THE USE OF KINECT AS A DIAGNOSIS TOOLS FOR AUTISM LEVEL DETECTION

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LAMPIRAN B: BORANG PENGESAHAN STATUS TESIS

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SESI PENGAJIAN: 2015/2016

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Tarikh: 17/8/2016

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NUR INA FAZIRA BINTI MAZELAN

This report is submitted in partial fulfilment of the requirements for the Bachelor of Computer Science (Interactive Media)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2016

i

DECLARATION

I hereby declare that this project report entitled

THE USE OF KINECT AS A DIAGNOSIS TOOLS FOR AUTISM LEVEL DETECTION

is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT : _____ Date: 17/8/2016

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I hereby declare that I have read this project report and found this project report is sufficient in term of the scope and quality for the award of

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SUPERVISOR: _____ Date: 17/8/2016

(PROF DR. FAAIZAH BT SHAHBODIN)

DEDICATION

To my beloved parents

Ma and Abah

"Thank you for being there when nobody else was. You are the reason why I'm still smiling.

I love you." – Nur Ina Fazira

Dear Friends

"Thanks for always standing by myself when times get hard.

I'm grateful for you ." – Nur Ina Fazira

ACKNOWLEDGEMENTS

Assalamualaikum w.b.t.

I would like to express my special thanks of gratitude to my parents for giving me the financial and moral support and for teaching me that everything can be done with the help of The Almighty. As well as to my Supervisor PROF DR. FAAIZAH BT SHAHBODIN who gave me the golden opportunity to do this wonderful project on the topic THE USE OF KINECT AS A DIAGNOSIS TOOLS FOR AUTISM LEVEL DETECTION, which also helped me in doing a lot of Research and i came to know about so many new things I am really thankful to them. Secondly i would also like to thank my lecturers and friends who helped me a lot in finalizing this project within the limited time frame.

Thank you, May Allah blesses all of you.

Wassalam.

ABSTRACT

The uses of Kinect in computer games now are increasing widely. Therefore, this study was done to identify the function of Kinect as a diagnosis tools to detect levels of autism. The purpose of this research is to facilitate detection level of autism using only the movement of the body. In addition, it also attracts students to take this test which they only need to play the computer games and move without having to write. There are five types of computer games that each student should finish to get the final results of their autism level. Upon completion of this computer games the level of autism of the student will be identified and a final report will suggest some module of teaching for the student according to their autism level in their learning.

ABSTRAK

Penggunaan Kinect dalam permainan komputer sekarang semakin meluas. Oleh itu, kajian ini dibuat untuk mengenalpasti fungsi Kinect sebagai bahan diagnosis untuk mengesan tahap autism. Tujuan kajian ini adalah untuk memudahkan lagi proses mengesan tahap autism dengan hanya menggunakan pergerakan badan. Selain itu, ia juga dapat menarik minat pelajar untuk menghadapi ujian ini dengan hanya bermain permainan komputer dan bergerak tanpa perlu menulis. Terdapat lima jenis permainan komputer yang harus setiap pelajar jalani untuk mendapat keputusan akhir tahap autism mereka. Setelah selesai bermain permainan computer ini, tahap autism pelajar akan dapat dikenalpasti dan laporan akhir juga akan menyarankan beberapa modul pengajaran yang sesuai bagi pelajar tersebut dalam pembelajaran mereka.

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CHAPTER 1

INTRODUCTION

1.1 Overview

Kinect device that being used today was originally built by an Israeli company named Prime Sense. From artificial intelligence, Microsoft found that Kinect can help computer to interpret human body language include the mood. For video games, it helps reaching out and grabbing something instead of using game controller. It also being defines as sign language translator.

Autism is known as the second most common neurodevelopmental disorder among children. However, only a few of people aware about this complex disorder. In Malaysia, it was estimated that one out of 600 children was born with autism. Recent statistic shows that 47,000 of the people in this country are autistic and it is estimated that 4 out of 10,000 suffer from severe autism. Until today, the cause of autism remains unknown. That is why the symbol used for autism is puzzle, the cause is mystery.

There were a few school in Malaysia that teach autistic student. Example is Sekolah Pendidikan Khas Bukit Katil Melaka. From the experience visiting that school, the autistic student were teach in the different class from other normal student. However , each autistic student actually has a different level of difficulties. So, the problem now is that the student there were teach equally among the autistic student.They only differentiate them when they show their progress.

So, this project was developed to identify the function of Kinect as a diagnosis tools to detect levels of autism. . The children that have autism are like normal children, but they may have difficulties communicating, coping with stimulation from their surroundings and behaving in accordance with socially-accepted norms. Since the Kinect seen to be a simple way and approachable for everyone, this project will develop a game which using Kinect that enable to detect their autism level.

1.2 Problem Statements

There were a few school in Malaysia that teach autistic student. Example is Sekolah Pendidikan Khas Bukit Katil Melaka. From the experience visiting the school, the autistic student were teach in the different class from other normal student. However , each autistic student actually has a different level of difficulties. So, the problem now is that the student there were teach equally among the autistic student.They only differentiate them when they show their progress.

Since the use of kinect is growing widely nowadays, this project decide to identify whether kinect can be used to detect autism level. This project will build a game which use kinect to detect autism. The autism children may have difficulties communicating, coping with stimulation from their surroundings and behaving in accordance with socially-accepted norms. So, by using the Kinect will this problem will be handled?

1.3 Objective

This project was developed to fulfil these objectives:

1. To identify the use of Kinect as a diagnosis tools for autism level detection.
2. To develop a diagnose system using Kinect .
3. To test the effectiveness of Kinect.

1.4 Scopes

This project will focus on the use of kinect for autism children. The aim is to make the process of differentation autism level easier using body language. Only the visual perception will be measured in this project.

Specific User

The target user is autism children in secondary school aged 15-19 to diferentiate their autism level for educational use.

1.5 Contributions

This project was aim to contribute an easier way for the teacher to categorize autistic student based on their visual perception and make the learning process easier. Since the level of autism for each kids were different, so they need to be teach in different way. So, with the use of Kinect, this project will identify whether Kinect can be used as a diagnosis tool and not only helpful for games, but educational too.

1.6 Expected output

1. Novel theories/New findings/Knowledge

-Theories to detect autism level and knowledge how to make the learning process easier for them

-Theoris the use of kinect for educational

2. Project Publications

- Games

1.7 Conclusion

Upon completion of this project, the use of Kinect should be able to help in differentiating the autism level. In this chapter, it has been discussed about the reason why this project is going to be developed. The main reason is to make the process of identification of autism level based on visual perception for educational use at school. At the same time, this project will lessen the workload of the teacher.

In the chapter 2, details about the similar research that have been done before will be discussed along with the project flow.

CHAPTER 2

LITERATURE REVIEW AND METHODOLOGY

2.1 Introduction

Impairments in communication, behaviour and social functioning that begin in childhood are neurodevelopmental disorder which is known as Autism Spectrum Disorder (ASD). In Malaysia, there is no local epidemiological study on ASD (Malaysia Health Technology Assessment Section (MaHTAS) 2014). Based on previous study, ASD can be detected earlier on age 18 to 36 months. The numbers of children with speech delay and communications difficulty that need further assessment have been increasing. All of these children were frequently placed in a special education classes but without an accurate diagnosis. Therefore, there were a lot of screening tools that can help to get the accurate diagnosis of autism level. This chapter will discuss about research on screening tools and Kinect regarding this project matter.

2.2 Fact and finding

2.2.1 Domain

This section will explain regarding why games and Microsoft Kinect being choose to develop this project. There also will be research about games and Microsoft Kinect for educational use, and how the learning process of autism kids.

Why use serious games?

This project will build a serious game for autism kids as a diagnosis tools to detect their autism level. Serious game is designed in order to improve some specific aspect of learning and player plays it with that expectation. This technique can be found at every level of education including special education. Based on study, in 2010 serious game appear to be recent phenomenon which the market study shows that worldwide serious game market is worth 1.5 billion (J. Alvarez, V. Alvarez, Djaouti, & Michaud, 2010). The use of this technique has been proven effective in different setting such as school environment and so on. One of the examples is America's Army which was the first successful and well executed serious game technique that gained total public awareness (Gudmundsen, 2006). What sets serious game apart from other is the focus on specific and intentional learning outcome to achieve serious, measurable, sustained changes in performance and behaviour.

This project will use this serious game technique with intention of diagnosis the student level of autism. This game only test about the vision of the autism kids. Instead of having an early examination on paper to determine their classes, this project intentionally to give autism student a kind of attractive tools of diagnosis so they will have fun playing while the result will define their autism level.

A Literature Review of Gaming in Education

First, this are summarization of a research report entitle "A literature review of gaming in education" (Pearson, June 2012). This report aims to claim five keys about the use of digital games in education. The claims were:-

1. Digital games are built on sound learning principle.
2. Provide more engagement for the learner.
3. Provide personalized learning opportunities.
4. Teach 21st century skills.
5. Provide an environment for authentic and relevant assessment.

This research also state that there were movement towards the use of educational video games as learning tools in school. In response, to enhance student's learning experience, there were several commercial and custom made game video games being introduced in K-12 classroom (Wastiau, Kearney & Van den Berghe, 2009).

Another important element for healthy child development stated in this research is play (Ginsburg, 2007). Imaginative playing can make children learn through it (Bodrova & Leong, 2003; Hirsh-Pasek, Golinkoff, & Eyer, 2003; Zigler, Singer, & Bishop-Josef, 2004).

Next, this research states that games also provide opportunities for continued practice as through playing games, it makes the player want to play again and again. Failure also a part of games nature. Failure is an integral part of learning experience. Then, games also built with a clear goal and provide fast feedback (Dickey, 2005). Player can change their strategies in order to reach their goals. This can be a useful learning skill.

Moreover, this research also stated that games provide personalize learning opportunities. The Organisation for Economic Co-operation & Development [OECD] ,2006 report suggest personalized learning in school through five process which are :-

(1) Knowing the strengths and weaknesses of students,

(2) Developing teaching and learning strategies based on student needs,

(3) Engaging curriculum choices,

(4) Supportive school organization, and

(5) Community, local institution, and social service support.

This research concludes that digital games can facilitate learning but it is still hard to draw proven conclusion about educational impact of digital games. It state that, there should be more research to continue explore the effectiveness of digital games for learning and instruction. Future research should highlight how games can best be used for learning.

Game-based learning: latest evidence and future directions

This research was conducted by NFER research which is worldwide known on excellence research in education and children service. This research discussed about the meaning of game-based learning in education. It stated that game-based learning refers to the use of video games to support teaching and learning. The literature review founds that video games can impact academic performance. It has made a few studies to find evidence to this statement. The studies consistently found that video games help improve skills of problem solving, broader knowledge acquisition motivation and engagement. The game cannot be rely to improve attainment but the evidence suggests that game-based learning can boost engagement and motivation. Then it gives some best way to integrate gaming into teaching which are:

- Place learning activities and academic contents within the video games then balance between fun and learning.
- Rather than add-on, make the academic content integral to the game
- Do not ever split decontextualized components of game from fictional context and rule of the game.

Then, it also found the work of Bogost (2011) where it's beneficial to explore a definition of game-based learning. Understanding the distinctive properties of video games as a medium, in order to examine the implications in a range of social contexts, include education and learning was concerned by Bogost. He stressed that game are the first and foremost representation that simulate certain behaviours and experiences. This statement make our project tools which is game highlighted as it will be helpful to detect the autistic kid's behaviours in order to know their autism level.

This research also views about the principles and mechanism of game-based learning. Then, it discussed the impact and potential impact of game-based learning. Next, it views about the implications for future research which it summarize the issues noted in review of empirical studies. Other than that, it also highlights the implications for teachers and schools and suggests a few ways for those that want to enable game-based learning.

As a conclusion, from the research it is clear that games also can be used for education. It's also highlight that games can be useful tools in education if people know how to use it wisely. Next, will be review of the research on Microsoft Kinect for education which is the other tools to complete this project.

Microsoft Kinect

Microsoft Kinect is widely known as a video game console. As Kinect has magical ways that can detect body movement, recognize face and voice, this project want to find out whether Kinect can be diagnosis tools for autistic kids to differentiate their autism level based on their visual perception. Kinect was famous as a game console, so why not this project develops a simple game that can be used with Kinect and find out whether it can be used as a diagnosis tools or not.

Kinect in Education: A Proposal for children with Autism

For Microsoft Kinect, this project review a research of proposal for children with Autism published on December 2014. This research suggests using Kinect as learning auxiliary tool for children with autism. As Kinect has been worldwide use for education, they want to step further and recommend using the learning model "Mnemonic techniques" follow by a game "Kinect adventure" for the learning tools. It have found that game based learning also known as serious game which are not only provide unique ways of learning but also support social interaction between learner and tutor.

Then, it reviews about functional of Kinect. Kinect can track user using three techniques which are: face recognition, clothing colour tracking and height estimation. For each user, the system will check with the database if the user has been connected before. Kinect also relies on the interaction between user and computer, Human Computer Interaction (HCI). Nowadays, the portable device has been use worldwide that make people have a huge interest to develop new and interactive methods of teaching.

Next, Kinect in classroom. According to Hsu, Kinect can be used as teaching tool due to multiple interaction types it support. Hsu also think that the affordable of Kinect in learning tools can be analyse in two major aspect, stimulating tools and learning tools.

There were many teachers that already use Kinect in their classroom. Its enable teacher and student learn with more meaningful, accessible and easy way. Then, it discussed on Kinect as a learning tool in special environments. People with special needs also can use Kinect. Example is “De Ruimte” school in Holland use Kinect for rehabbing students’ motor skills in special needs education. For students that have physical disabilities, Kinect also has several features which can make it suitable for them. “De Ruimte” schools claims that, Kinect can ensure longer attention span for students that often lack in special needs.

Next, it discuss possibilities of using Kinect to teach people with autism. Through the studies, it believe that they can expand the project of “De Ruimte” school and use Kinect as the platform to children with autism. To achieve the targets, it use a game calls “Kinect Adventures”. This game was designed to help user develop skills of matching, achieve goals and understand various features.

For the expected result, this research hopes that this project will help children improve their behaviour. As Kinect enable children works in team, this will increase their feels of self-esteem, self-understanding, autonomy and independence. Furthermore, it stated that the motion which is offered by Kinect is a way out to hyperactivity that characterizes peoples with autism in their daily activities.

Internet Research

From the research which found on the internet, there were a lot of screening tools available for parents and teachers. Below are the listed types of the screening tools that can be used. The link will be provided in reference.

- Observation tools such as the Autism Diagnostic Observation Schedule (ADOS-G)
- The Childhood Autism Rating Scale (CARS)
- The Autism Diagnostic Interview – Revised (ADI-R)
- Screening Tool for Autism in Toddlers and Young Children (STAT)
- Modified Checklist for Autism in Toddlers (MCHAT)
- Parents' Evaluation of Developmental Status (PEDS)
- Communication and Symbolic Behaviour Scales (CSBS)
- Ages and Stages Questionnaires (ASQ)

These screening tools was designed to identify children which might have development delay but it's do not provide conclusive evidence of developmental delays and do not result in diagnosis. Then, each of the screening tools has its own specification. This might be hard for parents and teachers to choose which questionnaire that they need to used. If they need to use the entire questionnaire, this will become a hard way for them and students to complete it. Since this project only wants to differentiate their classes level based on visual perception, this project better used a simple question so that it will not burden the parents, teachers and student.

2.3 Existing System

There were a few existing project that have been done before that relate and almost similar to this project. One of the examples is a proposal for children with Autism. That project use Kinect Adventure game as a learning tool for autism kid. The target is to help children improve their behaviour.

Next are the Internet tools. There were many games on the internet that helps students with autism learning a daily basic activity. One of the examples is www.autismgames.com.au. This game helps parents and teachers of children with moderate to severe autism. The games were free and help autistic children develop their independent living skills. They have eight types of games which are:

1. Coping With Change
2. Transactions
3. Matching Emotions
4. Nonverbal Gesture
5. Grouping Objects
6. Schedules
7. Finding A Route
8. Making Eye Contact

Then, there were also online screening tools which helps parents identify children that might have developmental delays. The website is www.autismcanada.org. This website offer early signs, characteristic, diagnosis, screening tools, toddler, and more. This website also can be used free without paying.

Lastly, below are the interfaces of existing website.

(http://www.autismgames.com.au/)

Figure 2.1: Interface of existing website (http://www.autismgames.com.au/)

Figure 2.2: Interface of existing website (http://www.autismgames.com.au/)

Figure 2.3: Interface of existing website (http://www.autismgames.com.au/)

Figure 2.4: Interface of existing website (http://www.autismgames.com.au/)

Autism detection level at school (Sekolah Menengah Pendidikan Khas Bukit Katil)

There were a lot of screening tools that can be used to detect autism. The famous one found from internet research is questionnaire. At Sekolah Menengah Pendidikan Khas Bukit Katil, they used a questionnaire to differentiate the student in each class. After visit the school, one of the teacher show two sample of questionnaire that was used to test the student about simple Mathematics and Bahasa Melayu. The sample of the questionnaire will be provided in the appendices. After studying the questionnaire, this question might make the student feel bored because the questions were in black and white and not interactive. The questionnaire must be interactive so that it can attract the autistic kids to answer it. Then Ithis project review some more research which identifies whether game can be used for educational function or not.

2.5 Table of Comparison between Existing System and Proposed System

Existing System / System capabilities	Questionnaire (SM Pendidikan Khas Bukit Katil	www.autismgames.au	www.autismcanada.org	Diagnosis Games to detect autism
Types	Questionnaire paper	Online games	Online Screening tools	Games
Technique	Question	Games	Question	Games
Skills Taught	None	Independent living skills	Suggestion	Autism Level Detection & Suggestion Module of learning
Availability	School used only	Universal used	Universal used	Currently for KPM used only
Developer country	Malaysia	Australia	Canada	Malaysia

2.4 High-Level Project Requirements

2.5. Project Requirements

2.5.1. Software Requirements

Below are the lists of software requirement needed for this project.

I. Unity 3D – use for developing game
II. Visual Studio (C# programming) – use for writing coding of the game
III. The related for developing end product

2.5.2. Hardware Requirement

Below are the lists of hardware requirement needed for this project.

I. Kinect & Xbox One – use as a tools to play using body gesture (capture movement)
II. USB 3.0 – use to connect computer with Kinect & Xbox One
III. Computer with USB 3.0 – port to connect USB 3.0
IV. The related for developing the end product

2.6 Conclusion

In this chapter, it has been discussed about the domain of the project, the existing system, and comparison of the existing system, project methodology, instructional design and project requirement. From this discussion, the reason why this project is going to be developed becomes clearer.

In the chapter 3, details analysis will be highlighted. The current scenario analysis, requirement analysis, software and hardware requirement and other requirement will be discussed in more details.

CHAPTER 3

ANALYSIS

3.1 Introduction

In this chapter, the topics that will be discussed are current scenario analysis, requirement analysis, project requirement, software requirement, hardware requirement, other requirement and the conclusion for this topic. In the requirement analysis, specific genre will be detailed out and the proposed storyline of the game will be show. In the project development, there will be detailed about analyse existing system, comparison and more. Then, there will be listed software, hardware and others requirement needed to complete this project. Last but not least, there will be a conclusion of this topic at the end of the chapter.

3.2. Requirement analysis

Games nowadays not just being used for entertainment but also being used for education. There were a lot of research have been done to prove that games also useful for education. So, to make the reason become stronger, this project study a few researches that prove that games are also can be used for education. From Digital Games for learning report, it has found that games showed significant positive effects on science, mathematics and literacy. Then, why not this project focused to make a useful game for education that can be used by autistic student in order to make the learning process becomes easier.

Games being used for educational are widely famous nowadays. In 2012, Bill & Melinda Gates Foundation that cooperates with MacArthur foundation made an investment to establish Games Learning & Assessment Lab (Glass Lab). This assessment is being developed in respond to the climate of student disengagement that currently exists in many classrooms.

Storyline of the game

The proposed storyline for this game are:

I. The autism student will be playing five types of visual disclosure game to complete the diagnosis.

II. The first game is about their visual discrimination which they will play the same discrimination game which will test whether they can choose the same object continuously or not.

III. The second game is about to test their spatial relationship which they will play odd discrimination game which will observe whether they can detect the odd object within the game.

IV. The third game is about form constancy which will test whether their visual of size discrimination. They will play the game that they must choose the same size object.

V. The fourth game is about the visual memory. In this game, they will test their visual memory where they will play a puzzle memory game.

VI. The last game is about the visual closure. Their vision will be tested whether they can complete a picture puzzle or not.

VII. All of this game will be played with Kinect and Xbox One which the autism kids only will use their hand gesture to play it.

3.2.1. Project Requirement - Analysis of system to be developed

3.2.2 Analysis of Current System

Existing games

The existing games example that will be analysed in this project is the autism games which known as Autism games.com.au. This game can be used by the autism kids to practice their daily chores.This were the interface of the existing autism games.

Refer website - http://www.autismgames.com.au/

Figure 3.1: Interface of existing autism games (http://www.autismgames.com.au/)

Figure 3.2: Interface of existing autism games (http://www.autismgames.com.au/)

Autism games.com.au provides exercise games for kids with autism. This games help autism kids practice what they are doing in their daily life. The games that will be developed have a different concept compare to this existing games. The game of this project is serious games which will help teacher detect the student autism level based on the mark of the game (visual disclosure) that the student plays. This game also using kinect and Xbox One as a tool of diagnosis. Below are the comparison table between games that are being developed with the existing games.

Table 3.1: Table of Comparison between Diagnosis Games that with the existing games

Comparison	Diagnosis Games	Autism games
Use	Kinect and Xbox One to play game	Mouse/Keyboard to play game
Purpose	Help to detect autism level based on visual disclosure	Help autism kids practice daily live activities
Goal	The output result to categorize autism level	To help autism kids doing daily live activities
Focus	For school autism kids to differentiate their class level	For autism kids

3.2.3 Analysis of Proposed System

The games that will be developed are the serious games used as diagnosis tools to detect autism level, so it will be a bit different with the basic games for autism kids. The purpose also not the same and the flow also will be different. Below are the basic different flows of the diagnosis games compare to existing games.

Table 3.2: Table of Comparison flow between Diagnosis Games with existing games

Diagnosis Games	Autism games
Student have to play all the games to get the full report	Kids can choose which games they want to play
At the end, teacher will review the score to differentiate the kids autism level	The kids can stop playing anytime
There will be a recommendation for teacher on how they can teach the autism kids based on the result	At the end, the games will motivate the kids based on their result

This project will be developed for the autism kids because this project might improve the existing system and help the teacher in diagnosing the autism kids. Teacher in SMK Bukit Katil used to give the student a question paper to differentiate their class's level. Using these tools, time will be needed to mark their answer on that paper first. The autism kid's handwriting also is not neat, so this will take the time for the teacher to finish marking the paper.

The existing techniques are not user friendly for both student and teacher. So, by using this project, it might help the process become easier and faster. Since based on the study, the autism kids like to play computer game but they do not know how to use the mouse well. So this project will be using kinect and Xbox one which can allow them play with using their body movement. There also will be tested and proved whether kinect can be as a diagnosis tools to detect autism level or not which are one of the objective of this project.

These games are using kinect because to check whether it can be used for autism kids or not. Then, this games are being developed is to help teacher differentiate their student autism level. There were no games before this used to test and differentiate autism level. The existing games only used to make autism kids practice learning. The existing games also using a mouse as the controller which based on the research are not preferable by autism kids. Other uniqueness of this projects also, the test only about their visual disclosure. So the tested part is only for the visual, not fully observation.

User Analysis autism kids

- A child is not disabled because they cannot talk, understand, see or hear. They are disabled by a society that excludes them.

Figure 3.3: Population of disability kids in Malaysia (parentinggroupsix.blogspot.com)

- One of the school that promote a program for learning difficulties student :
    - **SMK BUKIT KATIL**
        - ✓ *"Program Pendidikan Khas Integrasi"* was established in 2002 by Puan Aidah bt Md Tion that participate by 6 students only.
        - ✓ Members of SMK Bukit Katil include the administration teachers and students known this program as 'PERMATA'.
        - ✓ In 2011, the total student joined this program were 56 student that conducted by 12 teacher and 3 assistant administer.

Autism is a neurobiological disorder and the kids with autism have difficulty processing and responding to information from their senses. Most of them also have difficulties with social interaction and communication. The effective technique treatment for autism that known nowadays is ABA. What is ABA? ABA is Applied Behaviour Analysis that focuses on how learning is conducted. If behaviour was followed by some sort of reward, the behaviour has high possibility to be repeated. Through the research, the field of behaviour analysis has developed a variety technique to increase useful behaviours and reduce those that may be interfering with learning. In specific, ABA principles and technique can improve basic skills such as looking, listening and imitating, and also other complex skills such as reading, conversing and understanding another person's perspective.

Next, from OVD issue 40-3, COVD journal issue dedicated to autism and vision. They study about the analysis of visual problems and autism. Since this project will focus only about their vision test, the basic vision characteristic of autism must be known well. As people know, student with autism are very common to have visual problems. They have difficulties which are lack of eye contact, staring at spinning object or light, side viewing and difficulty attending visually. The autistic people commonly use the visual information inefficiently. They cannot coordinate their central and peripheral vision perfectly. For instance, if they were asked to follow an object with their eyes, they basically do not look at the object directly. They will look off to the side of the object. The autistic people also have difficulty to maintain their visual attention. They commonly having eye movement disorder and crossed eyes.

Other characteristic of autism are their sensory integration. They might be extremely sensitive to sounds, touch, taste, sights or smell which similarly known as sensory integration disorder. They may be upset if the light is too bright or the phone ringing sound is too loud. Moreover, the autism kids and assistive technology will match well. As many study said that they like to play the computer game and even nonverbal children can communicate with new device that are designed to covert pictures or text to spoken words. A well-known tools used by the autism people are Go Talk. By using Go Talk, they only have to click the picture with simple text in order to describe what they wanted to do. Below are the varieties of Go Talk version.

Figure 3.4: Go Talk version 20+ and 32+ (http://boundlessat.com/)

Technical Analysis

The devices technologies being used are Kinect and Xbox one. The Kinect are used suitable with the objective of why these games are being developed. This is because this project wants to identify whether Kinect also can be a diagnosis tools for autism. This project also wants to know whether autism kids can used the Kinect easily and comfortably or not. The capabilities are the game will be able to play with using body gesture. The cost of these tools is a bit expensive and higher efforts require connecting it and making the gesture become accurate.

There will be implications that might face by this project which the connection of the player with Kinect. Other implications will be calculation of the result of this game that will be needed in the database on the web in order to display the suggestion for the teacher on how they should teach the student based on the result. Minor implications might be face when the project will be added to the website. The database of the game and the website also will be the implications of this project. Along the development of the project, the code used in Unity 3D to link with the gesture will be an implication too.

Resource Analysis

The learning material in this project is the visual disclosure. It will detect and diagnose student level of autism in order to place them in different classes since they need to be taught based on their visual capability. They have to complete all five games in order to get the result.

3.2.4. Software Requirements

The software that will be used in this project is:-

- Unity 3D – use to develop the games
- Visual studio –C# programming – use to code the game coding
- The related for developing end product

3.2.5. Hardware Requirements

The software that will be used in this project is:-

- Kinect & Xbox One – use to play with using body movement (capture gesture)
- USB 3.0 – use to connect the Kinect & Xbox One with computer
- Computer with USB 3.0 – port to connect USB 3.0
- The related for developing the end product

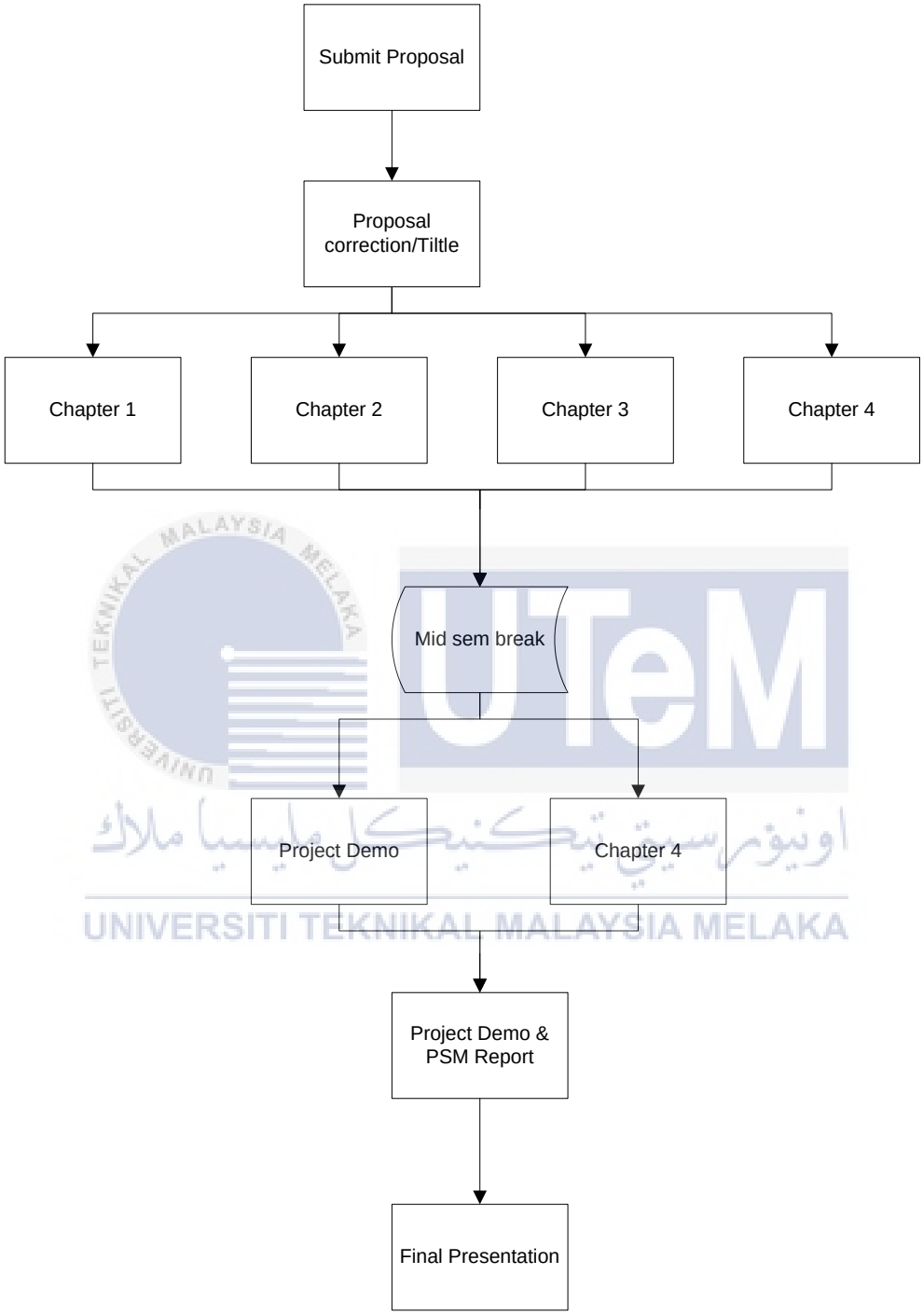
3.2.6. Others Requirement

– Requirement Gathering

The requirement gathering techniques that will be used in this system are interview, research and prototyping. The questionnaire will be distributed once the systems have been tested by the user. For the interview session, teacher in Smk Bukit Katil will be choosen to do this session since they will be one of the users of this project.

3.3. Project Schedule and Milestones

Flow Chart



Gantt Chart

Task	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14	W 15	W 16
Submission proposal and verification																
Proposal correction and confirmation supervisor & title																
Chapter 1 (System Developments begin)																
Chapter 1 &Chapter 2																
Chapter 2																
Chapter 2& Chapter 3 Progress presentation 1																
Project Demo & Chapter 3 Chapter 4																
Mid Semester Break																
Project Demo &Chapter 4																
Project Demo &Chapter 4																
Project Demo																
Project Demo & PSM Report																
Project Demo & PSM Report/ Presentation																
Project Demo & PSM Report																
Final Presentation																
Submission																

3.4 Conclusion

All of the analysis and requirement already being discussed and clearly explained in this chapter. The project schedule and milestone also will be provided. On the next chapter there will be details information for system architecture, preliminary design and user interface design.

CHAPTER 4

DESIGN

4.1 Introduction

This chapter will discuss the development phase and design of the interfaces of this project. Design is the important part of the project as it plays the big role in exposing the game to the user. The design is the main key point as it was capable to capture user first impression whether they like to play it or not. This chapter shows the preliminary design and also the result of detailed design.

In this chapter, both system architecture and storyboard need to be fulfilled in the production of this project. The design is build based on the storyboard. The main goal of this design phase is to create outline of the three independent structures which are system architecture, preliminary design and user interface design.

4.2 Design Process

Design phase is essential to be done before entering implementation phase. Hence, this chapter will detail out the design of the object and interface. The design of this game must be simple as it was going to be used by the autism kids. As the user can not focus as the usual kids, the design must be a simple one to make them keep focus.

This section shows the system architecture for the implementation of this project. The figure below will show the delivery flow of this project.

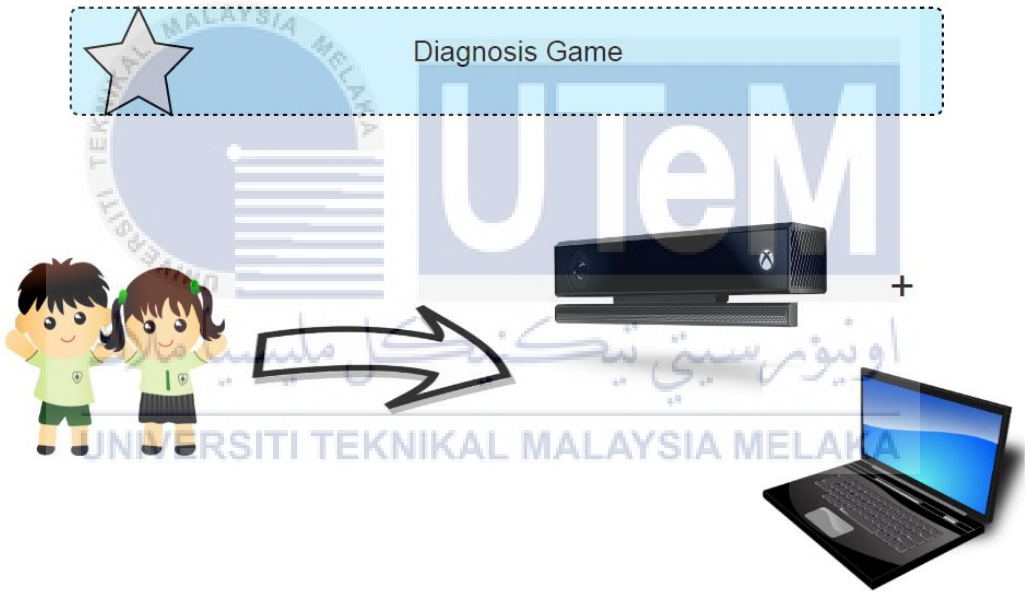


Figure 4.1: Design Process of Diagnosis Game

4.2.1 Navigation Structure

In order to keep track of the development process, the navigation structure was created. This navigation will ensure that all requirement of the application is completely identified.

This diagnosis game consist of five game which will test their vision which are Roll a ball (size), Roll a ball (odd), Roll a ball (same), memory puzzle and jigsaw picture puzzle. Figure below shows the navigational structure of this game.

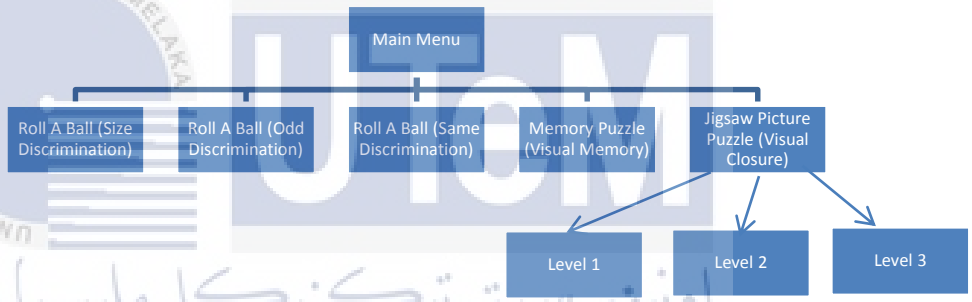


Figure 4.2: Navigational Structure Diagnosis Game

4.3 Preliminary Design

In this preliminary design, the discussion will focus on how the realistic flow of product, storyboard design and the user interface design. Preliminary design is the basic structure design that will lead the developer to do the final design of the project.

4.3.1 Storyboard Design and Sound

In order to guide developer to plan and implement a product or application, the storyboard will be used and act as a graphic organizer.

The information that will be included is details of the storyline, types of shot or scripts that being used and also the duration (if necessary). Besides that, this game includes a few instrumental of background music in order to make it more attractive. The use of script will not be used much in this project as the austim kids cannot read word well. So this project will use a simple word. The audio and picture will be used as replacement of the script.

4.3.1.1 Initial Storyboard & Sound

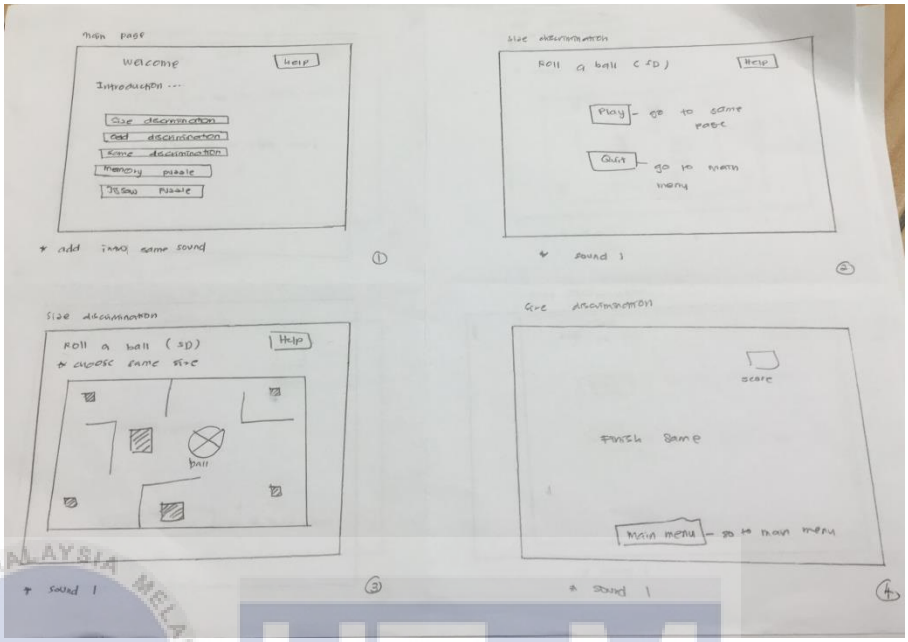


Figure 4.3: Initial Storyboard

The other part of the storyboard will be included on the attachments list.

4.4 User Interface Design

The user interface design shows the framework for the content of this project as below:

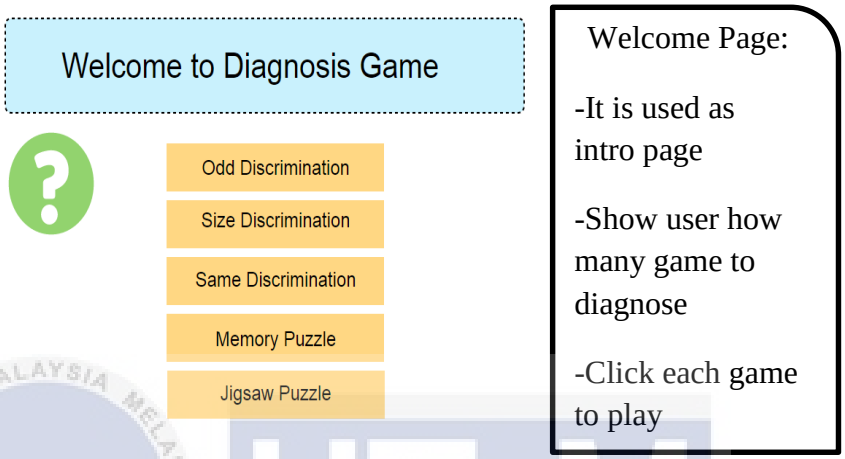


Figure 4.4 :User Interface Diagram (Welcome Page)

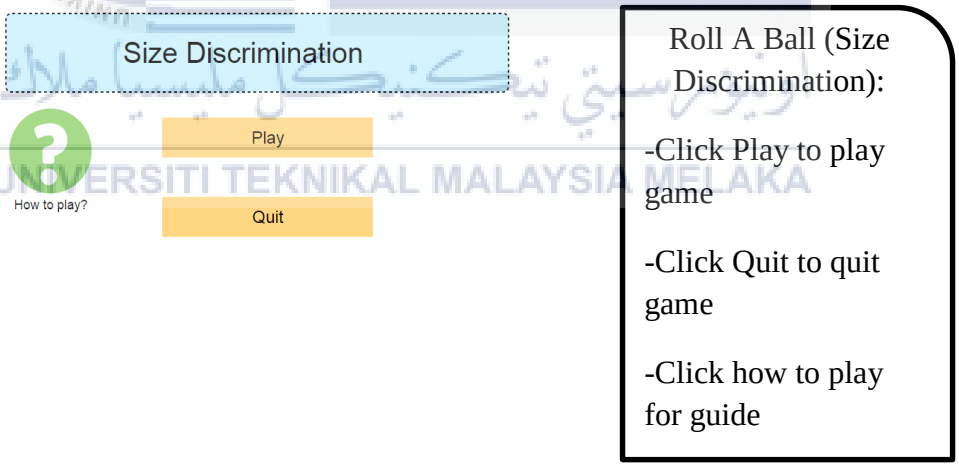


Figure 4.5: User Interface Diagram (Size Discrimination Page)

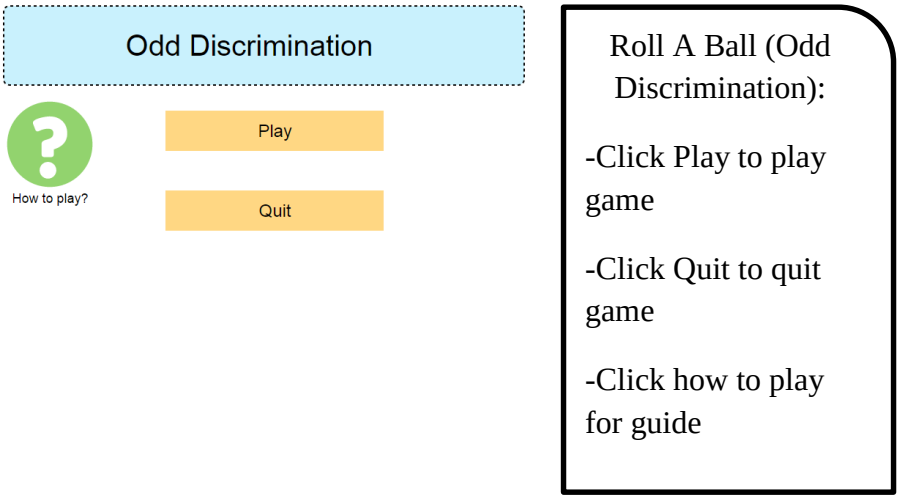


Figure 4.6: User Interface Diagram (Odd Discrimination Page)

Figure 4.7: User Interface Diagram (Same Discrimination Page)

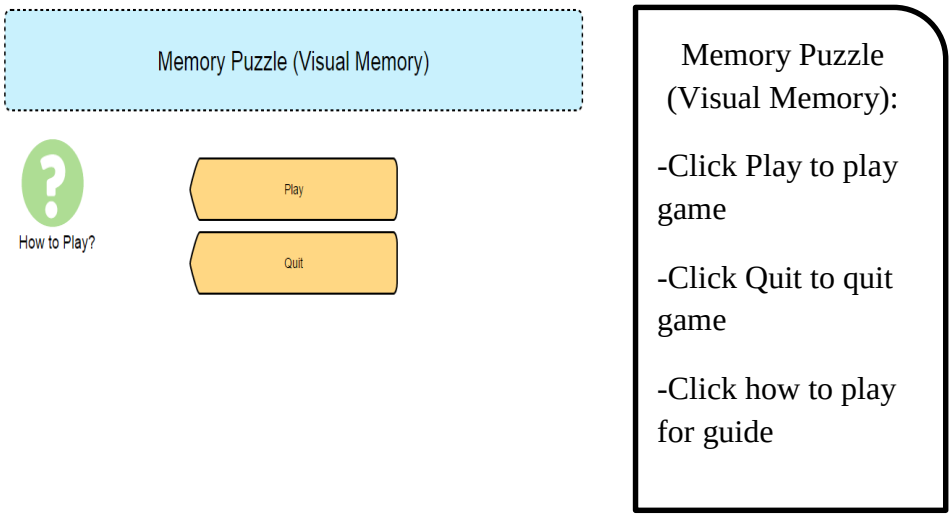


Figure 4.8: User Interface Diagram (Memory Puzzle Page)

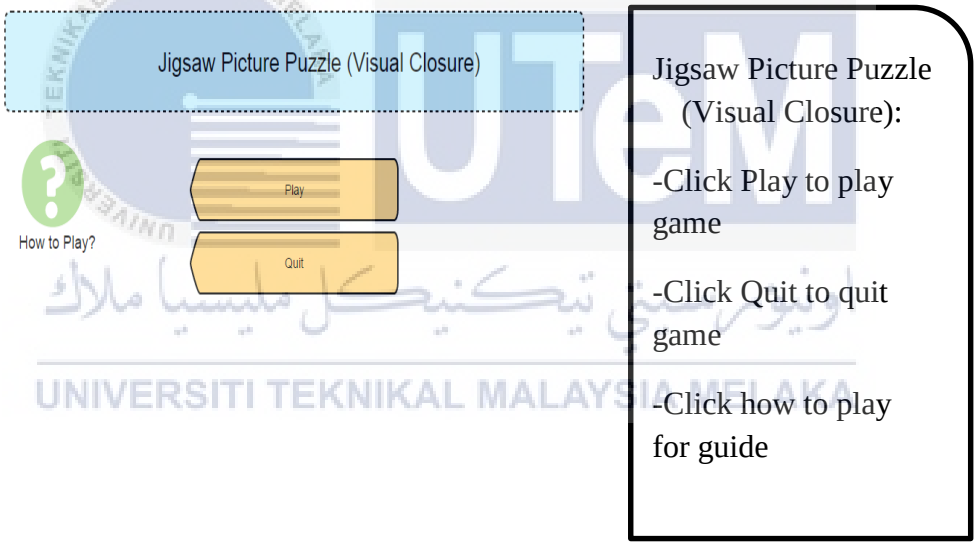


Figure 4.9: User Interface Diagram (Jigsaw Puzzle Page)

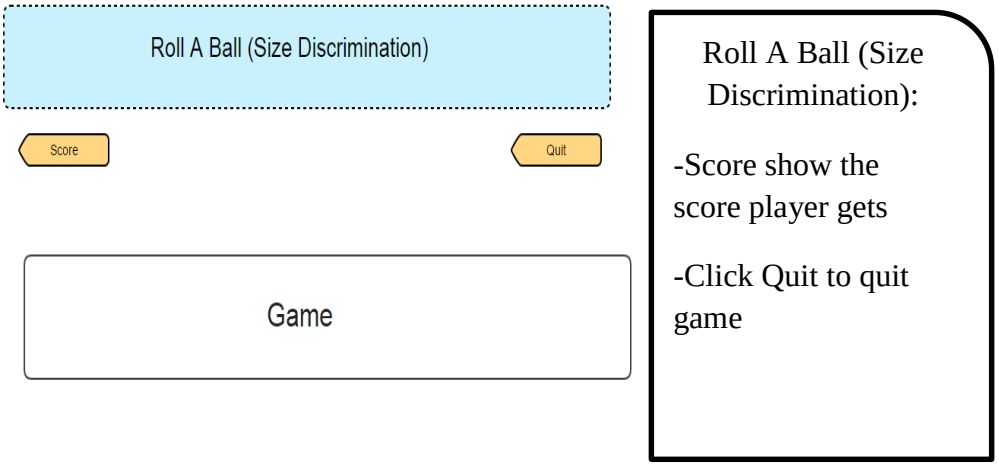


Figure 4.10: User Interface Diagram (Size Discrimination Game Page)

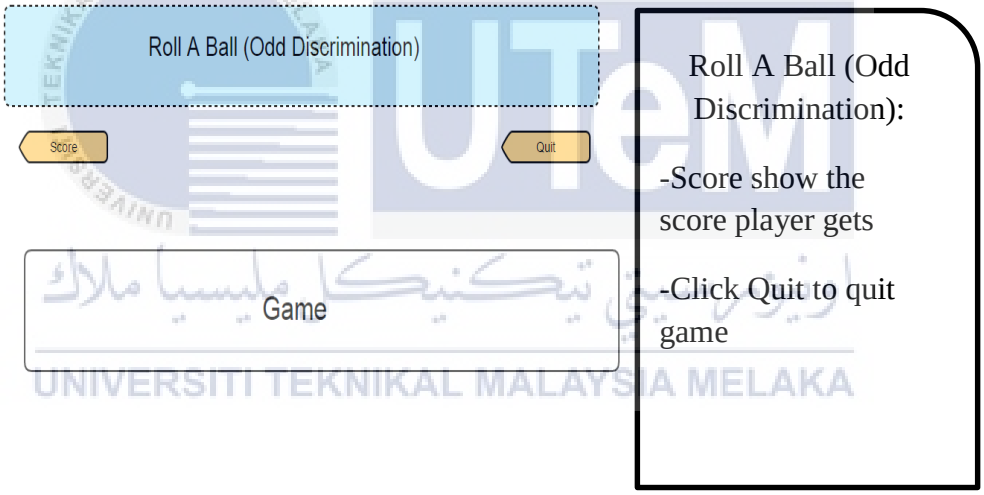


Figure 4.11: User Interface Diagram (Odd Discrimination Game Page)

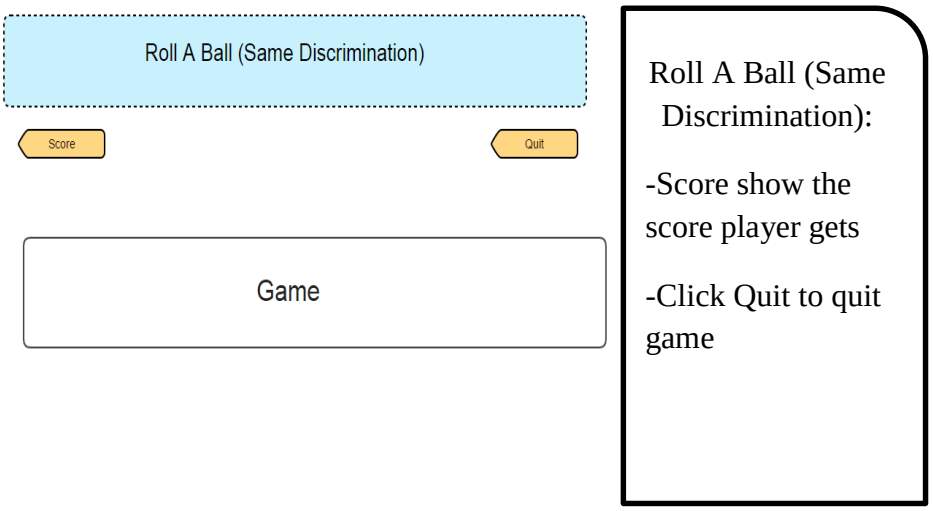


Figure 4.12: User Interface Diagram (Same Discrimination Game Page)

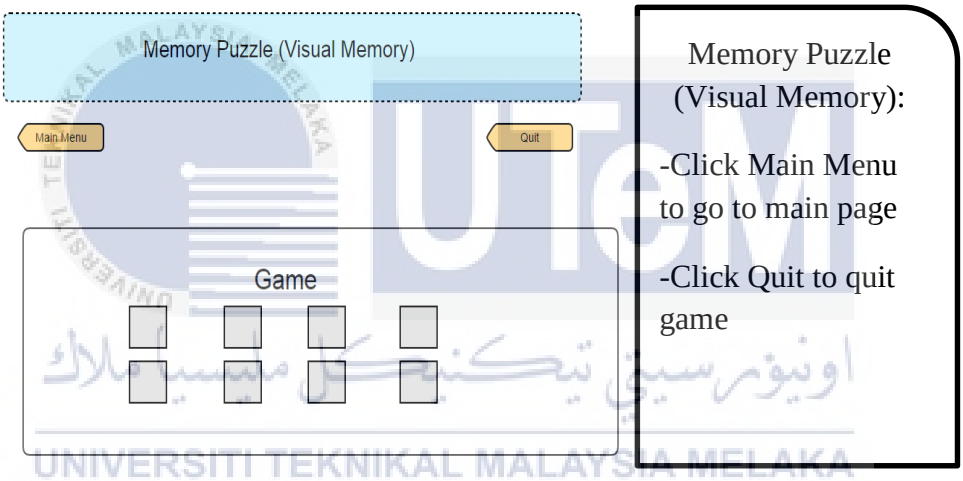


Figure 4.13: User Interface Diagram (Memory Puzzle Game Page)

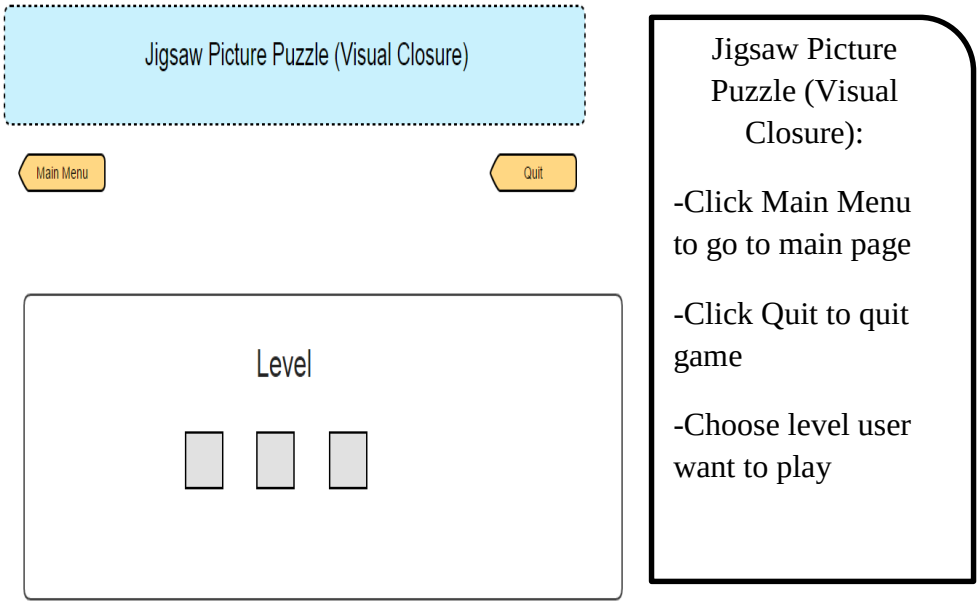


Figure 4.14: User Interface Diagram (Jigsaw Puzzle Level Page)

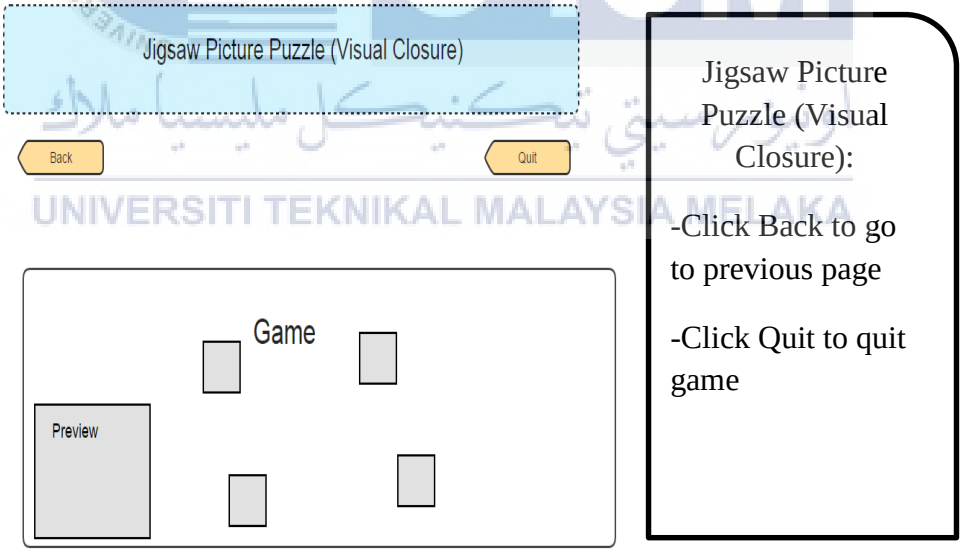


Figure 4.15: User Interface Diagram (Jigsaw Puzzle Game Page)

4.5 Conclusion

As a conclusion, the design phase defines all the design process in order to build this project. This chapter discuss the navigation structure, preliminary design, flow chart, storyboard and graphic user interface to make reader understand the flow of this project. This chapter explained details about each items in order to make user understand the design of this project.

CHAPTER 5

IMPLEMENTATION

5.1 Introduction

This chapter will discuss about the process of development includes the process of creating and implementing the element of multimedia into this project. All of the media creation process which is production of text, graphic and audio will also be discuss in this chapter.

As people already known, multimedia element consist of text, graphic, audio, video and animation. These elements are needed in computer application or also in games development in order to make it more interesting and attracting to play.

In the last part of this chapter, the progress of the project development based on the Gantt chart built in the previous chapter will be shown. There were also a summary concluded in the summary of this chapter. In this project, the elements of multimedia were used hoping that this project will run smoothly and user friendly as the objectives of this project.

5.2 Media Creation

Media creation is one of the important subtopic for developing this project. It was call multimedia integration process as it put all elements to encourage user's engagement. Therefore, in this project there were four elements of multimedia used. Each of the elements used was describe in details in this subtopic.

I. Production of Text

Most of the text in this project used Arial as this font is simple and easier to read. As the user of this project was students with autism, they need a type of font that was easier to read. So this is why this font was used as the font type is clear. The autism kids do not like to read, so there were no needs of complicated and curly for them as they prefer picture and sound than text elements.

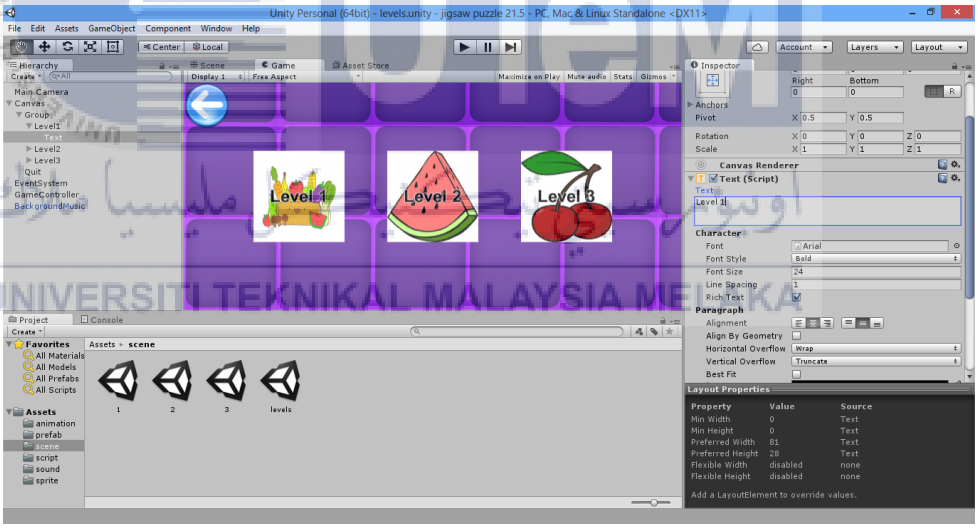


Figure 5.1: Production of Text

II. Production of Graphic

In this project, 2D image were used in the graphic element. For the jigsaw picture puzzle and puzzle memory, the picture of animal and fruits were used in this game. All of the images elements were from the internet's sources.

Figure 5.2: Production of Graphic (Jigsaw Puzzle)

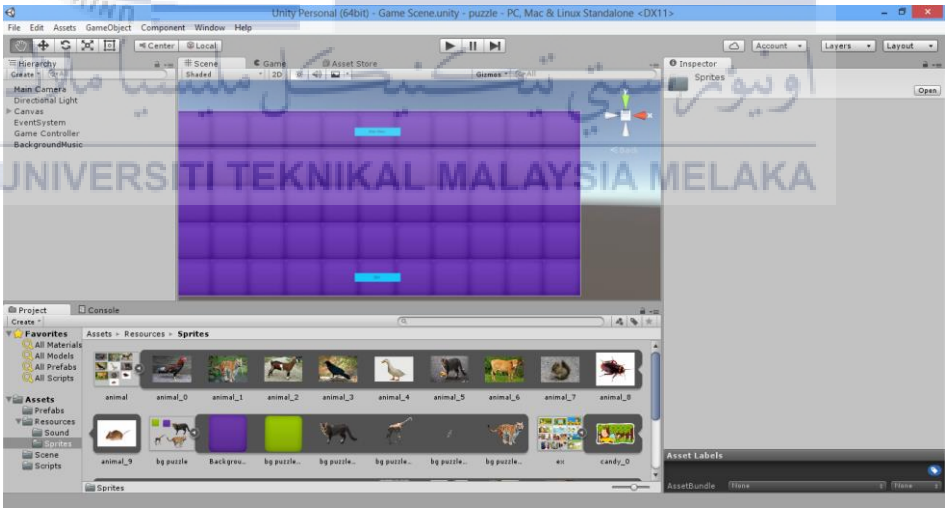


Figure 5.3: Production of Graphic (Memory Puzzle)

III. Production of Audio

The audio source for this project was obtained from the You Tube and the free source in the Internet. A calm instrumental was chosen as the autism kids do not like the loud sound, but in other to make feel of this game, a few instrumental was used.

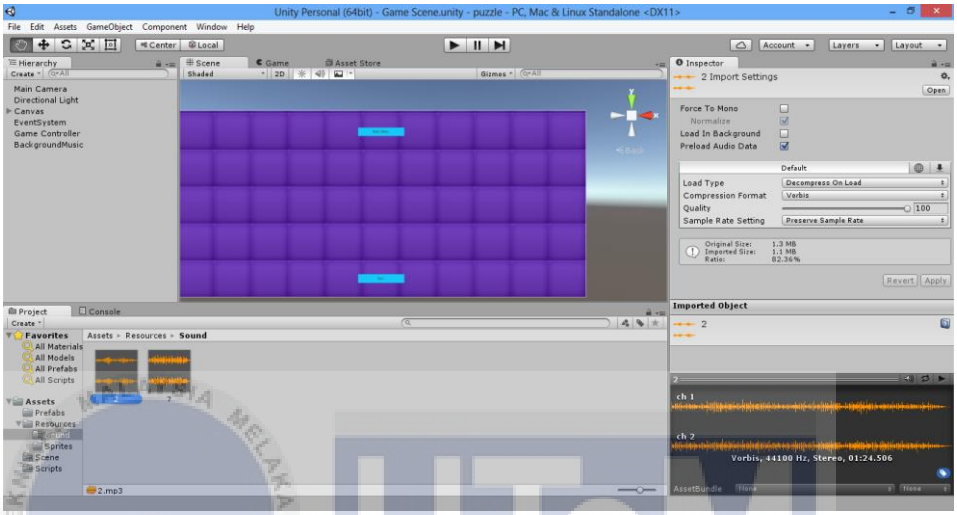


Figure 5.4: Production of Audio (Memory Puzzle)

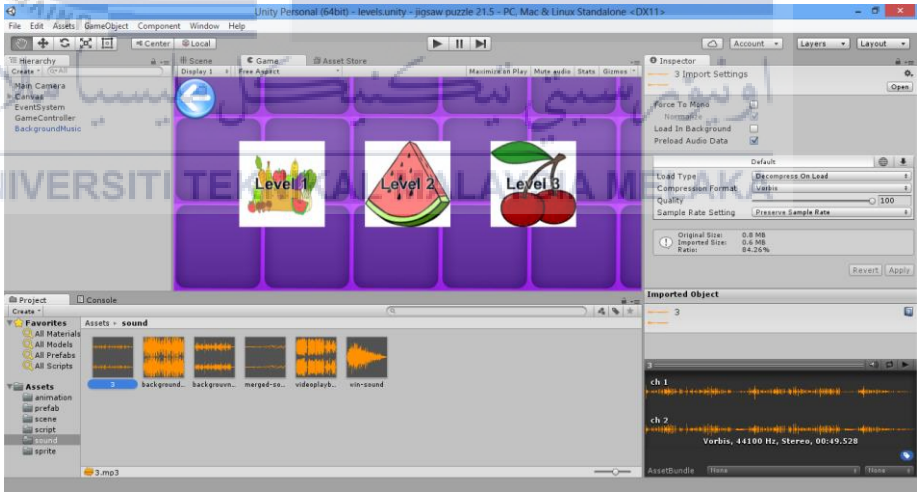


Figure 5.5: Production of Audio (Jigsaw Puzzle)

IV. Production of Animation

Animation for this project were built in Unity 3D. It was used in Jigsaw Puzzle where the pictures that will be preview were shown and shrinks after the preview.

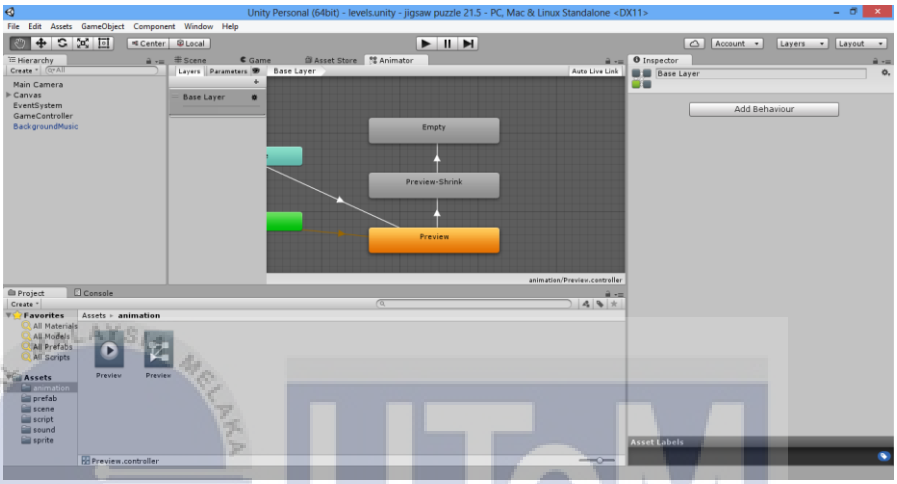


Figure 5.6: Production of Animation

5.3 Product Configuration Management

In this part, the configuration environment setup was shown. It includes software used in producing this project from the beginning until the end.

5.3.1 Configuration Environment Setup

In order to produce a good product, the configuration environment setup must be right. The table below show how the configuration environment setup was done for this project.

Figure 5.7: Configuration Environment Setup

5.3.2 Version Control Procedure

For this version control procedure, two testing were used which are alpha testing and beta testing. Simulated or actual operational testing by potential users/customer or an independent test team at the developers' site is alpha testing. Alpha testing is often goes before beta testing and is employed for off-the-shelf software as a form of internal acceptance testing.

Meanwhile the beta testing is the last stage of testing and normally can involve sending the product to beta test sites outside the company for exposure in the real word or offering the product for a free trial which can be download from the internet. The result will be gotten after the testing. Similar like pre-testing concept.

5.4 Implementation Status

In this section, the detail status of the progress development in each module will be briefly explained. The details are shown in the table below.

Table 5.1: Table of Component Implementation Status

Component/ Module	Description	Duration to Complete	Date Completed	Status
Sketching	This part is to sketch storyboard and plan the flow of this project.	2 weeks	Week 2	On time
Game production	This is the part to make the each game according to the storyboard.	5 weeks	Week 8	Delay
Game coding	This is the part to implement the code of each game.	3 weeks	Week 9	Delay
Sound Production	This is the part to find suitable music for the game	1 week	Week 9	In time
Background	This is the part to sketch the background of the game, button and interface of the game.	2 week	-	In time
Integration	Combine all the scenes of games in this project.	2 weeks	-	In time

5.5 Conclusion

As a conclusion, this chapter concludes the process of implementing the multimedia elements such as text, graphics, animation and audio for this project. Moreover, the configuration process for the software used was also shown in this chapter. After this, the next chapter will be discussed about how the testing will be made. Then, the tabulate data obtained from the survey and analyse of the result will be discussed. Lastly, the user acceptance testing was also tested in order to achieve the objective of this project.

CHAPTER 6

TESTING

6.1 Introduction

This chapter will discuss about testing part. In this project, the testing part results are measured in order to know whether Kinect are suitable to be used as diagnosis tool or not. In this project, the testing was done using two methods. The first method is observation and the second method is questionnaire. The first method was conduct in two groups of autism kids' students. Each of group was tested using different approach which is mouse and Kinect. In the second method, the teacher will observe the student playing the game and will answer the questionnaire based on their observation. Then, the result and data collected will be drawn in this chapter.

6.2 Test Plan

Test plan will explain how the testing being carried out in order to ensure the objectives meets with the project. The test plan also can be describe as a document that describe the important details like scope, approach, reference and schedule.

6.2.1 Test Organization / Test User

This testing session involve 8 autism students and 4 teachers from SMK Pendidikan Khas Bukit Katil, Melaka. The students were divide in two groups which one group will testify the test using Kinect and the other group using mouse. For teacher, they were given a questionnaire after observing the student playing this game.

6.2.2 Test Environment

Figure below show the environment testing that was carried out in this project. This test was carried out in a small classroom in SMK Pendidikan Khas Bukit Katil, Melaka.

The hardware used in this testing is shown in the table below.

Table 6.1 :Table of hardware requirement list in test environment

Hardware	Function
PC personal computer	To display the game interface
Kinect & Xbox 1	To allow user play using gesture
Mouse	User play using mouse

Figure 6.1 :Picture of testing environment

The other picture of testing environment will be included in the attachments.

6.2.3 Test Schedule

Test schedule are being used to manage all of the testing activities. In this testing part, Group 1 will be using Kinect as the tools and Group 2 will be using mouse as the tools. The result will show which tools are suitable to used by the autism kids. Table below will show the testing schedule.

Table 6.2 : Table of Testing Schedule

	Group 1	**Group 2**
Type of testing	Tools: Kinect	Tools: Mouse
Venue of testing	(PERMATA)Classroom in SMK Pendidikan Khas Bukit Katil, Melaka	(PERMATA)Classroom in SMK Pendidikan Khas Bukit Katil, Melaka
Number of respondent	4	4
Age of respondent	13-17 years old	13-17 years old
Duration	1 ½ hour	1 ½ hour
Date and time	D: 27/7/2016, T: 10.00 a.m	D: 27/7/2016, T: 10.00 a.m

6.3 Test Strategy

This section explained the test strategy that was used in this project. In this project, the result was taken by watching the student playing the game. The table below show the testing strategy that has been done.

Test using Kinect

Table 6.3 : Table of Test strategy using Kinect

Respondent	Observe
Student A1	Level of difficulty
Student B1	Level of difficulty
Student C1	Level of difficulty
Student D1	Level of difficulty

Test using Mouse

Table 6.4 : Table of Test strategy using Mouse

Respondent	Observe
Student A2	Level of difficulty
Student B2	Level of difficulty
Student C2	Level of difficulty
Student D2	Level of difficulty

The teacher will observe the student and answer the questionnaire. The answer of the questionnaire will be collected and shown in test data.

6.4 Test Implementation

This section will discuss about the implementation that will be done in the testing. The details of the testing procedure will be discussed.

6.4.1 Test Description

This test description will explain details about how the test have been prepared and done. Before the testing, the teacher will be brief about what are the objective of this testing. The teacher will be guide on how to use the software and hardware that will be used.

After briefing, the test started. Teacher will observe the level of difficulty that faced by the student. Then, teacher will answer the questionnaire based on their observation. The result was collected from that questionnaire. The expected result is which tools the teacher will choose as a diagnosis tools.

6.4.2 Test Data

This section will show the data observed and also the answer of the questionnaire given. Table below show the observation of 8 students test the game using Kinect and mouse.

Observation (Kinect)

Table 6.5 : Table of Observation playing game using Kinect

Student level	**Observation**
Student A (Excellent)	Can complete the game but facing a little difficulty (Kinect detection sensitivity)
Student B (Good)	Facing more difficulty than Student A but still can play the games
Student C (Low)	Facing more difficulty than Student B and having difficulties to move the hand using the instruction
Student D (Low)	Facing more difficulty than Student C and having difficulties to move the hand using the instruction

Observation (Mouse)

Table 6.6 : Table of Observation playing game using Mouse

Student level	**Observation**
Student A (Excellent)	Can complete the game easily
Student B (Good)	Facing a little difficulty than Student A but still can play the games easily
Student C (Low)	Facing more difficulty than Student B but still can play the games.
Student D (Low)	Facing more difficulty than Student C but still can play the games.

Questionnaire

The full questionnaire can be referred at the attachments. The table below show the data collected from 4 teachers.

The used of Kinect

Table 6.7 : Table of 4 teachers perception's about The used of Kinect

Question	Neutral	Agreed	Strongly agree
User friendly	0	4	0
Easy to set up	3	1	0
Teacher know how to use		3	1
Autism kids know how to use	2	2	0
Teacher can easily guide student	2	1	1

The use of D-Games to detect autism level

Table 6.8 : Table of 4 teachers perception's about The used of D-Games

Question	Neutral	Ageeed	Strongly agree
Easy to play	1	2	1
Effective to use	0	3	1
Screen display interesting	0	2	2
Good tools for autism level detection	1	2	1
Help improve student visual skill	2	1	1

Test game using Kinect

Table 6.9: Table of 4 teachers perception's about Testing the game using Kinect

Question	Neutral	Ageeed
Easier to play	4	0
Autism kids like to use	3	1
Most student can complete game	3	1

Test game using mouse

Table 6.10 : Table of 4 teachers perception's about Testing the game using mouse

Question	Neutral	Ageeed
Easier to play	2	2
Autism kids like to use	3	1
Most student can complete game	3	1

Responds shows by the autism student

Table 6.11 : Table of 4 teachers observation's about Responds shows by the autism student

Question	Neutral	Ageeed
They like to play the games	1	3
Result are effective	1	3
Student having difficulties to play	3	1

Which one do you prefer?: Mouse / Kinect

Table 6.12 : Table of 4 teachers preferable's between mouse and Kinect

Kinect	Mouse
0	4

6.5 Test Result and Analysis

The main reason of this testing were to identify Kinect can be used as the diagnosis tools for the autism kids or not. Based on the observation, the autism kids nowadays can play using mouse easily. As in this cyber world, autism kids also know how to use mouse in daily life. The autism kids are not exposed to the Kinect yet. For the testing result, the student having difficulties using Kinect as they need to take a time to understand on how to play using Kinect . The teachers need to expose the use of Kinect to the student.

The autism kids needs to take time learning the new thing. As this testing was their first experience using Kinect, they have a little bit difficulties to use it. As the result of this testing, the student play this game easily using mouse rather than using Kinect.

For the questionnaire, the teachers prefer that the student use mouse as the diagnosis tools. This is because some of them think that Kinect is costly for them to use it. The teachers were new to the use of Kinect. Since Kinect also sensitive to the body detection, teachers need to do the examination in a classroom with only one student. All of the teacher show their interest with Kinect. The answer for Kinect also neutral, teachers do not disagree or strongly disagree with the use of Kinect as a diagnosis tools. Teachers also think that they need a time to expose the use of Kinect to the student first. Then they can decide whether the Kinect can be used as the new diagnosis tools.

Overall, teachers think that this diagnosis tools are effective to use. Teachers also agree that these games can be good tools for autism level detection. Teacher choose mouse as the diagnosis tools to play the games. As a conclusion, this test case results is fail. The Kinect not suitable to be a diagnosis tools for autism yet. The autism kids need to be exposed to the use of Kinect first, and then the testing can be done again to get the result.

6.6. Analysis Testing

This section will show the graph/chart of the data collected from the questionnaire.

Figure 6.1 show overall perception of 4 teachers about the used of Kinect. Three scale were used to measure the data which are neutral, agreed and strongly agree.

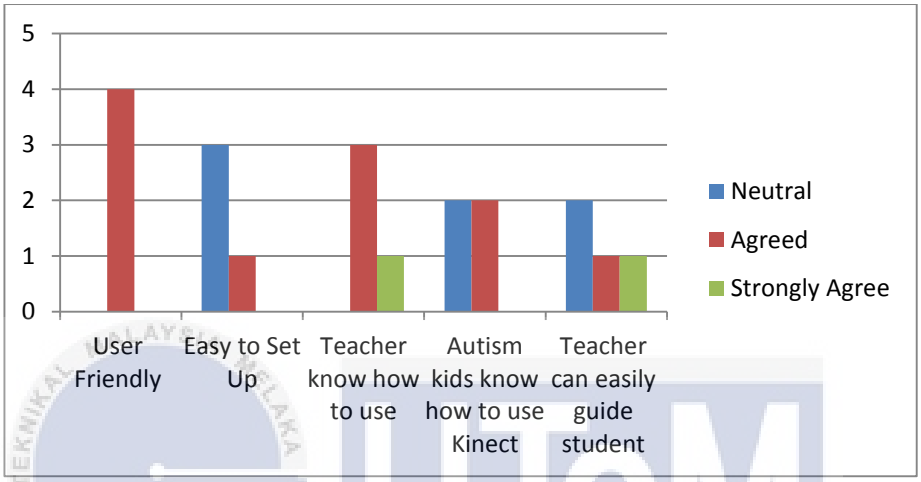


Figure 6.2 : Perception of 4 teachers about The used of Kinect

Figure 6.2 show overall perception of 4 teachers about the used of D-Games. Three scale were used to measure the data which are neutral, agreed and strongly agree.

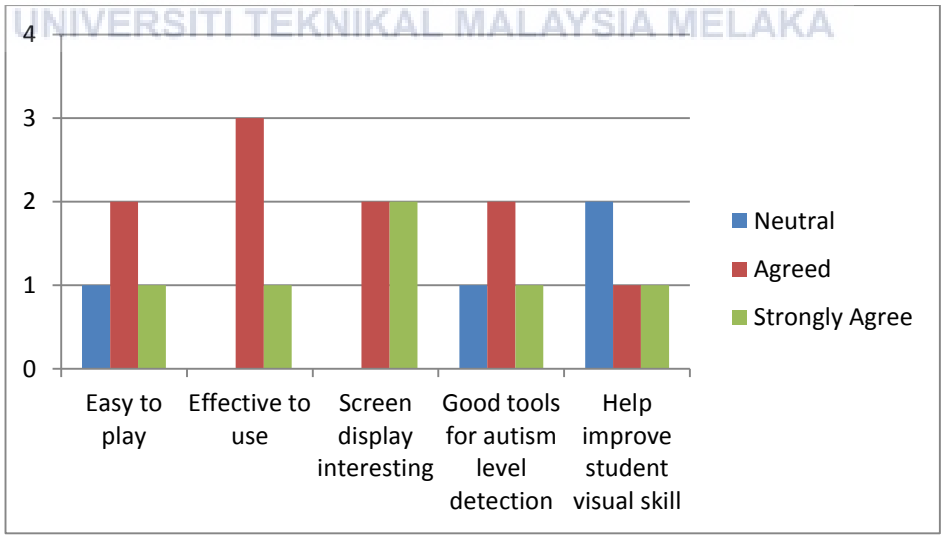


Figure 6.3 : Perception of 4 teachers about The use of D-Games to detect autism level

Figure 6.3 show overall perception of 4 teachers about testing the game using Kinect.Two scale were used to measure the data which are neutral and agreed.

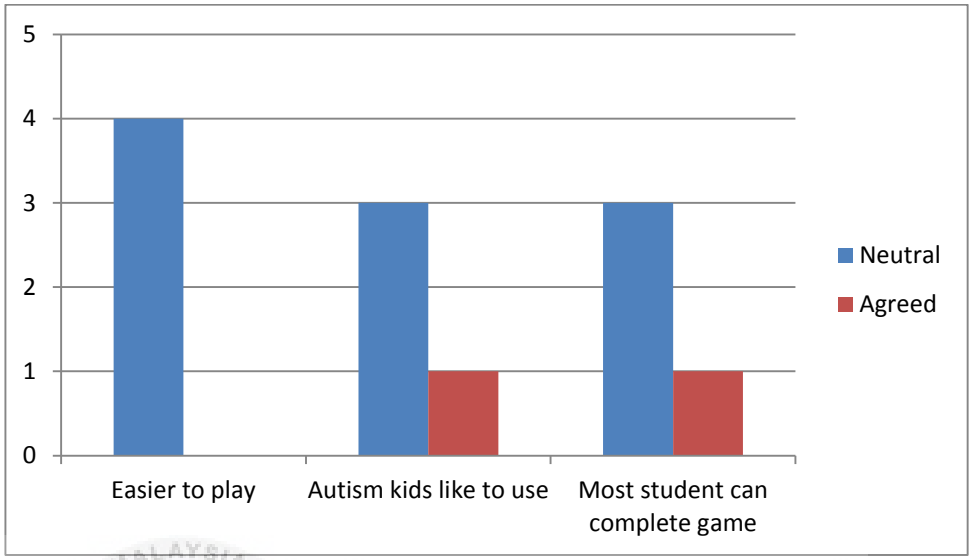


Figure 6.4 : Perception of 4 teachers about Testing the game using Kinect

Figure 6.4 show overall perception of 4 teachers about testing the game using Mouse. Two scale were used to measure the data which are neutral and agreed.

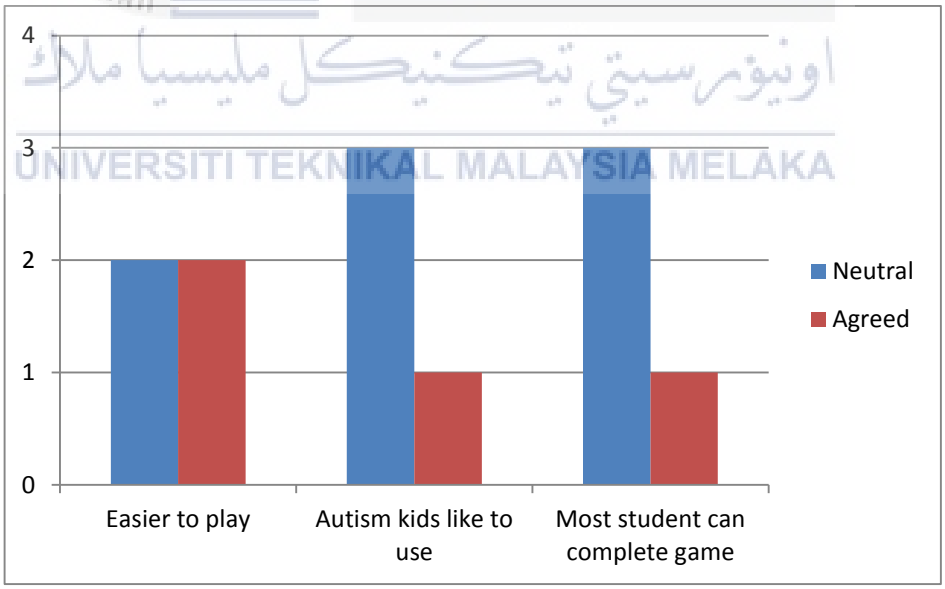


Figure 6.5 : Perception of 4 teachers about Testing the game using Mouse

Figure 6.4 show overall observation of 4 teachers about responds shows by the autism student. Two scale were used to measure the data which are neutral and agreed.

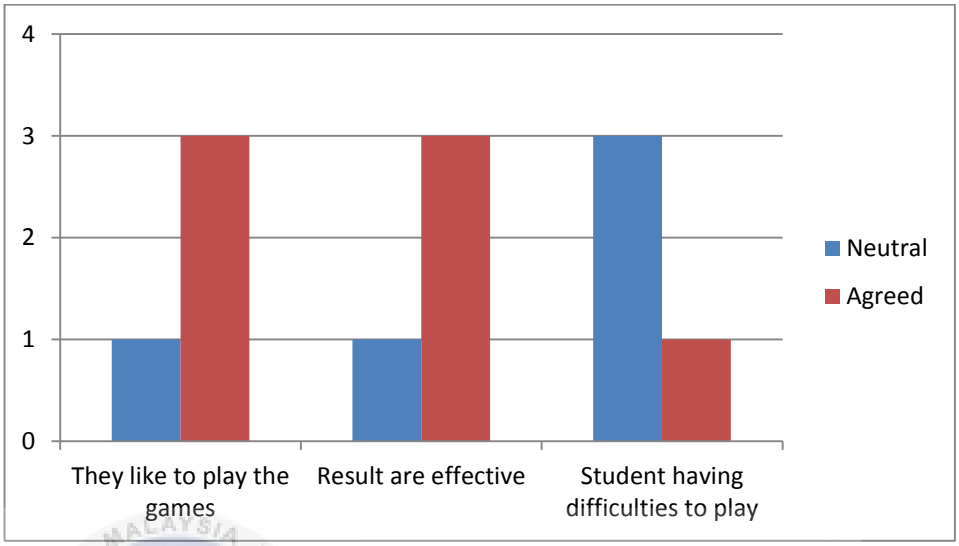


Figure 6.6 : Observation of 4 teachers about Responds shows by the autism student

Figure 6.6 and figure 6.7 show overall perception of 4 teachers about about testing game using mouse and Kinect. Four scale were used to measure the data which are not dependable, moderate, good and very good.

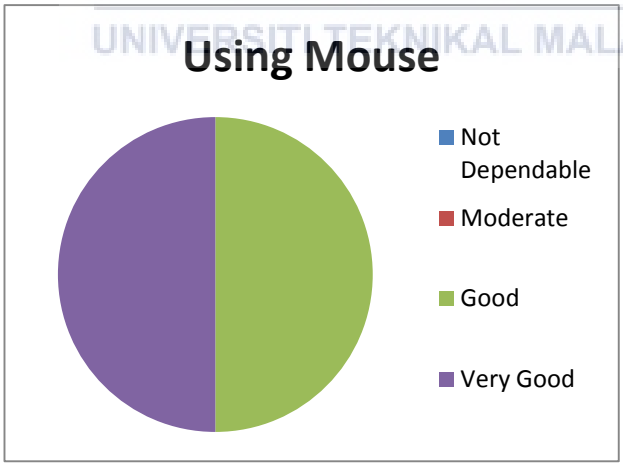


Figure 6.7 : Overall perception of 4 teachers about testing game using mouse

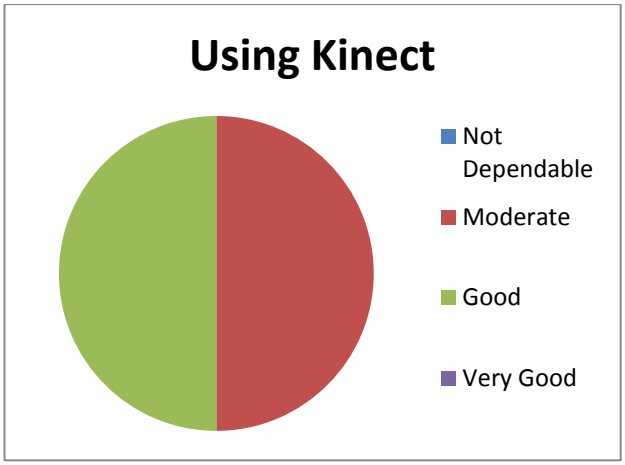


Figure 6.8 : Overall perception of 4 teachers about testing game using Kinect

Figure 6.8 preferable by 4 teachers between mouse and Kinect. Two scale were used to measure the data which are mouse and Kinect.

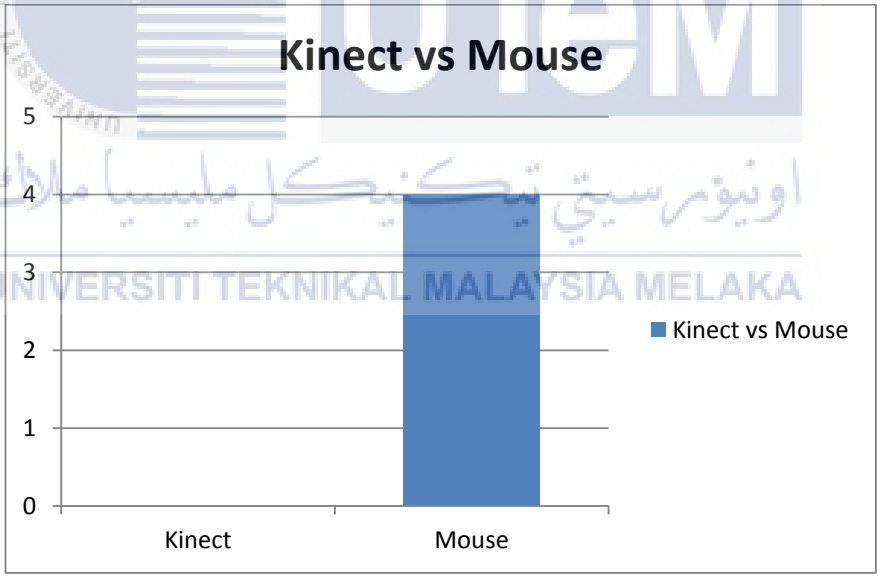


Figure 6.9 : Preferable by 4 teachers between mouse and Kinect

6.7 Conclusion

As a conclusion, all of the data collected were analysed in details to measure the required information to fulfil the objectives of this project. The result shows that mouse was chosen by the teachers as a suitable for autism kids to use as a diagnosis tools. Based on the test, the result was contradicted with the previous finding because the uses of Kinect at Malaysia are still new.

CHAPTER 7

CONCLUSION

7.1 Introduction

After observe and analyse the result collected from testing, flaws and weakness of the project was discovered. Despite from all those weakness, the strength of the object also been discovered. This project have been develop a prototype to meet with the objective which are to identify the use of Kinect as a diagnosis tools for autism level detection, to develop a diagnose system using Kinect and to test the effectiveness of Kinect.

The questionnaire obtained from the teachers show that they prefer to use mouse rather than Kinect as a diagnosis tools. Moreover, the uses of Kinect at Malaysia were still new. The teacher and student still not getting used with Kinect. Besides, they also give a positive feedback about the use of Kinect. They do not prefer Kinect because of a few limitations in order to use it especially the cost of Kinect. However, the testing only be done in one school. There might be different feedback if it has been done in others school. All of the weakness and strength of this project will be discussed in detailed. It will be considered as the guide in order to improve the project quality.

7.2 Observation on Weaknesses and Strengths

For this section, the weakness and strengths of this project will be discussed. Only the prototype has been developed in this project. This prototype needs to be improved for the project to be completed.

Project weakness

I. The detection sensitivity of Kinect
   - The Kinect is so sensitive, sometimes it detect others person and the mouse sensitivity is to high that lead to poor cursor smoothing. (low-end version)

II. How to play/ How to use
   - There must be a clear instruction in each game on how to play it and also a manual for teacher on how to use this system.

III. No entertainment element, interactive sound, time taken and competition on the games

- The interface for each game should be interesting and the object use in the game must be interactive to attract user. The screen display also was small and need to be enlarged for ease of use. This game also not uses the element of competition.

IV. Cost

- This project need a higher cost since it need to use Kinect and Xbox together. The higher cost needed to use the high end version of Kinect and Xbox.

Project Strengths

I. The use of Kinect

- The use of Kinect as a diagnosis tools was a new idea that attract user to use it.

II. The use of game in order to diagnose autism level

- The teachers agreed that this games are effective to use and can be a good tools for autism level detection.

III. Visual perception based on 5 criteria

- This game used 5 criteria which were highlighted by Kementrian Pelajaran Malaysia to diagnosed autism level.

IV. Help teacher diagnose student easily

- The teachers in SMK Bukit Katil use the exam question to diagnose student level of autism to differentiate their class. Using this games, the result will be easily calculated and measured.

7.3 Propositions for Improvement

After analysing and observing the project weakness, there were a few improvements that need to be done in order to fix it. First, for the detection sensitivity of Kinect, it has to be improved in order to make it easier to use. There need to be more research to find out how to improve the detection sensitivity for the better quality of the project. Then, Xbox latest version which is Xbox One S has better resolution than Xbox One. It allows 4K (HDR) resolution and 4K Blu-ray, DVD of physical media. The Xbox One S also available with hard drive of up to 2TB in size, while Xbox One only goes up to 1TB. The better version of the Xbox used allow the better detection sensitivity to play the games.

Next, how to play/ how to use the system, there should be a button that can show user on how to play the game. The manual also need to be prepared for the teachers in order to guide them on how to use the system. Then, the interface need to be more interactive to the user. The screen display needs to be enlarged as it will be easier for the student to use it. The games also need to use competition elements to make it more attractive to the student. More level also need to be added in each game to make the games more interesting and challenging. The multimedia elements and colour should be suitable for the user to use it. For sound, a calm and suitable sound should be used as the autism students are so sensitive to the loud sound.

7.4 Project Contribution

This project will contribute for the diagnosis of autism level that can be used by the teacher and autism student. Hopefully this game also helps to improve the visual skill for autism student. Lastly, this project hope is to encourage the use of Kinect as a diagnosis tools for autism and other disabilities student.

7.5 Conclusion

As a conclusion, the D-Games have been finished to develop a prototype version according to the schedule. This project answer the three objectives stated and help to give a new discovery to the use of Kinect. Thus, with all of the data collected from the testing, and suggestion for better improvement, hopefully this project help to discover a good tool for autism level detection. Although the result of this project is contradict with the objective, more research needed in order to prove it. The teachers prefer mouse than Kinect are because the use of Kinect are still new in Malaysia. Better improvement in this project may lead the Kinect to be a new diagnosis tools for autism level detection in Malaysia. So, more research and project that use Kinect must be develop in order to make user compatible to use Kinect and replace the use of mouse.

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Kod Projek :	BITU 3973

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

PROJEK SARJANA MUDA 1
PROPOSAL FORM
[Incomplete form will be rejected]

A	**TITLE OF PROPOSED PROJECT: The Use of Kinect in using Diagnosis Tools for Autism Detection** *Tajuk projek yang dicadangkan :*
B	**DETAILS OF STUDENT** / *MAKLUMAT PELAJAR*
B(i)	**Name of Student: Identity card no.: Nur Ina Fazira Bt Mazelan- 941214115140** *Nama Pelajar:No. Kad Pengenalan :* Student card no.: ***No. Kad Pelajar :*** **B031310465**
B(ii)	**Correspondence Address : Lot 1861, Taman Wakaf Jaya, Bukit Payong, Marang, Kuala Terengganu** *Alamat Surat Menyurat :*
B(iii)	**Program Pengajian:** *Study Program:* ☐ BITC ☐ BITD ☐ BITI ☒ BITM ☐ BITS
B(iv)	**Home Telephone No.: 09-6194119** *No. Telefon Rumah:* **Handphone No.: 013-9853586** *No. Telefon Bimbit:*
B(v)	**E-mail Address: yayanifm94@gmail.com** *Alamat e-mel:*

C	PROJECT INFORMATION / MAKLUMAT PROJEK
C(i)	Project Area (Please tick): Bidang Projek (Sila tanda (√)): A. ☐ Intelligent Information Systems Sistem Informasi Pintar ☒ B. Software Technology Teknologi Perisian ☐ C. Database Technology Teknologi Pangkalan Data ☐ **D.** Computer System Technology Teknologi SistemKomputer ☐ **E.** Computer and Network Security Komputer dan Keselamatan Rangkaian ☐ F. Networking and Distributed Computing Rangkaian dan Pengkomputeran Teragih ☐ G. Immersive Technology Teknologi Imersif
C(ii)	Duration of this project (Maximum 12 months): Tempoh masa projek ini (Maksimum 12 bulan): Duration: 6 months Tempoh : From : 22-Feb-2016 Dari : To : 10-June-2016 Hingga :
C(v)	Executive Summary of Project Proposal (maximum 300 words) (Please include the background of project, literature reviews, objectives, project methodology and expected outcomes from the project) Ringkasan Cadangan Eksekutif Projek (maksima 300 patah perkataan) (Meliputi latar belakang projek, kajian literatur,kaedah projek,objektif dan jangkaan hasil projek)

	Kinect device that being used today was originally built by an Israeli company named Prime Sense. From artificial intelligence, Microsoft found that kinect can help computer to interpret human body language include the mood. For video games, it helps reaching out and grabbing something instead of using game controller. It also being defines as sign language translator. Autism is known as the second most common neurodevelopmental disorder among children. However, only a few of us aware about this complex disorder. In Malaysia, it was estimated that one out of 600 children was born with autism. Recent statistic shows that 47,000 of the people in this country are autistic and it is estimated that 4 out of 10,000 suffer from severe autism. Until today, the cause of autism remains unknown. That is why the symbol used for autism is puzzle, the cause is mystery. There were a few school in Malaysia that teach autistic student. Example is Sekolah Pendidikan Khas Bukit Katil Melaka. From my experience visiting that school, the autistic student were teach in the different class from other normal student. However , each autistic student actually has a different level of difficulties. So, the problem now is that the student there were teach equally among the autistic student.They only differentiate them when they show their progress. So, this project was developing to identify the function of kinect as a diagnosis tools to detect levels of autism. . The children that have autism are like normal children, but they may have difficulties communicating, coping with stimulation from their surroundings and behaving in accordance with socially-accepted norms. Since the kinect seen to be a simple way and approachable for everyone, this project will develop a game which using kinect that enable to detect their autism level.
C(vi)	Detailed proposal of project: Cadangan maklumat projek secara terperinci: (a) Project background including Introduction / Problem Statements and Literature Reviews. Keterangan latar belakang projek termasuk pengenalan / penyataan masalah dan kajian literatur. 1. Introduction This game was developed for a teacher that teach autistic student. This game is available online and teacher can register their student on the website. After the student play the games, their result will show which stage they are and the way to teach them will be provided according to their potential. 2. Problem Statements There were a few school in Malaysia that teach autistic student. Example is Sekolah Pendidikan Khas Bukit Katil Melaka. From my experience visiting the school, the autistic student were teach in the different class from other normal student. However , each autistic student actually has a different level of difficulties. So, the problem now is that the student there were teach equally among the autistic student.They only differentiate them when they show their progress.Can we use the kinect as a diagnosis tool to detect autism level? 3. Literature Review Kinect device that being used today was originally built by an Israeli company named Prime Sense. From artificial intelligence, Microsoft found that kinect can help computer to interpret human body language include the mood. For video games, it helps reaching out and grabbing something instead of using game controller. It also being defines as sign language translator. So, this project was developing to identify the function of kinect as a diagnosis tools to detect levels of autism. . The children that have autism are like normal children, but they may have difficulties communicating, coping with stimulation from their surroundings and behaving in accordance with socially-accepted norms. Since the kinect seen to be a simple way and approachable for everyone, this project will develop a game which using kinect that enable to detect their autism level.

(b) Objective (s) of the Project
Objektif Projek

This project embarks on the following objectives:

4. To identify the use of Kinect as a diagnosis tools for autism level detection.
5. To develop a diagnose system using Kinect .
6. To test the effectiveness of Kinect.

(c)Project Methodology
Kaedah projek

Please state in the form / Sila nyatakan di borang ini

1. Description of Methodology

I have browsed on the internet about the autism and the statistic. I also have experience visiting a school which have autistic student (Sekolah Pendidikan Khas Bukit Katil) and from that i come out with a problem statement. Other than that, i will review some research from the past about autism to learn more about autistic student. To develop the games, i also refer to a few of Adobe Flash Book. About kinect, i also do some research using the internet

2. Flow Chart of Project Activities (Please enclose in the Appendix)

3. Gantt Chart of Project Activities (Please enclose in the Appendix)

4. Milestones and Dates

2,3 & 4 in the Appendix

(d) Expected Results/Benefit
Jangkaan Hasil Projek

1. Novel theories/New findings/Knowledge

-Theories to detect autism level and knowledge how to make the learning process easier for them

2. Project Publications

-An online games

3. Specific or Potential Applications (if any)

<table>
<tr><td>D</td><td>REFERENCES</td></tr>
<tr><td></td><td>State your references

www.moe.gov.my
http://www.disabilitymalaysia.com/
http://www.autismmalaysia.com/
http://www.themalaysiantimes.com.my/
Sekolah Pendidikan Khas Bukit Katil ,Melaka
Adobe Flash Professional CS6 (Classroom in a book)
Adobe Flash Professional CS5 (Classroom in a book)
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<tr><td>E</td><td>ACCESS TO EQUIPMENT AND MATERIAL (PLEASE LIST IN DETAIL) / KEMUDAHAN SEDIA ADA UNTUK KEGUNAAN BAGI PROJEK INI (SILA SENARAIKAN DENGAN TERPERINCI)</td></tr>
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Universiti</td><td>Other Sources or Places
Lain-lain tempat/sumber</td></tr>
<tr><td>Example / Contoh:

Equipments: Computer lab</td><td>Research about autism student (Sekolah Pendidikan Khas Bukit Katil)</td></tr>
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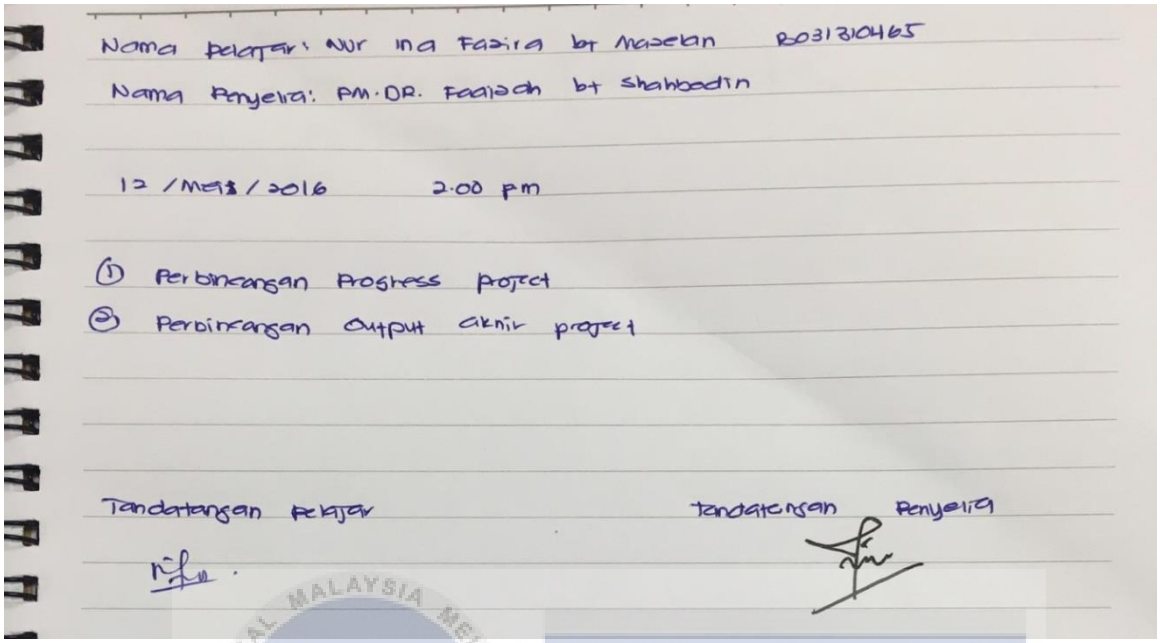
F (ii)	Recommended by the Supervisor *Perakuan oleh Penyelia*	Recommendation by the Evaluator *Perakuan oleh Penilai*
	Please tick (√) *Silatandakan (√)* **Recommended:** *Diperakukan:* ☐ **A. Highly Recommended** *Sangat Disokong* ☑ **B. Recommended** *Disokong* ☐ **C. Not Recommended (Please specify reason)** *Tidak Disokong (Sila Nyatakan Sebab)* **General Comments:** *Ulasan umum:* for search purposes.	**Please tick (√)** *Silatandakan (√)* **Recommended:** *Diperakukan:* ☐ **A. Highly Recommended** *Sangat Disokong* ☐ **B. Recommended** *Disokong* ☐ **C. Not Recommended (Please specify reason)** *Tidak Disokong (Sila Nyatakan Sebab)* **General Comments:** *Ulasan umum:*
	Supervisor's Name: PM.DR.FAAIZAH BT SHAHBODIN *Nama Penyelia:* **Signature:** *Tandatangan:* **Date:** 25-12-2015 *Tarikh:*	**Evaluator's Name:** *Nama Penilai:* **Signature:** *Tandatangan:* **Date:** *Tarikh:*

PROF. MADYA DR. FAAIZAH BINTI SHAHBODIN
Timbalan Dekan (Akademik)
Fakulti Teknologi Maklumat dan Komunikasi
Universiti Teknikal Malaysia Melaka

PSM & PD COMMITTEE Comments

Log Book



Nama Pelajar: Nur Ina Fazira bt Maselan B031310465

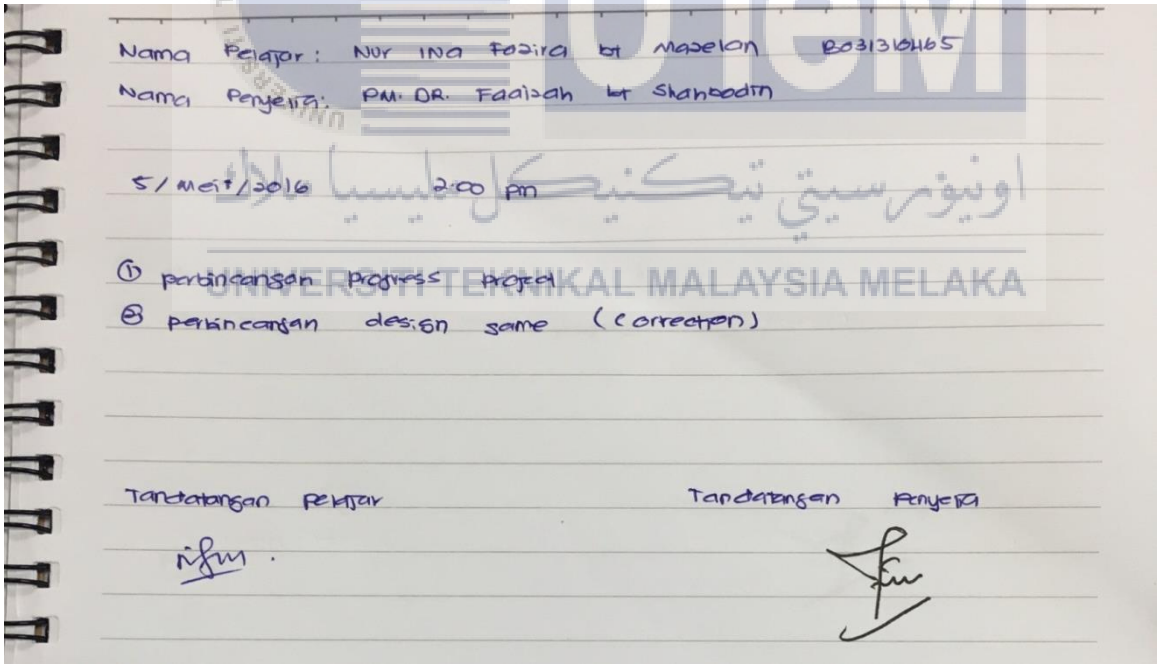
Nama Penyelia: PM. DR. Faaizah bt Shahbodin

12/Mei/2016 2.00 pm

1. Perbincangan Progress Project
2. Perbincangan Output Akhir project

Tandatangan Pelajar

Tandatangan Penyelia



Nama Pelajar: Nur Ina Fazira bt Maselan B031310465

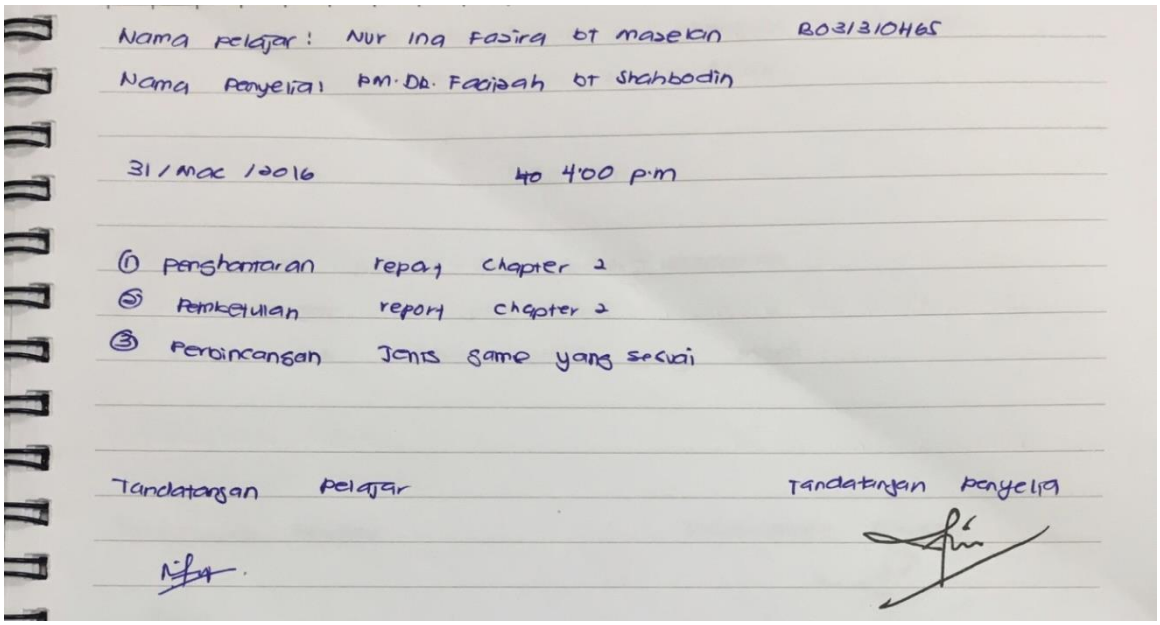
Nama Penyelia: PM. DR. Faaizah bt Shahbodin

5/Mei/2016 2.00 pm

1. perbincangan Progress Project
2. perbincangan design game (correction)

Tandatangan Pelajar

Tandatangan Penyelia



Nama pelajar : Nur ina Fazira bt masekan B031310465

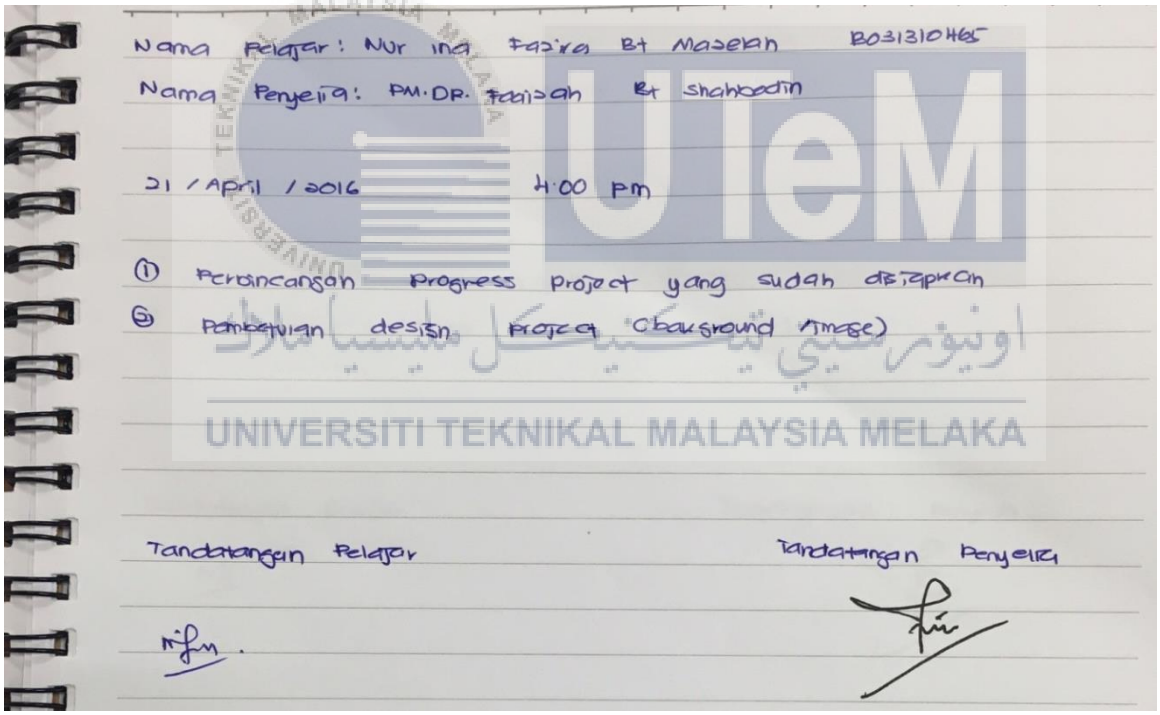
Nama penyelia : PM. Dr. Fadzlah bt Shahbodin

31 / Mac / 2016 4o 4:00 p.m

① penghantaran repay chapter 2
② Pemkelulan report chapter 2
③ Perancangan jenis game yang sesuai

Tandatangan pelajar

Tandatangan penyelia



Nama pelajar : Nur ina Fazira Bt Masekan B031310465

Nama penyelia : PM. Dr. Fadzlah Bt Shahbodin

21 / April / 2016 4:00 pm

① Perancangan progress project yang sudah dijalankan
② Pembetulan desisn project (background image)

Tandatangan pelajar

Tandatangan penyelia

Nama Pelajar: Nur Ina Fazira bt Maselan B031310465

Nama Penyelia: PM. DR. Faqihah bt Shahbodin

7/ April /2016 4.00 pm

① Progress project yang sudah disiapkan
② Perbincangan tools yang sesuai
③ Perbincangan & design game yang sesuai

Tandatangan Pelajar Tandatangan Penyelia

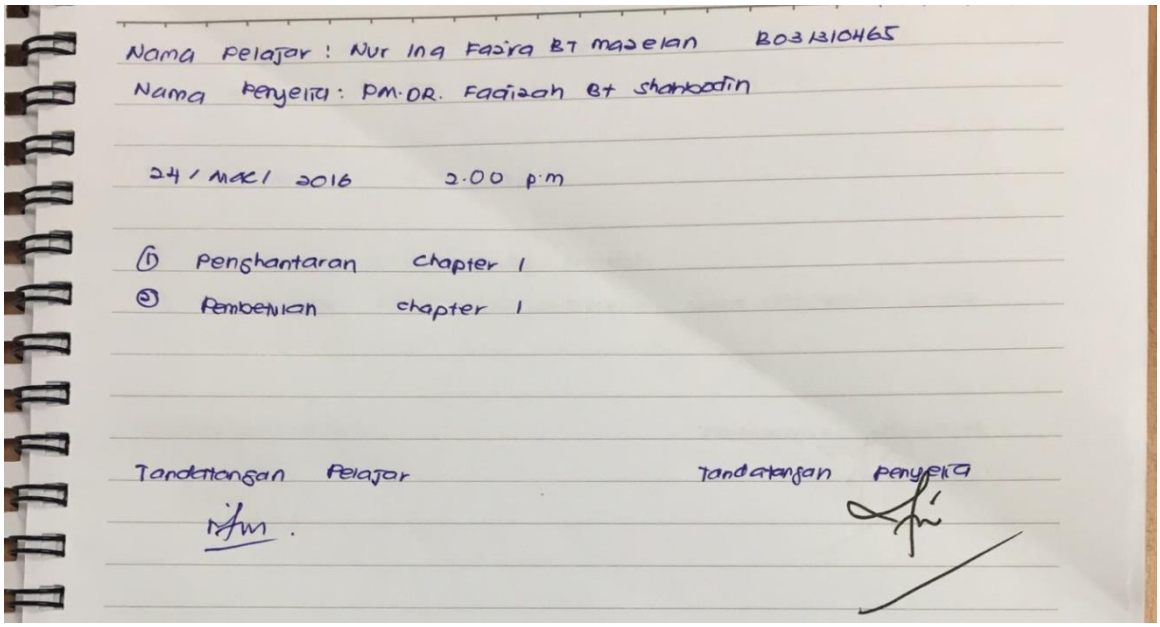
Nama Pelajar: Nur Ina Fazira bt Maselan B031310465

Nama Penyelia: PM. DR. Faqihah bt Shahbodin

28/ Mac /2016 3.00 pm

① Perbincangan development project
② Perbincangan tools yang disarankan untuk menyiapkan projek

Tandatangan Pelajar Tandatangan Penyelia



Nama Pelajar : Nur Ing Fasira Bt Maselan B031310465

Nama Penyelia : PM. DR. Faqizah Bt Shahbodin

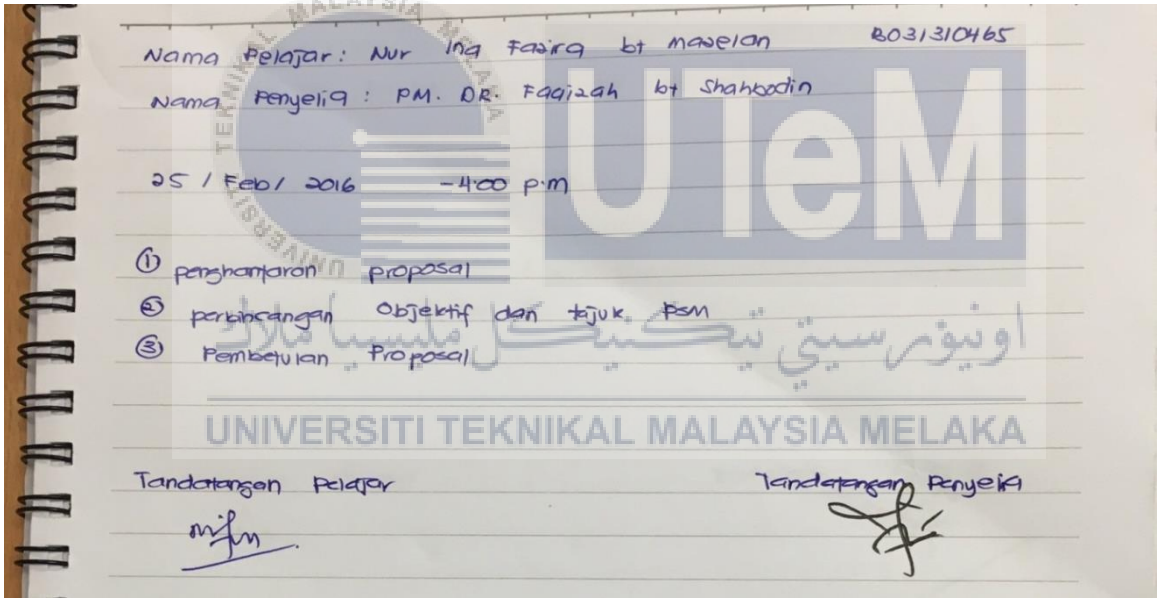
24 / Mac / 2016 2.00 p.m

① Penghantaran chapter 1

② Pembetulan chapter 1

Tandatangan Pelajar

Tandatangan penyelia



Nama Pelajar: Nur Ing Fasira bt Maselan B031310465

Nama Penyelia : PM. DR. Faqizah bt Shahbodin

25 / Feb / 2016 -4:00 p.m

① penghantaran proposal

② perkembangan objektif dan tajuk psm

③ Pembetulan Proposal

Tandatangan Pelajar

Tandatangan Penyelia

Testing Environment Picture

Test using Kinect

Test using Mouse

Questionnaire

THE USE OF KINECT AS A DIAGNOSIS TOOLS FOR AUTISM LEVEL DETECTION

This question was conducted to investigate on the use of Kinect as a diagnosis tools to detect autism level. In this survey, two different groups of autism kids were tested to play the same game using different method. One group using Kinect and the other group using mouse

A. BASIC INFORMATION

Instructions: Please circle your answer and fill in the blank with your information in the space provide

Gender : Male / Female

Experience : Below 1 Year / 2-5 Year / 5-10 Year / 11 Year & Above

B. USABILITY OF KINECT AS DIAGNOSIS TOOLS FOR AUTISM LEVEL DETECTION

Instructions: Please circle the following scale to reflect your opinion about the effectiveness of use of kinect as diagnosis tools.

1= Strongly Disagree 2= Disagree 3= Neutral 4=Agreed 5=Strongly Agree

The use of Kinect

Features	**Scale**				
Kinect is a user friendly hardware	1	2	3	4	5
Kinect is easy to set up	1	2	3	4	5
Teacher will easily know how to use Kinect	1	2	3	4	5
Kinect can be used easily by autism kids	1	2	3	4	5
Teacher can easily guide student on how to use Kinect	1	2	3	4	5

The use of D-Games to detect autism level

Features	**Scale**				
This games are easy to play	1	2	3	4	5
This games are effective to use	1	2	3	4	5
The screen display are interesting, attractive and appropriate for autism kids	1	2	3	4	5
This games can be a good tools for autism level detection	1	2	3	4	5
This games helps student improve their visual skill	1	2	3	4	5

Test game using mouse

Features	**Scale**				
This game were easier to play using mouse	1	2	3	4	5
Autism kids students like to play using mouse	1	2	3	4	5
Most of the autism kids student can complete of 5 modules of this game	1	2	3	4	5
The autism kids student do not know how to play using mouse	1	2	3	4	5

Test game using Kinect

Features	**Scale**				
This game were easier to play using gesture	1	2	3	4	5
Autism kids students like to play using Kinect	1	2	3	4	5
Most of the autism kids student can complete of 5 modules of this game	1	2	3	4	5
The autism kids student do not know how to play	1	2	3	4	5

Responds shows by the autism student

Features	**Scale**				
They like to play the games	1	2	3	4	5
The result are effective	1	2	3	4	5
Most of the student can complete of 5 modules of this game	1	2	3	4	5
They having difficulties to play this game using gesture	1	2	3	4	5

C. OVERALL PERCEPTION OF THIS SYSTEM

Not dependable ==1 Moderate ==2 Good ==3 Very good ==4

Overall scale (using mouse): _____

Overall scale (using Kinect): _____

Which one do you prefer?: Mouse / Kinect

Opinion for improvement (if necessary) :

o

Student Report Guide

Report for Diagnostic test of Visual Observation

Name of Student:

Mykid/IC No:

Gender:

Teacher's Name/ Experts:

Bil	Skills	Games names	Types of observational	Marks	Level
1	Same discrimination	Ball	Visual discrimination	-	
2	Odd discrimination	Capsule	Spatial relationship	-	
3	Size discrimination	Cube	Form constancy	-	
4	Remember back	Puzzle memory	Visual memory	/Guest Count	
5	Complete the picture	Jigsaw picture puzzle	Visual closure	/Complete picture	

Autism Class Level

Level	Rank
5/4 Excellent	1
3 Excellent	2
<2 Excellent	3

Scoring guide:

Capsule	Level
Got the capsule on the 1st try	Excellent
Got the capsule on the 2nd try	Excellent
Got the capsule on the 3rd try	Good
Got the capsule on the 4th try	Good
Got the capsule on the 5th try	Bad
Got the capsule on the 6th try	Bad
Got the capsule on the 7th try	Bad

Ball	Level
Got 3 ball at 1st try	Excellent
Got 2 ball at 1st try	good
Got 1 ball at 1st try	Bad

Big Cube	Level
Got 3 big cube at 1st try	Excellent
Got 2 big cube at 1st try	good
Got 1 big cube at 1st try	Bad

Memory Puzzle	Mark
100-65	Excellent
64-40	Good
<39	Bad

Jigsaw picture puzzle Complete picture	Mark
3 picture	Excellent
2 picture	Good
1 picture	Bad

Proposed recovery activities

Visual Discrimination

- Finding pictures, shapes ,letters and symbol that are not the same
- Searching for differences and similarities of objects. i.e., chairs, tables, blackboard, etc.
- Objects that are similar which are available from pictures of animals, flowers, leaves, etc.
- Matching letters with the words
- Tracing pattern ,shapes and letters

Spatial relationship

- Encourage the child to produce thinking against an object and instruct them to criticize the object.
- Give some guided questions.
- Teach the child contrastive concept for example small and large, high and low, or about what they sees.
- Use pictures that are related with others like a dog with bone, cats with mice and book with pencil. Ask student to narrate these.
- Train students on group concepts by providing pictures of food, animals, flowers, plants and others.

Form constancy

- Requires finding the illustration that matches the shape of the stimulus but is smaller, bigger or darker than stimulus
- Set up objects with different size and ask student to put it in order, ex:(large to small)

Visual Memory

- Set up objects on a table and ask students observe them. Close the objects and ask the students to mention things that they have seen.
- Show a pattern or picture to students. Cover it and ask the student to draw it.
- Show a picture to students and then cover it. Discuss the picture with the students.
- Take a rope and put some photographs in a particular order. Take the picture down and ask students to put it back in the original order.
- Develop children's memory by discussing the things that they have seen. Then, ask them to tell you what they remember; i.e., the places they have visited, people they have seen, color of clothing, and others.

Visual closure

- Match or combine pictures (jigsaw puzzle)
- Conduct a quiz: i.e., - teacher provides words such as red, blue, yellow, and green. Then ask students to provide a one word answer that can summarize the meaning of all the words. The students' answer must be highlighted with the corresponding colour.

R

Gantt Chart PSM 1

Task	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14	W 15	W 16
Submission proposal and verification																
Proposal correction and confirmation supervisor & title																
Chapter 1 (System Developments begin)																
Chapter 1 &Chapter 2																
Chapter 2																
Chapter 2& Chapter 3 Progress presentation 1																
Project Demo & Chapter 3 Chapter 4																
Mid Semester Break																
Project Demo &Chapter 4																
Project Demo &Chapter 4																
Project Demo																
Project Demo & PSM Report																
Project Demo & PSM Report/ Presentation																
Project Demo & PSM Report																
Final Presentation																
Submission																

Gantt Chart PSM 2

Task	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14	W 15	W 16
Chapter 4 -Design																
Chapter 4 –Design (Progress Evaluation)																
Chapter 5 - Implementation																
Chapter 6- Testing (Progress Evaluation)																
Mid-Sem Break																
Chapter 6- Testing																
Chapter 7- Conclusion																
-Complete Final Report (draft) - Progress Evaluation																
Presentation Schedule																
PSM 2 presentation and evaluation																
-Submit PSM complete report for supervisor's signature and binding																

Questionnaire from SMK Bukit Katil

PROGRAM PENDIDIKAN KHAS INTEGRASI (PEMBELAJARAN)

SMK BUKIT KATIL

UJIAN DIAGNOSTIK

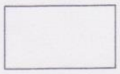
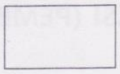
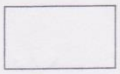
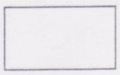
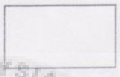
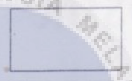
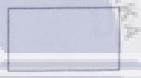
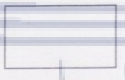
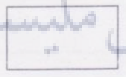
BAHASA MELAYU

NAMA : _____

TARIKH : _____

U

Kemahiran 1 dan 2 :
Mengenal Abjad (huruf kecil dan besar).
Arahan :
Soalan 1 hingga 10
Murid menulis huruf abjad selepas setiap diimbas (3 saat).

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 

Kemahiran 3 :

Mengenal Huruf Vokal.

Arahan :

A. Murid mendengar bunyi vocal yang disebut.

B. Murid menulis vokal yang didengar.

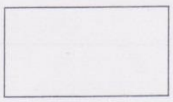
Bil.	Vokal
11.	
12.	
13.	
14.	
15.	

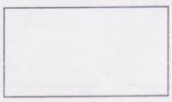
Kemahiran 4, 8, 16 :

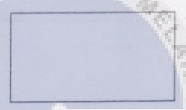
Suku Kata KV, KVK, KVKK, KKVK.

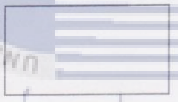
Arahan :

Murid menulis suku kata berdasarkan suku kata berdasarkan suku kata yang didengar.

16. 

17. 

18. 

19. 

Kemahiran 5, 6, 11, 15, 17, 18, 19, 20, 22, :

KV + KV, V + KV, V + KVK, KV + KVK, KVK + KV + KVK, KVKK, V + KVKK, KV +KVKK, KVK + KVKK, KVKK + KVKK.

Arahan :

Tuliskan perkataan yang disebut oleh guru.

Bil	Jawapan Murid
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	

Kemahiran 8, 11,, 12, 25, 30 :

KVK + KV, KV + KVK + KVKK, KV + KVK, VKK + KV, KVK.

Arahan :

Tulis Perkataan berdasarkan gambar yang betul.

belimbing gajah lembu angsa jam

30. 

31. 

32. 

33. 

34. 

Kemahiran 7, 8, 11, 22, 24,

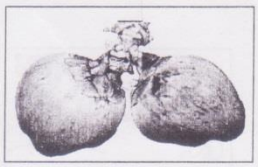
KV + KVK, KV + KV + KV + KV + KV + KVKK, KVKK + KVK, V + KVK.

Arahan :

Tulis perkataan yang betul pada tempat kosong yang disediakan.

35. 

_____

36. 

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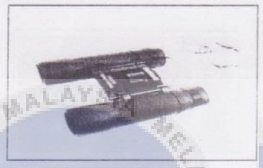
37. 

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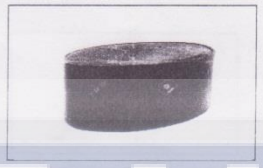
38. 

_____

39. 

_____

Kemahiran 29 :

Diftong, (Konsonan Berganding).

Arahan :

Tulis suku kata yang betul pada tempat kosong yang diberi.

40. 

hari ☐

41. 

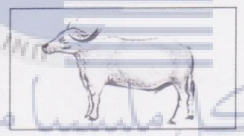
bu ☐

42. 

si ☐

43. 

tu ☐

44. 

ker ☐

Kemahiran 13, 14, 31 :

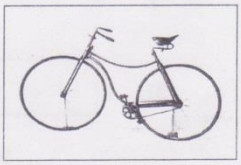
KVK + KVK, KV + KV + KVK, Ayat Mudah.

Arahan :

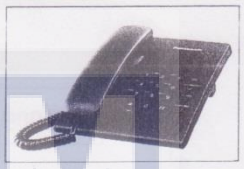
Padankan ayat berdasarkan gambar yang betul.

45. Masjid itu cantik.

46. Posmen hantar surat.



47. Doktor sedang merawat pesakit.



48. Abang beli basikal baru.

49. Telefon ini rosak.

Kemahiran 31 :

Ayat Mudah.

Arahan :

Susun perkataan menjadi ayat yang betul.

50. | baju | Bapa | beli | . | itu |

_____

51. | . | baca | suka | Ali | buku |

_____

52. | datang | Pihak | polis | . | ke | situ |

_____

53. | ada | Ravi | guli | . | baru |

_____

54. | . | guru | meja | ini | Saya |

_____

Kemahiran 26, 27, 28, 31.

KVK + KV + KVKK, KVKK +KV + KVK, KV + KVKK + KVK, Membaca Dan Membina Ayat Mudah.

Arahan :

Tulis ayat dengan menggunakan perkataan yang diberi.

55. beg

_____

56. cawan

_____

57. tangga

_____

58. tempurung

_____

59. tengkorak

_____

60. merangkak

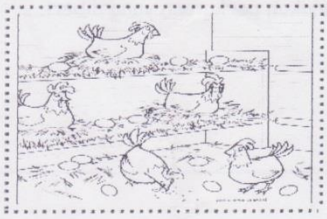
_____

Kemahiran 32 :

Bacaan Dan Pemahaman.

Arahan :

Baca petikan yang diberi dan jawab soalan-soalan yang berikutnya.



Ini ayam.
Ini ayam betina.
Ayam betina boleh bertelur.
Ayam betina berketuk.
Ayam suka makan jagung.
Saya suka makan daging ayam dan telur ayam.

Jawab soalan-soalan berikut.

61. Ini gambar apa?

_____

62. Bolehkan ayam betina bertelur?

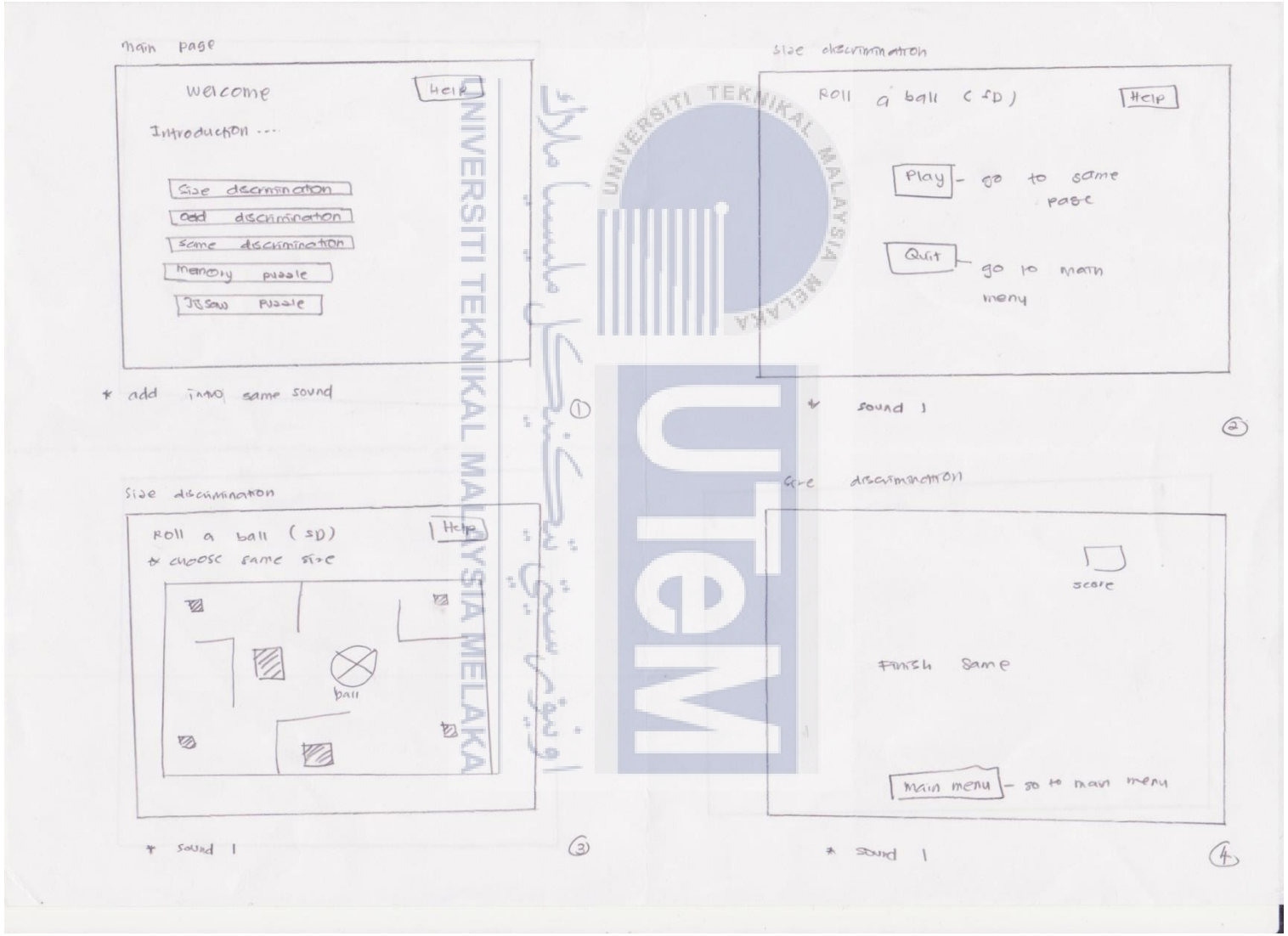
_____

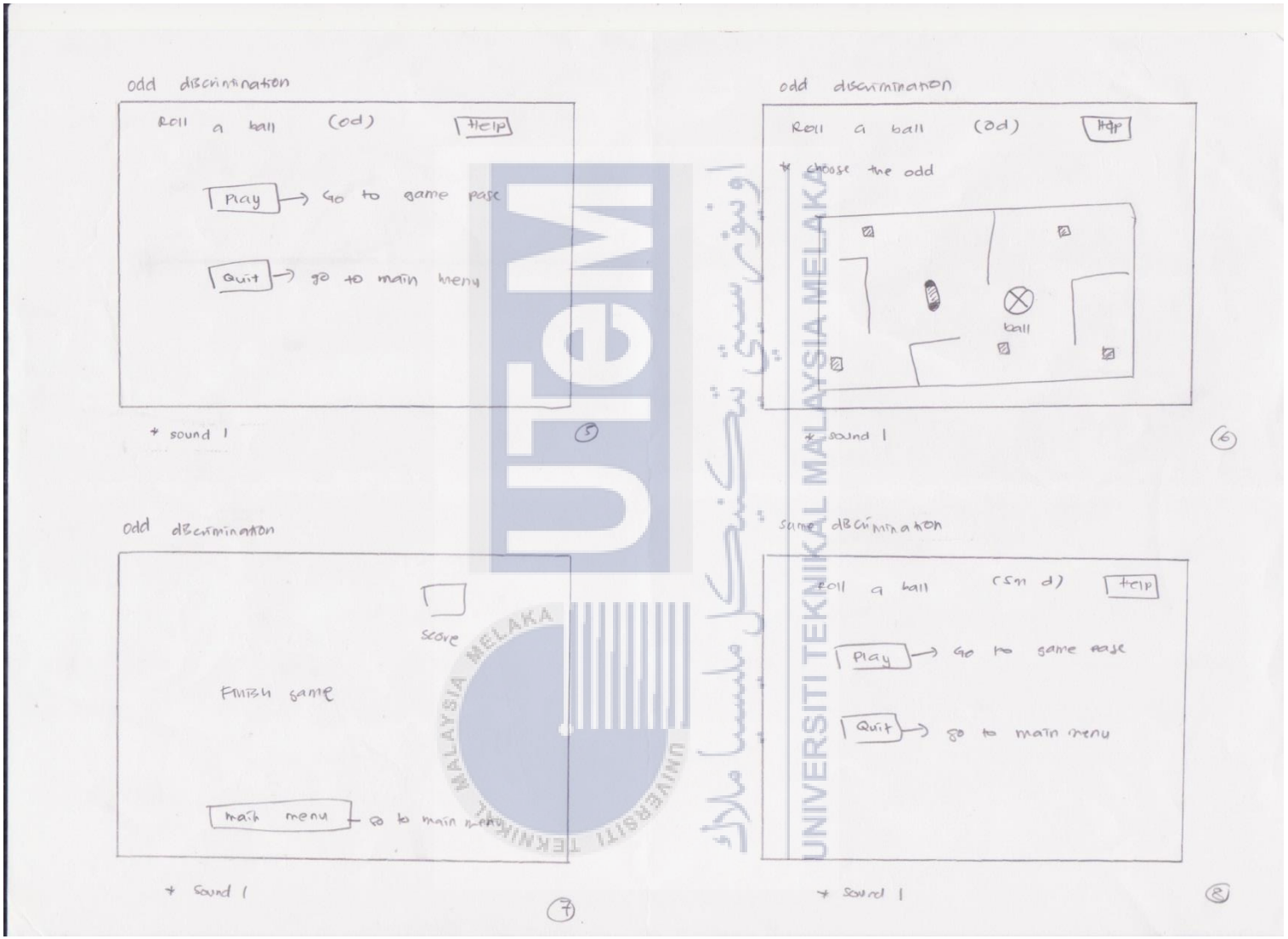
63. Ayam ada berapa kaki?

_____

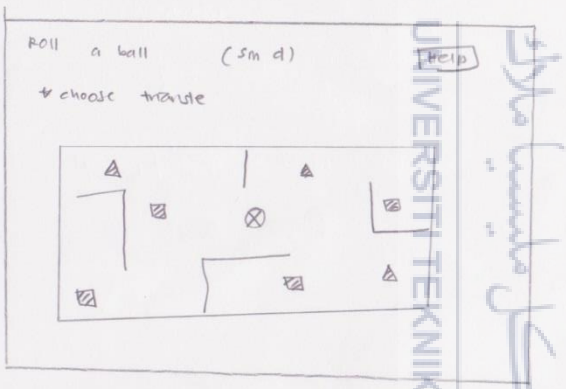
64. Bolehkah ayam betina berketuk?

_____



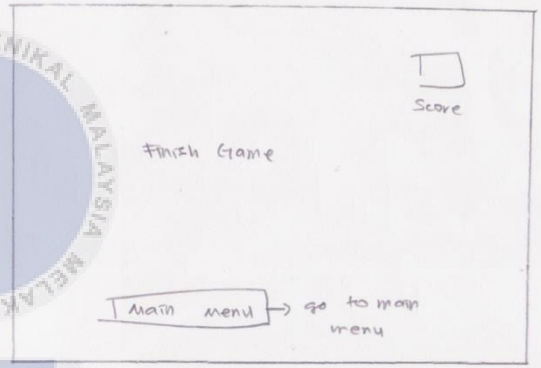


Same discrimination



* sound 1

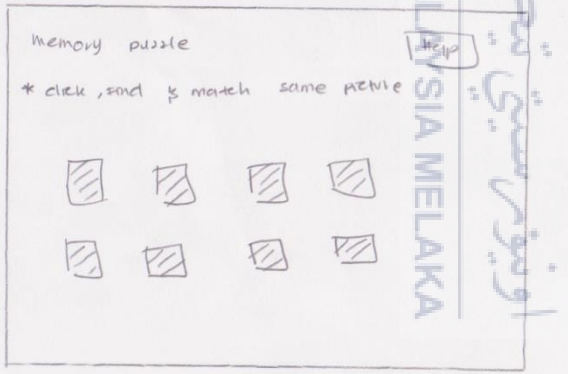
9



* sound 1

10

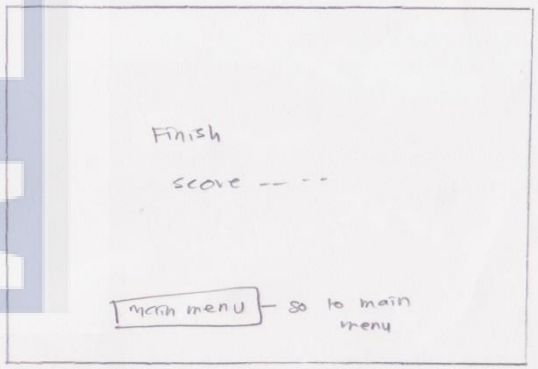
memory puzzle



* sound 2

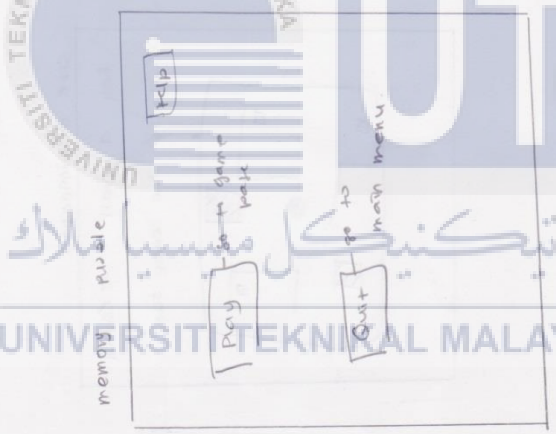
17

memory puzzle



* sound 2

18



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