CHAPTER 1: INTRODUCTION

1.1 Background

Attention-deficit/hyperactivity disorder (ADHD) is a developmental, neurobiological condition defined by the presence of severe and pervasive symptoms of inattention, hyperactivity and impulsivity [1]. Screening for hyperactivity and inattention (the major symptoms of ADHD) in a community survey amongst Malaysian children and adolescents between the ages of 5 – 15 years showed a prevalence rate of 3.9 %. ADHD is three times more likely to occur in males. It is more common in males compared to females [3].

Children with a diagnosis of attention-deficit/hyperactivity disorder (ADHD) usually present with a wide range of characteristics and problems including academic underachievement and learning disabilities. In fact, it has been estimated that approximately 80% of children with ADHD experience academic underachievement and approximately one-third of children with ADHD have specific learning disabilities [8] [6].

ADHD can't be cured. One method having been used to help ADHD relieved is stimulant medications making use of Ritalin, Dexedrine, Cylert. The other is behaviour therapy based on several simple and sensible notions about what leads children to behave in socially appropriate ways. But both two methods have some following disadvantages; side-effects (Ritalin can cause a cancer of liver [17]), needs of much time and efforts from many persons concerned. To overcome these disadvantages, we developed the learning system using Augmented Reality (AR) technology.

1.2 Problem Statement

Inattention, hyperactivity, and impulsivity are the core symptoms of Attention Deficit Hyperactivity Disorder (ADHD). A child's academic success is often dependent on his or her ability to attend to tasks and teacher and classroom expectations with minimal distraction. Such skill enables a student to acquire necessary information, complete assignments, and participate in classroom activities and discussions. When a child exhibits behaviours associated with ADHD, consequences may include difficulties with academics and with forming relationships with his or her peers if appropriate instructional methodologies and interventions are not implemented. Although many children have only ADHD, others have additional academic or behavioural diagnoses. For instance, it has been documented that approximately a quarter to one-third of all children with ADHD also has learning disabilities [11]. In conclusion, ADHD children have difficulties in learning because:

- Tend to forget what they've learnt
- Easily distracted
- Current Teaching tools such as exercise book and homework is not effective enough for them.
  - AR has many advantages over traditional manual-based and VR models in training and learning applications because users can see and touch the real objects, and at the same time have an interactive guided support to allow the users to work at their own pace. This support includes highlighting and sequencing specific objects in the users' field of view, depending on the task and the users' experience, or presentation of documentation. Furthermore, it would be possible for a remote expert to provide assistance by controlling the information displayed by the system [10].

1.3 Objective

The objectives of this project are:

- Develop Augmented Reality learning software to assist ADHD children in pre-school.
- Provide interactive and effective study environment for ADHD children to learn English using AR approach.

1.4 Scope of Study

There are three main elements in the scope of this project:

- **Pre-School Children with ADHD**

  The pre-school years are a key period of a child's development, where the building blocks for later success are laid, and where social, behavioural and academic skills necessary for academic development are acquired [5]. Cases of ADHD tend to be concentrated in school-age children; however, research now shows that ADHD also exists in preschool children [12][4], adolescence[8][14] and in adulthood [15][12].

- **Augmented Reality (AR)**

  AR naturally draws people's attention. Drawing students' attention is an important factor in instruction. [11]

1.5 Relevancy of Project

The project is relevant to help ADHD children learning since the current teaching tools is not effective enough for them. AR provide new learning environment for them and build up their motivation to study. Hence, increase their academic performance.

1.6 Feasibility within Timeframe

The project development will take two semesters of study which is enough for the author to complete the development of the project. The first semester involving the planning, analysis and design phases and the expected output in this semester will help in the implementation phase next semester.

CHAPTER 2: LITERATURE REVIEW

2.1 Attention Deficit Hyperactivity Disorder (ADHD)

ADHD is a disorder in which a person has a difficulty to learn effectively, caused by the disorder that affects the brain's ability to receive and process information [7].

ADHD has three subtypes [1] [3]:

• Predominantly hyperactive-impulsive (ADHD-H)

– Most symptoms (six or more) are in the hyperactivity-impulsivity categories.

– Fewer than six symptoms of inattention are present, although inattention may still be present to some degree.

• Predominantly inattentive (ADHD-I)

– The majority of symptoms (six or more) are in the inattention category and fewer than six symptoms of hyperactivity-impulsivity are present, although hyperactivity-impulsivity may still be present to some degree.

– Children with this subtype are less likely to act out or have difficulties getting along with other children. They may sit quietly, but they are not paying attention to what they are doing. Therefore, the child may be overlooked, and parents and teachers may not notice that he or she has ADHD

• Combined hyperactive-impulsive and inattentive (ADHD-C)

– Six or more symptoms of inattention and six or more symptoms of hyperactivity-impulsivity are present.

– Most children have the combined type of ADHD.

2.2 Symptoms of Attention Deficit Hyperactivity Disorder (ADHD)

The symptoms of ADD/ADHD usually exhibited before the age of seven [12]. There are three major symptoms of Attention Deficit Hyperactivity Disorder (ADHD), which are inattention, hyperactivity, and impulsivity [1]. ADHD can be defined by behaviours exhibited by the individuals.

Children who have symptoms of **inattention** may [12] [3][4]:

• Be easily distracted, miss details, forget things, and frequently switch from one activity to another

• Have difficulty focusing on one thing

• Become bored with a task after only a few minutes, unless they are doing something enjoyable

• Have difficulty focusing attention on organizing and completing a task or learning something new

• Have trouble completing or turning in homework assignments, often losing things (e.g., pencils, toys, assignments) needed to complete tasks or activities

• Not seem to listen when spoken to

• Daydream, become easily confused, and move slowly

• Have difficulty processing information as quickly and accurately as others• Struggle to follow instructions.

Children who have symptoms of **hyperactivity** may [12] [3][4]:

• Fidget and squirm in their seats

• Talk nonstop

• Dash around, touching or playing with anything and everything in sight

• Have trouble sitting still during dinner, school, and story time

• Be constantly in motion

• Have difficulty doing quiet tasks or activities

Children who have symptoms of **impulsivity** may [12] [3][4]:

• Be very impatient

• Blurt out inappropriate comments, show their emotions without restraint, and act without regard for consequences

• Have difficulty waiting for things they want or waiting their turns in games

• Often interrupt conversations or others' activities.

2.3 Pre School

In Malaysia, Ministry of Education has set certain requirements for Malaysian children to enter preschool. The requirements are:

I. For Malaysian only.

II. A child who reaches the age of five years on the first day of January in the year during his schooling. (1 Jan 2010)

III. According to per capita income on the income poverty line (Garis Kemiskinan).

IV. Merit based on income ranking parent / guardian from low to high. Rate for each class the student is not more than 25 people.

V. Preschool student selection process shall be made by the preschool committee.

2.4 Curriculum Standard for Special Kids

Under MOE there are two categories of special education programmes,

i) Special Schools for students with visual, auditory and learning disabilities (secondary level),

ii) Special Education Integration Programme for students with visual, auditory and learning disabilities –employs both isolated and partially inclusive teaching and learning approaches (primary, secondary and vocational levels).

In the secondary level the students are able to either follow the national curriculum or opt for vocational courses. The Special Schools are administered by the Ministry's Special Education Division. The Special Education Integration Programmes at primary and secondary schools levels are administered by the State Education Department. For the Special Education Integration Programme in technical and vocational schools are administered by the Ministry's Special Education Division, responsible for matters pertaining to policy and content. Education for special needs children is also provided through community centres. These centres focus on providing education to students with more severe disabilities. The students are trained with living and basic vocational skills so that they could live independently and secure employment. These community centres are run by social welfare department. Many efforts are taken by the government to enhance the education quality for the special education students including allocation of generous amount of money to enhance the usage of ICT.

Malaysia government through Ministry of Education has drafted a special curriculum standard for special kids in level 1(year 1-3). The modules were categorized in 3 sections according to disabilities. The modules were divided into:

    I.   Learning problem

   II.   Hearing problem

  III.   Vision problem

In level 1 (year 1-3), they will learn 5 subjects which are:

    I.   Asas 3M (Menulis, membaca, mengira) / 3M basic (writing, reading, calculating)

   II.   Pengurusan kehidupan / Life Management

  III.   Pendidikan Jasmani / Physical Education

  IV.   Pendidikan Islam/ Islamic Education

   V.   Pendidikan Moral/ Moral Education

  VI.   Pendidikan Seni Kreatif/ Creative Art Education.

Figure 12 and figure 13 showed the component of English module that will be taught to student. Since this project only focusing on English subject, only the English module showed.

TOPIC	CONTENT STANDARDS	LEARNING STANDARDS

9. Parts Of The Body	**Listening and Speaking**
	9.1 Recognise body parts
		9.1.1 Able to identify parts of the head
		    i. face
		9.1.2 Able to identify parts of the limbs
		    i. arms
		    ii. legs

	Reading
	9.2 Recognise and read words
		9.2.1 Able to read word parts of the head
		    i. face
		9.2.2 Able to read word parts o the limbs
		    i. arms
		    ii. legs

	Writing
	9.3 To form letters and words in neat legible print
		9.3.1 Able to trace word parts of the head
		    i. face
		9.3.2 Able to trace word parts of the limbs
		    i. arms
		    ii. legs

Figure 1: English Module Component

TOPIC	CONTENT STANDARDS	LEARNING STANDARDS
14. Animals	**Listening and Speaking** 14.1 Recognise animals	14.1.1 Able to identify various types of animals i. tame animals ii. wild animals
	Reading 14.2 Recognise and read words	14.2.1 Able to read words of various types of animals i. tame animals ii wild animals
	Writing 14.3 To form letters and words in neat legible print	14.3.1 Able to trace words of various types of animals i. tame animals ii. wild animals
15. Occupation	**Listening and Speaking** 15.1 Recognise different types of occupation	15.1.1 Able to identify occupation i. teacher

Figure 2: English Module Component

2.5 Augmented Reality

Augmented reality (AR) is related to the concept of virtual reality (VR). Both of the concepts enable a person to experience and explore interactively, predominantly through his or her sense of vision, but also via studio, tactile and other forms of feedback. The main point that differentiate between both of them is VR attempts to create an entirely artificial environment while AR aims to blend the virtual objects into the real world [13].

AR systems can either be marker-based or markerless- based. Marker-based applications are comprised of three basic components which include a booklet for offering marker information, a gripper for getting information from the booklet and converting it to another type of data, and a cube for augmenting information into 3D-rendered information on a screen. On the other hand, markerless-based applications need a tracking system that involves GPS (Global Positioning System), a compass, and an image recognition device instead of the three elements of maker-based systems. Markerless applications have wider applicability because they function anywhere without the need for special labelling or supplemental reference points [20].

2.6 Augmented Reality in Education

The implementation of augmented reality in education has grown rapidly and being implemented in various level of education from primary school to higher learning institute.

AR has strong potential to provide both powerful contextual, on-site learning experiences and serendipitous exploration and discovery of the connected nature of information in the real world [20].

The combination of AR technology with the education contents gives birth to a new type of automated applications and act to enhance the effectiveness and attractiveness of teaching and learning for students in a real life scene. The technology provides a simple way of progressing to the teaching, learning and training in education. It promotes 'active' training, both in the psychological and physical sense, and will encourage the users to have diverse thinking perspectives, which should prepare them better for their other day-to-day activities [10].

Advancement of technology has created a lot of learning software for children. One of them SMART (System of Augmented Reality for Teaching). SMART puts children exploring concepts like means of transportation, types of animals and similar semantic categories through the use of a set of racquets that are used to manipulate a TV-show style game with 3D models which are superimposed to the real time video feed of the whole class. Several experiments were performed with 54 students in three different schools in Portugal. The results of studies indicated that SMART helps increase motivation among students, and it has a positive impact on the learning experiences of these students, especially among the less academically successful students [22].

Figure 3: Example of AR in SMART

Another brilliant idea based on augmented reality in education is Letters alive™. Education's first classroom curriculum based on "augmented reality" technology attracted huge crowds at just-completed educational technology conferences in Florida and Texas. Pioneered by Logical Choice Technologies, Letters alive™ - a new phonics curriculum for children learning to read-has seemingly-alive animals popping up in the hands of students and even responding to student questions and actions. Teachers and administrators in attendance were taken aback by the mind-blowing interactivity and intelligence of the virtual animals. Educators recognized the profound impact the curriculum could have on learning not only with pre-k and kindergarten students, but also with English Second Language (ESL) and Special Needs students [9]. The "Letters alive" Augmented Reality teaching cards and software work in conjunction with four common classroom technologies:

- Teacher's laptop (PC or Mac)
- Compatible USB document camera
- Classroom audio system
- Digital projector and screen or an interactive whiteboard

Figure 4: *A kindergartener interacting with a virtual 3D giraffe from the new Letters alive™ reading curriculum.*

Source: http://www.logicalchoice.com

2.7 Proposed Solution

By implementing AR element in ADHD-Edu, ADHD children will experience an effective and interactive learning environment.

They will learn English subject in a new way which more interactive. For beginning the will learn about body parts.

Once they have chosen the module, what they need to do is they just have to stand in front of camera. The markers attached to their body will display the word, for example hand. The marker actually did not place in right position. The marker on their hand might be display the word head. So, they need to arrange and place the marker into correction position.

CHAPTER 3: METHODOLOGY

3.1 Choosing Software Development Methodology

The project will be using Throwaway Prototyping that is falls under the rapid application development (RAD) based methodology. Throwaway prototyping based methodology is similar to prototyping methodology with difference that it will be done at different phase of system development life cycle (SDLC).

Throwaway prototyping is basically intended to help users to visualize how the module looks after it being built. This type of methodology is also known as Dummy (mock-up) prototype as it will be a presentation before implementing the real finish module. The phases of this methodology are based on system development life cycles which consist of 4 phase which are planning, analysis, design and implementation. As for throwaway prototype, it will relies on few design prototypes during the analysis and design phases before continue with the implementation phase.
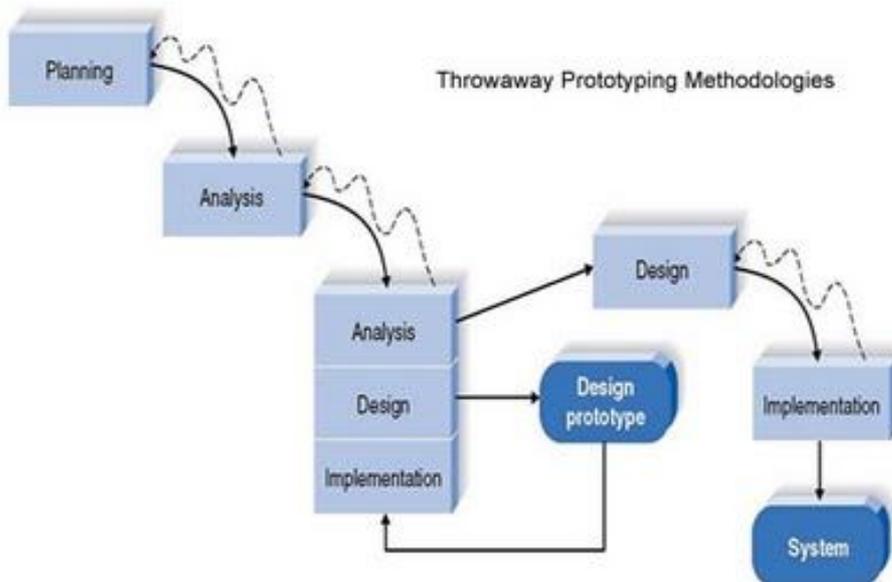

Figure 5: Throwaway Prototyping Methodologies

3.2 Research Methodology

There were few data gathering methodology is being implemented to get all information that is relate and relevant with the project title. The information is obtained from few sources such as:

- World Wide Web (www)/internet: Internet provides a lot of related information. The research result, information yielded from internet is most helpful tool to find idea for the project. Their research and journal are produce by the experts in their own field can be obtained through journal database such as:

  i. Springer

  ii. IEEE

  iii. ACM

  iv. Science Direct

  Google advance search is powerful tools to search information easier.

- UTP Information Resource Centre (UTP IRC)

  UTP IRC provides book and journal to be borrowed by students for reading and research purposes. There are several books that related with the project that can be found at UTP IRC.

3.3 Tools

<u>AR development</u>

- **ARToolKit**

ARToolKit is a software library for building Augmented Reality (AR) applications. That these are applications involve the overlay of virtual imagery on the real world. For example, in the image to the right a three-dimensional virtual character appears standing on a real card. It can be seen by the user in the head set display hire are Wearing. When the user moves the card, the virtual character moves with it and appears attached to the real object.

One of the key difficulties in developing Augmented Reality applications is the problem of tracking the users viewpoint. In order to know from what viewpoint to draw the virtual imagery, the application needs to know where the user is looking in the real world.

ARToolKit uses computer vision algorithms to solve this problem. The ARToolKit video tracking libraries calculate the real camera position and orientation relative to physical markers in real time. This enables the easy development of a wide range of Augmented Reality applications. Some of the features of ARToolKit include:

- Single camera position/orientation tracking.
- Tracking code that uses simple black squares.
- The ability to use any square marker patterns.
- Easy camera calibration code.
- Fast enough for real time AR applications.
- SGI IRIX, Linux, MacOS and Windows OS distributions.
- Distributed with complete source code.
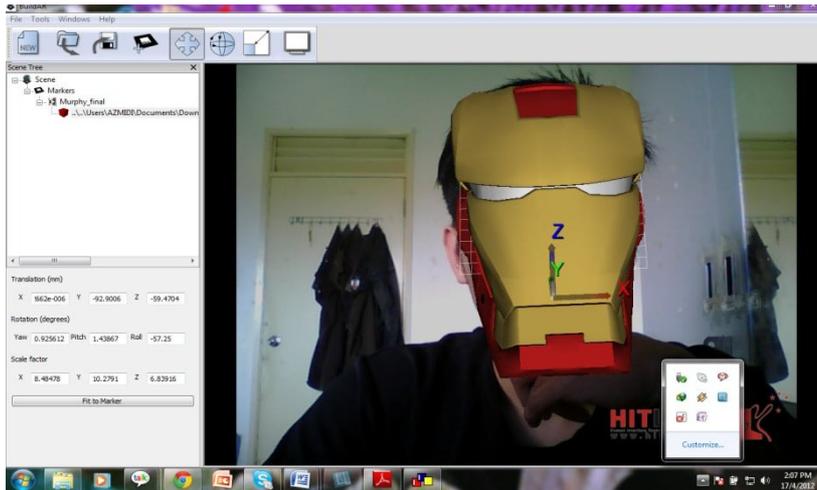
Figure 6: AR using BuildAR

<u>Hardware</u>

- PC
- Webcam or digital camera
- Projector (optional)

<u>Graphics development</u>

- **Blender**

Blender is used to create 3D object that is more complex for AR. The finished object will be published according to certain standard format that compatible with Android to be exported. This tools help to counter the problem of drawing 3D object programmatically using OpenGL ES.

- **Autodesk 3ds Max 2009**

Autodesk 3ds Max, formerly 3D Studio Max, is 3D computer graphics software for making 3D animations, models, and images. It was developed and produced by Autodesk Media and Entertainment. It has modelling capabilities, a flexible plug in architecture and can be used on the Microsoft Windows platform. It is frequently used by video game developers, TV commercial studios and architectural visualization studios. It is also used for movie effects and movie pre-visualization.

For this project 3ds Max is used to export the 3D model into .3Ds which is readable by BuildAR.
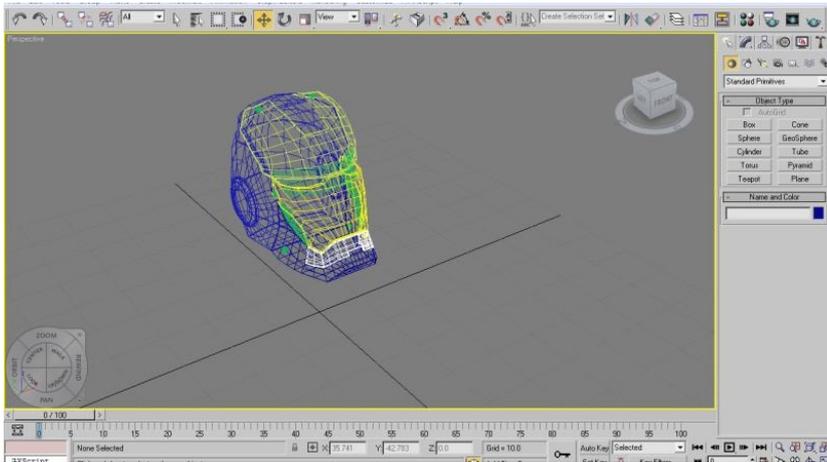

Figure 7: Modelling using 3Ds Max 2009

Figure 8: Modelling using 3Ds Max 2009
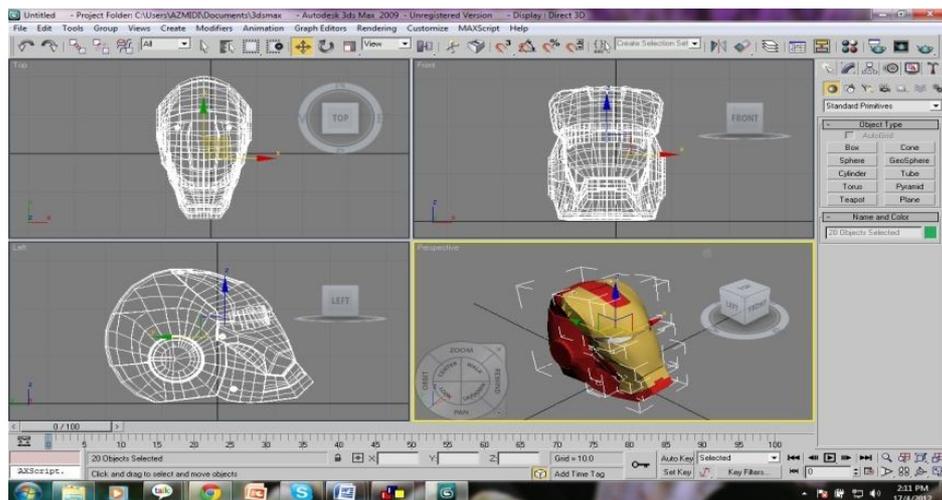
3.4 Key Milestones / Gant Chart

The key milestones that need to be achieved in the first semester of Final Year Project (FYP) are as below and refer Gantt chart at the attachment.

Milestone	Date
Project Proposal	8 February 2012
Extended Proposal	29 February 2012
VIVA: Proposal Defense and Progress Evaluation	21 March 2012
Interim Report	12 April 2012

Table 1: Milestones

Project	Project Activities	Week No											
		1	2	3	4	5	6	7	8	9	10	11	12
FYP1	Planning	█	█										
	Project Proposal			█									
	Information Gathering	█	█	█	█	█	█	█					
	Extended Proposal				█	█	█						
	Materials and Tools Acquisition	█	█	█	█	█	█	█					
	VIVA									█			
	Interim Report							█	█	█	█	█	█

Table 2: Gantt chart

CHAPTER 4: RESULT

4.1 Result

   This is the home screen. Whenever user click on .exe file it will show this screen. They will navigate to next page when they click on "Let's start" button.


Figure 9: Start screen

When user start the AR program, this pop up will shown. On this window the user can configure and edit the setting such as frame rate and output size of the program.
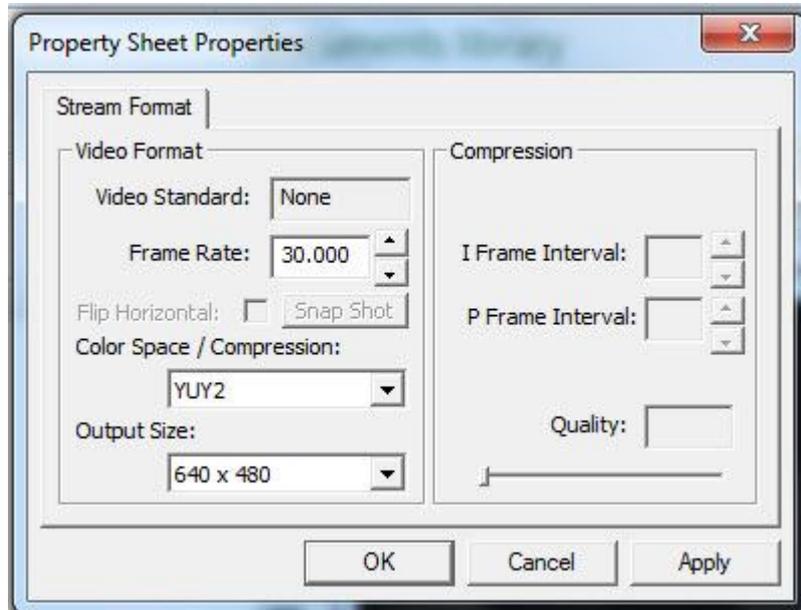
Figure 10: Configuration

The cmd window shows the information of the object being rendered.
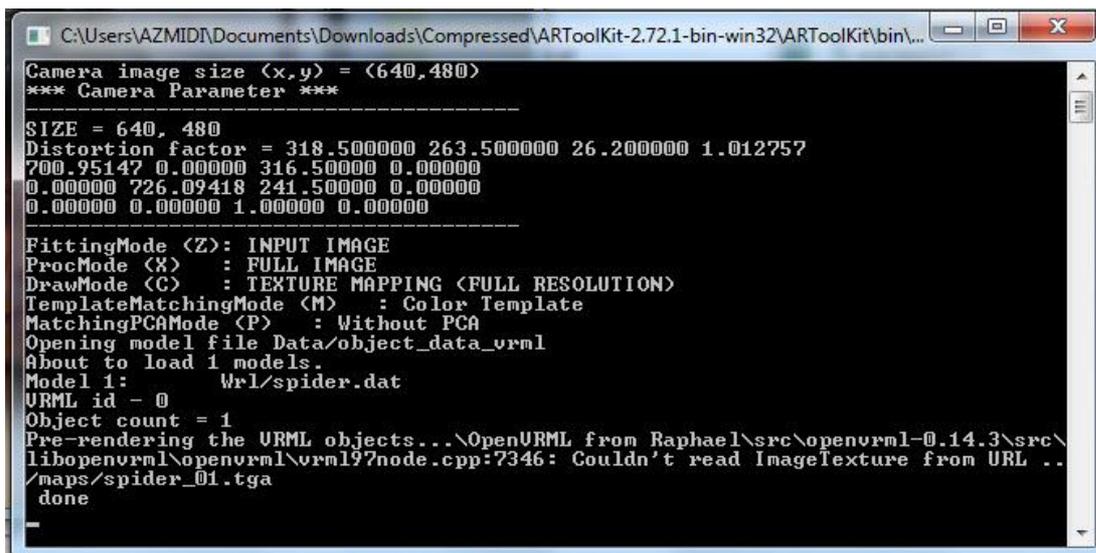
Figure 11: Cmd windows
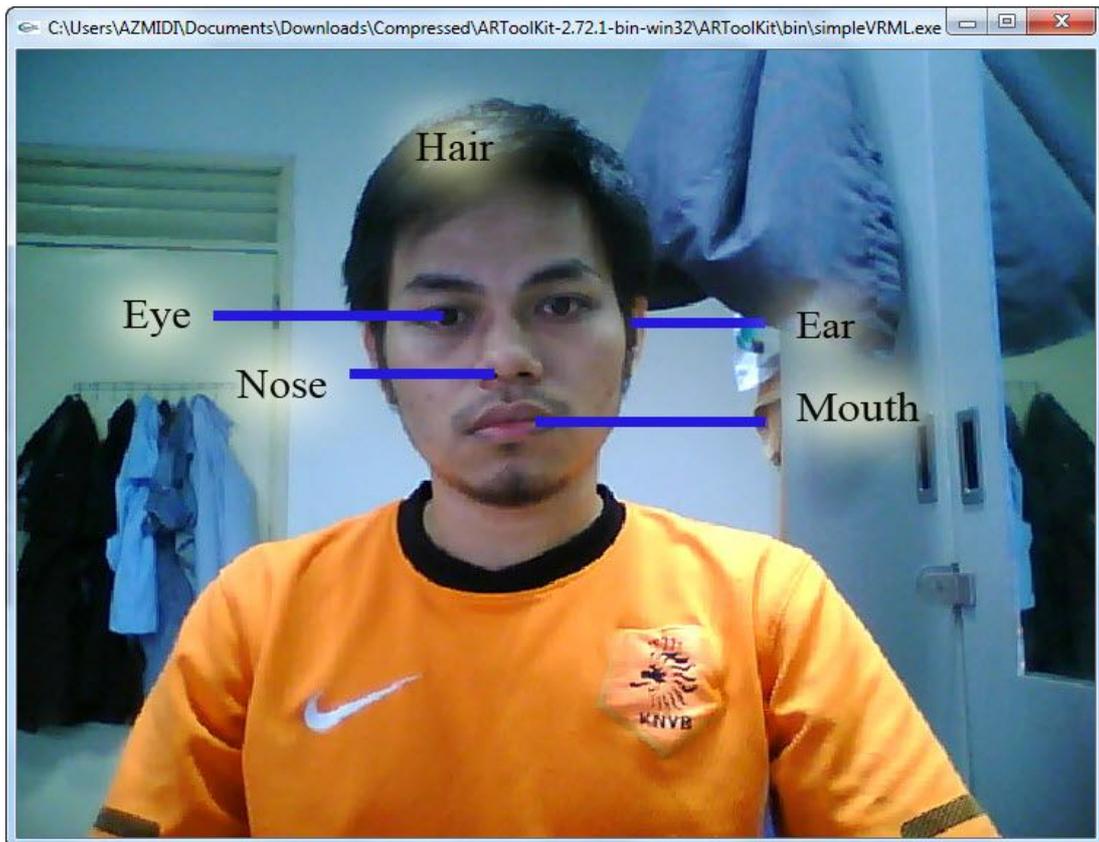
Figure 12: Example of program

CHAPTER 5: CONCLUSION

5.1 Conclusion

This project is helping children with ADHD to learn and understand what have been taught by teacher. Pre-school children are the target because at this stage the children with ADHD start to exhibit the symptoms. This project is not meant to cure the ADHD children but to help them understand and not left behind in class. With the learning module according to pre school curriculum ADHD-Edu will improve their academic performance and overcome the disabilities.

5.2 Future Work

A person still can have ADHD even they are growing up and become adult. For future work ADHD-Edu will expand the target to adult. New learning module will develop according to high school curriculum and with more interactive application.

5.1 Flow Chart

```
                    ┌─────────────┐
                    (    Start    )
                    └──────┬──────┘
                           │
                           ▼
                    ┌─────────────┐
                    │  Main menu  │
                    └──────┬──────┘
                           │
                           ▼
                         ◇ Choose
                           Module ◇ ◄──────────────┐
                           │                       │
                           ▼                       │
                    ┌─────────────┐                │
                    │  My Body    │                │
                    └──────┬──────┘                │
                           │                       │
                           ▼                       │
                         ◇ Continue        Yes     │
                           Module? ◇ ──────────────┘
                           │
                           │  No
                           ▼
                    ┌─────────────┐
                    (    End      )
                    └─────────────┘
```
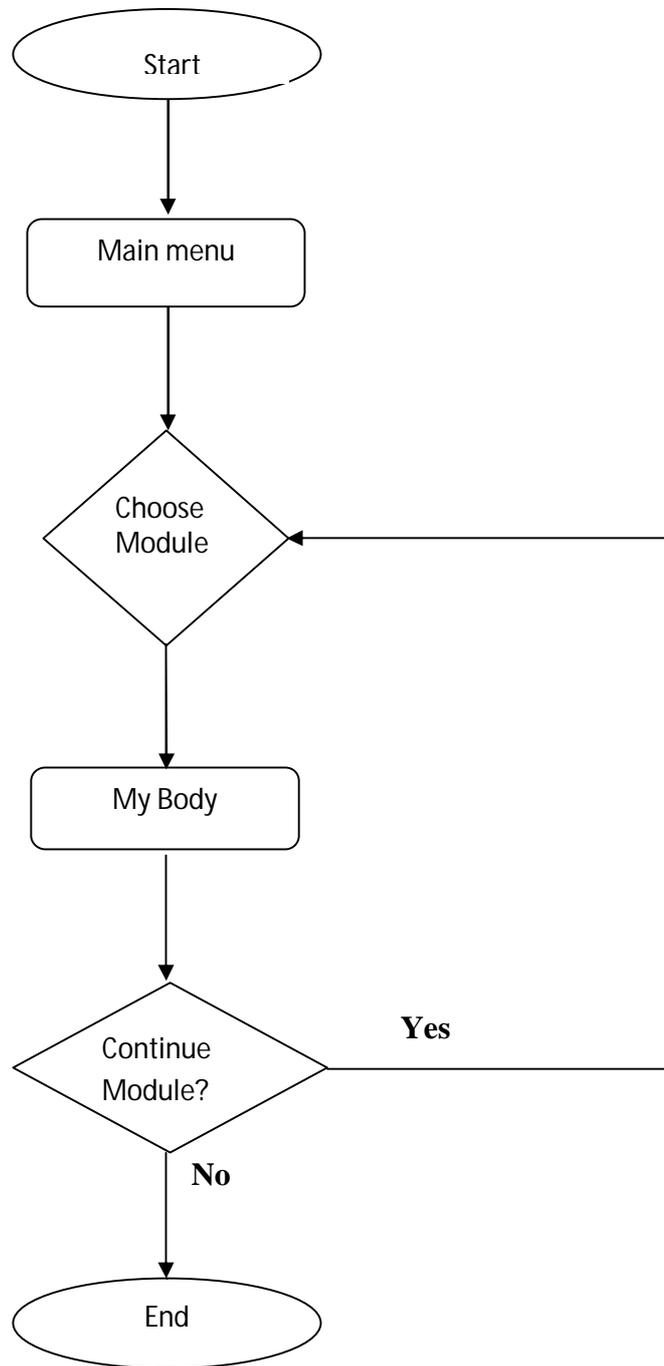
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APPENDIXES

(Please refer to the next pa