Motion Based Learning for Preschools Mathematics via Kinect

(Counting Number)

By

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14374

Dissertation Report submitted in partial fulfillment of

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CERTIFICATION OF APPROVAL

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Approved by,

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TRONOH, PERAK

Jan 2014

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the reference and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or person.

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(Muhammad Saifullah Bin Abdul Rahim)

ABSTRACT

Kids start learning numbers since they in preschools. Every kids have difficulties to start learn about mathematics. They do not recognize and might be difficult for them to remember the numbers at first. Teacher will help them to teach and assist them to solve this problem and it usually happens after some stages and time. The only problem is education system use currently is not helping much in increasing the speed of children's learning. With current education system that sometime bored and only use whiteboard as medium of teaching, kids cannot give their full commitment in class. In Malaysia, traditional and conventional teaching still widely being practiced. However, with the advancement of technology nowadays, it can help to overcome this problem. By using current technology, it can help to complement current education system. Education system can utilize the advancement of technology to overcome problem such as boring and not interactive learning. Example of technology that can be use is Kinect. Kinect is a device that can track human body to interact with an application. It can help make learning become active, interactive and at it also involving all body parts. The objective of introducing kinect in education is to develop a motion based learning application for preschools' mathematics. To achieve this objective, the author has decided to test the application for preschools kid age from 3 to 6 years old. It will focus on teaching simple numbers. Kinect in mathematic will cover on basic numbers among preschool kids. Since the time given to develop this project is very limited, the methodology chosen for this development is throwaway prototype methodology. By using throwaway prototyping methodology this project have improved and increase user involvement. Results showing that kids enjoy the kinect technology in mathematics and teachers have found one of interactive ways of teaching. From data collected and analyzed, results showed that kids enjoy this kinect technology in mathematics and at same time teachers have found one of interactive ways of teaching.

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CHAPTER 1
INTRODUCTION

1.1 Background of study

Preschools or commonly known as kindergartens are usually the first place for kids to start learning and understand mathematics. Learning mathematics includes learn and understand things related to numbers and operation. It isvery common that every kid will have problem and difficulties to start recognize and also remember numbers at first.Research showing that it is very crucial and importance to understand mathematics at preschool level for future academic success (Freedberg ,2012).Parents are highly motivates that their sons can learn basic numbers and mathematical operation well during their preschools education. Parents want that their children can know mathematical stuffs very well so that they won't face any problem when dealing with more complex and difficult mathematical operations during their school and university.With the advancement of Information and Communication Technology (ICT), the use of digital tools and programs have been widely been used as parts of high class well educated people. Digital tools can provide more interactive and interesting ways of learning.Furthermore, by using technology, class will become more attractive and also can provide active interaction style (two ways interaction between teachers and learners).

Malaysian government is very concern to develop and reforming a better education system. So that, it could be linear with the educations systems that have been used around the world. However, there are many challenges to be faced by the government to implementing a better education than what have been offered currently. Probably one of the challenge is the quality of education been teach in school itself.

1.2 Problem statement

1.2.1 Problem Identification

In worldwide, learning has evolved from traditional education tools into more interactive tools in classroom setting. Also, the learning style also have changes from passive learning; which only involve one way interaction into active learning; involve two ways communication of teachers and learners. This improvement of learning style can help to improve the interactivity and learning experiences in teaching.

Nusir, S., et al (2012) wrote in their research paper that it is sometime boring and uninteresting to present to students the course of material on a board or direct rehearsal. With the advancement of information and technology, education system may need to utilize these technology advancement to solve the regarding problem. There is a lot of possibilities ways of utilizing technology such as using animation and also user interaction with kinect to present some of boring and complex problems. By using these techniques, it can be useful for teaching kids at early ages in preschools in more interesting environment.

1.2.2 Significant of the project

It seems that Malaysia are still far behind other countries in term of education system. According to Pusat Perkembangan Kurikulum (2001) under Ministry of Education Malaysia, preschools in Malaysia are still practicing conventional educations which only use whiteboards and some stuffs to teach kids in preschools. Only few kindergartens have improved their learning tools and teaching method.

Furthermore, many people currently have explored the use of kinect in education. Some examples of existing kinect application in education are 'Kinectimals' and 'Kinect Adventure'. Even though many people have explored the use of kinect in education, not many of them are actually exploring the mathematics courses especially the one that been teach in preschools.

Hence, by using this opportunity, the author will use the current technology to develop an application that can support and improving the education system level in Malaysia especially in preschools. Also, author will develop a kinect based interaction in mathematics application for preschools.

1.3 Objective of Study

The aim of this project is to develop a motion based interaction for mathematics in preschools. And to achieve it, some objectives have been identified and listed. There are three different objectives of this project which:

1. To explore the use of motion based as an interaction technique for mathematics application among preschools students.
2. To develop a kinect based in mathematics application for learning basic numbers.
3. To evaluate the usability of mathematics application among the potential users.

1.4 Scope of Study

In order to develop and complete this application within the time frame, several scopes of studies that would involve for the development of this project need to identify. The scope of studies can be divided into five which are; target user, content, focus, concept and device.

1.4.1 Target user

The target user for the application is preschools kids who are age in range of 3 to 6 years old. This application can interact with one user at one time.

1.4.2 Content

The application will be design following standard that have been measured by the Ministry of Education Malaysia in the 2001 national preschools curriculum report. This application will cover basic stuffs of mathematics numbers following with the current syllabus that been teach by teachers in preschools and kindergartens.Among of the things that will be cover are

- Numbers
  - From 0 to 9 (Recognizing number in sequences, shape of each number and the way how to draw numbers)
  - From 10 to 20 (Recognizing number in sequences, shape of each number and the way how to draw each numbers)
  - Series number of 20, 30, 40 and 50 (recognizing the sequence series of numbers of 20, 30, 40 and 50, how to draw it and shape of each numbers).

1.4.3 Focus

The focus of this project is to enhance teaching and learning methods that been implement nowadays. Mainly, this project will focus in learning mathematics for preschool kids. The aim is to create interactive tools for kids to learn and at the same time, teachers can use kinect as new tool for teaching. These will introduce a new learning experience for both parties; students and teachers. The final outcome of this project is to provide more interactive and interesting learning process.

1.4.4 Concept

The concept of this project is we try to implement the preschools syllabus and make a kinect program. This program will help improving the learning process and also become more interactive and fun. Currently, teachers use white boards and books to explain mathematics to students. This been done by using method of drawing and reading. The idea of this project basically still the same with current teaching method, however with some additional method, which students and teachers can interact with the subject through kinect program. This will give students better understanding as they are able to see and feel themselves interacting with the program. Thus, it will help students to understand easily what they will learn about the subject.

1.4.5 Device

This application will be use Microsoft Kinect device which will be connect based on Windows platform. Basically, the kinect will focus more on detecting the human motion.

CHAPTER 2
LITERATURE REVIEW

2.1 Mathematic Education

Mathematics is all about numbers and operations. It starts from basic number of 0 until infinity and operation of additional till algebra operation.All of these will be teach in schools and universities. Mathematics is a continuous process of learning in our life. It will involve not only in education level but also in our daily routine. For kids in preschools, they will only been taught simple numbers of 1 until 9 and also a series of 10,20,30,40 and 50. They also have been taught the basic operation of additional and subtraction (Pusat Perkembangan Kurikulum, 2001). According to Clements, D. H. (1999), everything around us can be better understood with mathematics. His research have been supported that, encouraging children to talk about their observations, thought and reasoning as part of mathematical will helps kids to develop not just their facility with the language of mathematics but also more general communications skills and their awareness of their own thinking (Greenes, C. 1999).

Very young kids shows natural interest in exploring everyday mathematics concept. They count steps as they walk, create patterns with different colors, build up tower using LEGO blocks and differentiate which tower is taller than the other. These early explorations and engagement associates as a foundation processes of learning as children will continue learning formally in preschools for better understanding (Brenneman, K., et al, 2010). For children to mature understand the learning of mathematics, they will need to develop the cognitive development which is harder for them to build alone. Teachers will support the process of cognitive development of children by encouraging preschoolers to reason mathematically, explore the concept in the domains and explain their thinking whenthey are explaining.

When teachers and parents consider mathematics in preschools, they were thought that learners will only learn counting and identify numbers but learners also process the numerical operations, spatial relations, geometry, data analysis, algebraic thinking and also measurement. Most preschoolers count verbally what written on boards or projected on the screen. However, some research suggested that children can understand better if they are being approach to one-to-one basis. Everyday day applications of knowledge and also intuitive may help lay the underground for understanding the concept of numerical equivalence and operations, such addition and subtraction.

Table 1.Hypothesized learning trajectory for mathematic in preschools level

Level	*Behavioral Example*	*Instructional Task*
Non-Verbal Addition. Children reproduce small (< 5) sums when shown the addition of subtraction of groups of objects (Mix, Huttenlocher, & Levine, 2002).	After watching 2 objects, then 1 more placed under a cloth, children choose or make collections of 3 to show how many are hidden in all.	"Mrs. Double" puts 3 chips, then 1 more, on a cookie under a napkin. Children put the same number of chips on the other cookie. 
Small Number Addition. Children solve simple "join, "result unknown" word problems with sums to 5, usually by subitizing (instant identification of small collections) or using a "counting all" strategy (Baroody, 1987; Fuson, 1988).	"You have 2 balls and get 1 more. How many in all?" Child counts out 2, then counts out 1 more, then counts all 3.	The customer wants his order in one box; what should the label for that (rightmost) box be? 

Find Result. Children solve "join, result unknown" problems by direct modeling—"separating from" for subtraction or counting all for addition, with sums to 10 (Carpenter et al., 1993; Clements & Conference Working Group, 2004; Fuson, 1992a).	"You have 3 red balls and 3 blue balls. How many in all? Child counts out 3 red, then counts out 3 blue, then counts all 6.	Children play with toy dinosaurs on a background scene. For example, they might place 4 tyrannosaurus rexes and 5 apatosauruses on the paper and then count all 9 to see how many dinosaurs they have in all. 
Find Change. Children solve "change unknown" word problems by direct modeling. For example, they might "add on" to answer how many more blocks they would have to get if they had 4 blocks and needed 6 blocks in all (Clements & Conference Working Group, 2004).	"You have 5 balls and then get some more. Now you have 7 in all. How many did you get? Child counts out 5, then counts those 5 again starting at one, then adds more, counting "6, 7," then counts the balls added to find the answer, 2.	Mrs. Double tells children the cookie has 5 chips, but should have 8. She asks them to "make it 8." 
Counting On. Children continue developing their counting methods even further, often using objects to keep track. Such counting requires conceptually embedding the 3 inside the total, 5 (Baroody, 2004; Carpenter & Moser, 1984; Fuson, 1992b).	"How much is 4 and 3 more?" "Fourrrr…five [putting up one finger], six [putting up a second finger], seven [putting up a third finger]. Seven!"	Children use cutout "cookies" and brown disks for chocolate chips. The teacher asks them to put 5 chips on their cookies, and then asks how many they would have in all if they put on 3 more. They count on to answer, then actually put the chips on to check.

Furthermore, young kids enjoy exploring relationships and properties of geometric shapes and also spatial positions (Clements, D., H. & Sarama, J., 2004). By understanding how body moves in space and learning how to manipulate objects and shapes can improve their cognitive developments. Learners in preschools learn about spatial relationship in mathematics by moving the geometry objects in their classroom and also by manipulating toys such as puzzles and dimensional shapes. In this tasks, the will also demonstrates the awareness of measurement, weight, height, length of various objects. This means that children as young age of 3 and 4 years old already begin to think about algebraically by manipulating the pattern, do their own patterns and calling attention to patterns that they observe in environment (Epstein, A., S., 2003). The kid's ability to collect and sort items by their attributes is a key components of the ability represent, analyze and interpret mathematical data.

2.2 Interactive Learning

Interactivity has long been identified to contribute to successful teaching and learning (Hsu, H. J.,2011) and also as an important element of effective teaching (Kennewell, 2004). The degree of interactive of the classroom is judge by how much effort the teachers try to control the classroom interactions with the learners.

According to Beauchamp, G., et al,conceptualize interactivity in whole class teaching on a continuum according to the degree of teacher or pupil control, the nature of the interaction and the character of the scaffolding provided through the dialogue (see TABLE2).

TABLE2.Interaction in classroom.

Nature of the Interaction	**Control**
➢ Lecture No interactivity or only internal interactivity	High degree of teacher control
➢ Low level/funneling questioning Rigid scaffolding and deeper interactivity	
➢ Focusing or uptake questioning Dynamic scaffolding and deep interactivity	
➢ Collective reflection Reflective scaffolding and full interaction	High degree of pupil control

There are four main important characteristics to create an interactive lessons; reciprocal opportunities to talk, level of student autonomy, guidance and modeling and also environments for participation (Hsu, H. J.,2011). In this project, the author will focus more on the environments for participation because without thisteachers-student participation, classroom activities will be less interactive. Thus, the opportunities to attract kids are lesser and it will cause them to not paying attention during the class session.

2.3 Interaction Styles

In generally, there are a lot of interaction technology can be used in technology. These techniques can be divided into three main interaction styles which are consists of command language, function key, icon, menu selection and window (Shneiderman, 1987).

- Command language is the first interaction style that is believes to be the oldest way of interaction with computer. The advantage of this style is in the command mode, user has maximum number of direct access with all available operations and functions. However, user can't be guaranteed to have permanent feedback of all available functions points, which this is the drawback of command language interaction style.

- Menu selection. This second interaction style will be includes the pop-up and pop-down menus, rigid menu structures and etc. This interaction style only works with ASCII character set. The advantage of menu selection is all available functions can be represented with visible interaction points. However, the drawback of this interaction style is it can become troublesome in finding function point in deeper menu hierarchies.

- Third interaction style is direct manipulation. It will not spread until the bit mapped graphics displays came on the market. Direct manipulation development will use any work environment (table, files, basket, etc) as their interaction with input and output interfaces. The advantage of this interaction style is any functions will continuously represented by visible interaction points and the disadvantages of it is difficulty in handling variables or distinguishing depiction of an individual element from set of elements.

2.4 Technology in Education

According to Subrahmanyam (2000), he said in his research paper that frequent practice of technology in home and community setting by young children may influence their early literacy no less than any other purposeful learning. Supported by Atkins, M. S. and Li, X. M. (2004) saying that in their research have shown that the use of technology in education can enhances children's fine motor skills, alphabet recognition, concept learning, numerical recognition, counting skills and pre-mathematical knowledge, cognitive development and self-esteem or self-concept. Some example of using technology in education is Interactive White Boards (IWB) and Montessori Method.

2.4.1 Interactive White Boards (IWB)

FIGURE 1. Teacher teaching using IWB

As interactivity has long been regarded as key affordances of ICT, teachers are encourage to exploit the use of technology in support of effective learning. Interactive white board is one of the examples of new technology in education system. Based on studies conducted in England and Wales, a large-scale investment have been spend in IWB technology recently (Beauchamp, Jones, Kennewell, Tanner, 2004). In addition, according to Kennewell and Beauchamp (2003) in another research, the pedagogical practices by many teachers using IWBs are not been influenced by introduction of new technology. Every school will be provided with an interactive white board and five network PCs.

The existence of this IWB will take sure that daily routine of teachers will become more enthusiastic in teaching students (Beauchamp & Kennewell, 2003; Kennewell,2004).

FIGURE 2. Interaction between teacher-learners

The degree of interaction that IWBs can provide will be varying on the use to which they put it and also with the teacher's abilities to conduct the context (Beauchamp, Jones, Kennewell, Tanner, 2004). Teachers who use IWBs can monitor the learners' abilities and also the objective of the tasks (Kennewell,2004). According to Becta (2003), the interaction of IWBs associated will be depends on the pace, engagement, motivation, participation, involvement and collaboration between teachers and students.

2.4.2 Montessori Method

FIGURE 3. Montessori Method

Montessori method is a method that developed by Italian physician and educator named Maria Montessori. It's a method that characterized by an emphasis on independence, freedom within a limits and respect for child's natural psychological, physical and social development. (AMIUSA, n.d).

Montessori method is about children development that carries distinctive educational application that led to the development of learning. The Montessori classroom will contains extensive apparatus and self-teaching materials designed to aid self-development of children who aged range from three to six years old. The teachers and learners situation is highly individualized where children are encouraged to select their own activities while the teachers, will observes the children and assists with and help if they are truly need it. (Solveiga, n.d).

The concept of Montessori Methods implies that the children will be active learners whose drive for self-development is sustained by orderly but stimulating environments. Children will be provided with totally freedom to develop any things that will help their learning and they are also been encouraged to develop and exercise self-discipline attitude.

2.5 Kinect

2.5.1 Definition and Kinect Architecture

FIGURE 4. Kinect device

Kinect is a motion sensing input device produced by Microsoft for the Xbox360 video game console (Hsu, 2011). It is a motion sensing input device which can capture, track and decipher body movements, gestures and voices (Hsu,2011). Kinect Xbox 360 has been around on November 4, 2010 (Chen,2010). However, the existent of kinect actually have been around for quite a while. Kinect is software that enables any users not to tie to any devices such as keyboards and controller to play and control any kind of software programs that allowed kinect. Previously, kinect is design for Xbox for purpose of entertainment and games. Then, after the release of open source drivers, kinect are now able to be connected to any computers or laptops and software programs (Giles,2010). Kinect application is available in C++, C#, and Visual Basic.NET programming language. This has offer new interest to public and it has opened up a lot of opportunities to existing field to try implementing kinect in their application for the betterment to human being.

Kinect is originally Xbox peripheral device which been built only for gaming purposes that can give user a controller-less immersion experience (Kinect, 2014). Xbox with kinect have been recorded in Guinness World Book of Records for fastest selling consumer electronics device (Redmond, 2011). Kinect is originally response to the next generation of human-computer interaction (HCI).

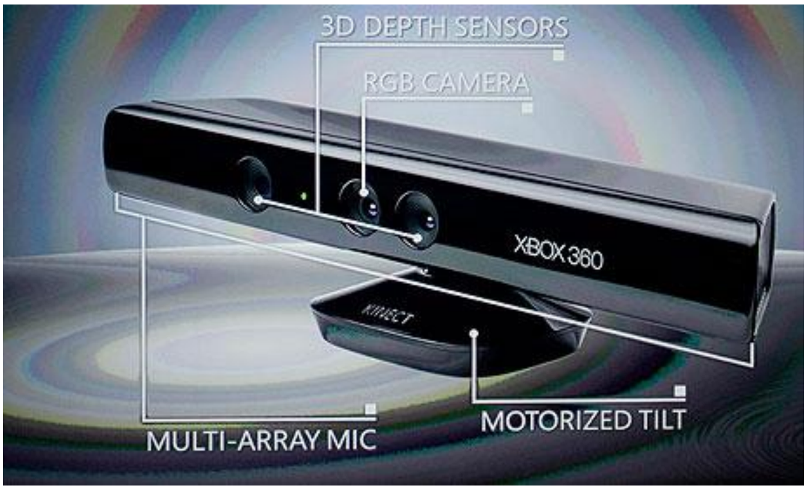

FIGURE 5. Kinect device description

Kinect consists of body, the stand, power cable and USB cable as it physical characteristics. The body houses with 3 different cameras; IR camera, IR emitter and RGB camera while the bottom part of this body consists of 4 arrays of microphones. Kinect body also houses the main PCB which holds analogue-to-digital converter, MOSFET International Rectifier, USB 2.0 controller, SDRAM Hynex Semiconductor, image processor, 2 regulators and a bus transceiver.

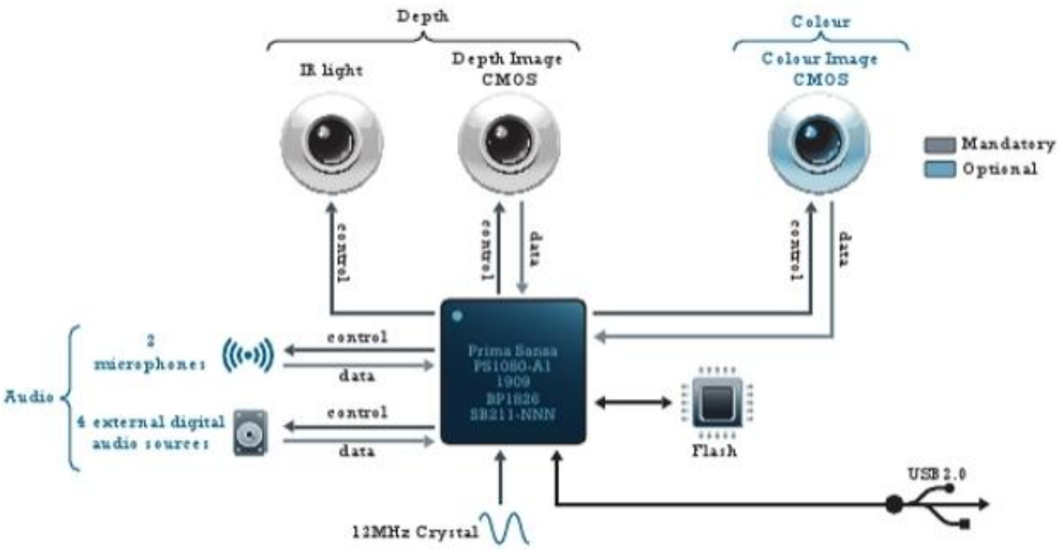

FIGURE 6. Prime Sense platform design for Kinect

Kinect was designed by company named Prime Sense. Prime Sense is a partner of Microsoft and it utilizes a proprietary image processor. As we can see in **FIGURE 6** the Infrared (IR) camera is on the left side and the right side of the Kinect device. The middle side of the device is the color camera. The IR cameras function to capture 2D and 3D representations of the gamer while the color camera will capture the color. The IR camera will acts as depth camera that records the distance of the objects in front of it. IR projector will shine a grid of infrared dots in front of it and the IR camera will reads the reflected IR dots. It used displacement of the captured dots to figure out the distance of object from the scene. This makes kinect can 'see' how far any objects in front of it. Humans cannot see the infrared lines using their naked eyes but this will considered safe since human already exposed to the infrared rays from the sun naturally. The IR camera will also works in the darks because it doesn't count the light matters of the objects or image.

According to Richard (2010), in gaming terms of Kinect Xbox360, there's a little but definable lag in between user's action and on-screen's reaction of it. Kinect been developed so that it can acknowledge full-body sensors which in literally the users can have a genuine feeling of involvement in the game.

2.5.2 Kinect Tools

2.5.2.1 A Tool for Teaching

According to Smith, Higgins, Wall and Miller (2005) the potential benefits of kinect as tool for teaching can be class into 6: multimedia, flexibility and versatility, efficiency, supporting planning, presentation and interactivity. Interactivity also can be related to participations of students in lessons. For example, students will have more tendency to encourage themselves to come out in front of class to interact virtually with objects depicted in readings. By connected kinect to computers and projectors, it helps to provide natural and intuitive patterns via gesture, body and voice over digital contents. With this incorporation of kinect, it will help teachers to enhance ability to present and manipulate all multimedia sources. Consequently, by combining the useful materials of visual and auditory, it helps to utilize students' multiple intelligences (Hsu, 2011).

FIGURE 7. Kinect as tools in Teaching

Additionally according to Hsu (2011), there are four characteristics of tools for teaching using kinect. First, kinect is a flexible teaching tool. Teachers can use interaction of body movements, gesture and voice without using any hardware devices or get close with classroom computer. Secondly, kinect can accommodate with multiple users in a time. So far, kinect in Xbox360 can been used by two users simultaneously. By enabling kinect in teaching, teacher can have one-to-one interaction with students in the classroom. Third, kinect is a versatile tool. As it contains 3-dimensional information, kinect can helps teacher to provide several of activities such as martial arts and dance. If the contents of interactive activities are designed correctly, it's helps participations in providing physical activities. Fourth, kinect engages participations of students. The interaction provided by kinect helps involvement of students and also more time on task from students. This makes them to utilize time and their intelligences.

2.5.2.2 A Tool for Learning

FIGURE 8. Kinect as tool for learning

Kinect can also be a tool to support learning (Hsu,2011). The affordance of kinect as learning tool can be divided into three main aspects. First of all, kinect can be as a stimulating tool. Kinect can be simulated the environments and greatly enhances student's verisimilitude. If the activities are planned wisely and the lessons learnt are carefully designed, the Kinect-enabled classroom will have affordances to create joyful and interesting interaction to boost up students' motivation. Second, kinect tool help to promote learning in its multimedia and multi-sensory itself. Kinesthetic interactions inside the kinect help to coordinate with visual and auditory information which reinforce student learning. This also helps to grasp easily the ideas and concept been teaching in class. Third, kinect can be used as a program to enhance its role of learning tools. Kinect emphasizes more on building external and personal relationship with knowledge in the process of learning (Papert,1980),(Papert,1996). Kinect can also add information from users like height of user, speed movements and any body language which helps students to add creativity to their multimedia works by feeding all of this information.

2.5.3 Kinect in Education

2.5.3.1 Kinect in English Language

According to Lisle (2010), a survey and video interviews done at Lakeview Primary showed that teachers having problem in teaching English. This is due to many factors which are:

- The large size of classroom which cause to almost impossible to have an individual attention. This leads teachers to maintain controlling the class and be a passive role in teaching.
- Most of students come from families which doesn't practice English as medium of communication at homes. This made that students faced difficulties to done their homework and parents can't help them.
- Students have too much tasks to grasp at a time; they need to become literate, need to learn English and need to learn how to use English at the same time across the curriculum syllabus.
- Teachers not feeling too confident to teach English. This might because of lack of training for them.

The situation faced at Lakeview Primary also happened in Africa. Students in primary school need to done multitasks in learning English because they need to follow the curricular concepts of English. They need to be a good language learners of this subject through its second language (Clegg, Ogange, Rodseth,2003).

In order to provide a solution for that regarding problem, teachers are suggested to use digital resources as sources to teach English (Lisle,2010). Among of the digital resources, Kinect is one of the best options to be chosen into an educational setting especially in English education. For example, Xbox360 can be used as a facilitate learning like video conferences between teachers and students from home. Also, can be used to view photos, presentations and video (Lankwardern, 2011).

Some examples of existing Kinect Xbox360 games that can help in learning English:

TABLE 3. Sonic Free Riders Game

Game	*Sonic Free Riders*
Age appropriate	Suitable for all
Content	Control your avatar through a variety of races
Language content	Minimal
Possible uses	1, 2, 3
Feedback	This game test how player will decide every movement in shortest duration. The game play quite fast. Player need to move fast and sometime kinect are not sensitive especially in brightness surrounding.

TABLE 4. Kinect Adventures Game

Game	*Kinect Adventures*
Age appropriate	Suitable for all
Content	Control your avatar through a 5 mini adventures
Language content	Minimal
Possible uses	1, 2, 3, 4, 8
Feedback	This game very interactive and interesting. It use whole body parts and have many games that have different objectives.

TABLE 5.Kinectimal Game

Game	*Kinectimals*
Age appropriate	Suitable for all, although it is a bit complex for young children
Content	Train and care for an adopted cub; various activities to be played by the player with the assistance of the cub; unlock parts of a map
Language content	Fairly complex written and spoken instructions
Possible uses	1, 2, 3, 4, 6, 8, 9, 10, 11, 12
Feedback	A acronym for kinect animals, Kinectimals very suitable to be played by young children. It help you develop a sense of loving animals. The action also mostly jumping and using hand gesture.

TABLE 6. Dance Central Game

Game	*Dance Central*
Age appropriate	Age 12, sex and bad language; well, that's what it says on the box, but it's because the music is "real" music (eg Lady Gaga), and the dancers are cool and sexy.
Content	Control your avatar learning to dance
Language content	Song lyrics; instructions
Possible uses	1, 2, 3, 4, 6
Feedback	Very interesting game that involve all parts of body. This game give you a freedom to move and it will capture your movement.

2.5.3.2 Kinect in Mathematics

Mathematics is one of the main courses in education (Eduardo, G. M., et. al, 2013). Kinect are also been use in mathematics. One of the difficult tasks in education is to make it intuitive, including mathematics where it is pencil and paper based subject. When kinect comes in mathematics, it has become a perfect piece of hardware that been set to develop for the understanding and learning of mathematics for learners.

Some of existing Kinect mathematics applications are:

Application	KinectMath
Description	KinectMath provides more interactive, way for teachers to teach these abstract concepts to their students and also gives the students an easier way to visualize the mathematical concepts by using a real time display.
Age appropriate	University' students

Application	Brain zapping
Description	Brain zapping helps you improving your mathematical skills as easy as play Kinect video game in a hat.The kinect device is controlled by a computer; it wills controls things like the duration of the zapping.
Age appropriate	15 years old and above

2.5.3.3 Kinect in Science

Kinect device is a versatile technology that has successfully been built nowadays. Even the kinect application can be used and implement in many fields. Science field also has try to used kinect device. In 2011, SIEMENS has conducted a competition named as SIEMENS Competition in Math, Science and Technology. The purpose of this competition is to explore new possibilities of mathematics, science and also technology and at the same time to recognize young talents and foster growth in them. The winner of 2011 SIEMENS competition is using kinect as their project. Consists of Cassee Cain and Ziyuan Liu as the team members, they used kinect device to create an application that can analyze human walking pattern. This application will helps to track and prescribe treatment to those who suffers from injuries or alignment that effects their movements and people who need amputations or surgery for joint replacement. The team was awarded $100,000 as winner prize for their projects (Siemens, 2011).

Another example of using kinect device in science subject is the ergonomics application. Ergonomics is an analysis of human working postures. Traditionally been measured using pen and paper. The issue is this method allows a given period of time and very limited count of ergonomics analyses can be made. To overcome this problem, they used the aid of Microsoft Kinect device (Horejsi, et al, 2013). Kinect device is connected with software package called Process Simulate. The skeletal tracking application is used to transfer movements from real human body to human model in digital environments built in Process Simulate software. Microsoft Kinect can recognize up to six persons in its vision and two of these six persons can be monitored closely. Kinect also can recognize standing and seated users and then match them with appropriate number of joints. A standing figure can assigns up to 20 joints in a figure and seated figure has only 10 joints. This kinect application can help to eliminate using pen and paper to detect and analyze the ergonomics.

2.5.3.4 Kinect in Medical

Kinect based application system has also been developed in medical education that purposely to helps medical students learns and understand any medic subjects easily. One of medical courses that use kinect-based is the physical rehabilitation system named as Kinerehab (combination of the words “Kinetic” and “rehabilation”). This system lets user to interact and also control the game without using any tools on body. By using kinect, it will help to check whether the patient performed exercise correctly or not during the physical rehabilitation training. Using kinect device will also help patient not to bother anymore with body sensors detector that usually they will need to wear during rehabilitation. This wills also avoiding the patient from facing any disturbing when conducting the physical rehabilitation. Kinerehab will detect user’s joint position and then will use the data collected to determine whether the user are doing exercise correctly following the example and also have done sufficient number of exercise in a day. Kinerehab system use kinect sensor to detect human body gesture. By using this system, it will motivate user to do exercise more frequently and in correct ways in physical rehabilitation. This will then result the user to recover in shorter time (Jun-Da, et al, 2011).

2.6 Natural User Interface (NUI)

2.6.1 Definition of NUI

Technologies in virtual environment always keep improving from decade ago till today. After series of criticism in command language, interfaces, obstacles and limitations of virtual reality (VR) and augmented reality (AR), it's time to go beyond it (Steiger and Rauterberg, 2011). VR only enriches people to interact with virtual world, while AR augments the real world and human using some intelligent features. Only after the existent of AR, human can interact as much as they possible in virtual environment.

With the interest of human interaction design and due to some constraints in AR, the next generations of user interfaces; Natural User Interface (NUI) has been introduced. NUI is a system for human-computer interaction that the user operates through intuitive actions related to natural, everyday human behavior (Rouse, M., 2011). NUI is a system that uses human abilities such as vision, touch, voice motion and other higher cognitive functions as a method of communication. The purpose is to make human and computer interaction simpler for the user as it uses human interaction and body language which people understand but machines yet to comprehend. Thus, it will make easier for the user to learn and use this technology.

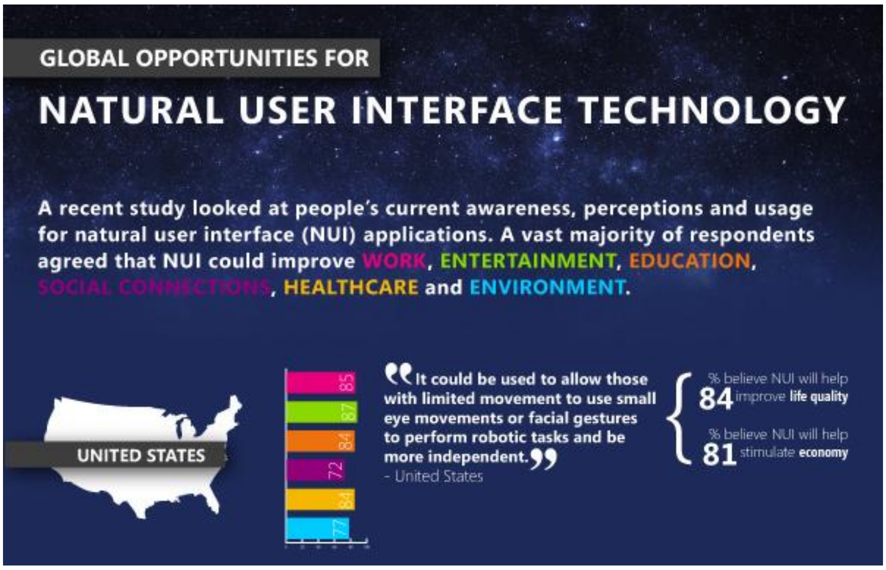

FIGURE 9. Recent study of perception people towards NUI in United States

The predecessors of NUI are command line interface (CLI) in where user had to use the command prompt to send instructions, batch interface where commonly remembered that used punch cards and graphical user interface (GUI) which will allow users to interact with electronic devices using images.

NUI can be characterized by several features such as being user-centered with machine adapting to the user instead vice versa, inexact; user does not have to be exact but machine must understand the exact intention, multi-channel that make full use of one or more sensory and motor channels that can capture the complementary characteristics of user’s command. Other than these, NUI can also been characterized by high bandwidth, implementing of voice-based interaction, behavior based interaction and image-based interaction. Kinect is one of the best examples of NUI because it embraces all of these definitions.

2.6.2 Framework for Natural User Interfaces (NUI)

Augmented Reality (AR) recognizes already that people are used to the real world and that the real world cannot be reproduced completely and accurately enough on computer. AR is build engineering on the real world with assist from computational capabilities. AR is the general design behind the NUI. In NUI, there is a system that support the mix of real and virtual objects. As input will recognizes the objects and understands the physical objects and human acting in natural way. While the output will based on pattern projection such as video projection, holography or 3D audio patterns. For example is kinect device. The spatial position of user will be capture by two cameras which also will create the stereoscopic picture. Sound will recorded by a microphones that will allow the internal 3D model of the user be maintain. Then the virtual and real physical object will be fully integrated.

Since that human beings manipulate objects in physical worlds more frequent and naturally with hands, there still a chances to apply this skills to user-system interaction. NUIs also allow the user to interact with real and virtual objects on working purpose, literally, a direct manipulative way. This will make sure that user can get the feedback of the state of manipulated objects exactly at the same spot where they manipulate the objects.

2.7 Human User Interaction

Each interaction in real worlds involves matters of physics, (example energy, matter, light, heat, sound, electricity and etc.). More or less, same way, each interaction with real world, human is needed as based of social and cultural norms (Rauterberg,1999). Social communication is multifunctional and can be divided into two parts; human to human communication and human to object communication. Any communication act will encloses simultaneously different perspectives like emotive, referential and many more. First, author will describe the necessary conditions for human to human communication and then will talk about human interactions with real objects.

2.7.1 Human-Human Communication

According to Beavin, et al., (1967) each human to human interaction communication act has a content and relationship part. The content part referring to technical information systems and relationship part is a 'metacontent' level where to control or accompany the content level of human to human interaction and communication, example are speech and storytelling.

Cassell and McNeill (1990) have discovered that human to human communication or according to them, face-to-face communication, status of content level is often to informally and spontaneous gestures of the speaker. In some ways, gestures may add another dimension to the speech which the act of certain aspects of events that cannot be conveyed by speech, this will give the recipient more complete view of speaker's conception of the event (McNeill, 1992).

McNeill (1992) also identified that there are four type of different non-facial gesture associated with speech:

- Iconic: feature of some gesture of action that described the situation.
- Metaphoric gestures: representational where the concept being depicted has no physical form.
- Deictic: spatial or locate in physical space in front of the narrator as aspects of the story being narrated.
- Beat gestures: small movements that do not change in form of the content of the speech.

These all four type of gestures can be found in any informal speech universally.

In human to human communication, arguments cannot be convincing if the emotional level is absence (Rauterberg,1999). This is one of the reason why smiley are created in internet that will help to improve their text based chatting. This is because smiley is also part of so-call emoticons (emotional icons).

2.7.2 Human-Object Communication

Human and object interaction is a task related activities that can be differentiate into two types; everyday skills of behavior and other motor movements. While the major classes of motor movements can be categorized into 5 parts;

1. Discrete movements. Involve a single reaching movements to a stationary target. This movements can be made either with or without visual control.
2. Repetitive movements. A repetition of a single movement to a target. Example is hammering a nail.
3. Sequential movements. Includes the discrete movements to a number of stationary targets regularly or irregularly space. Example is trying reach for parts in various stocks bin.
4. Continuous movements, movements that will require muscular control adjustments into some degrees during the movement. For example, guiding a piece of wood through a band saw.
5. Static positioning consists of maintaining specific position for a period of time. It's actually not a movement but rather absence of movement. For example, holding hands while soldering or holding a needle when try to needle it.

Actions are usually functionally and not anatomically or mechanically specific. For example, catching a ball could be carried out by either using left or right hand. The starting position and also the ways approach the ball might be change from one reach to the next. This movements will be still classified as same action although it movement will be different.

2.8 Edutainment

With the increasingly widespread availability of computers and technology, more energy been devoted to find educational using technology and specifically in computer-based games (Lisle,2010). Educational uses of computer games can be divided into two categories:

- Computer as teacher: computer software will present material to be learn and then provide practice activities on how well the skills or subjects has been mastered.
- Computer as Creator of Context: computer software provides an immersive experience which can stimulates real life and as a medium for teachers to make learners explore a topic in new way, in process of learning relevant content and skills.

At this point, gaming consoles can also been categorize under "computers" (Lisle,2010).

Lankwarden (2011) has his own point of view regarding entertainment in education,

> "The more I think about Xbox in the classroom, the more I am convinced that the games can’t really do anything other than teach hand and eye coordination or teamwork. At this particular time, there can't been categorized in any educational games. What we can do is kinect needs to launch math's title games, where it asks what 4+5 is for example and the kid will points to the answer. Another possibility is a game says “spell APPLE” and the child has to say or select the correct spelling. This will then appropriate to have an educational game in classroom. "

As an alternative approach to see games and computers in education, teachers need to conjure up a world for learners and use their engagement with that world to relate it with useful education purpose. The best example to shows that edutainment is one step ahead for better education is Ollie Bray's project using Xbox game name "Guitar Hero" as source of learning to teach creating and managing a rock band to assist Grade 7 students (Bray, 2009). Another source cited that, this approach to use games is well summed up (Times Higher Eduaction,2009).

2.9 Computer in Preschools

There was at least one desktop computer available in each of playrooms in preschools. With this access of resources, whiteboards that were beginning being used in some settings can be fairly widespread and be change with the computers. Because of some of these technologies are more familiar to practitioners they promote confidence, they can be more affordable and they can give their children opportunity to build on competences and knowledge that they may develop in home (Plowman, Stephen, McPake, 2010).

2.10 Conclusion

As a conclusion based on this literature review, the author has decided to come out with a project that develop kinect for mathematics among preschools children. The main reason of doing this development project is the author sees that there is not much exposure have been made for children in preschools with this kinect devices, especially in mathematics. Besides that, author has many references from previous people who have done kinect in education which he believe will help him develop his project. Most of the projects are focused for language learning and also for medical field training. Therefore, the author has taken an opportunity to develop a project for kinect in mathematics for preschools children. The purpose of this project are to evaluate the use of motion based as an interaction technique in mathematics application, to develop kinect based in mathematics application and to evaluate the usability and user perception of mathematics application among the preschools students. Author has named his project as "Motion Based Learning for Preschools via Kinect".

CHAPTER 3
METHODOLOGY

3.1 Research Methodology

Choosing the right methodology are often to be very crucial especially in project that focused to work on development. The methodology that the author has chosen is based on agile approaches or also known as lightweight approaches. The main reason that this approaches been chosen is because it promote fixed time period of an activity. Besides that, agile approaches also enhance the evolutionary of development and delivery.

Agile approaches always the best approach to be chosen in development project. Speaking of agile approaches system itself, there are plenty of choices of methodology inside it. For this project, the author has decided to come out with more specific and reliable methodology with the project's process. The methodology is called, "**Throwaway Prototyping Methodology**".This methodology perform the analysis, design and implementation phase concurrently and all of the phases will be repeated until the system is completed (Dennis, Wixom and Tegarden,2005).

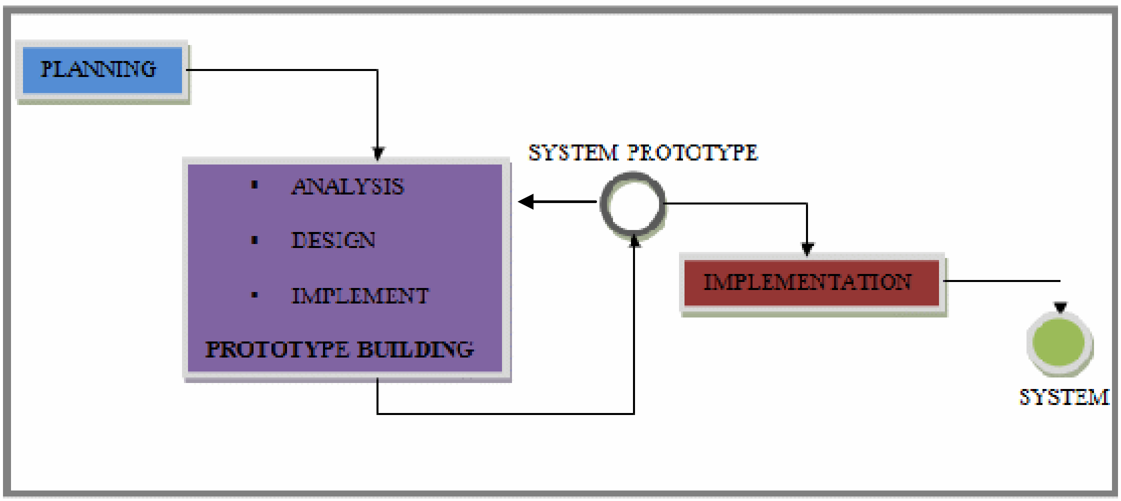

FIGURE 10.Throwaway Prototyping Methodology

In throwaway prototyping methodology, it consists of 5 main parts;

1.Planning

2.Analysis, design, andimplement

3.System prototype

4.Implementation

5.System

Each of them needs to be done step by step following the sequences as shown in FIGURE 10.

Some of advantages that can be gain when doing development under prototyping methodology are:

1. Reduced the time and costs.

2. Improved and increased user involvement.

3. System design and functionalities can be change concurrently to leads for better solutions.

4. Missing functionality can be detected easily.

5. Quick implementation of functional application.

3.1.1 Planning

The first and important phase in prototyping methodology is planning. The author needs to find the main reason why the system should be built and at the same time understand the requirements. It's also important to find out necessary and important information regarding the project. In this phase, it is important to be aware with any update on latest Kinect motion sensing system and application. Also, the author need to understand how well the preschool education system being used in time being. Also, author needs to know on what kind of modules will be needed and essentially need to be implementing to help kids improve their mathematics learning abilities.

Some tools that will required for the development of this project are:

a) Hardware

The Kinect sensor required to generate three-dimensional moving objects and human beings by utilizing its 3D depth camera. The full body motion tracking capability can be achieve and serve as the input for users to immerse in the virtual environment. Apart from that, PC desktop or laptop should require at least good CPU and GPU to run this project.

b) Software

An integrated development environment for game creation known as Unity 3D is used for this project. The main reason of using Unity 3D is because it offers powerful and automated physics engine inside its library that can integrated with kinect. Some of them are detection, destroy, rigid body and many more. These libraries that being offer in Unity 3D gives programmers to focus their attention towards scripting game flow easily. Unity 3D offers different types of languages tobe used in scripting which are C++, Boo and Javascript. Furthermore, Unity 3D can support the integration with kinect data through NITE, OpenNI, and Sensor Kinect drivers which opens wide range of possibilities to develop controller-less game experience.

Since kinect can work with any operating systems such as Windows and Linux, it still require a middleware software called Prime Sense's NITE and also Sensor Kinect drivers to establish connection between kinect device and operating system. OpenNI provides general framework to obtain data from kinect such as depth image and color. While PrimeSense's NITE consists a skeleton tracking that will detect the gesture and motion and write it into Natural Interface (NI) application. Sensor kinect driver serves as interface between NITE middleware and kinect itself.

For software development, Unity 3D itself have a built-in script editor that been used for developing algorithm and scripting for the game. And to utilize kinect inside the Unity 3D, an Unity-OpenNi binding script is required and its actually available for free.

3.1.2 Analysis, design and implement

After the author have done list out the important information for his project. The next phase he need to focus is the analysis, design and implementation phases. All of these phases can be perform at same time and also concurrently.

During analysis phase, author need to do some research regarding the information he list out and analyze it. For this project, author should plan to conduct a survey about mathematics subject in preschools, how it been teach and also how to conduct teaching mathematics using kinect. Besides that, author should plan to do the research precisely to avoid plagiarism of previous people project. All of the analysis from the research that had been carried out will be documented in literature review.

While in design phase, author will start to do the development of the basic architecture design for the system that the author have identified in his research analysis.The design of that system will be describe in details including the entire layout, diagrams and other documentations. At this phase, author should know how will the graphics, interface of the application will look, what will be the input and output process of the application, functionalities of the system and the information that will be stored in the application. During this phase, author also need to identify the importance of Kinect motion sensing devices in helping preschools kids to learn numbers and basic mathematics. In addition, the author will also need to taking into consideration of type of software that will need to be used to develop the application.

The next phase is implement phase. After the system architecture has being established and designed, the prototype of the system is develop in this phase. This phase will involve the building of the application in details specifications using software provided for kinect application and real code will be written in this phase.

3.1.3 System Prototype

In this phase, the system prototype that has been built will be testing.The important part in this phase is to carried out the usability test, which to ensure that the system works as expected and meet the user's requirements. For the testing, lecturers, tutors, teachers and students are expected to be the participation. Another purpose of this phase is to detect any errors and bugs in that application. So that, the bugs can be fixing before the real system is produce.

3.1.4 Implementation

When any errors of the prototype system have been fixed and the application works well and according to plan, the prototype will be executed in the final implementation phase. In this phase, user testing will be carried out to see whether the prototype meets user's expectations and usability functions. The purpose of this phase is the final testing process before the real system is produced and also to run demonstration to the potential target users.

FIGURE 11: User testing with the preschools teachers

FIGURE 12: User testing with lecturers

3.1.5 System

A complete system will be delivered to the user when all it is ready. Users can use this application using their own computer or kinect device.

3.2 Project Activities

There are three project activities that been conducted in this project, which are:

- Questionnaires

  Questionnaires are one of the way to gather data from users. Generally, questionnaires are conducted by filling the form or survey. This questionnaires are part of quantitative analysis of result.

- Interview

  Interview is slightly different from questionnaires although both of these are being conducted to get feedback and data from the users. Interview is one of example in qualitative analysis. The purpose of conducting interview is to make sure that this game are compatible to be implemented and use by people. Also, to identify the strength and weaknesses of this game.

- Thinking aloud

  Thinking aloud is method of understand how user approach this system and what are user think during conducting the system. Users need to describe verbally what are their feeling when testing the game prototype.

3.3 Tools

Software

- ➢ Unity 3D
- ➢ Adobe Photoshop

Hardware

- ➢ Kinect devices
- ➢ Desktop/Laptop
- ➢ Projector (not necessary)

3.4 Key Milestone

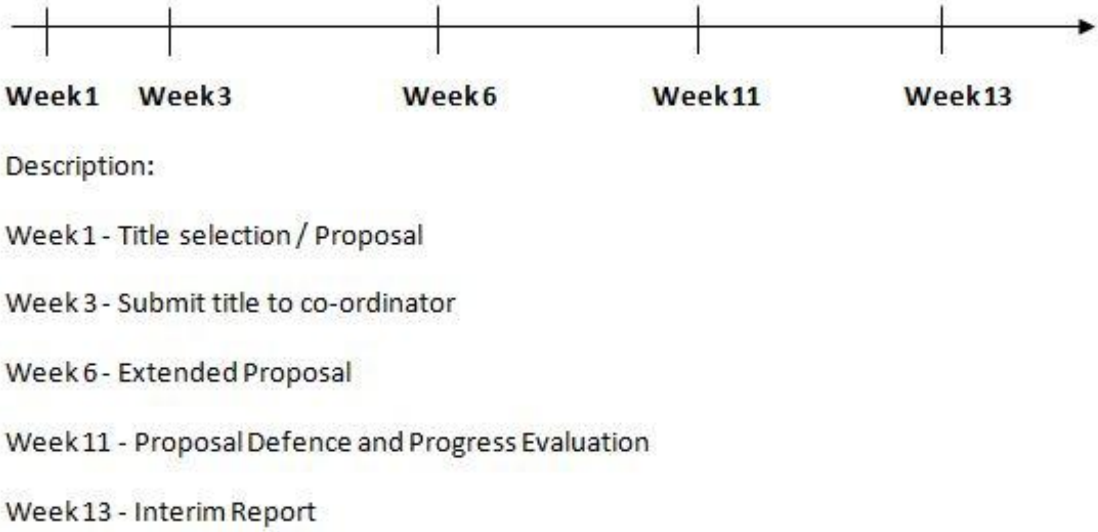

FIGURE 13.FYP 1 Key Milestones

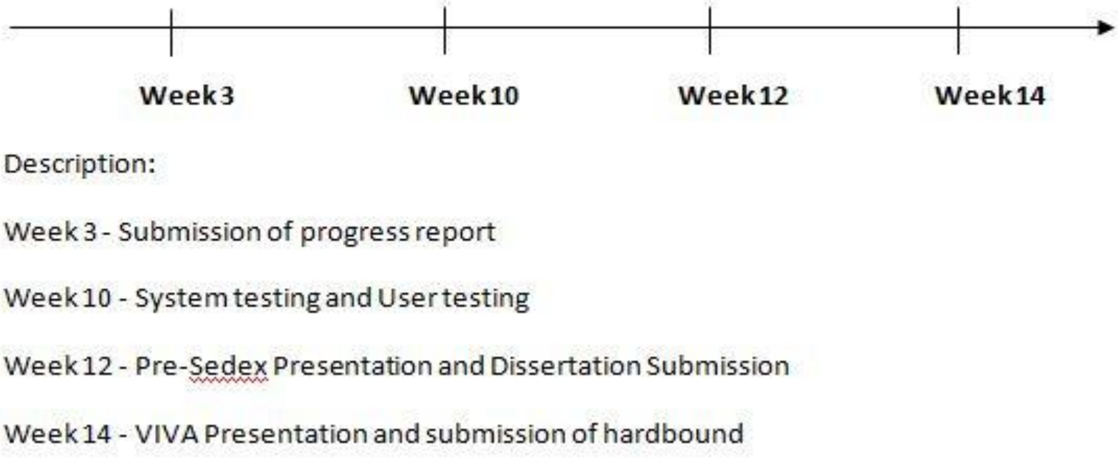

FIGURE 14.FYP 2 Key Milestones

3.5Gantt-Chart

TABLE7. Gantt Chart of Final Year Project 1

No.	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Project Planning														
2	Literature Review/Theory														
3	Data Gathering & Analysis														
4	Determine components of application														
5	Develop system architecture														
6	Designing interface of the system														
7	Proposal Defense & Submission of Interim Report														

TABLE 8. Gantt Chart of Final Year Project 2

No.	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Development & Prototyping														
2	System Testing & Monitoring														
3	Tabulate result and discussion														
4	Submission of Progress Report														
5	Implementation														
6	Documentation														
7	Pre-Sedex& VIVA														
8	Final Dissertation														

3.6 System Architecture

The system architecture of this project can be best describe in Figure 13.

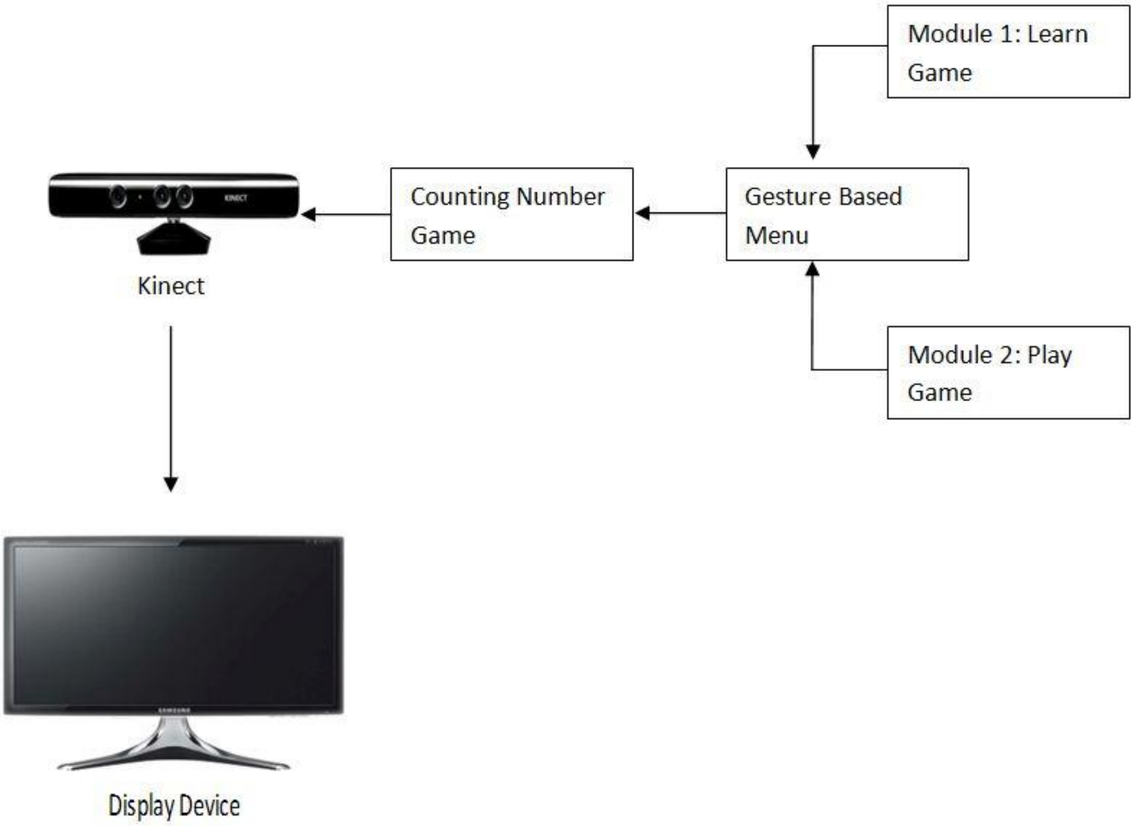

FIGURE 15. System architecture of the application

In order to start using kinect in mathematics for preschools, users will need to install Unity 3D, which a program that allows you to use kinect in Windows platform. Kinect itself is a plug-ins for computer. After that, user can install necessary software for kinect to work.

After finish install software and setting up, user may now install the application itself. User then can run the application and test the application. After all the applications have been fully loaded, the main screen will be pop up in the windows.

Basically, the application consists of 2 main modules which are:

1. Learning knowing numbers.
2. Know the sequence of numbers.

Further explanation about the system application will be discuss in the next chapter. Kindly refer to FIGURE 14 for the brief flowchart of the application.

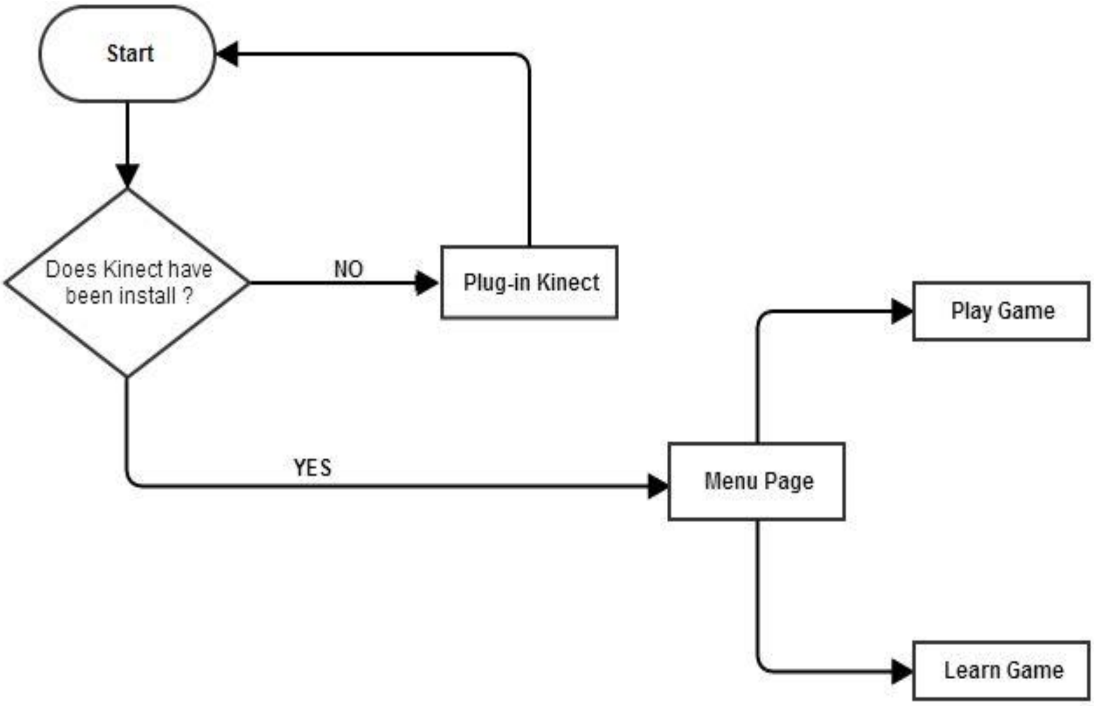

FIGURE 16. Flowchart of the application

CHAPTER 4
RESULT AND DISCUSSION

4.1 Data Gathering and Analysis

Generally, data gathering is the process of collecting information from reliable sources such as documents, targeted users and reports. These need to done to measure how far the objectives of this project can be achieved. To recap, objectives of this project are further elaborate in section 1.3. targeted users are the main source of information for this project while observation and questionnaire are selected as the main data gathering techniques for this project.

Since this project using kinect and kinect device is quite new technology available in the market, there are no concrete research have been done to test the usability of kinect with education games. Till today there are not many developers are venture and interested to do research on kinect on education games. In section 2 of this report also have explain that kinect only been test on education based on certain subjects only such as mathematics, English and science. Other subjects are so far not yet been tested with kinect.

Observation of the target users also involves monitoring and recording during the project activities been carried out. This observation then will be used for interpretation and to make a conclusion. Since this project required users to move around an interact with game objects in real time, by doing observation make developer to understand more users behavior and determine whether they are learning the subject in the game or vice versa. As for questionnaire forms, System Usability Scale (SUS) is used in this project because it offer a 'quick and dirty' way of assessing usability of the system at low cost. Furthermore, SUS has widely been used in many projects because of it robustness and reliability in measuring usability in terms of efficiency and effectiveness of system and also user satisfaction towards the system.

4.2 Prototype

After the application has done with the installation and it's already open the application in computer. User will need to make sure that their body has been detected by the kinect device. Then, user can start the application. The main page will prompt on the screen immediately after the application has been fully load.

4.2.1 Menu Page

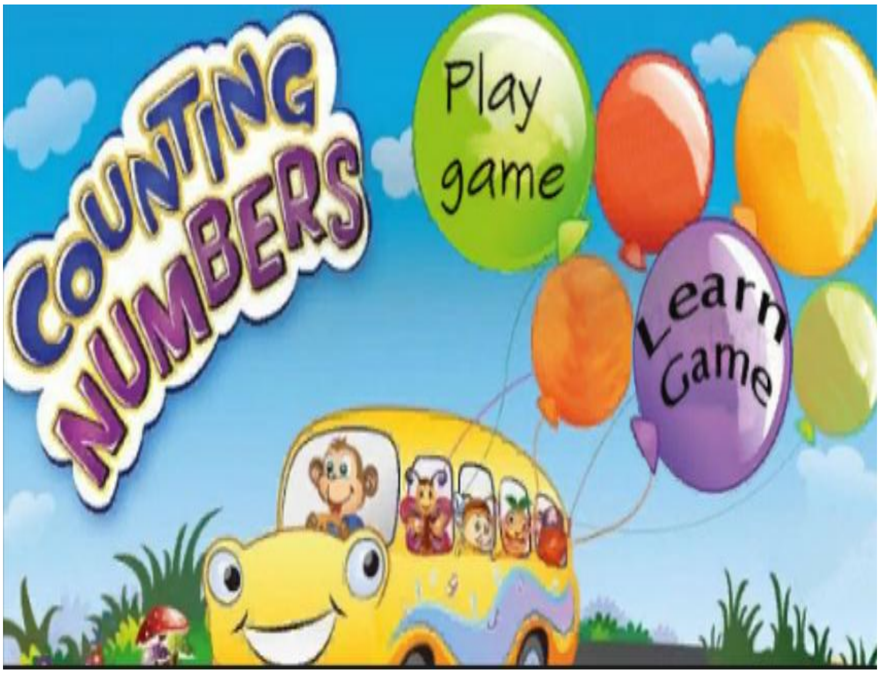

FIGURE 17. Menu page of the application

The menu will show two modules that contains in the application. User need to play each modules.. Users have freedom to choose which module they want to play first. However, it is suggested to play the "Learn Game" module first before they can proceed with "Play Game" module.

4.2.3 Module 1: Learn Game

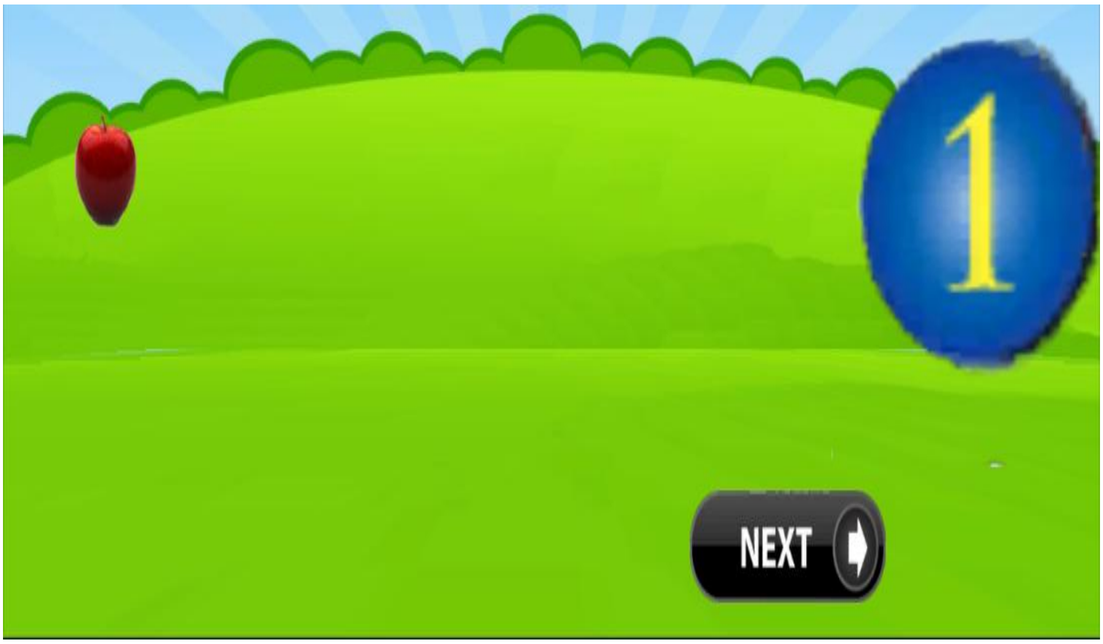

FIGURE 18. "Learn Game" module

The first module of this application is Learn Game. User will see the numbers prompt out on the screen. There will also picture of the apples on the screen to teach students with numbers. Students will need to pronounce the numbers and relate it with numbers of apples shown on the screen. Students will also need to know how to draw the numbers accordingly. Once teacher satisfied with the student's capabilities of understand and learning of number, teacher can press the "Next" button to continue with next number. This task will be repeating with others numbers such as 2,3,4,5 and so on.

4.2.4 Module 2: Play Game

FIGURE 19. "Play Game" module

The second idea is module "Play Game". What user will do in this module is they need to collect every single objects shows in the environment. For example, the apple. User need to touch the apple using his right hand. When it touch the objects, that objects will disappear and number 1 will shown on the screen. When user continue to pick another apples, the apple will destroy itself once user touch it using his right hand and next number will continue to shown in term of increasing. The same process will repeat and continue until all apples have been touch and destroy from the screen. Only right hand are allowed to be used. This modules will be play also with another arrange of number in random order.

4.3 Findings

Usability testing are being conducted at the end of the testing of the prototype. The usability testing system that the author use is System Usability Scale (SUS). In SUS, end-users are required to answer questions that will be given in form. In SUS questionnaire form, each of the users are been given of 10 questions and being rank in 5 range from "Strongly Disagree" as point scale 1 to "Strongly Agree" as point scale number 5. All the data from the questionnaire are being collected and analyze.

The average score of System Usability Scale score are illustrated below :

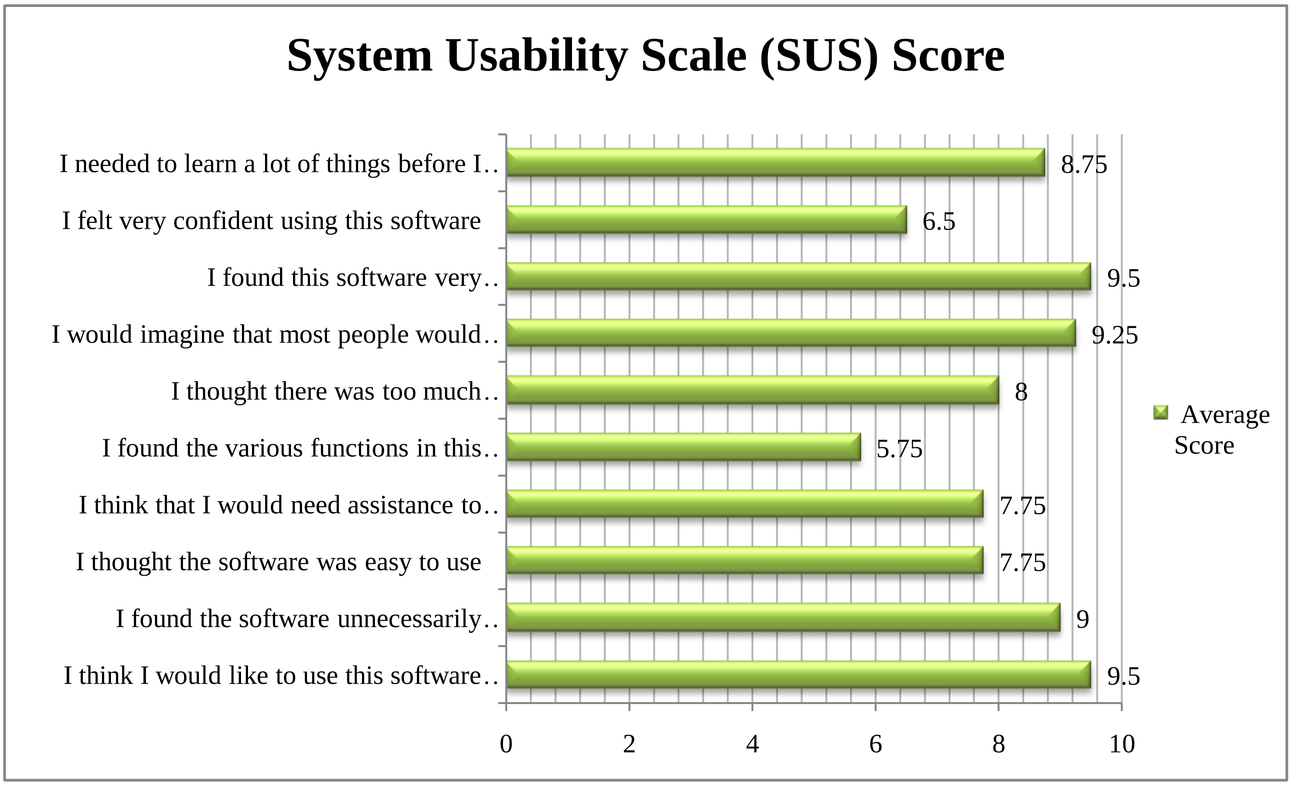

Figure 20: System Usability Scale (SUS) Average Score

Figure above shows that the average of sum of all the score in each questions. Data are collected from 10 random respondents who have tried the game. Respondents are among of preschool teachers, preschool kids, lecturers and university students. To calculate the average, they are two different calculations need to be taken. The calculation for odd numbers will be differ from even number.

To calculate the average of odd numbered questions, author using the formula:

[No. of Users * (Scale Position – 1)] * 2.5 / Total No. of Users

To calculate the average of even numbered questions:

[No. of Users * (5 – scale position)] * 2.5 / Total No. of Users

While the average score of total SUS for this game,

Total average score = 9.5+9+7.75+7.75+5.75+8+9.25+9.5+6.5+8.75

= 81.75

According to SUS score range, above 80 is an A. So this project is getting an A from SUS survey that the author have done from random respondents.

From this findings, what can be said is this projects is following accordingly what are needed in usability aspects. This shows author have produce a good quality of product to be use for the people easily without find any difficulties to use it even for the first time user.

[Source: *Jeff Sauro, February 2, 2011. Measuring Usability with The System Usability Scale (SUS). Retrieved from http://www.measuringusability.com/sus.php]*

4.4 User Feedback

After conducting all the user testing of the prototype, all the feedbacks are collected. Feedback are received from 3 different types of people; preschool teachers, preschool kids and lecturer.

According to the preschool teachers, this application is interesting and interactive. They agree that this application can complement the current system that they teach in their preschools. Furthermore, they said also that this application is one of interesting way to teach kids. They said that kids cannot focus and give attention when they teach using whiteboards and that the only reason why they try to teach kids using Montessori method and using stuffs. By using this application, they said it at least can give kids more attention to learn and they can participate during the learning activities as well. However, teachers encourage to add more features and learning style in this application in the future.

While, the preschool kids said that this application is cool and they seem not to be bored when playing this application during testing. Some of them also questioning that whether can they play this application at home because they want to show to their parents what they learn in school. Some of them said that they can understand numbers easily while playing this application comparing to what they currently learn in class. Feedbacks from kids are one of the important feedback to gather because they are the main target user to test this application and give feedback from what they feel during conducting the application.

Lecturers feedback are the important feedback that author should gather to improve the system, so that the application won't face any difficulties when it been conducted. Some of their feedback is this application currently is operate based on one user at a time, what the author can improve is try to get more users to interact at one time. This is because learning in class is not involving only one person, more than one students are learning and engaging with what they been teach in class. Lecturer also ask the author to improve the environment of the application so that users can feel more exciting and interactive when trying this application in the future. Apart from the comments and feedbacks from the lecturers itself, the author find out that these are the real challenging and difficult part to be implement especially with the short time given to do this final year project. However, author will try to improve this application as better as he could in the time given.

CHAPTER 5
CONCLUSION

5.1 Conclusion

"Motion Based Learning for Preschools Mathematics via Kinect" has the abilities to help kids in preschools to improve their learning abilities thus improving their understanding with numbers. In addition, kinect also help teachers and learners to involve in active learning and at the same time improving the interactivity of learning mathematics. The development of this application will surely contribute to both parties (teachers and learners) and at the same time provide guidance for teacher in teaching kids in today learning environment by using technology which is kinect. Thus, this project is another contribution on kinect technology to be usable and acceptance by the community regarding age. Also, at the same time will contributes in improving education system in the world and specifically in Malaysia.

In relation with the first objective, the motion-based interaction is used to replace the normal ways of teaching and learning mathematics. Based on findings in section 4.4, users felt that this application very interactive to be learn especially it use kinect which at same time can provide an interactive learning capability. Second objective dealt numbers with kinect device, the controller-less that kinect offers give freedom and intuitive way for users to navigating the game and at same time learning numbers. The last objective dealt with understanding of user's understanding towards the learning of mathematics. Their motivation, enjoyment and engagement in learning mathematics are being observed. The result of prototype testing shown in section 4.4 shows that users are learning well and enjoyed the game.

Comments and criticize on making the game more engaging and interactive are taking in consideration in developing and improving the game in the future. Further improvement on the game are also been considered from the recommendations suggested by the users from the questionnaire feedback.

5. 2 Future Work

Since this project will only covers counting numbers and not all numbers are being included, for future work, the author hope it can cover the rest of the numbers and also simple mathematics operations. Author also hope that more syllabus that been teach by teacher in preschools will be cover in this game. Also, the implementation can be applied to others subjects in preschools as well such as English and science. Further studies also need to be done to improve the current modules to really cater with the current education system to help kids in preschools to improve their learning abilities. Another recommendations in the future is the game should more engaging by adding more depth into each module instead of only 2 dimensional in what the game currently have right now. This will ensure that the game will be more interactive and interesting.

REFERENCES

[1] AMIUSA. (n.d.). Montessori School Standards. Association Montessori International.

[2] Atkins, M. S. and Li, X. M. (2004). Early Childhood Computer Experience and Cognitive and Motor Development. Pediatrics. Illnois: American Academy of Pediatrics. 113;1715.

[3] Beauchamp, G., Jones, S., Kennewell, S., Tanner, H. (2004). Interactive Whole Class Teaching and Interactive White Boards. University of Wales.

[4] Beauchamp, G., Kennewell, S. (2003). The influence of a technology-rich classroom environment on elementary teachers' pedagogy and children's learning. In J. Wright, A. McDougall, J. Murnane& J. Lowe (Eds.), Young children and learning technologies (pp. 65-70). Sydney: Australian Computer Society.

[5] Beavin, J., Jackson, D., Watzlawik, P. (1967). A study of interactional patters, pathologies and paradoxes. Norton & Company, New York.

[6] Bray, O. (2009). MGS gets first prize in European Innovative Teacher Awards. Retrieved on November 29, 2013 from http://olliebray.typepad.com/olliebraycom/2009/03/mgs-gets-first-prize-in-european-innovative-teacher-awards.html

[7] Cassell, J., McNeill, D. (1990). Gesture and Ground. Proc. Of 16th Annual Meeting of Berkeley Linguistics Society.

[8]Chen, J. (2010). Microsoft Xbox 360 Kinect Launches November 4. Retrieved on November 22, 2013 from http://gizmodo.com/5563148/microsoft-xbox-360-kinect-launches-november-4

[9] Clegg, J., Ogange, B., &Rodseth, V. (2003). Evaluating digital learning material for English language development. IMFUNDO Knowledge Bank.

[10] Clements, D. H. (1999). Playing math with young children. Curriculum Administrator, 35(4), 25-28.

[11] Dennis, Wixom and Tegarden (2005). System Analysis and Design with UML. John Wiley and Sons, Inc. Version 2.0.

[12] Freedberg, L. (October 18,2012). Preschools math curriculum faces significant challenges. Retrieved October 22, 2013 from http://www.edsource.org/today/2012/preschool-math-curriculum-faces-significant-challenges/21602#.Um_O1PlWbo1

[13] Giles, J. (November 2010). Inside the race to hack the Kinect. Retrieved on November 22, 2013 from http://www.newscientist.com/article/dn19762-inside-the-race-to-hack-the-kinect.html#.UpNhtMRWZVA

[14] Greenes, C. (1999). Ready to learn: Developing children's mathematical powers.

[15] Hsu, H. J. (2011). The potential of kinect in education. International Journal of Information and Education Technology. 1(5).

[16] Kennewell, S. (2004). University of Wales Swansea. Interactive teaching with interactive technology.

[17] Lankwarden, T. (2011). Some of our Live Projects. Personal Communication to Janet Thomson.

[18] Lisle, P. (2010). Research: Using the Xbox Kinect in Foundation Phase English Language Acquisition. SchoolNet South Africa.

[19] M., Solveiga (n.d). The Montessori Method: Some Recent Research. OISE.

[20] McNeill, D. (1992). Hand and mind: what gestures reveal about thought. University of Chicago Press.

[21] Nusir, S. ,Alsmadi, I. , Al-Kabi, M. and Sharadgah, F. (2012). Studying the impact of using multimedia interactive programs at children ability to learn basic math skills, 5(2).

[22] Papert, S. (1980). Mindstorm, New York. NY:Basic Books.

[23] Papert, S. (1996). “A word for learning,” in Constructionism in practice: Designing, thinking, and learning in a digital world. Y. B. Kafai and M. Resnick, Eds. Mahwah, NJ: Lawrence Erlbaum Associates.

[24] Plowman, L., Stephen, C., McPake, J. (2010). Supporting young children's learning with technology at home and in preschool. Research Paper in Education 25(1), pages 93-113.

[25] Pusat Perkembangan Kurikulum. (2001). Kurikulum Prasekolah Kebangsaan. Kementerian Pendidikan Malaysia.

[26] Rauterberg, M. (1999). From Gesture to Action: Natural User Interfaces. TU/e Eindhoven University of Technology.

[27] Rauterberg, M., Steiger, P. (2011). Pattern Recognition as a Key Technology for the Next Generation of User Interfaces. Swiss Federal Institute of Technology (ETH).

[28] Richards, G. (November 2010). Kinect games controller- review. Theguardian. Retrieved on November 22, 2013 from http://www.theguardian.com/technology/2010/nov/07/microsoft-kinect-review-giles-richards

[29] Rouse, M. (2011). Natural User Interface. http://whatis.techtarget.com/definition/natural-user-interface-NUI. Retrieved on November 11, 2013.

[30] Shneiderman, B. (1987). Designing the User Interface. Addison-Wesley, Reading MA.

[31] Smith, H. J., Higgins, S., Wall, K., and Miller, J. (2005). Interactive whiteboards: boon or bandwagon? Journal of Computer Assisted Learning. Volume 21.

[32] Subrahmanyam, K. (2000). The impact of hoe computer use on children's activities and development. Future Child. 2000;10:123-144.

[33] Times Higher Education. (2009). The Xbox factor: gaming's role in future assessment. Retrieved on November 29, 2013 from http://www.timeshighereducation.co.uk/408492.article

[34] Eduardo, G. M., Horacio, R., Patricia, S., and Nestor, A. R. A. (2013). Kinesthetic Learning Applied to Mathematics Using Kinect. 2013 International Conference on Virtual and Augmented Reality in Education.

[35] Siemens. (2011). Retrieve January 23, 2014 from Siemens website http://inr.synapticdigital.com/Siemens/Competition2011/

[36] Horejsi, P., Gorner, T., Januska, M., Kurtin, O., and Polasek, P. (2013). Using Kinect Technology Equipment for Ergonomics. University of West Bohemia.

[37] Jun-Da H. C., Shu-Fang C. B., Yao-Jen C. A. (2011). A Kinect-basedsystemforphysical rehabilitation:Apilot study for youngadults with motor disabilities. Research in Developmental Disabilities 32 (2011) 2566–2570.

[38] Kinect. (2014). Retrieved on January 26, 2014 from Wikipedia, http://en.wikipedia.org/wiki/Kinect

[39] Redmond, W. (2011). ‘Kinect Effect’ Magic Pushes Beyond the Living Room. Microsoft News Center.

[40] Brenneman, K., Frede, E. C. (2010). Mathematics and Science in Preschools: Policy and Practice.

[41]Clements, D. H., &Sarama, J. (2008). Experimental evaluation of the effects of a research-basedpreschool mathematics curriculum.American Educational Research Journal, 45, 443-494.

[42] Epstein, A. S. (2003). How planning and reflection develop young children's thinking skills. Young Children.

[43] Jeff Sauro. (2011). Measuring Usability with The System Usability Scale (SUS). Retrieved from http://www.measuringusability.com/sus.php

APPENDICES

Appendix 1: SUS Questionnaire Form

	Strongly Disagree				Strongly Agree
1. I think that I would like to use this product frequently.	1	2	3	4	5
2. I found the product unnecessarily complex.	1	2	3	4	5
3. I thought the product was easy to use.	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this product.	1	2	3	4	5
5. I found the various functions in the product were well integrated.	1	2	3	4	5
6. I thought there was too much inconsistency in this product.	1	2	3	4	5
7. I imagine that most people would learn to use this product very quickly.	1	2	3	4	5
8. I found the product very awkward to use.	1	2	3	4	5
9. I felt very confident using the product.	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this product.	1	2	3	4	5

Appendix 2: Part of the Code

Main Menu Code

```
using UnityEngine;

using System.Collections;

public class main : MonoBehaviour {

	// Use this for initialization

	void Start () {

	}

	// Update is called once per frame

	void Update () {

	}

	void OnCollisionEnter (Collision Col) {

		if (Col.gameObject.name == "play"){

			Application.LoadLevel("level1");

			Debug.Log("Load Level 1");			}

		else if (Col.gameObject.name == "learn"){

			Application.LoadLevel("learn1");

			Debug.Log("Load Learn 1");

		}

	}

}
```

Learn Game Code

```
using UnityEngine;

using System.Collections;

public class Learn : MonoBehaviour {

	// Use this for initialization

	void Start () {

	}

	// Update is called once per frame

	void Update () {

	}

	void OnCollisionEnter (Collision Col) {

		if (Col.gameObject.name == "next1"){

			Application.LoadLevel("learn2");

			Debug.Log ("Load Learn 2");

		}

		else if (Col.gameObject.name == "next2"){

			Application.LoadLevel("learn3");

			Debug.Log ("Load Learn 3");

		}

		else if (Col.gameObject.name == "next3"){

			Application.LoadLevel("learn4");

			Debug.Log ("Load Learn 4");

		}

		else if (Col.gameObject.name == "next4"){

			Application.LoadLevel("learn5");

			Debug.Log ("Load Learn 5");

		}

		else if (Col.gameObject.name == "next5"){

			Application.LoadLevel("learn6");

			Debug.Log ("Load Learn 6");
```

```
        }
        else if (Col.gameObject.name == "next6"){
            Application.LoadLevel("learn7");
            Debug.Log ("Load Learn 7");
        }
        else if (Col.gameObject.name == "next7"){
            Application.LoadLevel("learn8");
            Debug.Log ("Load Learn 8");
        }
        else if (Col.gameObject.name == "next8"){
            Application.LoadLevel("learn9");
            Debug.Log ("Load Learn 9");
        }
        else if (Col.gameObject.name == "next9"){
            Application.LoadLevel("learn10");
            Debug.Log ("Load Learn 10");
        }
        else if (Col.gameObject.name == "next10"){
            Application.LoadLevel("menu");
            Debug.Log ("Load Menu");            }
    }
}
```

Play Game Code

```
using UnityEngine;

using System.Collections;

public class Applepick : MonoBehaviour {

        public int count = 0;

        public int level = 1;

        public int level1 = 1;

        //public GameObject number1;

        public GameObject count1,count2,count3,count4,count5;

        public GameObject count6,count7,count8,count9,count10;

        public GameObject mark;

        // Use this for initialization

        void Start () {

        }

        // Update is called once per frame

        void Update () {

        }

        void OnCollisionEnter (Collision col) {

                if(col.gameObject.name == "apple") {

                        Destroy(col.gameObject);

                        count++;

                        Debug.Log("count"+count);

                        //SelectNumber();

                        if (count ==1){

                                Debug.Log("Instantiate 1");

                                count1 = (GameObject)
Instantiate(count1,mark.transform.position,mark.transform.rotation);

                                //Instantiate (count1, new Vector3(7.946008, 2.295642, -4.7), transform.rotation);

                        }

                        else if (count==2){
```

```
			Debug.Log("Instantiate 2");
			Destroy(count1);
			count2 = (GameObject)
Instantiate(count2,mark.transform.position,mark.transform.rotation);
			//Instantiate (count1, new Vector3(7.946008, 2.295642, -4.7), transform.rotation);
		}
		else if (count==3){
			Debug.Log("Instantiate 3");
			Destroy(count2);
			count3 = (GameObject)
Instantiate(count3,mark.transform.position,mark.transform.rotation);
		}
		else if (count==4){
			Debug.Log("Instantiate 4");
			Destroy(count3);
			count4 = (GameObject)
Instantiate(count4,mark.transform.position,mark.transform.rotation);
		}
		else if (count==5){
			Debug.Log("Instantiate 5");
			Destroy(count4);
			count5 = (GameObject)
Instantiate(count5,mark.transform.position,mark.transform.rotation);
			if (level1==1){
				level++;
				//Application.LoadLevel("level3");
			}
		}
		else if (count==6){
			Debug.Log("Instantiate 6");
			Destroy(count5);
```

```
                count6 = (GameObject)
Instantiate(count6,mark.transform.position,mark.transform.rotation);

            }

            else if (count==7){

                Debug.Log("Instantiate 7");

                Destroy(count6);

                count7 = (GameObject)
Instantiate(count7,mark.transform.position,mark.transform.rotation);

            }

            else if (count==8){

                Debug.Log("Instantiate 8");

                Destroy(count7);

                count8 = (GameObject)
Instantiate(count8,mark.transform.position,mark.transform.rotation);

                if(level==1){

                    count++;

                    Application.LoadLevel("level2");

                }

            }

            else if (count==9){

                Debug.Log("Instantiate 9");

                Destroy(count8);

                count9 = (GameObject)
Instantiate(count9,mark.transform.position,mark.transform.rotation);

            }

            else if (count==10){

                Debug.Log("Instantiate 10");

                Destroy(count9);

                count10 = (GameObject)
Instantiate(count10,mark.transform.position,mark.transform.rotation);

            }

            else if (col.gameObject.name == "apple1"){
```

```
                    //Application.LoadLevel("level2");

                    Debug.Log ("Load Learn 2");

                }

            //Instantiate

                }

            }



        }
```