

Universiti Teknologi MARA

Endangered Ecosystem Awareness Game:

Save The World

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**Thesis submitted in fulfilment of the requirements for
Bachelor of Computer Science (Hons.) Multimedia Computing
Faculty of Computer and Mathematical Sciences**

February 2021

SUPERVISOR APPROVAL

ENDANGERED ECOSYSTEM AWARENESS GAME: SAVE THE WORLD

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This thesis was prepared under the supervision of the project supervisor, Muhammad Hamiz bin Mohd Radzi. It was submitted to the Faculty of Computer and Mathematical Sciences and was accepted in partial fulfilment of the requirements for the degree of Bachelor of Computer Science (Hons.) of Multimedia Computing.

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STUDENT DECLARATION

I certify that this thesis and the project to which it refers is the product of my own work and that any idea or quotation from the work of other people, published or otherwise are fully acknowledged in accordance with the standard referring practices of the discipline.

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ACKNOWLEDGEMENT

Because of His Almighty and His utmost blessings, Alhamdulillah, praise and gratitude to Allah, I was able to finish my research within the specified time frame. First of all, my special thanks to my boss, Muhammad Hamiz bin Mohd Radzi, and my lecturers at the CSP, Dr. Azlan bin Abdul Aziz and Dr. Nurul Hidayah Binti Mat Zain, for supporting me and offering invaluable assistance. In addition, they also never tire of helping to correct my mistake and directing me in the right direction to perfect this report during the production of this project study from the beginning until the end of the presentation.

My beloved parents also deserve special thanks for always encouraging me in the production of this project and helping me to complete this project research process.

Finally, I would like to personally thank my friends for helping me complete my report over the period, who are always available to help me solve the issues.

ABSTRACT

An ecosystem is a geographic environment where plants, animals, and other species work together to form a pattern of life, as well as the weather and landscape. The most valuable life resource is the environment or setting. The ecosystem is important because it consists of populations of organisms and non-living matter interacting together. Each part of the ecosystem is important because ecosystems are independent. Damaged or imbalanced ecosystems can cause many problems. In order to conserve the environment, people knowledge about the importance of keeping the ecosystem good is still insufficient. Besides that, the level of pollution in Malaysia is in a worrying state as the citizen do not aware of this situation. In this country, every day the environment is experiencing the variety types of pollution- from air, water, and noise pollution to seemingly endless waste, despite many educational and environmental awareness campaigns in various forms, reading materials, print and social media are handled by various responsible parties and this topic also been taught in the secondary school. The level of public awareness of the importance of the environment is still at a low and almost disappointing level. To raise an awareness, current technology like VR games can be used as an alternative way to raise the goal. VR may help user in applying the concept into real life environment. The methodology that have been choosen in the development process of this project is game development life cycle (GDLC). The developed application is used by the youngster to evaluate the enjoyment of the application under surveillance and guidance from the developer and EGameflow model is used to evaluate the enjoyment. A questionnaire was used to collect data on how they get knowledge when using the application. The expected results show that the application is user-friendly where each feature is easily accessible and used by the youth, and the navigation is not complex.

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CHAPTER 1

INTRODUCTION

This chapter provided a project summary. The layout of this chapter starts with a context analysis, the statement of problems and the goal. Also included here is variety and meaning. The purpose of writing this chapter is to assist the author so that according to the schedule the project can be handled and completed.

1.1 Background of Study

An ecosystem is a geographic area where all the living things, work together to form a pattern of life. The healthy ecosystem is the most important resource for a healthy life. It consists of power, water and oxygen from the environment. A healthy environment will prevent pollution and it is a large habitat for animals. Currently, gases and fumes made by cars and factories are very harmful as it will pollute the earth. For healthy living, a clean environment is fundamental. Pollution such as air pollution, water pollution, thermal pollution and noise pollution can be created by the bad climate (Kampa & Castanas, 2008). Water pollution can lead to cancer. For example, in China, there is a term called ‘cancer villages’ that refers to a village in which the rate of cancer is higher than the average level most probably caused by air pollution (Yong, 2014). Noise pollution is the sound present in the atmosphere that causes or may cause temporary or permanent harm to humans or animals for a period of time and often causes complete or partial hearing loss, rendering the person unhappy and being a handicap (Gupta, A. & Jain, K., 2018).

In the past few decades, conservation planning around the world has transformed from single-species management to multispecies planning and ecosystem-based management (Casazza, M. L., C. T. Overton, and T.-V. D. Bui 2016). Conservation

plans to preserve and recover endangered species often recognize that the causes such as habitat loss, fragmentation, or degradation are the primary causes that will risk the ecosystem (Wilcove et al. 1998, Venter et al. 2006). Consequently, special protections may be applied to endangered species habitats to promote sustainable populations, and restore the habitat as the importance for recovery (Kerr and Deguise 2004, Taylor et al. 2005). The initiatives of biological conservation succeed as it is not simply reliant on the collection of ecological information, but equally on public regarding to protection programs. For example, China has implemented a wide range of national policies to protect its natural ecosystems which are the nature reserve policy, the afforestation policy, and the zoning policy and these all play important roles in protecting natural ecosystems, although they can sometimes cause new problems (Cao, 2008) and lack of targets for healthy environmental outcomes (Bennet, 2008).

In Malaysia, the atmosphere experiences a range of types of pollution every day, from air, water and noise pollution to almost endless waste, despite multiple educational and environmental awareness initiatives in different ways, different responsible parties manage reading materials, print and social media. However, the purported effort was like falling to deaf ears, although millions of dollars were invested in the campaign. The level of public awareness of the importance of the environment is still at a low and almost disappointing level (Idrus, 2015). On the other hand, the awareness and sensitivity of the events that occur around us may be due to insecurity and lack of understanding of the relevance of the ecological system. Environmental education, which has been widely implemented among school students, whether formally or informally, has not reached its goals and demands new changes and approaches (Peter and Cheruto, 2013). In order to ensure that these problems will not continuously happen, one of the ways to raise the awareness is by using virtual reality (VR) as VR has been rapidly recognized and implemented in construction engineering education and training (CEET) in recent years due to its benefits of providing an engaging and immersive environment (Wang, Wu, and Chi, 2018). VR has been seen as an effective learning system capable of providing a better learning atmosphere to facilitate interactive, engaging and immersive activities (Kim, 2017). They also stated that by allowing simulated practices or activities that students can rarely encounter in a typical classroom setting, the VR-based environment can immerse learners in the activities.

The VR helps enrich and illuminate their learning experiences in this respect (Johnson & Levine, 2008). A study by Lau and Lee (2015) emphasized that educators should be more encouraged to design and build simulated virtual-based learning environments for students, such as game-like environments, in order to lead them in their learning process to more productive learning behaviors. Learners enjoy and actively engage in learning experiences while they play video games, according to Ang and Rao (2008). The authors have found that incorporating game components into learning (or instruction) facilitates the participation of learners in activities. Learners were conscious that in the game operation, learning material was embedded and they were also prepared to play games to learn. Thus, by incorporating it into educational game, to make VR more interesting is (Mario and Fransisco, 2013). Educational games can be an efficient learning tool that motivates children to engage in game-based learning (GBL) practices, according to a study by Habgood, Ainsworth, and Benford (2005). Additionally, Garris, Ahlers, and Driskell (2002) claimed that GBL requires an iterative user-game interaction game loop. Game experiences are closely related to the encouragement of children to continue to participate in game-play.

1.2 Problem Statement

The environment really makes the populations of organisms and non-living matter that interact together so important. As the ecosystem is interdependent, each part of the ecosystem is very important. There are many problems will happen caused by the damaged or imbalanced ecosystems. In order to conserve the environment, people should be more exposed to the environment issue but people concerned about the importance of keeping the ecosystem good is still insufficient (Bennett, Cramer, and Begossi, 2015).

The rising stresses of habitat loss, deforestation, over-exploitation, invasive species and climate change are currently in a troubling state (Isabelle, Emily, and Christopher, 2016).

Besides that, the level of pollution in Malaysia is in a worrying state as the citizen do not aware of this situation. The ecosystem experiences a number of types of pollution every day in this country, from air, water, and noise pollution to seemingly endless waste, despite many educational and environmental awareness initiatives in different ways, reading materials, printing and social media are managed by different responsible parties and this subject was also taught in secondary school. The level of public awareness of the importance of the environment is still at a low and almost disappointing level (Idrus, 2015). So, one of the ways is to develop VR games because it is clear that VR game should not only raise awareness of the complexity of consent, but also offer player's clear teaching or learning moments throughout (Laredo, Sandham, John and Lindsay, 2019).

1.3 Objectives

1. To design an educational VR game to learn about the endangered ecosystem in an interactive way.
2. To develop a game of endangered ecosystem by applying non-immersive virtual reality.
3. To evaluate the effectiveness of the application in the provision of user details.

1.4 Project Scope

The scope of this project was focusing on user who are interested in using this application, which focuses to form 4 students who take the Biology subject by applying non-immersive virtual reality based game. Virtual reality has become popular nowadays and has also gained a lot of worldwide appeal by introducing an immersive game based on virtual reality, people would be more attracted to use this technology at the same time to inform people about the endangered ecosystem.

In addition, the content of this project is taken from Biology Subject, Endangered Ecosystem, chapter 9 in the form 4 Biology textbook. So, by using this application, student will have alternative way to understand more about this chapter.

In the concept of virtual reality, this application was be created as the user explore the world at risk and the user solve a few tasks in order to know more about the ecosystem at risk. The user is set at one level of emissions, which is the first level of air pollution. The user needs to solve few tasks regarding the air pollution before moving on to the next level which is thermal pollution, followed by noise pollution and the final level is water pollution.

1.5 Significance

The significance of this project are:

1. It might help user to increase the awareness level of public about the importance of conserving the environment.
2. It can provide alternative medium to learn about the endangered ecosystem as in the syllabus of biology subject.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the details of information about endangered ecosystem and VR games were discussed. First on the detailed information about the ecosystem is discussed. Next the study discussed on the details about the VR and the game that has been developed. The third study discussed the evaluation of the VR games. Lastly, comparison with the existing application that are similar with the VR game.

2.1 Ecosystem

An ecosystem consists of, along with its physical environment, a population of species. Ecosystems can be different in size and can be terrestrial or aquatic. Biomes are a broad group of terrestrial ecosystems. The most valuable resource for life is the environment. It consists of environmental resources, oxygen, and water (Oliver et al., 2015). Higher biodiversity habitats tend to be more stable with higher resistance and the organisms that make them up, sustain and fulfill human lives that preserve biodiversity in the environment and generate ecosystem products such as seafood, forage, timber, biomass fuels, natural fibre, and many pharmaceuticals, industrial products, and their precursors (Gretchen, 1997). So, it is clearly stated that ecosystem services are the benefits obtained from the environment that increase human well-being (Kunz, de Torrez, Bauer, Lobova, & Fleming, 2011).

Ecosystems are a unit of organization that include the interactions of the ecological community with its non-living environment (Fath, 2019). Therefore, there are a lot of advantages by conserving the environment in a good state. The advantages include, ecosystems can be an energy transformers and nutrient processors (Salomon, 2008). Next, ecosystems are the source of a variety of services, including food, fresh water,

building materials, and medical and industrial products, as well as cultural and recreational services and the supporting and regulatory services that support other services (Schowalter, 2016). The definition of ecosystem function is promoted in conservation as a way of attributing importance to particular ecosystem processes for the benefit of humans, such as clean water, as a result of reforestation, and some have proposed that a healthy ecosystem is an addition to promoting important ecological functions, resists invasive species colonization, and has low disease possibilities, events (Hernandez & Yabsley, 2012). Besides that, a single ecosystem function may provide more than one service for example, the function “soil retention” may both maintain farmland and also prevent soil erosion (Bonin and Lal, 2012).

2.1.1 Type of ecosystem

An ecosystem is a series of interrelated populations of both living and non-living things. Although there are many species on land and in the world's oceans, those found only on land are terrestrial ecosystems. Although several classification systems have been established over time, six types of terrestrial habitats are now widely recognized, including taiga, tundra, deciduous forest, grasslands, tropical rain forests, and deserts (Arrington, 2014). The taiga is a forested ecosystem which covers a vast expanse of North America (Walter and William, 1985).

- The taiga or northern coniferous forest is a broad band round the northern hemisphere comprising a largely untapped forest and wildlife resource (Vierick, 1975).
- Tundra ecosystem is when there have net carbon dioxide, water, and energy exchange using micrometeorological methods due to the difficulty of performing these measurements in cold and remote regions during summer season (Uskirchen, Arte, Cott, & Dgar, 2012).
- The deciduous trees which lose their leaves seasonally is dominating the biome of a deciduous forest. Deciduous forests generally have two distinctive leaf types, namely shaded and sunlit leaves. Shaded leaves are commonly larger and thinner than sunlit leaves and it is well known that sunlit leaves, which develop

under high irradiances, are much less susceptible to photo inhibitory damage than shaded leaves (Sonobe & Wang, 2018).

- The next is grassland with grassland biomes that occur naturally worldwide, with an estimated 1.5 million square kilometers in North America alone, and the three are tall, mixed and short grass, each of which provides significant human services that provide almost complete ecological services (Abbey and John, 2016).
- Tropical rainforests are the tall, dense, multi-layered, broad-leaved evergreen forests that form the natural vegetation in those areas of the tropics where the climate is always hot and the dry season is brief or non-existent (Corlett and Primack, 2011). Tropical rainforests occur where the climate is warm and wet year-round, which limits their distribution to lowlands within tropical latitudes (T. Wang et al., 2018).
- Desert ecosystems are first and foremost defined and limited by deficiency of water, heat stress and limitations of food and nutrients resources are secondarily correlated (Holzapfel, 2008).

Aquatic ecosystems comprise the largest portion of the biosphere and include both freshwater and marine ecosystems (Wang and D'Odorico, 2013).

- Freshwater habitats are increasingly accumulating numbers of invasive water species such as lakes that can communicate with each other, thereby generating new food web links and altering existing ones (Schowalter, 2016).
- The environments that complete the larger structure from the coasts to the dark sea floor are known to be marine ecosystems. Marine ecosystems on continental shelves endure an increasing burden of human activity offshore, and the impacts on benthic habitats are not well known (Thaiënne, 2012).

2.1.2 Endangered ecosystem

There is a real loss of biodiversity. Biologists have alerted each other to the contemporary mass extinction of species in the world and most of the general public. Biodiversity decline at ecosystem level is less known, which occurs when distinct ecosystems, species declining, and natural processes are reduced or degraded in quality (Noss, Laroe, & Scott, 1995). In Malaysia, the awareness of endangered ecosystem is being taught in government school. Endangered ecosystem can be found in the syllabus learned by form 4 students in chapter 9 of Biology subject. This chapter covers three subchapters which are human activities that endanger the ecosystem as the 9.1 subchapter, the greenhouse effect and the thinning of the ozone layer as the 9.2 subchapter and the importance of proper management of development activities and the ecosystem as the last subchapter, 9.3.

Human activities which threaten the ecosystem includes development and industrialisation, increase in the number of motor vehicles, increase in the usage of pesticides and chemical fertilisers in the agriculture sectors, and uncontrolled deforestation and the impact of deforestation includes soil erosion, flash flood, landslide, eutrophication, various types of pollution, global warming, depletion or thinning of the ozone layer, climatic change and extinction of living things (Gan, 2013). Air pollution, water pollution, thermal pollution and noise pollution are the different forms of pollution covered in this chapter.

Air pollution has both acute and chronic effects on human health, affecting a number of different systems and organs. It ranges from minor upper respiratory irritation to chronic respiratory and heart disease, lung cancer, acute respiratory infections in children and chronic bronchitis in adults, aggravating pre-existing heart and lung disease, or asthmatic attacks. In addition, short- and long-term exposures have

also been linked with premature mortality and reduced life expectancy (Kampa & Castanas, 2008). Water pollution is defined as, ‘Any direct or indirect alteration of the physical, thermal, chemical, biological, radioactive properties of any part of the environment by, discharge, emission or deposit of wastes so as to affect any beneficial use adversely or to cause a condition, which is hazardous to public health, safety or welfare of animals, birds, wildlife, aquatic life or to plants of every description’ (Ferguson, van den Broek, & van Oostendorp, 2020). Thermal pollution can be dealt with in a way similar to that of pollutants, whereby the load consists of heat and the assimilation capacity depends on the accepted temperature increase of the receiving water body (Arjen, 2015). Noise pollution is the presence of intrusive and unnecessary sounds that can seriously influence human mental and physical health (T. Wang et al., 2018). The next subchapter is explaining about the greenhouse effect and the thinning of the ozone layer. A gas that absorbs and emits infrared radiation is called greenhouse gas. The primary greenhouse gases in the atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone while the atmospheric carbon dioxide (CO₂) is a nontoxic, colourless, odourless gas that also contributes in greenhouse effect (Easterbrook, 2016). The thinning of ozone layer explained that the ozone layer filters is decreasing out of UV radiation from the sun. Skin damage and lead to certain forms of cancer can be caused by this UV radiation (Daniel, 2014).

The last subchapter covers about the importance of proper management of development activities and the ecosystem. The measurements include the implementation of law such as Environmental Quality Act 1974, 1985, National Forestry Act 1984 which is protecting and preserving forests and wildlife. The other legislation were the Pesticides Act 1974, the Wildlife Conservation Act 1972 and the Fisheries Act 1985. The second calculation is the use of recycling technology, the use of a catalytic converter to minimize the quantity of nitrogen oxide and the use of unleaded fuel. The next method to have a proper management of development activities and the ecosystem is through education, preservation and conservation, biological control, efficient use of energy and the use of renewable energy such as solar energy, wave energy, wind energy, hydroelectric, geothermic energy, and biomass energy.

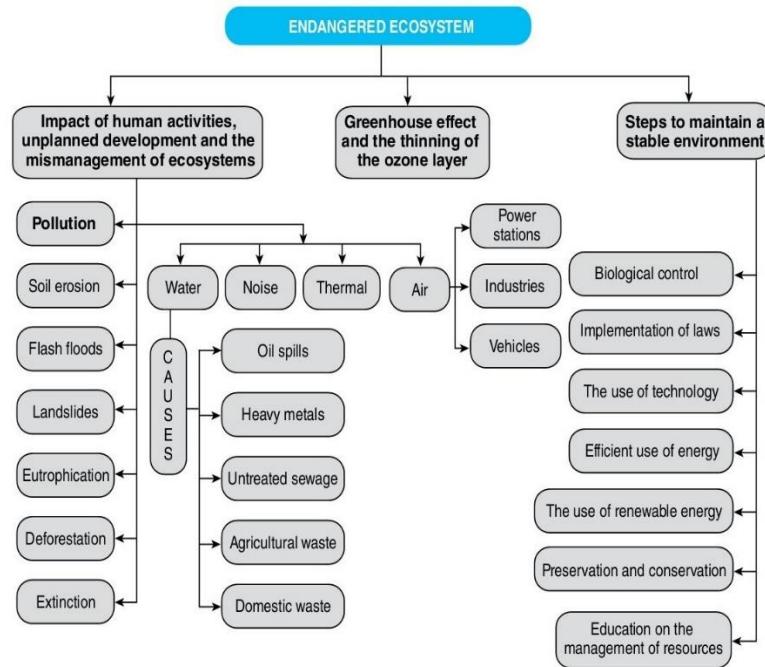


Figure 2.1: Success Biology, Endangered Ecosystem Summary (Gan, 2013)

Ecosystem is important because it consists of communities of organisms and non-living matter that interact together. As ecosystems are interdependent, each part of the ecosystem is important. Many issues can be caused by damaged or imbalanced ecosystems. In order to protect the environment, there is inadequate knowledge of the value of maintaining the ecosystem (Bennett, Cramer and Begossi, 2015). Nowadays, the pressures of habitat loss, pollution, overexploitation, invasive species and climate change are increasing globally (Isabelle, Emily, and Christopher, 2016).

Besides that, the level of pollution in Malaysia is in a worrying state as the citizens do not aware of this situation. As stated by Idrus (2015), in this country, every day the environment is experiencing the variety types of pollution- from air, water, and noise pollution to seemingly endless waste, despite many educational and environmental awareness campaigns in various forms, reading materials, print and social media are

handled by various responsible parties. The level of public awareness of the importance of the environment is still at a low and almost disappointing level. (Idrus,2015). To raise an awareness, current technology like virtual reality game can be used (Heaven, 2013). By applying virtual reality in game, people will realise more about the importance of conserving the endangered ecosystem.

2.2 Virtual Reality

Virtual reality (VR) technology plays an important role in realizing telesensation, through it, a virtual world is created that viewers can enter and walk through and where they can handle virtual objects and the virtual world allows a stereoscopic view from front or side, depending on the viewpoint, just as in the real world. What makes VR immersive is that the ability to reach and move around the virtual world and manipulate virtual objects using hand gestures is the most important function (Terashima, 2002). VR is a non-invasive simulation technology that allows a user to interact with a computer-generated environment, in the three dimensions (3D) of width, height, and depth (Shahrbanian, Ma, Aghaei, Bitensky, Moshiri and Simmonds, 2012).

The purpose of VR is to provide a virtual environment for human beings to communicate with a machine just as in the real world, i.e. by talking in a spoken language with a virtual human, writing a letter, or drawing an image. It also enables a hand gesture to grasp a virtual object and bring it to another location. The contact is with a computer without any difficulties or obstacles in a human-friendly simulated world. When VR technology creates a virtual landscape, it will be as if it were a landscape in a real life setting. Sound and scent also helps to enjoy the scenery, not only giving a 3D picture of the landscape (Terashima, 2002).The very first application of VR was the training of air force pilots in flight simulators which is the first computer-graphics based flight simulator was built in the 1970s and by the 1980s, with better

software and hardware, the market for VR technology had grown far beyond military use (Gillner and Mallot, 2001).

VR also helps in a marketing strategy which it can demonstrate that a particular company or high technology product, forward looking, or just plain cool. In this case, VR has been used several times as part of advertising campaigns such as the television advertisements which gives the opportunity to advertisers to provide advertising that people want to participate in which this has been done through the development of a specific VR game that relates to the company or product (Alan and Jeffrey, 2009).

2.2.1 Types of virtual reality

There are different types of VR technology and they include non-immersive VR, fully immersive VR, augmented reality, collaborative VR and web-based VR.

Non-immersive VR is an strategy to enhance motor performance for stroke rehabilitation and there has been rapid adoption of non-immersive VR as a rehabilitation strategy despite the limited evidence about its safety and effectiveness (Saposnik et al., 2016). The non-immersive VR environment refers to the least interactive implementation of VR techniques, so that 2D interface devices such as keyboards and mice can usually communicate with the VR environment without completely immersing themselves in the environment (Shahrbanian, Ma, Aghaei, Bitensky, Moshiri and Simmonds, 2012). Non-immersive VR simulations is very common in everyday lives. Most of video game is technically considered as a non-immersive VR experience.



Figure 2.2: Example of non-immersive VR (Poetker, 2019)

Immersive VR allow the user to fully experience a realistic or artificial environment (Burns, 2011). Immersive VR environments and 3D immersive environments in particular are considered the highest interactive application of VR techniques in which subjects are fully immersed and communicate with the VR world (Shahrbanian, Ma, Aghaei, Bitensky, Moshiri and Simmonds, 2012). As this technology is really engaging, rich experience can be achieved by user. By using the immersive VR environment, it has the potential to improve learning relative motion concepts (Kozhevnikov and Gurlitt, 2013). Immersive learning environments is the newly great idea that students can learn better by doing rather than seeing (Ferguson et al., 2020). Head Mounted Display (HMD) in education which immersive VR can offer great advantages for learning as it allows a direct feeling of objects and events that are physically out of our reach. This type of VR is commonly used for gaming and other entertainment purposes in VR arcades or even at home (empty, non-fragile room advised.)



Figure 2.3: Example of immersive VR (Poetker, 2019)

Augmented Reality (AR) is a technology that combines a real thing into virtual environment interactively (Layona, Yulianto, & Tunardi, 2018). AR and VR use the same hardware technologies and share several variables, such as virtual scenes created by computers, 3D objects and interactivity. The primary distinction between them is that VR tries to replace the real world, while AR respectfully complements it. Displays, monitors, input and monitoring systems are the major devices for AR. Two main types of displays used in AR are See-through and Monitor-based displays. See-through displays display both see-through and optical see-through displays (Kesim & Ozarslan, 2012). AR provides an excellent solution for easily spotting manufacturing errors.



Figure 2.4: Example of AR (Rai, 2019)

Internet-based virtual reality collaborative environment (VRCE) was developed using VNet, a free software, Java and Virtual Reality Modelling Language (VRML) to demonstrate the feasibility of collaboration design for small to medium size companies that focus on a narrow range of low costs products (Kan, Duffy, & Su, 2001). Web based virtual reality is something like application development method which is done by using waterfall method that includes planning (collect data and analysis), design (user interface and diagram), implementation, and testing such as research result is VR application for human body anatomy learning that contains 3D object, organ explanation and position that can be accessible on web (Layona, Yulianto and Tunardi, 2018).

2.2.2 Advantages of Virtual Reality

VR technology have many benefits for users. It allows users to view objects in three dimensions or two dimensions. Eventhough it is difficult to evaluate 2D objects, as the size, shape, and texture are so hard to be determined, by applying VR on it, it will be more attractive and effective. However, 3D objects provide more informations. In simulating dangerous tasks, VR also can be used (Denby and Schofield 1999) also handling expensive equipments (Gunther-Mohr 1997). User can experience any type of risky situation such as hazardous tasks or simulate rare occurences in a realistic view without worrying about the safety issue. User can also practice for the objects that do

not exist or hard to access by using VR. In sum, in a risk-free environment, VR enable users to make the best decisions in every situation (Aguinas, Henle, & Beaty Jr., 2001).

Recent technological developments are changing the ways people experience the physical and the virtual environments. Specifically, VR is likely to play a key role in several industries such as retail, tourism, education, healthcare, entertainment and research (Flavián, Ibáñez-Sánchez, & Orús, 2019). VR is now commonly used in many domains because of its ability to interact with environment. In balance assessment, it can be used to control stimuli presented to patients and thus accurately evaluate their progression (Morel, Bideau, Lardy, & Kulpa, 2015). In realising tele-sensation, VR technology plays an important role. Through it, a virtual environment is created where audiences can join and move through and manage virtual objects where the virtual world allows, depending on the point of view, a stereoscopic view from the front or side, much as in the real world and the opportunity to enter and walk through the virtual world (Terashima, 2002). Besides that, there are many applications of VR of training and education, especially in the field of medicine, for example, many practising surgeons completed their training before the so-called laparoscopic era of the 1990s or minimal invasive surgery which has dramatically changed the way surgery is performed, which makes it necessary to teach even very experienced physicians (Neil and Paul, 2001). Neil and Paul also stated that computer graphics has been used for many years in the generation of experimental stimuli to examine the visual system and with VR, the sensory system and related behaviour can be investigated, that is, it is possible to examine a whole action perception cycle.

The advantages of using VR to teach educational objectives are similar in many ways to the advantages of using a computer or interactive simulation, particularly a three-dimensional computer simulation (Freina & Ott, 2015). Marketing strategy also can be one of the VR aspects which to demonstrate that a particular company or product is high tech, forward looking, or just plain cool (Alan, William and Jeffrey, 2009). In

this case, people will realize that VR is really helping in any kind of style. Besides that, VR also has been used several times and be as a main part of advertising campaigns. It is highly recommended as the design of the environment and the way of interacting with it is really suitable in advertising (James, 2015). Applications of VR tend to be more valid than some traditional techniques because of the realistic aspects, with VR, the work environment stimuli can be presented with high fidelity (Aguinas et al., 2001).

Non-immersive VR is likely to be more suitable as in immersive VR, animation and simulation are interactively controlled in response to the user's direct manipulation and much of the technology used to support immersive while non-immersive VR is the same as they use the same 3D modelling and rendering and many of the same interaction techniques and non-immersive VR can be based on the desktop view, immersive VR is still evolving as the needed devices are not so user-friendly and the equipment also in a highly cost so, non-immersive VR is more suitable because there was a major difficulty about using equipment such as a helmet with goggles (Freina & Ott, 2015). Non-immersive VR is much more easier to be applied compared to immersive virtual reality as the immersive system has a lot of bulky components, such as HMD, glove, and other input devices, which makes it difficult to move the system around the network while, in the other approach, a highly mobile notebook computer can be used as the network management workstation by using non-immersive VR (Kahani, 1997). The other advantage of the non-immersive system is the higher accessibility to the network management system and the prices of browsers are so low that most computers have a copy of them installed (Kahani & Beadle, 1997). This clearly stated that by applying non-immersive VR, it can reduce the financial challenges. Non-immersive VR simulations based on computers can be an accessible and inexpensive technique as it will make it easier for the user to use it (Dubovi, Levy, & Dagan, 2017). Non-immersive VR can also be introduced in games, so consumers would find it more appealing to use this technology by introducing non-immersive VR in games (Heaven, 2013).

2.2.3 Virtual Reality Games

Since VR and AR have become promising technologies in the entertainment and display industry, a large number of companies have provided content and services with VR and AR technologies. Among them, video games have been considered as one of the biggest markets for VR technologies because those technologies can be used to increase the degree of players perceived reality. The findings of the current study present both theoretical and industrial implications for researchers related to VR games. From an academic perspective, the current study finds the roles and validity of three external factors in understanding players perspectives toward VR games, indicating the beginning points of cultivating a better experience for players in the games thus, future studies can manipulate the findings and research model of the current study in order to provide a better understanding of players experience in the games and VR games can find advancement points for their games from the proposed research model (Jang & Park, 2019).

VR games are among the most popular games for children and adolescents. Nevertheless, their complex 3-D interfaces constitute an issue to be examined in terms of usability and likeability (Virvou and Katsionis, 2008). They also stated that in VR games, the evaluation conducted focuses mainly on educational effects and this evaluation is fully described as that educational evaluation aimed at finding out whether the educational game environment achieved better educational effects in comparison with educational software of no gaming environment. Besides that, Educational Environmental Narrative (EEN) games in VR provide rich, high fidelity environments that provide a fully immersive and interactive storytelling experience for use in teaching (Ferguson et al., 2020).

With the growth of VR and the popularity of games as a means for storytelling, another type of simulation game is growing: ‘Walking Simulators’, a genre of video games which lacks many of the traditional aspects of a game such as a goal, win or loss

conditions, any kind of game system to interact with despite taking the form of a video game (Prata, Oliveira, & Melo, 2018). In Walking Simulator games players move through the game environment, often without a clear goal, explore the world offered by the game and while doing so learn gradually more and more about it. A genre called Environmental Narrative (EN) games would also fit into this category with the most well-known of these games is “Dear Esther” (The Chinese Room, 2012) being released to critical acclaim and leading to similar games being developed for VR platforms, such as the highly-rated “The Price of Freedom” (Construct Studio, 2016). EN games are characterized by rich, high-fidelity environments which are often unpopulated, but scattered with evidence of human activity which relates to the overarching narrative. The narrative is typically communicated through voiceovers or written artefacts which reveal the story in an intriguing, non-linear fashion (Habgood, Moore, Alapont, Ferguson, & Van Oostendorp, 2018). The current study uses a VR game as the stimulus as it is perceived to be more appealing to the user, enhancing maximum immersion; furthermore players show a higher anxiety level which would enhance their post VR-gaming response (Pallavicini, 2018). Due to the expanded field of view (FOV) of the VR headset, VR gaming blocks the external world while facilitating sensory immersion, providing users with a greater immersion experience (Martel and Muldner, 2017).

2.2.4 Elements in non-immersive virtual reality games

For the past few years, the VR gaming industry has already won significant market size and still shows fast growth rate. In the beginning, the idea of VR was fascinating and a little bit fantastic. The VR application can be developed with the VR game engine software such as Unity and some features of the VR application include VR visualisation, VR simulation, interactive content, 3D holograms, 360° immersive video, and 3D data visualisation (Shakarishvili, 2019). VR is used for real-time visualization of specific virtual models and simulation situations and due to the constant changes in simulation technologies a constant updating is required which means continuously updating and even the creation and redesigning of a viable use case scenario requires

heavy programming effort (Liagkou, Salmas, and Stylios, 2019). Digital graphics, emulation techniques, interactive technology, artificial intelligence, network technology, parallel processing, and multi-parameter environmental sensing techniques are also components that are incorporated in VR applications that mimic the vision, auditory sense, and sense of touch of people that allow people immerse themselves in the virtual world (J. Wang, 2012).

As of today, there are already enough VR gadgets that are ideal for different audiences. As for non-immersive VR, there is no necessary complex gadget. The non-immersive VR is when it places the user in a 3D environment that can be directly manipulated, but it more in using monitor, a keyboard, and a mouse, also being referred as a desktop VR (Freina & Ott, 2015).

Non-immersive systems, simply are the least immersive implementation of VR techniques by using the desktop system, the virtual environment is viewed through a portal or window by implementing a high standard resolution monitor. The interaction of VR elements also can occur by devices such as mice, keyboards, and trackballs or it is also can be enhanced by using 3D interaction devices (Costello & Costello, 1997). By according to Nacke (2014), these are the requirements needed in designing VR game:

- a) **Bits of Players/Avatars/Game.** The rules of the game are set by players in motion and often have some form of representation in the game world. In certain games, there are no representations and the player represents himself.
- b) **Objectives/Goals.** They are also known as tasks or quests, as the task list of the player tells them what they should work for.
- c) **Rules/Mechanics.** Mechanics decide how anything performs in games, just as game rules do. They are about the possibilities that will change the state of the game for the players. The most distinguishing aspect in games are the rules. The general properties of the laws include the following:

- limit player actions
- explicit and unambiguous
- shared by all players
- fixed
- binding
- repeatable

d) **Special effect**

- Non-immersive VR effect

e) **Game States.** At one point in the game loop, the state of the game system. Anything you can write to a save file in essence. A collection of all relevant details about variable games that changes during gameplay.

f) **Game Views.** Various stages of the game can allow a player to see various details. The part of the state of the game that is noticeable to a player is called the view of the game.

g) **Information.** All the necessary details to play the game.

h) **Sequencing.** The order in which rules, analogous to turns in a board game, unfold. This is important for thinking about when the data changes in a game and with it the current state of the game.

i) **Player Interaction.** For players, the types of interaction allowed.

j) **Theme/Setting.** Although an environment for games is not necessary, many games have some kind of theme that helps players make sense of game data. That's what the whole game is about. This may apply to things like colour, style, narrative or plot. This makes players feel more at ease with the mechanics of their game.

So, by applying non-immersive VR in games, there are several elements of evaluation that need to be discussed and applied.

2.3 Evaluation of Games

Many research in literature have been seeking to determine the usefulness of video games in education in recent decades. The outcomes of these attempts, however, are problematic. In order to assess the efficacy of games in education, the standard of games

needs to be specified. In every educational video game, there are different methods to define the significance of a quality that is enjoyment, learning and usability (Ak, 2012).

- Enjoyment/fun

In the category of enjoyment, Malone (1980) described a set of heuristics or guidelines for educational game designers that will make the game enjoyable as challenge, fantasy and curiosity are three constructs. In addition, an instrument or a number of innovative methods must be created to calculate the enjoyment of video game play (Jang & Park, 2019). As computer game play resembles media consumption in many aspects, it is reasonable to borrow a theory in this relevant field as the first step towards building a theoretical base for computer game play. Furthermore, in order to measure enjoyment of computer game play, it is necessary to identify the contributing factors of enjoyment (Feng, Chan, Brezinski and Nair, 2008). Many different models have been developed to explain and analyze media enjoyment, including disposition theory, attitude, transportation theory, cognition, parasocial interaction and flow (Sweetser and Wyeth, 2005).

- Learning

Squires and Preece (1999) defined elements of games, both accessibility and learning. In this case, the constructs for the compilation of certain elements of possession, reputation and uncertainty relevant to the idea of learning. In addition, an experiential gaming model has been developed that relies on experiential learning theory, flow theory and game design and is effective (Killi, 2004).

- Usability

Usability is about maximizing effectiveness, efficiency and satisfaction and this definition originates from the traditional software industry, but it translates well to game development. In games, usability is about delivering a better and deeper experience with less unnecessary interruptions or challenges that have not been designed by the developers (Laitinen, 2005). Applying usability techniques to computer game design presents a unique set of problems to a usability practitioner (Brown, 2008). Usability describes the degree to which a product can be used by specified consumers, such as video games, to achieve specific objectives with performance, effectiveness and

satisfaction in a specified context of use (Saari, 2017). Heuristic or expert assessment, which has also been applied in the game sense and proven effective in game creation, is one popular approach to ensure good usability (Rajanen & Rajanen, 2018).

- Effectiveness

Effectiveness which is the accuracy and completeness with which users achieve certain goals. Effectiveness metrics include solution quality and error rates that use solution quality as the primary predictor of effectiveness, i.e. the assessment of the result of the user's contact with the system (FrØkjaer.E, Hertzum.M, & Hornbæk.K, 2000).

Therefore, to evaluate the product of the project, effectiveness test is chosen because the third objective for this project is to evaluate the enjoyment of the application in delivering information to user.

2.4 Comparison between Existing Application and Game

These are the comparison between existing application and game that are provide to learn and gain awareness in endangered ecosystem. This comparison can help developer to create another application or game that are suitable for user and convenient to use. Moreover, this comparison also can help developer to add the important elements in the application or game that will be developed.

Table 2.2: Comparison of Existing Application and Game

	 a) Lake Serenity	 b) EcoBalance	 c) DNATION 2
a) Learning Material	Game Based-Learning	Mobile application	Game Based-Learning
b) Platform	Desktop	Android, iOS and desktop	Desktop

c)Players/ Avatars	✓	✓	✓
d) Game Rules	✓	✗	✓
e) Special effect (VR)	✓	✗	✓
f) User Interface	Interactive user interface	Lack interactive user interface	Interactive user interface
g) Game States	✗	✓	✗
h) Provide information	✓	✓	✓
i)Player interaction	✓	✓	✓
j)Theme	✓	✓	✓

Based on Table 2.2, each application and game have its own purpose to provide with all the element. To develop a game, game space is one of the important element that should have in a game. Furthermore, interactive user interface is also one of the important factor to develop a game or an application for user friendly. In the game, should also include reward for user feedback. A game also need to have a complete storyline so that the game will become more interesting and the user will be more understand about the game. To develop a more interesting game, VR also can be apply.

2.5 Summary

Firstly, this chapter is discussing about the introduction of ecosystem and endangered ecosystem. Next, it also describes more about VR which are introduction of VR, types of VR, advantages of VR, VR games, elements in VR and the evaluation of games. Furthermore, this chapter also describe about the ISO model for evaluating usability in VR game. Lastly, this chapter also include comparison of existing application and game.

CHAPTER 3

METHODOLOGY

This chapter discussed about methodology that has been used in the project. Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Methodology is the entire framework or design of the research, the choice of paradigm, methods and tools or techniques to explore research questions and to create new knowledge (Cirp et al., 2018). Methodology is a philosophy of generating information through analysis, according to Zeegers and Barron (2015), and offers a justification for the way a researcher continues, and it is the philosophical basis of a particular research practice. The approach chosen in the development process is the Game Development Life Cycle (GDLC) model. In the GDLC model, the initiation phase, pre-production phase, production phase, test phase, beta phase and release phase are six stages in the life cycle of development. The value of methodology is to include measures to assist and direct developers in managing projects well and systematically.

3.1 Game Development Life Cycle

The methodology that have been chosen in the development process of this project is game development life cycle (GDLC). Game is not just pure art, a creation of creativity and imaginative thinking, but game is more like a craft, created from the combination of interleaving, multidiscipline aspect, from art, music, programming, acting, and the management and integration of those aspects, therefore, a game development requires specific guidelines which govern its development process, the GDLC (Games, 2016).

The systems development life cycle (**SDLC**), also referred to as the application development life-cycle, is a term used in systems engineering, information systems and software engineering to describe a process for planning, design, develop, testing, and deploying an information system. Software Development product always require a need for an existing problem and its developed for providing a solution, whereas, Game Development product is for entertainment to engage people to have fun, learn and spend good time. Hence the product will require an idea, story, innovation, creativity, writing skills and technical expertise. Hence, just following SDLC engineering principles as a product will have complications and iterations in design and development as a gaming product. Therefore simply adopting the SDLC is not enough, as the developers face several challenges such as artwork, visuals, animations, character interactions, collisions, physics, and sounds during its life cycle (Jain, 2017). To address the problem, the specific approach must be used which is GDLC. According to GDLC phases, there six phases is initiation phase, pre-production phase, production phase, testing phase, beta phase and release phase in GDLC model.

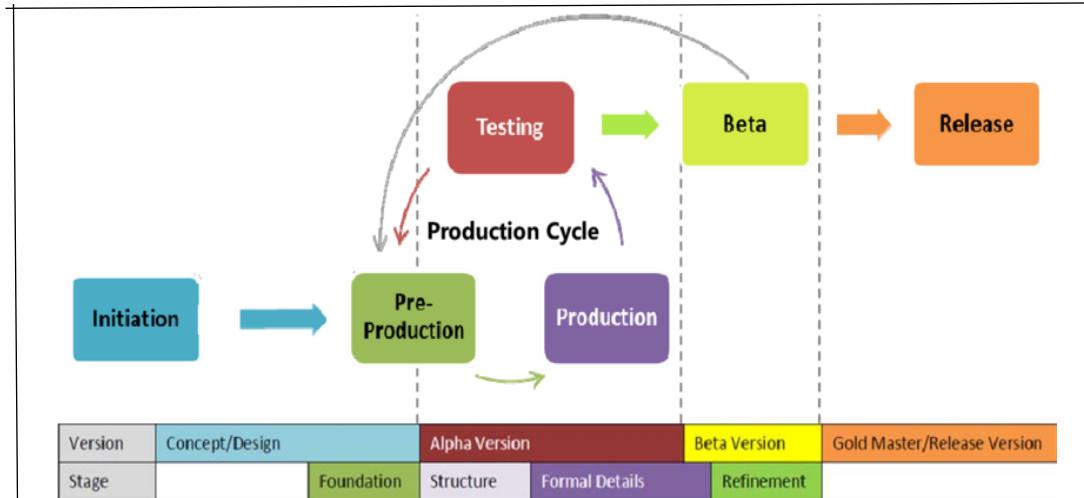


Figure 3.1: The Proposed GDLC model (Widyani, 2013)

Firstly, the reason why GDLC is used in this project is because every phase in GDLC will be derived with the suitable activities. Secondly, to generate a best level degree of functionality and flexibility towards changes occurs in the game development process by using an iterative approach by GDLC. GDLC is able to maintain the quality of the project by creating an address for every prototype stage involve. Hence, the project

that used GDLC are developed the entertainment for people easier to learn, having fun, reduce time and require more idea while using it.

3.2 Methodology Phases

The initiation phase, pre-production phase, production phase, test phase, beta phase and release phase in the GDLC model are six phases in the game development life cycle.

Table 3.1: Methodology phases

Phase	Activity	Deliverable	Objectives
Initiation	1. Searching article, journal, website and books, about problem in endangered ecosystem. 2. Identify the target user. 3. Identify scope for game.	1. Problem statement, objective, target user, project scope, project significant and expected outcome.	
Pre-production	1. Game design 2. Game prototype	1. Consists of: - character designing - background designing -music and sound 2. Create flowchart and storyboard.	To design the interface and the content of the game concept.
Production	1. Use a suitable programming language and Game Engine to develop a game. 2. Modelling the character. 3. Creating the game in non-immersive VR	1. Use C# programming language and the Game Engine is unity3D. 2. Use 3Ds Max as the modelling designing tool.	To develop a VR game based on Endangered Ecosystem Awareness.

Testing	1. Test the game functionality.	1. Use testing case to test the functionality of the game.	To ensure the game will functioned properly.
Beta testing	1. Search the evaluation model.	1. Using ISO model to evaluate usability.	To evaluate the usability of the game.
Release	1. Release the game.	1. Release the prototype game to the respondent.	

3.2.1 Initiation phase

When making a game, the first step is to create a rough idea of what kind of game is going to be made. Initiation performance is the notion of the game and a basic explanation of the game. Prior planning can be conducted when finish drafting the game concept. In the initiation phase, data and information need to be collected as a purpose for defining problems occurs and the suitable solution. All information can be collected from journals, article, book and trusted website as references. The importance of the initiation step is to provide methods on how to brainstorm ideas and game concept. The title of the project also being created as to rough the idea of the game and also the problem statement, objective, project scope, project significant and expected outcome.

3.2.2 Pre- production Phase

In the development cycle, pre-production is one of the first and foremost stages. The development and revision of the game concept and the creation of the game prototype are involved in pre-production. The aim of game design is to describe the game genre, gameplay, mechanics, plot, characters, challenges, fun factors, technical aspects, and documentation of its components.

- Character Designing

The character design starts with the character development. The priorities must revolve around determining what is the character's story is about, and how they will interact with the player to achieve the goals of the game. Closely related to the character's story arc and personality is the physical character design, need to work out specific traits physical, emotional, and behavioural that truly create

the character. In this game there will be five characters that play roles in the game. Table 3.2 shows the five characters that will be develop in the game:

Table 3.2: Character designing

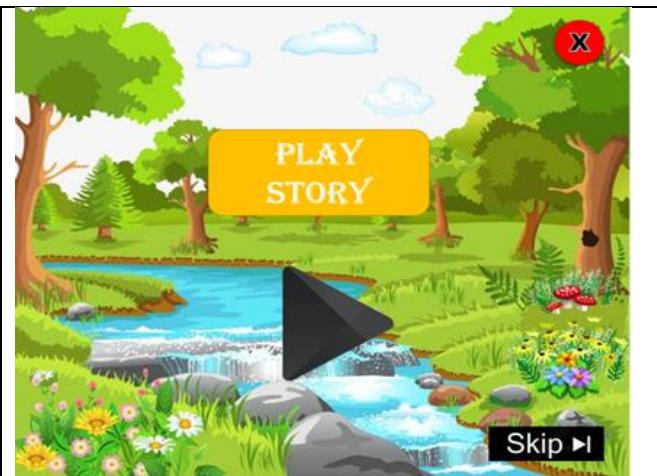
Character	Description
	Main character <ul style="list-style-type: none"> - 3D design character of a woman - A powerful woman that responsible in saving the world.
	Extra character <ul style="list-style-type: none"> - 3D design character of an elephant. - A character that will give the first mission to the user. - An elephant that trapped in an air pollution.
	Extra character <ul style="list-style-type: none"> - 3D design character of a deer. - A character that will give the second mission to the user. - A deer that trapped in a thermal pollution.

- Storyboard

Storyboard is the visualization of the idea in storyline. The storyboard is a very important part of the pre-production process because it clearly conveys how the story of the game will flow to see how the storyline works. It also allows to see potential problems that would not go unnoticed. When making films, games, animations, concepts, short stories and ads, storyboarding is an incredibly necessary and valuable technique. When making something moving or animated, it is one of the first things done. Basically, it is a group of static diagrams or pictures put together in an order that illustrates how the scene would run its course in a game or something. The kind of data that needs to be included in storyboards is things like the way a person is going to travel and things that can be easily missed if not drawn down, pictures and accompanying notes do this. Doing this would allow the scene to be prepared before it is actually produced, to see if there will be any issues and fix them before starting, and will save a lot of time that would otherwise be wasted. The aim of the storyboard is to be able to control their concept and understand how the game will work for the developer. Table 3.3 shows storyboard in this project

Table 3.3: The storyboard of the game

Scene	Description
Scene 1 	<ul style="list-style-type: none"> • Main page for the game • Consists of logo of game • Button: start button and exit button. • Background: scenery of a healthy environment • Sound: Classic piano with the sound of the river
Scene 2	<ul style="list-style-type: none"> • Prompt user to play story or skip the story • Button: exit, play, and skip

	<ul style="list-style-type: none"> • Background: scenery of a healthy environment • Sound: Classic piano with the sound of the river
<p>Scene 3</p> 	<ul style="list-style-type: none"> • It shows the story in comic view • Button: home, exit, and next • Background: scenery of a healthy environment • Concentration: Elements that determine the ability of player to focus throughout the game. • Sound: Classic piano Story scene before enter the game.
<p>Scene 4</p> 	<ul style="list-style-type: none"> • The user need to choose the stage. • The user need to pass each stage to complete the mission given. • Button: home, exit, and next • Background: scenery of a healthy environment • Control: The user can choose the stage to complete the mission . • Sound: Classic piano with the sound of the river
<p>Scene 5</p>	<ul style="list-style-type: none"> • The first mission, main character (user) will find an elephant that



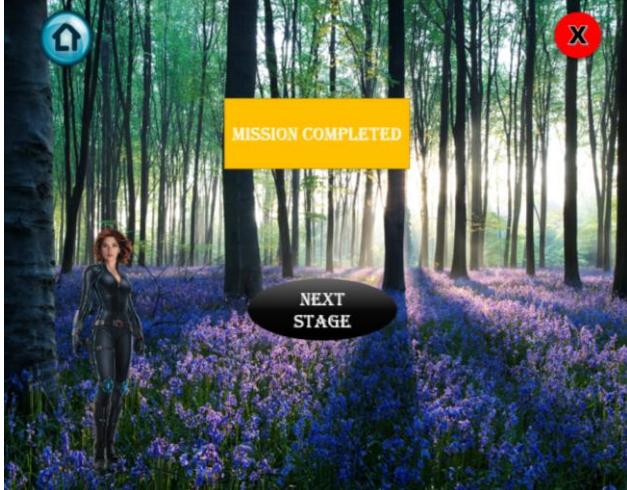
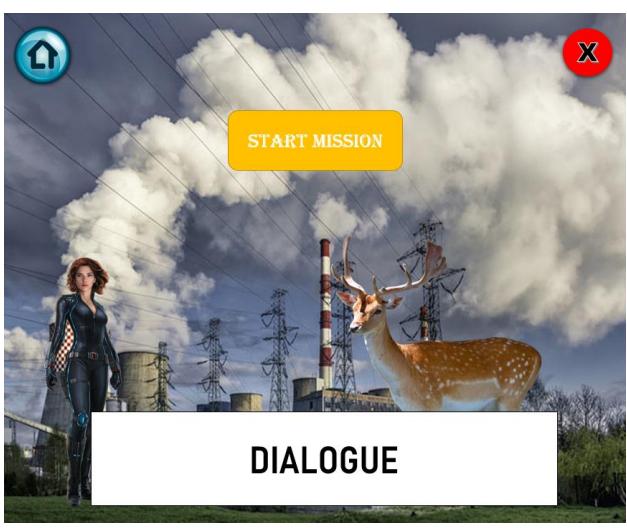
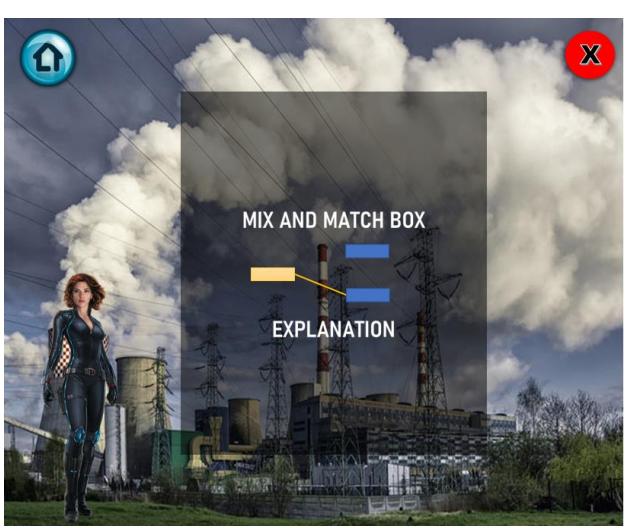
trapped in an air pollution environment.

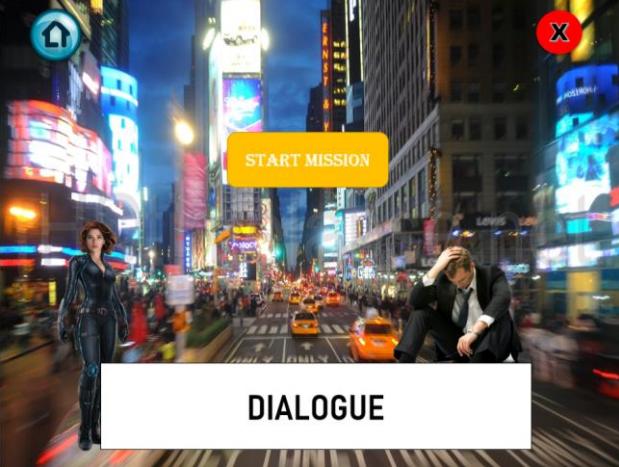
- The elephant will explain the mission to the user in the dialogue box.
- Button: exit, start mission, and home
- Concentration: Elements that determine the ability of player to focus throughout the game.
- Immersion: Elements that ensure player to focus as they are the real character inside the game.
- Background: panic piano sound

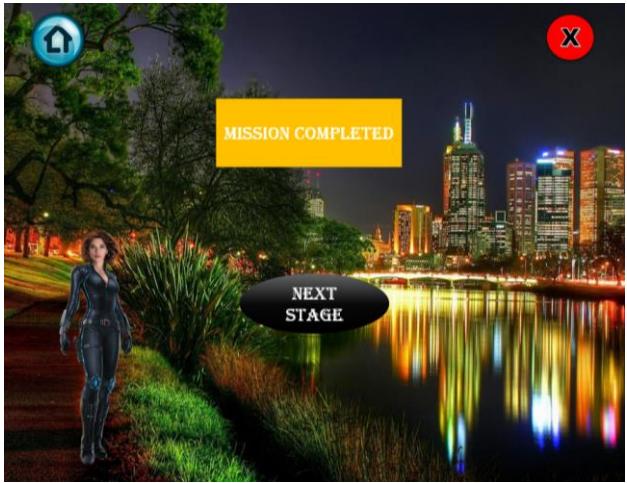
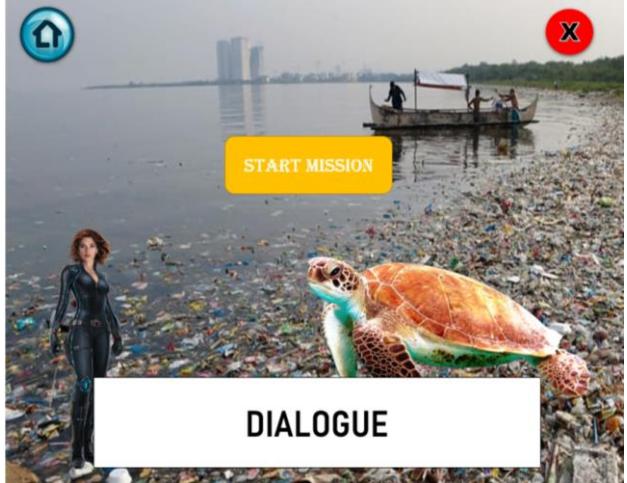
Scene 6

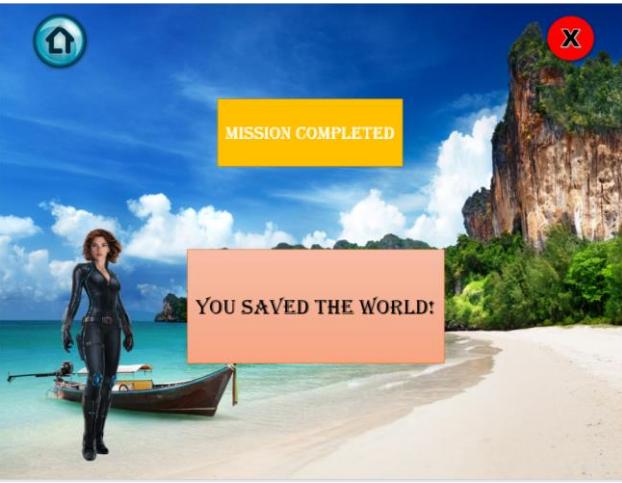


- User need to find all the things and sources that can cause the air pollution.
- Each cause founded will pop up mix and match box which user need to match the object that causes the pollution to its consequences.
- A little bit explanation about the situation
- Button: exit and home
- Challenge: This scene contains elements that determine the challenges and the difficulties of the game.
- Player skills: Player should be able to develop some skills and knowledge after passing the mission.
- Clear goals: Elements that provide specific goals that need to be achieved by the player.
- Background: panic piano sound

<p>Scene 7</p>  <p>The screenshot shows a woman in a black suit standing in a forest with blue flowers. A yellow box at the top center says "MISSION COMPLETED". Below it is a black oval with the words "NEXT STAGE". Top left and right corners have a house icon and an X icon respectively.</p>	<ul style="list-style-type: none"> After all the causes been found, user will complete the mission. User can choose to proceed to the next stage. Button: exit, next stage and home Feedback: Elements that provided feedback or rewards after player manage to finish the mission. Background: classic piano sound
<p>Scene 8</p>  <p>The screenshot shows a woman in a black suit standing in front of a power plant with a deer. A yellow box at the top center says "START MISSION". Below it is a white box with the word "DIALOGUE". Top left and right corners have a house icon and an X icon respectively.</p>	<ul style="list-style-type: none"> The second mission, user will find a deer that trapped in a thermal pollution environment. The deer will explain the mission to the user in the dialogue box. Button: exit, start mission, and home Concentration: Elements that determine the ability of player to focus throughout the game. Immersion: Elements that ensure player to focus as they are the real character inside the game. Background: panic piano sound.
<p>Scene 9</p>  <p>The screenshot shows a woman in a black suit standing in front of a power plant. A dark box in the center has "MIX AND MATCH BOX" at the top. Inside are two blue squares with arrows pointing to a yellow square labeled "EXPLANATION". Top left and right corners have a house icon and an X icon respectively.</p>	<ul style="list-style-type: none"> User need to find all the things and sources that can cause the thermal pollution. Each cause founded will pop up mix and match box which user need to match the object that causes the pollution to its consequences. A little bit explanation about the situation Button: exit and home Challenge: This scene contains elements that determine the challenges and the difficulties of the game.

	<ul style="list-style-type: none"> • Player skills: Player should be able to develop some skills and knowledge after passing the mission. • Clear goals: Elements that provide specific goals that need to be achieved by the player. • Background: panic piano sound.
Scene 10	 <ul style="list-style-type: none"> • After all the causes been found, user will complete the mission. • User can choose to proceed to the next stage. • Button: exit, next stage and home. • Feedback: Elements that provided feedback or rewards after player manage to finish the mission. • Background: classic piano sound
Scene 11	 <ul style="list-style-type: none"> • The third mission, user will find a stressed business man that trapped in a noise pollution environment. • The man will explain the mission to the user in the dialogue box. • Concentration: Elements that determine the ability of player to focus throughout the game. • Immersion: Elements that ensure player to focus as they are the real character inside the game. • Button: exit, start mission, and home • Background: panic piano sound.

<p>Scene 12</p> 	<ul style="list-style-type: none"> User need to find all the things and sources that can cause the thermal pollution. Each cause founded will pop up mix and match box which user need to match the object that causes the pollution to its consequences. A little bit explanation about the situation Button: exit and home Background: panic piano sound
<p>Scene 13</p> 	<ul style="list-style-type: none"> After all the causes have been found, user will complete the mission. User can choose to proceed to the next stage. Button: exit, next stage and home Feedback: Elements that provided feedback or rewards after player manage to finish the mission. Background: classic piano sound
<p>Scene 14</p> 	<ul style="list-style-type: none"> The last mission, user will find a turtle that trapped in a noise pollution environment. The turtle will explain the mission to the user in the dialogue box. Button: exit, start mission, and home Concentration: Elements that determine the ability of player to focus throughout the game. Immersion: Elements that ensure player to focus as they are the real character inside the game. Background: panic piano sound.

<p>Scene 15</p>  <p>MIX AND MATCH BOX</p> <p>EXPLANATION</p>	<ul style="list-style-type: none"> User need to find all the things and sources that can cause the water pollution. Each cause founded will pop up mix and match box which user need to match the object that causes the pollution to its consequences. A little bit explanation about the situation Button: exit and home Challenge: This scene contains elements that determine the challenges and the difficulties of the game. Player skills: Player should be able to develop some skills and knowledge after passing the mission. Clear goals: Elements that provide specific goals that need to be achieved by the player. Background: panic piano sound
<p>Scene 16</p>  <p>MISSION COMPLETED</p> <p>YOU SAVED THE WORLD!</p>	<ul style="list-style-type: none"> After all the causes have been found, user will complete the mission. User has completed the game missions. Button: exit and home Feedback: Elements that provided feedback or rewards after player manage to finish the mission. Background: classic piano sound

• Flowchart

A flow chart, or flow diagram, is a graphical representation of a process or system that details the sequencing of steps required to create output. A typical flow chart uses a set of basic symbols to represent various functions, and shows the sequence and interconnection of functions with lines and arrows. A diagram

that is called a flowchart, showing flow and step by step for a process. Specialized flow chart symbols show the processes that take place, the actions that are performed in each step, and the relationship between various steps. The flowchart is to understand what is happening in the process of the project. Figure 3.2 shows the flowchart that describes the project process involved.

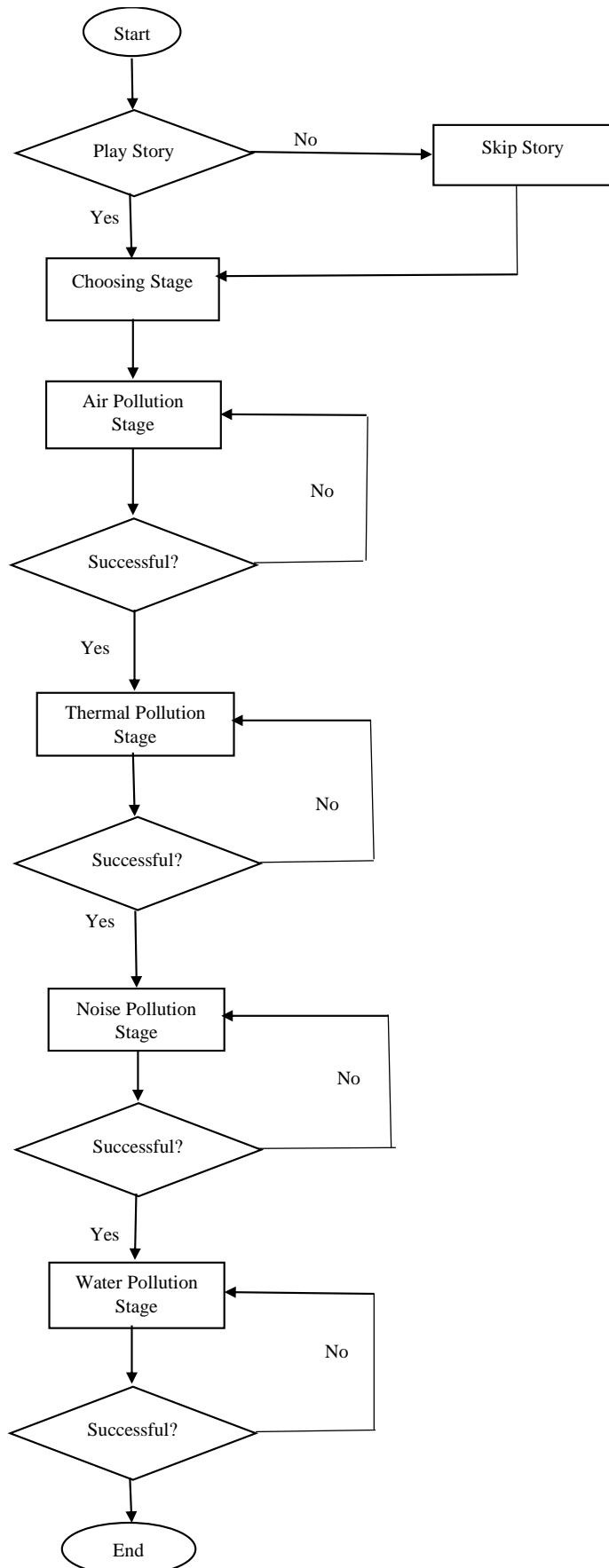


Figure 3.2: Flowchart of the game

The flowchart of the game is shown in figure 3.2 above. In this project begin when player start the game through the main menu. Then the player can choose either to play the story or just skip it. By choosing to play the story, the player view the story and can also press the next or previous button and after the story is ended, player need to choose the stage in the stage choices interface. If the player chooses to skip the story, it directly bring the player to the stage choices. For the first time player, the player needs to start the game from the first stage which is air pollution, if the player has completed the mission in the first stage, the player may proceed to the next stage which is thermal pollution stage. If the player has failed the first mission, player need to try again the same mission until manage to proceed to the next stage. Same goes to the next stage which is thermal pollution, noise pollution, and water pollution, player need to pass the current stage they are playing before proceed to the next stage. When all the mission of the stages completed, player win the game.

3.2.3 Production Phase

Phase of production is the third phase of the game development life cycle. Production is the core process which revolves around the asset creation, source codes creation, and the integration of both elements. The related prototypes in these phases are formal details and refinement. The activities involved while developing the game is to choose suitable programming language and game engine, define software requirement and hardware requirement, creating assets and source code and also use information have been collected from pre-production phase to develop the project. In this project, programming language, game engine, software and hardware requirement need to be decided for using in developing process. To develop this game, programming language that suitable to develop this game are C# and C++. Furthermore, in developing this game Unity can be the game engine and 3Ds Max can be used in modelling the characters and items inside the games. Furthermore, unity and 3Ds Max is very suitable in handling VR elements in game development.

- Software Requirement

In this project, Blender, C#, and Unity is being used as software to designing and developing process. The software requirements used in the development process are shown in table 3.3 below.

Table 3.3: Software Requirement

Features	Software
Game Engine	Unity
Modelling Designing Tool	Blender
Programming Language	C#
Operating System	Windows 10

- Blender

Blender is a software that able to model and design a 3D object. This software will provide more functionality in modelling 3D object which is realization of virtual reality by rendering modelling and appropriate modelling. This software is being used in modelling tree, obstacles and some characters needed in the games. Figure 3.3 shows the interface of Blender.

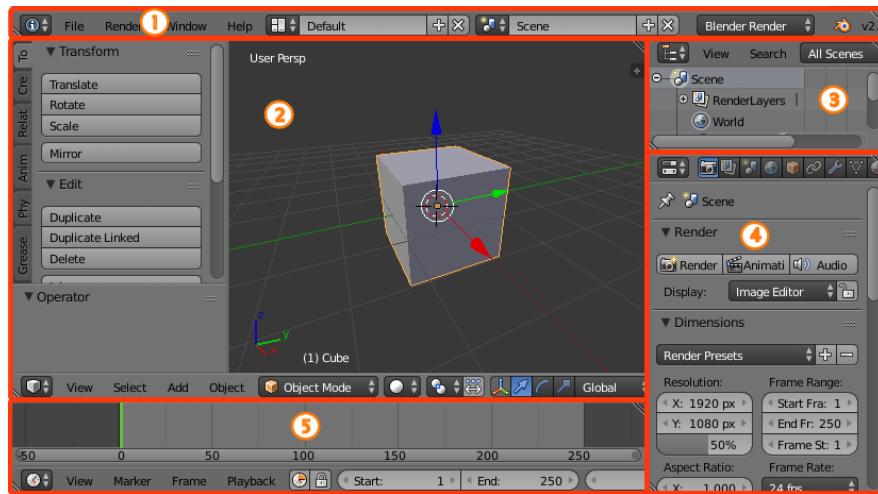


Figure 3.3: Interface of Blender

- Unity

Unity being used as a platform that will be merge modelling from 3Ds Max into a user-friendly and effective environment. This made the content to be deliver across the desktop platform or mobile platform. Unity also being used as the game engine of this project. Figure 3.4 shows the interface of Unity.



Figure 3.4: Interface of Unity

(Source: <https://unity3d.com/learn/tutorials/topics/interface-essentials/interfaceoverview>)

- Hardware Requirement

The purpose of identifying the hardware requirement is to develop the smooth development activities without facing any problem that related with hardware

and the time taken for development process will reduced. Table 3.4 below shows the specification of hardware requirement in this project.

Table 3.4: Hardware Requirement

Laptop	Specification
Model	ASUS VivoBook S14
OS	Windows 10
Processor	Intel® Core™ i5-8250U, CPU @ 3.40GHz
Storage	1TB
RAM	4GB
Graphic card	NVIDIA GeForce MX150

3.2.4 Testing Phase

Testing in this context means internal testing conducted to test the game usability and playability. The testing method is specific to each prototype stage. This phase also ensures smooth and error-free running of the project. After the games are ready to run, the phase will take place. This method to test functional quality criteria is via features playtesting. To test the internally complete quality criteria, it can be done via play testing simultaneously with functionality test.

When a tester discovered bugs, loopholes, or dead-ends during playtesting, the causes and scenarios to reproduce the error needed to be documented and analysed. To test the balanced quality criteria, playtesting with several different treatments is used to categorized whether a treatment is too difficult, too easy, or just fine. The testing performance is the bug report, the request for improvement, and the decision to improve. If it is time to switch to the next stage (Beta) or reiterate the development cycle will be determined by the outcome.

3.2.5 Beta Phase

Beta is a stage called beta testing for third-party or external users to run. Beta testing also uses the same test methods as the previous test process, since both formal descriptions and refinement are the associated prototypes in the beta test. Beta testing is used to identify unsolved problems and feedbacks from the third party. In beta testing, the project will test for effectiveness, satisfaction and functionality. The quality criteria in beta are closely related to the current prototype stage. In formal details testing, the testers are demanded to discover the bugs (related to functional and internally complete quality criteria). In refinement testing, the testers are given more freedom to enjoy the game, as the goals are more directed to get the feedback (related to fun and quality criteria).

For this game, Endangered Ecosystem Awareness VR game will be tested by form 4 students at a secondary school and a few of random publics. They will be allowed to play the game, and then, after the students have finished playing the game, the evaluation form will be distributed.

The examples of concept of question that will be asked is:

- Opinion of using VR games in learning about endangered ecosystem
- The effectiveness of using VR games in learning about endangered ecosystem
- The level of difficulty in using this VR game
- The usability of this VR game

The purpose of evaluation form is to test whether the game is achieving the goals or not which is to test the usability, satisfaction and functionality for every element in the game. The evaluation form will consist of several questions that will ask about some feedbacks after playing the game. From here, it may proceed to the development cycle to refine the product again or, if the outcome is satisfactory, continue to release the game.

3.2.6 Release Phase

Release phase is the final stage in this methodology. In this phase, the complete project will available to be release for user. It is time when the game build has reach final stage and ready to be released to public. The developer needs to include in this phase is product launching, game expansion, project documentation and planning maintenance in process of release the project.

If majority of the respondents agree that the games is effective to be used, free from error and at the same time can improve their knowledge about the Endangered Ecosystem chapter after being tested by the targeted students, the aim for this game is achieved so that the next process is to release the game for publics.

3.3 Gantt Chart

Table 3.5: Gantt Chart

No	Task	Weeks												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Propose title and find supervisor		■											
2	Topic discussion with supervisor			■										
3	Start Chapter 1 (Introduction)				■									
4	Present the problem statement and objectives to CSP600 and supervisor					■								
5	Preparing and submitting Chapter 1						■							
6	Data and information analysis							■						
7	Start develop Chapter 2 (Literature Review)								■■■					
8	Chapter 1 presentation									■				
9	Chapter 2 presentation										■			
10	Start develop Chapter 3 (Methodology)									■				
11	Submit Chapter 3										■			
12	Evaluate and revise the overall chapter and combine the report											■■■		
13	Presentation and final submission											■	■	■

3.4 Conclusion

In the nutshell, as project guidelines, the Game Development Life Cycle (GDLC) will be applied. The phase involved in this methodology is the phase of initiation, pre-

production phase, phase of production, phase of testing, phase of beta and phase of release. In the development of games, GDLC has gained more benefit because this model can entertain users and also ensure high-quality applications are produced. (Idris, Cheong, Nor, Abdul Razak, & Saad, 2007).

CHAPTER 4

DESIGN AND DEVELOPMENT

4.1 Introduction

This chapter highlights the overall process of the project design and development for “Endangered Ecosystem Awareness, ‘Save The World’ via Virtual Reality Game”. This chapter is divided into sub-topics which further explain the use of tools, software, programming languages, design and development steps or techniques for this project, user interfaces, project material, and the list of features included in the application.

4.2 Analysis Requirements of Project Design and Development

The main requirement needed to be taken into account to design and develop a multimedia application is choosing the reliable hardware and software. It is to ensure that the process of the development can be supported in order to complete the project. This section will give the detail explanations about the specification of hardware, software, scripting and other requirements suit for this project.

4.2.1 Hardware Requirement

The hardware section is divided into two parts: the hardware specification used on the user's side for the design and production of the application and brief details on the hardware specification for the operation or running of the application. The criteria and specifications for the hardware specifications used for this project are described in Table 4.1.

Table 4.1 Hardware requirements and specifications

	Hardware	Specification
1.	 Figure 4.1 ASUS VivoBook S14	<ul style="list-style-type: none"> Processor: Intel Core i5-8250u Graphics: NVIDIA® GeForce® MX150 Storage: 512 GB NVMe-SSD 1TB HDD Operating System: Microsoft Windows 10 Home 64 Bit
2.	 Figure 4.2 AOAS wireless mouse	<ul style="list-style-type: none"> 2.4G Wireless Mouse Rating: 3.0V—15mA

4.2.2 Software Requirement

The range of software used to design and create this application is dependent on the software's user-friendliness and ability to generate the necessary components, components, and artifacts needed in the application. This software is used for object modeling, context illustration, 2D object creation, audio editing, video manipulation and editing, element coding and compilation, and integration. Table

4.2 demonstrates the specifications for the program and its functions used for this project.

Table 4.2 Software requirements and specifications

	Software	Functions
1.	 Figure 4.3 Unity 3D	Main software in the development of this application which offered many functionalities and capabilities. Unity 3D provide away from code-free path. The integration of 2D design is much easier to develop game using this software.
2.	 Figure 4.4 Visual Studio 2017	An integrated development environment (IDE) that works with Unity3D as a tool to write the programming language which is C# language for the development of the application.
3.	 Figure 4.5 Blender	A software that creates 3D visualizations such as still images, 3D animations, VFX shots, and video editing. It is well suited to individuals and small studios who benefit from its unified pipeline and responsive development process.

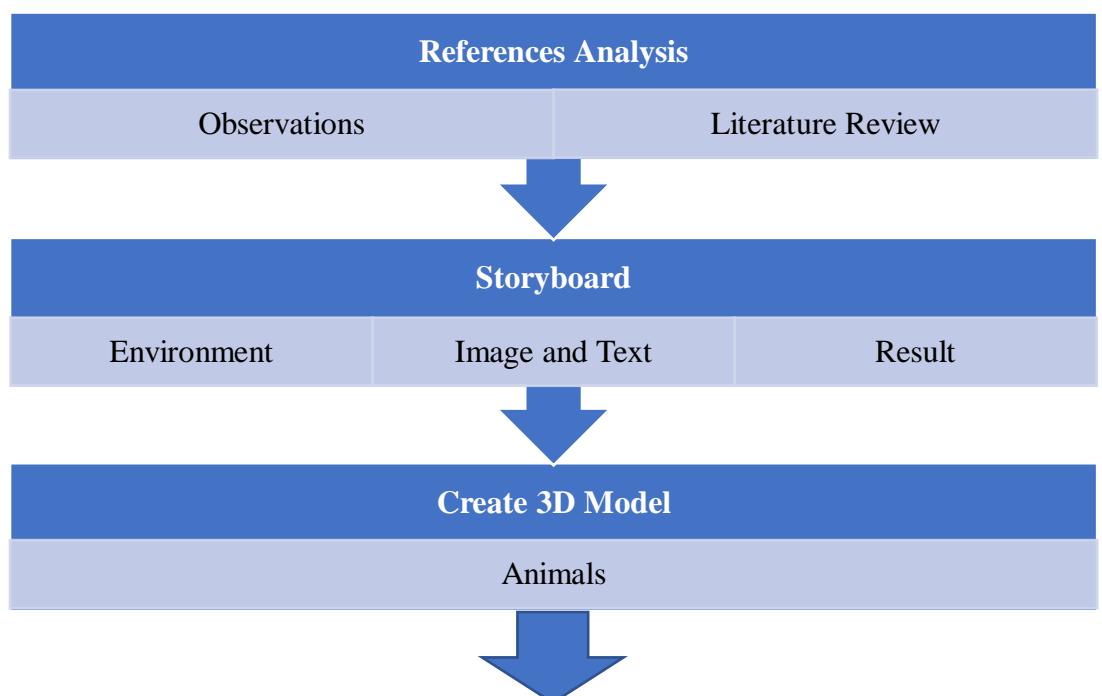
4.3 Project Design

Before creating an application, the usual thing to do is to visualize the ideas in a creative way, such as designing the storyboard and the flow of the application. It is to make sure that the application development process can run smoothly. As for a multimedia application, as the key attraction for users to use the application, design is a very important factor. In this section, all project design phases will be clarified.

4.3.1 Content of the Game

As shown in Figure 4.7, the overall phase of the project in the game involves seven processes during the game's development. The first one to be listed is the study of the comparison. All data on the game was gathered from observation and literature review at this point. The next stage is the storyboard, which is the most significant step in making the game more exciting as the first idea of a game. The design of each scene depicted in the game and the operation of all the buttons used are involved in this phase.

After that, there is development of a 3D Model of some animals in the game, followed by main menu that contains 'Play' button which is to direct user to play the game, 'How To Play' which is giving user the instruction on how to handle the game, and the 'Quit' button which will make the user to exit the application. Next is the creation of a game script. Without the scripting, the game engine would not work properly. The overall development finishes with the Windows Operating System Program, where it will be design in Unity.



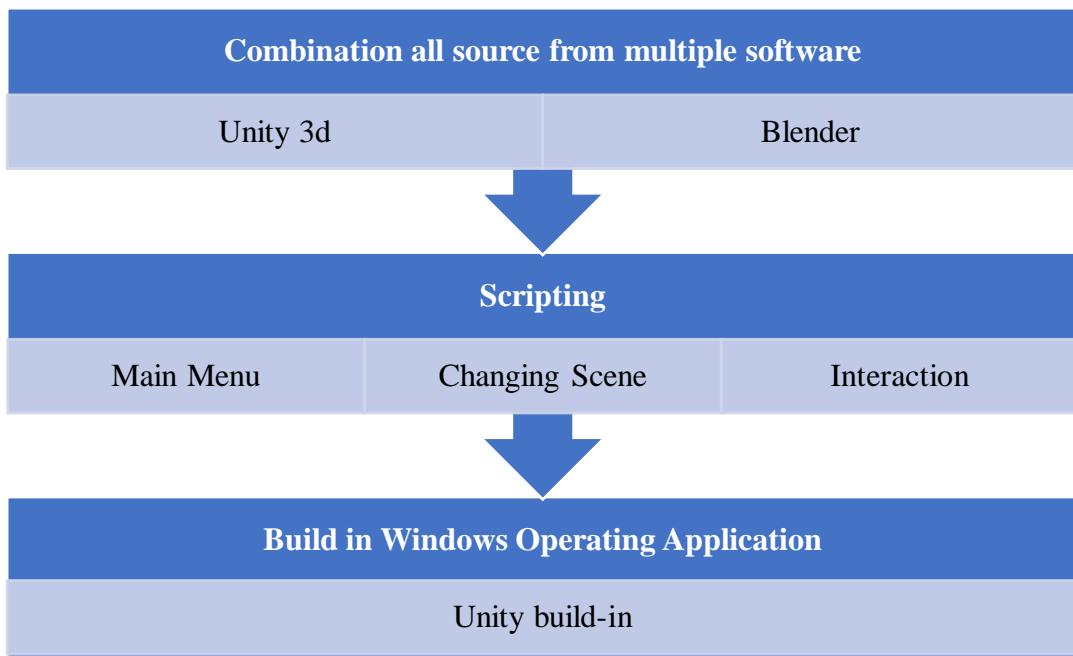
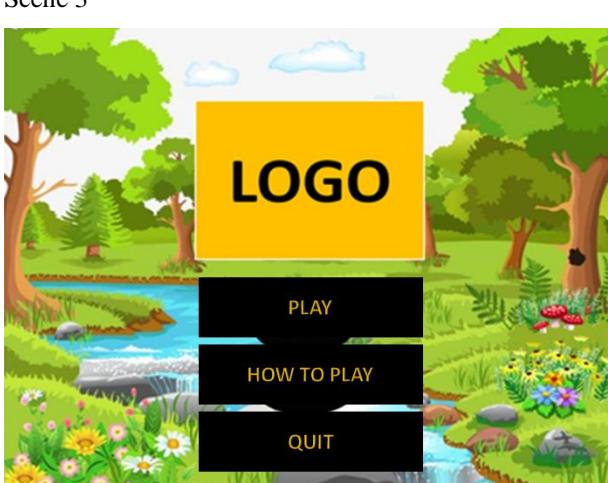


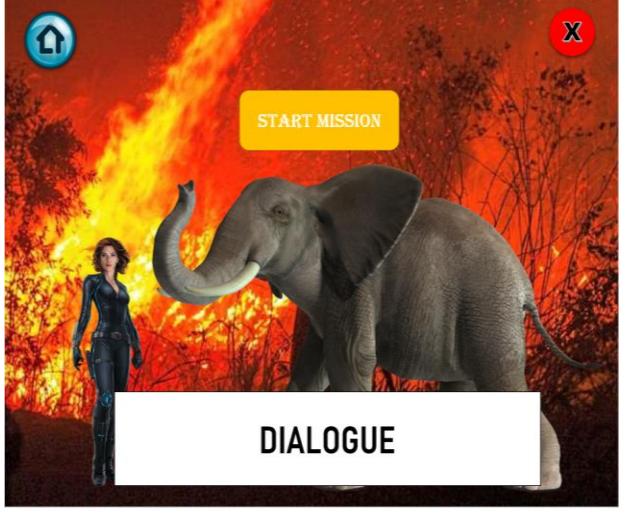
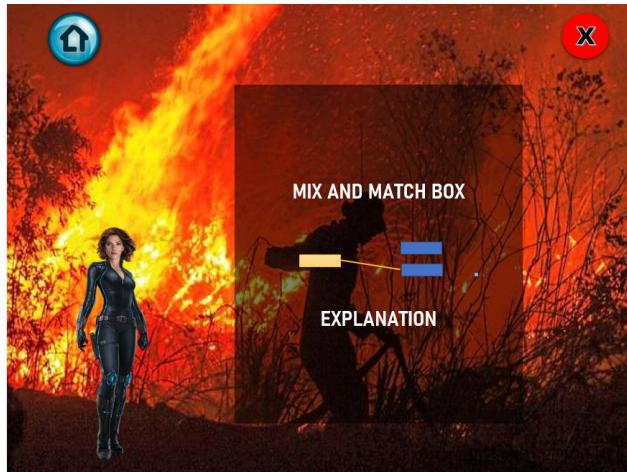
Figure 4.6 The overall process of the game development

4.3.2 High Fidelity Storyboard

Storyboard is needed at the beginning of design process before developing an application. It shows a clear picture on the outcome of the final product of the application include the look and the functionalities. It is a guide in graphic form that give more depth visual presentation in design and development of the application. Table 4.5 shows the storyboard of the Endangered Ecosystem Awareness, ‘Save The World’.

Table 4.3: High Fidelity Storyboard

Scene	Description
<p>Scene 1</p> 	<ul style="list-style-type: none"> • Main page for the game • Consists of logo of game • Button: ‘Play’ button, ‘How to play’ button, and ‘Quit’ button. • Background: scenery of a healthy environment • Sound: Classic piano with the sound of the river
<p>Scene 2</p> 	<ul style="list-style-type: none"> • The ‘How To Play Button will pop up a box that contains the instruction to the user. • Button: ‘Play’ button, ‘How to play’ button, and ‘Quit’ button. • Background: scenery of a healthy environment • Sound: Classic piano Story scene before enter the game. •
<p>Scene 3</p> 	<ul style="list-style-type: none"> • User click the play button • The user will directly go into the game and user can move the third person shooter character in the game to any direction that they want. • The Quit button will exit the user from the application.

<p>Scene 4</p> 	<ul style="list-style-type: none"> • Prompt user to play the game • The first mission, main character (user) will find an elephant that trapped in an air pollution environment. • The elephant will explain the mission to the user in the dialogue box. • Concentration: Elements that determine the ability of player to focus throughout the game. • Immersion: Elements that ensure player to focus as they are the real character inside the game. •
<p>Scene 5</p> 	<ul style="list-style-type: none"> • The user need to solve some quiz. • A little bit explanation about the situation • Challenge: This scene contains elements that determine the challenges and the difficulties of the game. • Player skills: Player should be able to develop some skills and knowledge after passing the mission. • Clear goals: Elements that provide specific goals that need to be achieved by the player.

4.4 Project Development

In this section, the step-by-step processes for developing this application are further developed. The list of software and resources used to build 'Endangered Ecosystem Awareness,' 'Save The World' as mentioned in Section 4.2.2" is as a consequence, further details are clarified in order to fulfill the second goal.

4.4.1 Create the Character and Environment of the Game

The environment of the game is being created by using terrain function in Unity. The forest scene is being developed and some trees and flowers are being insert inside the environment. Unity also being used in developing the main menu page of the game. Besides that, in order to model the character of animals inside the game, Blender is being used. Blender is functioning in creating a 3D model character.

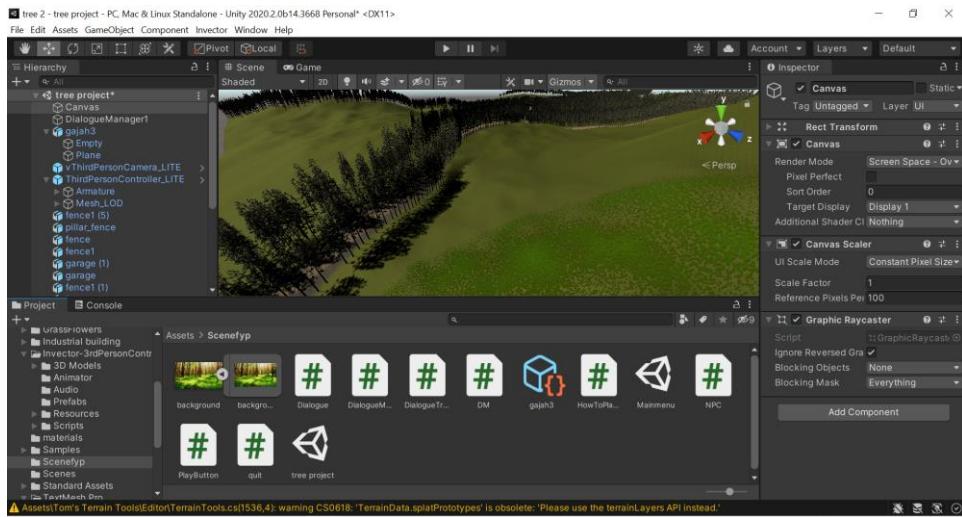


Figure 4.7 The use of Unity to develop the main environment of the game.

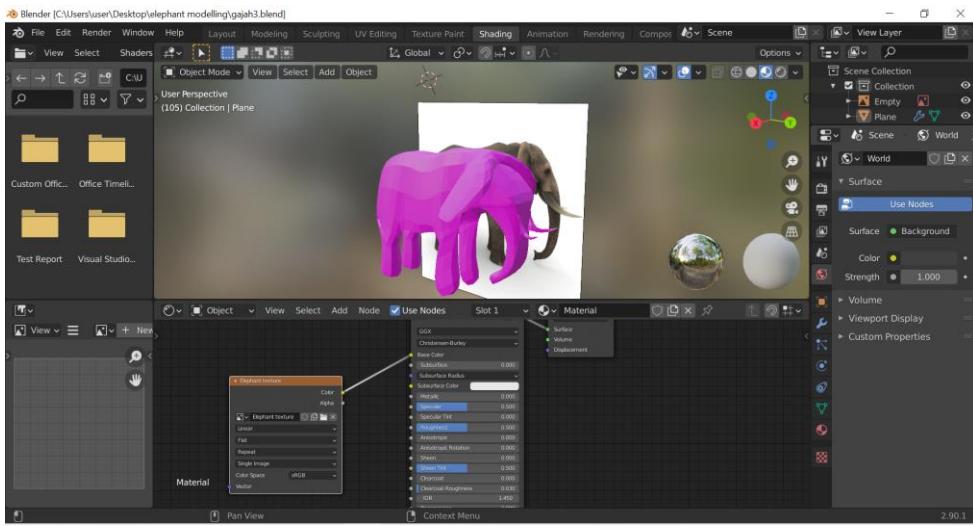


Figure 4.8 The use of Blender to model the character of the game.

4.4.2 Creation of Main Menu

The menu page of the game is being created inside unity by using canvas and panel function. Inside the canvas, all the buttons are created to make the menu page functioning.

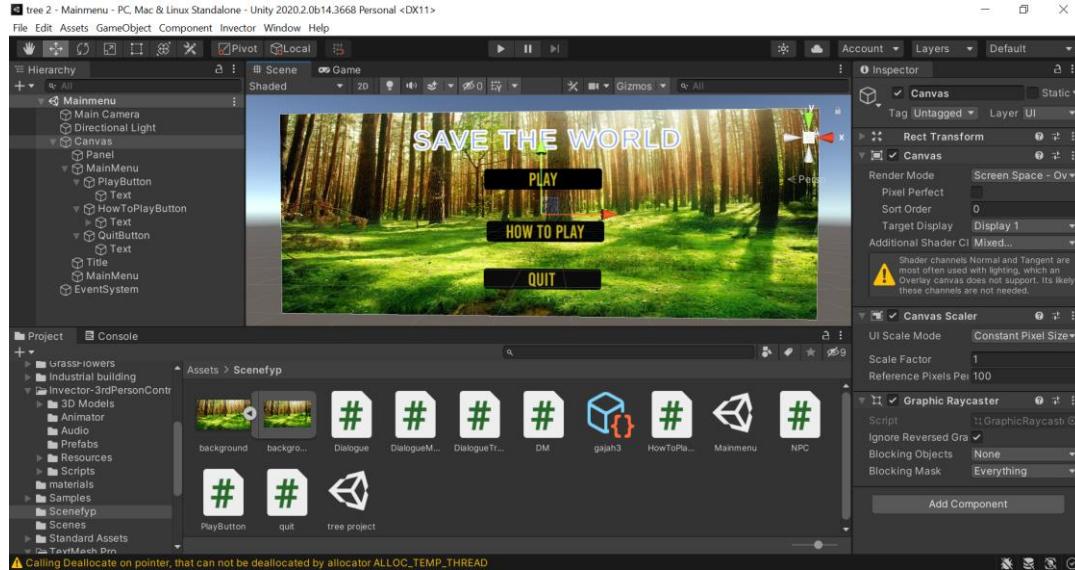


Figure 4.9 The use of Unity to create the main menu page.

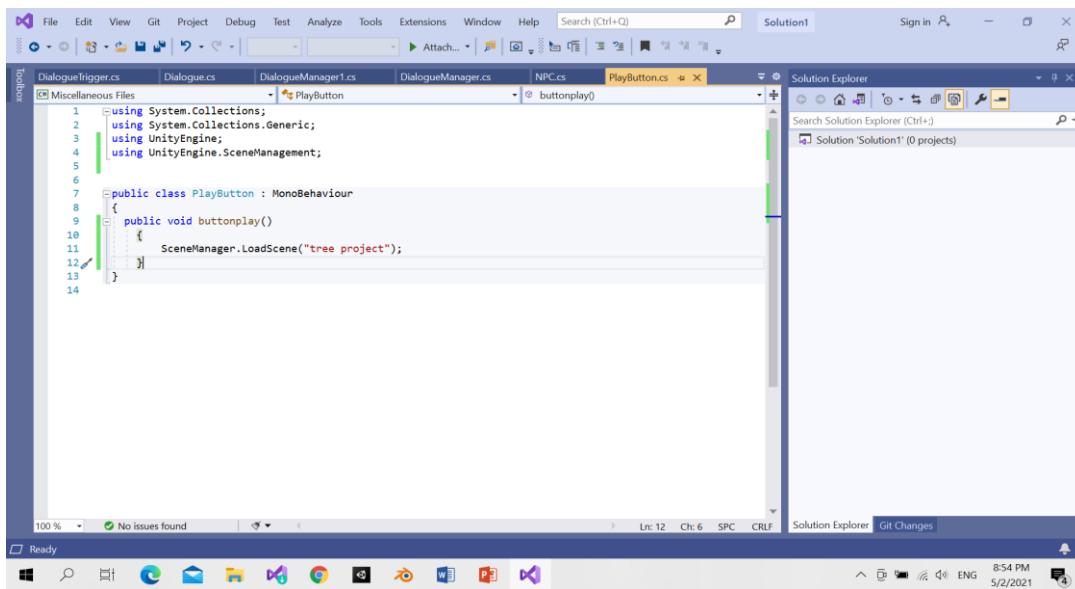


Figure 4.10 The interface of Visual Studio Code

4.4.3 Creation of Gameplay

The gameplay of this application is based on simulation game. This game contains elements inside it which are the character, 3D objects and other props that suitable with the application. All these elements then are organized inside Unity3D with the used of scripting to make the gameplay functional.



Figure 4.11 The environment of the gameplay



Figure 4.12 The Pop up Information

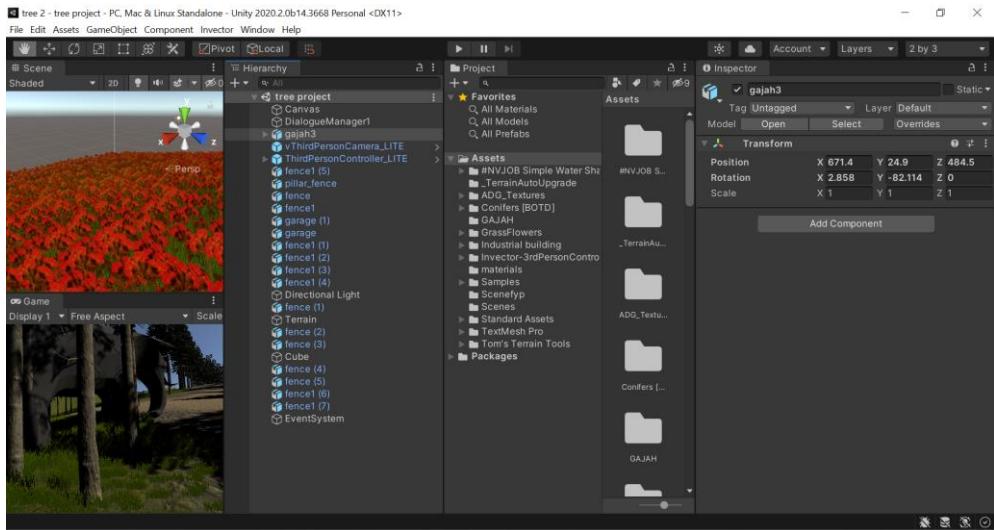


Figure 4.13 The elements included in the gameplay

4.5 Project Implementation

Implementation is the next step after the development has been completed. The goal is to gather and organize all the elements generated during the development of the project, including the character, button environments, backgrounds, props, and many more within the game, and test all the functionalities available in the application.

4.5.1 List of Features

'Endangered Ecosystem Awareness,' Save The World' has several features that able to attract user's attention and level of interactivity between user and the application. Table 4.4 below shows all the features that available in the game.

Table 4.4 List of features in the application

	Feature	Explanation
1	VR game	The application is in a VR mode which absorbs user to feel like being inside the game.
2	Pollution information	Pollution information will be included in the application to educate user and to absorb the awareness of keeping a healthy environment.
3	Animated Character	The animals characters inside the game will allow the user to interact with it.

4	Animation and gameplay	Each level of this game has different difficulty and obstacle for this game inside the game will have specific animation which the enemy will move forward and the numbers of enemy will increase if the level increase. Also, background of the game such as sky is animated to make the game livelier.
5	Guidance	User will be given a guidance and instructions on how to play the game before play the game. All the functionalities inside this game will be teach in the 'How To Play' button.
6	Feedback	At the end of the game, player will get notification that the world is saved.

4.6 Conclusion

The important processes in developing an application project are the design, development and implementation of a project. Before starting the procedures, all the appropriate materials were collected through study. The ideas, sketch, designs are compiled together to make a complete interface of the application and then proceed to the development for a functional application. This application then tested by the end-user to identify any errors for improvement and better functionality.

CHAPTER 5

RESULT AND ANALYSIS

5.1 Introduction

This chapter collects the results and conclusions from the assessment process of this project. Using the support of a graph, it was then measured and represented. The assessment for this software is to evaluate the user's enjoyment of the Endangered Ecosystem Awareness VR game: Save The World.

5.2 Effectiveness Evaluation

In general, effectiveness can be defined as the ability to do something efficiently that achieves the target objectives (Fadzlah.A, 2017). Effectiveness is also defined as the consistency of users' problem solving and error rates when targeting certain objectives (FrØkjaer.E, Hertzum.M, & Hornbæk.K, 2000). Effectiveness assessment is generally found to test mobile applications for the development of useful and useful goods rather than focusing in depth on the calculation of use effectiveness (Fadzlah.A, 2017). Therefore, this project essentially adopts the effectiveness assessment model invented by Fadzlah.A et al. to test the usability of the use of mobile applications.

5.2.1 Participants

The evaluation for this game involved in testing is Malaysian citizen from 10 years old to 54 years old. They need to answer the questionnaires after they play the game in order to get the quality tester for the project. The questionnaires were distributed to ensure the element of the effectiveness could be measured by the participants. The language used in the questionnaires is English and the phrases that are now being rephrased to give participants a better understanding to allow

them to assess properly. Most of the questionnaires use the scale from one to five to simplify decision taking easily. This evaluation was conducted in Bukit Katil,Melaka since Malaysia still in Movement Control Order (MCO). The testing successfully gathers about 20 participants.

5.2.2 Procedures

'Endangered Ecosystem Awareness,' Save The World' can be accessed from personal computer (PC). As all of the participants participating in this assessment have already adapted and familiarized themselves with the new technologies, it has become much easier to continue with this test. The demonstration of how to play the game and how to use all the buttons presented inside the application was demonstrated during the training session. Approximately 10-20 minutes of game play and research per participant. Once the player has already completed the game, they need to respond to the application questionnaires that have already been inserted via Google Form.

5.2.3 Instruments

The questionnaire approach was chosen as the tool for evaluating the project. Since the questionnaire offers an efficient way to demonstrate the collected information and provide the lowest possible cost of gathering the outcome of the research results. After the research was carried out, a series of questionnaires were prepared and distributed to the participants in order to assess the user's enjoyment of this application. Set of the the questionnaire used in the research survey is adopted from the Attention, Relevance, Confidence, and Relevance (ARCS) model. The ARCS model illustrates how the curiosity of a learner ("attention") and motives or values ("relevance") are shown. In combination with his or her expectation of success ("confidence"), the objectives of the goals will be determined highest saliency and will therefore contribute to a purposeful effort to achieve the objective (Hao. K.C, & Lee. L.C, 2019).

5.3 Result and Data Analysis

In order to evaluate the results, input from all participants was estimated and collected during the evaluation process. To get the figures, the overall average must be divided by five and multiplied by 100. The results for each feature in the ARCS model are explained in detail in this section.

Table 5.1 Endangered Ecosystem Awareness, 'Save The World' ARCS Model

ARCS Model	Question(s)	Elements	Modes
Attention	How do you get the learner's attention?	Adventure Focus	VR elements 3D models
Relevance	What is in for the learner?	Real Forest Environment	Forest in VR mode
Confidence	Can the learner achieve the objectives?	Content-Knowledge Digital Literacy Knowledge Self-Knowledge	Gaining Information and Knowledge
Satisfaction	What is the satisfaction or reward?	Meaningful Experiences Authentic Real-Time	VR game

5.3.1 Attention

The attention category includes human characteristics such as the orienting reflex, curiosity, and sensation seeking. The criteria of Attention element is explained in the table 5.2 below.

Table 5.2 Attention Requirements in ARCS Model

Concepts and Process Questions	Main Supporting Tactics
A1. Perceptual arousal What can I do to capture their interest?	Create curiosity and wonderment by using novel approaches, injecting personal and/or emotional material.
A2. Inquiry arousal How can I stimulate an attitude of inquiry?	Increase curiosity by asking questions, creating paradoxes, generating inquiry, and nurturing thinking challenges.
A3. Variability How can I maintain their attention?	Sustain interest by variations in presentation style, concrete analogies, human interest examples, and unexpected events.

Table 5.3 Mean score and frequency of Attention element

Categories	No.	1	2	3	4	5	Mean
Attention	2	0	0	6	13	1	3.75
	5	0	0	0	15	5	4.25
	6	0	0	6	12	2	3.80
	7	0	0	5	13	2	3.85
Total							3.92
Percentage							78.4%

1- Not True, 2- Slightly True, 3- Moderately True, 4- Mostly True, 5- Very True

5.3.2 Relevance

In its most general sense, relevance refers to those items which individuals see it as necessary to meet needs and to fulfill personal needs. Wishes, like reaching personal goals (Keller, 1983). The criteria of Relevance element is explained in the table 5.4 below.

Table 5.4 Relevance Requirements in ARCS Model

Concepts and Process Questions	Main Supporting Tactics
R1. Goal Orientation How can I best meet my learner's needs?	Provide statements or examples of the utility of the instruction, and either present goals or have learners define them.
R2. Motive matching How and when can I link my instruction to the learning styles and personal interests of the learners?	Make instruction responsive to learner motives and values by providing personal achievement opportunities, cooperative activities, leadership responsibilities, and positive role models.
R3. Familiarity How can I tie the instruction to the learners' experiences?	Make the materials and concepts familiar by providing concrete examples and analogies related to the learners' work or background.

Table 5.5 Mean score and frequency of Relevance element

Categories	No.	1	2	3	4	5	Mean
Relevance	4	0	0	8	10	2	3.70
	8	0	0	0	16	4	4.20
	9	0	0	3	15	2	3.95
	10	0	0	5	13	2	3.85
Total							3.93
Percentage							78.6%

1- Not True, 2- Slightly True, 3- Moderately True, 4- Mostly True, 5- Very True

5.3.3 Confidence

Like the other significant parts of the Confidence, an ARCS model, is a complex term that involves several motivational structures that are distinct from those that clarify interpretations of perceptions to the other extreme, personal influence and expectation of success which is helplessness, helplessness (Keller, 1983). The criteria of Confidence element is explained in the table 5.6 below.

Table 5.6 Confidence Requirements in ARCS Model

Concepts and Process Questions	Main Supporting Tactics
C1. Learning Requirements How can I assist in building a positive expectation for success?	Establish trust and positive expectations by explaining the requirements for success and the evaluate criteria.
C2. Success Opportunities How will the learning experience support or enhance the learners' beliefs in their competence.	Increase belief in competence by providing many, varied, and challenging experiences that increase learning success.
C3. Personal Control How will the learners clearly know their success is based upon their efforts and abilities?	Use techniques that offer personal control and provide feedback that attributes success to personal effort.

Table 5.7 Mean score and frequency of Confidence element

Categories	No.	1	2	3	4	5	Mean
Confidence	1	0	0	0	18	2	4.10
	3	0	0	0	17	3	4.15
	11	0	0	4	14	2	3.90
	12	0	0	1	18	1	4.00
Total							4.04
Percentage							80.8%

1- Not True, 2- Slightly True, 3- Moderately True, 4- Mostly True, 5- Very True

5.3.4 Satisfaction

The final step in the motivational process is to build satisfaction so that there is fulfillment. The Motivational Concept Arcs Model will be continued encouragement to learn, and constructive recommendations of the course for other individuals. In this section, the three Strategy Categories provide instructions on how to decide what styles of strategy to encourage contentment. The criteria of Satisfaction element is explained in the table 5.8 below.

Table 5.8 Satisfactins Requirements in ARCS Model

Concepts and Process Questions	Main Supporting Tactics
S1. Intrinsic Reinforcement How can I encourage and support their intrinsic enjoyment of the learning experience?	Provide feedback and other information that reinforces positive feelings for personal effort and accomplishment.
S2. Extrinsic Rewards What will provide rewarding consequences to the learners' success?	Use verbal praise, real or symbolic rewards, and incentives, or let learners present the results of their efforts to reward success.
S3. Equity What can I do to build learner perceptions of fair treatment?	Make performance requirements consistent with stated expectations, and use consistent measurement standards for all learners' tasks and accomplishments.

Table 5.9 Mean score and frequency of Satisfactions element

Categories	No.	1	2	3	4	5	Mean
Satisfactions	13	0	0	8	12	0	3.60
	14	0	0	0	19	1	4.05
	15	0	0	6	13	1	3.75
	16	0	0	0	18	2	4.10
Total							3.88
Percentage							77.6%

1- Not True, 2- Slightly True, 3- Moderately True, 4- Mostly True, 5- Very True

5.3.5 Overall Results

The overall average from all the ARCS model elements were compute in order to get agreeability of the effectiveness of Endangered Ecosystem Awareness,' Save The World' application. The percentage of success rate is calculated in order to measure the effectiveness of this application.

Table 5.10 Total of overall mean

Categories	Mean Average
Attention	3.92
Relevance	3.93
Confidence	4.04
Satisfaction	3.88
Total	4.03

Frome the table 5.10 above, the calculation is based on likert scale (1-5). The total point is 5 and the total mean average is 4.03. Therefore, to count the overall effectiveness testing for this set of tasks, this equation is used:

$$\begin{aligned}\text{Effectiveness (\%)} &= (\text{Total Mean Average} / \text{Total Point}) \times 100\% \\ &= 4.03/5 * 100 \\ &= 80.6\%\end{aligned}$$

Based on the result above, the effectiveness test for Endangered Ecosystem Awareness, 'Save The World' is 80.6%.

5.4 Conclusion

The overall results obtained from the data analysis based on the ARCS model instrument conclude that all respondents accepted that this game met the user's enjoyment criterion based on a high score of 80.6 percent achieved for this application. The result obtained from this evaluation also will help on the future effectiveness of this application. Furthermore, the results also proved that the respondents are interested and enjoy using this application as a medium to learn more about the healthy environment.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Introduction

The final step for the research project is to list the entire project's ultimate conclusion, which includes the shortcomings that can be found on the application and potential suggestions for future progress. Below, both of these are explained.

6.2 Features

Different features have been introduced in Endangered Ecosystem Awareness,' Save The World' to ensure the program user-friendly and enjoy to use. This feature can be seen in the way of deliver the content of the application.

The main features is to supply information and knowledge about the pollution that occurs and how to overcome it. All the information can be accessed according to the character. Hence, user can learn about the environment in an enjoyable way.

Next, players are can go through the environment of the forest inside the game, that prompt user to communicate with the animals then answering the quizzes given.

Finally, this game is a computer platform that means that when playing with a big screen, using desktop PC screens with a large screen size, an immersive

experience and players can have more satisfaction experience. In addition, the keyboard and mouse were used more by desktop PCs, enabling the user to scroll and click more familiarly and comfortably using experience.

6.3 Limitation

During the development and testing process of Endangered Ecosystem Awareness,' Save The World', several product shortcomings have been discovered and detected. The first drawback is that this program is only designed for computer devices so it is not quite compact, which means that it is not possible to move the user as quickly as a console or smartphone application. The second limitation is that the user cannot play the game through level by level, there is only one scene that user face to get all of the information and knowledge from the application.

6.4 Recommendations

For the continued development of this project, the principles and possible additional concepts for this application have been evaluated. Moreover, to make the game more fun, all the constraints that have been found will hit their solutions for improvements and better functionality.

The first suggestion is to create an application that fits not only machine or PC platforms, but also cell phones for both platforms. It is hoped that this application would be able to reach the market by publishing it on the online market, such as GooglePlay and AppStore.

The second suggestion is that several languages be added and supported within this application. This application can be commercialized with this feature without any language barrier.

The third recommendation is to build several enemy characters to make it easier for the user to demonstrate the difference between levels. In addition, as there is more personality, the application will become more interesting.

Finally, with more fun sound effects, the last suggestion for this application is to create different gameplay within the application, such as puzzles, drag and drop, and many more. This can make the program more appealing and encourage users to choose different kinds of games.

6.5 Conclusion

It can be concluded that the three goals described at the beginning of the first chapter have been successfully achieved after going through every stage in the creation of this project. The first objectives are to design an educational VR game to learn about the endangered ecosystem in an interactive way. The second objective is to develop a game of endangered ecosystem by applying non-immersive virtual reality and the last one is to evaluate the enjoyment of the application in delivering information to user.

Based on the result measured in Chapter 5, it shown that the Endangered Ecosystem Awareness,' Save The World' as for the young generation, it is beneficial that most of the participants have positive feedback while evaluating the application. In this chapter, the features and limitations are clarified in detail and further changes or recommendations are described on the basis of the limitations in order to update this application in the future.

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APPENDICES

APPENDIX A: GANTT CHART

SEMESTER 5 (CSP600)														
PROPOSAL ACTIVITIES	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Proposed Supervisor	■	■												
Mutual Acceptance Form (F1) submission			■											
Proposal Outline Form (F2) submission			■											
Submission of Chapter 1				■										
Chapter 2 – Literature Review					■	■	■							
Mock Presentation - Chapter 1						■	■	■						
Submission of Chapter 2								■						
Chapter 3 - Methodology									■	■				

Submission of Chapter 3														
Plagiarisms Checking														
Final Proposal Submission														
Proposal Presentation														

SEMESTER 6 (CSP650)														
PROJECT DEVELOPMENT	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Software installation														
Design interface														
Design image assets														
Design animation														
Page navigation														
Insert data														
Develop quiz section														
Check overall application														
Chapter 4 (Design and Development)														
Project testing preparation														
Project testing														

Mock presentation															
Chapter 5 (Evaluation)															
Chapter 6 (Conclusion and Recommendation)															

APPENDIX B: EVALUATION QUESTION

Part A

Answer all of the following questions.

Gender

- Male
- Female

Allocated time to play games within a week

- 0 hours a week
- 1-3 hours a week
- 4-6 hours a week
- 7-9 hours a week
- More than 10 hours

Next

Part B

Check (/) the most appropriate for the statements below.

When i first looked at this application, i had the impression that it would be easy for me.

1 2 3 4 5

Not True Very True

There was something interesting at the beginning of this application that got my attention.

1 2 3 4 5

Not True Very True

After reading the instruction given in the menu of the game, i knew what i supposed to learn from this application.

1 2 3 4 5

Not True Very True



It is clear to me how the content of this application is related to things i already know.

1 2 3 4 5

Not True Very True

The quality of font writing in this game helped me to hold my attention.

1 2 3 4 5

Not True Very True

The way the information is arranged in the game helped keep my attention.

1 2 3 4 5

Not True Very True

This application has things that stimulates my curiosity.

1 2 3 4 5

Not True Very True

There were objects, pictures or examples that showed me how this application could be important to people.

1 2 3 4 5

Not True Very True

Completing this application successfully was important for me.

1 2 3 4 5

Not True Very True

I could relate the content of this lesson to things i have seen, done, or thought about in my own life.

1 2 3 4 5

Not True



Very True

As i worked on this game, i was confident that i could learn the content.

1 2 3 4 5

Not True



Very True

I understand the information in the game very well.

1 2 3 4 5

Not True



Very True

I feel that by playing this game gave me a lot of satisfaction.

1 2 3 4 5

Not True Very True

Completing this game gave me a satisfying feeling of accomplishment.

1 2 3 4 5

Not True Very True

I really enjoy playing this game.

1 2 3 4 5

Not True Very True

It felt good to successfully complete this game.

1 2 3 4 5

Not True Very True



APPENDIX C: TURNITIN RESULT

fyp report			
ORIGINALITY REPORT			
29%	18%	17%	18%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS
PRIMARY SOURCES			
1 Submitted to Universiti Teknologi MARA Student Paper	6%		
2 jiharu.github.io Internet Source	2%		
3 Chris Ferguson, Egon L. van den Broek, Herre van Oostendorp. "On the role of interaction mode and story structure in virtual reality serious games", Computers & Education, 2020 Publication	1%		
4 acagamic.com Internet Source	1%		
5 Yeon Ju Jang, Eunil Park. "An Adoption Model for Virtual Reality Games: The Roles of Presence and Enjoyment", Telematics and Informatics, 2019 Publication	1%		
6 es.scribd.com Internet Source	1%		
7 hdl.handle.net			