INTERACTIVE MATHEMATICS GAME USING KINECT

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EXECUTIVE SUMMARY

This document discusses about Interactive Mathematics Game using Kinect. For kindergarten student they may feel boring during their class, so this project is to target them to gain more interest in their study mainly in mathematics subjects. This gesture based mathematics games proposed will have two part, user interface and Kinect gesture. The user interface was created as interesting as possible to attract the kindergarten student's attentions. The Kinect gesture detects the skeleton movement of the user and process the data to the applications.To develop this system, gesture recognition devices have to be use. There are four gesture recognition devices that available in the market nowadays. After making several analyses on the findings, finally, Kinect was chosen because it has a better gesture recognition ability as compare to others. After the findings, the designing of the system takes place and a Software Development Life Cycle (SDLC) phase was implemented to design and build this system on times and more systematics. So the purpose of this interaction games is to ensure teaching of the kindergarten students to be fun and enjoyable besides learning what they are needed to. This really helps in the study of the kindergarten students. This project is target for the kindergarten students to implant the joyful of studying through interaction games for them.

RINGKASAN EXECUTIVE

Dokumen ini membincangkan tentang Interaktif Permainan Matematik menggunakan Kinect. Bagi pelajar tadika mereka mungkin merasa membosankan dalam kelas mereka, supaya projek ini adalah untuk sasaran mereka untuk mendapatkan lebih banyak kepentingan dalam kajian mereka terutamanya dalam mata pelajaran matematik. Ini isyarat permainan matematik berasaskan dicadangkan akan mempunyai dua bahagian, antara muka pengguna dan isyarat Kinect. Antara muka pengguna telah diwujudkan sebagai menarik yang mungkin untuk menarik perhatian pelajar tadika ini. Isyarat Kinect mengesan pergerakan rangka pengguna dan memproses data kepada applications.To membangunkan sistem ini, alat-alat pengiktirafan isyarat perlu digunakan. Terdapat empat peranti pengiktirafan isyarat yang terdapat di pasaran pada masa kini. Selepas membuat beberapa analisis mengenai hasil, akhirnya, Kinect telah dipilih kerana ia mempunyai sikap yang lebih baik keupayaan pengiktirafan berbanding dengan orang lain. Selepas penemuan, mereka bentuk sistem berlaku dan Pembangunan Perisian Kitaran Hidup (SDLC) fasa telah dilaksanakan untuk mereka bentuk dan membina sistem ini pada masa-masa dan lebih sistematik. Jadi tujuan permainan ini interaksi adalah untuk memastikan pengajaran pelajar tadika menjadi seronok dan menyeronokkan selain belajar apa yang mereka perlu. Ini benar-benar membantu dalam kajian pelajar tadika. Projek ini adalah sasaran untuk pelajar tadika untuk implan yang gembira belajar melalui permainan interaksi untuk mereka.

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CHAPTER 1: INTRODUCTION

1.1. Introduction

In past, games are played by us with interaction. The traditional games were famous and it is being practiced in the old time. Most of the games need full interaction within the people and the games. Unfortunately, by time passing, due to the advance in technology of this era, computer, cell phone, and so on, was introduced. More and more games were played by using computers.

There are many types of games introduced. Examples are interaction games, social games, and board games. Interaction game was played by the player by using an electronic control to move points of light or graphical symbols on the screen of a visual display unit. Hence, the player needs to move their body according to the visual display by the screen. The advantages of this game to other game were it need full human interaction to play it compare to other which is just clicking on the buttons. By using Kinect, user was able to control and interact with Xbox 360 console without using controller with Kinect. Kinect is a device that sense motion input device by Microsoft for the Xbox 360 video game console and Windows PCs and Kinect is a webcam-style add-on peripheral that is use to capture the movement of the user (Boehret. K, 2010). According to Mr. Toffee (2010), in November 18, 2010, Kinect will be launch in Singapore. From one of the L.A Times articles (2011), Microsoft released a new Kinect for Windows software development kit on June 12, 2011, that works with the company's Windows 7 operating system. Kinect enable many possibility of creating interaction games, this even include gesture recognition as one of the function of Kinect. Gesture recognition enables Kinect to detect motion of for example a weaving hand, kicking, or bending the body. This is an interesting function and it's still new to the world and still can be develop further more. Thus, I choose my title namely "Interaction Game with Gesture Recognition using Kinect".

1.1.1. Background and Problem Statement

- We can make use of the computer and create some interaction games with a more interesting and have educational value in the games itself.
- If the game exists, students will be able to play while learning, that will be like hitting two birds with one stone concept.
- Sometimes, student will felt that the teacher teaching is boring and will eventually lose concentration in their study.
- Hence, with the interaction game exists, teacher can make us of the interaction game for their teaching and thus will make their teaching plan more interesting and students will also not bored.
- Moreover, computer games also don't provide interaction between the player and the games itself. The only interaction is with the mouse and the keyboard only.
- By using this interaction game, student will be able to move their body according to what the game require them to do. No mouse and keyboard is needed.
- Students result is not good to the expectations of the teachers.
- As a conclusion, interaction using gesture recognition will help in student study and teacher teaching as well. Student also can gets good result in playing this interaction game.. This is very important because the student interest in study need to be built from childhood to ensure that they are interested in their study in the future.

1.1.2. Objective

Following is the list of objectives that need to be achieved in the system.

- To develop the mathematic game that suitable for kindergarten children.
- To develop Mathematic interactive game with gesture recognition using Kinect.
- To verify kindergarten students and teacher can use this software for education.

1.1.3. Scope Of Study

- Students

  The targeted user is mainly student from kindergarten school. This interaction game will help the kindergarten in their study and made the class more interesting for them. As kids, they surely love games, so an early introduced of this interaction game will surely make the student to gain their interest in their

study. Moreover, kindergarten students will have to move their body when playing the games, this also can help them to exercise their body and keep them healthy. This is important because as we all know that kids are easy to fall sick during their age. As conclusion, this interaction games were important to be introduced the kindergarten student so that they will gain 100% of interest and be able to keep their body healthy in their study.

- Teachers

  In the teaching, teachers face a lot of difficulties in their teaching. One of them was hard to get their student interest in their teaching. This happen because the teacher only ask the student to read whatever in the books only. Due to this, the students mind become dull and will fall as sleep. Not only that, teacher also work as admin to maintain some simple problem in the kinect device.

- Admin

  Further complicated maintenances and system upgrade will be done mainly by the admin. Admin will announce update for some driver online and provide user on how to install the driver of kinect correctly.

1.2. Description of existing system

There is a lot of existing product about software and application that is using gesture recognition based interactions. There are now three companies that are developing the gesture based gaming devices that is Nintendo, Sony and Microsoft. These three competitive companies were developing their own gesture device with different approach. According to TGNDireGaming (2012), by joining Nintendo in the motion market, Sony released the PlayStation Move in September 2010. The PlayStation Move features motion sensing gaming, similar to that of the Wii. Microsoft also joined Sony and Nintendo, with its Kinect. Unlike the other two systems (PlayStation 3 and Wii), Kinect does not use any controllers of any sort and makes the users the "controller".

1.2.1. Uses or Nintendo Wii Remote as an interactive white board using gesture.

Firstly, is about Wii Remote Plus that comes with a Sensor Bar. Scott Stein (2010) state that, while Microsoft and Sony are exploring motion-based gaming for the first time this holiday season, Nintendo's already been there and done that for years.

While the Wii debuted in 2006 with its iconic Wii Remote, an upgrade to the Wii Remote technology called Wii Motion Plus was unveiled mid-last year. Looking like a television remote control, the Wii controller, Wii Remote or Wiimote, uses a wireless Bluetooth connection, contains a small speaker that can reproduce sounds from the main sound system, and has a small motor that is used to convey rumble impacts (Lee, 2008). The Wii Remote contains a infrared camera and the sensor bar contain two sources of infrared light in two edge horizontally. When we move the Wii Remote, the infrared light of the Wii Remote will be detected by the sensor bar thus will detect the location of the Wii Remote and will gesture will be produced (Lee, J.C, 2007). In 2007, Dr. Johnny Chung Lee of Carnegie Mellon University created the first wiimote whiteboard which employed the Nintendo Wii remote technology and made the impossible become possible. This system is literally thousands of dollars cheaper than the cheapest whiteboard on the market today (Wang, Z and Louey, J, 2008). The Wiimote interactive whiteboard uses Nintendo Wii remotes camera to identify the infrared locations. The two infrared point in the motion sensor measure the angle from Wii Remote from the light source from the motion sensor. The Wiimote whiteboard program uses a four point calibration to measure the size or the screen which is at the edge of the projector screen. The edge need to be touch by the infrared pen before using the whiteboard. The Wiimote whiteboard can stand on par with the normal commercials interactive whiteboard. The commercials whiteboard need to use pen and draw on the whiteboard with a little pressure needed to make it work. When the user need to scroll or switch applications, they will need to replace the pen in the pen tray or else the actions will be determine as Brush Stroke by the computer. This is why Wiimote interactive Whiteboard is better the then the commercials interactive whiteboard because it do not distinguish between the stroke and the hand gesture. It only identifies the light from the LED light source which is known by the Wiimote as an input device. Hence we don't need to worry about our body blocking the Wiimote camera while writing. Another advantages of Wii Remote is that is can be used on the smooth surface like LCD screen, table or even wall can be used as the screen of the Wiimote white board., unlike the commercials interactive white board which is limited on the size of screen. As a conclusion, Wiimote whiteboard is the most economical multimedia tool for teaching and presentation, especially for the schools and companies that have a limited budget. The price of the Wiimote whiteboard can pose a potential threat to big interactive

whiteboard companies, like SMART. These companies will be forced to think of new ways to lower the price of their interactive whiteboards.

1.2.2. Function of Wii Fit in an Exercising Interaction Games

There is another product that is released by Nintendo also that is Nintendo Wii Balance Board. In 2008, Nintendo released the Wii Balance Board accessory bundled with the Wii Fit software. The bundle gives Wii owners the ability to perform an interactive exercise program and track their progress over time. Wii Balance Board is the Balance Board is the interface of the Wii Fit and contains multiple pressure sensors in it (Clark et al., 2010). Wii Fit is an interactive fitness game designed for the Wii. Players can design fitness routines, compete against the game or play with other players. This game can be an effective fitness routine, especially for people not previously following a fitness program. Combined with a healthy diet, the Wii Fit can help you lose weight and tone your muscles (Travis, C, 2012). This can open up whole new fitness possibilities for people looking to get in shape in the comfort of their own homes (Soto, C, 2010). The Wii Fit uses a balance board calibrated to each player to measure balance, weight and body mass. This allows players to track their weight loss as they progress through the game. Players can play a number of virtual sports and engage in fitness tests. The Wii Fit also allows players to customize a workout program and adjust the program's difficulty level (Travis, C, 2012). There are several types of interaction game that is release by Nintendo to be played by Wii Fit is the training plus, yoga, strength training, aerobic and balance games which can be found in the menu while login in to Wii Fit. All of the exercise technique is the collaboration of Nintendo with the expert in that certain field to ensure that player can achieve maximum work out while following the exercises. According to Hinkei, in 2006, NeuroGym Technologies introduced a training system for use in rehab called the NeuroGym Trainer. This computer based technology offered therapists a way to provide rehab patients with visual and auditory feedback. A therapist could use this system to help patients learn to shift their weight, to help strengthen a targeted muscle group, or to help improve coordination. This system utilized sensor pads and a video game format (Hinkel, 2011). By using this Wii Fit, the patients can work out their therapist while having fun no like old times that they need to keep exercising over and over again for the same exercise. As a conclusion, Wii Fit is can produce interaction between player and the games. Wii

Fit is very convenient because it itself is a measuring board so the player can view their weight from time to time while playing the games and see how their progress.

1.2.3. Function of Playstation Movesport Simulation Games

Sony Company also joining the motions market by developing the Sony Play Station Move, together with the motion controller wand and also a Play Station Eye. According to one of the article wrote by Chen, J (2010), in Tokyo, March 10, 2010 - Sony Computer Entertainment (SCE) today announced that PlayStation®Move motion controller for PlayStation®3 (PS3™) computer entertainment system, launches worldwide this fall, offering a motion-based, high-definition gaming experience unlike anything on the market. Concurrently with its launch, SCE will also release PlayStation®Move sub-controller to be used along with the motion controller for intuitive navigation of in-game characters and objects. The PlayStation Move platform, including the motion controller, sub-controller, and PlayStation®Eye camera*1, together with a strong lineup of software titles, will deliver an innovative and highly immersive experience on the PS3 system (Chen, J, 2010).

The PlayStation Eye has been programmed to recognize the exact size and shape of the ball on top of the Move remote. Once the Move controller is visible to the camera, it's able to detect the exact positioning of the ball in 3-D space. By tracking the size of the ball (and easily following it, thanks to the glowing LED) the PlayStation Eye can accurately tell where the ball is at any time. In addition to tracking the ball's coordinates, the PlayStation Eye can identify human faces and perform head tracking, once it recognizes the people in front of it, the Eye can accurately follow the movements of their heads, but not quite as accurately as following the Move's sphere -- after all, people don't come in an exact size and shape! This entire process can be carried out within the span of less than one frame of movement (out of 60 per second) thanks to the power of the PlayStation 3's processor. The video interface isn't the Eye's only ability. It can also pick up audio via an array of four microphones. Primarily, though, the Eye's task is keeping up with the Move remote's location. But location only paints half the picture -- it takes a whole other mess of sensors to interpret the orientation and movements of the Move, and they're all packed tightly into the controller itself (Wesley, 2010). Nowadays, the play station move was played together with the Play Station Three game console. Sony Company still hasn’t release the Play Station Move.me that

is the development kit for window. Thus, development of the application on Play Station Move is not so widely practice by people nowadays. There are many games been released for Play Station Move. The games released for play station move was mostly in HD quality. One of the games is called the Sport Champion. According to Nelson (2010), this games is develop by Zindagi Games, a second-party studios that's been working with Sony on Move since the earliest days of the technology. The games come with five sports are featured on the disc: disc golf, beach volleyball, archery, table tennis, and bocce and gladiator arena (Nelson, R, 2010). As a conclusion, Play Station Move can encourage people to move their body while playing the game. Thus, playing using Play Station Move will enchant health of the player.

1.2.4. Function of Kinect Making Learning Playful with Help from Sesame Street and National Geographic

Lastly is the product from Microsoft namely Kinect, the Kinect device is a peripheral sensor system designed to operate as a motion capture and control input with the Microsoft® Xbox® gaming console. The device has a variety of sensors, including: a video camera, an Infra-Red camera and depth camera, 4 microphones and a 3-axis accelerometer (J. Fabian, T. Young, J.C. Peyton Jones and G.M. Clayton, 2012). According to Kelvin Sung (2011), Kinect hardware features a pair of depth-sensing range cameras, the depth-sensing cameras can approximate distances of objects by continuously projecting and interpreting reflected results from the structured infrared light. The multi array microphone assists in acoustic source localization and ambient noise suppression and provides support for voice recognition and headset-free live chats. Kelvin Sung (2011) state that also the system supports facial recognition, automatic player sign-in, 3D scene approximation and reconstruction, full-body motion capture, and tracking of four players simultaneously with 48 skeletal positions per player at 30 Hz. The Kinect interface has large advantages over the other interfaces that utilize motion controllers. The interface of the depth camera enables the game system to recognize a player’s various motions. Furthermore, the interface senses not only players but also other objects in the field. That means that it provides enough data for making an Augmented Reality (AR) environment that allows players to interact with virtual objects in the real world (Tanaka, Parker, Baradoy, Sheehan, Holash & Katz, 2011). The game is called Kinect Sesame Street TV. The initiative sees Microsoft

collaborating with some of the biggest names in educational entertainment including National Geographic, Disney and Sesame Workshop – the company behind the educational TV show Sesame Street. All of the new games are played using Microsoft's hands-free interface module, Kinect (Cowen, N, 2011). These games will be very effective for student's learning environment is by engaging and exciting, this will foster collaboration and a positive attitude toward learning in the future. The game was based on seven key actions: jumping, throwing waving, clapping, pointing, speaking and standing still (Dredge, S, 2012). Kinect will recognize these actions and perform the action of the performed task. As a conclusion, Kinect have the ability to perform an interaction with the player and the games. Kinect is probably the best devices that can perform interaction between the game and the users because Kinect don't need any controller but the user gesture itself can act as the controller.

1.3. **Limitation of the Current Product Device**

The limitations in Nintendo Wii Remote Plus are difficult to apply the 3D estimation method for the game control due to the limitation to the controller position and posture. When player use the controller in a wrong posture, Nintendo Wii Remote Plus camera will have difficulties to estimate the location of the player and will eventually cause delay in the reactions in the game. Secondly is in the Nintendo Wii Balance Board or Wii Fit, the limitation is on the small board size that of 511mm*316mm. The action is limited to the board size, hence player can't move out of the board or else the Nintendo Wii Fir cannot detect the movement of the player. As compare to Wii interface is the advantages of PlayStation's ability to detect 3D positioning. However, the interface extracts hand motion information similar to the Wii. Upper body motion can be estimated by using Inverse Kinematics, but the estimation accuracy is worse (Tanaka, Parker, Baradoy, Sheehan, Holash & Katz, 2011). One of the Kinect limitations is that Kinect can only detect up to two players at a time. According to Truth Kim (2012), the Microsoft Kinect still has some privacy and security issues that need to be addressed through further research and development by Microsoft. As well as some legal, ethical, and social concerns associated with the misuse of its technology as it moves across the various industries around the world. Therefore, a strong commitment by Microsoft and the Government is needed in order for the Kinect to be safe for its users and its industries. By comparing all the

devices after listing out the limitations, we can conclude that Kinect was the device that outruns the other device in the function and less limitation as compare to the three other gesture devices.

1.4. Comparison on the Existing Product

Table 1.1: Comparison between the existing products

Existing Product / Goal	Wii Remote Plus and Sensor Bar	Wii Balance Board	PlayStation Move Eye & Motion Controller	Xbox 360 Kinect sensor
Provide Interaction with the system	Yes	Partially	Yes	Yes
Uses player as the controller	Yes. By player holding the Wii Remote	Only with Feet	Yes. By using sensor wand hold by the player	Yes. By full body Gesture
Suitable played by kids	Not so suitable.	Not so suitable	Not suitable.	Suitable
Function of the Application produced.	Teacher can in teaching their students	Teach how to exercise.	No. It only for gaming purposes.	Aid student in their study and exercise.
Open for development for SDK	Yes. With Registration	Yes. With Registration	No. Coming Soon	Yes. Open to all.
Advantages	Cheap and easy to obtain.	Help the player to exercise.	Simulation of the player's avatar on doing sport.	Many learning based application is produced

Limitations	The Wii sensor only sense the light source in the Wii Remote in directly in front of it	Limited board size.	Its only track upper parts of the body.	Limited to two user per times only.

CHAPTER 2: REPORT BODY

2.1. User Requirement

Client Name:

Introduction

This is a mathematical interaction games using gesture with Kinect for kindergarten students. This project purpose is to allow joy and movement of the students learning while playing games. The game main purpose is to aid the kindergarten students in learning mathematics. This mathematics game required the students to move their hand while playing the game. This game required a Kinect for Xbox 360 to be played.

User Requirement as follows:

The mathematics Game Module

- This game was created with flash.
- The purpose flash is chosen is because it provide a more interactive interface compare to other platform.
- These games contain three stages easy, medium and hard..
- Student can choose between the stages and play.
- After finish play the certain stage, they can retry the other stage to be played.
- If the finish playing the can press close to end the game.

The Kinect Module

- Before playing this game, users need to install the Middleware needed to run the Kinect application.
- Then plug in the Kinect sensor to the USB port of computer and wait the driver to be update and when the update complete, the kinect is ready to be used.

- The middleware purpose is to let the Kinect to interact with the computer mouse and controlling it using kinect.
- User need to tilt the height to be suitable to the user before playing the game using Kinect.
- The kinect application will notify the user to be how far exactly the user from the Kinect sensor. This is to enable the system work in the top conditions.
- Once the distance is correct, the user can use them to control the mouse with their right hand and play the games.
- To perform right click actions, user has to raise their left hand above their head to perform the action.

Conclusion

User can use their body movement to move the mouse cursor without using the mouse. This will ensure the user to be moving their body and not just sitting down and move only the mouse. The main purpose of this software is to make sure that user will move their body and play the flash game and also they can learn in the process of playing this game.

Signature,

( )

Date:

2.2.Technique/theory/modeling/flow chart/storyboard/all relevant diagrams

In this chapter, we will discuss about the methodology and techniques which uses to develop the system for the project which is Interaction Game with Gesture Recognition using Kinect. In this chapter, user requirement was presented in section one and all the user requirement was listed down in the user requirement form. This chapter will also explain on the type of System Development Life Cycle (SDLC) used and what is the phased available in the Development Cycle to develop the program. This chapter will also show clearly on the technique and algorithm used in the project. Lastly, this chapter will also contain the method or approach and the materials used in designing the project prototype.

2.3 Design Descriptions

2.3.1. Architecture

This interaction game is created by using a combination of several devices and applications. The most important piece of device is the work stations that is a laptop that we are using it to integrated all the devices and connect them as a working system. The laptop will gather the information from the database which is created internally in the laptop memory. All information and data from the application which is required to store in the database will be saved. Next is the applications, this application is a software that is created by following the story board and is installed in the laptop for functioning. This application required a projector to be plug in in order to send the image of the application into the projector. Projector is plug in through the laptop to link with the applications. The application also needs a Kinect to be plug in the laptop to enable the application to be able to sense the gesture of the movement of the player. This gesture recognition ability needs a programing to be inserted into the Kinect according to what gesture we want Kinect to sense from the player. Moreover the Kinect is a device that can sense a gesture within minimum of 800mm to a maximum of 4000mm from the player.

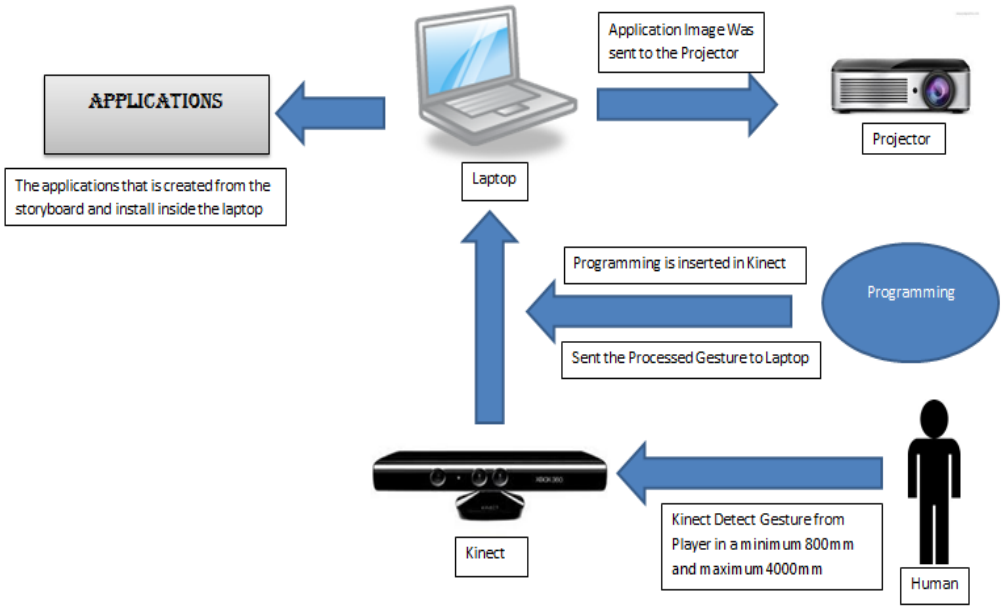

Figure 2.1 Architecture of the System

2.3.2. System Flow Chart

The system name is Kinect Interaction Mathematic Games. Firstly, in the login page the admin or the teacher will required to login before start their configurations of the questions. Once the login is successful the selection page will appear and if it is wrong password, the login page will appear again and there will be a message says that the password is wrong. For the first times user, they are required to register for a new ID. After registering, they will be redirected to the login page. On the selection page, the admin is either can choose to view the record of the students that have already use this system in the past or the configuration page to start off a new questions for the students. After the configuration page, the system will check whether the device is connected to the laptop or not, if it's not, error message on the device not connected will be shown. The message will appear until the device is connected properly. From here is where the students come in and play the games that are in the application page. Once the start Game button is stepped by the students, the questions will appear based on how many questions were based on the number of questions that is keyed in. Until the final questions there will be a submit button for the students to submit all their answer, students also can check and view all their questions and answer again. After the submission, the grade will be shown for the student. After that, the result will be saved

inside the records and that end the process. The system flow chart was shown on the figure 2.

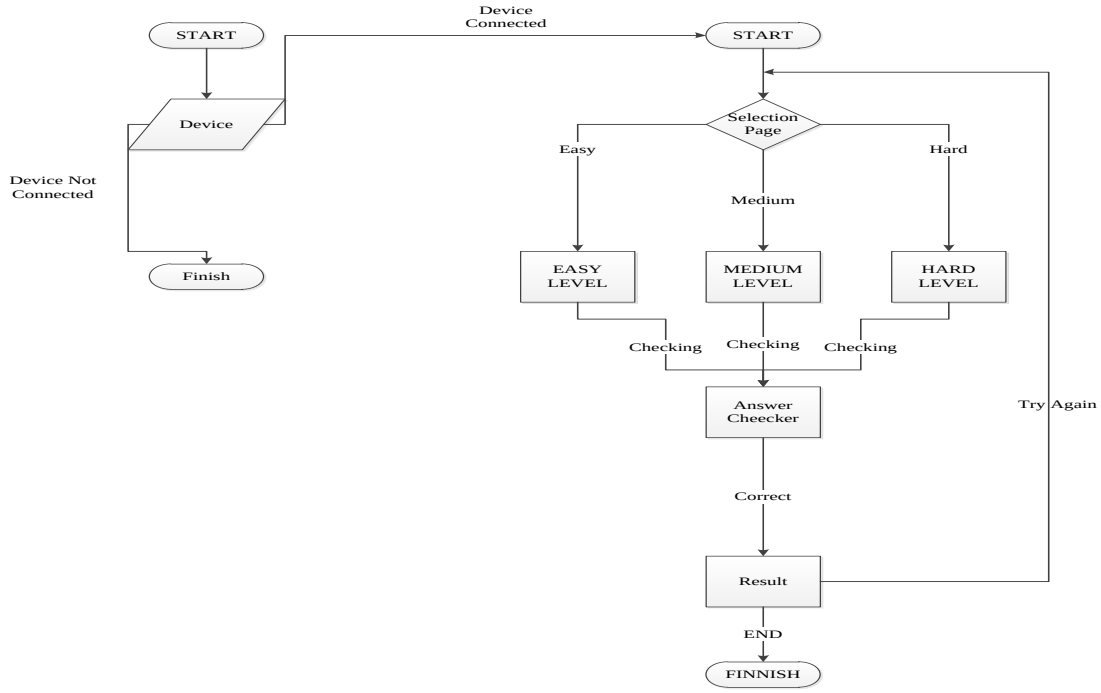

Figure 2.2 Flowchart of the System

2.3.3. System Context Diagram

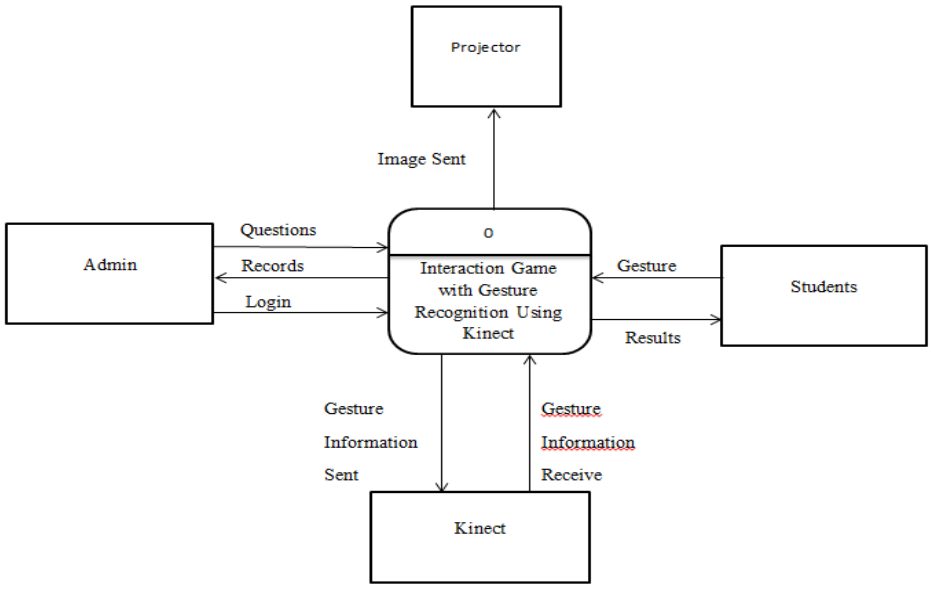

Figure 2.3 System Context Diagram

In this context diagram, it shows that the admin have the right to configure questions, view students records and have the privilege to login to the system. Student is only the player and they can only view their result at the end of the games. There is a projector that will receive the image and display the image of the system. Kinect receive the gesture from the students and process the students gesture the nit will sent the processed gesture back to the system to be processed.

2.4. Method

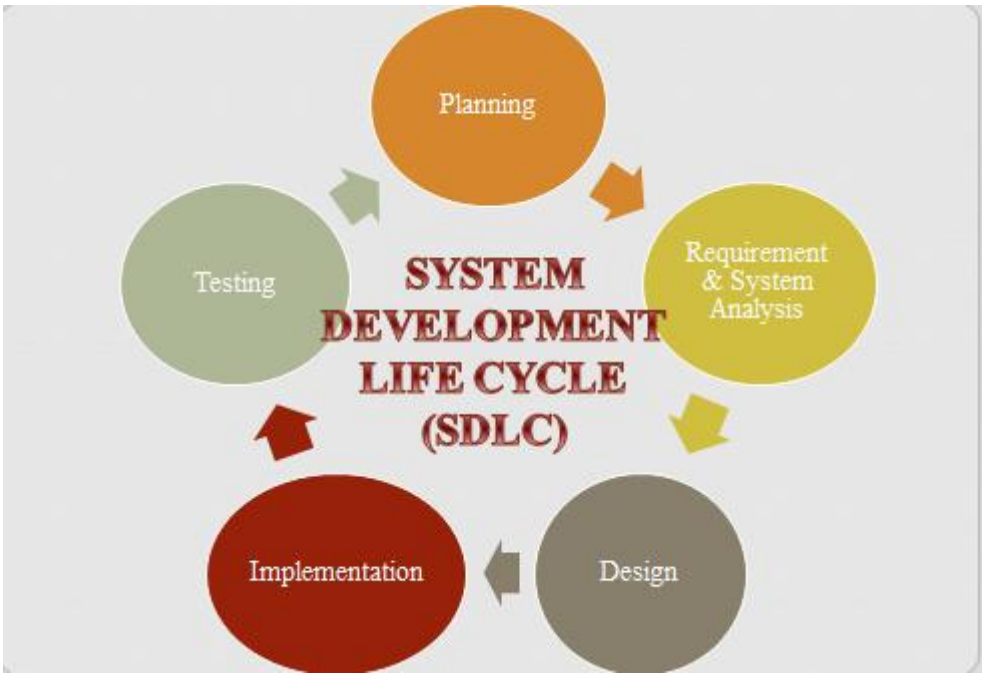

Figure 2.4: Software Development Life Cycle (SDLC)

To aid the development of this interaction game, System Development Life Cycle (SDLC) was being referred and used. There are five phase in the SDLC process that is, Requirement Analysis, System Analysis & Design, Code Generation, Testing, Implementation, and maintenance. By following this phases in SDLC, the project will be done in more systematic and also will help in developing the software on time. Following is the diagram that shows the process that is used to develop the system.

2.4.1. Planning

This phase start when acquire title from supervisor take place. First, in the pass system, the interaction game require students to interaction with the keyboard and mouse only. This project aim is to create a keyboard and mouse free gaming