Virtual Reality Vertical Jump Measurement using Microsoft Kinect™ for Children

(KinectVertex)

By

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Project dissertation submitted in partial fulfillment

of the requirements for the

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(Information & Communication Technology)

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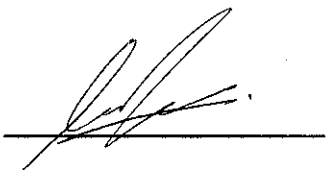
CERTIFICATION OF ORIGINALITY

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 references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



AMZAR FAHAZAN MAAIN

CERTIFICATION OF APPROVAL

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ABSTRACT

This research project studied the usability of vertical jump equipment for children and how it would work virtually using Microsoft Kinect. This research provides information on the vertical jump, and how it is directly concerned for the children. Based on the literature in this project, an in-depth analysis on vertical jumping and its measurement methods are also discussed. The advantages and disadvantages of different methods are highlighted to show the relevancy of the project. Besides that, this paper also covers the development of the vertical jump ability among children and the importance of harnessing the potential of their ability through a fun and exciting method vertical jumping testing that is virtual reality.

The paper provides both the technical aspects of the project and the academic challenges in making the application enjoyable to children as a game and useful to researchers as an archiving tool. This system presents children with an attractive and intuitive interface, which they caninteract and record their physical attributes as well as vertical jump.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Nowadays, sports in general have become essential in a child growth in almost every parts of the world [1]. Malaysia for example has taken a good step towards the right direction to step up the sport development for children. Millions of RM has been spent for developing youth talents as well as sports facility in Malaysia[2]. Gone by the days where academic is the only path to a successful career as accepted by parents. Sports in this era are a global industry where athletes are getting recognized for their excellence in their respective field. However due to competitive nature of sports, some young athletes may be left out although they have potential yet to be discovered. Currently in sports development for young children, we have yet to see virtual reality or augmented reality technique to discover their potential in sports. The usage of augmented reality can make the process of training or performance testing itself to be more fun and engaging especially to them.

1.2 Problem Statement

A vertical jump or vertical leap is the act of raising one's center of gravity higher in the vertical plane solely with the use of one's own muscles; it is a measure of how high an individual or athlete can elevate off the ground (jump) from a standstill.

Currently the method of testing varies based on the athlete's level. Schoolchildren usually are tested jumping against the wall whereas more advanced athlete will use specialized vertical jumping equipment called Vertec or infrared laser placed at ground level. This equipment is very costly and at the same time do not motivate schoolchildren to jump. This equipment is tedious and slow at the same time.

Athletes or officials needs to readjust the measurement device after the athlete finished jumping.

1.3 Project Objectives

- To create low-cost VR vertical jump measurement tool.
- To achieve acceptable accuracy around 2.5cm from actual measurement.
- To develop usability testing of Kinect Vertex.

1.4 Project Scope

The scope of the project is to develop a vertical jumping measurement device system for children using Microsoft Kinect to replace traditional measurement method in 6 months' time. Kinect is useful for this purpose because it can detect motion and transform it directly to screen. This research also focus to create an environment that is very engaging and fun at the same time for children where they can compete with their friends. Target demographic for this project is children between 8-12 years old as the leg strength is begin to develop during this time. Children also shorter in general which makes detection using Kinect sensor feasible compared to taller people. Project scope also focuses on making the precision of measurement and actual life as accurate as possible.

CHAPTER 2

LITERATURE REVIEW

2.1 Virtual Reality

Virtual reality is an artificial environment which is created by software and presented to the user in a way of the user belief and accepts it as a real environment. On a computer, virtual reality is primarily experienced through two elements of senses, which are sight and sound.By the end of the twentieth century, virtual reality not only condensedto a specific technology, but also signaled a broader set of inquiries about the place of this technology in modern life.

2.1.1 Application

There are many applications have been made by utilizing VR technology especially in gaming and entertainment industry. Some industry use VR technology extensively to develop their product efficiently and cost effective. Engineers have been using VR to develop aircraft prototype without actually building it in real life[3]. It also allows the designers to try out different ideas - all the ideas can be looked at in detail and they can then select the best one. NASA has used virtual reality to design a helicopter and Boeing has used it to design their latest aircraft.Military also use VR technology to train their officers and also enlisted soldiers in using high tech machine, weapons and also vehicles.The possibilities for virtual reality are enormous. Future residents of new towns will be able to walk around virtual streets, shops, houses and parks before a single brick has been laid. There are already plans to redesign the whole of the city of Berlin, the capital of Germany, using virtual reality.

2.2 Sports Performance

Success in sports, measured in a competitive performance often depends uponnumerous components. Somatotype, motor skills, age, nutritional status, physiology, psychology, training level, genetic endowment, and injury risk are the major independent variables influencing performance [4]. An athlete may succeed if he or she has combination of the components. Successful athletes tend to have or acquire somatotypes characteristic of individuals already successful in a particular sport. For the most part, motor skills are age (chronological) and gender dependent.

In general, the efficiency of movement progressively improves throughout childhood and into early adolescence and is highly dependent on environmental influences. Children however tend to have little or no interest in sports unless given by adult. Children have to be exposed to sports and parents have to provide encouragement for them. Physical fitness of pre adolescence is developed through playing around not by organized or structured like adult. Usually, children lean to acquire skill to run, walk, jump, and roll by playing around through frequency, duration and intensity of the movements performed.

2.2.1 Virtual Reality in Sports Performance

Virtual Reality also has seen purpose in sports whereby it is regularly used to improve or measure athletes' performance. Virtual Reality (VR) provides numerical simulations and immersive, interactive environments to test various parameters especially in biomechanics. Biomechanical analyses give trainers kinematic and dynamic data to help optimize particular movements or adopt new techniques through strength-and-conditioning training programs.

Long before VR is introduce and burst into sports scene, the use of computer technology to improve the performance of athletes has already been worldwide phenomenon. The use of multimedia is great supporting tool for the coaches and has been proven to be successful against traditional method [5]. VR offers the potential to enhance sports and fitness by creating realistic simulations and enhancing the

experience of indoor exercise[6]. Sports simulation games tend to focus on the strategy of the sport and the "fun" of the competition.Such early examplesever made areAccess Software Corporation's Links386 Pro golf for the IBM PCand Sega Corporation's Outrun 2019 driving simulation for the Sega Genesis NTSC video game system.

Figure 2: Access Software Corporation's Link 386 Pro

Figure 1: Sega Corporation's Outrun 2019 driving game

However these types of games do little to improve actual performance of athletes. One might participate in this form of simulated sport to practice for improvement, to develop coordination, to develop a mental understanding of game strategies, to engage in fitness, or just simply to entertain oneself.Depending on the simulated sport, the impacts of physical and visual immersion can require tactile and/or force feedback. This feedback not only creates realism by compensating for muscular movements or indicating contact with objects, but also is required to keep the virtual world from colliding with the real world possibly causing an injury. Most immersive sport simulations that require tactile feedback are forced to trade reality for some unnatural adjustment to the sport due to the inadequacy of current haptic VR technology.

Benefits of combining both sports and virtual reality are very lucrative. One of the most popular combinations to date, the LifeCycle, which can be found in most any upscale fitness center in United States.This model adjusts adjusted pedaling resistance conforming to the slope of the incline shown in the screen. In addition, a biofeedback sensor monitors heart rate and adjusts pedaling resistance to keep the heartrate in a predetermined range. An example of a more immersive but experimental system is the Autodesk cyberspace system adapted to an exercise bike.

The user wears a HMD to generate realistic images while feedback from the cycle wheel speed and handlebar direction guide changes to the visual display[7].

All of these technologies may only concerned children slightly but the attractiveness of VR for children cannot be denied. Immersive VR games for children are getting exciting every year which makes VR a thrilling area of research for developing children product.

2.3 Vertical Jump

A vertical jump or vertical leap is the act of raising one's center of gravity higher in the vertical plane solely with the use of one's own muscles; it is a measure of how high an individual or athlete can elevate off the ground (jump) from a standstill. It is well practiced, familiar and part of everyday physical activity for children aged between 5 and 12 years old [8]. Vertical jump measurements are used primarily in athletic circles both to measure performance and as something athletes brag about among themselves. The most common sports in which one's vertical jump is measured are track and field, basketball, football, and volleyball, but many sports measure their players' vertical jumping ability during physical examinations. The vertical jump is very important in these sports where it can make all the difference in winning or losing. Children usually recognized movement pattern of vertical jumping even in the age of 3 years old.

However, jump height is influenced by the anatomical and physiological diversity and attributes of individual combined with regular practice.

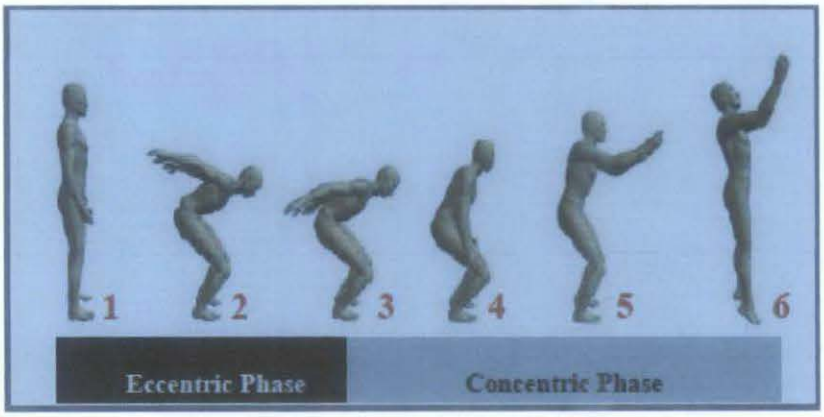

Figure 3: Typical two legged vertical jumping movement

A typical movement pattern is exhibited in Figure 3. The movement pattern consists of 2 phases which is eccentric which is also known as countermovement. During this phase the muscle-tendon complex is stretched and energy is stored. Transition from the first phase to second phase starts immediately at the lowest point of position 3. This movement is known to children as identical to an adult.

Figure 5: Leonel Marshall's 125cm vertical jump

Figure 4: Michael Jordan's 118cm vertical jump

Talent identification through vertical is necessary to maximize children potential in sports. This is because those who possess phenomenal jumping ability in the young age are most likely able to train in other areas to improve themselves. Athletes that do not possess great vertical jumping however must spend enormous time to improve his or her ability even to reach those with natural ability.Generally, athletes that display significant jumping prowess are also paid more than their normal counterpart like Michael Jordan and Leonel Marshall.

2.3.1 Vertical Jump Equipment

Vertical jumping ability is important for many sports, and there are a plethora of programs for training to increase your vertical jump ability. It is important to monitor the changes in your vertical jump, to see if there really are increases. The traditional method for assessing vertical jump ability is by measuring jump height using a wall or Vertec device. The method described below measures the jump air time using an electrical contact operated system, and from that calculates jump height.

2.2.2.1 Vertec

Vertec is equipment for measuring vertical jumping ability. Professional and college team in United States uses it widely. It is still not used in Malaysia due to its high cost, which is substitute by standard jumping against a wall method. Vertec made from steel frame construction with horizontal vanes which are rotated out of the way by the hand to indicate the height reached. Each vane is in 1/2" increments, and the height of the vanes is adjustable from 6' to 12' to test elite athletes as well as beginners[9].

Figure 7: Vertec

Figure 6: Jumping test on Vertec

In order to use this equipment athlete must first take measurement with arm fully extending upward. After that, athlete must jump and touch the highest possible vane. The difference of initial measurement and the touched vane is the jumping height. Drawback of this apparatus is its high cost. A single Vertec can reach as much as USD600 excluding shipping cost to Malaysia[10]. Price of this tool is pretty questionable for specialized equipment for school to utilize. It is also not engaging enough for children to jump using this tool and it can get dull after a while. Furthermore, athletes or official needs to readjust affected vane to original position where it is tedious and slow. Low cost devices that can measure vertical jump which can sped up the process and also fun at the same time can be develop to solve these problems.

2.2.2.2Contact mat

Contact mat is one of the methods used for measuring vertical jump height. One of the most popular brands around the world is *The Just Jump System. This device* is an electrical contact operated system which measure vertical jump height by measuring the time that the feet are not in contact with the mat.

When a subject left his feet off the mat, the device will begin the timer until the subject's feet return to the mat again. After that, the mat will return the height estimation based on the time recorded.

This device is the most portable and lightest in terms of weight compared to any technique which user can carry inside their backpack. Reliability research has been made by Szmuchrowski[11]to test the contact mat accuracy which proved this technique is reliable. However, there are few problemswhich stemmed from this device.

The cost of the device is still high which sells at roughly USD400 to USD600. Second disadvantage of the device is that athletes can cheat to get higher score which they can bend their knees upon landing. Third, without a mark on the wall to aim for and motivate the subject, jump height using this method is often lower. Last but not least, movements of athlete on the floor can trigger the contacts and this can cause a jump height calculation without jumping.

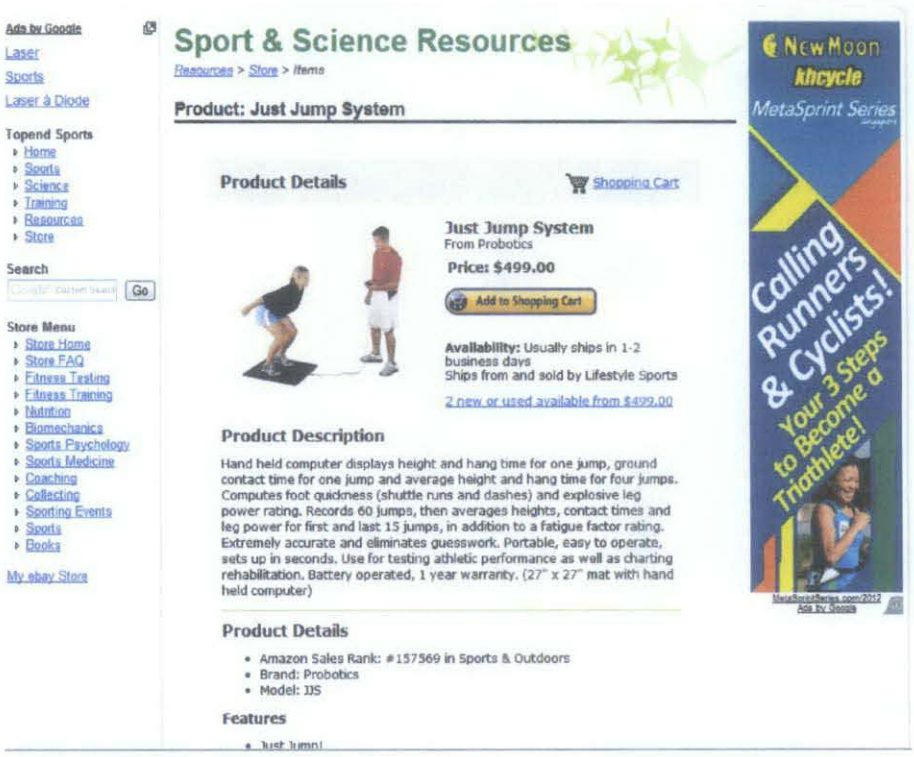

Figure 8: Contact mat

2.4 Microsoft Kinect

Kinect,or used to be known as Project Natal was designed for a style add-on peripheral for Microsoft Xbox 360 console game platform. What make it is interesting is that users now are relieved from normal controller or joystick to play game. Instead, they have to use their body parts to interact with the game. Itconsists of single sensor bar that contains two depth sensors and a standard RGB camera. The main feature for Kinect is the depth which is the cameras can track both of our movement from side to side, front to front and as well as up and down.Kinect can capture 30frames per second at 640 x 480 resolutions, which is vital in this project. Lag or missed frame can cause miscalculation or even error in the game. It also comes with built in microphone that is not used in this project. Microsoft Kinect is priced around USD130 to USD170 depending on where it is sold.

Figure 9: Microsoft Kinect

2.4.1 Kinect in Fitness and Sports

Nowadays, many companies have been developing games especially for Microsoft XBOX 360 Kinect system geared towards fitness enthusiast.The exquisite design of Kinect gameplay could motivate user exert energy in a close emulation of daily exercise. EA Sports Active that is published by EA is one of the great Kinect game in the market. Sales of the interactive fitness game EA Sports Active have exceeded $USD125m[12]and the product has recently been recognized by the American Heart Association[13].EA also published a game such as NFL Training Camp which allows users to train like professional NFL players. It sold well in United States and is most popular with players' age around 10-14 which is also the target demographic for this project. However, they are still zero products available for vertical jump testing.

Figure 10: Demonstrating how to play EA Sports Active 2

CHAPTER 3

METHODOLOGY

3.1 Project Model

There are methodologies that can be used to develop the System Development Life Cycle (SDLC) from start to finish. One of the appropriate approaches onto developing the Kinect Vertical Jump Measurement Device is the Incremental Model. The **Incremental Model** combines elements of the Linear Sequential Model (applied repetitively) with the iterative philosophy of prototyping. When an Incremental Model is used, the first increment is often the "**core product**".

The reasons this model been selected because is the fact that it's generates working software faster and early during the software lifecycle so that we can respond to each build, in addition it also easier to test and debug during a smaller iteration thus it could reduce the potential of getting complicated bugs on final product later on. Moreover, this method uses divides and conquer breakdown of task causes easier to manage risk because risky pieces are identified and handle during the iteration process. Other than that, this model provides lower initial delivery cost because it develops only major function at the first place so that we can get important functionality early. As the result, the risk of changing requirement is reduced due to the good planning and design at the early stages.

3.2 Project Phases

Most of the time, there are 4 tasks in single iteration. It can have as much iteration until the whole program is finish.

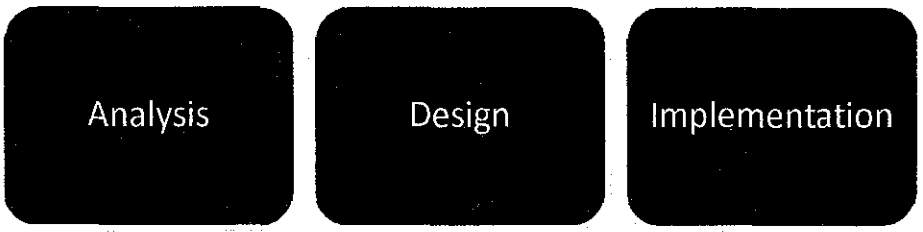

Figure 11: Incremental Model

3.2.1 Requirement Analysis

Requirement analysis involve information gathering in order to evaluate the project scope as well as the problem statement associated with the traditional method of testing vertical jumping for children. All information including pictures and figures are being collected through the reading material such as journals, websites and scholar articles. In addition, software and tools to develop process from the ground up is identified and discussed further. **Hardware** that is needed to meet the requirement is personal computer with Windows 7 x64 bit operating system and Microsoft Kinect.

Software that was used such as Microsoft Visio, Unity3D, OpenNI and Microsoft Visual Studio are studied in order to make the project goes smoothly. Once the basic and important parts of the system have been identified, an analysis is done to let the process of design important functions and modules which are to be developed afterward. Core module of the project is the ability to test maximum height of vertical jump.

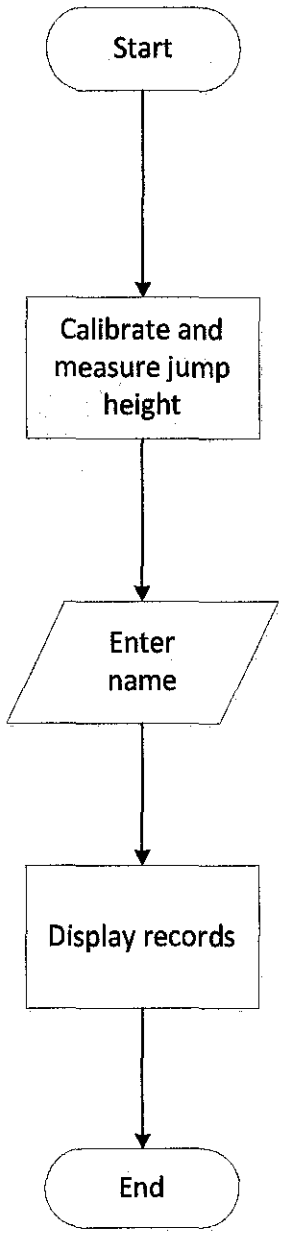

Figure 12: Early Flowchart of the system

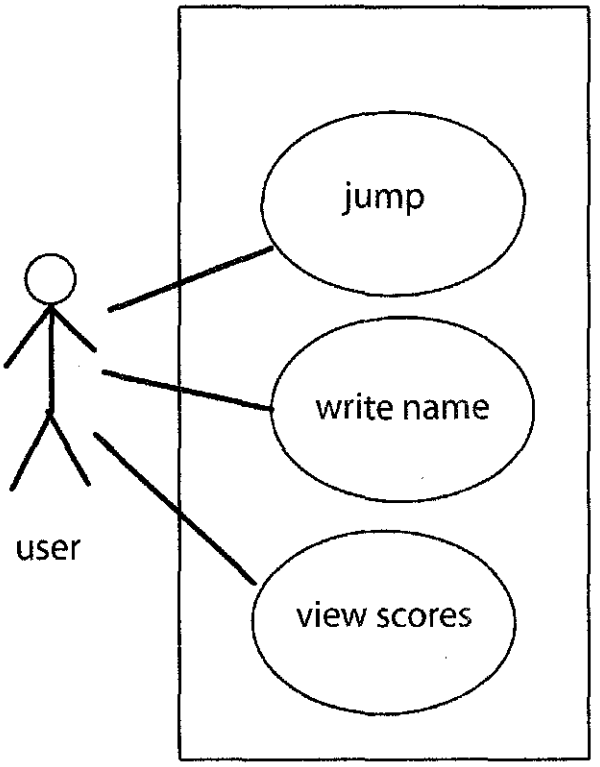

Figure 13: Early use case of the system

3.2.2 Design

After thorough analysis were done in the previous phase, the project can proceed to the design phase whereby the most important starting part in the developing the system to determine the successfulness of the project whether it meets given time and around budget. The purpose of the analysis phase is to figure out the requirement of the project meanwhile the purpose of the design phase is to decide which requirement is to be implemented and how to execute it. Inside the phase as well, all the information and requirements gathered during the analysis phase were organized and presented in the form of key milestone and Gantt chart diagram. Moreover, a simple prototype has been work out to demonstrate the basic idea of using Kinect for initial incentive. An early design of the main feature is shown on figure 14. Important features such as 3D marking are added on later stages. This is important as individuals tend to jump lower without any target above them.

Figure 14: Early design using Unity3D

3.2.3 Implementation

Model was build based on the design and analysis phases. Background environment of the system is built using software called Unity3D. This phase involve the building of the actual natural user interface system itself using an Integrated Development Environment (IDE) or known as Microsoft Visual Studio 2010 using the C# and Javascriptprogramming language. However, different software are needed to set up the Kinect to the personal computer and to allow modification procedure, they were called OpenNI and OpenNI provides application programming interface (API) for writing applications which utilizing natural interaction [14]. There are certain limitations of using basic version of Unity3D where developer cannot embed video clips of any type into the game. Consequently, video tutorial module asked by the supervisor cannot be designed.

3.2.4 Testing

As soon as the system is built successfully, the system-testing phase was used to test out the implementations, this system testing phase also known as the prototype evaluation phase whereby during this phase, the prototype was thoroughly checked and examined the functionalities whether it meets the requirement or the other way around. According to the incremental methodology, if an error or lacking of function was found within the phase, the analysis, design, implementation and test phases need to be continuously repeated until it satisfies the entire requirement. This testing phase was also used to identify and fix any bugs that occur during the built system.

CHAPTER 4

RESULT AND DISCUSSION

Part 1: Result

4.1 System Architecture

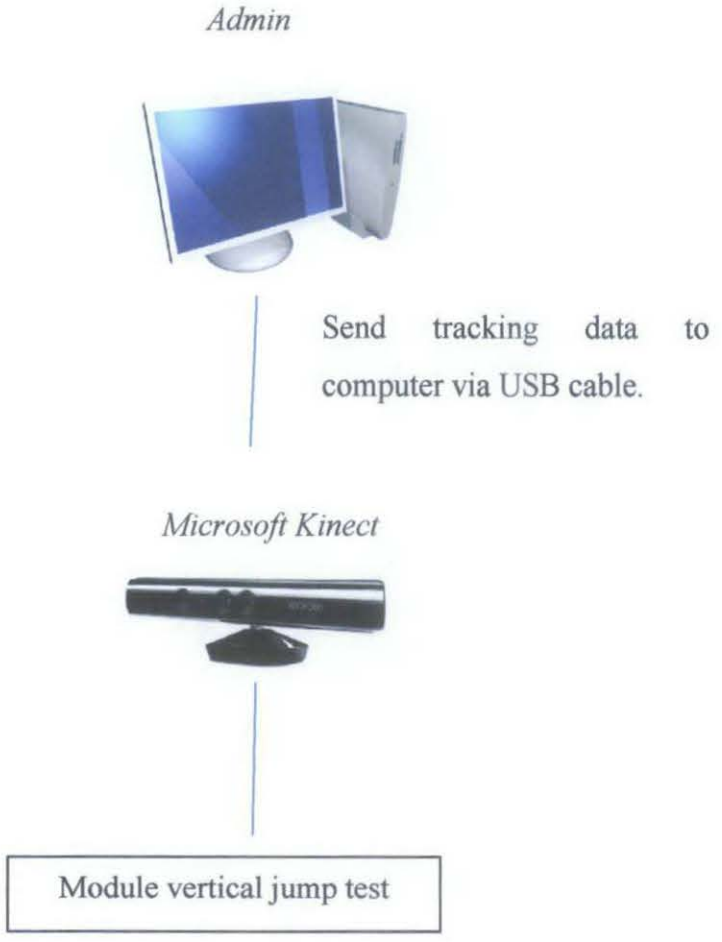

Figure 15: System Architecture

The architecture of the system consists of 2 main parts:

1. **Admin**

   Admin is a personal computer which fulfills specification below:

   - Operating System must be Windows 7 x64
   - At least 2GB RAM
   - At least 40MB Hard disk free space

2. Microsoft Kinect

4.2 Flowchart

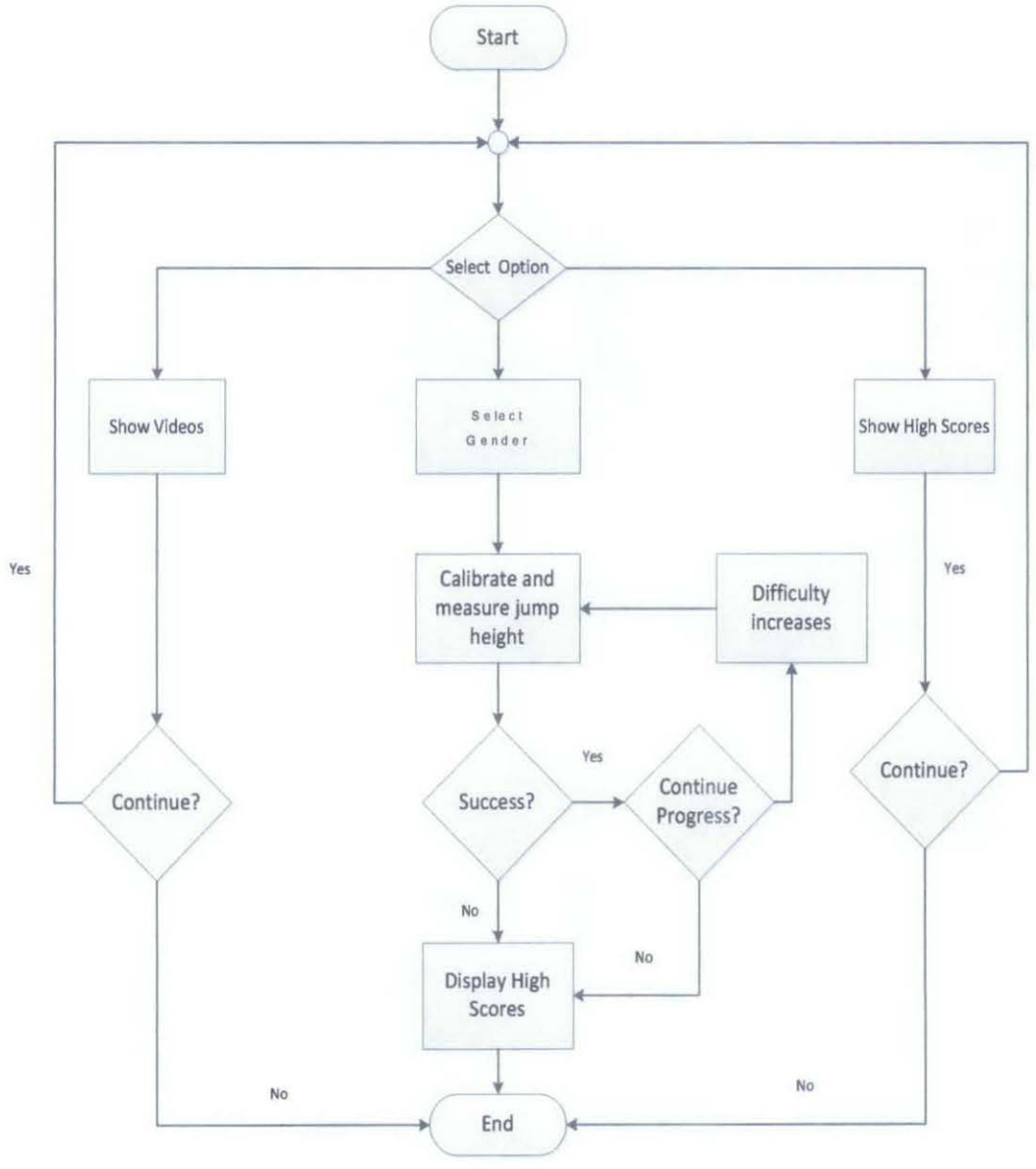

Figure 16: Flowchart

Figure 5 is the flowchart of the overall system which is expanded from the early one. The reason why it is expanded because the early system lacks various modules which is vital in ensuring the game achieves its objective. For example, one of the most important one is the lack of progression stages. Children enjoys playing when they are objectives existed in the game where the early flow is lacking. Professional athletes already have goals in mind which they do not need extra motivation contained within the game.

4.3 Usability Testing

Testing is a technique used in user-centered interaction design to evaluate a product by testing it on users. This can be seen as a unique usability practice, since it gives direct input on how real users use the system. It is not just simply gathering opinions as it is called market research or qualitative research. Usability testing is essentially a black box testing to see and observe people using the product to discover errors and areas of improvement.

For this purpose of this project, 10 male schoolchildren had participated of the study as voluntary with average age of 12 ± 2 years, mass 30.8 ± 7.0 kg and height 1.38 ± 0.10 m. All the volunteers had been informed about procedures of the tests and had signed an assent term to participate of the study, after an explanation about the procedures by the testers. They were asked to play this game with teacher acting as admin. Before that, the teacher was given a brief summary on the controls of the game. At the end of the session, participants excluded the teacher were given questionnaires to evaluate several aspects of the game.

Participants were given 10 questions for system usability survey. Sample of questions is attached at appendix A. Based on the survey,KinectVertex received a favourable average score of 68.

Participants were also asked to answer 6 questions on the overall content of the game. For the first question, they were asked whether this game achieve its objectives which are to highlight Microsoft Kinect as a sports supporting tool for children and also low cost Virtual Reality program. Half of the respondent remains neutral, 20% agreed with the question, another 20% slightly disagree and 10% responded slightly agree. Figure 6 shows the figures in pie chart form. Second question, they were asked whether this game is fun or otherwise. Majority remains neutral but numbers of disagree is higher than agree with the statement. For the third question, they were asked whether this game can benefit the target group in sports. Majority responded positively and 30% remains neutral. Others disagreed with the question.

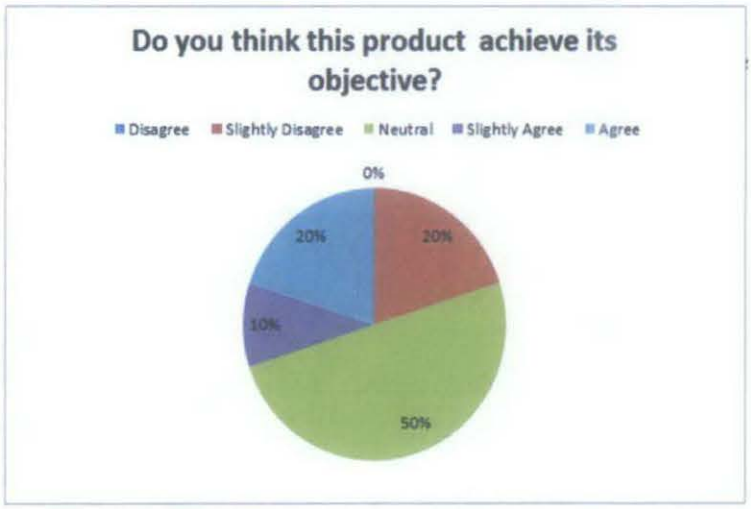

Figure 17: Question on whether this game achieves its objectives or not

Figure 18:Question on whether the product is fun or not.

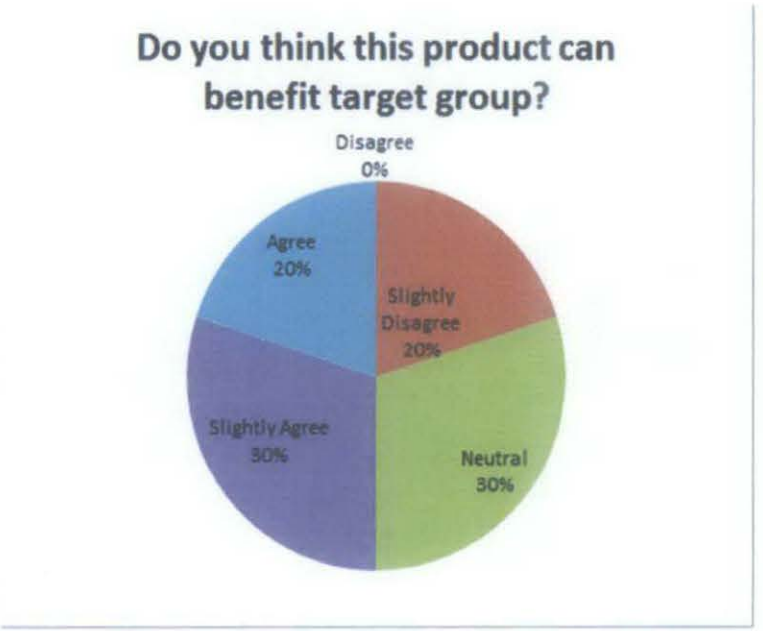

Figure 19: Question on whether this game achieves its objectives or not.

There were other questions that were asked during the testing session. Question such as accuracy had a quite outstanding fare with the most positive feedback. Feedback from the teacher was also taken to evaluate test result. Most of the positive comments are about the accuracy of the measurement which was the highlight of the testing. On the side note, there was a negative comment on the simplicity of the interface and ways to resolve it. Here are some comments taken from the participants.

I like the mechanics of the game and how it appeals to children...
Graphical User Interface is too simple...
I was surprised of the accuracy of the measurement...

Part 2: Discussion

4.4 Data Gathering and Analysis

Data gathering is used to describe a process of preparing and collecting data, for example, as part of a process improvement or similar project. The purpose of data gathering is to obtain information to keep on record, to make decisions about important issues, to pass information on to others.

Microsoft Kinect is still a new technology thus limited deal of information can only be obtained through experimentation and community projects. After hours of research, it can be suffice to say there is no vertical jumping measurement using Microsoft Kinect or even virtual reality ever made by anyone. Game such as Microsoft Kinect Sports earned rave reviews worldwide but it only serves as guideline for this project where its scope differs greatly.

4.4.1 Experimental/Modeling

Following experiments are done based on the incremental model framework referenced in Appendix B.

4.4.1.1 Incremental 1: Create players models

First increment of the project is to design and create 3D models for users. This is done by creating character from scratch via maximo.com website. After that rigging process is done straight in Unity3D by assigning joints according OpenNiSkeleton scripts. Character for both genders is scaled with the same height to make calculation easier.

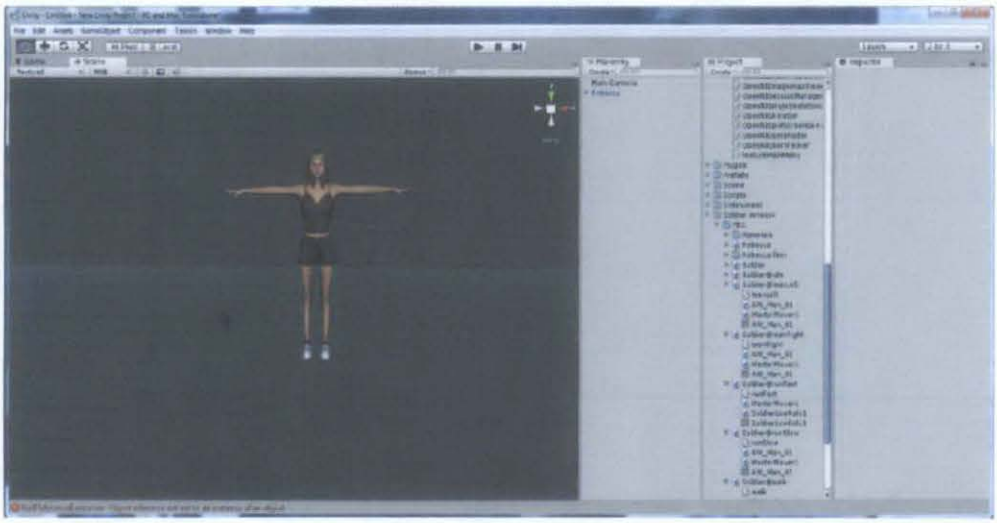

Figure 20: Rigging female character model

Interpretation and Analysis

There are missing joints when the character is rigged in unity. After thorough discussion, developer needs to use more powerful animation software like Maya to ensure fluidity of its movement. Nevertheless, the project only focused on jumping animation so it is ignored.

4.4.1.2 Incremental 2: Develop environment and game script.

Second increment of the project is analysis, design and also code game environment. Other things included in this phase are the development of measurement algorithm which can capture height of jump as accurate as ±2.5cm.

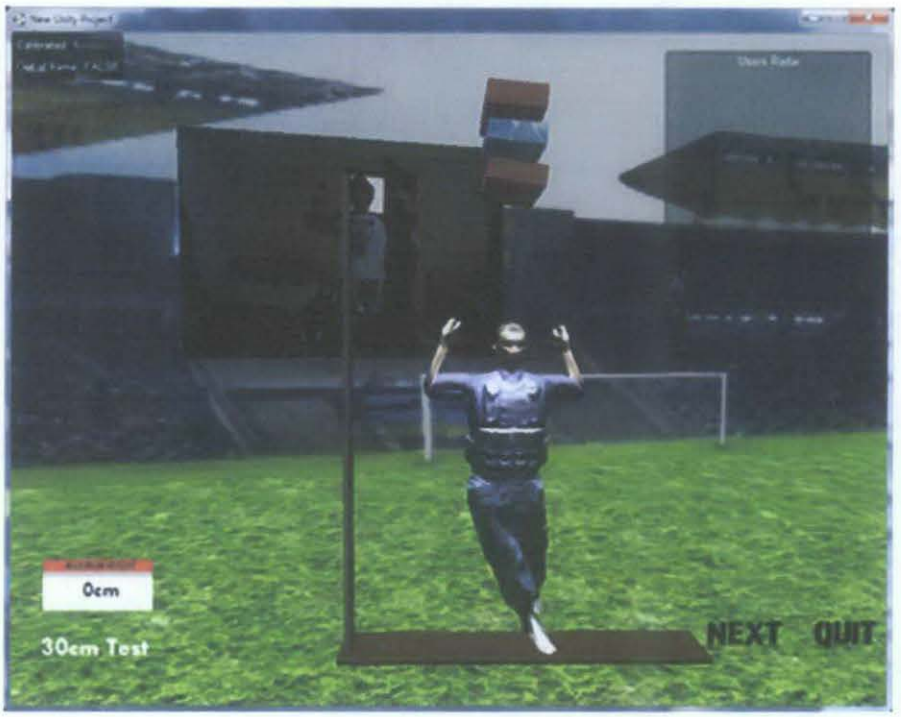

Figure 21: Main game environment

Interpretation and Analysis

The greatest challenge of the project is to ensure accurate measurement during jumping. Examples is shown in **Figure 20**, admin can monitor if a player step out of bounds of which is shown at the top left corner. If it is shown false, it means that there is a player currently active. Basically, the player model must step the wooden plank display before jumping in order to hit the hanging ball sitting directly above it. Once player's head touch the ball, the score will be display at the top left corner in the screen. The accuracy of height measurement is spot-on. Difference of less of an inch (2.5cm) is barely achieved.

4.4.1.3 Incremental 3: Create main menu and gender selection screen.

Third increment is developing and testing the main menu and gender selection screen. There are 3 options available in the main menu. First is "Test Now!" which launches the vertical jump mode. Second is "High Scores" which displays current high scores. Last but not least, there's "quit" button to exit to desktop.Figure shows the gender selection for the game. This is important because gender plays a role in determining grades benchmark.

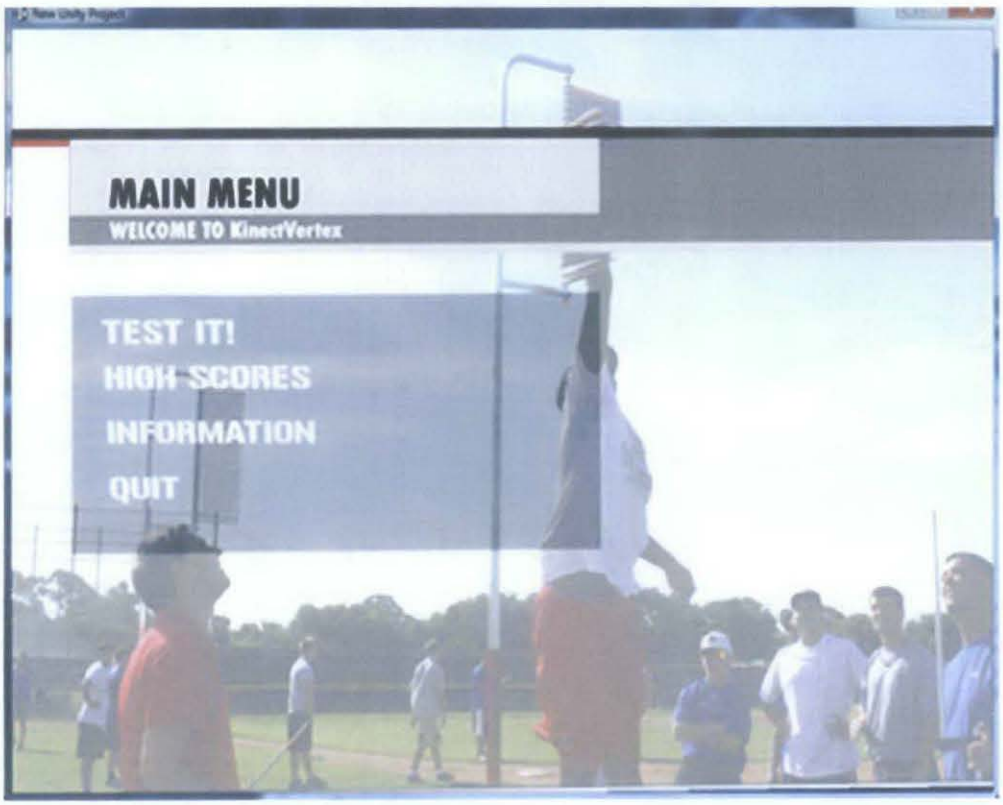

Figure 22: Main menu screen

Figure 23: Gender selection screen

Interpretation and Analysis

Design of the main menu and gender selection is minimalistic and pretty consistent. Minimalistic UI is where colours are used as few as possible to create UI. This combination made the design veryclean and easier to comprehend for everyone.

4.4.1.4 Incremental 4: Develop high scores

High scores or stat sheet is the most important pieces in the whole project. Basically, this scene shows 20 highest grade ever recorded as well as maximum height ever reached by the users. This is very useful information for talent scouts, teachers and coaches to identify talents for suitable sports for them to partake.

Figure 24: High scores screen

Interpretation and Analysis

If there is some feature is missing, it would likely be the capability to sort or filter data. Sorting data is very important for talent scouts because their scoutsheets are jumbled up with numerous skill categories. Fortunately, this project only for vertical jumping ability which is pretty limited in terms of variables compared to sprinting or strength.

CONCLUSION

5.1 Conclusion and Recommendation

Given the project has achieved all the objectives successfully; the developer would like to thank Dr. DayangRohayaBtAwangRambli for her close assistance to ensure the success of this project.

Completion of the game

The objectives stated have also been achieved in this project and they were:

1. **To create low-cost VR vertical jump measurement tool.**
    - This objective is achieved by eliminating the need for Vertec to measure vertical jump.
2. **To display and highlight the Kinect as a sports supportive device for children.**
    - The game shows Kinect can be utilized to increase athletic performance of children and also alternative method to educate them about sports.
3. **To achieve acceptable accuracy measurement this is around 2.5cm.**
    - This objective is achieved by carefully implementing detail invisible vane that gives measurement when collided.

Talent identification through vertical jump is important in many sports and children who possess this ability are highly regarded. However, entertaining and engaging environment is more crucial for children rather than developed or elite athletes. It has been proven that multimedia or even virtual reality can be a great environment for children to play around. Microsoft Kinect is a great tool for this purpose and makes the training fun and exciting.

Future work

For future work, developer would like to add the spreadsheet module in the project especially for talent scouts. Parsing the data in XML format into the document so that it can be viewed more efficiently is definitely the next goal in the project.

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Appendix A

System Usability Scale Sample Question

1. I think that I will use this game multiple times	1	2	3	4	5
2. I found the game was too complex	1	2	3	4	5
3. I thought the system was easy to use	1	2	3	4	5
4. I think that I would need the specialist help to play this game.	1	2	3	4	5

Note:

1 – Strongly Disagree

2 - Disagree

3 – Neutral

4 – Agree

5 – Strongly Agree

Appendix B

Gannt Chart

Increment 1: Create and assigning joints for player models					
No.	Activity / Month	June	July	August	September
1	Analysis				
2	Design				
3	Code				

Increment 2: Develop environment and game script.					
No.	Activity / Month	September	October	November	December
1	Analysis				
2	Design				
3	Code				

Increment 3: Create main menu and selection screen					
No.	Activity / Month	September	October	November	December
1	Analysis				
2	Design				
3	Code				

Increment 4: Develop high scores					
No.	Activity / Month	September	October	November	December
1	Analysis				
2	Design				
3	Code				

Appendix C

Poster used in SeEDX

UNIVERSITI TEKNOLOGI PETRONAS

KinectVertex

Virtual Reality Vertical Jump Measurement using Microsoft Kinect™ for Children

By: Amzar Fahazan Maan | 11218 | Information & Communication Technology | Supervisor: Dr. Dayang Rohaya Bt Awang Rambli

Introduction

Background Study

-Sports have become essential in a children development in almost every parts of the world including Malaysia. (MedNewPlus, 2010)

-Millions of RM have been spent for youth sports in Malaysia. (http://www.sportingmalaysia.com)

-Vertical jumping ability is very crucial in most athletic sports. (http://www.higher-faster-sports.com/important-vertical-jump.html)

Problem Statement

-Vertical jump measurement device is very expensive.

-Traditional method of testing is not engaging for children.

-Vertical jump measurement device is tedious and slow.

Objective

-To create low-cost VR vertical jump measurement tool.

-To display and highlight the Kinect as a sports supporting device for children.

Scope of Study

-Target demographic is children between 8 -12 years old.

-Develop using Microsoft Kinect,OpenNi and PrimeSense NITE driver for Kinect.

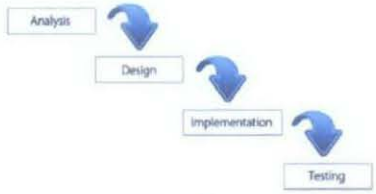
-Achieve accuracy of actual measurement with differences less than 2cm.

Project Significance

-Potential environment that is very engaging and fun.

-Potentially reduced long term cost.

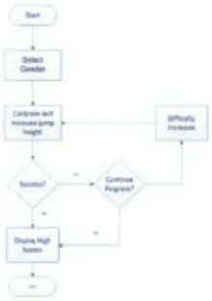
Methodology



Incremental Model

Results

Flowcharts



Screenshots

Survey/Evaluation Result

I like the mechanics of the game and how it appeals to children...

Graphical User Interface is too simple...

I was surprised of the accuracy of the measurement...

Conclusions

Users felt more competitive to showcase their jumping ability.

Users agreed that Kinect can be use to promote active lifestyle and skills development.