change the concept quickly to better fit the building's intended function if it does not fit. As long as a building's experimental qualities remain indicative of the core mechanic, the form of the building itself can be exchanged many times throughout the design process without losing sight of the design's overall "goal" [11].

The architectural representation of the top-down approach might not help to solve the design problem alone, even though it tries to expose the possible design solutions, may maintain the complexity of the design problem. The bottom-up method may help not to alienate the built-environment and also interfering the possible problems instantly. It may also provide feedback and ease of steer on the design process of the architectural space and environment. For that reason, the bottom-up method might be valid for upcoming architectural representation by unveiling spaces for users deeply in an advanced mode.

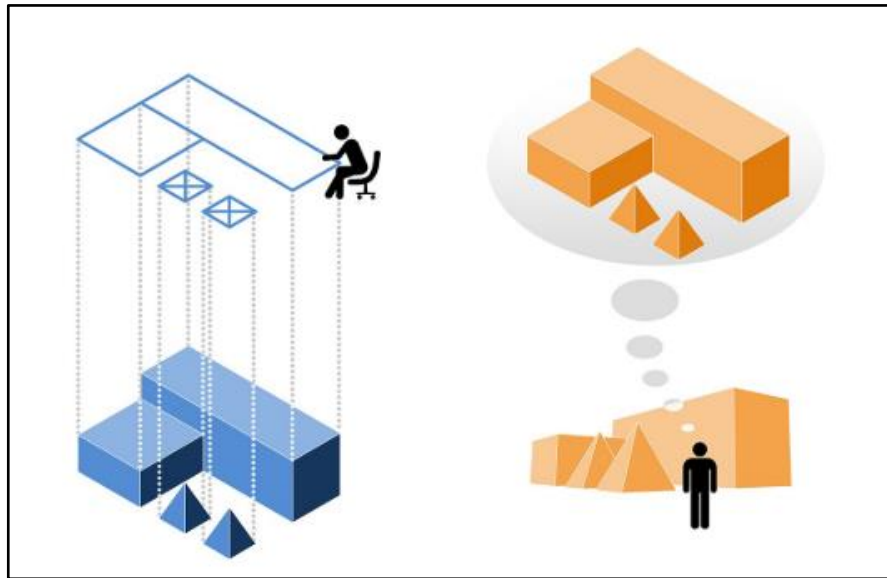


Figure 2.1. On the (left) demonstrates that Top-Down approach of Architectural Representation studies Architect/Designer creating abstract planning; On (right) Bottom-up approach of the Video Game approach that conducts directly user's experience of the building [4].

2.4. SCENARIO OF VIDEO-GAMES

Videogames has a dramatic effect on players' perception and touch their feelings with an immersive storytelling by presenting with a blessed scenario-based scenes, themes, movies and titles. The scenario may define as a specification, which forces a partial, or total ordering in the game execution [12]. Scenarios might have a descriptive partial scene that navigates and give players a clue to solve the puzzle of videogames. It provides users to set of actions that player must take an action to accomplish the level.

To address a significant scenario of any videogame, it should have a strong idea, story and script that attribute and addicted to the player. In addition, stories and gameplay of videogames may increase emotional immersion. Stories may become a potential entire part of the game itself [13].

Structure of story may affect dramatically significant factor. Two fundamental key elements of story, pacing that evolves the game and dramatic flow, mounting and diving through action [13]. There are some discussions that, scenario-based games, storytelling and scenario relation. Rollins asserts that, videogames as story-based ones may have a huge impact as a

significant movie for the players [14]. Besides, even gameplay may have a significant impact on how to play the videogame with navigating through the scenario and narrative of the videogame. Gameplay means as "a particular way of playing a game" which parts in three core elements that Perspective, Interaction Model and Gameplay [15][16].

2.4.1. Decisions Determine Scenario of Games

When it may examine today's perspective of video-game scenarios, some video-game stories endow players to decide and manipulate of the scenario and storytelling of video-game conclusion. By giving some speech-decision or acting decision, players may play and experience different characters and scenarios of dream environments. Witcher 3, one of the significant games of entertainment sector that tells a story on a magical Mediaeval beast world a nominee and won award of game of the year has some alternative scripts that navigate and change the scenario of the game and player can customize their own Witcher as a characteristic and behavioral aspect.

In contrast, some significant videogames such as SimCity and The Sims, may inspire and implement the real time social and earth-bound actions, stories and scenarios that witnessed of our built environment.

SimCity was designed by Will Wright used architecture for solution of social life and revealed users with an immersive 3D home architectural spaces and appliances. In this game the player can find any products, construction materials, home stuffs and many necessary architectural values too. The player may find different people with sex, skins, nationalities and lots of different pets as real life. Users may construct a house, buy a car, find a job, talk with people, even date with any people [12]. Players can customize their Sims by dressing up some clothes, making-up if they would, add some personalities and even determine he or she as a good person or bad person, smart or he or she is a romantic, flirty person. After that, player may create their own scenario by implementing and designing their dreamy house for their Sims and put them in a virtual space. Architectural design may also affect and manipulate the scenario and story of the gameplay for The Sims that player create rich Sims or poor as they level up by getting a job, earning money and social with other digital sims. For this reason, The Sims may become a representation and simulation of our social model of people's personal real life, socio-cultural conditions and built environment relation with

sociological aspects. The player may find all human actions, needs and source of our life on the game itself.

As revealing outstanding scenario and providing a chance to determine the variation and progression of video games, this virtual scripts and stories may represent the upcoming physical real life that people may aware and reminiscence and experience in their future life. If it may promote this argument deeply from Deleuze's concept of "virtual-actual" philosophy with a reflector effect. Firstly, it may be understood that the "virtual-actual" duo may relay the "possible-real" phenomenon, so that they are more capable for difference or the regeneration [17]. Transcendental concepts may not fulfill the "the conditions of possible experience. It is a virtual phenomenon that provides a genetic or fertile condition of real experience which is establishing of the title or story. When it may think about the process of the "possible" itself as a "pre-existing" reality, it may examine that the real may refer as something more possible. Because of this reason, possible may be named as "realized" in the real. The real may resemble of the "image" that the argument may refer as "possible" and simply existent when it is realized [17][18]. If the real, may supposed to be look like possible, then it may argue that the reality may not become a fictitious images or retrospectively "projected" determinations, it may not because remind the possible, it reminds the real itself. It transforms, changes shell and evolve through time-space concept, but also always chases up from pre-existing possible.

Even tough, the scenarios, characters and architectural spaces that experience, play and interact with videogames, may route the possible environments, ages and architectural trends as a "possible" life model, this virtual prototype simulations imprint from reality and people are playing in a potential "actual" scene that our age may witness and experience the spatiality for next decades.

Although, the possible may pair off to the attachment of resemblance, the virtual is actualized by various divergence conditions. This divergence is actualized in a ranging spatial-temporal relationships and the concepts may live in a very broad actual conditions [17].

2.4.2. Level Design and Scenario Collaboration

The level is defined by the geometry of the space: a given maze, a race circuit [12]. By supporting with an immersive scenario and level design of the game, players may integrate and concentrate of the game from the beginning to end of all the episodes and scenes. For Assassins Creed: Syndicate which is examined and case study of this academic thesis, the player may integrate on Victorian Period of London with representing all industrial buildings. As the game progresses, the game may lead players feel more and more integrated with the political incidents in the Victorian era of England with the eyes of assassination. The players may gain levels by assassinate of deceitful political people and guiding and clearing up the city with his character. With the dystopian and utopian scenario on video games, the players may find out the architectural, sociological and political aspects of the period. In addition, cinematics in videogames may place between levels to understand the game's scenario and concept while the player has a chance and enjoy the accomplishment of levels by calming down and watching the advanced graphics and resting for next level.

2.4.3. Game Design Document - Demand List of Architectural Projects

The game design document is a kind of a written papers that refers the potential future game contains all the elements of game design (characters, space, scenario, gameplay, etc.). Writing a game design document (GDD) may make video game design process planned, functional and memorable. The structural elements of game design document are affected by the core of game itself, game designer's personal notes and game studio's preferences [15].

The Demand list of architectural projects, seemly is created and written to construct and compose a series of demanded spaces, rules and mathematical calculations of architectural design rules according to scenario of design studio. Demand list reveals architects and designers show up where to begin and which steps and procedures may follow for an optimum design.

Both planned documents led designers template exist for memory and communication design of a video game is full of design decisions that define the game design parameters and orders. It also may use for not to forget and observe the permanent design notes. When the design

document is written form, all the designers may observe and review the design development process and it would tend to find design problems better or have ideas for development process [15].

2.5. THE GAME ENGINES

2.5.1. What is a Game Engine?

When architects and designers started to be drawing and revealing some artworks, many representations of drawing and sketching techniques launched and experienced in real-life since centuries. These techniques were almost around a fixed, top-down point of view. By the advancement of technology and finding in a new method, hardware and software architects and designers started to transform their framework for his/her architecture. If they create a sim-city for urban development, or and FPS game they created an immersive space that make feel players an immersive space experiment, or they tried to reveal a fluid, kinetic environment for players. Because of this reason, it makes game engines comes into play. In this chapter, the research will be examined about the game engines definition, research current popular game engines and how applicable to the architecture. Game Engine, term may be defined as: Software that is extensible and can be used as the foundation for many different games without major modification [4],[19].

A game engine refers as a game development tool that provide game designers make videogames more effective, productive and efficiently supporting some key features for video-game development in advanced artwork outcome [20]. With the development of video game engines, architects and game designers may have a chance to render high quality and resolution spaces close to the real time by supporting any other devices. Over past decades the demand of catching the real time spaces and not only 3D but also multi-dimensional spaces have been preferring by the clients and users to experience and interacting with the desired space. Although the traditional drawing and representation techniques have been still carrying out, by using game engines and 3D representations of a skyscraper, office, house provide an intense highly detailed environments that support and contribute of clients, users and players by perceiving in a realistic manner.

Game engines interaction would allow more engagement with the product and get a sense that how a person can perceive that environment in a real life. They produced users to experience and run-in real time and allow user to walk and interact with the designed space in a human scale perception. Since video game engines ensure game designers and architects freedom to have access to a huge range of purposes has grown and developed itself started from 1990s with the first launching of game engines. Concentrating with one aim that it has been providing a high-level adjustment, customization, and optimization [19]. The deeper research on game engines for architectural applications will examine on 1.6 Game Engines for Architectural Design Benefits, so that current game engines will be researching for the next chapters.

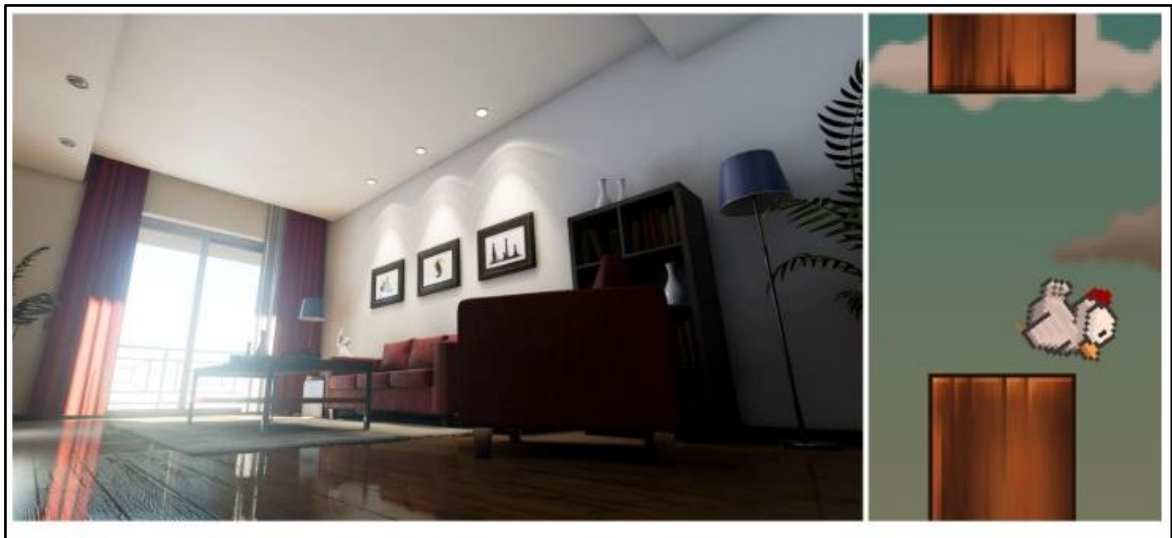
2.5.2. Key Game Engines

As for the diversity of software and generating a wide range of spatiality, particular game engines have been producing and some of them giving access free to use and interact for designers and players. It can be asserted that, beyond wide games have a huge benefit and provide designer overwhelming architectural spaces (physics, sound, graphics, video); they also provide free license and bring about a stormy competition globally [21].

2.5.2.1. Unreal Engine

Unreal Engine may refer as one of the most popular and preferred game engine tools launched by Epic Games Corporation. The company introduced Unreal Engine to the marketing through gaming community with the game called: "Unreal" in 1998 [22]. The newest version of the Unreal Engine is Unreal Engine 4.25 edition [23].

The newest version of the Unreal Engine is Unreal Engine 4.25 edition [23]. The Unreal Engine has a significant compatibility of all platforms which are Pc, Mac, IOS, Android, Xbox Series X/S and PlayStation 5, ranging from 2D game layout perspectives to 3D immersive advance environments. The game engine also supports DirectX 12 which is a software that created for playing videogames mainly and using multimedia software for rendering applications and provide a software strength that authorize designers.



(a)

(b)

Figure 2.2. (a) Unreal Engine 4 can be used as a representation of architectural visualization as indicated from the rendered image. (b) It also may be used as a 2D game design as Tappy Chicken (2014) with the regeneration of Flappy Bird (2013) created by a single artist [4],[24],[25].

Game engines have started to conquer the film industry to provide the virtual environment and architecture with an advanced visual outcome by giving the virtuality without physical environment. Mandalorian, TV series from Disney+ signed the first that the producers decided to use Unreal game engine for their Dystopian scenes. Jeff Harris, the technical director of Epic Games claims that the traditional methods of visual effects seem to be decentralized. By building a LED panels and ceilings LED view and manipulate the visual scenes that producer or director would like to edit it with flexibility. By demanding the changes, the operators have a chance to intervene the lighting, shadow and effects of the wall instantly [26]. The crew may edit all the features and conditions of the scene with capturing important VFX shots from iPad.

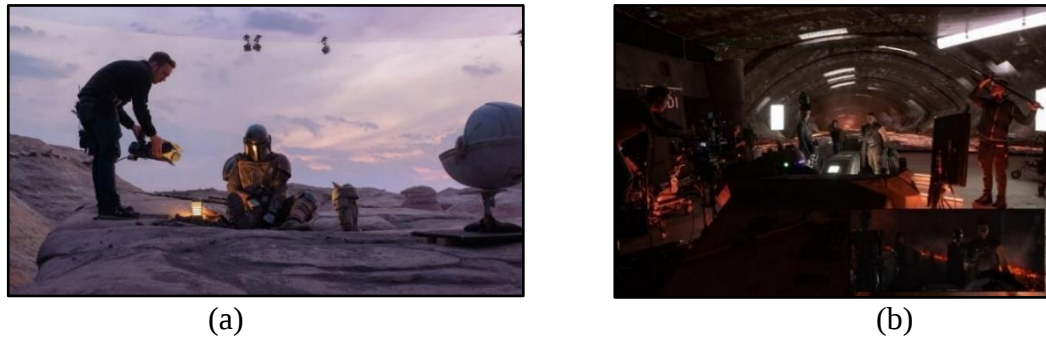


Figure 2.3. (a), (b) The footages from the scenes that used Unreal Engine for Star Wars: Mandalorian tv series by supplying the virtual exterior and interior spaces [26].

Epic Games have also gamer friendly purchasing policy that, Clients can buy the license UE5-6-7-8? For only 20 USD per monthly with some discount features. The company also give an access first month free subscription entirely. With the starting of subscription, game designers and architects have a chance to access to the C++ source code of the game engine.

2.5.2.2. *Unity*

According to the Mc Kinsey, Unity places approximately 50 percent of the mobile gaming industry, and this trend has been rising rapidly [29]. The reason why Unity has such a major percentage in industry has a user-friendly user interface, optimization of previous and current gaming platforms and consoles. In addition, Unity has a notable works for mobile platforms and operating systems and Virtual Reality (VR) [4],[30].

Another significant feature for Unity may show as supporting file format types and third-party content creation support.

The game engine features some remarkable components such as advance shadows and lighting. Unity preserved its free availability for everyone since it has launched for the first time. The payment policy of Unity is still backing that, it is available for a one-time payment of 1500 USD or 75 USD monthly subscription.



(a)

(b)

Figure 2.4. (a) Unity 5 advanced rendering technologies. (b) The game engine used for mobile gaming such as Monument Valley [4],[27],[28].

2.5.2.3. *Cry Engine*

Cry Engine made its reputation and population in gaming preference by releasing the game called Crysis (2007) which has stunning real-time graphics compared to rivals. The research asserts that the subject: "Can it play Crysis ?" spoken and written in many respectable forums about computer and gaming news [4],[31]. The game engine offers remarkable graphic results with an advanced shadow and lighting as does in Crysis and adapted for all platforms such as Playstation4, Xbox Series One, PC and integrate with mobile platforms [4],[32].

The Company provides two versions of the game engine that one of is free version with a non-commercial use, the other one is a fully professional and chance to reach the C++ source code. The pricing of Cry Engine reaches 19 USD per month with subscription member which obviously build a competitive environment in gaming industry. The handicap of the free version reveals a limited version of the software that not possible to receive updates and new components and additional backups.

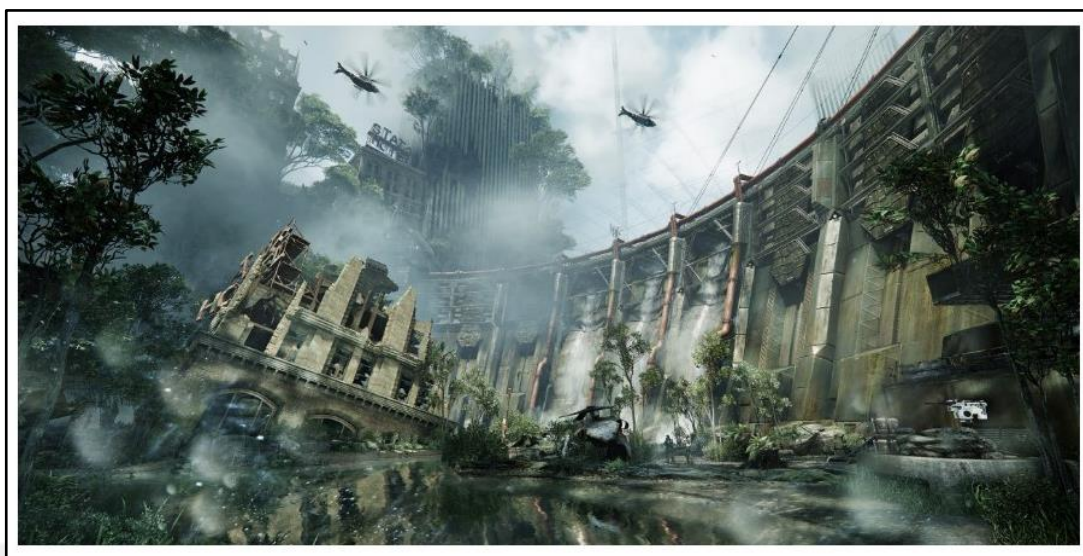


Figure 2.5. Cry Engine created Crysis 3 (2013) with stunning graphics and representing architecture in a realistic graphics with powerful level designs [4],[33].

2.5.2.4. Motion Effects and Graphics on Game Engines

Motion effects on videogames both audio and visual aspect may generally mesmerize the player with supporting a stunning animation that created. It may be clearly understood that the visual and audio-visual artistic works present the spatiality in a more entertaining and advanced level. Thanks to game engines and machine learning system, spaces that created and revealed in a flow; graphically advanced and close to the real physical one, player observe and experience on videogames the game designers/architects have a chance to represent the spatiality, environmental atmosphere and architectural components.

A typical game engine grouped in a three main department that contains; rendering engine that allows game designers to create virtual game spaces through the player's screen. The second one namely as audio engine, tests, records and creates all the realistic sounds, natural sounds and special sound effects. The third engine that contains in a game engine would be the physics engine which is a significant engine that game designers/architects can freely design and apply the natural motion effects connecting with the objects by handling different range of acting happening on screen and other platforms [20].

Capcom, one of the recognized game studio corporations has launched the fifth and latest series of the Devil May Cry 5 video- game which I also experienced and played the game

released in 2019 for Pc, PlayStation 4-5 and all Xbox One, Series X and S series. The video-game's scenario is about to save the world from the demon creatures by selecting Dante who is the main character of DMC series, Nero or Vergil, brothers of Dante that allows players with stunning combat experiences in a dystopian world. The videogame takes an advantage from RE Engine to use the motion graphics, rendering and sound effects to present in an advanced rendering and visual system that represent realistic spatiality animated and flow graphical video-game system.



Figure 2.6. Footage from Devil May Cry5 experiencing spatiality in RE game engine [34].



Figure 2.7. The footage from Combat Motion graphic from Devil May Cry5 [35].

It may be anticipated that the video game buildings that designers inspired from the physical architectural landmarks that exist in the world. For instance, it is obvious to observe that Capcom created a historical passage that inspired from Galleria Vittorio Emanuele II from Milan, Italy. The ceiling, roof system and structural system that game designers revealed in game scene is based on the historical building itself. There are some shops that designed in game the dimension, façade and texture properties may be recognized as the exact building itself. By using game engine, game designers tried to represent and inspire the Galleria Vittorio Emanuele II's texture, shadow, lighting and realistic spatiality in an advanced atmosphere.



(a)



(b)

Figure 2.8. (a) The videogame was inspired from the ceiling and structural system of Galleria Vittorio Emanuele II. (b) Devil May Cry 5 scenes the anticipation of Passages and stores of Galleria Vittorio Emanuele [36].

Simon Boes, academician at University of Ghent, writing on his master thesis about the benefit of using motion effects on game engine as experiencing the spatiality in a motion effect comparing designing 3D rendering software on architectural offices with this quote:

It is easy to be carried away with the seemingly effortless realism achieved in some games, where walls collapse after being hit, tall grass waves in the wind, rain drops leave splashes on the wet ground, and

so on, especially when making in the comparison with the typical quality of 3D visualization achieved in the architecture office [4].

2.5.3. Materiality and Lighting

Architecture is the skilled, correct, and magnificent play of masses brought together in light [37].

The buildings' materiality and lighting may become one of significant issue to reflect what game designer or architect would like to show up and make experience players/clients for the spatiality.

When presenting their ideas, projects and game environments for the clients and players, it may worthy of note that having realistic rendering images with supporting material, shadow, advanced lightning would be efficiency for experiencing of the atmosphere. Firstly, architects and designers tried to reveal their drawings in a hand-made with ink and crayons and colorful pencils. However, it would appear to be better to support and develop your ideas in a traditional way, but 21st century, by advancements of technology, architects, game designers have been starting to use high-tech rendering and game engine software catching lightning and material close to the physical life's perception that make feel people. By using game engine with machine learning the game designers may specify the light's location, orientation, color and distribution, they may give an outstanding rendering image that visually realistic buildings and environments.

Architects have been starting curious about game engines in revealing visually realistic renderings. Besides, ray tracing technology using with radiosity which is used for lighting technology may use for method of architectural rendering [38]. Nvidia, one of the world's leading video card manufacturers revealed every year Ge Force RTX series that provide players to play the latest videogames in a realistic environment by switching on Ray Tracing feature.

Ray tracing technology refers as a technique that supplies computational advanced realistic images. It provides to render all kinds of visual aspects, reflects, fraction and illumination. However, the handicap would be as needing a high computational cost [39].

In 2019, 2020 and 2021 many videogames launched with ray-tracing technology that used for buildings and environments. With this benefit, the player may experience the buildings advanced realistic materiality and texture, the realistic lighting-shadow entertaining and perceive the space by rotating with 360 degrees. Control, the videogame that collects many awards including game of the year and game design in BAFTA (British Academy of Film and Television Arts). I also had a chance to experience it with ray-tracing technology. When the computer switching on ray-tracing technology, the buildings' material and texture condition of the game have an observable change.



Figure 2.9. The floors reflecting on lighting and the concrete material of the building may be seen in a realistic with Ray Tracing on Control, Screenshot on gameplay [40].

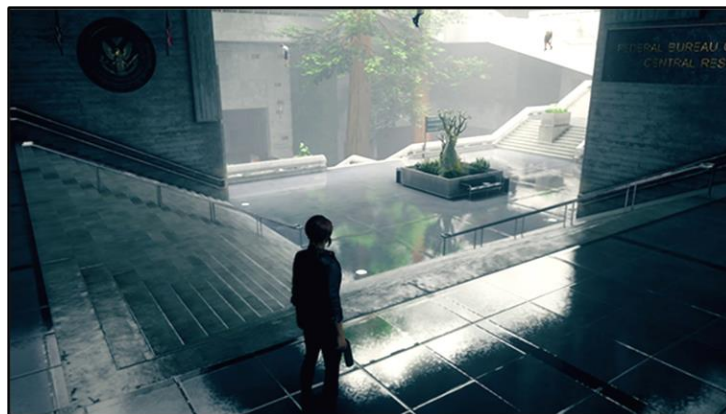


Figure 2.10. The scene from game presenting lighting and materiality when the Ray-Tracing Technology is switched on [40].

Cyberpunk 2077, one of the video games written in blogs, hits global gaming marketing and has been waiting for years. The videogame takes place from the time, 2077 Cyber dystopian world inspired from Blade-Runner movie. It has been rumored that how will the game's

scenario, spatiality, architecture. In addition, the creator of the video- game, Cd Projekt Red video-game studio company agreed with famous Canadian actor Keanu Reeves that his virtual character has been taking an influential effect on the videogame. It would be significant that in videogame, players may use and experience the Ray-tracing technology that observe and see the advanced reflection of the city-light through water, advanced shadows and lighting that reflects from architecture. It may be obvious that, the players or users may see the detail and texture of the finished material of the buildings that created.



(a)

(b)

Figure 2.11. (a) On the left image, it may be seen that the ray tracing is switched on. The reflections, shadows, lightning, textures and the finished materials may be more realistic. (b) On the right image indicates that, ray-tracing feature is switched off and the reflections, material details, lighting and shadow details seen blurred [41].

2.5.4. Sound of Games and Effect on Spatiality

As examined from 1.3.3. Motion Effects and Graphics on Game Engines that the sound engine is responsible for creating video-game music, natural sounds, battle action sound effects, the sound in videogames may have a significant factor to integrate with the spatiality through the videogame.

To editing and providing an outstanding audio performance, video-game studio companies, game designers and even architects may use an integrated audio application programming interface, API module that applicable with open free portal that integrated on sound module, can edit the background sound and music in an advanced mode [20].

One of the audio module Steam audio modules manufactured by Steam Gaming Shopping and Blog Portal created the system that, have a chance to manipulate the sounds according to the geometrical information of spatiality. In addition, the system has a remarkable sound system that supports surround with dual speakers. Because of this reason, players may have a realistic sharp sound with 3d acoustics effects. Steam audio delivers trusty flow sounds that integrates with physics-based space [42].

2.5.5. Graphic Impact

Graphic quality in videogames may have a key essential factor to represent and integrate the game space for the players. In gaming history, the graphics of videogames has been changing dramatically according to development of technology and launching of gaming consoles, producing advanced graphic cards for PCs.

From 8bit to 64bits processors containing graphics, sound and texture quality for today's gaming resolutions, game designers have been trying to use graphically smooth and flow spaces to perceive in a realistic perspective.

First game in 16 bits videogame was launched by PlayStation 1 with a releasing of Rayman (1995) in North America with a rich color palette. The Sega corporation made the game 64 color on one screen at the same time [43].



Figure 2.12. The screenshot from Rayman Game launched on PS1 [43].

By the development of animations and containing more processors, the game designers started to create 32-bit games such as Arc the Lad (1995) with medieval animations, camera perspectives and actions. The game has a 2d artistic stylish theme that, provides colorful characters and new 3D tips [43].



(a)



(b)



(c)

Figure 2.13. (a) Arc the Lad's characters. (b) A scene that providing changeable camera perspective, first the game presents an axonometric perspective that perceiving the spatiality with zooming-out. (c) Then, the camera zooms in and able to see the gameplay in more detailed way [43].

By the advancements of technology, it would be seen that there is an observable difference between PlayStation 1 game and PlayStation 4 game graphics to represent the spatiality and architectural buildings with supporting scenario and narratives. The Last of Us part II one of the most anticipated console-game created by Naughty Dog game studio company, launched the second series of the game in June 2020 for PlayStation 4 series.

The game provides players more detailed connection between motion effects and the physical environment. Plus, the effects were used with GPU (Graphics Processing Unit) driven, providing more less manual attachment from artists, and utilized physical world information. The GPU defines as a specialized electronic circuit designed to rapidly manipulate and alter the computer memory and accelerate the creation of images on a display device via frame buffer [44]. The GPU may refer as an essential hardware that, used for the game simulates geometry more efficiently, integrate with better geometry than the older game, and integrate the surface game elements on animating geometry [45].

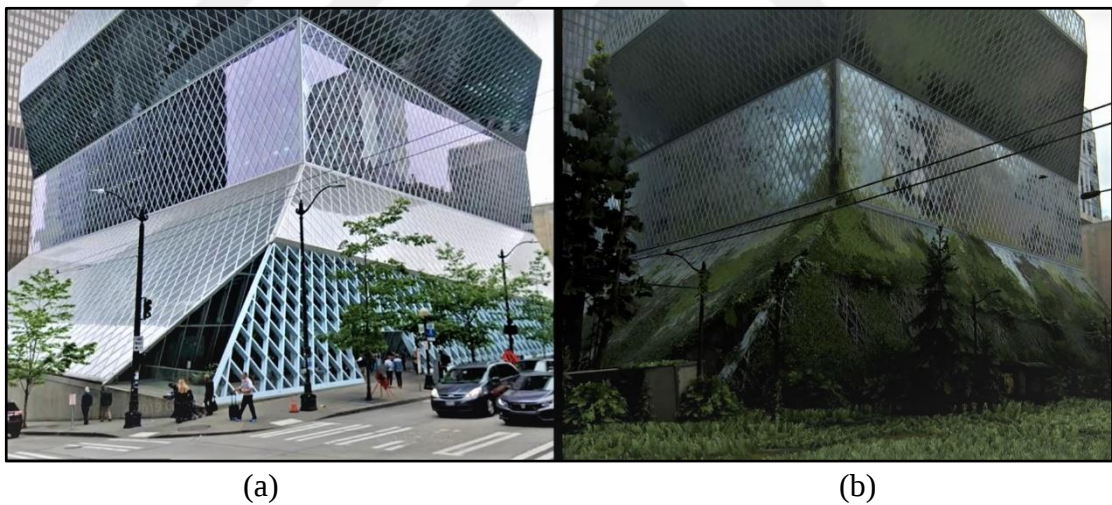


Figure 2.14. (a) On the left, footage from Seattle Public Library designed by Rem Koolhaas physical building. (b) On the right, footage from the virtual representation of Seattle Public Library from the Last of Us Part:2 video-game rendering with advanced environment elements such as texture, shadow, geometrical process [46].

Arch daily, one of the recognized architectural websites asked about architects which videogame has impressed them as architectural and spatiality aspects. The answers were not only a direct manner. The requests would be for architects that answered may need a virtually built environment is essential for an impressive videogame. Games may be essential

graphically modest when it is constructed in an architectural space with material and texture [47].

In videogames, to provide a better smooth graphic result, the hardware would give players better FPS (Frame Per Second) that, every pixel frame that human eye cannot see the pixel easily should be the more frames hardware provide players the preferable smooth graphics supplied.

2.5.6. Game Engines as Architectural Spaces, Applications

In today's architectural trending, it depends on how to represent the spatiality in a realistic, artistic and feels clients, users how to interact them as "interactive" as possible. The same situation may prevail for game designers to join and convince players what video-game studios desire to create the environment. Because of this reason, both interdisciplinary fields may need to produce outstanding immersive spaces that saving from time, costings and taking the most efficient outcome as if possible. In this part, it is tried to research on the game engines' advantage on architectural design process to create 3D realistic environments.

It would be essential to experience of viewing and navigating with 3D space through game engines may reveal architects speed, interactivity, and an advanced rendering quality. To come up with this solution, it would be useful to apply algorithmic design framework with a Game Engine to promote better visualization of architectural models and bright optimized rendering performances in the context of the design [48].

In order to create an advanced realistic architectural rendering, Architects generally benefit from modelling tools with render engines, optimized plug-ins for CAD/BIM software. On the other hand, the software may take a major time that waiting and creating only one rendered image. The problem may not occur a satisfactory reply for representing the project [48][49].

Game Engines are created for supplying realistic advanced environments that interacts in a big atmosphere, indoor-outdoor spaces in a physically realistic optimized space precisely. In addition, game engines provide advanced reflection and surface results in somewhere to create a controversial outcome with supporting manipulation for ambiances [48],[50].

One of the popular game engines, Unity provides advanced visual quality, satisfactory performance, flexibility with another platforms, giving remarkable assets and library contents, updating perpetual, ease of use and up to date technical documentation and economical costings [48][51]. Plus, Unity gives users to present an up-to-date art representing methods such as Virtual Reality (VR) taking through in a new level of interactivity and stunning experiences through a real human perception in a virtual way for architectural projects [48],[52].

For observing and declaration of game engines as more productive, efficient and time saving for architectural design, ArchiCAD one of popular BIM software and Unity which is used for creating videogames, industrial and architectural visualization software that Astana National Library (ANL) project designed by BIG (Bjarke Ingles Group) Architects in 2008, for Kazakhstan is selected to compare the rendering results. ANL is selected for the experiment because of the building has repetitive geometry and its shaping may resemble as a Moebius shaping that suitable for the pleasing outcomes in Algorithmic Game Engine. For interior architecture the objects used both software ArchiCAD and Unity to fulfill the interior space adding doors, staircases, elevators, bookshelves, tables, and chairs



Figure 2.15. Objects refer as ArchiCAD's models that used B objects are used the same modelling at Unity [48].

After rendering from the same software, it may be seen the results of rendering aspects of the taking time. Both renderings taken from the same computer system which is dual Xenon E5-2670, 64 GB Ram 512 Gb SSD and graphic card Nvidia Quadro 6000 Gpu. [48].

Table 2.1. Comparison of the results timing that taken from ArchiCAD render and Unity rendering outcomes. Time presented in: HH: Hours, MM: Minutes; SS: Seconds, Milliseconds: 00.Taken Screenshot [48].

RENDER SEQUENCE	ARCHICAD RENDER		UNITY RENDER	
	SIZE	TIME PER FRAME [HH:MM:SS,00]	SIZE	TIME PER FRAME [HH:MM:SS,00]
1 Dolly-zoom forth	1620 x 880	00:56:57,00	1920 x 1080	00:00:00,30
2 Tracking aerial		01:16:03,07		00:00:01,60
3 Tracking parallel		00:40:37,20		00:00:00,92
4 Walktrought outer ring	1680 x 1050	01:48:22,70		00:00:06,32
Walktrought inner ring	1820 x 980	00:34:44,15		00:00:03,75
5 Tracking line	1620 x 880	01:13:56,40		00:00:00,75
6 Tilting	1820 x 980	00:59:11,14		00:00:00,60
7 Tracking fly-over	800 x 600	00:04:48,97		00:00:02,80
8 Panning sideways		00:46:36,14		00:00:00,59
9 Dolly-zoom back	1620 x 880	01:21:34,74		00:00:00,28

As it may be seen from the table, there is a gap that observed as a significant timing difference in rendering for the same building between ArchiCAD and Unity. With Unity, producing films may take a just a couple of minutes in contrast to taking some couple of days with ArchiCAD [48].

The quality of revealing better spatiality comparison illustrates on the figure and figure that on the left taken render from Unity video-game engine software that better lighting, shadows, reflections, and texture to represent the architectural project more realistic way. Unity may compute all the detail in real time that users, architects, or the players may navigate the model with advanced rendering detail.

It may be exposed to exhibit apparently, game engines have an outstanding powerful algorithmic system that, allows to extract advanced visual and realistic environments by using time efficiently for architects and designers. In addition, Götz tries to point out the operative side of the game spaces for architecture with this quote:

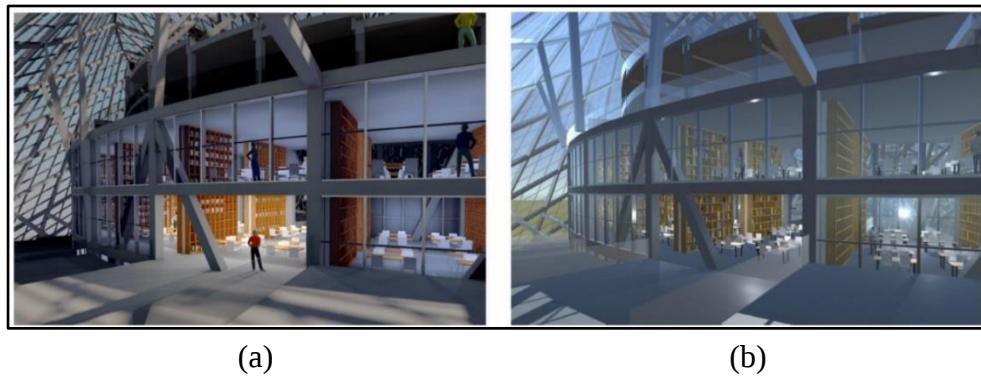


Figure 2.16. (a) On the left the rendering image was taken from ArchiCAD software may seem the building in less detail. (b) On the right rendering image was taken from Unity game with an advanced detailing spatiality engine [48].

The video game model can be worked and reworked into a product within the model world itself, in contrast to an architectural model. And so arises a paradox that game designers copy the limits under which real architects operate even though these have no significance for virtual space. What architects experience as undesirable limits are welcomed by game designers because they confer authenticity on the desire end-product [3],[53].

Even though this researching brings multiple controversial results for game designers and architects, this may refer as an illusion. The outcomes reveal us these virtual spaces are artificial and has not implemented yet.

2.6. ARCHITECTURAL DESIGN PROCESS

2.6.1. Design Problem

The world has been changing, updating and demanding a new approach to adapt and integrate with the modern age requirements. In architecture, architects and designers are trying to refresh the rules and creating a path for the architectural design problems to solve and reach the optimum spatial standards.

Architecture as an interdisciplinary field with a feature of functional side ensuring proper and better quality of life standards. It may solve the future problems and tackles with a contemporary manner. The new millennium brings architecture as several factors providing with technology development and phenomenological aspect of globalization [54].

Architectural design tries to fight with the regional economies, humanities and its sociological manners, lifestyles, cultures, transport, territory, and the market of the countries.

Architectural approach tries to aim the function that needed for the rational design templates and ideas for a suited design approach for the environments. Because of this reason, the solution or the approach may inspire or directly take from the time lapse that creates a hybrid solutions and creations that depend on and associated with past, present and the future time [54].

Architectural drawings may have a respectable source of inspiring and creating as representing the architectural design in a design process. Architectural sketching embraces new upcoming design solutions for 21st century world architectural trends.

Today, digital imagery tools and creations are available at any smart platforms such as mobile technology, personal computer in a high-quality and ready to use them [55].

This chance was not ready for production of space, designing any buildings and need to high cost with a non-ease of use until a few years ago. Today, architects and designers may reach the computing technology with only a hand reach. By using these digital devices and software, producing, editing, manipulating, transmitting, and sharing images have not been so elementary before. The effect of this technological digital imagery may help to analyze and solve the contemporary society and culture to develop and intervene the society, art and not the least architecture [55].

2.6.2. Objectives, Rules and Limitations of Solving Architectural Design Problems

With changing and refreshing of architectural expectations and design trends; Architects and clients have been modifying their demands from spatiality and buildings. Because of this reason, users may expect from architects, designers and game-designers are expected to reveal and represent their architectural intentions with interdisciplinary mediums.

Architecture and architectural design proceedings may hinge and connect with the steps of the human being's updating post-trend approach in the design phases. These results reconsider of the architectural design studio process from Bauhaus to present [56].



Figure 2.17. The image of the Bauhaus, the first school of architecture located in Dessau, Germany presented the first architectural design studio culture and spread all over globally [57].

The phases of architectural design studio have been shaping and developing with the methodology and perception of the architects and academics since Bauhaus, the first school of architecture by launching the design pedagogy with the modern design aspects. This method also combines with the aesthetic and technology for working on modern industrial world [58]. On the other hand, thinking as three-dimensional spatiality and collaboration integrated on architectural design studio for architectural studio culture has never been changed or manipulated [59]. There may be no quandary that, the significance and essential of the multi design, sketching, schematical design, design etude, development and documentation of design attached on studio training [60].

For the starting through a design studio, the architects apply different range of design mediums from two-dimensional drawings to three-dimensional models. Shaping, sketching, creating a concept and plan drawings that draw by architects contains with these documents and modellings. In addition, they may deal with the perceive and multi representation tools to present the abstraction of the projects with different angles, characteristic and information on paper [61].

Architectural design, naturally has a sense that, contains poetical process and develops with this path [56]. With this poetical and emotional aspect, Architecture may demand from

architects and designers that put on his/her buildings adapt on the site; integrating with the community and fulfill the requirements of the functional spaces aesthetically in harmony.

Because of this reason, academics and professionals meet one key oneness that for architectural education that; it should hold the studio courses mainly as a studio-based instruction model [62]. Teamwork may become one of the significant and fundamental method for architectural design studio and education [63]. Thanks to the collaboration of group-based projects and multi attendance in studio, the problems may overcome with the brainstorming and sharing their ideas to reach a goal [64].

After brainstorming, analyzing and gathering data for the design process, all for design studio offices and also architecture schools from all over the globe, new design mediums such as BIM and CAD systems may overcome the complex structures and templates of desired potential architectural buildings [65]. Although, most architects have been using CAD (Computer Aided Design) and BIM (Building Information Modelling) based software because of its user-friendly, flexibility and compatible with digital archive and supportive; game engines have a strong and determined to replace them. To accomplish in an immersive renderings and outcomes for architecture; architecture studio offices may adapt their companies as launching of a 3D video game engine [66]. As trying to research previous parts and explaining the effects of using, integrating and using of video-game engine for architectural design, visualizations; game engines may refer as 3D rendering software that, enables architects, designers interact and produce the environment that outstanding results in real time and provide to walk about the virtually in space as if they would [66].

Unlike, the traditional methods of architectural design, such as sketching and 2D plan drawing; it may assert that, there are some new methods of design studio evaluation in virtual environments and three-dimensional digital mesh modelling software that, they may have a chance to provide for the architects to observe the efficiency of the communication virtually. In addition, virtual environments may become beneficial for experiencing and pointing out as the volume of the architectural project by providing preferable the field of view and interactions [67].

However, using the digital software may become advantage or a disadvantage because of perceiving the project aspect of motion sickness, the field of view and many other

perceptions on virtual environment as analyzing and interpreting the façade, spaces, plan organizations of the project that working on [67].

2.7. VIDEO-GAME DESIGN PROCESS

2.7.1. Objectives, Rules and Limitations of Designing Video Game Process

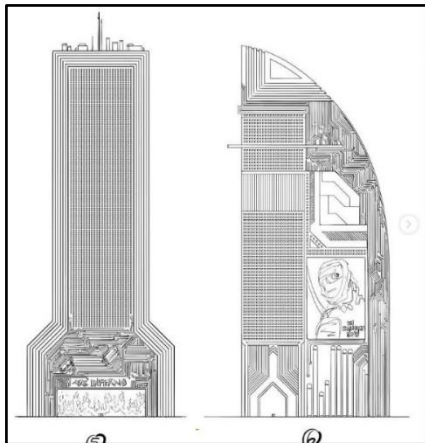
Generally, the aim of the designing a videogame may assert that providing an entertainment or give a chance for players to interact with the virtual environment that representing any historical period or a timeless Utopia/Dystopia.

Every videogame starts from an idea. However, to transform these ideas in an entertaining, functional and creative form may depend to visualization. Concept design in videogames use as a key element for understanding and developing of the ideas that put-on videogames [68]. It may be a notable factor that, concept designer and game designers should collaborate and work in parallel with communication. They may represent and create their ideas with designing characters, space design with supporting multi sketching and actualize the visions that desired on [69].

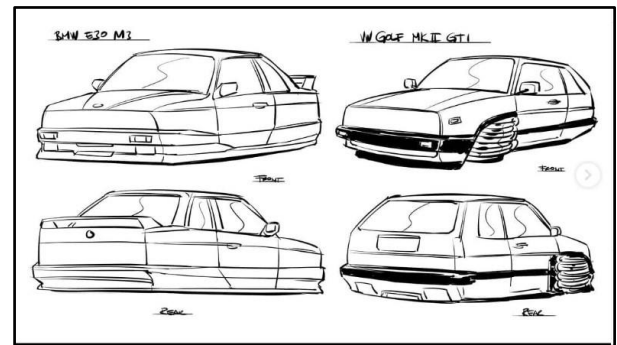
Firstly, concept designers start many drawings, sketches and templates that represent video-game story that determined on minds. Then, it would be an important factor that with this accepted ideas and design principles, a game design document may be required to keep and archive this information and outcomes by filing [70]



Figure 2.18. Cyberpunk videogame and Cyberpunk Dystopian City concept drawing, Illustrated by Emir Yardımcı [71].



(a)



(b)

Figure 2.19. (a) Cyberpunk video-game concept, architectural building templates. (b) Vehicle concept drawing, Illustrated by Game Designer Emir Yardımcı [71].

For the first video-game concept design example may refer as "ToeJam&Earl" videogame created in 1991. The game's story is about two rapper art performers come from out of the world and fall their spaceships on Earth. The theme of the video-game contains about the city culture of 90's and make fun of it [68].



(a)



(b)

Figure 2.20. The first concepts of the "Toe&Jam" video-game characters. (a) On the left illustrates "Toe&Jam" [68],[72]. (b) On the right image shows "Earl" character [68],[72].

Concept design may one of the substantial phases for focusing on the right point of view of the video-game project with teamwork and become consistent in a game design inside [73].

It may count as using traditional methods on designing a video-game concept such as sketch, charcoal drawing and coloring and painting with pencils and watercolor paintings; Game

designers and artist generally use digital representation tools namely drawing tablets and software. These devices and digital software may shorten the duration of production and limit the handicaps and mistakes. The game artists use Adobe Photoshop and Corel Painter widely in every aspect of the game design process [68]. In addition, to draw rapidly in game design, the methods that they consult in may sort in matte painting, speed painting, sketches and 3D overpaints [74].

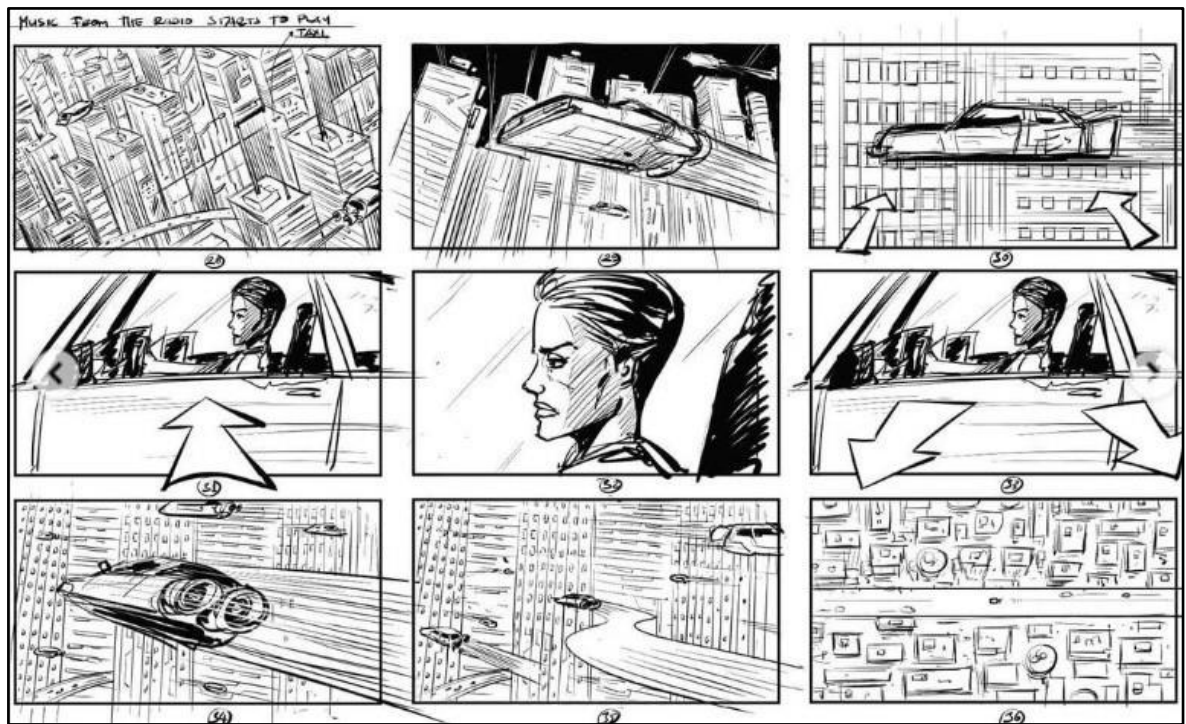


Figure 2.21. Cyberpunk game sketches of story-telling architectural building and vehicle concept drawing, Illustrated by Emir Yardımcı [71].

In video-games design principle, it would be essential to design many characters that designed according defined as proper and suitable, they support the emotional attractiveness and satisfaction in gameplay for players [75]. Designing as multi characters may support the narrative and constitute with each other may observe the changings of characters that experience.

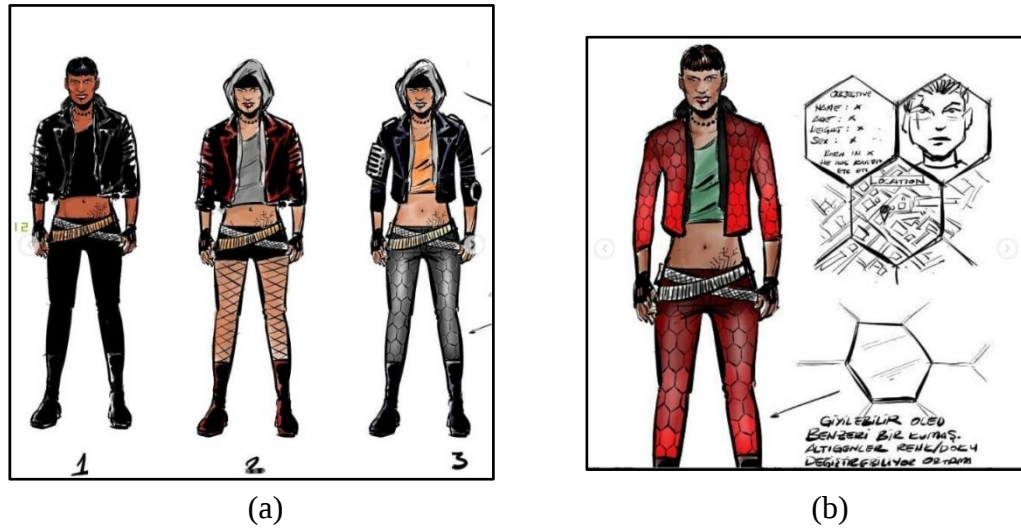


Figure 2.22. (a) Cyberpunk video-game sketches and character drawings. (b) A detailed outfit design concept drawing, Illustrated by Emir Yardımcı [71].

Space design is about the creation of the world that locates on this videogame. Because of this reason, space design has a controversial impact on narrative connected with game design phase [68]. Space design bounds with the aesthetics, architecture and the environment that created in some points [76]. Game designer may be responsible for creating spaces that integrating with spatiality in harmony, spreading the environment with naturally and make player feel alive/dead regions [68].

In addition, game design may refer as comparative actions of players connected with their mentality. Game designers may provide to access and adjust the player's performance and mindset according to what player demand from a videogame. This is what game designers ought to consider about this situation. Game design may have controversial effect on players as supplying better outstanding experiences. By the impact of convincing and inviting players; the video-game design may plan strategically if it would like to increase the performance or mood of the players in general. Video-game designers may change the player's mood by implementing drama effect.

Unlike for the phases of architectural design studio by drawing with pen and pencil, it may be notable factor that, considering about the mood or frame of mind of players have priority on video-game-design before passing through sketching. Creating a new manipulation and adjusting the mood of players may have a significant for game designers.

In addition, environment that game designers working on may steer players to accomplish the task and manipulate on their mindsets [77]. Because of this reason for game designing, both exterior and interior architectural organizations may have a contribution to interact with the game persistently as conducted.

2.7.2. Comparing and Similarities of Games and Architectural Design

Both interdisciplinary approach as researched starts with the designing a concept. After that, traditional drawings, sketching use as the first templates and design templates. It may recollect to explain that, both architectural design studio and game design phases, it is using 3D software for illustration and representation to produce better visualizations and provide saving from time. The question of how digital technology affects our perception of the world is important in the construction of knowledge in design education. First, digital technology leads to imaginary thinking; it allows us to look through different lenses to discover new ways of thinking and new ways of seeing [78].

In addition, just like teamwork may become fundamental and assistive factor for productivity and reveal outstanding outcomes for architectural studio; Video game design process need to work in a collaboration with game designers, artists, creators, producers to stay in a balance and work in coherent game design parameters as Kolsal states that:

Transitions between digital and analog worlds, intertwining, interface formations, increase awareness and develop the ability to think divergently for both architectural studio and video game design process. There are too many potentials of some hybrid applications of the tools. Collaboration and mixed representation tools in the digital environment, which allows the ability to think different scales together, helps the student to internalize the problem of scale which is difficult to assimilate in the reality level [56].

According to this idea, architecture would be a playing field where all these games, the re-emerging greenness game, the affordability game, pop-culture/branding game, digital game, geometry game, and other technological playing are being carried out simultaneously, some of which have a stronger presence than others. Architecture games obey their logic, have their values and measures of judgment, and sometimes even directly oppose each other.

2.8. GAME ENGINES FOR ARCHITECTURAL DESIGN BENEFITS

2.8.1. Free to Design and Functional User Interface

Game engine developers have been trying to join architects and designers to promote using game engine for their architectural and design purposes, explaining the possible impact of the medium's capability as a common language between all these common fields (game design, industrial design, architecture and filmmaking) quotes this speech the founder of Epic Games, Tim Sweeney [79]. Modern game engines' integrated and developed user-friendliness, cost savings and potential adaptation of creating realistic real-time environment recognized for both academics and professionals [4].

The freedom that provided by game engine research starts from 1990's. [4]. The game engines may allow make fine-tuning and integrating their projects and design, depend on the performance of hardware that contains in PC or laptop for designers and architects [19].

Generally, architects and designers may limit themselves for defined and desired project that work on computer. For an ideal design thinking, the architect or a designer are expected to feel free with the depend on the gravity and laws of physics. To fulfill this intention and freedom in architectural studio, it may gather around with the video game engine spatiality to editing the 3D models without exit from the game engine software of his/her design. However, in game engine software the components count as a natural size, detailed finishes providing designer to interact and navigate with the virtual environment freely in sensible perception [4].

Game engines have a basic and supportive user interface for the game designers and architects that may keep up to date functional buttons and easy to adapt on it. CryEngine delivers the Scaleform GfX third-party special software that providing rendering quick rendering such as functional button system and other command layer system. This quick interface leads a tremendous graphically user interface (GUI). It would like to assert that less old-fashion graphically hackneyed user interface, it may put on the table the gap between the user's body and the virtual environment bounds in a functional way [4].

However, not every software may not consider as beneficial as user-friendly. Unreal Engine 4 has a more intense and tangled user interface in comparison with Unity that provides all the functional workings and command tools just one elementary window [80].

2.8.2. User Friendly

Game engines created for supporting and creating a videogame that connect and bound with other platforms, software and modellings by importing and exporting through the project. Game engines may speed development of the game project or an architectural project by letting game designers or architects to use existing templates, assets and components, so that they may evaluate to implement on their projects. Moreover, game engines provide designers to collaborate and design a game and extract and export from different range of platforms namely as mobile devices by editing and changing the originality Game engines are the technological software that open to modification and plug-in some features that game designers or architects that desired [80].

2.8.3. Integrate with CAD and BIM Software

Game developers have been beginning to make an awareness to point out the requirements of gaming content creators. Polygon based data may exchange and convert to come out in an advanced modeling software that provide exchange of geometry supporting with game editing mediums. In addition, 3DsMax creators made software to create and extract some game components and assets namely: landscape, vegetation, vehicles and furniture stuffs. In addition, character design and creation of avatar templates have caused one of their priorities and represent their shifting intention by establishing character studio [81].

All the extended reality (XR) applications and software, whose interface working on virtual, mixed, or augmented reality can attach and use the functions of CAD software. Modern game engines may be the perfect consulting point to research and experiment on a platform to experience XR-CAD collaboration as involving many qualifications. Collaborating with the CAD software with a game engine provides all necessary features that essential for XR-CAD platform. The Cad importing and integrating also brings geometric data management at the same time editing and manipulating the necessary data. [82].

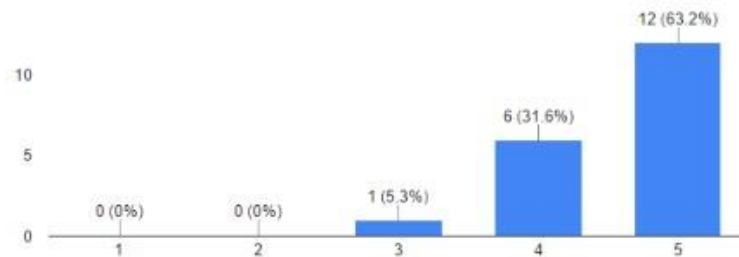
While 3Ds Max, one of the most preferred 3D architectural digital software tool for architects, may connect with the Cad based software and CryEngine game engine, many architects may have a chance to use this software. Game engines may provide efficiency if the software may integrate with the third-party modeling tool that provides outstanding control on modifying the geometry [4].

This method refers as "white boxing" that considering about a white box geometrical shape designing the general game level or a building with layout before adding textures, details and adding into an immersive colorful environment [83]. By using this feature, game designers and architects may have looked for their design and concept workings that if it works for the game design or a building. This method generally used as for architectural purposes, supporting with CryEngine. The 3D model can be viewed from CryEngine game engine software with the updating almost immediately when the game designer or architect updates the geometry is exported from 3Ds Max without using editor to restart. In addition, Photoshop may be used as for texturing the maps of the video game by editing and designing on it. Plus, CryEngine delivers for the designers to interact with Photoshop/3Dsmx in multi-screen makes switching between modeling and playtesting in a short cut way [4].

2.8.4. Experience of Spatiality in a Walk Through

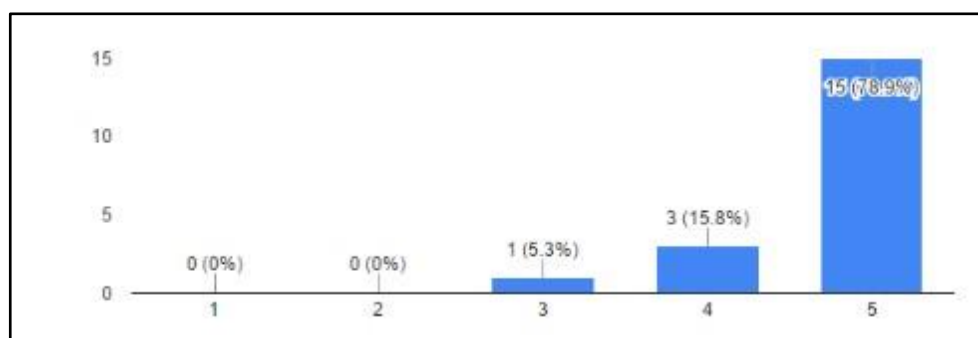
By integrating the use of video game engine, Architectural companies may gain multiple realistic contents and interactions. Game engines are software that, provide designers all run and realistic spaces that allow users to walk through the space and experience in a human scale perception if they would [66]. The title of article which is "How can 3D Game Engines Create Photo-Realistic Interactive Architectural Visualizations" tried to find out that the Game Engines may produce a high-density realistic spaces and Game Engines let users to experience, perceive and interact in a real time space. The authors asked audience: "Does the additional interaction (e.g., Open doors, walk through) benefit the visualization?". The results are extremely outstanding that 63.2 percent of attendants preferred interactive additional specifications have significant advantages like opening the doors and walking through of the virtual space. However, according to table 2.2 some users found that, they have some issues not too willing to control and experience of these interactions and experiences [66].

Table 2.2. The slices that attained the survey and 63.2 percent answered absolutely yes for the question: "Does the additional interaction (e.g., Open doors, walk through) benefit the visualization?" [66].



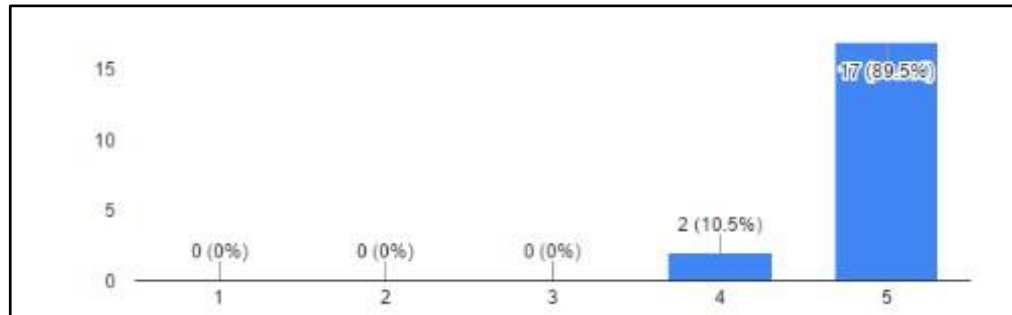
Another question of article for the audience is, "did you prefer the video presentation over the interactive walk through? ". The answers given for the question demonstrate that almost 80 percent of participators give their election for the interactive walk through extremely higher than other 3D render walk throughs. The reason why users prefer the game engine walkthrough would be able to view every aspect that they desire. Better understanding, video version of walk through only provides a singular, limited benefit of the visual property and also, floor layout impact has a significant effect on choosing game engine [66].

Table 2.3. The slices that attained the survey and 78.9 percent answered yes for the question: "Did you prefer the video presentation over the interactive walk through?" [66].



The final question of the article about video Game walk through is: "Do you think interactive walk through's have a place in the future?" and the answers were not surprise. The 89.5 percent of participators answered will take place in the visualization industry. Although some experiments conduct that virtual reality and mobile technology perhaps have a better exploitation of visual industry, game engines may have a bouncing impact on architecture and gaming industry [66].

Table 2.4. The slices that attained the survey and 89.5 percent answered yes for the question: "Do you think interactive walk through's have a place in the future?" [66].



As analyzing the survey, most of participators voted game engine's features beneficial for architectural advantage. For all questionnaires, there is a dramatical difference that, a great majority of people believed the video-game engine for architectural visualization by interacting walkthrough experience because of integrating the spatiality more effective when comparing other platforms.

2.9. HISTORY AND GENRES OF VIDEO- GAMES

In the previous parts, the research tried to research and find out the potential outcomes of representation of video games on architectural design. The research focused on the narrative, storytelling, gameplay and video game engines which are the core mechanics of videogame itself. However, to understand and process the potential relation of videogames and architecture deeply, it is a significant issue that, theoretical approach of videogames and types of videogames may contribute and notice the architecture relation.

If it must start from the definition of video games: A game played by electronically manipulating images produced by a computer program on a monitor or other display (Oxford Languages Dictionary). With this definition, both videogame and architecture disciplines come from a flat screen that manipulating, interacting and discovering in a virtual world. The gaming sector in the world has been dramatically jumping and increasing for our 21st century. The researchers illustrate that, 164 million people in U.S.A. have been playing videogames [84], 9.3 million people are playing videogames every day in Netherlands [85] and over billions of gamers in the world [86].

It may be examined that, videogames may be a medium that contribute and connection with the information technology at the end of 20th century. However, physical plays are the natural, primitive toys that video games may be the evolving version of the physical plays [87].

Game design started to become a "field" only recently, with the introduction of computer technologies [88].

According to McGonogal, the video-game designers may collaborate with the architects and engineers with a quote: "We need to build hybrid industries and unconventional partnerships, so that game researchers and game designers and game developers can work with engineers and architects and policy makers and executives of all kinds to harness the power of games" [89].

The similarity of videogames and architecture takes at the same place that, they deal with the same spatiality, physical cognitive visual concerns and same functional goals with both are using the same technological tools [87].

Neurkar asserts that both videogames and architecture match the Vitruvius's quality of spatiality and dealing with his three-core context [90].

Videogames may create the designers and players to let discover and free to design the spatiality that, architects may feed and test the videogames to achieve and solve the close design solution by giving the new architectural solutions and may give a fresh updated architectural perspective [87]. It may be a significant issue that, by analyzing the anatomy of videogames, the research may stir up a fundamental theory for overlapping the architecture [91].

Especially if it would like to analyze the last decade for the context, videogames, digital spaces and virtual reality studies and projects have dramatically increased and affected our design trends and became one of the most popular trending. They not only affected player's perspective virtually but also manipulated and conquered the physical manner. Videogames have started with the connection of physical-virtual space on bodily in physical space but exist in a virtual world in mind. In this part, the research tries to examine and reveal the historical development of videogames.

The history of videogames parallelizing with the development of technology and integrating with the technology for videogames requires an advanced system that multiplying simultaneously calculation and visualization system [91]. In the first development of videogame in an advanced computer, which used for military purposes. "Spacewar" the first videogame created by military purposes that videogames can used for the multiple disciples from past to present [91]. The game has a controversial population for U.S.A. that, it provided to give a lecture in a few Universities. Plus, for the effective gaming, "Spacewar" caused to invent the first joystick to motivate better game performance and aim try not to damage keyboards when people play the game [92]. It may be noticed that videogames have been providing strong, powerful 3D generating computer systems for the last decades. [93]. They also may not affect the video-game industry but also affect the economy of the countries. MIT Student Nolan Bushnell, the later founder of "Atari" produced the automated version of the game by the American Game Manufacturer Nutting Associates and started to produce the first mass-production game in 1971 [53].



Figure 2.23. The first videogame, Space War created for Military purposes [91]

The first videogame, "Spacewar", launched in 1962 and wrote its name through the gaming history. The videogame takes place in a space that provide players to control and accelerate the spaceship by dealing with the space wars [91].

Bushnell, the founder of Atari had an idea for the better success of locating videogame in market stocks. Because of this reason, he catches with this intention by creating "Pong" just one year later from "Spacewar". With "Pong" the video-game spaces were created and spread all over the American Cities. It also made a significant profitable business that continued through 1980's [3]. The videogame created not only a virtual entertainment stuff, but also revealed a newborn architectural space that experience its spatiality. Today, this

machinery spaces have become an aesthetically fine products that, people are purchasing and using as a decorative element of their house because of retro and punk/futuristic graphic matters.

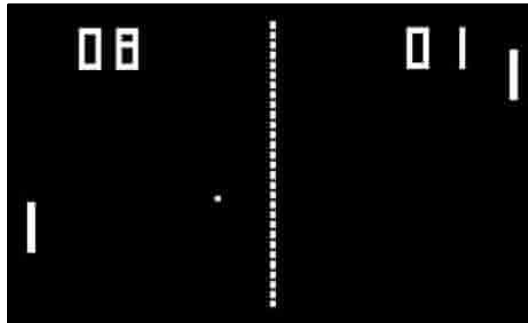


Figure 2.24. The footage from the "Pong" game that chasing the dot with the bar that given to you [94].

These are the trying that to reveal the first templates, stable and establishing the first market and economical trying for videogame industrywide the parallelizing of the development of technology, video-game spaces changed the dimension adding perspectives and most significantly, the industry started to create spatiality, adding narratives and architecture. The first 3D game, Wolfenstein 3D was accepted as the first FPS (First Person Shooter) game for 1992 that, there is a ground level and the vertical panels and walls that define the spatiality [3]. With developing the technology and originate, periodically 3D buildings that represent the history of architecture and create a new utopian and dystopian "hybrid" spaces. These "digital-arts" may be operating as an inspiration of next-gen potential architectural space typologies as Wolfenstein 3D demonstrate to players.



Figure 2.25. Footage taken from Wolfenstein; the first FPS (First Person Shooter) Game created with Wolfenstein 3D Game Engine [95].

2.9.1. *M.M.O.R.P.G.*

In this chapter, the research tries to select and assign some video-game typologies that, despite, there are many video- game genres; The research assigned which video- game genres represent architectural representation deeply as with proper perspectives and cameras for the representation of architecture and provide to experience virtual and real buildings, monumental, renders and footages exist in the world. The three-dimensional videogames ensure players' virtual reality perception in a dramatically shifting through immersive environments, narratives and avatars with supporting weather, spatiality, infrastructure... etc. Game Theorist Katie Salen asserts that, by providing better gaming experience and interaction, the videogame should have a system that connect with players as well as the importance of game's context itself [88]. Today's videogames generally set up and create a system that provide a collaboration, interaction and back-up with multiple players at the same time same virtual environment. This kind of game refers as M.M.O.R.P.G. (Massively Multiplayer Online Role-Playing Games). M.M.O.R.P.G. games, enables interactivity with multiple players and increase the experience of the spatiality thanks to internet connection. This kind of games generally expected to reveal an advanced graphic technology that call for player-addicted people that outcomes may come out prospering that the reality of simulation was developed an advanced level from sports to simulation video-game genre [3].



Figure 2.26. The Footage from M.M.O.R.P.G. Game: New World [96].

2.9.2. Real-Time Strategy (RTS)

Real Time Strategy videogames as refers as a computer and video game genre. The game takes places in a virtual world that the theme of the space asserts about the definite time, military, technology and trying to control high-level other opponents [97]. Generally, real-time strategy videogames provide an aim for player to control and conquer the territory and set-up a new kind of defense systems against other players as the countries of our physical world. They may become a leader that leading of a military colonial country or a planet on this utopian/dystopian world [98]. For instance, Age of Empires the creator from Microsoft would refer to the essential and popular strategy game that all over the world has been playing since 90's. The game locates in a middle-age landscape and historically represented architectural buildings that, every player tries to establish their kingdoms and producing economically, growing defensively and acquiring ground savagely so that there may be a worthy competition in the game. Players construct their military base, build stunning castles and villages, producing coins, meat and power for the needs of development.

The game eventually, considered as a making decisions and training skills. Real time strategy games expect from users to make a set of some significant decisions and see what will happen after these decisions [97]. The real time strategy games have a strong landscape and architectural content that inspire from architecture, literature, movies, legends, history, sociology and philosophy. The player would like to expect controversial content and interface for a better playing area or a field, the graphics engine for graphics, Artificial Intelligence for routing, spirited characters... etc.

The video-game's cameras that present and perceive are top-down and isometric view that acquainting from the architectural design perspectives. The real-time strategy games may let architects and designers experience those virtual environments in an axonometric view that explore and analyze the building in a different utopian/dystopian or a fantastic world perspective that, perceive the spatiality in a macro scale. The perception may let architects view the environment with the desired territory and observer, edit and manipulate the architecture through designing a game from game-engines.

To create this such games, the suitable ones may be CryEngine3, Unity4, Shiva 3D and Unreal Development Kit (U.D.K.) would be the profitable ones [97].

2.9.3. Simulation

Simulation games may have a huge marketplace in the gaming industry. "The Sims" and "SimCity" from the creator of Maxis and Electronic Arts Game Studio has an impact on gaming industry. A 3D game provides to design both interior and exterior side of the houses designed and created from foundations, adding masonry on siding and elevations, creating rooms, purchasing all the living stuffs chairs, tables and armchairs to roof design. The structural spatial fiction of the Sims was inspired from American Suburbia system and real estate marketing. The player also bulldozes the existing old house and purchase a new open space for their house. This perspective also "the clean slate" of U.S. frontier thinking and urban design policy [3].

Most people who interested in design and create and building a house and put in a virtual world customized "Sims" idea may have a significant idea for children and who are interested in architecture and virtual life. For the "SimCity", the game may let you become the president of municipality so that, all players have a chance to design and build their dreamy, ideal city according to their scenarios. In SimCity, the game supplies you to construct main roads, buildings, skyscrapers, suburbs and even landscape design to reveal a city scale. After starting to play as a creator and a mayor of the city, players may deal with some natural disasters like storm, earthquake, and other actions that your city design may appropriate and durable or not for external acting. After interpreting the research on both videogames related to architecture and urban planning process, it may draw attention that, this digital, virtual spaces may be a reference for upcoming city design templates and simulate and guide players to edit and steer with good deal architectural and city planning design rules by playtesting.



Figure 2.27. The footage from the Sim-city videogame that may observe to design a virtual city that designed and constructed according to the ideas of the player with becoming a "virtual mayor" [99].



Figure 2.28. The footage from The Sims 4 game representing an ideal, designed house creation made by players by providing to become "virtual architect" [100].

Simulation in the 21st century, has a significant role that not only in a videogame made remarkable, but it also makes possible designers to create virtual world that alerts and helps the outcomes of design works from the actual-real facts by simulating. Architectural Simulation may be range from drawings, photographs and different scale 3D models that represent with a different dimensional medium [101].

When it ought to define the simulation with a basic and architectural connection as if it possible: "In simply, Simulation is a process through which one can study and analyze the real-world scenario by creating a virtual world" [101].

The thesis will assert and explain deeply the simulation in the part of 1.8 Simulations part deeply, However, Simulation may be referring as a hypothesized real-world perception and replication of a real world. The acting, references and spatiality traces from real world and reflects the physical world in a virtual world [102].

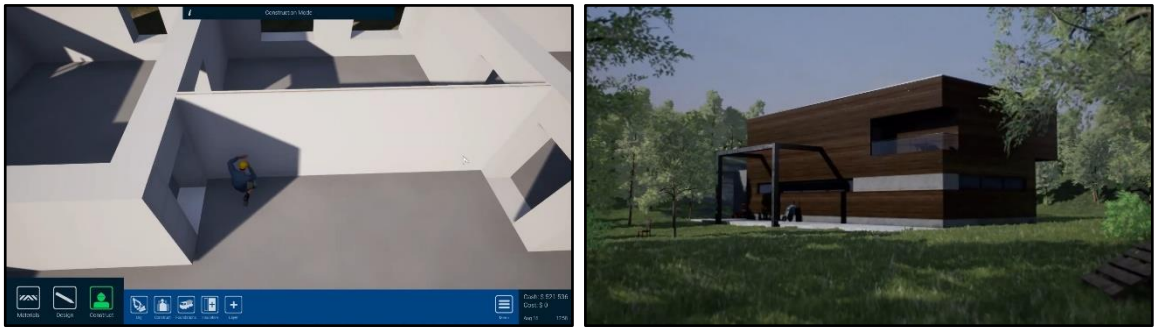
As asserting from the beginning for "SimCity" videogame for simulating and facing players the natural disasters, gaming technology may also refer and give a clue with a virtual simulation such as, firefighting, winding conditions, climate change and temperature regulation for both upcoming future buildings and current buildings [103].

Game designers and studios have been researching and developing advanced simulation games that refer and guide architecture and building information day by day. The game studio SimFabric launched a game called "House Designer" in 2021 that, the videogame presents players to witness a house or a building from foundations to insulations, constructing and all the digging and filling construction processes.



Figure 2.29. (a) On the left, footage from House Designer videogame that presents a scene of the construction phase of a single house, foundation phase of the single house. taken screenshot from [104]. (b) On the right House Designer videogame showing the exterior and interior walls building and continue to build it [104].

The game also tries to trigger and awaken designer/plater's architectural design side that, provide in a full of architectural stuffs and items that manipulate and create their desired buildings. The "House Designer" game may have a kind of a guide game that every architecture student may exploit the game itself that observe and experience of all the construction and architectural phases in a virtual simulation videogame.



(a)

(b)

Figure 2.30. (a) On the left, footage from House Designer videogame showing a worker building a wall for interior architectural organizations constructed and designed single family house project in. (b) On the right, 3D perspective camera that illustrates all the finishing, windows with landscape design [104].

2.9.4. Arcade

Before the releasing PONG (Atari 1972) first videogame launched in the world, arcades named as a highly quantity of physical games that, skeet ball, whack a mole, shoot hoops to win a teddy bear. Arcade games have a connection with a physical joystick to locate and steer the player and some functional buttons for action and acquiring tasks. Arcade games in which players can use traditional buttons and controllers: "punching" for the fighter, steering a car or shooting pistols. Arcade business owners may have to reset up their location according to their architectural spaces. Arcade games have a physical and aesthetically fine machinery spaces that may fit or support the spatiality that, arcade fans have been buying and collecting the Retro arcade games in their hobby-room or even in their main living room to attract their close friends or relatives. Arcade games need architectural components that any Wall or floor system may enough to play and interact with it.



Figure 2.31. The pong game with a physical Atari mini arcade gaming.

Arcade games may start a new kind of phenomenon called: "Ubiquitous Gaming" a vision for the future of enchanted spaces. Ubiquitous computation, or ubicomp, as a new kind of an interest of computer science that aims to integrate physical objects and spaces invisible and synchronized with digital environment. In ubiquitous games such as "Can You See Me Now?" (2001) and "You are in Control" (2005). The interactive video-game, "Can You See Me Now? " By using the city's virtual spatiality, there are some online players that visible in a game that chasing and traversing in the actual city streets to catch-up the online players. Maximum fifteen players may allow to play in this game support many online players and four physical street players who chase the virtual ones by analyzing and locating the opponents in the minicomputer devices. The players can communicate via walkie-talkies and exchange each other. Runners can see their position with the context of the city and locate the virtual players. Because of this reason, the players may experience the city streets, traffic condition, the actions that holding on the streets, people moving around and the sounds of the physical elements that alerts in a virtual space [105].



Figure 2.32. The footage from the Can you see me now? videogame that represents the virtual players can be detected [106].

2.9.5. Sports and Competition

Sports videogames may refer all the physical sports department mainly such as: football, basketball, tennis and all other physical public sports that hold on in physical world. Generally famous stadiums, basketball arenas and famous locations represent and designed precisely for the immersion of the player that ranked as a kind of landmark of the city. For instance, Staples center in the Los Angeles, U.S.A belongs to Los Angeles Lakers basketball arena confronts to the players at NBA 2k series. All the architectural elements of Staples Center including exterior and interior atmosphere may represent in a virtual world as possible as it may.



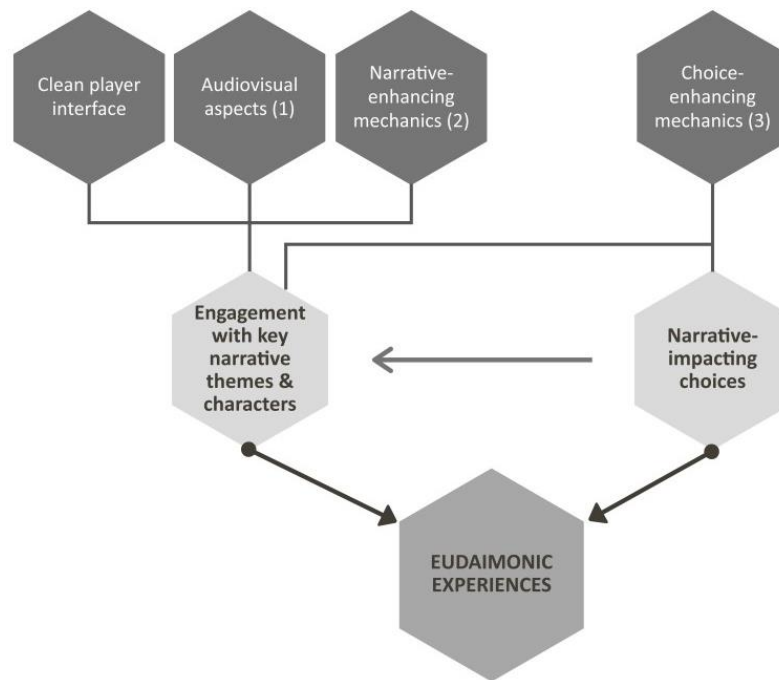
Figure 2.33. The Footage from NBA 2k 2020 Los Angeles Lakers vs Los Angeles Clippers basketball match interior space represented Staples Center, Los Angeles, California [107].

2.10. CAMERAS OF VIDEO GAMES

2.10.1. Perceive the Game

It may be a significant issue that perception provided by videogames with interaction of spatiality has a critical impact for the players and users that experienced in. To perceive in a productive and effective way, camera perspectives of a videogame may shape and close the gap between player and character. Some research and experiments conduct that, to interact with the video- game with experiencing emotional changes, reactional feelings and reaching Eudaimonic experiences; it may become substantial to consider the character design, understandable user-interface, different camera perspectives may have a controversial impact on intersecting with the virtual space [108].

Table 2.5. The graph illustrates the one of the key elements to fulfill the Eudaimonic experience for the players and users' audiovisual aspects including camera perspectives [108].



Eudaimonic experience, the term comes from Aristotle, in the 4th B.C. based on Eu means good and daimon (spirit) leads to refer a good life [109]. To reach a Eudaimonic experience, visual representation may come up with the narrative and technical themes and characters may depend on audiovisual aspects, including namely as real-time architecture and graphics, advanced characters integrated with the narrative, most significantly camera perspectives and soundtracks [108].

What by the game designers, architects represent for the videogames by using cameras, architecture and narrative with an immersive character design, they may also try to reflect the spatiality in videogames by triggering the perception of players and clients in a virtual space. Virtuality may let on player to consider both linguistic or apart from the nature's visual considerations and reality itself. Technical essence of the virtuality comes from technology of language which activates the metaphors of thinking and ideas. Deleuze asserts that, the event or an action may represent itself from virtual to actual by creating an immersive flawless architecture by forming new events and actions more than itself. To experience virtuality, supporting with the illusion of perception comes with the eye and

imagination that breeds with human mind may replace and caused to manipulate on experience of the action [110].

Therefore, the cameras of videogames that representing and processing with architectural design, may experience players with different perceptions by interacting with videogames in different camera perceptions using first person, third person, top-down or a perspective game. The game design studio companies or architects prefer to implement the cameras according to demonstrating the spatiality or narrative of the videogame that shapes the gameplay directly itself.

2.10.2. Perceive via the First Person

First Person Shooter games refer as representing the videogame by perceiving in his/her own human eye vision that may enable to experience with walking through the environment that designed [111].

It may be a noteworthy issue that, the connection between game space and gameplay that how to perceive the video-game space for players have affirmed with the method as videogame genres may seize the spatiality of videogame. Because of this reason, first person shooter games contain competitive environments that lead to interact with them. By supporting with these environments that improving always on process; the camera may represent architecture in videogames more dynamic flow [112].

First person camera brings players and users perceiving the architecture in virtual world by seeing from the eyes of the character and watching the game space in a clear view of the spaces through right across. The perception of first-person gaming camera allows separating from real world is much stronger with reflecting their thoughts and actions by reducing the gap between game space and themselves [113].



Figure 2.34. The footage from Cyberpunk 2077, the F.P.S (First Person Shooter) game that the player is riding a motorcycle that enable to experience the dystopian city and its architectural design with human-eye perception. [114].

FPS videogames presents an outstanding three-dimensional environment by routing through the virtual space for the players with competitive environment [115].

The Silent-Hill 4: The room, which refers as a Japan horror survivor game, uses as first-person shooter camera that locates in apartment flat, metro station and other architectural buildings. The core of the narrative and spatiality locates at Henry, the game character's house. To interact and analyzing the architecture that takes place in the videogame, first person camera work on this game. In addition, it may become suitable to play with first person camera guide players by focusing on some significant architectural details to find out some clues or tips to accomplish the level [111].



Figure 2.35. The footage from Silent Hill-4 video-game that perceive in First Person Game Camera interacting with Henry's apartment [116].

Minecraft, which conquered all the computer and mobile platforms that owned by humans from all over the world using first person camera perspective. The game describes as a forming "digital Lego" that allows players to make their rules with playing for any purpose what they desire. The game created with a 3D grid blocks that enables to replace, create and destroy them [117]. With this perspective camera, the videogame may make player related to building a site, designing and constructing directly by determining the camera view as a controversial design tool [118].



Figure 2.36. The footage from the gameplay of the videogame "Minecraft" creating, extracting and building the site depend on your sources. [119].

2.10.3. Perceiving via Third Person

In third-person game camera, the player perceives the architecture in virtual environment by experiencing with more distance than the first-person camera. By enabling with the third-person perspective, the player may interact with built-environment digitally. In third-person camera the user can see and observe the full-body experiment in a spatiality uplifting interaction in context enabling to see more of the game space and gameplay experience connecting with the measurement and view perspective. Especially, in VR applications and interacting architectural design with third-person camera perspectives, mixed-reality perspectives may put some teeth into something to focus on the game world and observing the action [120].



Figure 2.37. The footage from the gameplay of the Star Wars: Jedi Fallen that experiencing the game and virtual space with third-person perspective by observing and experiencing of the character's movement [121].

2.10.4. Perceive via Top-Down Plan, Isometric Perspective and "God Effect"

Top-Down plan camera perspective may allow to experience with all the spatiality with macro scale city or a building scale with 2-dimensional plan perspective that generally used as to experience and focus on the projection view of the environment.

If it has to resemble the top-down camera, aspect of the methodologies that used both video-game design and playing and the plan drawings of through architectural design process, indeed, both architects and game-designers are "playing" with their own video-game spaces. Both interdisciplinary fields may try to present the desired spatiality, narrative, architecture and social model that designed and created for people that live in.

The videogame designed by some architectural students at Bartlett School of Design University College London called "Greatest Grids" reveals a top-down plan with shifting the perspective and camera that provides multi dimension transforming through New York with grid city plan, representing Manhattan's Island district leads to shape and developing buildings. The players have a chance to play the game with always taller skyscrapers inspired

from Rem Koolhaas's thinking for Manhattan's monumental that assert on "Delirious New York" [118],[122].

The impact and usability of these kind of video-game projects have a multi significant and noteworthy effects. It may be claimed that this kind of architecture-video game collaborations artistic videogames may bring an introduction for using the game technologies and concentrate on to obtaining their design principles and experience in software by providing design decisions. In addition, the students may comprehend the potential functionality of game spaces, when it applies on phenomenological architectural theory and design. Plus, it may assert in a noteworthy situation that using the virtual, fictional worlds may create a researching area that may study on possibilities of game engines on spatiality [118],[122].



Figure 2.38. The videogame "Greatest Grids" represents the New York's Manhattan as perceiving top-down plan projection by experiencing and interacting with the city [118],[122],[123].

Another possible interpretation of vide-games as analyzing through its camera perspective may prove player to become and play as an individual "God ". Generally, city-building games may give an assignment by placing the visible assets in a virtual city or a building by

such as SimCity (1989) and Cities: Skyline (2015) or The Sims 4 (2014) by supplying and observing all the territory with an overview and control the "God games" isometric cameras [118],[122].



Figure 2.39. The image from Cities: Skyline (2015) videogame that represents the desired city that observing in an isometrical perspective camera [124].



Figure 2.40. The image from Cities: Skyline (2015) videogame that playing the desired city as a "God" observing in a top-down perspective camera [124].

Only the videogames in top-down camera itself also directly as a videogame may not represent the "God Effect" on players' perception. There may be some other medias that using the theme or a scenario as Videogame that may connect with our decisions, actions and intentions. One of the popular tv series called Black Mirror published an exclusive Episode called "Bandersnatch" that takes place in a video-game studio. The game designer struggles with his psychological problems parallel with designing a videogame called "Bandersnatch" a dungeon role playing game. The tv series let users to change the narrative, speeches, actions, scenario, and decisions that shape and change the way its story. In "Interview with Paolo Pedercini" conversation with Andri Gerber and Paolo Pedercini asserts in a part of the interview speaking of the Bandersnatch:

Gerber: This calls for a question about participation. In a video game you are actively playing, you have to make decisions, you commit yourself to it, which cannot be done with books or while watching a movie, at least not to the same degree. On the other hand, with Black Mirror: Bandersnatch, Netflix is trying something in this direction; I remember similar experiments in the television programming of the 1990s. How would you describe the specific form of "personal investment" when playing video games? Pedercini: I think Bandersnatch didn't put any effort in making you care about the fate of the characters. It wants you to explore the limits of this agency, to break its structure, while pulling all sorts of meta-fictional tricks to avoid the problem of branching stories. The result is somewhat cynical and sadistic: you are playing God with the life of the protagonist, fiddling with this new (in the context of television) technology, but maybe it's YOU the viewer who is being duped. All of which is in line with the techno-dystopian themes of the series [125].

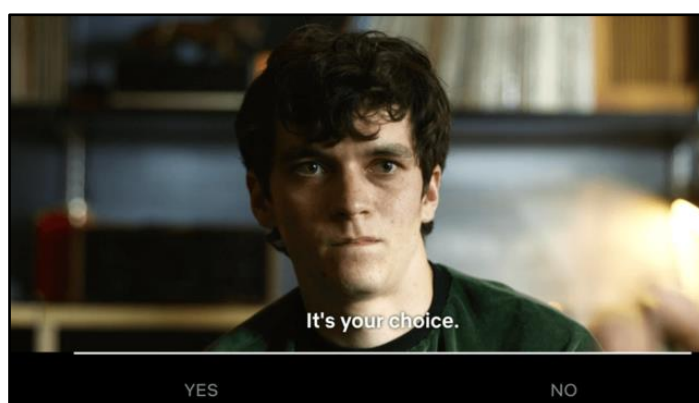


Figure 2.41. The footage from Netflix's Black Mirror: Bandersnatch that allows watchers providing to select and manipulate the scenario by making a decision through duration for the game designer Stefan Butler acted as Fionn Whitehead, game designer [126].

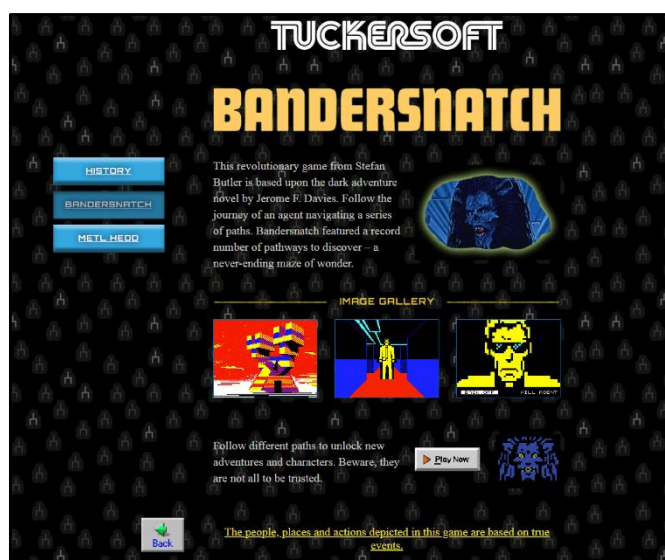


Figure 2.42. The footage from Netflix's Black Mirror: Bandersnatch videogame provides a mazing by unlocking the spaces and make some decisions according to game structure [127].

As asserting with the "God Effect" with the aspect of the perceiving the spatiality, simulations may consolidate the effect of real or simulative spaces. Video- games may try to catch the next generation reality by representing the spatiality, at least this virtually entertainment medias integrated by gamers, architects and game designers with full of simulations. Abstract and abstract idea nowadays hasn't been reflecting and routing the theme as itself purely in a desired space. Simulation may consider as a regeneration of potential models extracting new possibilities and models by escaping from reality or origin of physical and artificial reality that produces various alternatives and sources.

It is a map that management of the territory, it is a motion of a Simulacra that a real space which is the revival of spatiality, However, it represents also substitution of the "here" and "there" which is also no longer of the previous space, but people have. Simulacra, a kind of a reflection, a reflector. It may admit as an "embodiment" of the simulations of the earthbound [128].

If it may present an example for Simulacra, once in history, the castles were constructed in a territory, but then with elapsing with periods, the territory stays the same, but the context of the substitution may have changed. Replacing the built environment on the same territory may refer as simulacra, it is the reproduction by templates of a physical space and time without origin or reality: It is a Hyperreal [128].

It may associate with the simulations and architecture with the aspect of space syntax, Architectural spaces may become as a simulacrum, spatiality of illusions that people reuse, restore, and rebuild them that reveals a new reality, a new possibility from the previous one. The outcome also creates a hyperspace that substitute of the physical condition from one to another. Spatiality can never be last forever as its origin and its tradition aspects. It always transforms, changes, manipulates and constructs since its beginnings. Hyper spaces are everywhere that people touch and re-design the spaces.

Architecture may also be defined as a full of codes that entangled and formed in a proper geometry as the same Simulation that domination of schema of the current level that manipulated by the code. Hyperrealism in the Architecture compose a coded reality that significance of the exchange on the process of simulacrum concession and dictation in entirely on simulation. Baudrillard refers about the absolute shifting of the reality with this quote that:

We live everywhere already in an "aesthetic" hallucination of reality. The old slogan "truth" is stranger than fiction that still corresponded to the surrealist phase of this aestheticization of life, is absolute. There is no more fiction that life could possibly confront, even victoriously, it is reality itself that disappears utterly in the game of reality radical disenchantment the cool and cybernetic phase following the hot stage of fantasy [128].

Simulacra, intents to represent reality by perceiving itself directly. Because of this reason, Simulacrum may not be able to hide the existence with the supporting with reality. On the other hand, simulacra would like to take control and replace and copying reality from simulation. Reproduction, images, visual representations may apply precisely through the territory with the idea of the Baudrillard's idea that assert on Simulations (1983) [128]. The idea that existence of the Simulacra by creating the images, may bring with the replacing the reality in somehow. It may be a significant factor that, the equilibrium of the real and virtual siftings may become inevitable to not to lose the perceiving the reality [56].

Disneyland is a significant model that might refer as a simulacrum and the establishing of hyper-real concept. It could be meaning for people of an exclusive "play-space" that provides people tangled with a full of fantastic illusional spaces just like "Pirates", "The Frontier", "Future World", etc. Disneyland is represented as imaginary to realize that other spaces are real and also the reference of the hyperreal and of simulations. It is effortless to investigate the question of a false representation of reality as ideologically, but of bottling up the fact

that the real is no longer real and thus saving the reality principle. The Disneyland imaginary is not a true also cannot say false, it may be referred as a transformation of a fiction of the reality itself. It is a kind of an inflatable space that make adults believe that the real childishness is located everywhere, an illusion of timeless, an abstract non space. It provides to dream come true with a unique, colorful simulation spatiality [128].



Figure 2.43. Disneyland California, Anaheim represents a Simulacrum that replacing the reality and presenting a substitute hyper-real spaces [129].



Figure 2.44. The map that represent the area of Disneyland California, Anaheim represents the theme-park area that takes place on a territory [129].

Hyperspaces refer as a substituting icon of the real itself, it is a kind of an operation, a metastable programmatic perfect mechanic that provides real and short-term sessions.

Simulations warns about the realization of the "true" and "false" between "real" and "imaginary" [128]. Hyperreality provides a new unborn reality that unbound from past and previous all times. It may define as representing and shifting through as a reveal of a new reality, a new spatiality.

When it must be compared with the Videogames and Simulations relation, The videogames may count as a simulation that reproducing and providing new kind of representations, scenarios, architecture, social and cultural models that generating possible models between real and virtual. It is considered as both spawn from matrices, memory banks and command models. They also represent with the infinite number of times, and they also no longer must be rational and operational. They are also no longer real at all. It is hyperreal. The outcome of the multidirectional synthesis of endless models in a hyperspace.

If it would like to deal with this context in deeply that, the issue may become a controversial effect that approaching and understanding the reality of architects and game designers may distinguish as intellection of thinking and designing the spaces. Even "realistic" videogames may provide a hyper realistic space that make player believe in different realities and illusions to reach outstanding atmospheres [130].

The purpose of the videogame may define as providing an entertainment with the using game engines not giving a realism. The game designers may have a chance to design and construct their videogames freely through the game design phase. On the other hand, architects may struggle with testing their designs according to reality and integrating with the natural laws [4].

The very definition of the real has become that of which it is possible to give an equivalent reproduction. The real is not only what can be reproduced but that which is always reproduced. The hyperreal which is entirely in simulation [128].

3. LITERATURE REVIEWS OF REPRESENTING ARCHITECTURE VIA VIDEO GAMES

3.1. VIDEO-GAMES AS ARCHITECTURAL HERITAGE

The protection, development and renovation of heritage buildings, monuments, historical buildings, landscapes and related with the historical and culturally embedded values may stand out and a significant issue for education, humanity and sustain of national and international identity. In addition, virtual spaces of videogames may be transmitting and spreading across the globe with artistic and advanced graphical representation by extracting from its original materials, historical books. By using this technique, the virtual crafted material, texture codes may intend and research to influence on players [131].

To protect this matter, video games and game engines may have a spirited and efficient tool to draw an attention for cultural value and prominent effect on player to focus on the game play with an outstanding spatiality and make environment more authentic by providing the myths, legends, historical characters and outfits and heroes [131].

Some respectable factors may assert that the reason of video-game designers consult to add on their game space integrating well-known monuments and places, as to integrate the players attaching with their personal experiences that those environments may support to empower the message that aimed for the reminding. Another issue may assert that, it may possibly to put over the video-game's spatiality by supplying historically ethnic standardizations that keep up with the behaviors and cultural values for players [132].

In addition, many gaming online forums and platforms also may have a noteworthy effect on considering the architectural heritages. One of the spoken and written for presenting and advertising the videogame as a significant spatiality and contains monuments named, Ghost of Tsushima located at Tsushima Island, Japan videogame created by Sucker Punch Productions launched the game in 2020. The game forums created a poster that indicates the Island of Tsushima because of its beautiful portrait for encouraging to visit there [133]. In addition, it may assert of the significance of the game developers' potential impact that, Tsushima Island mayor recognized them as ambassadors to introduce the land all over the world [134].

3.1.1. Assassin's Creed: Unity

Assassin's Creed: Unity was created by Ubisoft Montreal Video-Game studio and the game series consist of several historical periods that represent from 12th century Jerusalem, Renaissance of Rome, Florence Cathedral, Saint Marks' Basilica in Venice, French Revolution of Paris, struggling with the freedom of Boston and Victorian period of London.

The videogame takes place in a density built-environment of Paris that, video-game designers tried a technique called "Radical Scale" technique that, the buildings may appear as to become spread all over the city with the movement of the player designed with one to-one scale representation and creation of Paris' central and significant area. In addition, with applying this technique, the primary landmarks [135].

Some significant landmarks namely Louvre Museum, Pantheon even after the developing through level and time of the game directly; Eiffel Tower which was constructed in after one hundred years after the declaration and starting the French Revolution, placed the exact plot and proper place according to the real Paris city planning process [136].



Figure 3.1. The footage from the representation and reconstruction of the Eiffel Tower as virtually in Assassin's Creed: Unity (2014) [137].

3.1.2. Ubisoft made it: Revival of Notre Dame Church after Fire

The video game studio Ubisoft, the creator of Assassin's Creed: Unity which takes place on the French Revolution of Paris, France had a controversial workings, reproductions and representation as historical architectural built environment as preserving of the period. The news had been reported that in April 2019, as published with the daily media, one of the prestigious gothic landmarks of the Paris, the Notre Dame Cathedral was dealing with the fire, and the historical monument became exposed to a major harm with the aspect of its architectural and historical and cultural value. Even though, all the significant scientists, architects and academics had been promoting many solutions to recover the cathedral. However, the fire in Notre Dame triggered the magnitude the impact and the videogame demonstrated the idea of the reconstructing of the historical, cultural, and architectural preserving that, the way of modelling in a digital environment [138]. In addition, it may consider examining of the visual reproduction process of the virtual spatiality, the game artist, Caroline Miousse accomplished the revealing of the virtual Notre Dame Cathedral, took place over two years [138],[139].



Figure 3.2. The Notre Dame Cathedral from Assassin's Creed: Unity reproduction for the videogame refers the representing precisely [140].

3.1.3. Tom Clancy's The Division

Another videogame that worked and created precisely on it may refer Tom Clancy's: The Division game released in 2016, created by Ubisoft again. The game takes place on a modern New-York city that conquered by pandemic situation and caused by a war.

The game's central and core area locates on the South-Central Park. The video-game designers dealt with the extracting one third of Manhattan's area that means eighty-seven kilometers square thanks to game engine's functionality. The videogame created with Snowdrop game engine that leads to producing condition based generating environments. The scene is regenerating itself by using basic items through the position of the game space by replacing automatically by the game engine [131].

The detail level that used for the game space may see as remarkable outcomes. In addition, the game designers and authors worked on the details that located some graffiti on the walls and advertising billboard charts which accepted as a characteristic identity of New-York city. The designers tried to add the graffiti and advertisement by spending more than one thousand hours by applying on the game space. This method may increase the level of reality that used as a marking of a place to guide a player for the level development [135].

Also, the video-game designers designed the iconic architectural buildings and landscapes virtually that accepted as a landmark of the New York city which may list that Manhattan Bridge and Madison Square Garden by integrating both exterior and interior by experiencing these buildings [131].



Figure 3.3. The footage from the screenshot showing the Manhattan Bridge reproduction at Tom Clancy's: The Division's virtual New York City [141].

4. REPRESENTING ARCHITECTURE VIA VIDEO GAME: ASSASIN'S CREED: SYNDICATE AS CASE-STUDY

Through with the final part of the thesis, as indicating in the abstract part of the research, it may be apprehensible, experimental, and wisely to promote the research by determining and playing a videogame and revealing the impressions, representations and acquiring the spatiality with the aspect of the history of architecture as an architect, academician, and a Master Student. The reason this dissertation tried to promote Assassin's Creed: Syndicate as a case study videogame is the videogame present many architectural representations with detailed because of its historical architectural features such as ornamentation of building facades, observing iron and steel as a construction material, experiencing texture for all the buildings created and landscape renderings. Because of this reason, Assassin's Creed: Syndicate was selected as one of the suitable video-game as a case research.

The research asserted and conducted few Assassin's Creed Game series, because of projecting the essential historical periods by providing virtual screens directly, aspect of architecture, history of architecture, culture, history of art, social life etc.

Assassin's Creed: Syndicate created by Ubisoft Game Studio launched in October 2015 started to market globally for all gaming markets.

The videogame takes a closer look of the Victorian Period of England that, started the first machinery and industrial age sprawled from about 1750-1760 till 1820-1840. The time presents the transformation of the human-animal power to machine power step into the steam machines, coke smelting, puddling, bending and rolling process of the iron [142].

This development exposed some social disorders that shape to create the social classification, child labor, working in tough conditions, and so on. In addition, most of the farmers and workers living at the outside of the city or towns started to collaborate by working at the factories rapidly and total sum of farmers was started to decrease dramatically [142],[143]. By the development and advancement of the industrial buildings especially producing and transforming the textile and iron crafting techniques caused the changing of the social and business orders [144]. By manipulating the order of the humanity, economics, and law contrast to development of technology, some noteworthy activists came up with the

manifestos and declaration that they accepted socialism as a communism that all the railroads, factories, mills, and buildings must owned by the people themselves (Engels,1969). Karl Marx (1818-1883), one of significant German activist that, may still imprint his manifesto and defending for the social equality all over the world. His book, "Communist Manifesto" asserts with developing the Industrialism period Communist Manifesto addresses the birth of "Bourgeoise" term. The bourgeoisie has played an extremely revolutionary role in history. The bourgeoisie broke through all the feudal, patriarchal, rural paradise fantasies wherever it came to power [145].

4.1. REPRESENTING OF SIGNIFICANT BUILDINGS AND ARCHITECTURAL STYLES OF THE PERIOD

4.1.1. Factories and Mills

The videogame that presents the Victorian Period of London presents the spatiality with almost the exact architectural and city reproductions. The videogame starts with the first spatiality of Victorian London that a mission to play at iron factory to manipulate the machines with playing at the coal factory building.

When it may examine the virtual building with architectural aspect, it may attract the attention that the density of iron and wrought iron used as many structural phases as possible with crafted and manufactured. Also, by analyzing in existing physical factories built in Victorian period, The argument may promote the settlement of all the constructive and architectural aspects was created by engineers who work and design the machines [146].

The structural system of the factory created and built with the cast iron that was accepted as a building material. The material had been approved to use the building material as using the wood, brick and stone too [147]. Truss structural system may also be observing and integrated into the videogame that, by finding the new assembling and constructing techniques. In addition, many balconies, handrails created from cast-iron material in both physical buildings and video-game virtual spaces.



Figure 4.1. The representation of interior design of a coal-mining factory that structured in wood, steel and cast-iron materials [149].



Figure 4.2. The truss structural elements were constructed for the building and represented by the videogame [149].

After levelling-up through the videogame the character had to deal with an issue that, he was responsible to save the children from the child labor by infiltrating through the building noiseless. The walls of factory building were covered by a red brick material. Brick and stone material may have known as a "flexible" material as an advantage of minimum tensile strength, dealing with the pre-stress for the structure [148]. Because of this reason, the

videogame may both provide architectural features of the early industrial revolution and a history of sociological and economical disorder of the period.



Figure 4.3. A scene with acting child labor that children are working and gathering around in a bowl [149].

The beginning of the nineteenth century may architecturally be described as a celebration and revival of past structural designs. Gothic architecture approved and considered as a national characteristic of buildings' form. Britain architectural style in Victorian Period transforms from the Gothic architecture to basic British style which combines with the modern architecture with the revival of gothic style imprints that rose window, triangle frontal and the red brick material for exterior facade, started from 15th century [150].



Figure 4.4. Whitechapel Sawmill designed faithfully to the history for the videogame [149].

For Victorian architecture, the ornament had started to develop itself as examining through buildings and environment, but also the design thinking was so simplified. With the development of machines, the building and designing of new factories, mills and buildings were have an issue as a design problem for the engineers. On the other hand, mills were designing in a classical architectural detail that, many of the mills have square windows covered with the stone lintels. Round top windows also used for the decoration and design principle with classical motifs as examining. In addition, some small glass glazing panels and bars may build in windows and used for the construction of housing Projects [151].

The width of the mill was determined by two factors, the requirements of interior lighting and the necessity for keeping the machines close to the main shaft. The answer was not only many windows but windows which were reasonably close to the machines. several late eighteenth century mills still extant in England have masonry walls and a kind of heavy wooden framework that had been in use since gothic times.

At first the machinery was installed only in the attic; the timber roof trusses soon to be replaced by trusses of cast iron left enough space down the center for the installation of the long spinning frames. Later, the use of cast iron pillars made it possible to install machinery on all floors.



Figure 4.5. The footage from a brewing company building designed as a British style that revival of the romantic Gothic style [149].

Greenhouses were also commonly designed and gave a place on the videogame. Greenhouses were constructed in London in 18th. And 19th. The greenhouses were generally covered with markets, bazaars, and exhibition spaces. The materials that used for greenhouses may refer with wrought iron, glass, and concrete. For both exterior and interior space of the Victorian period buildings, wood and stone was represented on the videogame, as natural and stable materials by crafting and producing with machine as parallel with iron and concrete.



Figure 4.6. Greenhouse was constructed for the videogame with iron and steel materials [149].



Figure 4.7. The interior space of a fabric building that the finishing of floor, ceiling and door was made from wood [149].

4.1.2. Landmarks of London City

By proceeding and considering as the cultural memory and heritage of a city in terms of architecture, monuments may have a controversial impact on people to stick in mind what makes city's core element. It may be seen that, the representation of architectural iconic buildings constructed before pre-global phase, (before 1950s) define as a control mechanism of power and driven the industrial sector dominantly by getting support from architectural forms. Iconicity means power and taking control for pre global period and started a fire as activating the capitalist globalization [152].

When it ought to examine and detect the iconic buildings and landmarks of the Victorian period through the videogame namely, Big-Ben, Westminster Palace, St. Paul's Cathedral, Westminster Abbey, and Westminster Bridge.

Playing with the videogame, it may observe the details of Big-Ben's golden and ornament details closely resemble from the real one. The videogame let players with a mission that, by hooking up through the top of the historical iconic tower, it provides to experience the architectural details in a closer look. Thanks to video-game engine, all the finishing materials, gold lace ornaments and details and the proportion of Big-Ben as seen precisely and sharp clean.



Figure 4.8. The realistic height and proportion of Big Ben may be observable in videogame [149].



Figure 4.9. The details of Big-Ben in videogame [149].

Besides, the video-game Anvil 2.0 was used as a game-engine for designing the Assassin's Creed: Syndicate to create the spatiality. For supporting as a representing the architectural spatiality for the Victorian period, Westminster Abbey and Westminster Palace and Parliament House was designed in an advanced carefulness like the reality. The Gothic style Westminster Abbey church was represented with all the gothic details from rose window, buttresses, steeples, lancet arches, and detailed ornaments. The Westminster Abbey and The Parliament House was designed even in its detailed court with landscape, advanced realistic facades carefully.

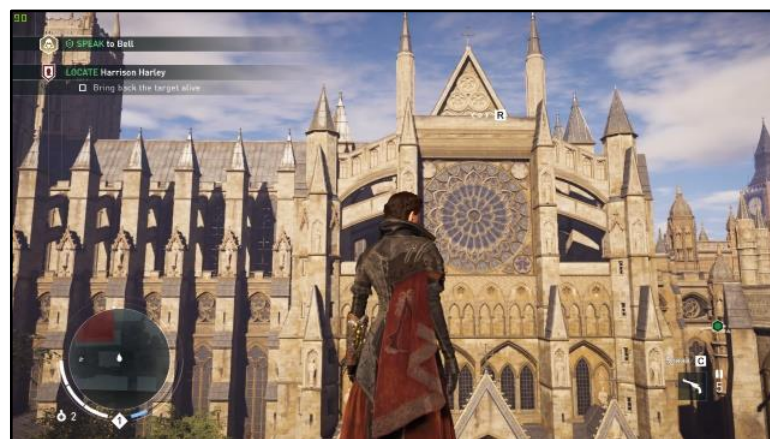


Figure 4.10. Virtual Westminster Abbey designed in all the construction and architectural details presented [149].

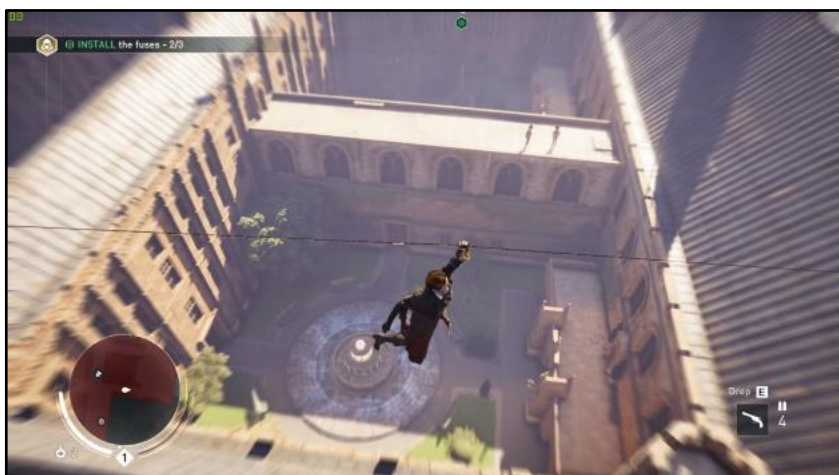


Figure 4.11. The character is traversing with the rope at the top of the Westminster Palace, seen its proportional symmetrical courtyard [149].

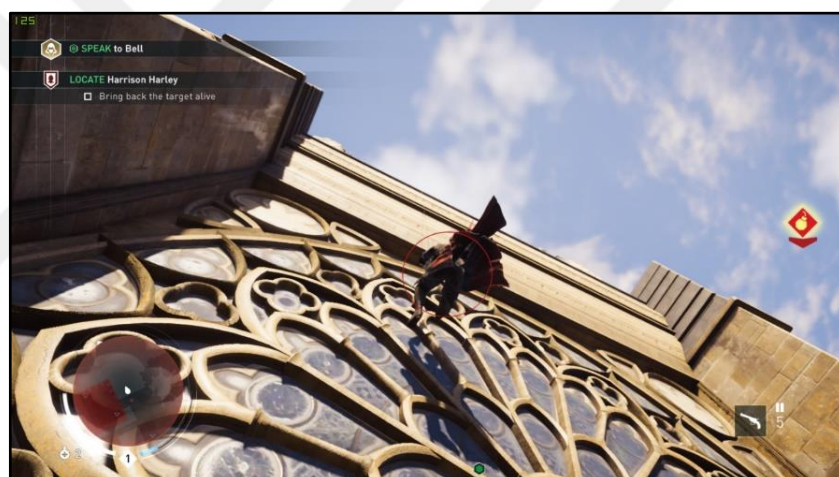


Figure 4.12. The rosace detail of the Westminister Abbey from the gameplay, indicates from the material detail, gold finishes and ornament details from Assassin's Creed: Syndicate [149].

4.1.3. Landscape and Orientalism

When it may conduct through the architectural style of early industrial revolution had presented and deal with the neo-classicism that aim to represent the romanticism aspiration of the nature in a pure intention and desire. The buildings and landscape were coupling with that shaping and presenting their existing in a contrast and diversity manner and entered a confusing in 18th century of Britain by that period, the relationship between art and nature had been considering again [153]. The landscape design of Victorian Period was affected

from many countries' design principle such as: Italy, France, Germany and France but also inspired from Anglo-Chinese gardens. From 1770 to 1800 the landscape design development dramatically increased radically and critics that arguing and speaking of landscape was towering [154].

In the late of 17th. and 18th. Centuries, Chinese-dominated orientalism may also deeply examine and seen in Victorian England. This ornamentation spread with the garden arrangements, wallpapers that used interiors, window frames and furniture as well [155].



Figure 4.13. Footage from the screenshot of the landscape garden near the Westminster Palace that may be seen with the symmetrical garden design with a tiny pool and oriental streetlights [149].

Enrichment of the palaces and pavilions, streams and rivers may be found in early gardens, where the building is so respectable as representing the power of owner [156].

British architecture of Early Industrial Revolution period may also be perceived as Palladianism which name refers from Andrea Palladio (1508-1580) whose buildings were designed as Venetian culture and built in a simplicity symbolism of villa, comprehensible lines and vegetation and garden thinking define as a center of control within the middle of the 18th century [157].

As pointing out the Landscape design style in Victorian Britain with the history of architecture, the videogame features the same elements that represent the Chinese oriented

landscape design principles belong to the kingdom buildings, or present cultivated some supportive structural elements with wrought iron.



Figure 4.14. Footage from the videogame created an arbor, which is a kind of a landscape artifact may see ornamentation and orientalism in structural details [149].



Figure 4.15. Footage from the structural system of virtual space made from iron and its ornament details [149].

5. CONCLUSION

If it may conclude the research, video-game engines and video-game theory may have a controversial impact on architectural representation. By developing technological improvements and demanding and addicting videogames and its spatiality, architectural representation may evolve uniquely by integrating video games and engines. In addition, by using video-game engine and being familiar with the gaming theory and genres, as well as endowing architects as enable creating unfamiliar spatiality; but also, if it may apply suitable perspectives, cameras, and C.A.D.-game engine collaboration; Professional and academicians in the department of architecture and related fields have a potential chance to monitor better representations for historical period of architecture. This method may not only present graphically advanced outcomes, but also open a path for digital conservation and creating a digital archive for all over the world monumental and historical buildings. The research tried to declare that video-game engines contain many numerous artifacts that may empower the architectural representation in an advanced mode. In the first part of the research, it tried to investigate the main concern of the representations and the role of representations of game engines and game theory for architecture. The research also mentioned with the significance of new representation mediums, trends and skills that may require for the future upcoming architectural design essentially with the development of technology. After that, the part of the research examined with the substantial features, potential applications and benefits of the game engines by comparing and finding out the similarities of videogames and architectural design processes. The first part of the thesis concludes with the examination of game theory that, comprehend the types of videogames, camera effect and potential impact on perceiving environment and architecture through perspectives. Finally, promoting with the theory of simulations as a starting point of the videogame, approved to unpack the videogames and engines as a candidate of representation of architecture with the aspect of upcoming architectural design projects, architectural heritage, digital archive with declaring some immersive video-game spaces.

The second part of the thesis completely concentrated on the case study video game: Assassin's Creed: Syndicate by examining, researching and documenting its some remarkable landmarks, some key architectural buildings, landscape design outcomes in

virtually. In addition, the part of the research tried to assert with the theoretical and practical approach of history of early industrial revolution architecture correspondingly.

It may literally demonstrate that, game engines have remarkable benefits and advantages on designing and rendering architectural projects as both technological and entertaining aspects. The navigable approach and integrating with the virtual environment with close to the real time graphics, textures and shadow quality; video-game engines may deserve to campaign the next generation architectural design medium in a short time. However, architects may struggle with the using and switching to the game-engine software instantly because of dealing with the familiar of the software, integrating and collaborating with CAD and BIM software, cost issues, and hardware expectations. On the other hand, videogames have a noteworthy affinity for architecture that, may influence each other and game design studios and architectural offices may cooperate each other with being a hybrid partner and compass this concern through a positive and productive advantage.

As examining and explaining with the videogames and case studies, video game engines ought to consult with the architectural professionals and it may consider a significant issue to preserve the architectural heritage and leading a digital archive; architects and academicians ought to support from video-game engines and video-game designers' aspect of its technological functionality, data saving and representation of architectural spaces. Video-game theory also count another remarkable issue that, may lead to witness architects, how its immersion, interactivity, spatiality and graphical features for architecture had so developed since its launching to the market. In addition, the unity of videogames and architecture may foster the uncover 3D virtual spaces with awakening outstanding and marvelous gameplay enchantment.

It may obviously appear that, these two inter-disciplinary approaches will collaborate and promoting themselves increasingly for every architectural office, video-game studios, and markets for the next decades. Besides, by supporting game engine technology, a new architectural style may bring to light that "Impossible Architecture" may write its potential style that, imprints through the history of architecture books that may see many virtual and physically impossible manipulated design parameters everywhere. In addition, digital architecture may reveal its contemporary artworks that integrate with the computer-science and artificial intelligence that, by using video-game engines some architectural reproductions, animated videos may be applied and reflected to the physical buildings with

poetic ai works as artist and architect Refik Anadol prepared for his brand-new exhibition holding at Pilevneli Gallery, İstanbul named: Quantum Memories.

Because of this reason, this research may finish with this quote: "Let architects play the architecture".



REFERENCES

1. Vesely D. *Architecture in the divided representation the question of creativity in the shadow of production*. Cambridge: The MIT Press; 2004.
2. Jones W. Architecture games. *Log*. 2010;19(1):29-35.
3. Von Borries F, Walz S P, Böttger M, Davidson D, Kelley H, Kücklich J. *Space time play: computer games, architecture and urbanism- the next level*. Basel: Birkhauser; 2007.
4. Boes S. Playing architecture: the usability of a game engine as a real-time design tool. Master thesis, University of Ghent, 2015.
5. Brouchoud J. The Importance of architecture in video games and virtual worlds. [cited 2019 7 October]. Available from: <https://archvirtual.com/2013/02/09/the-importance-of-architecture-in-video-games-and-virtual-worlds/>.
6. Saggio A. The new mental landscape: why games are important for architecture. In: *Space time play: computer games, architecture and urbanism- the next level*. Basel: Birkhauser; 2007:398-400.
7. Evans R. *Translations from drawing to building and other essays*. London: Architectural Association; 1997.
8. Cook P. *Drawing: the motive force of architecture*. West Sussex: Chichester; 2014.
9. Bender R. Games. *Journal of Architectural Education*. 1979;33(1):2.
10. Chien S. Design gaming, designing games: learning design through game playing and game making. *Conference on eCAADe National Taiwan University of Science & Technology*; 2002:2-6.
11. Totten C. *Game design and architecture*. Master Thesis, Catholic University of America School of architecture and planning, 2008.

12. Gal Viviane & Le Prado, Cecile & Natkin, Stéphane & Vega, Liliana. Writing for video games. CNAM (*Conservatoire National des Arts et Metiers*), IRCAM (*Institut de Recherche et Coordination Acoustique/Musique*), Cedric Laboratory;2002.
13. Kaplancalı U. Story design & dialogue. [cited 2021 4 January]. Available from: <https://sites.google.com/site/acmyeditepe/home/pp-slides>
14. Rollins A, Morris D. *Game architecture and design*, Indianapolis: New Riders publishing; 2004.
15. Haltsonen J. *Guide to writing a game design document*. Bachelor's thesis, Oulu university of applied sciences department of technology, 2015.
16. Adams E. Designing with gameplay modes and flowboards. [cited 2021 4 January]. Available from:http://www.designersnotebook.com/Columns/061_Designing_With_Gameplay_Mo/061_designing_with_gameplay_modes.html.
17. Smith DW. Deleuze's concept of the virtual and the critique of the possible. *Journal of Philosophy a Cross Discipline Inquiry*. 2009;4(9):34-43.
18. Deleuze G. *Difference and repetition*. New York: Columbia University Press;1994.
19. Gregory J. *Game Engine Architecture*. Florida: CRC Press; 2015.
20. Park H, Baek N. Developing an open-source lightweight game engine with dnn support. *School of computer science and engineering, Kyungpook national university*. 2020;9(9):1-6.
21. Batchelor J. The year that unlocked the game engine. [cited 2021 29 October]. Available from: <http://www.develop-online.net/opinions/2014-the-year-that-unlocked-the-game-engine/0201434.pdf>.
22. Unrealengine's homepage website. [cited 2021 13 February]. Available from: <https://www.unrealengine.com/en-US/>.
23. Epicgames homepage website. [cited 2021 13 February]. Available from: <https://www.epicgames.com/store/en-us/>.

24. Unrealengine's homepage website. [cited 2020 29 october]. Available from: <https://docs.unrealengine.com/latest/int/resources/showcases/realisticrendering/index>.
25. Epic's unreal engine 4 'flappy bird' homage 'tappy chicken' now available for free. [cited 2020 29 october]. Available from: <http://www.engadget.com/2014/05/22/unreal-engine-4-tappy-chicken/>.
26. Farris J. Forging new paths for filmmakers on the "the Mandalorian". [cited 2021 13 February]. Available from: <https://www.unrealengine.com/en-US/blog/forging-new-paths-for-filmmakers-on-the-mandalorian>.
27. Körlner E. Working with physically-based shading: a practical approach. [cited 2021 13 February]. Available from: <https://blogs.unity3d.com/2015/02/18/working-with-physically-based-shading-a-practical-approach/>.
28. Monument Valley: the quest for a game everyone can finish. [cited 2021 13 February]. Available from: <http://www.polygon.com/2014/3/18/5522874/monument-valley-everyone-finish>.
29. Unity Engine: a unicorn powering the video game and VR/AR economy. [cited 2021 13 February]. Available from: <https://digital.hbs.edu/platform-digit/submission/unity-engine-a-unicorn-powering-the-video-game-and-vr-ar-economy/>.
30. Brodtkin J. How Unity 3D became a game-development beast. [cited 2021 13 February]. Available from: <http://news.dice.com/2013/06/03/how-unity3d-become-a-game-development-beast/>.
31. Leather A. Crysis did you upgrade?. [cited 2021 13 February]. Available from: <http://www.bit-tech.net/blog/2009/12/15/crysis-did-you-upgrade/>.
32. Caoili E. Crytek dips into mobile with CryEngine 3-powered game. [cited 2021 14 February]. Available from: http://gamasutra.com/view/news/164424/Crytek_dips_toes_into_mobile_with_CryEngine_3powered_game.php.
33. Crysis 3 The hunted becomes the hunter. [cited 2021 14 February]. Available from: <https://www.cryengine.com/showcase/view/crysis-3>.

34. Devil May Cry 5 demo thoughts. [cited 2021 26 April. Available from: <https://www.gamesreviews.com/news/02/devil-may-cry-5-demo-thoughts/>.
35. Greenmangaming. [cited 2021 26 April]. Available from: <https://www.greenmangaming.com/tr/games/devil-may-cry-5-pc/>.
36. Real world/Italian reference in Devil May Cry 5. reddit website. [cited 2021 26 April]. Available from: https://www.reddit.com/r/DevilMayCry/comments/b1kdn4/real_world_italian_reference_in_devil_may_cry_5/.
37. Le corbusier. *Towards a new architecture*. New York: Dover Publications; 1963.
38. Lu C. Roetter A. Schultz A. Sophomore Colege Ray Tracing Presentation website. [cited 2021 9 April]. Available from: <https://cs.stanford.edu/people/eroberts/courses/soco/projects/1997-98/raytracing/index.html>.
39. Horna S, Maria M, Aveneau L. Topological space parititon for ray tracing in architectural models. *Proceedings, Conference on Computer Graphics Theory and Applications*. Lisbon; 2014:225-235.
40. Control video-game. Remedy Entertainment. Purchased by the author. [cited 2021 26April]. Available from: https://store.steampowered.com/app/870780/Control_Ultimate_Edition/.
41. Nvidia website. [cited 2021 09 April]. Available from: <https://www.nvidia.com/tr-tr/geforce/rtx/>.
42. Steamaudio. [cited 2021 11 April]. Available from: <https://valvesoftware.github.io/steam-audio/>.
43. Lee R. The forgotten pixel art masterpieces of the Playstation1 era. [cited 2021 11 April]. Available from: <https://onezero.medium.com/the-forgotten-pixel-art-masterpieces-of-the-playstation-1-era-8b453dfe00bf>.
44. Robledo J, Leloux J, Pigueiras E.L, Gueymard C. From video games to solar energy: 3d shading for PV using GPU. *Journal of Solar Consulting Services*. 2019;193(10):962-980.

45. Kovalovs K. Gpu driven effects of the last of us: part two. [cited 2021 11 April]. Available from: <https://dl.acm.org/doi/abs/10.1145/3388767.3407349>.
46. The Last of Us part II Seattle city comparison shows Naughty Dog's stunning attention to detail and rendering fidelity. [cited 2021 11 April]. Available from: <https://wccftech.com/the-last-of-us-part-ii-seattle-city-comparison/>.
47. Stouhi D. From backdrop to spotlight: the significance of architecture in video game design. [cited 2021 11 April]. Available from: <https://www.archdaily.com/938307/from-backdrop-to-spotlight-the-significance-of-architecture-in-video-game-design>.
48. Leitao AM, Castelo-Branco R, Santos G. Game of Renders: The use of game engines for architectural visualization. *INESC-ID Intelligent & Informed Proceedings, the 24th CAADRIA Conference*. Lisbon; 2019:655-664.
49. Castelo B, Leitão A. Algorithmic Architecture Visualization. *Proceedings, the 24th International CAADRIA Conference*. Beijing; 2018:557-566.
50. Andreoli R, Chiara, RD, Erra, U. Scarano, V. Interactive 3D environments by using videogame engines. *Proceedings, the 9th International IV Conference. London*; 2005:515-520.
51. Hocking J. *Unity in Action: Multiplatform Game Development in C#*. New York: Manning Publications; 2015.
52. Nandavar A, Petzold F, Nassif D, Schubert G. Interactive Virtual Reality Tool for BIM Based on IFC. *Proceedings, the 23rd International CAADRIA Conference, Beijing*; 2018:453-462.
53. Götz U. Load and Support: Architectural Realism in Video Games. In: *Space Time Play: Computer Games, Architecture and Urbanism: The Next Level*. Basel: Birkhäuser; 2007:134-137.
54. Bajçinovci B, Bajçinovci B, Bajçinovci U. Architectural design process: consulting with nature. *Journal of Science, Humanities and Arts*. 2020;7(1):2-6.

55. Bar-eli A. Architectural drawings new uses in the architectural design process. *Athens Journal of Architecture*. 2020;6(3):273-278.
56. Kolsal F. Re-thinking creativity in architectural design education. Master Thesis, Eskişehir Technical University, 2020.
57. Bauhaus Building by Walter Gropius. [cited 2021 23 April]. Available from: <https://www.bauhaus-dessau.de/en/architecture/bauhaus-building.html>.
58. Priya S, Shabitha P, Radhakrishnan S. Collaborative and participatory design approach in architectural design studios. *The journal of Social Sciences and Humanities Open Elsevier*. 2020;2(1):1-3.
59. Soliman AM. Appropriate teaching and learning strategies for the architectural design process in pedagogic design studios. *Frontiers of Architectural Research*. 2017;6(2):204-217.
60. Coolidge R. The architectural process. [cited 2021 8 April]. Available from: <http://www.robertcoolidge.com/process-1.html>.
61. Dorta, T, Lalande P. The Impact of Virtual Reality on the Design Process. *Proceedings, Conference from Digital Design Studios: Do computers make a difference? ACADIA 98 The Association for Computer-Aided Design in Architecture*. Quebec; 1998:139–161.
62. Büyükkeçeci E. Generation z in beginning design studio: A case study in Art and Design Studio. Master Thesis, İzmir University of Economics, 2017.
63. Bråthen K. Collaboration with BIM- Learning from the Front Runners in the Norwegian Industry. *Proceedings, 8th Nordic Conference on Construction Economics and Organization*. Tampere; 2015;21(1):439–445.
64. Idi D, Khaidzir K. Critical perspective of design collaboration: A review. *Frontiers of Architectural Research*. 2018;7(4):544-560.
65. Froese T. The impact of emerging information technology on project management for construction. *Journal of Automation in Construction*. 2010;19(5):531-538.

66. Simons R, Ratcliffe J. How can 3D game engines create photo-realistic interactive architectural visualizations ?. *Journal of Performance Measurement and Metrics*. 2017;8(1):7-17.
67. Ölmez D. The Role Of Virtual Environments in Architectural Design Education: Spatial Perception And Distant Collaboration. Master Thesis, Yaşar University, 2017.
68. Işık C. Bilgisayar oyunlarının yapım sürecinde konsept tasarımı, üretilmesi ve uygulanması. Master Thesis, Hacettepe University, 2019.
69. Bates B. *Game design*. Boston: Thomson Course Technology; 2004.
70. Iuppa N, Borst T. *End to End Game Development: Creating Independent Serious Games and Simulations from Start to Finish*. Massachusettes: Focal Press; 2012.
71. Emir Yardımcı Instagram social media profile. [cited 2021 18 April]. Available from: www.instagram.com/deafhead.
72. ToeJam&Earl Artwork. [cited 2021 8 May]. Available from: https://segaetro.org/ToeJam_%26_Earl#Artwork.
73. Honkanen T. Creation of concept art for an action role-playing game. Bachelor's Thesis, Helsinki Metropolia University of Applied Sciences, 2017.
74. Greenway T. *Masters collection: Volume 1 Digital Painting Techniques*. Massachusettes: Focal Press; 2009.
75. Mayer A. *Making games better: the art and process of game design and development*. Washington: Amazon E-book; 2016.
76. Bycer J. Level design vs environment design.[cited 2021 8 May]. Available from: <https://superjumpmagazine.com/level-design-vs-environmental-design-b8d19992924e>.
77. Kosa M. Theory of action phases in video games:effects on deliberative and implemental mindset differences in video game design. Master Thesis, Middle East Technical University, 2016.

78. Berger J. *Ways of seeing*. London: Penguin Books; 2019.
79. Plante C. Why video game engines may power the future of film and architecture. [cited 2021 8 May]. Available from: <http://www.theverge.com/2015/3/4/8150057/unreal-engine-4-epic-games-tim-sweeney-gdc-2015>.
80. Xinogalos S, Christopoulou E. Overview and comparative analysis of game engines for desktop and mobile devices. *International Journal of Serious Games*. 2017;4(4):21-36.
81. Jabi W, Hoon M, Goldman G. Immersion, interaction, and collaboration in architectural design using game engines. *Proceedings, the 8th CAADRIA Conference*. Thailand; 2003:721-738.
82. Harlan J, Schleich B, Wartzack S. Linking a game-engine with CAD-software to create a flexible platform for researching extended reality interfaces for the industrial design process. *Symposium, 31st Symposium Design for X DFX 2020*. Erlangen; 2020:170-178.
83. Cohen D, Bustamante S. *Producing games: from business and budgets to creativity and design*. New York: Routledge Press, 2009.
84. E.S.A. Essential facts about the computer and video game industry. [cited 2021 22 March]. Available from: <https://www.theesa.com/wp-content/uploads/2019/05/2019-Essential-Facts-About-the-Computer-and-Video-Game-Industry.pdf>.
85. De Hooge J. Nederland telt 9,3 miljoen gamers. [cited 2021 22 March]. Available from: <http://www.dutchcowboys.nl/gaming/17904>.
86. Helder K. 1 miljard gamende mensen. [cited 2021 22 March]. Available from: http://www.psonly.nl/nieuws/23429/EA:_%E2%80%9C1_miljard_gamende_mensen%E2%80%9D/show/282997/.
87. Tiemersma S. Video games and architecture. Master Thesis, TU Delft University of Technology, 2014.
88. Salen K, Zimmerman E. *Rules of play*. Cambridge: The MIT Press; 2004.

89. McGonigal J. *Reality is broken*. New York: The Penguin Press; 2011.
90. Nerurkar M. *No more wrong turns*. [cited 2021 22 March] Available from: http://www.gamasutra.com/view/feature/132504/no_more_wrong_turns.php.
91. Çatak G. Bilgisayar oyunlarında mimarinin kullanımı. Master Thesis, Yıldız Technical University, 2003.
92. Russel S. The first computer video game. What more needs to be said?. [cited 2021 26 April]. Available from: <https://gamesoffame.wordpress.com/spacewar/>.
93. Juul J. Clash Between game and narrative. Master Thesis, Copenhagen University, 1999.
94. Why pong scored so highly for Atari. [cited 2021 26 April]. Available from: <https://www.theguardian.com/technology/2008/apr/17/games.atari>.
95. Original Wolfenstein 3D game released as free to play title. [cited 2021 23 April]. Available from: <https://www.unigamesity.com/original-wolfenstein-3d-game-released-as-free-to-play-title-play-now/>.
96. Amazon'un yeni MMO oyunu new world 2021 baharına ertelendi. [cited 2021 22 March]. Available from: <https://www.turkmmo.com/amazonun-yeni-mmo-oyunu-new-world-2021-baharina-ertelendi-h171160.html>.
97. Ayangbekun A, Akinde I. Development of real-time strategy game. *Asian Journal of Computer and Information Systems*. 2014;2(4):78-89.
98. Miles C. Co-evolving real-time strategy game players. Doctorate Thesis. University of Nevada, 2007.
99. Steam game shopping Simcity 4 deluxe edition. [cited 2021 4 April]. Available from: https://store.steampowered.com/app/24780/SimCity_4_Deluxe_Edition/.
100. Steam game shopping the Sims 4. [cited 2021 4 April]. Available from: https://store.steampowered.com/app/1222670/The_Sims_4/.

101. Mishra P, Patnayaka R. Simulation in architectural research. *Journal of Creative Space*. 2015;3(1):13-22.
102. Groat L, Wang D. *Architectural research methods*. New York: Wiley; 2013.
103. Fraser M. *Design research in architecture: an overview*. Burlington: Ashgate Publishing; 2014.
104. House designer Steam'de. [cited 2021 4 April]. Available from: https://store.steampowered.com/app/1296400/House_Designer/.
105. Crabtree A, Tandavanitj N, Adams M, Row-Farr J. Can you see me now? *Journal of ACM Transactions on Computer-Human Interaction*. 2006;13(1):100-133.
106. Can you see me now?. [cited 2021 4 April]. Available from: <https://www.nottingham.ac.uk/research/groups/mixedrealitylab/works/can-you-see-me-now.aspx>.
107. NLSC forum. [cited 2021 5 April]. Available from: <https://forums.nba-live.com/viewtopic.php?t=108324>.
108. Daneels R, Malliet S, Geerts L, Denayer L, Walrave M, Vandebosch H. Assassins, gods, and androids: how narratives and game mechanics shape eudaimonic game experiences. *Journal of Media and Communication*. 2021;9(1):49-61.
109. Joseph S. What is eudaimonic happiness?. [cited 2021 23 April]. Available from: <https://www.psychologytoday.com/us/blog/what-doesnt-kill-us/201901/what-is-eudaimonic-happiness>.
110. Telhan O. Virtual realities and real virtualities. Master Thesis, Bilkent University, 2002.
111. Önal S. Video oyunlarında mekan algısı ve mimari. Master Thesis, Mimar Sinan Fine Arts University, 2012.
112. McGregor G. Gamespace play & architecture in videogames. Doctorate Thesis. University of South Wales, 2009.

113. Denisova A. First person vs third person perspective in digital games: do player preferences affect immersion?. *Proceedings, (CHI) 2015 Conference on Human Factors in Computing Systems*. Seoul; 2015:145-148.
114. Vries N. No patch can fix Cyberpunk 2007. [cited 2021 24 April]. Available from: <https://thenextweb.com/news/no-patch-can-fix-cyberpunk-2007>.
115. Glavin F, Madden M. Dre-bot: a hierarchical first person shooter bot using multiple sarsa (λ) reinforcement learners. *Proceedings, (CGAMES'2012) 17th International Conference on Computer Games: AI, Animation, Mobile, Interactive Multimedia, Educational and Serious Games*. Louisville; 2012:148-152.
116. Skyes T. Silent hill 4's creepy apartment recreated in Unity. [cited 2021 24 April]. Available from: <https://www.pcgamer.com/uk/silent-hill-4s-creepy-apartment-recreated-in-unity/>.
117. Delaney J. Democracy, video games and urban design. Minecraft and public participation. In: *Architectonics in game spaces*. 2019:277-292.
118. Götz U, Gerber A. *Architectonics of game spaces*. Frankfurt: Deutsche National bibliothek; 2019.
119. Minecraft official website. [cited 2021 24 April]. Available from: <https://www.minecraft.net/en-us/article/how-minecraft>.
120. Krakov E, Krekhov A, Cmentovski S, Krüger J. Streaming Vr games to the broad audience: a comparison of the first-person and third-person perspectives. *Proceedings, Online Virtual Conference CHI*. Yokohama; 2021:1-14.
121. Star Wars: jedi fallen order gameplay. [cited 2021 24 April]. Available from: <https://punishedbacklog.com/index.php/2019/06/08/star-wars-jedi-fallen-order-kinda-bland/star-wars-fallen-order-facility-gameplay/>.
122. Pearson L. C. Video game urbanism. In: *Architectonics of game spaces*. Bielefeld: Transcript Publishing; 2019:293-312.

123. Videogame urbanism. [cited 2021 24 April]. Available from: <https://www.thesitemagazine.com/read/videogame-urbanism>.
124. Cities: Skyline steam'de. [cited 2021 24 April]. Available from: https://store.steampowered.com/app/255710/Cities_Skylines/?l=turkish.
125. Gerber A, Götz U. Invisible (Game) cities. In: *Architectonics of game spaces*. Bielefeld: Transcript Publishing; 2019:47-57.
126. Who really controlled Netflix's black mirror episode: "Bandersnatch": audience or director?. [cited 2021 24 April]. Available from: <https://edtimes.in/who-really-controlled-netflixs-black-mirror-episode-bandersnatch-audience-or-director/>.
127. Black mirror: bandersnatch. [cited 2021 24 April]. Available from: https://www.reddit.com/r/ARG/comments/ac65eo/black_mirror_bandersnatch_its_actually_playable/.
128. Baudrillard J. *Simulations*. Cambridge: MIT Press; 1983.
129. Disneyland website. [cited 2021 25 April]. Available from: <https://www.shopdisney.com/parks/disneyland/>.
130. Madigan J. The psychology of immersion in video games. [cited 2021 5 May]. Available from: <http://www.ludology.org/articles/ludology>.
131. Guzek K, Szrajber R, Jach S. Architectural heritage and its representation in video games. In: *Computer game innovations*. Lodz: Lodz University of Technology Press; 2016:231-243.
132. Szrajber R. Videogames as an element of heritage In: *The Limits of heritage*. Krakow: International Culture Centre; 2015:1-712.
133. Olomon J. Tsushima tourist board partners with ghost of Tsushima. [cited 2021 April 27]. Available from: <https://www.ign.com/articles/tsushima-tourist-board-partners-with-ghost-of-tsushima>.
134. Hughes T. Ghost of Tsushima developers appointed ambassadors of Tsushima Island. [cited 2021 27 April]. Available from:

https://www.nme.com/en_asia/news/gaming-news/ghost-of-tsushima-developers-appointed-ambassadors-of-tsushima-island-2897967.

135. Webster A. How The division uses fake ads and graffiti to make a more realistic New York. [cited 2021 27 April]. Available from: <http://www.theverge.com/2016/3/7/11172286/massive-the-division-game-xboxps4-designer-interview-nycgraffiti>.
136. Makedonski B. One dev spent two years making the Notre Dame in assassin's creed unity. [cited 2021 27 April]. Available from: <https://www.destructoid.com/one-dev-spent-two-years-making-the-notre-dame-in-assassin-s-creed-unity-282133.phtml>.
137. Assassin's creed: unity. [cited 2021 27 April]. Available from: <https://steamcommunity.com/sharedfiles/filedetails/?id=2056552893>.
138. Avila C, Corso A, Fischer G. Preservation and heritage at play in technoculture: the (re)construction of notre-dame cathedral in assassin's creed. *Journal of Digital Media & Interaction*. 2020;3(7):51-67.
139. Makedonski B. One dev spent two years making the Notre Dame in assassin's creed unity. [cited 2021 29 April]. Available from: <https://www.destructoid.com/one-dev-spent-two-years-making-the-notre-dame-inassassin-s-creed-unity-282133.phtml>.
140. Can assassin's creed help rebuild Notre Dame? how restoring the cathedral will rely on both new tech and ancient knowhow. [cited 2021 27 April]. Available from: <https://arttimes.co.za/can-assassins-creed-help-rebuild-notre-dame-how-restoring-the-cathedral-will-rely-on-both-new-tech-and-ancient-knowhow/>.
141. Tom Clancy's The Division shows off next-gen snowdrop engine. [cited 2021 27 April]. Available from: <https://nerdreactor.com/2013/12/09/tom-clancys-division-shows-next-gen/>.
142. Mohajan H. The first industrial revolution: creation of anew global era. *Journal of Social Scinces and Humanities*. 2019;5(4):377-387.

143. Berlanstein L. *The Industrial Revolution and work in Nineteenth-Century Europe*. London-New York: Routledge&CRC Press; 1992.
144. Ventura J. Voth HJ. Debt into Growth: How Sovereign Debt Accelerated the First Industrial Revolution. *Journal of Working Paper National Bureau of economic research*. 2015;21280(6):1-30.
145. Marx K, Engels F. *The communist manifesto*: London: Pluto Press; 1996.
146. Pierson HW. Notes on early industrial architecture in England. *Journal of the Society of Architectural Historians*. 1949;8(1-2):1–32.
147. Van Dyke S. The history of wrought iron and cast iron. Master Thesis, University of Tennessee, 2004.
148. Roman HR. Architectural conception and design in structural masonry: some practices to improve constructability. *International Journal for Housing Science*. 2009;33(1):57-67.
149. Assassin's Creed: Syndicate. Video-Game. Ubisoft game studios. Montreal. [cited 2021 11 April]. Available from: https://store.steampowered.com/app/368500/Assassins_Creed_Syndicate/?l=turkish.
150. Lei A, Xin Z. British architectural theory during the early modern architecture period in the 19th century. *Proceedings, 4th International Conference on Energy Equipment Science and Engineering, IOP Conference Series: Earth And Environmental Science*. Xi'an; 2019;242(6):1-5.
151. Harvey B. Early industrial architecture. *Journal of Architecture and Planning*. 1959;22(5):223-225.
152. Sklair L. Iconic architecture and capitalist globalization. *Journal of City Analysis of Urban Change, Theory, Action*. 2006;10(1):21-47.
153. Blamori D. Architecture, landscape, and the intermediate structure: eighteenth century experiments in mediation. *Journal of the Society of Architectural Historians*. 1991;50(1):38-56.

154. Lauterbach I. The european landscape garden European history online. [cited 2021 30 April]. Available from: <http://ieg-ego.eu/en/threads/models-and-stereotypes/anglophilia/iris-lauterbach-the-european-landscape-garden-ca-1710-1800>.
155. Varon A. Sultan Abdülaziz dönemi'nde dünya sergilerine katılımı. Doctorate Thesis, İstanbul Technical University, 2011.
156. Pinhal P. The English landscape garden: a walk through its identity. Master Thesis, Porto University, 2015.
157. Fry C. The dissemination of neo-palladian architecture in England, 1701-1758. Doctorate Thesis, Bristol University, 2006.