ÇANKAYA UNIVERSITY

FACULTY OF ENGINEERING

COMPUTER ENGINEERING DEPARTMENT

PROJECT REPORT

CENG 408

Innovative System Design and Development II

P2018-02

Digital Storytelling on a Virtual Heritage Museum with Believable Agents

Hasan Saygın DİKBAYIR – 201511019

Oğulcan MERDİVANLI – 201511041

Utku Mert DEĞİRMENCİ – 201411017

Advisor: Murat YILMAZ, Doç. Dr.

Instructor Co-advisor: Ulaş GÜLEÇ, Dr.

Lecturer

02.06.2019

Table Contents

ABSTRACT

Drawing on the fields of cultural heritage, digital storytelling on a set of believable agents, this project proposes a virtual museum, which is populated with virtual agents based on the Turkish horror folklore. Using the emerging trends in the field of game research, the goal is to demonstrate how selected characters from Turkish horror folklore could adequately be storied in a virtual museum environment, which aims to safeguard and transmit cultural heritage. This work aims to advance the immersion in interactive environments by exploring a selected set of believable agents. We will conduct a case-based reasoning approach to simulate virtual agents roles for exploring cultural heritage. In particular, virtual agents that would play different museum-based roles and ultimately interact with other role-based agents and some of which need to engage into interactions with human participants.

Keywords : Virtual Reality, Cultural Heritage, Virtual Heritage, Virtual Museum, Horror Culture

ÖZET:

Bu proje kültürel miras kavramını, dijital hikaye anlatımı ile birleştiren ve inandırıcılık unsurunu arttırma amacı doğrultusunda "inandırıcı ajanları" kullanan bir sanal müze projesidir. Projede bulunan sanal ajanlar, Türk korku kültüründen seçilmiştir. Oyun araştırmaları gündemindeki unsurları kullanarak, seçilmiş bu korku karakterlerinin bir sanal müze ortamında ve kurgusal bir olay örgüsü ile birlikte hikayeleştirilmesini amaçlayan projemiz, kültürel mirasımızı koruma ve aktarma amacı gütmektedir. Projemiz kapsamında, seçilen bir grup inandırıcı ajan ile etkileşime geçilmesi gayesi ile interaktif çevredeki gerçekçiliğin artırılması amaçlanmaktadır. Kültürel mirasımızın canlandırılması için simüle edilen sanal ajanlara, vaka bazlı bir akıl yürütme yaklaşımında bulunmaktayız. Sanal müzede bulunacak sanal ajanların, birbirinden faklı müze tabanlı rolleri paylaşırken, birbirleri ile etkileşime girmeleri aynı zamanda katılımcılar ile de etkileşime girmelerini amaçlamaktayız. Bu bağlamda sanal müzemizdeki inandıcı ajanların, müzeye yaşayan ortam hissiyatını katmalarını sağlayacağız.

Anahtar Kelimeler: Sanal Gerçeklik, Kültürel Miras, Sanal Miras, Sanal Müze, Korku Kültürü

1. INTRODUCTION

1.1. Motivation

As a result of literature review, it has been concluded that virtual museums attract attention by people by revitalizing the cultural elements that have been forgotten and giving the impression of visiting a museum on the spot (White, 2018). Within the scope of this project, we aimed to raise awareness about the written and verbal elements in Turkish culture.

With support of the Portakal Teknoloji company, the virtual museum to be developed taking into account the shortcomings and needs in the socio-cultural area, the rich Turkish oral culture that has been forgotten will be revived.

The benefits of people experiencing a culture in a virtual museum are given below.

- Models that are too old to be exhibited or objectionable can be exhibited to the visitors of the museum.
- To present the experience of living in the museum to those who visit the museum by fictionalizing the works which are not written but culturally valuable.
- Providing an isolated environment for a variety of research topics, focusing on the special interests of people visiting the museum
- To offer a more impressive museum experience in a Virtual Reality environment which is popular in recent years
- Saving time and costs by means of environment and tools created by simulation
- It is a pioneering project for innovative works and it is an framework for future projects.

1.2. Innovation

In recent years, the number of projects involving virtual reality has been increasing with the developments in technology (White, 2018). The virtual museum concept, which is one of the sub working areas of the virtual reality concept, is one of the project subjects that are in demand. In this project, which is planned to be developed, it is aimed to remind the culture again by bringing together the rich Turkish horror folklore and the modern virtual reality technology that has been forgotten along with the progress of the age and exhibiting it in a virtual museum. Although there is no study in our country yet, there are studies in the world that are only a replica of the museums and the valuable belongings in them (Wojciechowski, 2004). The virtual museum, which is planned to be made, will be a unique museum, and it will vary according to the similar ones and it can be considered first in its field. Although the realization of the project is a part of the culture of our country, it has a flexibility to be used in other subjects.

1.3. Methods and Tools

The process design in Figure 1 will be based on the project development. An extensive research will be conducted for the concept of believable agent and cultural heritage, one of the basic requirements of the project. In the light of the information obtained, it is aimed that the Turkish horror culture, which is processed in a virtual museum with a fictional story, contributes

to the user a unique experience and the user will learn this valuable culture. The level of progress of users in the storyline and puzzles in the virtual museum will be one of the main testing criteria of our game.

1. Aşama	2. Aşama	3. Aşama	4. Aşama	5. Aşama	6. Aşama	7. Aşama
Gereksinimlerin Belirlenmesi ve İhtiyaç Listesi	Puanlama ve Ölçülebilirlik Mekanizması	Metot ve Modellerin Uygulanabilirlik Testi	Test Sonuçlarına Göre Düzenleme Yapılması	Görsel Tasarımın Yapılması	Metotların Yazılıma Dökülmesi	Yazılımın Test Edilerek Düzenlenmesi

Figure 1: Development Cycles

Once the game is outlined, the game will be designed using the Unity3D platform in a three-dimensional environment. The Unity3D platform has achieved an increasing success in the practical and flexible playing field. This is because the user-friendly development environment and easy-to-understand user interface (Huang and Gui, 2015). Unity3D is also used to prepare simulation along with game development. This is an important factor for the virtual museum project to be realized. The virtual museum will provide realistic experience and facilitate the description of the plot. Another feature is cross-platform, easy to integrate. As programming languages, C #, Boo, UnityScript and JavaScript languages and multiple software platforms are supported (Okita, 2014). According to the alternatives, the C# programming language is stronger (Turk, 2016). C# is a fully object-oriented language, but it is a fast compiling programming language. In the development process of the project, the C# programming language will be used in the Microsoft Visual Studio 2017 development environment.

Due to the fact that the Virtual Museum is realistic, a detailed research has been carried out for the models, environment, animations and sounds to be created and certain tools have been selected depending on our level of competence. Autodesk Maya 2018, Z-Brush, Adobe Illusturator and Adobe Photoshop will be used for models, environment and animations. Due to the fact that the Virtual Museum is realistic, a detailed research has been carried out for the models, environment, animations and sounds to be created and certain tools have been selected depending on our level of competence. Autodesk Maya 2018, Z-Brush, Adobe Illusturator and Adobe Photoshop will be used for models, environment and animations. Autodesk Maya 2018, which will be used for modeling the characters and the environment, is determined as the most suitable program to create realistic feeling with the tools it contains. Characters and environment modeling will be done at Maya 2018. Z-Brush program will be used for baking and shaping the models. Z-Brush will help to increase the realism of the models to the next level thanks to the wide tool range. Adobe Illusturator and Adobe Photoshop programs will be used for basic concept designs of models. These programs are preferred because they can be quickly understood and have a user-friendly interface. The Maya 2018 program was chosen for the animations. The animations made with Maya 2018 were examined and it was decided to be the platform that would reflect the realistic feeling of the museum in the best way. The Virtual Reality laboratory, which is established within the Computer Engineering Department of Çankaya University, will be used for the completion of all of the studies successfully and safely. The aim of the Virtual Reality laboratory is to increase the quality of the software process and the quality of the product.

2. LITERATURE REVIEW

2.1. Introduction

The concept of virtual museums enables an experience based on the heritage of different cultures. Folklore, folk tales, decors, myths and motifs are part of cultural heritage [1]. The scope of this project is the treatment of the cultural elements belonging to horror stories of Turkish culture with a virtual museum concept. These characters will come to life with the help of a story set in the virtual museum. As a result of this, they will become more believable and passed to virtual environment by using dramatic elements of a game. Consequently, we revive this rich culture from its forgotten past and to allow people to interact with unique entities from the Turkish culture. In order to realize the project, a detailed research is conducted about the concepts of virtual museums and cultural heritage. The museums were examined by using similar techniques in different areas. Within the context of this work, firstly, we review the concept and requirements of the virtual museum. Next, we investigate the concept of cultural heritage with the virtual museum concept. Concurrently, the necessary information was given about the necessity of the notion of "Believable Agents" in the project and its contribution to make the museum fully alive. Last but not least, references to this information have been specified

2.2. Turkish Horror Culture and Cultural Heritage

Cultural Heritage is the accumulation of experiences, passed from generation to generation, including tradition, myths, space, object, artistic expression and values created by a society [1]. It produces concrete and abstract representations of value systems, beliefs, traditions and lifestyles as part of human activity. Therefore, it is an important part of a great whole culture. It does not only contain these visible and tangible traces of antiquity, but also includes various myths and folk stories that have not been written. A non-written cultural element contains superstitions, horror elements, and various symbols in it [2].

Turkish culture has a very rich, valuable deep heritage of horror stories, that has passed down from generation to generation but today most of the non-written horror culture is about to be forgotten [3]. According to Çolakoğlu [4], the types and experiences in which social or extraordinary personal experiences are established within the Turkish socio-cultural structure are divided into sub-headings in many different groups. It has been pointed out the transformational interactions that are taking place between the ones that reflect the values of rural life in the Turkish socio-cultural structure and those that are occurring in the modern or new Turkish city life and which are considered as unconventional values and extraordinary experience related to them.

Folk tales, myths and memorates in Turkish culture encompass many valuable horror elements [42]. These horror elements have become essentials of Turkish culture and horror literature [5]. Each generation and each individual of this generation has made these horror elements richer by adding their own imagination to the stories under the influence of time, place and belief systems.

Socially accepted traditional extraordinary beings communicating within the Turkish socio-cultural structure as "Alkarısı" or "Alkızı", "Karabasan" or "Erkebit", "Karakoncolos" and "Gulyabani" [4]. All these are the assets mentioned in common Turkish horror stories in different regions. The names and descriptions of the beings vary from region to region, but the behaviors, fears, or ways of thinking of beings are similar.

The creatures that are mentioned above and their identities, habitats, relationships between humans and each other, and precautions for their harmful effects are widely known by the locals around Anatolia [24]. Especially in the East of Blacksea Region in Turkey, there is a commonly seen creature named Karakoncolos that shows itself to people and harm them in coldest days of winter. It crawls in the streets and questions the people who encounters to learn that where they are coming from and what is their destination. The word "kara", which stands for "black" in English, must be contained within the answers. Otherwise it kills them with the huge comb that it holds in its hand [5].

Another creature is "Alkarısı" which is seen in almost all Turkish regions. Even though Alkarısı [4] appears in various shapes but she is usually tall, has long fingers with long nails, with messy hair, greasy body, with small hands and feet, toothy, naked, with one of his breasts tossed back, very ugly with an eye on the top, is depicted as wearing red shirt. There are lots of rumors that women who have just given birth have been haunted by Alkarısı. According to some sources [37], sometimes she enters the barns and harm the animals and also make animals grumpy. People should stick a pin to Alkarısı's body. As long as pin won't removes from the body, it will stay as a slave of the person who sticks the pin.

Another entity is Erkebit [4]. Erkebit is a torturer, which haunts people during sleep. By pressing his right hand into the human's mouth, it prevents the person from making a sound. His right palm has a hole in order to ensure that the person who is tortured to not get asphyxiated. By hitting the scrap pieces in his left hand, he makes the person to go crazy and prevents the person's screams from being heard. There is a fez upon its head [41]. If tortured person reaches the fez during the torture, the torture stops and the monster begins to plead to the person to recover the fez.

Gulyabani is another entity that is allegedly seen in Azerbaijan and Eastern Anatolia [25]. It is portrayed as a very tall and feeble. Gulyabani calls people who wander at night alone with their names [38]. If they answer to it, Gulyabani will harm them seriously. This harm can cause people to die from madness. People may protect themselves with sunlight from Gulyabani.

All these characters and many others are part of the verbal culture that has been passed on from generation to generation in Turkish culture[39]. The characteristics of monsters are evidence of the existence of a unique horror culture. Unfortunately, this culture has been forgotten [40], but it contains many elements which are very valuable for cultural heritage. As a result of this notion virtual relity can be a great practice for reviving the cultural heritage. In the follow-up section of this article we will touch upon virtual reality comprehensively.

2.3. Virtual Reality

The term virtual reality (VR) is a computer technology that individuals experience the computer-based 3D environments in a visually simulated environment [8]. Users experience these virtual environments via using various peripheral devices (helmet display, etc.). According to Stone [6], the definition of VR is such a technology that is developed to increase the communication between individuals and machines, addressing human senses. In support, Oppenheim [7] has described the VR as a technology that seeks to increase the human-machine interaction through senses not only with visual and audio communication.

VR has found the one of the first application areas in video games and the world of entertainment [32]. Various elements of VR technology have played important roles in many science fiction movies [9]. As an example of the usage of VR can be said as the project called Canadian Rockies has been designed by computer scientists and photographers as a virtual model on the computer, allowing two people to experience without changing the same space. "The abbey of Cluncy", which was destroyed in the Burgundy region of France in the wake of the French Revolution, was rebuilt in the computer with the help of VR from the archival records. Those who want to wander through the VR through the floors of this building, even the finest details can be seen on the walls.

Green Telepresence Surgery System [43], developed by Dr. Philip Green, is a system that simulates surgical intervention on the battlefield. This remote workspace consists of a surgeon and a workstation. This system enables 3D visualization by using 3D vision [30]. The system has a 6-DOF sensor input for moving the surgical hands to the 5-DOF system with dual CCD cameras for stereo vision. With these two prototypes, the surgeon can remotely control the operation. This system is mounted on an armored mobile vehicle and in case of injury of a soldier, it carries out the operation by driving to the location of the soldier. Thus, the surgical intervention required on the battlefield will be delivered more quickly.

In the field of education, Mustafa Hussein and Carl Nätterdal (University of Gothenburg) [31] aim to teach the planets in the solar system by visualizing the planets and placing the planets in the perspective of another. Four of the planets that are closest the sun were modeled in different scenes. Planets' description and summary are in those scenes. As far as possible, it was justified and the planets' distance to each other and rotation velocities were calculated and transferred to the virtual environment. The work is available on both VR and mobile application. After a valuable progress, users feedbacks gathered. 8 out of 15 users had a positive experience. In the experiment on VR, 11 out of 25 users stated that it is a useful way to teach the planets with virtual reality practice.

As a result, VR can be used in different fields such as health, military and education [44]. The experience of being in a natural environment, which contained by the concept of particular VR technology, can be provided by these different fields.

2.4. Virtual Museums

Virtual museum is a platform that includes historical, scientific or cultural values accessed through digital images, audio files, text documents and to be exhibited in a virtual environment [25]. Virtual museums are an option for people who do not have the possibility or condition to go and visit a particular museum. Virtual museum's function according to Lepouras & Vassilakis [10] is the exploration of virtual reality technology usage by the premises of museums. The features of the virtual museums support, both researchers and the general public to help with the rendering the artifacts in the computer environment, learning their use and in viewing exhibits that were not usually displayed.

Virtual museums appeal to a variety of purposes, functional features and many different audiences [15]. Especially processing the verbal and vocal elements of cultural heritage in a virtual museum concept provides an impressive experience [45]. Virtual museums may contain unique and rare objects that are part of cultural heritage which needed to be protected from external damages which is important for educational, research or scientific purposes.

One of the most important goals of the virtual museum is a presentation of culture, myths, and archeological artifacts in an attractive manner that would provide an exciting and unique way to learn about concepts of these elements. Also, virtual museum concept provides a chance to people who want to inspect the exhibition from all different angles or compare these objects or study them in different purposes which is strictly restricted by the museum [28]. Virtual museum concept can offer a great solution for this situation. Virtual reality technology provides solutions by enabling visualization models of museum artifacts in both virtual and real environments. By this sequence, visitors can interact with models in vary ways [29].

Virtual museums has various examples of research and applications on different projects. One of the first examples of an interactive virtual exhibition is an automated guidance system using the Augmented Reality (AR) technology [33]. This system can create a meaningful sound according to the user's location. The advantage of this prototype is that it can enrich visitor's experiences without interfering with their social interactions. Another project similar to this project is the Meta Museum Guidance System [34]. The Meta Museum provides a global communication environment using the knowledge base of the museum archives.

Another project is the ARCO project [35]. The ARCO project offers tools that allow museum collections, museum works to be digitalized. The ARCO project allows users to navigate virtual museums in Web 3D, AR and VR environments simultaneously with a concrete interface. Museum visitors can interact with objects in the museum by using natural interactions and SpaceMouse technology.

Virtual Dig Experience [12] is a project, which can be considered as a virtual museum that installed in the Seattle Art Museum that is using virtual reality and augmented reality technologies to provide people to inspect cultural objects [11]. Museum has presented not only the cultural object but also their archeological context to visitors. Virtual museum contains the virtual models of the real objects such as brushes, small shovels etc. that is available for visitor interaction.

The 3D Murale project [13] – 3D Measurement and Virtual Reconstruction of Ancient Lost Worlds of Europe – is aimed at building a system that capable of recording archaeological processes using Virtual Reality techniques. Murale Project contains, not only artifacts and cultural findings but also area's layers as models. This application depends on evaluting various 3D seizure methods. Furthermore, the project contains the idea of making pottery, sculpture, and buildings look like they are in that virtual environment throughout ages [11].

The WoofbertVR is an application that share world's leading museum's collections through visual as virtual reality experience developed by Boulevard [14]. There are several museums in this project such as The Courtauld Gallery. Users can reach this museum by peripherals like Samsung Gear VR, Google Daydream, Oculus Go and Oculus Rift [46]. This gallery was built in 18th century expressly for display art and show rich historical and architectural details. User can move around the gallery and study any painting. A zoom feature allows user to take a closer look to the painting. The experience of interaction with the paintings has reached to an upper level with WoofbertVR with feature of live paintings with audio narration that is provided by author Neil Gaiman. Application detects the focus point of the user by the sensors of the virtual technology, and when user locks into a painting the application pulls the user into the painting itself. This event makes paintings alive and allows user to dive

into painting. When users want to return to gallery, turning their head out of the picture frame will be enough to do it.

The concept of cultural heritage becomes open to new insights through the influence of modern information systems and resources [15]. The digital media is very diverse and contains a lot of information. Virtual museums play a multifunctional and important role in this environment.

As a result, the concept of virtual museum has a lot of potential to improve people's mindset both for educational and cultural purposes. Virtual museum is a shape of more efficient story telling, moving critical knowledge, more activities, more value and saving financial resources [16]. A virtual museum is a great way to show the people the verbal culture and cultural knowledge.

2.5. Believable Agents

Believable agents concept refers [17] to autonomous agents that has rich personality with the influential attributes of characters from the science, philosophy and art. They are a result of both the concept of believable characters from local myths and folklore and autonomous agent researches in the field of computer science.

The term "agent" derived from the researches of artificial intelligence area. Artificial intelligence researches desired to build agents that seem to do basic operations like thinking and feeling as closer as humans. Agents are entities with which you would want to have a role in your life. According to Bledsoe [18] from American Association of Artificial Intelligence Presidential address, told of his future dream to build a computer friend. He wants to create a partner that has a regular human activities such as thinking, loving, feeling, decision making, perceiving and hating as possible as human beings.

Interactivity is a feature that separates believable agent from aspects in traditional sophisticated fields and makes their creation even harder than usual techniques [36]. The creator of a believable agent cannot control or know the absolute result of the situations the agent will experience in time. In an on going story, the creator can bring all of its understanding of humanity to take on to decide how agent reacts to each situation in any phase that agent will encounter. In order to obtain a believable agent, a version, which contains all details of personality, must be created. The agent's reacts to situations that will be encountered should not always be dependent to its creator's expertise. To define the concept of believable agents, it is useful to consider some relevant but various goals [19]. According to Thomas and Johnston [27], this goal is to give emotions to believable agent. This emotion of the agent must be clearly defined. Loyall and Bates [27] define this goal as the suitability of the behaviors and argue that these behaviors should be the as close as possible to human nature. These behaviors can be exemplified as aggressiveness and alarm mechanism. The concept of virtual museum might be a suitable working environment for believable agent since a museum must be highly realistic, and the elements like staff members must convince the users of virtual reality experience that they are in a living environment.

Believable agents concept has been used for many years in several areas for both research and development purposes [47]. The entertainment industry is a practice of field for believable agent for such as games and simulations. Video games and simulations are perfect

practice and work areas for believable agents, to make the components like environment and non-player characters more natural and alive, in order to create a better experience to user.

In addition to entertainment industry, believable agent concept attracted attention in the psychology science. After that an environment built for research purposes in this field. Believable agent concept's aim is to make a "program" that is generated by a computer much more human like. The science of psychology [48] works and contributes on the idea of making "agents" to feel, think, hunger and hate like a human being. Related work on believable agents varies from entertainment industry to psychology.

The ICARUS [20] is a believable agent that created for an aerial combat simulation, which is a product of entertainment industry. The ICARUS agent is capable of performing two different types of discovery, both in physical and action fields. On a newly created map, users explore by moving around on mission map. The agent uses different approaches to exploration depending on whether the goal is to reach a region that is outdoor, indoor, or on a rooftop. The system also gathers the information of topological connections between regions as it encounters them, which it stores as new skills that encode path knowledge [49]. The agent prefers recently earned skills to explore the mission map. Sometimes the agent encounters a situation where objects block its path through a gateway or to a goal. The system then concentrates on trying to find the right activity to overcome the obstacle. The agent has previously taught a series of candidate actions including turning, running, jumping, ducking and climbing. The agent attempts these actions one by one, until they find the right method for the current obstacle. In this case, he learns a specific skill that he will perform when he encounters the same situation in the future.

Believable agent concept meet with psychology in the term of "believability" which stands for the agent's way of interact as natural as possible with humans. Psychologists have developed a system called ECA (Embodied Conversational Agents) [23] which has a goal to enhancing the believability feature in conversation between human computer interactions. Believability can be conceptualized both as a property of the ECA and as a property of the perceiver. ECA has provided a believability which is defined as the ability to communicate intuitively by applying the natural processes of human communication [50].

As a result, the concept of believable agent has done well so far with a set of projects and research. In any professional topic, believable agents are very useful in many different ways. Especially, the video games and simulations are cut out for believable agent concept. To feel like that you are in a real living environment in a game or simulation, believable agents are highly important.

3. SOFTWARE REQUIREMENTS SPECIFICATION

3.1. Introduction

The concept of virtual museums enables an experience based on the heritage of different cultures. Folklore, folk tales, decors, myths and motifs are part of cultural heritage [1]. The scope of this project is the treatment of the cultural elements belonging to horror stories of Turkish culture with a virtual museum concept. These characters will come to life with the help of a story set in the virtual museum, and the characters will become more believable and passed to virtual environment by using dramatic elements of a game. Consequently, we revive this rich culture from its forgotten past and to allow people to interact with unique entities from the

Turkish culture. In order to realize the project, a detailed research is conducted about the concepts of virtual museums and cultural heritage. The museums were examined by using similar techniques in different areas.

Within the context of this work, firstly, we review the concept and requirements of the virtual museum. Next, we investigate the concept of cultural heritage with the virtual museum concept. Concurrently, the necessary information was given about the necessity of the notion of "Believable Agents" in the project and its contribution to make the museum fully alive. Last but not least, references to this information have been specified.

3.1.1. Purpose of This Document

The purpose of this document is to plan and record the processes in the operation of the project. Processes in this project are divided as sections. The functional and non-functional requirements and system features of this project are clearly specified in this document.

3.1.2. Project Scope

Drawing on the fields of cultural heritage, this project aims to develop a computer game by contextualizing a virtual museum that is populated with virtual believable agents taken from Turkish horror folklore within the current field of game AI. In addition, it ultimately demonstrates how selected characters from Turkish horror folklore could adequately be simulated in a virtual museum that transmits cultural heritage in a digital medium. We are planning to conduct a case-based reasoning approach to simulate virtual agents' roles for exploring cultural heritage. Virtual agents should be able to play different museum-based roles and ultimately interact with other role-based agents and some of which need to engage into interactions with human participants. This study proposes an interactive drama (i.e. a serious game) based-on believable agent in virtual heritage museum.

3.1.3. Glossary

TERMS	DEFINITONS
Stakeholder	Any person who is a contibutor of this project.
Virtual Museum	A collection of digitally recorded images, sound files, text documents, and other data of historical, scientific, or cultural interest that are accessed through electronic media.(Marco Sampaolo, 2017)
Virtual Reality	A high- end user interface that involves real-time simulation and interaction through multiple sensorial channels. (Virtual and Augmented Reality Applications, Lucio Tommaso De Paolis)
NPC (Non-Player Characters)	Virtual agents controlled by the game, that interact with other NPCs, or with Player Characters controlled by humans.(Sabrina Campano ; Nicolas Sabouret, 2009)
Cultural Heritage	Traditional culture and ruled out all sort of things. (R. Kurin Museum International, 2004, UNESCO)
Believable Agents	Constructions that computational models of believable interact. (Thomas and Johnston 1981)

Figure 2: Glossary

3.2. Overall Description

3.2.1. Product Perspective

The virtual museum project, which features the elements of Turkish horror culture, aims to revive the forgotten or non-written Turkish culture and teach it to the future generations. At

the end of this project, this culture will be revitalized and raise awareness about the non-written Turkish culture.

3.2.1.1. Development Methodologies

Agile software methods are the same as their essence, but they are divided into various sub-branches that differ in their processes. A popular one of these arms is the Scrum method (M. John). Scrum is an administrative model with very simple rules at first glance [2]. It is implemented for the management of complex software projects whose requirements are not explicitly specific, open to change. Scrum does not specify the steps to be followed in detail in the project and instead offers a flexible management with a few simple but important rules. Scrum requires teamwork so everyone must act together. It makes the release within time and with the minimal cost. Scrum development methodology divides project development time into parcels and sub-works. In the project development process, sub-works are completed within a certain period of time. These periods are called "sprint". At the end of each sprint, the software product must appear to be available and applicable.

Ideal Scrum team must include Product Owner, Scrum Master, and Development team. Each member has its own tasks. Scrum describes this as a self-organizing and cross-functional team. For large enterprise projects, ideal team size should be 7 people. For smaller projects, team size should be 4 people (Jasper van der Hoek, 2017).

Sprint 1: Game Components Design	Sprint 2: Environment and Believable Agents	Sprint 3: Believability and Behaviors of Agents	Sprint 4: Testing
3D Modelling	3D Modelling	Coding	Unit Testing
Coding	Coding	Sound Effects and Animation	Acceptance Testing
Test Plan Documentation	Unit Testing	Unit Testing	System Testing
Acceptance Testing	Acceptance Testing	Acceptance Testing	Project Report
Unit Testing	Presentation & Demo	System Testing	Final Presentation
Deployment	Documentation	Deployment	Demo Preparation
Release	Deployment	Release	Final Release
Agile Retrospective Meeting	Release	Agile Retrospective Meeting	Agile Retrospective Meeting
	Agile Retrospective Meeting		

Figure 3: Sprints of the Project

Sprints are small, iterative, cross-functional and important development cycles of the scrum methodology. Sprints show us which jobs will be finished during the time period created. The entire project process is divided into sprints to provide a short version release. The structure of the sprints are intended to minimize errors in the continuation of the project. Unlike traditional methods, the sprint structure is flexible. Because our project is comprehensive and requires a multi-disciplinary study, sprint provides a significant benefit. We planned the sprint design as four sprints as seen in the figure. We took care to keep the tasks distributed to the sprints at an optimal level throughout the project. As the needs of the project may vary in the ongoing processes, the usage of the traditional method will increase the cost due to changing requirements, so this method is not suitable for the project. However, due to the reasons mentioned above we preferred to use agile methodologies in the project as the agile method minimizes the cost of changing requirements.

Figure 4: Scrum Board

A scrum board (Fig. 4) was also used to organize and plan tasks in existing sprints. The tasks are written to the cards. Scrum boards are divided into three stages, which can be increased or decreased according to different projects. The stages in the project are "To Do", "In Progress" and "Done" respectively. The "To Do" phase includes the definition of tasks according to their priority and the cards of defined tasks. "In Progress" phase represents the tasks currently being worked on. In the "Done" phase, successfully completed tasks are specified. These specified tasks are mentioned below.

• Game Components Design

• Environment and Believable Agents

• Believability and Behaviours of Agents

• Testing

3.2.2. User Characteristics
3.2.2.1. Player

• Player must have a basic knowledge about VR and its tools' usage.

• Player must not have a heart condition.

• Player should be immune to anxiety and eppilepsy problems which may be caused by loudness and screen change.

• Player must be at least 15 years old or higher.

3.3. Requirements Specification

3.3.1. External Interface Requirements

3.3.1.1. User Interfaces

The user interface will be competible with Virtual Reality Headsets and PC(Windows OS).

3.3.1.2. Hardware Interface Requirements

For HTC Vive;

GPU: Nvidia GeForce GTX 970, AMD Radeon R9 290 equivalent or better. CPU: Intel i5-4590, AMD FX 8350 equivalent or better.

RAM: 4 GB or more.

Video Output: HDMI 1.4, DisplayPort 1.2 or newer.

USB Port: 1x USB 2.0 or better port.

Operating System: Windows 7 SP1, Windows 8.1 or later, Windows 10.

For Oculus;

GPU: Nvidia GeForce GTX 1070, AMD Radeon RX 580 equivalent or better. CPU: Intel i56700, AMD First generation Rizen5 equivalent or better.

RAM: 8 GB or more.

Video Output: HDMI 1.4, DisplayPort 1.2 or newer.

USB Port: 1x USB 2.0 or better port.

Operating System: Windows 10.

3.3.1.3. Software Interfaces
There are no external requirements for software interface.

3.3.1.4. Communications Interfaces
There are no external requirements for communication interfaces.

3.3.2. Functional Requirements

3.3.2.1. Main Menu Use Cases

Use Cases

  • Create new game
  • Load game
  • Open settings
  • View credits
  • Exit from game

Diagram:
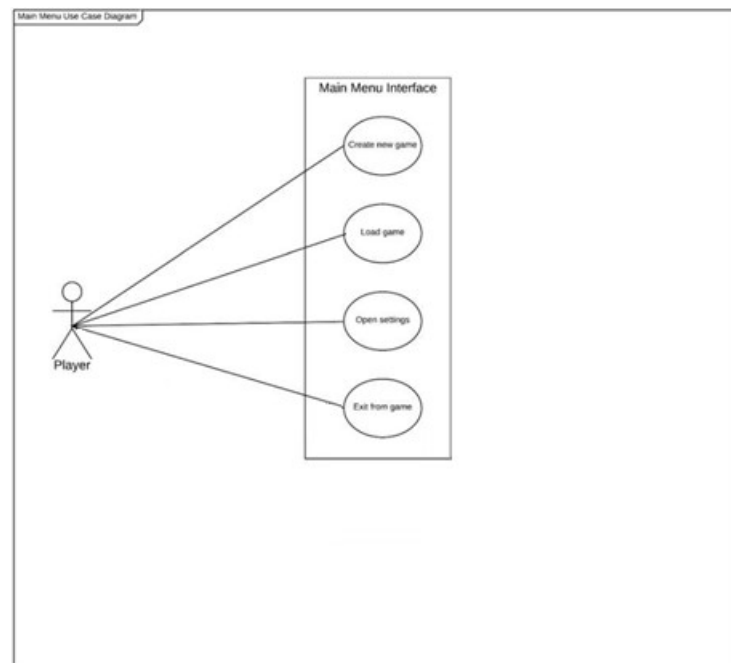
Figure 5: Main Menu Use Case Diagram

3.3.2.1.1. Brief Description
The use case diagram of main menu diagram is shown in Figure 3. Player can use the "Create new game", "Load game", "Open settings" and "Exit from game" functions in the main menu. As player opens the game, he/she will encounter with the main menu. Player can create a new game by simply pressing the "New Game" button. Settings

can be changed by pressing the "Settings" button. "Exit" button will close the game and return them to desktop.

3.3.2.1.2. Exemplary Scenario

When the player first opens the game, he will encounter the main menu screen. First, the player makes the desired changes by entering the settings menu. If the player is going to play the game for the first time, it starts a new game. The player encounters the loading screen. After the loading screen, the game begins. The player interacts with various objects in the game and tries to understand the story set in the game. Player makes investigations to solve the mystery with respect to the information that player obtained.

3.3.2.2. Settings Window Use Cases

Use Cases

- Video Settings
1. Change shadow preferences
2. Change resolution preferences
3. Change graphics quality

- Audio Settings

1. Adjust master volume

2. Adjust environment volume

3. Adjust music volume

Diagram:
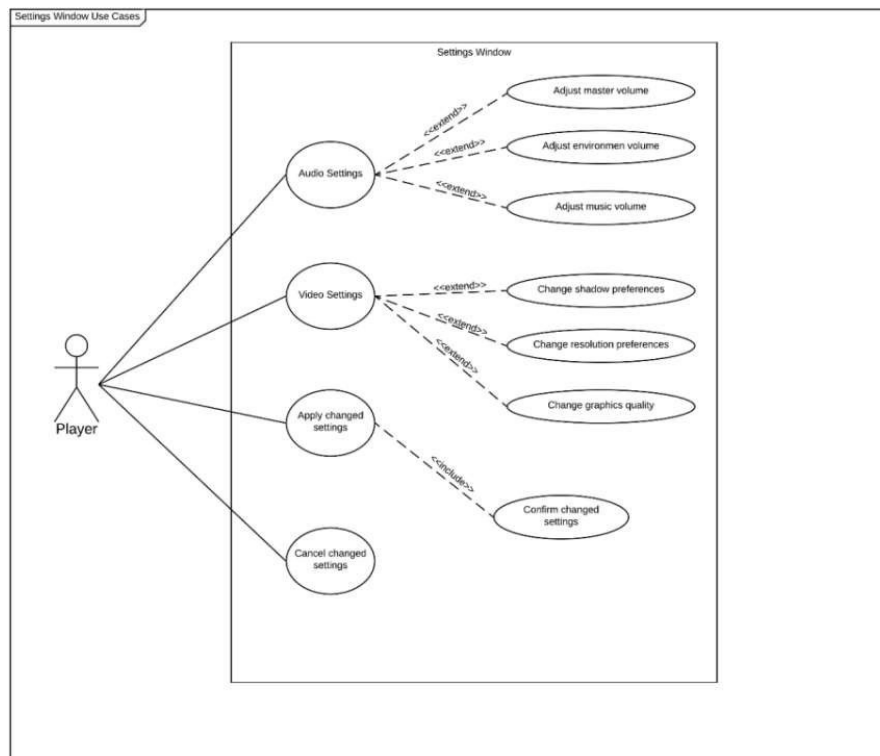
Figure 6: Settings Window Use Case Diagram

3.3.2.2.1. Brief Description

The use case diagram of settings window is shown in Figure 6. Player can change the "Audio Settings", "Video Settings" in different tabs respectively. In audio settings tab users are allowed to change different volume settings. "Adjust master volume" function can be used for changing overall volume level of the game by shifting along the volume slider. "Adjust environment volume" function can be used for changing only environmental sounds. "Adjust music volume" function can be used for changing background music of the game. In video settings tab users are allowed to change video settings. "Change shadow preferences" setting is used to change the shadow quality with three options of low, medium and high, also users are able to switch off/on the shadow feature. "Change resolution preferences" setting ables players to run the game on different screen resolution sizes. There are options available gathered from worldwide statistics. In that manner, "1920x1080", "1366x768", "1280x800", "1440x900", "1280x1024", "1600x900", "1024x768", "1680x1050" and "1920x1200" resolution sizes are available. "Change graphics quality" setting ables player to choose desired graphics quality among 3 options low, medium and high. Graphics quality changes scales the shaders, texture 10 quality, particle animations, reflections automatically. There is no option to change them one by one.

3.3.2.3. In-game Use Cases

Use Cases

• Move along environment

• Interact with objects

• Interact with NPC's

       i) View dialogue options

       ii) Choose response

       iii) End dialogue

• Open in-game menu

       i) Resume the game

       ii) Open settings window

       iii) Return to main menu

       iv) Exit to desktop

• Rotate camera
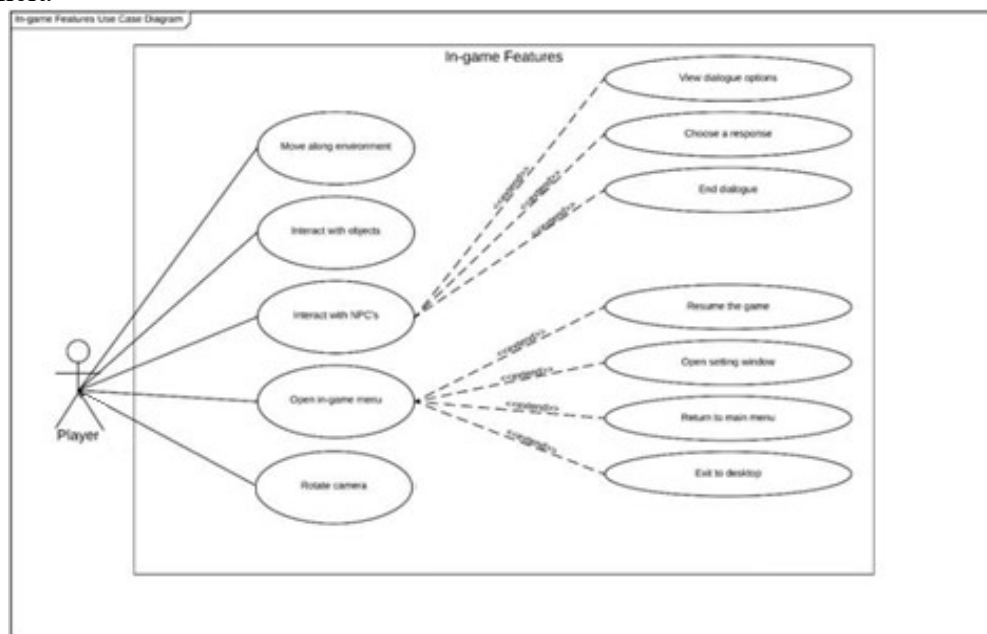
Figure 7: In-game Features Use Case Diagram

3.3.2.3.1. Brief Description

The use case diagram of in-game features is shown in Figure 7. Players are able to experience in-game mechanics like "Move along environment", "Interact with objects",

"Interact with NPC's" and "Rotate camera". "Move along environment" feature provides the walking function and ables players to move around the corridors of the museum. "Interact with objects" feature is used to make interactions with objects inside the museum. For example, reading a tablet, inspecting an exhibition and picking up items. "Interact with NPC's" feature ables player to interact with NPC's inside the museum, in our case, believable agents. Interacting with agents gives player the opportunity to talk with agents by "View dialogue options" feature. "Open settings window" feature ables player to change settings while in-game. It simply opens up the settings window that we mentioned in part 3.3.2 Settings Window Use Cases. "Return to main menu" feature ables player to return to main menu that we mentioned in part 3.3.1 Main Menu Use Cases. "Exit to desktop" feature closes the game and takes player back to their desktop. "Rotate camera" feature ables player to look around to environment by rotating their head while VR headtset is on.

3.3.3. Performance Requirements

The virtual museum will be created by using Unity 3D. Therefore, version of Unity 3D 2018 or higher versions must be supported. Operating system must be Windows 10 for Oculus, if you are playing the game with HTC Vive, Windows 7 or higher is required.

3.3.4. Software System Attributes

3.3.4.1. Portability

• The project does not need equipment other than the basic equipment. (mentioned in the document) This situation increases the portability of the project.

• The project to be developed with Unity 3D can be transferred to different platforms. Therefore, it provides advantages for portability to different platforms.

3.3.4.2. Performance

• In this project actions has consequences. The player can not see the consequences of that action before decide.

• The player needs some clues to solve the mystries. These clues cannot be obtained unless specific actions occur.

• The player needs to draw from NPC's behavior

3.3.4.3. Usability

• The project does not include complex hardware components. Thus, the installation and configuration of the project is simple as long as the required system requirements (mentioned in the documentation) are met.

3.3.4.4. Maintainability

• New features, add-ons and improvements can be made for the system with emerging technology. For this reason, object-oriented programming will be used to make changes, minimize maintenance costs and make improvements.

3.3.4.5. Security Requirement

Since the project is done on VR, it contains some requirements. These requirements for the player:

• Should not have epilepsy, heart disease or migraine.

• Must be at least 15 years old.

• Should be mentally strong.

4. SOFTWARE DESIGN DESCRIPTION

4.1. Introduction

4.1.1. Purpose

The aim of the Software Design Development Document is to detail the architectural and system design of the project called the Cultural Museum. The concept of virtual museums enables an experience based on the heritage of different cultures. Folklore, folk tales, decors, myths and motifs are part of cultural heritage [1]. The scope of this project is the treatment of the cultural elements belonging to horror stories of Turkish culture with a virtual museum concept. These characters will come to life with the help of a story set in the virtual museum, and the characters will become more believable and passed to virtual environment by using dramatic elements of a game. Consequently, we revive this rich culture from its forgotten past and to allow people to interact with unique entities from the Turkish culture. In order to realize the project, a detailed research is conducted about the concepts of virtual museums and cultural heritage. The museums were examined by using similar techniques in different areas.

4.1.2. Project Scope

Drawing on the fields of cultural heritage, this project aims to develop a computer game by contextualizing a virtual museum that is populated with virtual believable agents taken from Turkish horror folklore within the current field of game AI. In addition, it ultimately demonstrates how selected characters from Turkish horror folklore could adequately be simulated in a virtual museum that transmits cultural heritage in a digital medium. We are planning to conduct a case-based reasoning approach to simulate virtual agents' roles for exploring cultural heritage. Virtual agents should be able to play different museum-based roles and ultimately interact with other role-based agents and some of which need to engage into interactions with human participants. This study proposes an interactive drama (i.e. a serious game) based-on believable agent in virtual heritage museum.

4.1.3. Glossary

TERMS	DEFINITONS
UML Diagram	UML diagram A diagram represents the structure of an object-oriented software design
Virtual Museum	A collection of digitally recorded images, sound files, text documents, and other data of historical, scientific, or cultural interest that are accessed through electronic media.(Marco Sampaolo, 2017)
Virtual Reality	A high- end user interface that involves real-time simulation and interaction through multiple sensorial channels. (Virtual and Augmented Reality Applications, Lucio Tommaso De Paolis)
NPC (Non-Player Characters)	Virtual agents controlled by the game, that interact with other NPCs, or with Player Characters controlled by humans.(Sabrina Campano ; Nicolas Sabouret, 2009)
Cultural Heritage	Traditional culture and ruled out all sort of things. (R. Kurin Museum International, 2004, UNESCO)
Believable Agents	Constructions that computational models of believable interact. (Thomas and Johnston 1981)
Gannt Chart	The graphical demonstration of project schedule with the end dates, finish dates elements of the project. (Investopedia 2017)
Block Diagram	A diagram that illustrates the relation between components of the system with shapes and lines (BusinessDictionary.com, 2017).

Figure 8: Glossary

4.1.4. Motivation

Literature review had showed that people interested in virtual museums to learn about forgotten culture and feel realistic ambience of a real museum. In this project, we aimed to raise awareness about rich Turkish culture elements.

With the support of Portakal Technology, long forgotten rich Turkish vocal culture will be revived with the virtual museum that created along the needs and lack of things within the socio-cultural area. Advantages of virtual museum experience are listed below:

• Pieces that are too old or restricted can be exhibited through one-to-one models of each piece,

• Creating a fictional ambience to let people to live that moments which are not written but precious along cultural structure,

• Providing a isolated medium for researchers for their personal interests and different research topics,

• Lowering the cost with the help of Virtual Reality Technology, while maintaining impressive experience,

• Give opportunities to learn about folklore and horror stories to next generations,

• Saving from time and cost with the tools and environments that created with simulation,

• Providing a framework to further projects, while being first in the topic.

4.2. Architecture Design
4.2.1. Simulation Design Approach

Agile software methods are the same as their essence, but they are divided into various sub-branches that differ in their processes. A popular one of these arms is the Scrum method (M. John). Scrum is an administrative model with very simple rules at first glance [2].([2] Cohn, M. (2017). Scrum Methodology and Project Management. Mountain Goat Software. Available at: http://www.mountaingoatsoftware.com/agile/scrum Marco Sampaolo, The Educational Technology Journal - Virtual Museums, Mar 27, 2017. (Accessed 23.11.2018)) It is implemented for the management of complex software projects whose requirements are not explicitly specific, open to change. Scrum does not specify the steps to be followed in detail in the project and instead offers a flexible management with a few simple but important rules. Scrum requires teamwork so everyone must act together. It makes the release within time and with the minimal cost. Scrum development methodology divides project development time into parcels and sub-works. In the project development process, sub-works are completed within a certain period of time. These periods are called "sprint". At the end of each sprint, the software product must appear to be available and applicable.

Ideal Scrum team must include Product Owner, Scrum Master, and Development team. Each member has its own tasks. Scrum describes this as a self-organizing and cross-functional team. For large enterprise projects, ideal team size should be 7 people. For smaller projects, team size should be 4 people (Jasper van der Hoek, 2017).

Sprint 1 : Game Components Design	Sprint 2 : Environment and Believable Agents	Sprint 3: Believability and Behaviors of Agents	Sprint 4: Testing
3D Modelling	3D Modelling	Coding	Unit Testing
Coding	Coding	Sound Effects and Animation	Acceptance Testing
Test Plan Documentation	Unit Testing	Unit Testing	System Testing
Acceptance Testing	Acceptance Testing	Acceptance Testing	Project Report
Unit Testing	Presentation & Demo	System Testing	Final Presentation
Deployment	Documentation	Deployment	Demo Preparation
Release	Deployment	Release	Final Release
Agile Retrospective Meeting	Release	Agile Retrospective Meeting	Agile Retrospective Meeting
	Agile Retrospective Meeting		

Figure 9: Sprints of the Project

Sprints are small, iterative, cross-functional and important development cycles of the scrum methodology. Sprints show us which jobs will be finished during the time period created. The entire project process is divided into sprints to provide a short version release. The structure of the sprints are intended to minimize errors in the continuation of the project. Unlike traditional methods, the sprint structure is flexible. Because our project is comprehensive and requires a multi-disciplinary study, sprint provides a significant benefit. We planned the sprint design as four sprints as seen in the figure. We took care to keep the tasks distributed to the

sprints at an optimal level throughout the project. As the needs of the project may vary in the ongoing processes, the usage of the traditional method will increase the cost due to changing requirements, so this method is not suitable for the project. However, due to the reasons mentioned above we preferred to use agile methodologies in the project as the agile method minimizes the cost of changing requirements.

Figure 10: Scrum Board

A scrum board (Fig. 10) was also used to organize and plan tasks in existing sprints. The tasks are written to the cards. Scrum boards are divided into three stages, which can be increased or decreased according to different projects. The stages in the project are "To Do", "In Progress" and "Done" respectively. The "To Do" phase includes the definition of tasks according to their priority and the cards of defined tasks. "In Progress" phase represents the tasks currently being worked on. In the "Done" phase, successfully completed tasks are specified. These specified tasks are mentioned below.

- Game Components Design
- Environment and Believable Agents
- Believability and Behaviors of Agents
- Testing

The Gantt Chart represented in Appendix A shows the time schedule of the project. It consists of two parts. The first part consists of research and documentation. Documentations contains literature review and also preparation of SRS and SDD documents. In addition, the preparation of the project's website is among the works to be done in this section. All the jobs in the first section cover approximately 90 days. The second part deals with the development of the project. It consists of 4 sprints. Each sprint covers a 21-day period. In the Sprints, Scrum development was accepted as the work scheduling method, and at the end of each sprint a period of time was used for the test.

4.2.1.1. Class Diagram
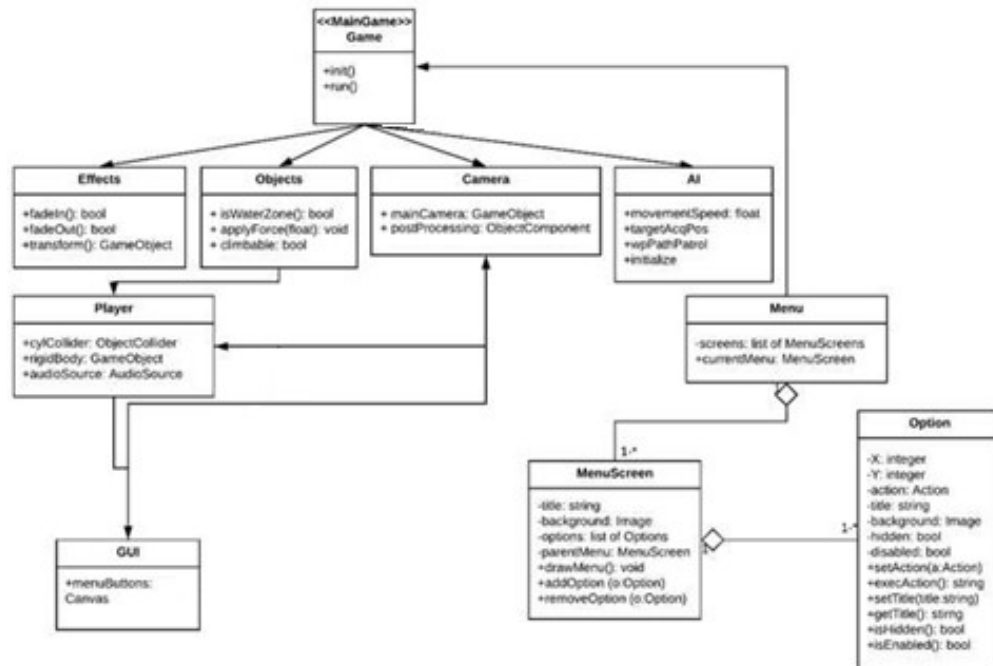
Figure 11: Class Diagram

UML diagrams are a standard method for modelling and planning the system's software. Figure 3 above shows the UML diagram for Museum Corvus. The "MainGame" class is the main class that involves all systems. It has a direct connection to all other subsystems. "MainGame" class includes "Effects", "Objects", "Camera" and "AI" classes. The main class provides the connection between subclasses. The "Player" class represents users who use the system and it holds FPS player object that contains player and movement related components, such as the player's capsule collider, rigidbody, and an audio source for sound effects like walking, player voices. The "Objects" class used for water zones and climbable objects and all apply forces or affect the player's rigidbody velocity. The "Camera" class is used for FPS Camera object and its parent to all cameras used by the scene, including the main camera. The "AI" class is used for the script controls most of the NPC's behavior including movement speed, target aquisition, waypoint path patrolling, initialization and character animation. The "Effect" class holds several scripts which includes visual effects such as fade in and fade out or even transform. The "GUI" class is used for to display certain things to player such as main menu. The "Menu" class holds the all menu related components of the game and it contains both main menu aspects and options tabs.

4.2.2. Architecture Design of Simulation

4.2.2.1. Settings Menu

Summary : This system is used to make changes about the game. Player can use this menu to see and use alternative choices about in-game settings including audio and graphics etc.

Actor: Player

Precondition: The game must be in a running state.

Basic Sequence:

      I.   Player opens the settings menu using the button or the defined hotkey.

II.   Player encounters with a settings screen with panels dividing sections and buttons to change default settings.

III.   After making the changes, player must use Apply button to carry the new settings into effect.

IV.   Player presses Confirm button to exit the settings menu. If player does not apply the new changes, player exits the menu without changing the properties.

4.2.2.2. Game Page

Summary: This system covers all the playable parts. Player advances while making decisions and taking actions inside the story and tries to reach to the end.

Actor: Player

Precondition: The game must be in a running state.

Basic Sequence:

I.   Player spawns in a pre-defined location.

II.   Player can walk inside the environment freely and encounter & interact with NPC's.

III.   The game makes player to make choices.

IV.   Story differs and evolves with each given choice.

V.   Player follows the story and solves the challanges to get to the end of the story.
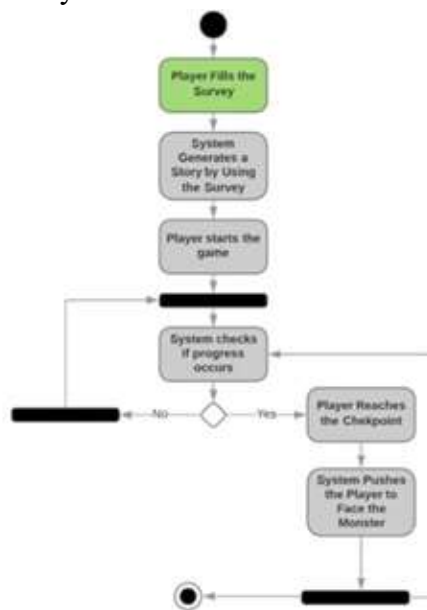
Figure 12: Activity Diagram

The activity diagram in the Figure 12 indicates working system of the overall system. First, player should answer the questions of survey. The system then adjusts the story according to the answers given by the player. The player starts the game and encounters the NPCs set by the system and tries to find a useful tip. The player makes an event by using hints, and the user accesses a checkpoint if the event is considered valuable by the system. Then the system encounters the player with monsters.

4.2.2.3. Flow Chart
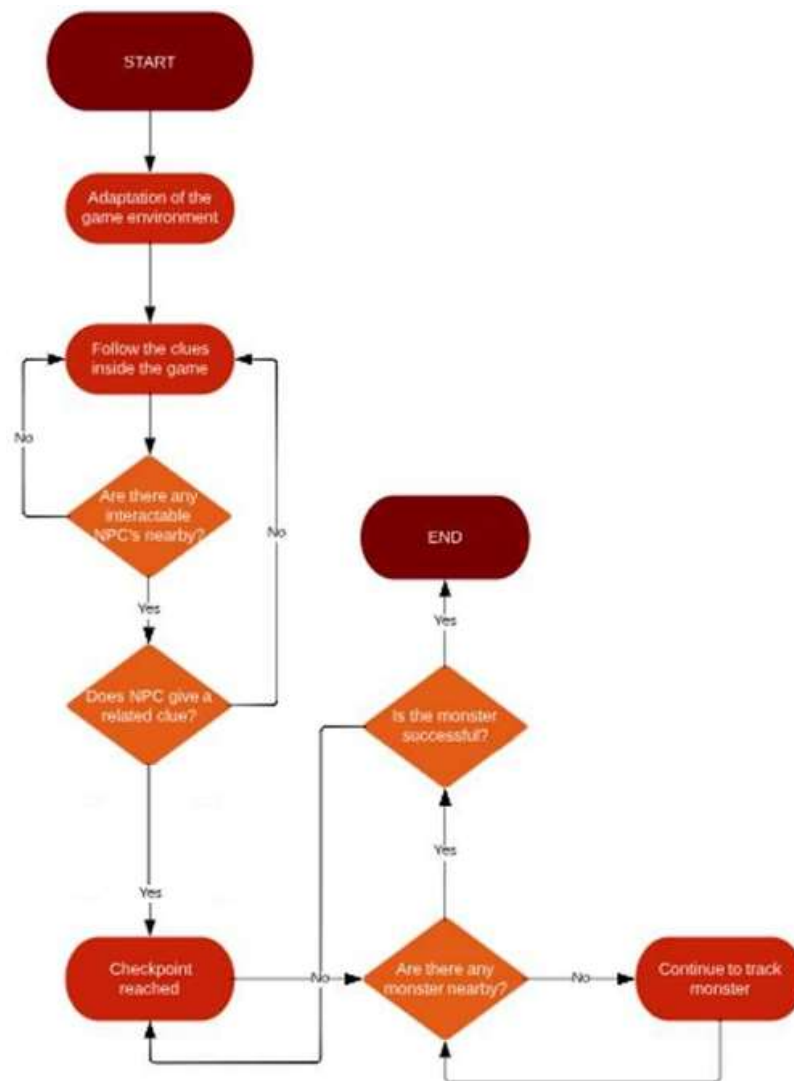
Figure 13: Flow Chart

In the Figure 13, flow of the game is illustrated with flowchart according to view of the player.

4.3   Use Case Realization
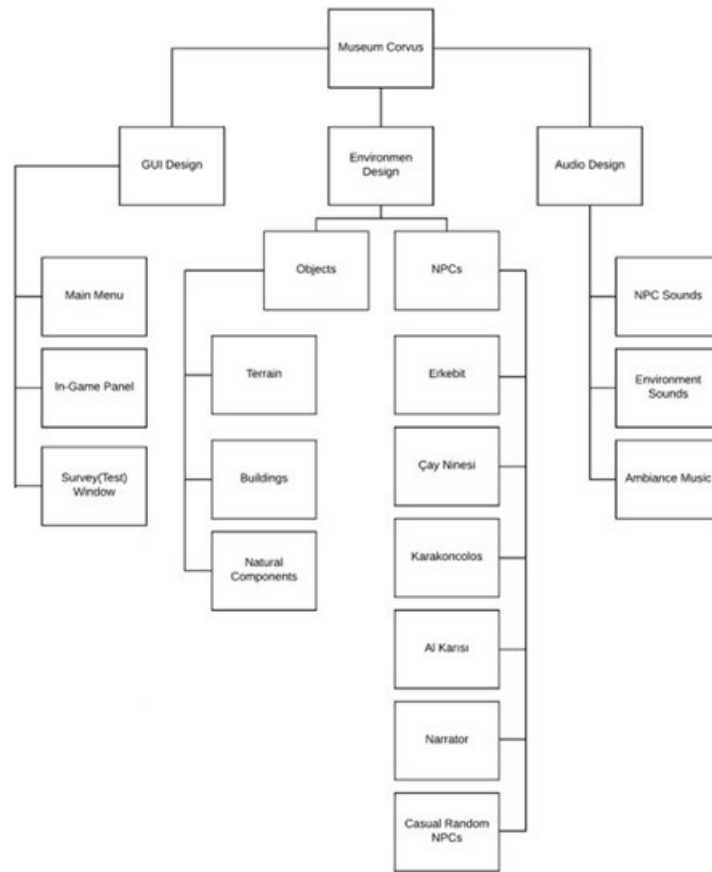
Figure 14: Components of the Museum

4.3.1. Components of Museum

In the figure 14, designed components of the museum is demonstrated with a block diagram. The system consists of three main components, and each component has own sub-system.

4.3.1.1. GUI Design

GUI design provides interaction between the player and the system. It comprises main menu and Survey (Test) Window. First of all, the player encounters with main menu which is the start page of the system. In addition, players are able to change the default settings from the options menu. At the beginning of the game player encounters with a survey. Survey need to be filled by player in order to determine player's psychology. Game starts as player finish the survey.

4.3.1.2. Environment Design

The game will contain different environment such as main story terrain and the museum lobby section. Main story will be experienced in the main map and player will interact with narrator and statues inside the museum lobby. The environments will contain non-player characters and object such as little girl as first encounter, villages, rivers, Erkebit, Çay Ninesi, Karakoncolos, Al Karısı etc.

4.3.1.3. Sound Design

Sound design gives the game it's reality closeness as player needs to experience a unique living environment. According to main story, related sounds such as wind, fire, ambiance music, voice actings etc.

4.4. Environment

4.4.1. Modelling Environment

This project will be developed by using Unity3D and its tools. In order to model realistic environment we will be using Autodesk Maya 2018 and Zbrush. Also project will contain some free assets from Unity's Asset Store in order to develop the game faster.

Figure 15: Screenshot from the Game

In the project, plan is to design different environments for the main story and museum lobby. One map will contain different themes for each horror character (Erkebit, Çay Ninesi, Karakoncolos, Al Karısı) and these environmental aspects will give the immersive historical experience about the myth and folk tales.

5. TEST PLAN, TEST DESIGN SPECIFICATIONS & TEST CASES

5.1. Version Control

Table 1: Version Control

Version No	Description of Changes	Date
0.1	Basic mechanics without the actual content	Feb 23, 2019
0.1.5	Mechanics bug fixes	March 15, 2019
0.2	Scenario storypoints	April 2, 2019
1.0	Full game without VR Build	May 1, 2019
1.2	Full game with AI Concept	May 23, 2019
1.5	VR Build	May 31, 2019

5.1.1. Overview

Use cases, graphical user interface features, system functionalities, and usability factors of Museum Corvus is planned to be tested. All the components of the project are defined on JIRA to be monitored. These components will be tested each sprint is done.

5.1.2. Scope

This part of the report includes the test plan, test design specifications and the test cases correspond to the test plan of the project named Museum Corvus.

5.1.3. Terminology

Table 2: Terminology

Acronym	Definition
VR	Virtual Reality
GUI	Graphical User Interface
SRS	Software Requirements Specification
JUMPSCARE	Technique that scare the audience by surprising them with an abrupt change in image or event, usually co-occurring with a frightening sound, mostly loud screaming.

SDD	Software Design Description
Insignificant	Execution time is less than a minute.

5.1.4. Features To Be Tested

There are three main parts and they have some subfeatures that need to be tested. This section lists and gives a brief description of all these major features to be tested. For each major feature there will be a Test Design Specification added at the end of this document.

5.1.5. Graphical User Interface

Graphical User Interface contains all the visual components that the user sees and uses in the game. There are texts, buttons, slidebars, panels, and some other visual objects seen while using the graphical user interface. For this feature, each GUI component will be tested individually whether they are placed correctly on the screen and whether they provide the correct functionality that is expected.

5.1.6. Survey Phase

After the player presses the start button, he / she will encounter a survey. The survey asks a several questions related to the variety of phobias. As a result of the answers given, the player is provided with a more immersive gaming experience. This questionnaire can be developed into a more extensive gaming experience for future work.

5.1.7. Play Mode

After the survey part is completed, the player starts the game. In this section, the player experiences the game by interacting with the environment and the story behind them. Each environment has its own unique solution. The user discovers these solutions and tries to pass through the episodes and finish the game.

6. ITEM PASS/FAIL CRITERIA

6.1. Exit Criteria:

- 100% of the test cases are executed
- 99.9% of the test cases passed
- All High and Medium Priority test cases passed

6.2. References

CENG408_Group_SRS_V2.0, May 31, 2019
CENG408_Group1_SDD_V2.0, May 31, 2019

7. TEST DESIGN SPECIFICATIONS

7.1 Graphical User Interface(GUI)

7.1.1 Subfeatures To Be Tested

Play Button (GUI.P_BTN)

> User should be able to start the game after "PLAY" button is pressed.

Settings Button (GUI.S_BTN)

> User should be able to see the settigs tab after click the "SESTTINGS" button.

Exit Button (GUI.E_BTN)

> User should be able to quit the game after click the "EXIT" button.

Music Volume Slider (GUI.S_SLD)

> User should be able to adjust the menu's music volume via "music volume" slider.

Return Button (GUI.R_BTN)

> User should be able to turn back to previous menu tab with "Return" button.

7.1.2 Test Cases

Table 3: Test Cases GUI

TC ID	Requirements	Priority	Scenario Description
GUI.P_BTN.01	3.2.1	H	Select "PLAY" button, after then select the "New Game" button, game should start.
GUI.S_BTN.01	3.2.1	M	Select "SETTINGS" button to see the settings tab. Adjustment will held there.
GUI.E_BTN.01	3.2.1	L	Select "EXIT" button to quit the game.
GUI.S_SLD.01	3.2.2	L	Go to settings tab, changed the value of the slider to the either left or right.
GUI.R_BTN.01	3.2.2	M	Select "Return" button to go back to previous tab.

7.2.   Survey Phase(SP)

User should take the game defining survey before the actual game with customized game objects and events according to results gathered. Survey phase customized the game that is suitable to player's phobias.

7.2.1   Test Cases

Table 4: Test Cases SP

TC ID	Requireme nts	Priori ty	Scenario Description
SP_.01	3.2.3	H	Select any of the given toggle buttons to choose your phobia, after the selection person point will be assigned and written to a binary file to define the game objects and events.
SP_.02	3.2.3	H	After the selection of phobias, click the save button to start the game.

7.3.   Play Mode (PM)

7.3.1   Subfeatures to be Tested

Basic Control Mechanics (PM.BCM)

   User should perform basic player controller tasks like moving the controller in any direction and camera rotations.

Play/Pause Operation (PM.PP)

   User should be able to play and pause the game in every scene except Karakoncolos scene.

Move in Environment (PM.ME)

   User should be able to move in the game's world partial free. This function varies in different places in the game.

Object Interactions (PM.OI)

   User should be able to interact with certain objects with "Left Mouse Button" and the "F" key.

NPC Interactions (PM.NI)

   User should be able interact wih NPC's like museum exhibition areas to read the content or the certain encounters.

Trigger Interactions (PM.TI)

> User can trigger certain events like sound clips, animations, scene transition or controller modifications.

Believable Agent Encounters (PM.BAE)

> User should encounter believable agents throughout the game that either chases them or gather information from.

7.3.2. Test Cases

Table 5: Test Cases PM

TC ID	Requirements	Priority	Scenario Description
PM.BCM_.01	3.2.3	H	Use "W, A, S, D" to move. "W" to move forward, "A" to move left, "S" to move backwards, "D" to move right.
PM.BCM_.02	3.2.3	H	Camera is controlled by the mouse. Verify that rotations can be done 360 degrees in horizontal, 180 degrees in vertical.
PM.BCM_.03	3.2.3	M	Verify that jump operation is available. Use "Space" button to jump. Check if there is any glitches like double jump or stuck.
PM.PP_.01	3.2.3	L	Push "ESC" button. Game will be paused if the game is running. Game will continue if the game is paused.
PM.ME_.01	3.2.3	H	Check if it is able to move anywhere inside the Museum Part scene except secret room that teleports player to the village.
PM.ME_.02	3.2.3	H	Check if secret room is discoverable and able to move in it after all exhibition areas are read.
PM.ME_.03	3.2.3	L	Verify that village scene is partially free to move. Check that there is no obstacles along the desired paths through scenario.
PM.ME_.04	3.2.3	L	Check that the inside of the Villige House(Erkebit) is all available to move freely except the obstacles in the rooms like chairs, tables or beds.
PM.ME_.05	3.2.3	H	Verify that there is nothing that stops player controller to move along the path in the scene Çay Ninesi while the scenario part "chasing the daughter" executes.
PM.ME_.06	3.2.3	M	Check that if player controller is able to move in any direction inside the village to run from the Al Karısı agent.

PM.ME_.07	3.2.3	H	Verify that if it is able to move freely in the Karakoncolos room except right front of the table that Karakoncolos questions the player.
PM.OI_.01	3.2.3	H	Verify that door inside the village scene is able to be knocked. Three or more village doors are implemented. One door will be opened where the other doors knocked.
PM.OI_.02	3.2.3	M	Verify that the well inside the village scene is interactable.
PM.OI_.03	3.2.3	H	Check that if the note papers inside the village house are interactable. They must be able to interact with "F" key to open and read, "TAB" key to close. Verify that after read and close that the note is disappeared from the world space.
PM.OI .04	3.2.3	H	Verify the vase in the village house which is places right on the table that is near the wall to the left of the door, can be picked up by looking to it and pressing the "Left Mouse Button" key.
PM.NI_.01	3.2.3	H	Verify that the statues in the exhibition areas can be interacted with the "F" key.
PM.NI_.02	3.2.3	L	Check that the narrator that placed right forward to starting point of Museum Part is playing it's animation and the voice over when interacted.
PM.NI_.03	3.2.3	H	Verify that Karakoncolos is interactable through the table which placed in the middle of the room in the scene Karakoncolos.
PM.TI_.01	3.2.3	H	Check that if an information appears that says "<F> Examine", when stand in front of the statue.
PM.TI_.02	3.2.3	H	Verify that secret door become discoverable after all the exhibitions visited.
PM.TI_.03	3.2.3	M	Check that camera starts to fade in and out, at secret room.
PM.TI_.04	3.2.3	H	Verify that scene transition is properly working at the end of the secret room.
PM.TI .05	3.2.3	H	Check if scene transition works properly in the village scene in front of the opened door.
PM.TI_.06	3.2.3	M	Verify that daughter jumpscare plays on trigger.
PM.TI_.07	3.2.3	H	Check that trigger to next scene becomes available when all the note papers are collected.
PM.TI_.08	3.2.3	H	Verify that scene transition trigger properly works in front of the exit door.
PM.TI_.09	3.2.3	M	Check that if the Çay Ninesi jumpscare works properly on trigger.

PM.TI_.0 10	3.2.3	H	Verify that scene transition works after Al Karısı catches the player.
PM.TI_.0 11	3.2.3	H	Check if the trigger works properly near the table in Karakoncolos scene.
PM.BAE _.01	3.2.3	H	Verify that Al Karısı agent encounter works properly.
PM.BAE _.02	3.2.3	H	Verify that Karakoncolos agent encounter works properly.

7.4. Detailed Test Cases

GUI.P_BTN

TC_ID	GUI.P_BTN.01
Purpose	Provides to "New Game" and "Return" button to appear.
Requirements	3.2.1
Priority	High
Estimated Time Needed	Insignificant.
Dependency	Main menu should be displayed.
Setup	Game exe should be installed to the PC and exe should in run time.
Procedure	[A01] Select "Play" button from main menu screen. [V01] "New Game" and "Return" button appears.
Cleanup	Go back to Main Menu.

GUI.S__BTN

TC_ID	GUI.S_BTN.01
Purpose	Provides to "Game", "Controls" and "Video" segments to appear.
Requirements	3.2.1
Priority	Medium
Estimated Time Needed	Insignificant.
Dependency	Main menu should be displayed.
Setup	Game exe should be installed to the PC and exe should be in run time.
Procedure	[A01] Select "Settings" button from main menu. [V01] ."Game" , " Controls" and "Video" and their subsegments appears.
Cleanup	Go Back to Main Menu.

GUI.E_BTN

TC_ID	GUI.E_BTN
Purpose	Provides to Exit the game while in Main Menu screen.
Requirements	3.2.1
Priority	Low
Estimated Time Needed	Insignificant.
Dependency	Main menu should be displayed.
Setup	Game exe should be installed to the PC and exe should be in run time.
Procedure	[A01] Select "Exit" button from main menu. [V01] "Are you sure" warning and "Yes" , "No" buttons appears in the screen, after the "Yes" button registered game closes.
Cleanup	Go back to main menu.

GUI.S_SLD

TC_ID	GUI.S_SLD
Purpose	Switching value of the slider to change the volume of the game.
Requirements	3.2.2
Priority	LOW
Estimated Time Needed	Insignificant.
Dependency	Settings menu should be displayed.
Setup	Setting screen and Game Segment should be displayed.
Procedure	[A01] Change the Value of the Slider. [V01 Volume of the game changed.
Cleanup	Go back to main menu.

GUI.R_BTN

TC_ID	GUI.R_BTN
Purpose	Performing return from Main Menu.
Requirements	3.2.2
Priority	Low
Estimated Time Needed	Insignificant.
Dependency	"Settings" or "Play" menu should be displayed.
Setup	Game exe should be installed to the PC and exe should be in run time.
Procedure	[A01] Select "Return" button from the screen. [V01] . Page changes and Main Menu appears.
Cleanup	-

SP_.01

TC_ID	SP_.01
Purpose	After the "Survey Screen" appears, player can choose phobias on toggle buttons.
Requirements	3.2.3
Priority	High
Estimated Time Needed	Insignificant.
Dependency	Survey Screen should be displayed.
Setup	Survey Screen should be prepared.
Procedure	[A01] Select any wanted Toggle buttons from Survey Screen. [V01] Selected Toggle Buttons are marked.
Cleanup	Exit.

SP_.02

TC_ID	SP_.02
Purpose	"Save" button performs to start the game after the survey decisions finished.
Requirements	3.2.3
Priority	High
Estimated Time Needed	1 Minute.
Dependency	Survey Screen should be displayed.
Setup	Survey Screen should be prepared.
Procedure	[A01] Select "Save" button from Survey Screen. [V01] Game will start.
Cleanup	Exit.

PM.BCM_.01

TC_ID	PM.BCM_.01
Purpose	Player can use keybord to move. "W" to move forward, "A" to move left, "S" to move backwards, "D" to move right.
Requirements	3.2.3
Priority	High
Estimated Time Needed	Insignificant.
Dependency	Player should be in any level of the game.
Setup	Game exe should be in run time.
Procedure	[A01] The player presses the direction key for his/her want to go through the keyboard. [V01] Movement in the desired direction occurs.
Cleanup	-

PM.BCM_.02

TC_ID	PM.BCM_.02
Purpose	Player controls the camera. Camera is controlled by the mouse. Verify that rotations can be done 360 degrees in horizontal, 180 degrees in vertical.
Requirements	3.2.3
Priority	High.
Estimated Time Needed	Insignificant.
Dependency	Player should be in any level of the game.
Setup	Game exe should be in run time.
Procedure	[A01] The user moves the mouse in any direction. [V01] The camera turns to the desired direction.
Cleanup	-

PM.BCM_.03

TC_ID	PM.BCM_.03
Purpose	Player press the "Space" Button from the keyboard for Jump.
Requirements	3.2.3
Priority	Meidum
Estimated Time Needed	Insignificant.
Dependency	Player should be in any level of the game.
Setup	Game exe should be in run time.
Procedure	[A01] Player presses the "Space" Button. [V01] Character Jumps.[A02] Player Presses the "Space" repeatedly.[V02] Character Jumps single time.
Cleanup	-

PM.PP_01

TC_ID	PM.PP_01
Purpose	Player press the "Escape" Button from the keyboard for Pause.
Requirements	3.2.3
Priority	Low
Estimated Time Needed	Insignificant.
Dependency	Player should be in any level of the game
Setup	Game exe should be in run time.
Procedure	[A01] Player press the "Escape" Button. [V01] All the game object freezes. [V02] In Karakongolos Scene nothing happens.
Cleanup	Escape Button Pressed Again.

PM.ME_02

TC_ID	PM.ME_02
Purpose	Player enters the Secret Room for teleport to teleport to the village scene.
Requirements	3.2.3
Priority	High
Estimated Time Needed	30 Seconds.
Dependency	Player must be in museum scene, interacted with objects and unlocked the Secret Room.
Setup	Secret Room should be unlocked.
Procedure	[A01]Player Enters the Secret Room. [V01] After entering the secret room character teleported the Village Scene.
Cleanup	Exit.

PM.ME_01

TC_ID	PM.ME_01
Purpose	Player able to move anywhere inside the Museum Part scene except secret room that teleports player to the village.
Requirements	3.2.3
Priority	High
Estimated Time Needed	5 Minutes.
Dependency	Player must be in museum scene.
Setup	Museum Scene should be prepared.
Procedure	[A01] Player Moves freely the Museum Scene , except the secret room. [V01] Character moves in the direction the player's desires. [A02] Player tries the enter secret room without any interaction. [V02] Character can not enter the secret room without any interaction.
Cleanup	Exit

PM.ME_03

TC_ID	PM.ME_03
Purpose	Player able to move anywhere inside the Village Scene through the scenario.
Requirements	3.2.3
Priority	Low
Estimated Time Needed	5 minutes
Dependency	Player must be in Village Scene.
Setup	Village Scene should be prepared.
Procedure	[A01] Player Moves freely the Village . [V01] Character moves in the direction the player's desires.
Cleanup	Exit

PM.ME_04

TC_ID	PM.ME_04
Purpose	Player able to move anywhere inside the Village House Scene through the scenario.
Requirements	3.2.3
Priority	Low
Estimated Time Needed	5 minutes
Dependency	Player must be in Village House Scene.
Setup	Village House Scene should be prepared.
Procedure	[A01] Player Moves freely the Village House. [A02] Player tries to pass through obstacles [V01] Character moves in the direction the player's desires. [V02] Character cannot pass through obstacles.
Cleanup	Exit

PM.ME_05

TC_ID	PM.ME_05
Purpose	Player tries to catch the NPC called daughter through the scenario.
Requirements	3.2.3
Priority	High
Estimated Time Needed	3 Minutes
Dependency	Player must be in alternative Village Scene.
Setup	Alternative Village House Scene should be prepared.
Procedure	[A01] Player Moves to NPC at the alternative Village Scene. [V01] Character can approach the NPC without any interruption.
Cleanup	Exit

PM.ME_06

TC_ID	PM.ME_06
Purpose	Player able to move anywhere inside the Village House Scene through the scenario.
Requirements	3.2.3
Priority	Medium
Estimated Time Needed	5 Minutes
Dependency	Player must be in alternative Village Scene.
Setup	Alternative Village Scene should be prepared.
Procedure	[A01] Player Moves freely the Alternative Village . [V01] Character moves in the direction the player's desires.
Cleanup	Exit

PM.ME_.07

TC_ID	PM.ME_.07
Purpose	Verification of the free player movement except in front of the table in the Karakoncolos room.
Requirements	3.2.3
Priority	High
Estimated Time Needed	2 Minutes
Dependency	Player must be in the Karakoncolos room.
Setup	Karakoncolos Room Scene should be prepared.
Procedure	[A01] Walk inside the room. [V01] Nothing will effect player movement except the table area.
Cleanup	Exit

PM.OI_.01

TC_ID	PM.OI_.01
Purpose	Verification of the doors inside the village. The door that did not knocked among the three will be opened.
Requirements	3.2.3
Priority	High
Estimated Time Needed	1 Minute
Dependency	Player must be in the Village Scene.
Setup	Village Scene should be prepared.
Procedure	[A01] Dependantly any two or more door will be knocked. [V01] Last door that has not knocked will be opened.
Cleanup	-

PM.OI_.02

TC_ID	PM.OI_.02
Purpose	Verifying that the well inside the Village Scene is interactable.
Requirements	3.2.3
Priority	Medium
Estimated Time Needed	2 Minutes
Dependency	Player must be near to the well inside the Village Scene.
Setup	Village Scene should be prepared.
Procedure	[A01] Press "F" key near to the well to interact. [V01]Well interaction cutsene will be played.
Cleanup	-

PM.OI_.03

TC_ID	PM.OI_.03
Purpose	Verifying the note papers inside the village house that they are interactable.
Requirements	3.2.3
Priority	High
Estimated Time Needed	1 Minute
Dependency	Player must be in the Village House Scene.
Setup	Village House Scene should be prepared.
Procedure	[A01] Press "F" key while pointing the note paper with the mouse pointer. [V01] Note paper with its contents will open. [A02] Press "TAB" key while note paper is open. [V02] Note paper will close and dissappear.
Cleanup	Exit

PM.OI_.04

TC_ID	PM.OI_.04
Purpose	Verifying that the vase inside the village house is interactable.
Requirements	3.2.3
Priority	High
Estimated Time Needed	1 Minute
Dependency	Player must be in the Village House Scene.
Setup	Village House Scene should be prepared.
Procedure	[A01] Press "Left Mouse Button" key while pointing the note paper with the mouse pointer.. [V01] Vase is lifted and carried as mouse pointer moves. [A02] Release "Left Mouse Button" [V02] Vase will fall and will shatter.
Cleanup	Exit

PM.NI_.01

TC_ID	PM.NI_.01
Purpose	Verifying that the statues inside the museum exhibition areas are interactable.
Requirements	3.2.3
Priority	High
Estimated Time Needed	3 minutes
Dependency	Player must be in the Museum Scene.
Setup	Museum Scene should be prepared.
Procedure	[A01] Press "F" near to the statue. [V01] Monster information screen will open.
Cleanup	Exit

PM.NI_.02

TC_ID	PM.NI_.02
Purpose	Verifying that the narrator inside the museum is interactable.
Requirements	3.2.3
Priority	Low
Estimated Time Needed	1 minute
Dependency	Player must be in the Museum Scene.
Setup	Museum Scene should be prepared.
Procedure	[A01] Get near to the narrator. [V01] Narrator will start playing its animations and audio files to welcome the player.
Cleanup	Exit

PM.NI_.03

TC_ID	PM.NI_.03
Purpose	Verifying that Karakoncolos is interactable.
Requirements	3.2.3
Priority	High
Estimated Time Needed	2 minutes
Dependency	Player must be in the Karakoncolos Scene.
Setup	Karakoncolos Scene should be prepared.
Procedure	[A01] Get near to the table inside the room. [V01] Karakoncolos will come and questionaire starts. [A02] Answer the questions [V02] For each question a candle will die if the answer is wrong. [V03] Game fails if there are no candles left.
Cleanup	Exit

PM.TI_.01

TC_ID	PM.TI_.01
Purpose	Verifying that statues give information message when player stands infront of them.
Requirements	3.2.3
Priority	High
Estimated Time Needed	1 Minute
Dependency	Player must be inside the Museum Scene.
Setup	Museum Scene should be prepared.
Procedure	[A01] Stand infront of a statue. [V01] System will give information that says "<F> Examine"
Cleanup	Exit

PM.TI_.02

TC_ID	PM.TI_.02
Purpose	Verifying that the secret door will open after each exhibitions are visited in the museum.
Requirements	3.2.3
Priority	High
Estimated Time Needed	3 Minutes
Dependency	Player must be inside the Museum Scene.
Setup	Museum Scene should be prepared.
Procedure	[A01] Interact with every statue. [V01] Secret door will open and a sound will play.
Cleanup	Exit

PM.TI_.03

TC_ID	PM.TI_.03
Purpose	Player enters the secret room , after a few steps came starts to fade in and out.
Requirements	3.2.3
Priority	Medium
Estimated Time Needed	30 seconds.
Dependency	Player must be in the Museum Scene.
Setup	Museum Scene should be prepared and secret door should be open.
Procedure	[A01] Player enters the secret room. [V01] Camera starts to fade in and out 2 times.
Cleanup	-

PM.TI_.04

TC_ID	PM.TI_.04
Purpose	After the Player reaches the end of the secret room player is teleported to the village scene.
Requirements	3.2.3
Priority	High
Estimated Time Needed	Insignificant.
Dependency	Player must be in the Museum Scene.
Setup	Museum Scene should be prepared, Village Scene should be prepared.
Procedure	[A01] Reach end of the secret room. [V01] Scene Changes.
Cleanup	-

PM.TI_.05

TC_ID	PM.TI_.05
Purpose	Player knocks doors, and looks down to the well. After this events one of the doors will open. Player reaches the door, than The player is teleported to the scene called the Village House.
Requirements	3.2.3
Priority	High
Estimated Time Needed	5 minutes.
Dependency	Player must be in the Village Scene.
Setup	Village House Scene should be prepared, Village scene should be prepared.
Procedure	[A01] Reach opened door of the Village Scene. [V01] Scene Changes.
Cleanup	Exit

PM.TI_.06

TC_ID	PM.TI_.06
Purpose	Player moves upstairs from the Village House. While the player about to enter the room, jumpscare occurs.
Requirements	3.2.3
Priority	Medium
Estimated Time Needed	5 Seconds.
Dependency	Player must be inside the Village House Scene.
Setup	Village House Scene should be prepared.
Procedure	[A01] Move Upstairs enter the dinner room. [V01] Little girls runs with sound.
Cleanup	-

PM.TI_.07

TC_ID	PM.TI_.07
Purpose	Player should collect all the note papers for teleport the other scene called Çayninesi.
Requirements	3.2.3
Priority	High
Estimated Time Needed	3 Minutes
Dependency	Player must be inside the Village House Scene.
Setup	Village House Scene should be prepared.
Procedure	[A01] Interact with every collectable note paper. [V01] Scene transiton occurs.
Cleanup	-

PM.TI_.08

TC_ID	PM.TI_.08
Purpose	Verifying that the door inside the Village House Scene is working correctly.
Requirements	3.2.3
Priority	High
Estimated Time Needed	3 Minutes
Dependency	Player must collect 4 note papers to unlock the door.
Setup	Village House Scene should be prepared.
Procedure	[A01] Collect four papers spread inside the house. [V01] Scene changer in front of the door will activate. [A02] Collide with the scene changer. [V02] System will unload the scene and load the next one.
Cleanup	Exit

PM.TI_.09

TC_ID	PM.TI_.09
Purpose	Verifying that the jumpscare inside the Çay Ninesi Scene works properly.
Requirements	3.2.3
Priority	Medium
Estimated Time Needed	3 Minutes
Dependency	Player must be in the Çay Ninesi Scene.
Setup	Çay Ninesi Scene should be prepared.
Procedure	[A01] Chase the running girl in the village and collide with the trigger on the pier. [V01] Jumpscare will trigger. [V02] After jumpscare cutscene, scene changer takes action and moves on to the next scene.
Cleanup	Exit

PM.TI_.010

TC_ID	PM.TI_.010
Purpose	Verifying that the scene transition works after Al Karısı catches the player.
Requirements	3.2.3
Priority	High
Estimated Time Needed	3 Minutes
Dependency	Player must be caught by the Al Karısı.
Setup	Al Karısı Scene should be prepared.
Procedure	[A01] Get caught up by the Al Karısı. [V01] Al Karısı will attack the player. [V02] After the attack, scene will change.
Cleanup	Exit

PM.TI_.011

TC_ID	PM.TI_.011
Purpose	Verifying that the trigger works properly for the table inside the Karakoncolos Scene.
Requirements	3.2.3
Priority	High
Estimated Time Needed	2 Minutes
Dependency	Player must be in the Karakoncolos Scene.
Setup	Karakoncolos Scene should be prepared.
Procedure	[A01] Approach to table and collide with the trigger. [V01] Karakoncolos will spawn and come.
Cleanup	Exit

PM.BAE_.01

TC_ID	PM.BAE_.01
Purpose	Verifying that the Al Karısı agent encounter works properly.
Requirements	3.2.3
Priority	High
Estimated Time Needed	2 Minutes
Dependency	Player must be in the Al Karısı Scene.
Setup	Al Karısı Scene should be prepared.
Procedure	[A01] Walk inside the scene. [V01] Al Karısı will run and chase the player. [V02] After getting caught, Al Karısı will start attacking.
Cleanup	Exit

PM.BAE_.02

TC_ID	PM.BAE_.02
Purpose	Verifying that the Karakoncolos agent encounter works properly.
Requirements	3.2.3
Priority	High
Estimated Time Needed	3 Minutes
Dependency	Player must be in the Karakoncolos Scene.
Setup	Karakoncolos Scene should be prepared.
Procedure	[A01] Collide with the trigger [V01] Karakoncolos will start asking questions. [V02] After four questions, scene will change.
Cleanup	Exit

7.5. Traceability Matrix

| Test Case ID | Requirement | | | | | | | | | | |
| | GUI | | | SP | PLAY MODE (PM) | | | | | | |
	Play	Settings	Exit	Survey Phase	Basic Control Mechanics	Play Pause Operation	Move in Environment	Object Interactions	NPC Interactions	Trigger Interactions	Believable Agent Encounters
GUI.P_BTN.01	X										
GUI.S_BTN.02		X									
GUI.E_BTN			X								
GUI.S_SLD		X									
GUI.R_BTN			X								
SP_.01				X							
SP_.02				X							
PM.BCM_.01					X						
PM.BCM_.02					X						
PM.BCM_.03					X						
PM.PP_.01						X					
PM.ME_.01							X				
PM.ME_.02							X				
PM.ME_.03							X				
PM.ME_.04							X				
PM.ME_.05							X				
PM.ME_.06							X				
PM.ME_.07							X				
PM.OI_.01								X			
PM.OI_.02								X			
PM.OI_.03								X			
PM.OI_.04								X			
PM.NI_.01									X		
PM.NI_.02									X		
PM.NI_.03									X		
PM.TI_.01										X	
PM.TI_.02										X	
PM.TI_.03										X	
PM.TI_.04										X	
PM.TI_.05										X	
PM.TI_.06										X	
PM.TI_.07										X	
PM.TI_.08										X	
PM.TI_.09										X	
PM.TI_.10										X	
PM.TI_.11										X	
PM.BAE_.01											X
PM.BAE_.02											X

Figure 16: Traceability Matrix

The traceability matrix in Table 1 includes all proposed requirements with test cases. Each test case has a relation with some requirement. This traceability matrix is used to check all test cases whether they are covered and none of the functional requirements is missing during the implementation.

7.6. Test Results

7.6.1. Individual Test Results

Table 6: Test Results

TC ID	Priority	Date Run	Run by	Result	Explanation
GUI.P_BTN.01	H	02.06.2019	Utku Mert Değirmenci	Pass	Play button and new game button selected, game started.
GUI.S_BTN.01	M	02.06.2019	Hasan Saygın Dikbayır	Pass	Settings button worked properly.
GUI.E_BTN.01	L	02.06.2019	Hasan Saygın Dikbayır	Pass	Exit button worked properly.
GUI.S_SLD.01	L	02.06.2019	Utku Mert Değirmenci	Pass	Volume Slider worked properly.
GUI.R_BTN.01	M	02.06.2019	Utku Mert Değirmenci	Pass	Main Menu Displayed.

TC ID	Priority	Date Run	Run by	Result	Explanation
SP_.01	H	02.06.2019	Oğulcan Merdivanlı	Pass	Phobia Toggle buttons worked properly.
SP_.02	H	02.06.2019	Oğulcan Merdivanlı	Pass	Game started.

TC ID	Priority	Date Run	Run by	Result	Explanation
PM.BCM_.01	H	02.06.2019	Oğulcan Merdivanlı	Pass	Player movement worked properly.
PM.BCM_.02	H	02.06.2019	Oğulcan Merdivanlı	Pass	Camera movement worked properly.
PM.BCM_.03	M	02.06.2019	Hasan Saygın Dikbayır	Pass	Player movement worked properly.
PM.PP_.01	L	02.06.2019	Utku Mert Değirmenci	Fail	Pause bug fix will be complete in next release.
PM.ME_.01	H	02.06.2019	Hasan Saygın Dikbayır	Pass	Player movement works properly outside the secret room.
PM.ME_.02	H	02.06.2019	Utku Mert Değirmenci	Pass	Secret room discovered.
PM.ME_.03	L	02.06.2019	Oğulcan Merdivanlı	Pass	Player movement works properly in desired path.
PM.ME_.04	L	02.06.2019	Hasan Saygın Dikbayır	Pass	Player movement works properly.
PM.ME_.05	H	02.06.2019	Utku Mert Değirmenci	Pass	Player movement works properly.

PM.ME_.06	M	02.06.2019	Oğulcan Merdivanlı	Pass	Player movement worked properly.
PM.ME_.07	H	02.06.2019	Hasan Saygın Dikbayır	Pass	Player movement worked properly.
PM.OI_.01	H	02.06.2019	Utku Mert Değirmenci	Pass	Village doors knocked and knocking animations worked.
PM.OI_.02	M	02.06.2019	Oğulcan Merdivanlı	Pass	Well inside the village interacted, and cutscene activeted.
PM.OI_.03	H	02.06.2019	Hasan Saygın Dikbayır	Pass	Note papers collected properly.
PM.OI_.04	H	02.06.2019	Utku Mert Değirmenci	Pass	Vase picked up and broke by the player.
PM.NI_.01	H	02.06.2019	Oğulcan Merdivanlı	Pass	Statues in the exhibition areas interacted.
PM.NI_.02	L	02.06.2019	Oğulcan Merdivanlı	Pass	Narrator animation worked properly.
PM.NI_.03	H	02.06.2019	Oğulcan Merdivanlı	Pass	Karakoncolos interacted.
PM.TI_.01	H	02.06.2019	Hasan Saygın Dikbayır	Pass	Canvas activated.
PM.TI_.02	H	02.06.2019	Hasan Saygın Dikbayır	Pass	Secret dodor activated after all exhibitions

PM.TI_.03	M	02.06.2019	Hasan Saygın Dikbayır	Pass	Camera faded.
PM.TI_.04	H	02.06.2019	Oğulcan Merdivanlı	Pass	Scene transitions worked.
PM.TI_.05	H	02.06.2019	Hasan Saygın Dikbayır	Pass	Scene transitions worked.
PM.TI_.06	M	02.06.2019	Utku Mert Değirmenci	Pass	Jumpscare cutscene activated.
PM.TI_.07	H	02.06.2019	Oğulcan Merdivanlı	Pass	Scene transitions worked.
PM.TI_.08	H	02.06.2019	Hasan Saygın Dikbayır	Pass	Scene transitions worked.
PM.TI_.09	M	02.06.2019	Utku Mert Değirmenci	Pass	Jumpscare cutscene activated.
PM.TI_.010	H	02.06.2019	Oğulcan Merdivanlı	Pass	Scene transitions worked.
PM.TI_.011	H	02.06.2019	Hasan Saygın Dikbayır	Pass	Canvas activated.
PM.BAE_.01	H	02.06.2019	Utku Mert Değirmenci	Pass	"Al karısı "agent worked properly.
PM.BAE_.02	H	02.06.2019	Utku Mert Değirmenci	Pass	"Karakoncolos "agent worked properly.

7.7. Summary of Test Results

Table 7: Summary

Priority	Number of TCs	Executed	Passed
H	25	25	25
M	8	8	8
L	6	6	5
Total	**38**	**38**	**37**

We have executed 38 test cases and 38 test cases are passed. Also, 38 of high and all of the medium priority test cases are passed. Exit criteria is met.

8. EXIT CRITERIA

We have executed all test cases and 97.36% of test cases are passed. Also, 100% of high and medium priority test cases are passed. Software development activities are completed within the anticipated cost. Software development activities are completed within the anticipated timeline. Exit criteria is met.

Table 8: Exit Criteria

Criteria	Met or Not
100% of the test cases are executed	M
95% of the test cases passed	M
95% of High and Medium Priority test cases passed	M
No high priority or severe bugs are left outstanding.	M
Verify if software development activities are completed within the projected cost.	M
Verify if software development activities are completed within the projected timelines.	M

8.1. Known Problems

In game pause menu is not working in couple scenes, in the next version of the game this bug will be fixed. Bug fix could not fixed in time.

8.2. Conclusion

This section includes the test results of the project "Museum Corvus: Digital Storytelling on a Virtual Heritage Museum with Believable Agents". The test cases are implemented and 97.36% of the test cases are completed successfully. Software development activities are completed within the planned time period. Current stage of the project is available to use. Failed test cases will be solved in time in order to increase the quality of the gameplay.

CONCLUSION

The project titled as "Digital Storytelling on a Virtual Heritage Museum with Believable Agents" is explained in detail. At the end of the project, a virtual museum, in which a story based on the Turkish horror culture is committed, will be revealed. Our aim is to advertise Turkish culture, and by using believable agent concept is to provide realism.

This project aims to design a virtual museum based on elements of Turkish horror culture by using virtual reality, believable agents and storytelling techniques. The aim is to provide a solution to the problems of computer engineering, with the help of storytelling approaches to be a reminder to the forgotten Turkish horror culture. Virtual reality addresses a wide area and this field is continuously gaining popularity (Okita, 2004). With the addition of many innovations and creativity elements, it can easily reach the masses that it cannot reach before. Virtual museums support the development of virtual reality (Ö. Türk, 2016); It includes many new technology elements and unique experiences. It is possible to observe many concepts in culture, technology and simulation studies in virtual museums. The concept of realism is very important in reflecting the culture (White, 2018); Therefore, in our project, a form of artificial intelligence called "believable agents" is used. In this way, the culture introduced to people will be transferred more efficiently. While our project offers a unique experience, it offers a more efficient way of transferring our forgotten culture. We do not only want to use this virtual museum project, but also with to provide an framework for future virtual museum projects.

First and foremost, we have made a comprehensive literature research. Throughout our research on literature we have seen that there were not similar projects based on specific aspects that we mentioned in this document. Projects that far similar were mostly replicas of actual museums implemented in a virtual world.

After the literature research has done, we discussed and specified the requirements of the project. According to requirements, software requirements specification (SRS) has prepared. Then, software software design document (SDD) has prepared, and the design of the project has explained in the SDD.

The project will be developed with Unity3D as a VR game. Therefore, the project will provide effective visual for the users, and users can be able to have an immersive experience of the living environment in the game. At the end of the game, it is aimed to improve our heritage awareness of Turkish horror culture.

ACKNOWLEDGEMENTS

REFERENCES

[1] COMOS, International Cultural Tourism Charter. Principles and Guidelines for Managing Tourism at Places of Cultural and Heritage Significance. ICOMOS International Cultural Tourism Committee, 2002.

[2] John Feather, "Managing the documentary heritage: issues for the present and future", In: (Gorman, G.E. and Sydney J. Shep [eds.]), Preservation management for libraries, archives and museums. pp. 1-18, London 2006.

[3] Simon Thurley, "Into the future. Our strategy for 2005-2010". In: Conservation Bulletin [English Heritage], pp. 49, 2005.

[4] Prof Dr. Özkul Çolakoğlu, Türk Halk Kültüründe Memoratlar ve Halk İnançları, Akçağ Yayınevi, Ankara 2003.

[5] Pertev Naili Boratav, 100 Soruda Türk Folklörü (İnanışlar Töreler ve Törenler,Oyunlar), Bilgesu Yayınevi, 2013.

[6] Robert J. Stone, "Virtual reality and cyberspace: From science fiction to science fact", pp. 283-300, 1991.

[7] Charles Oppenheim, "Virtual reality and the virtual library", pp. 215-227, 1993.

[8] S. Serap Kurbanoğlu, "Virtual Reality: Is It Real Or Not?" , Türk Kütüphaneciliği, 1996.

[9] Erkan Bayraktar, Fatih Kaleli, "Virtual Reality on Commercial Applications", Dumlupınar Üniversitesi, Kütahya, 31 Ocak-2 Şubat, 2007.

[10] George Lepouras & Costas Vassilakis, "Virtual Museums for all: Employing Game Technology for Edutainment", Department of Computer Science and Technology University of Peloponnisos, 21 February 2017.

[11] Rafaá Wojciechowski, Krzysztof Walczak, Martin White, Wojciech Cellary, "Building Virtual and Augmented Reality Museum Exhibitions", Department of Information Technology, The Pozn Center for the Study of Language and Information Stanford University, Stanford, California 94305, Conference Paper January 2007.

[12] VIRTUAL DIG EXPERIENCE [Online]. Available at: http://www.hitl.washington.edu/people/rmay/SAM/SAM.html [Accessed 02.10.2018]

[13] 3D MURALE. [Online]. Available at: http://www.brunel.ac.uk/project/murale/home.html [Accessed 02.10.2018]

[14] WoofbertVR Available at: http://blvrd.com/experiences/ [Accessed 03.10.2018]

[15] Nadezhda Povroznik, "Virtual Museums and Cultural Heritage: Challenges and Solutions", Center for Digital Humanities, Perm State National Research University, Perm, Russia.

[16] Charles White, "Virtual Heritage: Knowledge Management in VR", "Virtual and Augmented Reality for Space Science and Exploration" symposium, Keck Institute , January 30, 2018.

[17] [Agents 1997] "Proceedings of the First International Conference on Autonomous Agents", ACM Press, Marina del Rey, CA, 1997.

[18] Woody Bledsoe, "I had a dream: AAAI presidential address", AI Magazine, pp. 57-61, 1986.

[19] A. Bryan Loyall, "Believable Agents: Building Interactive Personalities", Carnegie Mellon University, Department of Computer Science, pp. 97-123, May 1997.

[20] Dongkyu Choi, Tolga Konik, Negin Nejati, Chunki Park, and Pat Langley, "A Believable Agent for First-Person Shooter Games", Computational Learning Laboratory Center for the Study of Language and Information Stanford University, Stanford, California 94305, Conference Paper January 2007.

[21] Iskander Umarov, "Building a Believable Agent for a 3D Boxing Simulation Game" Maxim Mozgovoy University of Aizu Aizu-Wakamatsu, Japan, TruSoft Inc. St. Petersburg, Florida, USA, Article, January 2010.

[22] Guy Taylor, Lin Padgham and Ghassan Al-Qaimari, "An Intelligent Believable Agent Environment", Department of Computer Science RMIT University, Melbourne, Australia, Article, December 1996.

[23] Felix D. Schönbrodt1 and Jens B. Asendorpf, "The Challenge of Constructing Psychologically Believable Agents", Department of Psychology, LMU, Munich, Germany, Humboldt University, Berlin, Germany, Article in Journal of Media Psychology Theories Methods and Applications, January 2011. [24] Yard. Doç. Dr. Ayşe Duvarcı, "Türklerde Tabiat Üstü Varlıklar ve Bunlarla İlgili Kabuller, İnanmalar, Uygulamalar", Ahmet Yesevi Üniversitesi Mütevelli Heyet Başkanlığı, sayı 32, sayfa no. 125-144, bilig Kış / 2005.

[25] Fuzuli Bayat, Türk Mitolojik Sistemi - 2, Ötüken Neşriyat , 2007

[26] The Editors of Encyclopaedia Britannica "Virtual museum", Avaliable at: https://www.britannica.com/topic/virtual-museum [Accessed 14.10.2018]

[27] Joseph Bates and A.Bryan Loyall, "The Role of Emotion in Believable Agents", April 1994.

[28] N. Mourkoussis, M. White, M. Patel, J. Chmielewski and K. Walzack, "AMS – Metadata for Cultural Exhibitions using Virtual Reality", Proceedings of Dublin Core Conference (DC2003), Seattle, Washington, USA, 2003.

[29] M. White, M. Patel, K. Walzack and P. Sayd, "Digitisation to Presentation - Building Virtual Museum Exhibitions", Proceedings of International Conference on Vision, Video and Graphics, Bath, UK, Editor: Peter Hall and Phil Willis, July 2003.

[30] P. S. Green, J. H. Hill and R. M. Satava, Telepresence: dextrous procedures in a virtual operating field. (Abstr). Surg. Endosc. 57, 192 (1991).

[31] MUSTAFA HUSSEIN, CARL NÄTTERDAL "The Benefits of Virtual Reality in Education A Comparison Study Bachelor of Science Thesis in Software Engineering and Management" Department of Computer Science and Engineering CHALMERS UNIVERSITY OF TECHNOLOGY UNIVERSITY OF GOTHENBURG Göteborg, Sweden, June 2015.

[32] B. Arnaldi, P. Guitton, G. Moreau "Virtual Reality and Augmented Reality: Myths and Realities", John Wiley & Sons Inc. 111 River Street, Hoboken, NJ 07030, USA, 2018.

[33] Sylaiou, S., Liarokapis, F., Sechidis, L., Patias, P. and Georgoula, O. "Virtual Museums: First Results of a Survey on Methods and Tools". In: XXth International Symposium (the ICOMOS & ISPRS Committee on Documentation of Cultural Heritage), the CIPA International Archives for Documentation of Cultural Heritage,. CIPA, Torino, Italy, pp. 1138-1143. ISBN 1682-1777,2005.

[34] Mase K., Kadobayashi R. and R. Nakatsu," Meta-Museum: A Supportive Augmented-Reality Environment for Knowledge Sharing". In: Proceedings of International Conference on Virtual Systems and Multimedia'96 in Gifu (VSMM'96), pp. 107-110. 1996

[35] White M., Mourkoussis N., Darcy J., Petridis P., Liarokapis F., Lister P.F., Walczak K., Wojciechowski R., Cellary W., Chmielewski J., Stawniak M., Wiza W., Patel M., Stevenson J., Manley, J., Giorgini F., Sayd P. and F. Gaspard, 2004. ARCO— An Architecture for Digitization, Management and Presentation of Virtual Exhibitions. In: IEEE Proceedings 22nd International Conference on Computer Graphics, Hersonissos, Crete, June 16- 19, pp. 622-625.

[36] Brian Mac Namee "A Proposal for an Agent Architecture for Proactive Persistent Non Player Characters", Pádraig Cunningham Department of Computer Science, Trinity College, Dublin 2, Ireland.

[37] A. Aydemir, International Periodical For The Languages, Literature and History of Turkish or Turkic Volume 8/6 Spring 2013, p. 61-67, ANKARA-TURKEY

[38] H. R. Gürpınar, "Gulyabani", 2014-03-28.

[39] Prof. Dr. M. Öcal, Emine AYDOĞAN, "ANADOLU SAHASI TÜRK HALK HİKÂYELERİNDE MİTOLOJİK UNSURLAR", OĞUZ GAZİ ÜNİVERSİTESİ SOSYAL BİLİMLER ENSTİTÜSÜ, TÜRK HALKBİLİMİ ANABİLİM DALI, 2006

[40] Giovanni Scognamillo, "Bir Levanten Şövalye ", İş Bankası Yayınları, 2008

[41] Prof. Dr. Esma ŞİMŞEK, TÜRK KÜLTÜRÜNDE "ALKARISI" İNANCI VE BU İNANCA BAĞLI OLARAK ANLATILAN EFSANELERİ, 07. 04. 2017.

[42] Bahar Arapkirli, Religion Takes Over: A Retrospective Analysis of Turkish Horror Genre, Simon Fraser University, October 22, 2017.

[43] Richard M. Satava, "Artificial Intelligence in Medicine",Volume 6, Issue 4, August 1994, Pages 281-288

[44] Ni Tao, Zhao DingXuan, Hironao Yamada, Ni Shui, "A Low-Cost Solution For Excavator Simulation With Realistic Visual Effect", IEEE Conference on Robotics, Automation and Mechatronics, 21-24 Sept. 2008

[45] Jiang Li1, Yiying Tong, Yong Wang, Heung-Yeung Shum, Ya-Qin Zhang, "IMAGE-BASED WALKTHROUGH OVER THE INTERNET", Microsoft Research, China, Dept. of Computer Science and Engineering, Zhejiang Univ. Dept. of Electrical Engineering and Applied Electronic Technology, Tsinghua Univ.

[46] Juno Rae, Lizzie Edwards,"Virtual reality at the British Museum: What is the value of virtual reality environments for learning by children and young people, schools, and families", British Museum, UK,The British Museum, England, The annual conference of Museums and the Web, April 6-9, 2016, Los Angeles, CA, USA.

[47] Si, Chen "Believable exploration : investigating human exploration behavior to inform the design of believable agents in video games", Thesis, 2017.

[48] Mathieu Bourgais, Patrick Taillandier, Laurent Vercouter, International Workshop on Multi-Agent Systems and Agent-Based Simulation: Multi-Agent Based Simulation XVIII pp 89-104 | Cite as "Enhancing the Behavior of Agents in Social Simulations with Emotions and Social Relations", 13 May 2018.

[49] Pat Langley, Progress and Challenges in Research on Cognitive Architectures Institute for the Study of Learning and Expertise 2164 Staunton Court, Palo Alto, CA 94306, 2017.

[50] Claude Draude, Computing Bodies "Realizing the Agent Interface", pp. 105-182, 14 June 2017.

APPENDIX A: COMPILATION & INSTALLATION GUIDE

Introduction

This document is the installation and compilation document for the project titled as "Digital Storytelling on a Virtual Heritage Museum with Believable Agents". This project aims to assist people that are curious about the Turkish horror culture by helping them learning our culture with the advantages of virtual reality.

Digital Storytelling on a Virtual Heritage Museum with Believable Agents project is developed using Unity 3D Game Engine and Oculus Integration tool for virtual reality support. Language that is used for coding is C#. This project is developed to run on Windows computer devices.

Purpose

Purpose of this document is to explain how to install and compile the project called Digital Storytelling on a Virtual Heritage Museum with Believable Agents. Required tools and conditions are explained in detail.

Compilation

Prerequisites / Tools

There are some prerequisites to install and run the project on a computer. Project is developed on platform Unity.

- Unity 2018.3.0f2 should be installed on the computer to run and compile the project.

Other versions of Unity can cause some problems, since the project is developed with the features of 2018.3.0f2.

- Since the project will run on Virtual Reality devices(in our case Oculus DK2), Oculus SDK for Unity should be installed in order to create a executable file from Unity.

Downloading the Project

Final version of the project is available at the link:

https://github.com/CankayaUniversity/ceng-407-408-Digital-storytelling-on-a-virtual-heritage-museum-with-believable-agents

It can be downloaded as a *.zip* file. Extract the files from *.zip* folder.

Opening the Project in Unity

• Open Unity.

• When Unity is opened, at home page click *Open* and then choose the *museumcorvus* folder from the downloaded project folder.

• After the project is set and opened in Unity, from Assets folder, as seen in Figure 1,

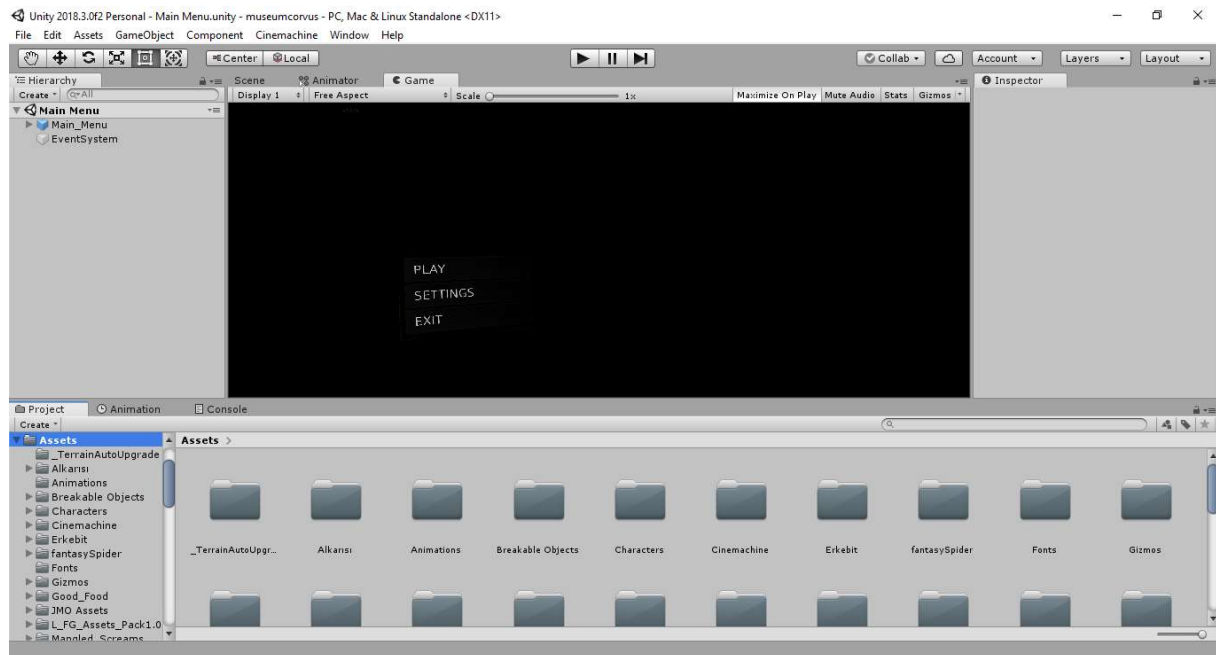choose *Main Menu* scene to start using the program from the beginning.

Figure 17 Project on Unity

After the Main Menu scene is chosen, press the Play button from the top. Then, program is built and run.

Creating .exe File for Windows Computer Devices

System is run on Windows computer devices; therefore, to transfer the project into Windows computer devices, .exe file should be created. "OpenVR", "OculusDK2 SDK" should be installed in the computer to create the .exe file from Unity.
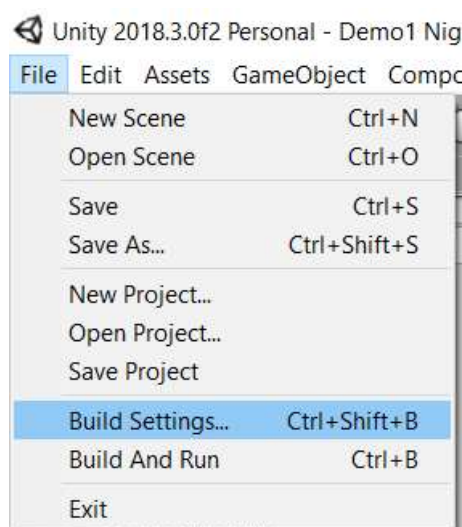
- Choose File -> Build Settings

Figure 18 Creating .exe file

- Connect your Virtual Reality Device to the computer.

- All the scenes in *Scenes In Build* panel must be checked and ordered as seen in the Figure 19.
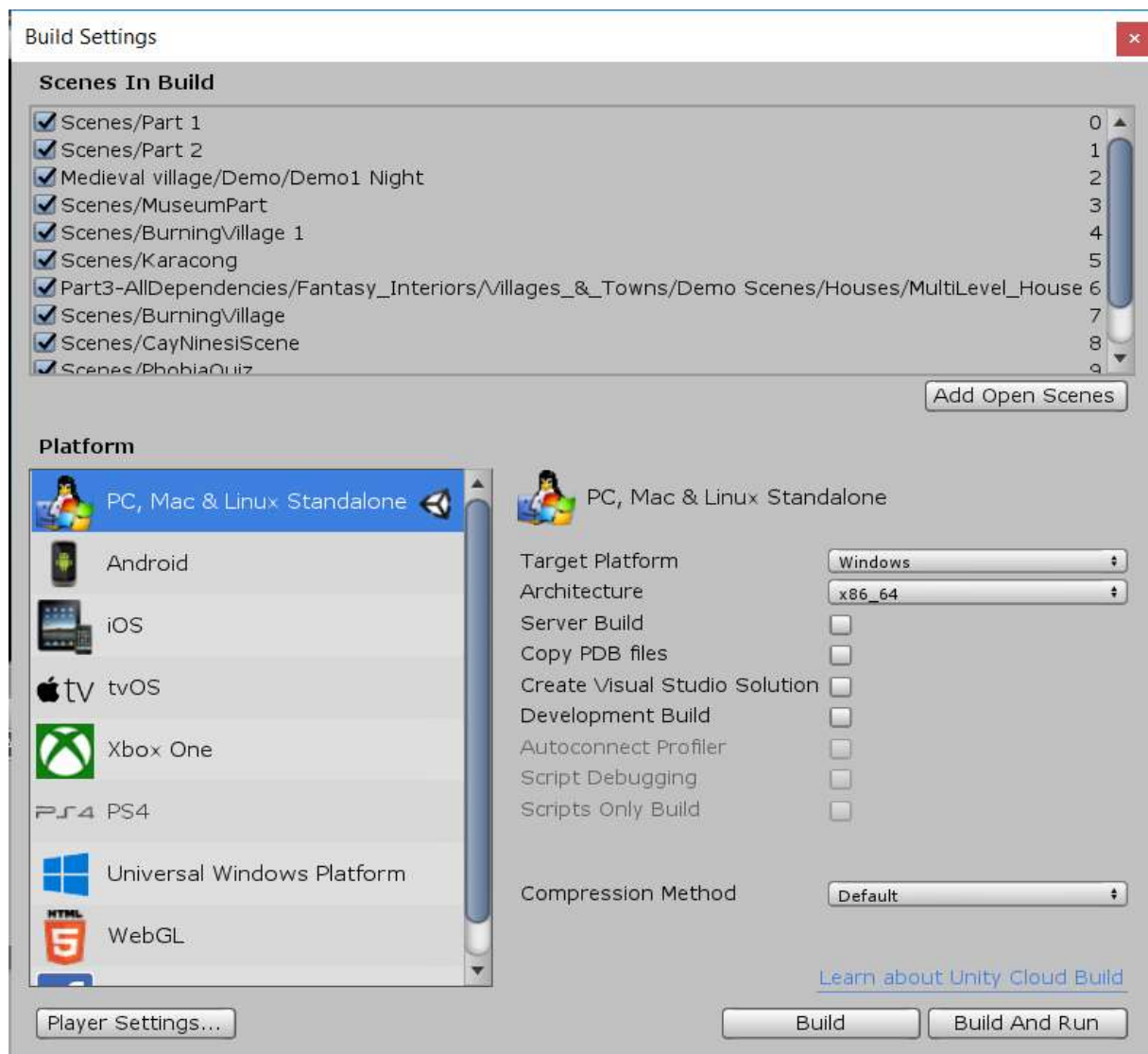
Figure 19 Build Settings

- From *Player Settings* panel-> *XR Settings* choose and press *Virtual Reality Supported* checkbox. Make sure that the required SDKs are added.
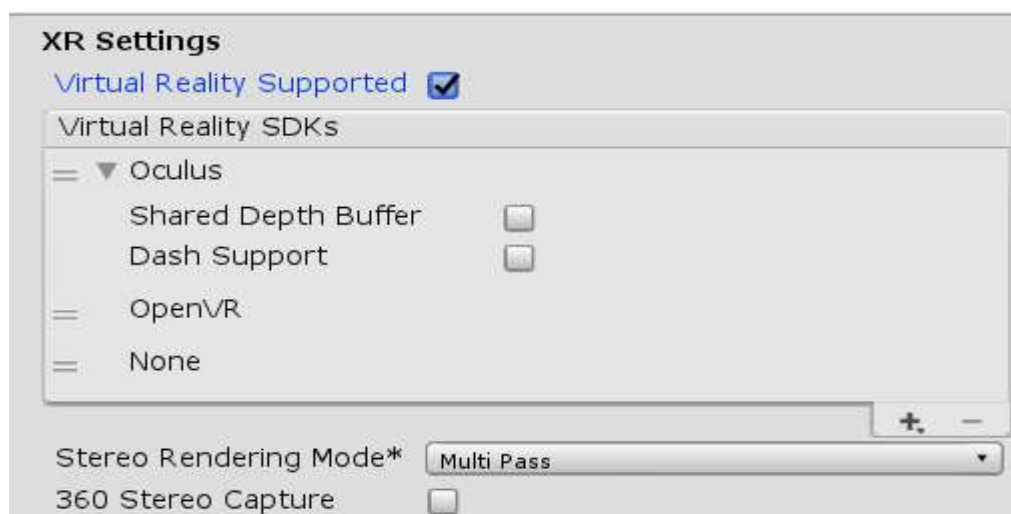
Figure 20 XR Settings

- After switch operation is completed, press *Build and Run* button.
- In the opening window, enter name of the *.exe* file.

APPENDIX B: USER MANUAL

About This Document

Intended Audience

This document is intended to be used by developers, testers and all other players. This document will be used together with the Digital Storytelling on a Virtual Heritage Museum with Believable Agents in order to guide the players about the game.

Additional Digital Storytelling on a Virtual Heritage Museum with Believable Agents Documents

- For detailed information about the requirements of the system, see Digital Storytelling on a Virtual Heritage Museum with Believable Agents Software Requirements Specification (SRS).
- For detailed information about the design of the system, see Digital Storytelling on a Virtual Heritage Museum with Believable Agents Software Design Document (SDD).

All of these documents are available at: https://github.com/CankayaUniversity/ceng-407-408-Digital-storytelling-on-a-virtual-heritage-museum-with-believable-agents/wiki

System Requirements

For HTC Vive;
- GPU: Nvidia GeForce GTX 970, AMD Radeon R9 290 equivalent or better.
- CPU: Intel i5-4590, AMD FX 8350 equivalent or better. RAM: 4 GB or more.
- Video Output: HDMI 1.4, DisplayPort 1.2 or newer. USB Port: 1x USB 2.0 or better port.
- Operating System: Windows 7 SP1, Windows 8.1 or later, Windows 10.

For Oculus;
- GPU: Nvidia GeForce GTX 1070, AMD Radeon RX 580 equivalent or better.
- CPU: Intel i5-6700, AMD First generation Rizen5 equivalent or better. RAM: 8 GB or more.
- Video Output: HDMI 1.4, DisplayPort 1.2 or newer. USB Port: 1x USB 2.0 or better port.
- Operating System: Windows 10.

Overview of the Product

Digital Storytelling on a Virtual Heritage Museum with Believable Agents is an virtual reality game that assists people to learn more easily about the turkish horror culture and it's riches. This is a game that uses virtual reality to increase the immersion in order to provide effective and efficient learning process.

Using the Digital Storytelling on a Virtual Heritage Museum with Believable Agents

Screens of the Project

Main Menu
The first scene that comes upon starting the game is the "Main Menu Scene". This scene ables players to make changes about the game and start the game.

Figure 21 Main Menu

- Play Button : Play Button ables to start the game.
- Settings Button : Settings Button ables to reach the Settings Menu.
- Exit Button : Exit Button closes the game.

Settings Menu
When settings button is pressed Settings Menu appears. Player can change the properties of game.
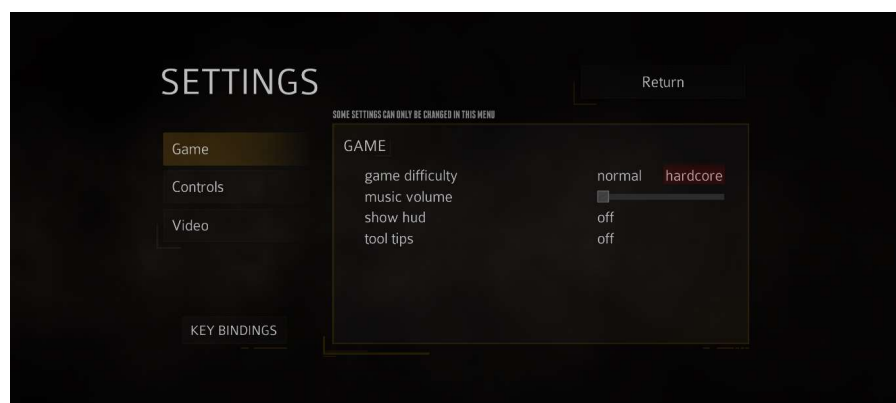
Figure 22 Main Menu

- Game Settings: Game Settings ables to change music volume.
- Control Settings: Control Settings ables to adjust mouse controls.
- Video Settings: Video Settings ables to adjust Screen Properties.

Survey Phase

After the new game button pressed survey screen appears. Player should choose between the phobias given in the survey to change gameplay.
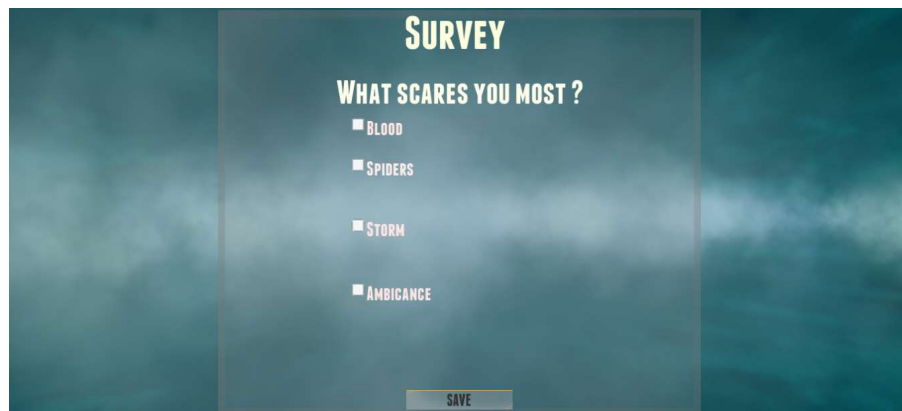

Figure 23 Survey Phase

*Each toggle button responds to a phobia and selecting activates them in the game.

Gameplay

Movement:

Movement in the game is provided with;
- "W Key" for forward direction.
- "A Key" for left direction.
- "S Key" for backward direction.
- "D Key" for right direction.

*In computer build, camera movement is provided from the mouse movements. In VR build, camera movement is provided from the VR headset movements.

Interaction:

Interactions in the game are provided with;
- "F Key" for to take action.
- "Left Mouse Click" for lifting an object.

*In computer build, all toggle buttons in the survey phase are interactable with "Left Mouse Button" click. In VR build, toggle buttons are navigated using the "Up" and "Down" Arrow Keys and "Enter Key" to toggle the option and also save the settings.

APPENDIX C: JIRA REPORTS

During the development of the project, we used Atlassian JIRA for the managemental issues and to keep track of our progress. JIRA helped us to see how efficient and effective we were during our sprints in both development and the documentation phases of our final project.
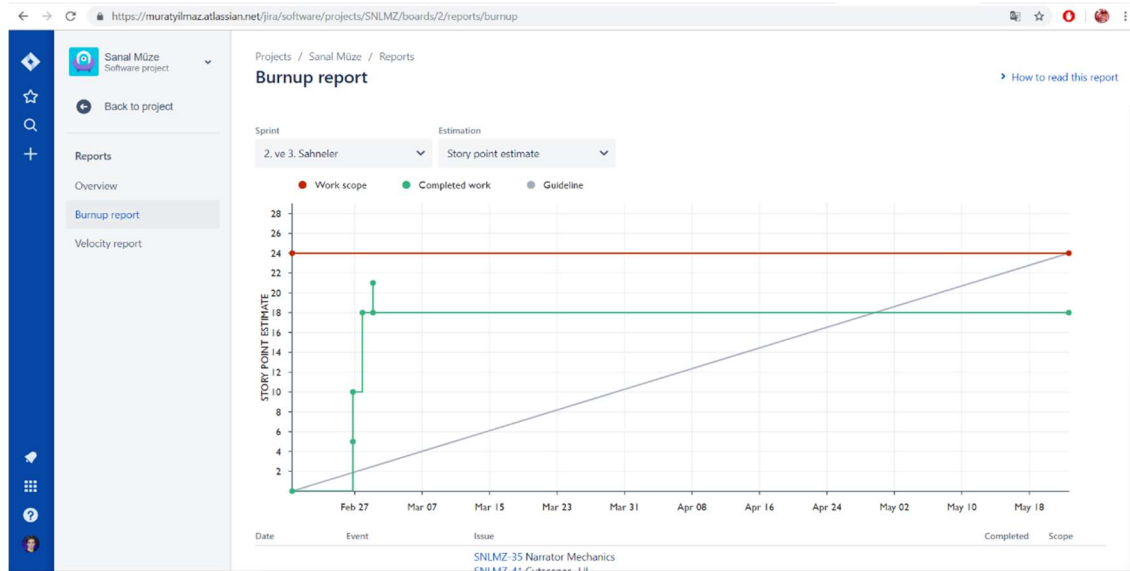

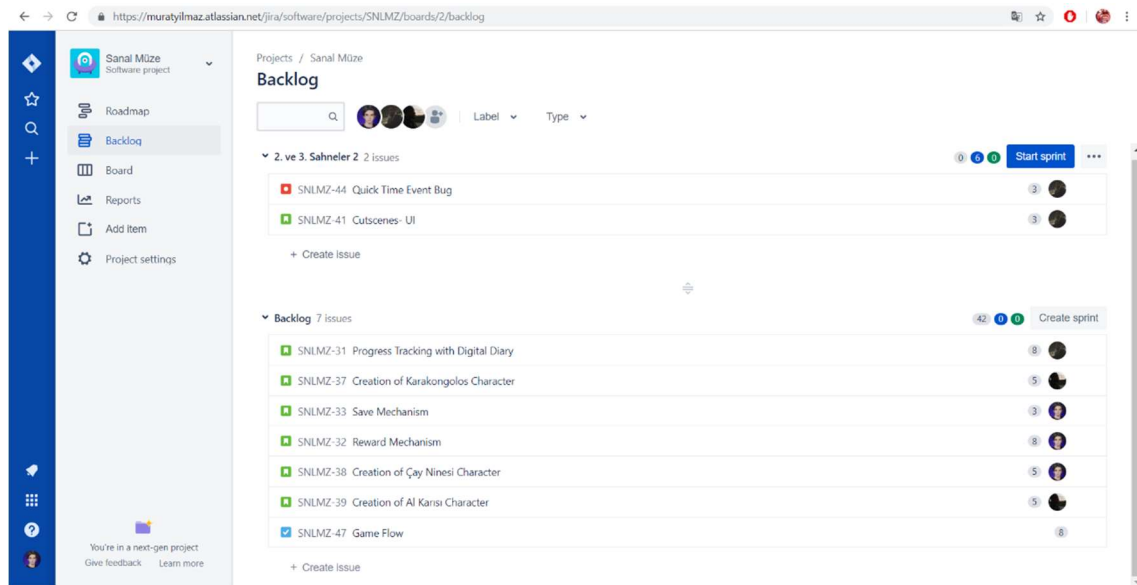*Figure 24 Jira-1*
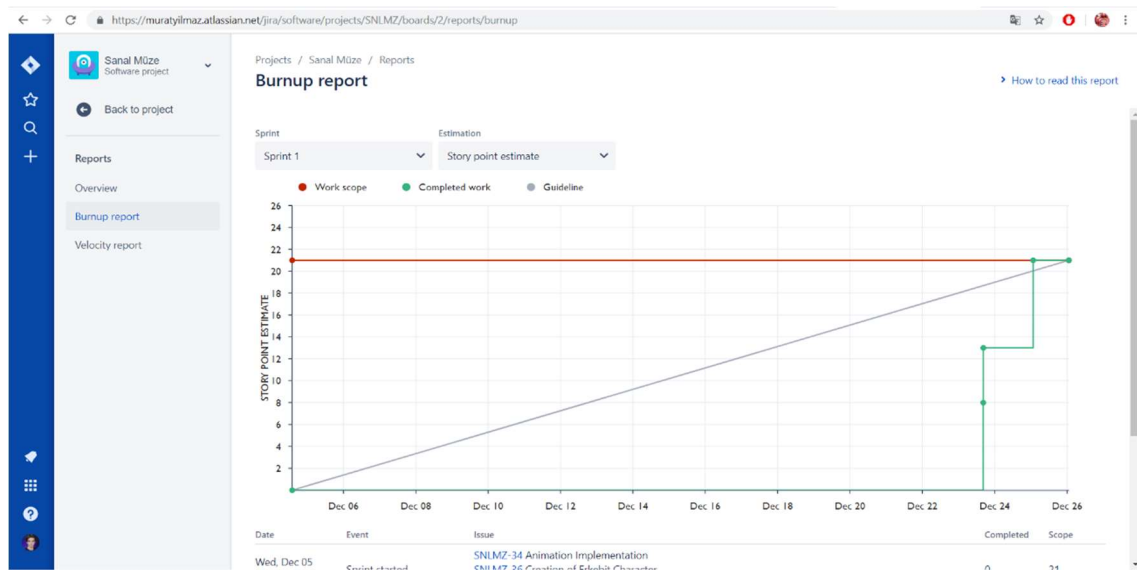

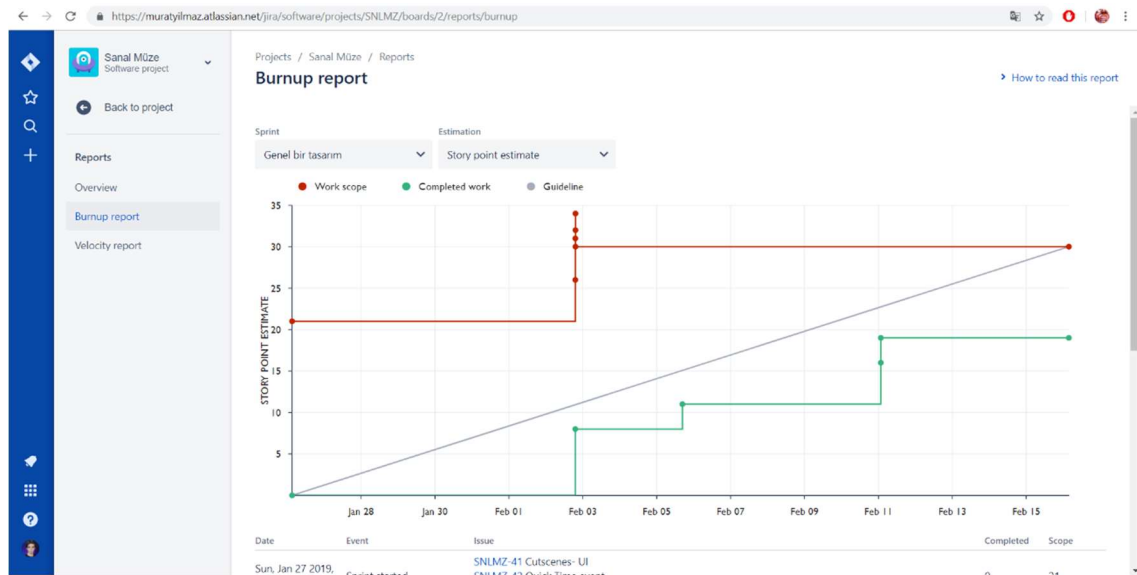*Figure 25 Jira-2*

Figure 26 Jira-3

Figure 27 Jira-4

Figure 28 Jira-5