PUBLIC AWARENESS THROUGH GAME-BASED LEARNING

Project ID: 2020-054

Final Project Thesis

Dassanayake D.K.M.P.M.M, S.N Wijesinghe, T.L.C Jayasiri,
K.A.R.T Keenawinna

B.Sc. (Hons) Degree in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology
Sri Lanka

September 2020

PUBLIC AWARENESS THROUGH GAME-BASED LEARNING

Project ID: 2020-054

(Dissertation submitted in partial fulfilment of the requirement for the
Degree of Bachelor of Science Special (Honors)
In Information Technology

B.Sc. (Hons) Degree in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology
Sri Lanka

September 2020

Declaration

We declare that this is our own work and this proposal does not incorporate information without acknowledgement of any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Student ID Number	Name	Signature
Dassanayake D.K.M.P.M.M (GROUP LEADER)	IT17160308	Moditha
S.N Wijesinghe	IT17013642	Sandali
T.L.C Jayasiri	IT17701174	Chamindi
K.A.R.T Keenawinna	IT17162142	Ruvin

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor: Date

24/02/2020

Dr.Windhya Rankothge

Abstract

Sri Lanka is a developing country as of the classifications done by several organizations throughout the world. A nation with minimum problems relating health, environment, infrastructure and technology are considered as developed countries. As Sri Lanka being a developing country, it still consists of problems of above-mentioned areas. Apart from the risk associated with these problems, the main challenge faced by developing countries is, making the public aware of these problems.

This thesis is mainly focusing on an effective solution named 'AwareMe' (1) health awareness (dengue fever), (2) environmental awareness (garbage disposal), (3) cyber security awareness (social media) and (4) safety awareness (road safety) using game based learning. The "AwareME" platform includes quizzes, 2D/3D puzzle games, and 3D action games with activities to improve the cognitive skills and awareness of the public. We have provided the results of an initial performance evaluation of "AwareME" platform.

Keyword: game-based learning, public awareness program, cognitive skills

Acknowledgement

The work mentioned in this document was done as our 4th year research project for the CDAP module. This project is a result of all the dedicated work of the group members and the encouragement, support and guidance given by many others. Our team would like to express our appreciation to all who gave us the support in completing this substantial task.

Initially I'm thankful for my research group members as this project is a result of all the dedicated work of them.

We're intensely grateful for Dr. Windya Rankothge the supervisor of the project for her intellectual comments, recommendations and the guidance given throughout the project.

We're also thankful for Ms. Narmada Gamage our co-supervisor for all the support and suggestions provided for the improvement of developing the research project and specially in our documentation process.

We owe our gratitude to Dr. Janaka Wijekoon, for accepting our research idea, directing us in finding a suitable supervisor at the beginning of our project and all the guidance and support given throughout the project.

Our sincere gratitude to Dr.Dasuni Nawinna and Ms.Dilani Lunugalage the panel members of presentations/viva who confirmed the permission to carry out this research and for feedbacks given at presentations.

We are grateful for Mr.Tharindu Dharmasena who provided an innovative idea as to make an awareness game while selecting the group research topic.

My deepest gratitude for Mr.Amila Nuwan senarathna for guiding us in selecting the individual research components relating to the field of specializations.

We also thank Mrs.a.d.y Anandani the divisional secretariat of kaduwela district for providing valuable information required for the research.

We are thankful for the participants of the online survey for lending their precious time in giving their responses at the requirement gathering phase and throughout the testing phase.

In addition, our team is grateful for the support, comments and advice received from our colleagues in Sri Lanka Institute of Information Technology and for their enormous support and guidance towards the success of this product. The support received from all other parties is acknowledged as well.

Finally, we would like to thank all others whose names are not listed particularly but have given their support in many ways and encouraged us to make this a success.

Table of Contents

List of figures

List of Table

List of Appendices

1 INTRODUCTION

Social issues rise day by day. Also, solutions for these issues are within the society. To overcome these problems a proper awareness should be provided. Even though there are public awareness programs on these problems, they are not very effective, as they are not attractive, and the public is too busy to attend the programs. However, in the modern society game-based learning is a new and certified concept to aware people easily about the problems. In fact, public awareness through game-based learning is rather a new conception. Games can be an interesting medium for conveying information.

1.1 Background

In modern world, developed countries have minimum problems related to areas such as health, environment, infrastructure, and technology. However, developing countries face many problems in those areas, such as, diseases, natural disasters, deathly accidents etc.

Through the data collected by the divisional secretariat of kaduwela a proper solution for the prevention of this further is highly required. Game based learning is the effective method to aware people about the social problems as it is an interesting awareness tool.

Serious mini games are promising tools to raise awareness. They motivate and enhance players' interest in a particular topic, and only require a small time-investment. The games should focus on a single concept or learning goal and should be carefully designed [1].

The research conducted by the NIHR MindTech Healthcare Technology Co-operative regarding Computer games for user engagement in Attention Deficit Hyperactivity Disorder (ADHD) monitoring and therapy has mentioned that "Games are an attractive means of engaging people in medical interventions and clinical studies and to encourage healthy behaviors or increase health awareness and education" [2].

A study indicated that the educational games with colorful images, multiple audio effects, and diversified teaching materials can be used to enhance students' learning motivation and to further improve learning effectiveness [3].So, in this research, we are planning to

use a game-based learning approach to improve the public awareness on dengue fever, garbage disposal, social media and road safety.

In the beginning of this Century as a developing third world country Sri Lanka is facing several health issues. According to the Health Ministry Reports Dengue Fever is the most widespread fever in Sri Lanka in past few decades. Even the World Health Organization (WHO) consider dengue as a major global public health challenge in the tropic and subtopic nations [4]. Many activities are implemented to reduce the dengue fever in Sri Lanka. A national-level multidisciplinary task force on DF/DHF has been established to govern the DF/DHF control activities [5].

Sri Lanka face huge problems due to garbage. As an example, part of the Meethotamulla garbage dump mountain recently collapsed. Taking 30 human lives toll as of 16-04-2017, this disaster had left 1,500 homeless and displaced families [6]. Not properly disposing of garbage can also harm human health. Through these activities, individuals are exposed to various diseases. Educational games are one form of application-based learning strategies that may have the pedagogical potential to enhance environmental education among the current generation [7].

We live in an exciting time of new technological advancements and opportunities, and we can access more information and make more connections all around the world than ever before. Social media is the platform providing these types of services. Facebook plays a major role in social media platforms. According to Mark Zuckerberg, "If Facebook were a country, it would be the 6th most populated country in the world". While enjoying the information sharing on social Medias, yet it requires a great deal for security and privacy. User privacy violation caused due to lack of knowledge in social media usage is the main cause for this. The real privacy risks are believed to arise when users disclose identifiable information about themselves online to people who they do not know or normally (that is, offline, in real life) would not trust (see e.g. Brooks, 2007). This is assumed to stem from the users' lack of privacy concerns (Gross & Acquisti, 2005) According to several studies,

however, the awareness of the importance of online privacy is still insufficiently widespread [8] [9] [10]

While there are about **21,381,002** population in Sri Lanka most of the people among die due to road accidents. Road accidents are on the rise and have reached a peak in recent times with fatal accidents recorded almost daily causing multiple deaths. Therefore, road safety is a serious issue which should be given proper attention. In learning of road safety, the use of computer is significant to ensure the knowledge can be converted to experience. The use of IT has already begun by children from the age of 2 years. These children are exposed to technology by their parents through gadgets and computers [11]. So, an awareness game using game-based learning will be the best method to aware about road safety.

1.2 Literature Review

As a developing country, social problems are significant in Sri Lanka. People need to be more aware about these to prevent these from happening further. At the end of the day, to ensure that a social issue sticks out, it must resonate with people in general at large. to take an action Individuals need to feel personally connected to a cause. The best way to reach the greatest audience is through awareness programs but it is not effective due to the busy lifestyle of the people. For that game-based learning is a good option which will be interesting for everyone. Many researches on the importance of game-based learning for awareness had been done. Some of the selected previous researches on public awareness on health, environment, Cyber security and road safety through game-based techniques are mentioned below.

When considering the environmental awareness previous researches are as follows: Trash Attack [12] which is a 2D Action Puzzle Video Game to Promote Environmental Awareness and Waste Segregation Behavior based with a storyline that revolves around a girl named Julie who is tasked by Heidegger Industries with cleaning up a community full of waste using her special weapon that can teleport trash to recycling or proper disposal

facilities. To help combat the increasing waste disposal and spread awareness about the environment, game mechanics were designed to familiarize players with the idea of waste segregation. The proponents created this video game over a three to four-month period using Unity Engine, Photoshop, Illustrator, Autodesk Maya and other multimedia editing software.

Another research on waste management through game-based learning is the implementation of the game recyclops.it is a virtual reality educational game for the awareness of the waste management [13].The research targets the freshman college students. The game's learning point is appropriate removal of waste, for example, treating the soil and reusing, inside a virtual model of a local college campus. Serious and educational games have been indicated not exclusively to engage and motivate students yet additionally to encourage the improvement of complex critical thinking abilities. Virtual Reality (VR) is another technological advance which is known to increase student engagement by immersion. VR has been shown to lead users to create empathic connections to their virtual environment.

As we live in an exciting time of new technological advancements and opportunities, access is possible to more information and more connections are made easily throughout the world in just few seconds. This was made easy with the introduction of social media platforms to the world. Though this sounds interesting there are many bad effects due to this technological improvement. Due to this, many researches have been done in the awareness of social media. A study by Bioglio, Livio & Capecchi, Sara & Peiretti, Federico & Sayed, Dennis & Torasso, Antonella & Pensa, Ruggero address the issue of upgrading youngsters' attention to the systems including security in online social networks by displaying an inventive methodology dependent on gamification. They proposed a web application named social4school that permits children and adults to encounter the normal elements of data spread through a sensible intuitive reenactment. Under the supervision of the teacher, the students are embedded in a little fake social chart, and, through the various phases of game, they can post sentences with various degrees of sensitivity, and

"like" or share messages distributed by friends. Toward the finish of game session, the application figures numerous conduct scores that can be utilized by the teacher to raise the interest of the students and stimulate discussions. Besides, a total intuitive report is created to dissect each students' actions of the ended game sessions. The study has been utilized inside a broad exploratory examination including in excess of 450 children and 22 teachers in seven Italian primary schools. The results show that our approach is stimulating and supports teachers in helping kids discover and recognize potential privacy risks in social network activities [14].

A serious game named friend inspector was developed by Cetto, M. Netter, G. Pernul, C. Richthammer, M. Riesner, C. Roth, and J. S¨anger to enhance the privacy awareness of the social network site (SNS) users. Friend Inspector tends to the present test of SNS clients, to be specific to comprehend who can see their shared personal items. A game-based approach was used to address the younger crowd. The applied plan of Friend Inspector depends on two foundations: firstly, an in-depth understanding of privacy awareness as the match or mismatch between perceived and actual visibility of shared items. Secondly, an inductive learning approach that allows its users to experiment and play with their own Facebook data in order to actively learn about the visibility of their personal items [15].

Understanding fundamental role of the awareness and knowledge of traffic guidelines and terrible driving rehearses in reducing traffic accidents is very important. Due to this Games to aware people about road safety was a research area done by several researches. Road Safety Awareness among College Students in a North Indian Town was one such research done. This game has mainly been used for the college students in a North Indian town. Using this system, the students are given a knowledge about road safety and traffic regulation [16].

A computer-based game which mainly covered about road accidents was done by M S Zeedyk Department of Psychology, University of Dundee, Dundee DD1 4HN, UK. How

they happened? / Who are victims? / Why their accidents happened the places? / Where accidents happened mostly?

This system has mainly been focused for children. As it is a computer base game, they use 2D technology [17]

A mobile based application called tackling children's road safety has been implemented to give the students and idea using video clips and animations about road safety**.**2d technology is used here. This is a method of tackling children's road safety [18]

A system using VR technology for road safety and timing was implemented. Answers for these questions were covered there, how they cross the road? / Traffic accidents? / How accidents occur? / How do they prevent them? Through this system it can be used to measure the knowledge about road safety of people [19].

Lord Buddha Quotes "health is the greatest gift, contentment the greatest wealth" [20] In the beginning of this Century as a developing third world country Sri Lanka faces some Health issues where dengue plays a major role in it. making people aware about, and as a public how we should prevent from the dengue fever is a big challenge.

Diego Buchinger and Marcelo da Silva Hounsell are graduate students in Santa Catarina State University, DCC – Computer Science Department, Brazil. for final year research project, they implemented a game including 8 sublevels to aware people about dengue fever.in this research they focused on traditional learning concept. Some levels of that game used Augmented Reality Technology while some levels used Virtual Reality Modeling Language [VRML]. They used sherlock homes 3d model as an Actor in this game. In this research using of Sherlock Holmes investigative skills and thinking ability to increase the effectiveness and the awareness of public was done [21]

In 2005 Jeffery L Lennon and David W Coombs publish a research paper about dengue awareness. They implemented an educational gaming tool called GBD for school age children. The purpose of this research was to examine the debriefing of Philippine students after playing of the health education game on dengue fever, determining the student's opinions of this game, their awareness of dengue fever and finally exploring the

possibilities of this game. In this research, researchers mainly focused on data collection part. They collected data from grade 5 students of two different schools and checked the current awareness of students. They encouraged the students to play the GBD. Finally, researchers manually analyzed the new awareness status of the students who played the game with the students who didn't play the game [22].

1.3 Research gap

With the rise of technology many researches were focused on awareness programs which can be done using technology. There, many had implemented games which covers a specific problematic area in the world whereas in the proposed game (AwareMe) a single gaming platform is made which covers four major problematic areas which includes health, environment, cyber security and road safety in Sri Lanka. Research gap of the proposed game with other researches are presented below.

Health awareness using game-based learning

A 3D/VR game was implemented as 'Sherlock Dengue game' where Sherlock Holmes investigative and thinking abilities were used [23]. The main difference of it with the game AwareMe is that it only encourages school children to play the game.

Good bye dengue game is a web-based application implemented using Augmented Reality Technology. It mainly focuses about the data collection part where they manually get feedbacks from the children those who played the game and who didn't play the game to check the new awareness status. Much consideration was not given for the game development process. They also encouraged only the school children to play the game.

X-Dengue game is a web-based gaming platform. It mainly used gamification techniques to implement the game. They mainly focused on information gathering about dengue fever as a research part of this research. User abilities were not focused. In the development part they used only 2D models to implement the X-Dengue Game.

Table 1. 1: Social media awareness projects

Features	Sherlock Dengue Game	Good Bye Dengue Game	Design and development Serious Dengue game	Dengue homothetic Fever Game	Proposed Game [AwareME]
Identifying the abilities of the player should improve	✓	✗	✗	✗	✓
Identifying the most suitable game to be implement	✗	✓	✗	✓	✓
Using Virtual Reality	✓	✗	✓	✗	✓
Using 3D modeling prototypes	✓	✗	✓	✗	✓
No restriction for the different ages	✗	✗	✗	✗	✓
Using Mobile Application	✓	✓	✗	✗	✓

Social media awareness using game-based learning

Social4school is a game implemented to aware the people about user privacy violation but there they have mainly focused on sharing of posts in Facebook while AwareMe is directly focusing on weak password usage and oversharing information as categories of user privacy violation. Another difference of the two games is that Social4School is designed for kids. But AwareMe was focused on all citizens aged above 10. When considering the technological side AwareMe used 2D/3D/VR technologies while Social4School was a 2D game. Ability identification and improvement of decision-making ability was given a vital role in AwareMe while Social4School is not directly focused on improving the abilities of the kids.

Current challenges of the social network users are focused in the game 'Friend Inspector' but it is to understand who can see their shared personal items. So, the difference of AwareMe is that it focuses on weak password usage and oversharing information. Friend Inspector is a web based 2D game while AwareMe is a mobile based 2D/3D and VR game. Ability identification and improvement is not concerned by Friend Inspector.

CyberCIEGE is a game mainly focusing on teaching the network security concepts to the players. This is a sophisticated game. Though it is an awareness game relating cyber security it doesn't aware about Facebook. It is a 3D game where as AwareMe uses three technologies. CyberCIEGE is a web-based game while AwareMe is a mobile based game [24].

Table 1. 2: Social media awareness projects

Features	**Social4school**	**Friend inspector**	**CyberCIEGE**	**AwareME (proposed game)**
User privacy violation awareness	✓	✓	✗	✓
Using virtual reality	✗	✗	✗	✓
Weak password and oversharing information awareness in Facebook	✗	✗	✗	✓
Identification of user abilities	✗	✗	✗	✓
No restrictions for different ages	✗	✗	✗	✓
Mobile based game	✗	✗	✗	✓

Waste management using game-based learning

Trash Attack, Attack of the Recyclops, reCyCLOR are the games which are substitutes of AwareMe, but they have several differences compared with AwareMe [25]. Most of the researches that have been completed is based on technology 2D and 3D. Some of the games have been used to aware people about garbage categories. A lot of games are designed to enhance the user's abilities at the end of the game. Most researches have not collected data from the users before the game was implemented.

The proposed system will be developed using 2D/3D and virtual reality (VR) technology. At the level of data gathering, the collected data is to be analyzed. The main research part of proposed system is to create the best game to improve user ability. The human ability to develop is determined by using gathered data. According to this environmental awareness game, it is mainly focused on garbage disposal. It has been decided to create games under environmental pollution, garbage disposal, and garbage collection.

Table 1. 3: Waste management projects

Researchers / Features	Trash Attack	Attack of the Recyclops	reCyCLOR	Proposed Project (AwareME)
Segregation of garbage (Bio-degradable, degradable , recycling)	✓	✓	✓	✓
Proper waste disposal	✗	✗	✓	✓
Improve user ability	✗	✓	✓	✓
Virtual reality	✗	✓	✗	✓
2D	✓	✓	✓	✓

Road safety awareness using game-based learning

There are many road safety systems developed by the people. But most of them are focused on small children. Most of the systems are developed by using different methods. And most of these systems are developed by looking at only the general problems. But here in the proposed game (AwareME) focusing on the user abilities and the improvement of it using game-based learning is mainly focused [26].

Table 1. 4: Road safety awareness projects

	Features	Road Safety Awareness among College Students in a North Indian Town	Computer Games as Learning Children Road Safety Education	Tackling children's road safety	Using VR with smart phones for road safety awareness and timing	Proposed game [AwareME]
Safety Awareness [Road Safety]	Rules of road (crossing the road, traffic accidents)	✓	✓	✗	✓	✓
	Audience (Children)	✓	✓	✓	✗	✓
	VR (Virtual Reality)	✗	✗	✗	✓	✓
	2D/3D Technology	✗	✓	✓	✗	✓
	Using ability	✗	✗	✓	✗	✓

1.3 Research Problem

There are many types of public awareness programs presented in Sri Lanka to understand people how they respond and solve public problems in day to day life. In past decade awareness programs are a bit similar, bored as well as complex, therefore the public faced difficulties in understanding how they should respond to public problems while living in the society. However, in the modern society in Sri Lanka game-based learning is a new and certified concept to aware people easily about the problems. In fact, public awareness through game-based learning is rather a new conception. It has not been the subject of much researches.

The divisional secretariat of Kaduwela district Mrs. A.D.Y.Anandani had a conversation with us where she said that environment, health, cyber security and road safety are areas where much concern should be given when talking about Sri Lankan social problems.

Problems related to health, environment, cyber security and safety are as follows:

- Health awareness (Dengue Fever)-Dengue which is the most widespread fever in the world and day by day the number of dengue patients are increasing.
- Environmental awareness (Garbage Disposal)-There is no proper garbage disposal method which leads to the incensement of the garbage level.
- Cyber security awareness (Social media)-User privacy violation caused due to lack of knowledge in social media usage.
- Safety awareness (Road Safety)-Improper road safety causing accidents and the death rate increases due to road accidents.

This showed the path to create an awareness game as answers to these questions.

- **How do we prevent, response and recover from dengue?**
- **How do we properly recycle the garbage?**
- **How do we use social media properly?**
- **How to decide the preventive actions in an accident?**

1.4 Objectives

1.4.1 Main objective

The main four areas where many problems arise are environment, health, safety and cybersecurity. A single platform designed for these problems is lacking. Therefore, there is a need to have one platform for these four categories. So, the main objective is to improve the abilities of people by making them aware on environment, safety, health, cyber security problems using game-based learning platform.

1.4.2 Specific Objectives

- To make people aware about health awareness mainly focusing on prevention of dengue by enhancing their thinking ability and recalling ability.

- To make people aware about Environmental awareness mainly focusing on garbage disposal by enhancing their recalling ability

- To make people aware about cyber security awareness mainly focusing on social media by enhancing their decision-making ability

- To make people aware about Safety awareness mainly focusing on road safety by enhancing their thinking ability and recalling ability.

2 METHODOLOGY

2.1 System Overview

The overview diagram shows the elements of the overall system in our proposed awareness game platform. According to Figure 2.1, it shows four main game functions based on the single platform of the public awareness game called AwareME.

First, the user must register and access the game. The user then has to select one of the awareness games to play. They are Health awareness, environmental awareness, cyber security awareness and safety awareness. The four main games are divided into several sub-areas. Each game is created using those sub-areas. While the selected game is being played, the system develops the player's knowledge and scores that knowledge. Once the user has played the game, their personal ability can be improved. The database includes the main game and all the game analysis is done.

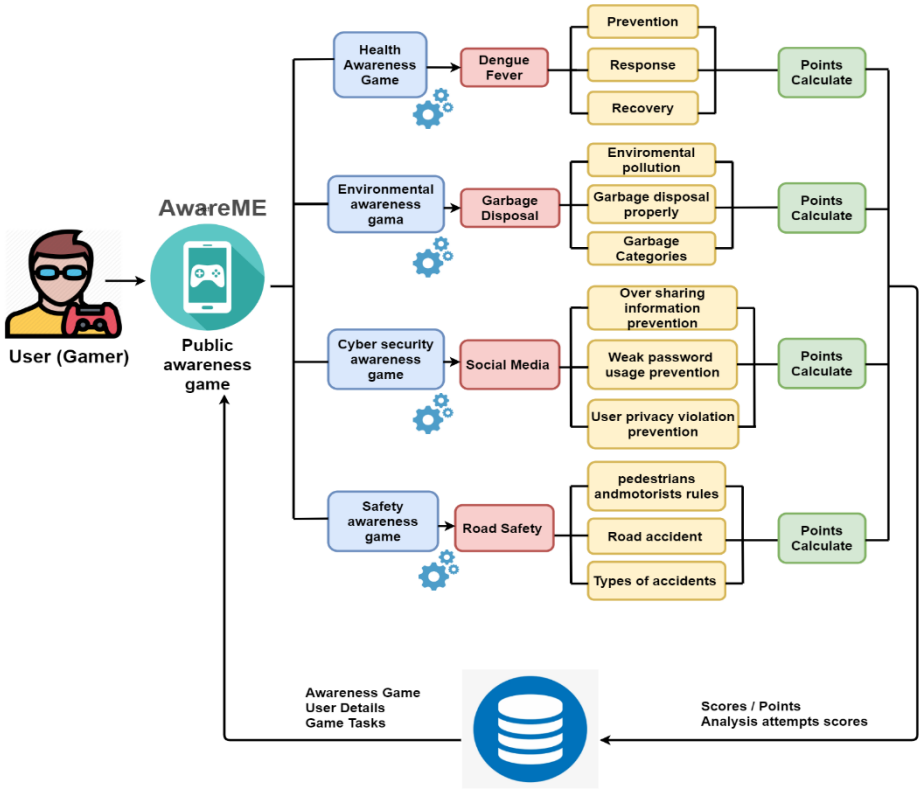


Figure 2. 1: System Overview

2.2 Flow of the Project

This section discusses all steps planned for the awareness gaming platform. In the end, every step helps to deliver a good product. Figure 2.2 below shows in detail all the steps that created the awareness gaming platform.

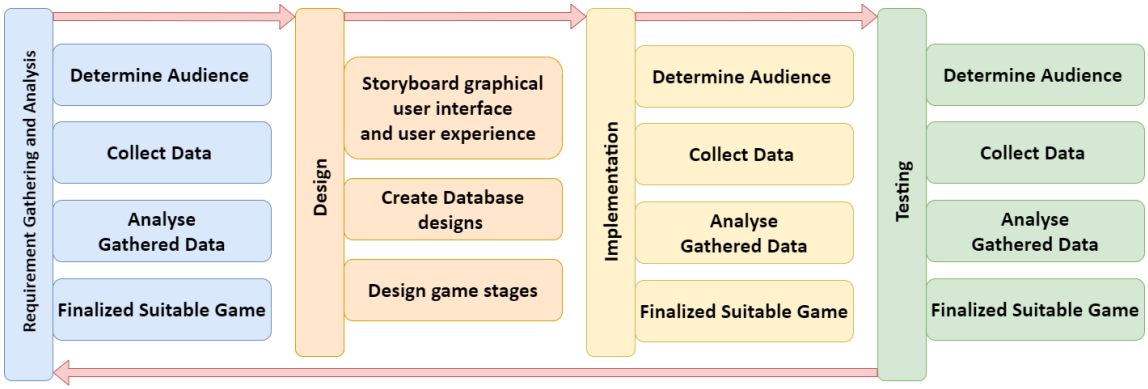


Figure 2. 2: Process of Project

2.2.1 Requirement collection and analysis

At the beginning of the research, the first thing that needs to be done is the process of data gathering and analysis. First, we went to meet the Kaduwela divisional secretariat to get an idea of our research areas and obtain information. Separate information was required for each area to create the game. For that we created separate Google forums for the four areas and was given for more than 50 people. After analyzing the information obtained from it, several conclusions were reached. Such as,

For dengue awareness

- Creating a puzzle game for kids under 18 years old
- Creating an action game for adults over 18 years old
- Improving recalling ability, thinking ability and decision making ability through games

For social media awareness

- Creating a quiz game and puzzle game
- Improving the ability decision making through games

For garbage disposal awareness

- Creating a quiz game for adults over 20 years old
- Creating an action game for kids under 20 years old
- Improving thinking ability, recalling ability and decision making ability through games

For road safety awareness

- Creating a quiz game for drivers
- Creating an action game for pedestrians
- Improving decision making ability, reacting ability and thinking ability through games

2.2.2 Design

This is where the game was created from the conclusion drawn after analyzing the data. In this gaming platform, there are four main components. Each of those parts was designed to create two games.

- In the dengue awareness game, it was decided to create an action game for adults using 3D technology and a puzzle game for children using 2D technology.
- In the social media awareness game, it was decided to create a puzzle game using 3D technology and a quiz game using 2D technology.
- In the garbage disposal awareness game, it was decided to create an action game for children using 3D technology and a quiz game for adults using 2D technology.
- In the road safety awareness game, it was decided to create an action game for pedestrian using 3D technology and a quiz game for drivers using 2D technology.

Then we decided on the points required for the levels and the scores given at the levels. Since this is an awareness game, we had to refer several materials for gathering knowledge and facts to make the game a success. Websites, research papers and articles had to be used to find those facts. Each game was designed to be difficult from level to level and the points were decided to vary for each level.

2.2.3 Implementation

During this phase, the games were implemented under the requirements and design specifications of the four main areas. The overall project implemented using the waterfall model. 2D, 3D and virtual reality are the main technologies we used in this awareness gaming platform. Unity, Blender, Visual Studio Code was used as tools for this implementation.

2.2.4 Testing

One of the most important stages in the research is the testing phase. In this stage, testing is done to see how the users have improved their awareness level after playing the game. It also tests the performance of the game.

2.3 Testing & Implementation

2.3.1 Implementation

There are four main categories included in the AwareMe platform. They are dengue fever, Social Media, Garbage disposal and Road safety. To improve the knowledge about this 2D and 3D technology has used. In the unity game engine C# language is used for the creation of backend and frontend. Our requirement was to create the game attractively to the user and player also to establish the user friendliness between the system and the user.

Improving awareness on dengue fever

The first module of "AwareMe" platform focuses on health awareness, specifically on dengue threat. Here, also 2D, 3D games have created. 2D game was for children and 3D game for both children and adults. Thinking ability, reacting ability and decision-making ability are improved through this. As shown in Figure 2.3 and Figure 2.4, we have developed two separate games for both adults and kids.

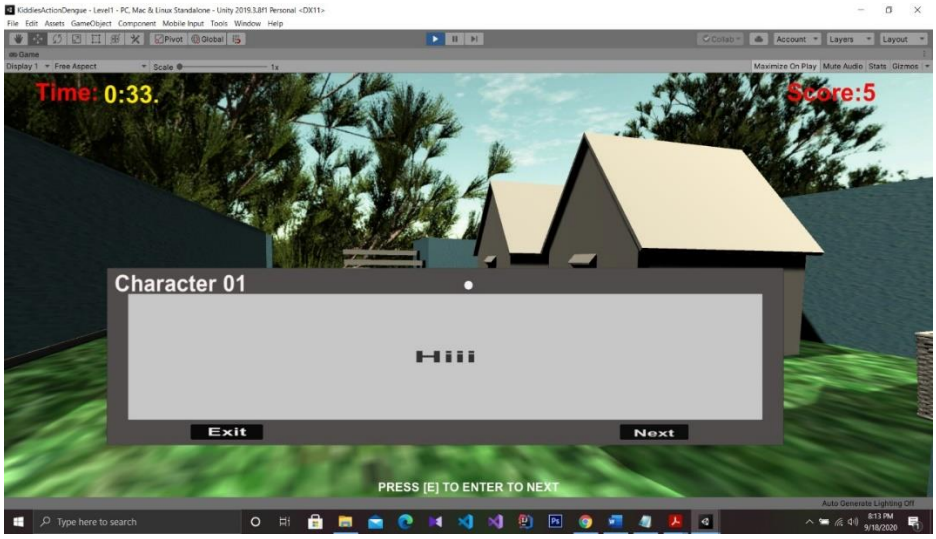


Figure 2. 3: 3D Adults game

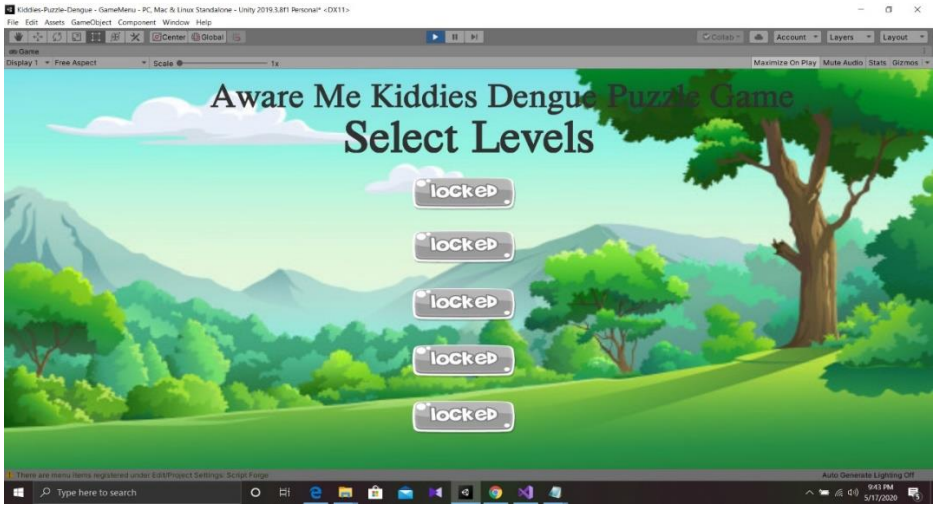


Figure 2. 4: 2D Kids game

Improving awareness on Social Media

The second module of "AwareMe" platform is on cyber security awareness, focusing on social media. As social media is used by people above age 10 a quiz game and puzzle game have been prepared for the users of that age. 2D, 3D technology was used for that. figure 2.5 and figure 2.6 below illustrates the quiz game and the puzzle game which was implemented.

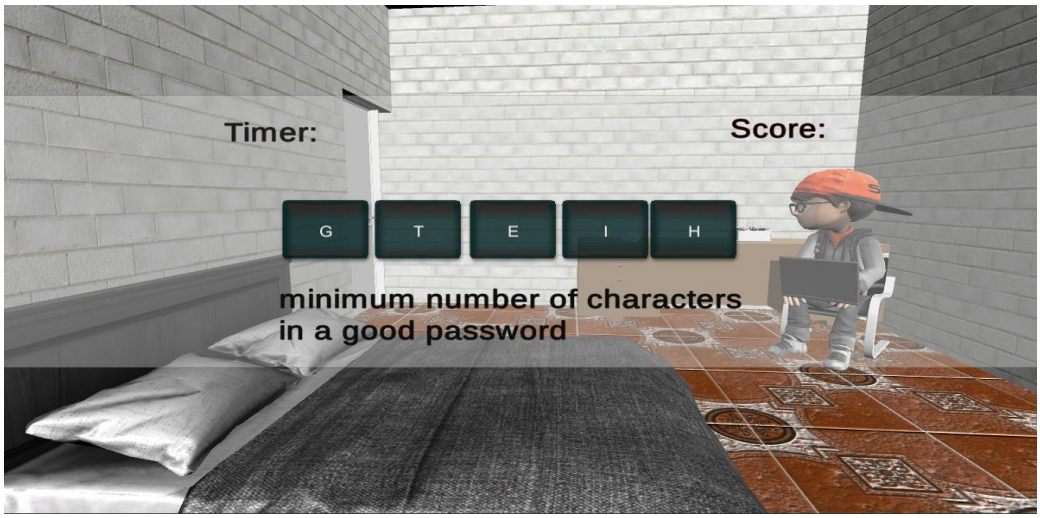


Figure 2. 5: 3D Puzzle game

Figure 2. 6: 2D Quiz game

Improving awareness on Garbage disposal

The third module of "AwareMe" platform is on environmental awareness, focusing on garbage disposal. 2d quiz game for adults and 3D game for kids was created. Here thinking ability, recalling ability and decision-making ability are improved. As shown in Figure 2.7 and Figure 2.8, we have developed two separate games for both adults and kids.

Figure 2. 7: 2D Quiz game for Adult's

Figure 2. 8: 3D Action game for Children's

Improving awareness on Road Safety

The fourth module of "AwareMe" platform is on safety awareness, focusing on road safety. Using this game decision making ability, thinking ability, recalling ability and reaction ability are improved. As shown in Figure 2.9 and Figure 2.10, we have developed two separate games for both pedestrians and motorists.

Figure 2. 9: 2D game for drivers

Figure 2. 10: 3D game for pedestrian

2.3.2 Testing

The main expected outcome of this research is to make people aware about dengue, social media, garbage disposal, and road safety through games as well as to develop human abilities. The testing stage is the most important stage to this gaming platform. All functions should be checked for functionality without any errors. If this game is unsuccessful, the model should be modified again with appropriate modifications until the desired results are obtained.

Unit Testing

Unit tests by level are performed here. When testing the game,

- Checking whether the points that are added and decreased at the level are calculated correctly
- Checking whether the questions at each level are working properly
- Checking whether the answer given is correct or incorrect
- Checking whether animations and sounds working properly

Component Testing

By combining all levels, component testing is performed. This component test is done to see if all the parts are working properly in individual games.

- Check to see if it is navigating correctly from level to level
- Check whether all Help functions correctly work or not
- Check if the animations, background tones, voices, sounds are working properly

Test Cases

These test cases are used to test the game after the implementation and helps to see if the system works properly.

Table 2. 1: Test cases of the games

Test Case #	**Test Case Description**		**Results**
1	Check background music and sound effects	Check • Sound • Background music	Pass

2	User Interface	Check • Animation • Movement of character • Graphics • Sounds	Pass
		Check Directing buttons	Pass
3	Performance	Check • Loading time of a game (Min time)	Pass
4	Score	Check Calculation of the score	Pass
		Check Reduce marks for wrong answers	Pass
		Check Score shows after finish level	Pass

2.4 Commercialization aspects of the product

Health, environment, safety, and cybersecurity are the main areas where problems arise in Sri Lanka. The main reason for these problems is the lack of public awareness in these areas. We have created a number of sports for health, environment, security, and cybersecurity using game-based learning. We believe that as modern society becomes more interested in games, this can be rapidly socialized and this can increase people's awareness of health, the environment, security, and cybersecurity. Our gaming product is highly useful for a variety of organizations and sessions. Below are the parties who are most in need of this awareness game

- **Divisional Secretariat**

  This product is mainly targeted at the Divisional Secretariat. Divisional Secretariat can recommend this application to the public. Therefore, the public can be easily made aware of health, environment, security, and cybersecurity issues by conducting several public awareness programs using this gaming product

- **Awareness Sessions**

  There are a number of awareness sessions conducted by different sections for different age groups in Sri Lanka. The game can be easily popularized as the game has raised awareness on health, environment, road safety, and cybersecurity.

- **Hospital**

  There are many different programs conducted by hospitals such as awareness programs on diseases caused by dengue, garbage, road safety. This application is very important for a hospital as it can host large groups of people at once

- **NGO**

  Now Non-governmental Organizations mostly conduct many programs for people to make aware of different areas. This product is very important to them as they can gather a large number of people here as well

- **School**

  This game is also very useful for school children. It is possible to conduct various sessions in the school to make children aware and to hold sessions with the participation of large groups at once.

Figure 2. 11: Commercialization aspects of the product

3 RESULTS AND DISCUSSION

Health Awareness

Table 3. 1: Results of the kid's game – dengue fever

Player	Marks (%)			
	Attempt 1 (Quiz game Kids)	Attempt 2 (Quiz game Kids)	Attempt 1 (Questionnaire)	Attempt 2 (Questionnaire)
01	60	70	60	60
02	50	40	50	30
03	80	80	60	90
04	70	70	70	100
05	50	70	60	90

Table 3. 2: Results of the adult's game – dengue fever

Player [3D Maze runner]	Marks (%)			
	Attempt 1 (Action Game Adults) [Time-Seconds[s]]	Attempt 2 (Action game Adults) [Time-Seconds[s]]	Attempt 1 (Questionnaire)	Attempt 2 (Questionnaire)
01	19.2s	17.9s	70	90
02	23.5s	21.9s	60	100
03	34.3s	29.3s	90	100
04	29.2s	29.8s	80	90
05	30.2s	26.6s	60	80

Table 3.1 and table 3.2 above illustrates the results of the game implemented for awareness of dengue fever. The score of the players in the two games which was designed for adults and kids are represented whereas each player's marks of the questionnaire in two attempts are also mentioned. The test results prove that the players had improved their awareness levels through attempt 1 and attempt 2.

Environmental Awareness

Table 3. 3: Results of the adult's game – garbage disposal

Player	Marks (%)			
	Attempt 1 (Quiz game Adults)	Attempt 2 (Quiz game Adults)	Attempt 1 (Questionnaire)	Attempt 2 (Questionnaire)
01	50	70	40	60
02	40	40	40	30
03	70	80	50	70
04	70	70	80	100
05	30	70	60	80

Table 3. 4: Results of the kid's game- garbage disposal

Player	Marks (%)			
	Attempt 1 (Action game Kids)	Attempt 2 (Action game Kids)	Attempt 1 (Questionnaire)	Attempt 2 (Questionnaire)
01	40	70	20	50
02	50	50	10	40
03	30	60	30	60

04	50	70	40	70
05	30	30	50	40

Table 3.3 and table 3.4 above illustrates the results of the game implemented for awareness of garbage disposal. The score of the players in the two games which was designed for adults and kids are represented whereas each player's marks of the questionnaire in two attempts are also mentioned. The test results prove that the players had improved their awareness levels through attempt 1 and attempt 2.

Road Safety Awareness

Table 3. 5: Results of the motorist game – road safety

Player [Motorist]	Marks (%)			
	Attempt 1 (game)	Attempt 2 (game)	Attempt 1 (Questionnaire)	Attempt 2 (Questionnaire)
01	40	60	50	80
02	60	90	50	100
03	50	70	45	60
04	30	65	60	65
05	80	80	70	90

Table 3. 6: Results of the driver game – road safety

Player [Pedestrian's]	Marks (%)			
	Attempt 1 (game)	Attempt 2 (game)	Attempt 1 (Questionnaire)	Attempt 2 (Questionnaire)
01	70	80	60	75
02	50	65	50	70
03	70	80	40	65
04	30	55	35	60
05	70	95	80	80

Table 3.5 and table 3.6 above illustrates the results of the game implemented for awareness of road safety. The score of the players in the two games which was designed for motorists and pedestrians are represented whereas each player's marks of the questionnaire in two attempts are also mentioned. The test results prove that the players had improved their awareness levels through attempt 1 and attempt 2.

Table 3. 7: 2D game – social media

Player	Marks (%)			
	Attempt 1 (game-Quiz)	Attempt 2 (game-Quiz)	Attempt 1 (Questionnaire)	Attempt 2 (Questionnaire)
01	50	70	60	80
02	40	80	40	40
03	70	80	60	60
04	100	100	80	80
05	90	100	90	100

Table 3. 8: 3D game – social media

Player	Marks (%)			
	Attempt 1 (game-puzzle)	Attempt 2 (game-puzzle)	Attempt 1 (Questionnaire)	Attempt 2 (Questionnaire)
01	60	75	60	80
02	40	65	40	40
03	100	100	60	60
04	30	50	80	80
05	60	90	90	100

Table 3.7 and table 3.8 above illustrates the results of the game implemented for awareness of social media. The score of the players in the two games which was designed for the players and the marks of the questionnaire in two attempts are mentioned. The test results prove that the players had improved their awareness levels through attempt 1 and attempt 2.

4 SUMMARY OF EACH STUDENT'S CONTRIBUTION

Table 4. 1: Description of Personal

Dassanayake D.K.M.P.M.M | IT17160308	
Component	**Task**
Implementing the health awareness module based on dengue fever -AwareME Gaming platform	• Identify the skills that prevent, respond to, and recover from dengue • Identify the most suitable game to be implemented • Design and implement a 2D puzzle game for kids to improve thinking and recalling ability. • Design and implement a 3D Action game for adults to improve decision making ability. [Children also encourage to play the 3D Game] • Awareness of dengue prevention is measured based on the number of attempts and grades of the standard questionnaire
S.N Wijesinghe | IT17013642	
Component	**Task**
Implementing the Cybersecurity awareness module based on Social Media Awareness -AwareME Gaming platform	• Identify the skills required to make better use of social media • Identify the most suitable game to be implemented • Design and implement a puzzle game for public to improve decision making ability. • Design and implement a quiz game for public to improve decision making ability. • Awareness of better use of social media is measured based on the number of attempts and grades of the standard questionnaire

T.L.C Jayasiri | IT17701174	
Component	**Task**
Implementing the Environmental awareness module based on proper garbage disposal - AwareME Gaming platform	• Identify the skills required to make proper garbage disposal • Identify the most suitable game to be implemented • Design and implement a quiz game for public to improve recalling and thinking ability. • Design and implement a 3D Action game for public to improve decision making ability. • Awareness of proper garbage disposal is measured based on the number of attempts and grades of the standard questionnaire
K.A.R.T Keenawinna | IT17162142	
Component	**Task**
Implementing Safety awareness module based on Secure road safety awareness - AwareME Gaming platform	• Identify the skills required to Road Safety Awareness • Identify the most suitable game to be implemented • Design and implement a quiz game for public to improve recalling and thinking ability. • Design and implement a 3D Action game for public to improve decision making ability and reacting ability.

5 CONCLUSION

It is widely recognized that a nation with minimum problems relating to areas such as health, environment, infrastructure, and technology is a developed country. Sri Lanka, being a developing country face many problems in those areas, such as, diseases, natural disasters, deathly accidents etc. According to the United Nations, some of the main problems faced by citizens of developing countries/ lower-middle income countries are related to health, environment, safety, and cyber security. Apart from the risk associated with these problems, the main challenge is making the public aware of these problems. Even though there are public awareness programs on these problems, they are not very effective, as they are not attractive, and the public is too busy to attend the programs. However, as people are more interested and addicted to mobile devices, developing an interactive awareness platform for mobile devices, is a productive way to improve the awareness. Additionally, rather than customary methodologies, embracing to new ideas, for example, game-based learning will be more powerful to improve the awareness. Therefore, improving public awareness through game-based learning with the use of mobile devices, will be an effective solution.

As mentioned in this thesis we have implemented a game-based learning platform: "AwareME" to improve the public awareness on four main problems in the developing countries: (1) health awareness (dengue fever), (2) environmental awareness (garbage disposal), (3) cyber security

To improve public awareness in each category, different skills need to be improved. Through different studies it is found that with the use of digital games Cognitive skills such as memory retention and analytical skills can be improved. Therefore, cognitive skills which are required for each awareness category are identified at the initial stage and games are designed accordingly.

The "AwareME" platform which consists of: (1) a health awareness game to improve the thinking, decision making and recalling ability, (2) an environmental awareness game to improve the recalling, thinking and decision making ability,(3) a cyber security awareness game to improve decision-making ability and (4) a safety awareness game to improve logical thinking, recalling, decision-making and reacting speed ability was proposed. The games consist of quizzes, puzzles, and action games where 2D, 3D and VR technologies are used for effectiveness.

The project used the waterfall life cycle model where data analysis was done using and online survey. We have conducted an initial review of the performance of the "AwareME" platform, and the results show that with the help of the "AwareME" platform, the expected skills of the people are improved, and through that, public awareness in all the four areas are improved. As future work, we are planning to enhance

our games with more effective techniques to attract players. Also, we are planning evaluate the performances of the games comprehensively using a large set of players.

References

[1] S. &. V. G. K. &. C. V. &. H. L. &. D. V. M. De Jans, "Using Games to Raise Awareness: How to Co-design Serious Mini-games?," 2017.

[2] M. G. M. Craven, "Computer Games for User Engagement in Attention Deficit Hyperactivity Disorder (ADHD) Monitoring and Therapy," 10.1109/iTAG.2015.9, 2015.

[3] T. C. T. M. S. M. ,. B. E. A. Hainey, "Evaluation of a game to teach requirements collection and analysis in software engineering at tertiary education level," 2011 .

[4] J. S. A. M. A. A. A. B. S. Hasan S, "Dengue virus: A global human threat," Journal of International society of preventive & community Dentisry," 2016.

[5] F. N. P.D.N.N. Sirisena, "Evolution of dengue in Sri Lanka—changes in the virus, vector,and climate," International Journal of infectious Dieseases, 2014.

[6] "Asia Pacific Alliance," [Online]. Available: https://apad.lk/index.php/meethotamulla-garbage-dump-a-man-made-disaster-creates-history/.

[7] F. &. Y. S. &. R. A. &. J. W. &. M. K. G. H. Castronovo, "Development of a Virtual Reality Educational Game for Waste Management: Attack of the Recyclops," Annual Conference & Exposition, Salt Lake City, UT, 2018.

[8] P. K. G. B. K. A. M. Y. Liu, "Analyzing facebook privacy settings: user expectations vs. reality," 2011.

[9] D. S. T. G. M. Kosinski, "Private traits and attributes are predictable from digital records of human behavior," 2013.

[10] V. T. M. Furini, "Location privacy and public metadata in social media platforms: attitudes, behaviors and opinions," 2015.

[11] M. F. N. Hussin, "Computer Games as Learning Tool towards Children Road Safety Education.," International Journal of Engineering & Technology," 2018.

[12] M. B. G. M. V. S. S. A. C. L. Ma. Corazon G. Fernando, "Trash Attack: A 2D Action Puzzle Video Game to Promote Environmental Awareness and Waste Segregation Behavior," 2019.

[13] F. &. Y. S. &. R. A. &. J. W. &. M. K. &. G. H. Castronovo, "Development of a Virtual Reality Educational Game for Waste Management: Attack of the Recyclops," in *ASEE Annual Conference & Exposition, Salt Lake City*, 2018.

[14] L. &. C. S. &. P. F. &. S. D. &. T. A. &. P. R. Bioglio, "A Social Network Simulation Game to Raise Awareness of Privacy among School Children," in *IEEE Transactions on Learning Technologies*, 2018.

[15] M. N. G. P. C. R. M. R. R. J. S. Cetto, "Friend inspector: A serious game toenhance privacy awareness in social networks," in *Proceedings ofIDGEI 2014*, Haifa, Israel, 2014.

[16] D. J. Mukhopadhyay, "Road Safety Awareness among College Students in a North Indian Town," 2017 .

[17] W. L. Zeedyk MS, "Tackling children's road safety through edutainment: an evaluation of effectiveness," 2003.

[18] N. H. M. F. Masnida Hussin, "Computer Games as Learning Tool towards Children Road," 2018.

[19] J. S. A., "Road accidents on the rise," 2019.

[20] "Lord Buddha Quotes," 2019. [Online]. Available: https://www.pinterest.com/pin/470766967270515990/.

[21] D. M. Silva, "A Serious Game for Teaching about Dengue Fever Prevention with Collaboration and Competition," 2014.

[22] J. a. D.Coombs, "the good bye to dengue game," 2005.

[23] D. M. Silva, "A Serious Game for Teaching about Dengue Fever Prevention with".

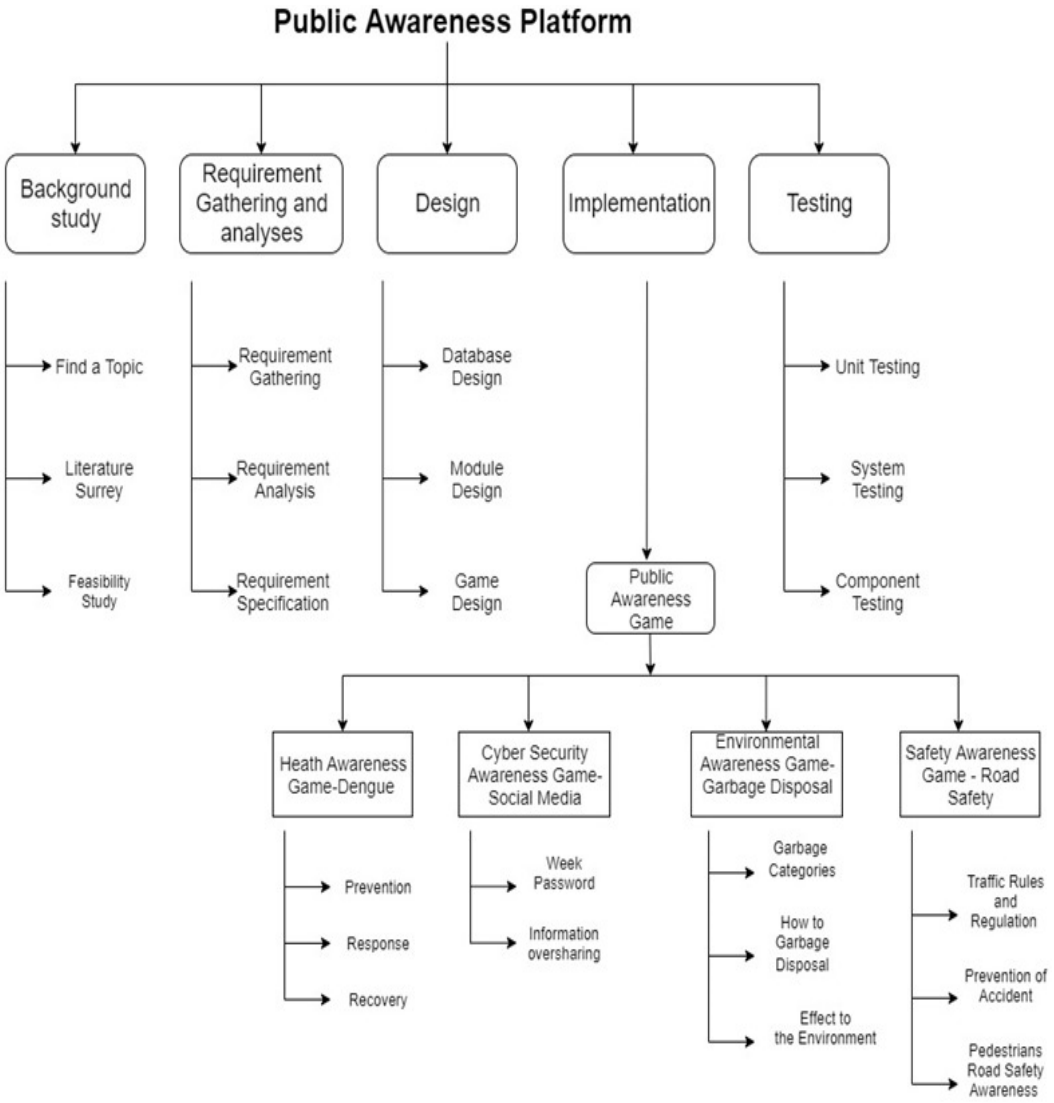
[24] C. &. T. M. &. A. K. Irvine, "CyberCIEGE: Gaming for information assurance," Security & Privacy," 2005.

[25] M. B. G. M. V. S. S. A. C. L. Ma. Corazon G. Fernando, "Trash Attack: A 2D Action Puzzle Video Game to Promote Environmental Awareness and Waste Segregation Behavior," ResearchGate, 2019.

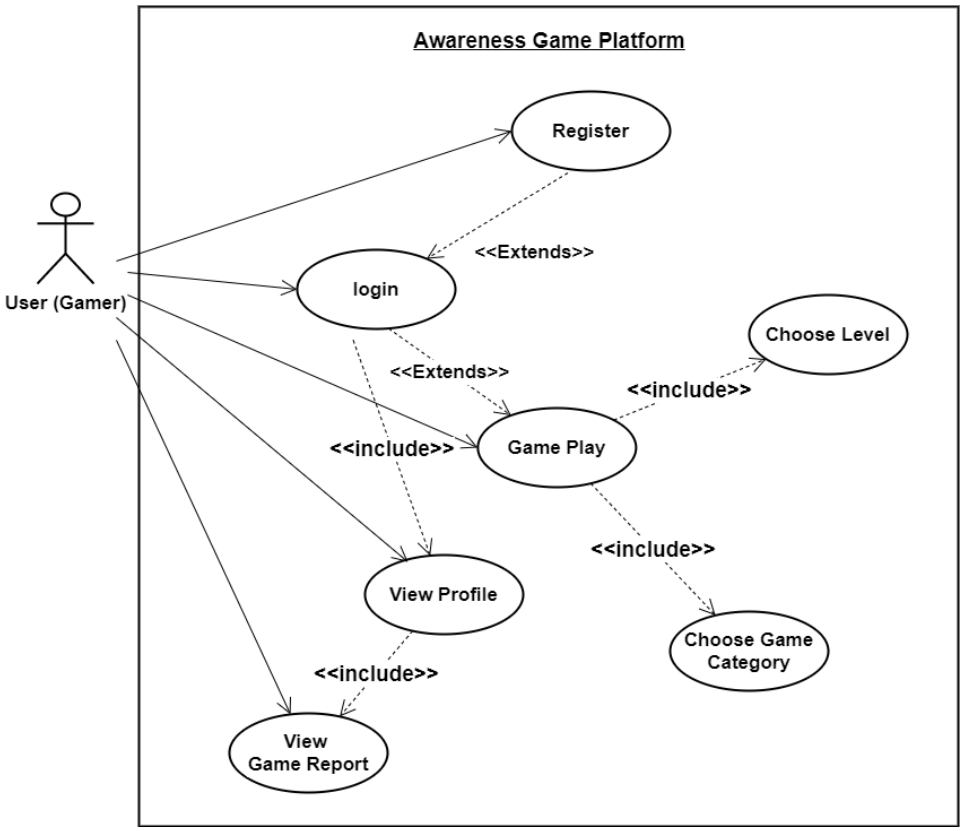
[26] T. J. Xuan, "The study about using VR with smart phones for road safety awareness and timing," in *The 5th International ACM In-Cooperation HCI and UX Conference*, 2019.

APPENDICES

Appendix A: Work break down Chart



Appendix B: Use case diagram



Appendix C: Google forms for data gathering

A study on "Garbage Disposal awareness through game-based learning"

A short survey to identify the depth of knowledge on the garbage disposal and identify the ability which needs to be increased proper garbage disposal.
This survey is a part of research to be completed as partial fulfillment of the requirements for the degree of bachelor Information Technology | Sri Lanka Institute of Information Technology (SLIIT)

* Required

Enter your email *

Your answer

1. What is your gender? *

- ◯ Male
- ◯ Female

2. What is your age group *

- ◯ Under 20 years old
- ◯ 20 years or older

A study on "dengue awareness through game-

A short survey to identify the current awareness level of public about the dengue fever and identifying the

Email address *

Valid email address

This form is collecting email addresses. Change settings

These may include a high fever, headache, vomiting, muscle and joint pains, and a characteristic skin rash.

A study on "Road safety awareness through game based learning"

You can measure a your position by answering the questionnaire.

What is your name? *

Short answer text

Enter your email *

A study on "social media awareness through game based learning"

A short survey to identify the awareness level of social media users and the ability which needs to be increased when using social media.

* Required

What is your name? *

Your answer

What is your age?

- ◯ 10-19
- ◯ 19-30
- ◯ 30-45
- ◯ 45+