Ministry of Higher Education &Scientific Research

Sana'a University

College of computer & IT
IT Department

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AUGMENTED REALITY FOR EDUCATION VISION

AR EduVision

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Supervisor

Dr. Aqeel Abdullah Al-Surmi

BACHELOR'S DEGREE OF IT DEPARTMENT
2017-2018

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2017-2018

DECLARATION

We hereby declare that the bachelor project thesis is based on our own work, except for quotations and summaries, which have been duly acknowledged. We also declare that it has not been previously or concurrently submitted for any other degree at FCIT or other institutions.

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DEDICATION

We dedicate this report to our loving parents. We never have experienced love like this, they have taught us, shown us, and helped us understand how to use what we have learned to help people. We are thankful for their sacrifice, patience, and understanding that were inevitable to make this work possible. Their sacrifice had inspired us from the day we learned how to read and write until what we have become now. We cannot find the appropriate words that could properly describe our appreciation for their devotion, support and faith in our ability to achieve our dreams.

ABSTRACT

Nowadays, many people (including students) in all over the world use smartphones such as android devices. Most students are getting tired of studying using the traditional techniques that are used currently in most of colleges and schools in the society. Today, technology is developed day after another. Augmented Reality (AR) is one of these technologies that has become famous recently. It has brought both the digital world and the physical world into a blended environment that helps users to experience digital information in the physical world. These two worlds are integrated through a camera, which gets a real view of the user environment, and analyse the views to add an additional information on the screen.

Therefore, the proposed project intended to create an android application that displays interactive information with Three Dimensional (3D) models for the hardware contents by using AR environment for novice students. Especially, first year students to understand computer fundamentals subject in universities. Moreover, computer student or teacher can use this project. For teachers in one hand, it will facilitate teaching processes and give them the ability to teach students interactively. In the other hand, it will help students to understand computer hardware. This project will be useful because AR environment has an interactive usage for users. The result of AR EduVision will improve the education techniques. Furthermore, the proposed project provides 3D environment in computer maintenance that allows students to plug in most of computer hardware stuff without the need for real computer in practicing processes.

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LIST OF ABBREVIATION

AR	Augmented Reality
3D	Three-Dimensional
2D	Two-Dimensions
RAM	Random Access Memory
CPU	Central Processing Unit
HDD	Hard Disk Drive
GB	Gigabyte
TB	Terabyte
OS	Operating System
HW	Hardware
SW	Software
ER	Entity-Relationship
FCIT	Faculty of Computer and Information Technology

CHAPTER 1

INTRODUCTION

1.1 Overview

This chapter includes brief introduction of AR EduVision application that can make users and readers understand what the application is and what the main problem, for which this application will solve.

1.2 Background

AR is a technology among which has been lately arising in modern education. It allows providing a layer of virtual information that may include 3D models, text, video, and audio over interactive real world objects in real time. Therefore, it can support smooth interaction between real and virtual environments. It provides chances to make students interact and learn faster. The learning experience that uses AR will look more realistic, authentic, interesting, and fun. It can also inspire and motivate learners to learn more.

Recently, most educators have used traditional teaching method to conduct the teaching and learning activities in the classroom by using face-to-face method via verbal communication [1]. It is remarkable that Yemen and most of the countries still needs laboratories to make students deal with computer and fixing its hardware problems. The advanced educational system capabilities of AR are various. It can create a rich user interaction, for instance. The user will be able to interact with Two Dimensional (2D) images, which exist in the same realistic environment, by using a camera to view an interactive 3D models including related information of those images and other features such as (Show position, Sounds, get Markers, and Share Screen Shots).

Along with the growing of technology, AR appears to offer new ways of human computer interaction. In such systems, android devices have considered as intelligent companions that help students through educational operations. Most of students in college do not comprehend how to collect and remove computer hardware components. Thus, the

proposed application will help them understand how to maintain computers without the need for real computer hardware. It can be used any time anywhere. Traditionally, college educators give their students electronic books, which contain text and 2D images, which make difficulties for students to understand computer hardware well.

1.3 Problem Statement

The main problem of current education is using traditional ways in teaching that is divided into sub problems as following:

- Complexity in designing computers today makes students having some difficulties to understand computer environment well.
- Raising the cost of computer maintenance courses.
- Computer faculty in Yemen has few laborites for computer maintenance, so teacher spend more efforts in teaching.
- Students face problems to use most of computer hardware application online.

1.4 Objectives

AR EduVision has objectives that will solve the main problem and its sub problems as following:

- To develop an application that make the information simple and clear that will reduce students' effort to understand computer hardware by providing an additional information with 3D models on live view of the physical world to create blended experiences.
- To create a free application. Because there is no need for real computer stuff to deal with computer hardware maintenance.
- To enhance the application to minimize the teaching efforts by providing visual maintenance laborites on the real vision of user's world.
- To develop the application to be flexible and available, so the student/user will be able to get and install the application, and use it anytime anywhere without using internet.

1.5 Acceptance criteria

AR EduVision has acceptance criteria that makes the application works properly as following:

- Scanning the marker and display an interactive 3D model.
- Showing the inner pieces inside personal computer (PC).
- Providing an attached book to make the application work properly.

1.6 Project Definition

The proposed project is an android application that will view an interactive information and 3D models by using AR environment, which will help students to understand computer hardware components easily.

1.7 Purpose

Serve students, casual computer users, and all educational society to understand computer hardware components well. Moreover, it serves teachers to reduce teaching effort, also it does not expose the computer hardware components to be damaged while maintenance.

1.8 Goal

The main goal of AR EduVision application is improving the traditional way of learning by interactive way using AR techniqe.

1.9 User characteristic

AR EduVision has users' characteristics that effect on application, as showing in Table 1.1.

Users	**Qualification**	**Age-period**	**Needed skills**	**Tasks**
Teacher	Has computer certificate	More than 20 years.	Teaching in university, school, or institute.	Presenting the application in front of students.
Student / Casual user	None.	More than 8 years.	Can Use Android smart phones.	Scanning the form in the attached book using the camera, plug in provided hardware components on visual computer frame, and reading existing books in application.

Developers	Has computer certificate	More than 18 years.	Having knowledge of computer fundamentals and experience in programming languages.	Building hardware 3D models, detect and correct fault toleration, and adding additional features to the application in the future.

Table 1.1 User Characteristic

1.10 Limitations

Some conditions and constraints prevent this application from being developed and implemented as described in the following statements:

- Needing high quality images to make them recognized by the application.
- High storage capacity because the data of the program will be offline.
- Misunderstanding of application usage by the client.
- Electricity problem in the country and Unity application consume computer battery very quickly.

1.11 Assumptions and Dependencies

AR EduVision has factors and dependencies that will solve limitation of this project as described in the following statements:

- Providing attached book with high quality images for processing.
- Reducing the duplicated codes.
- Simplicity of use. That is making the application as easy as anybody can use it.
- Providing full Solar Energy.

1.12 Scope

First year student of faculty of computer and information technology (FCIT) in Sana'a University, Sana'a, Yemen.

1.13 Project plan

The AR EduVision Gantt Chart that show project plan, as presented in the Figure 1.1.

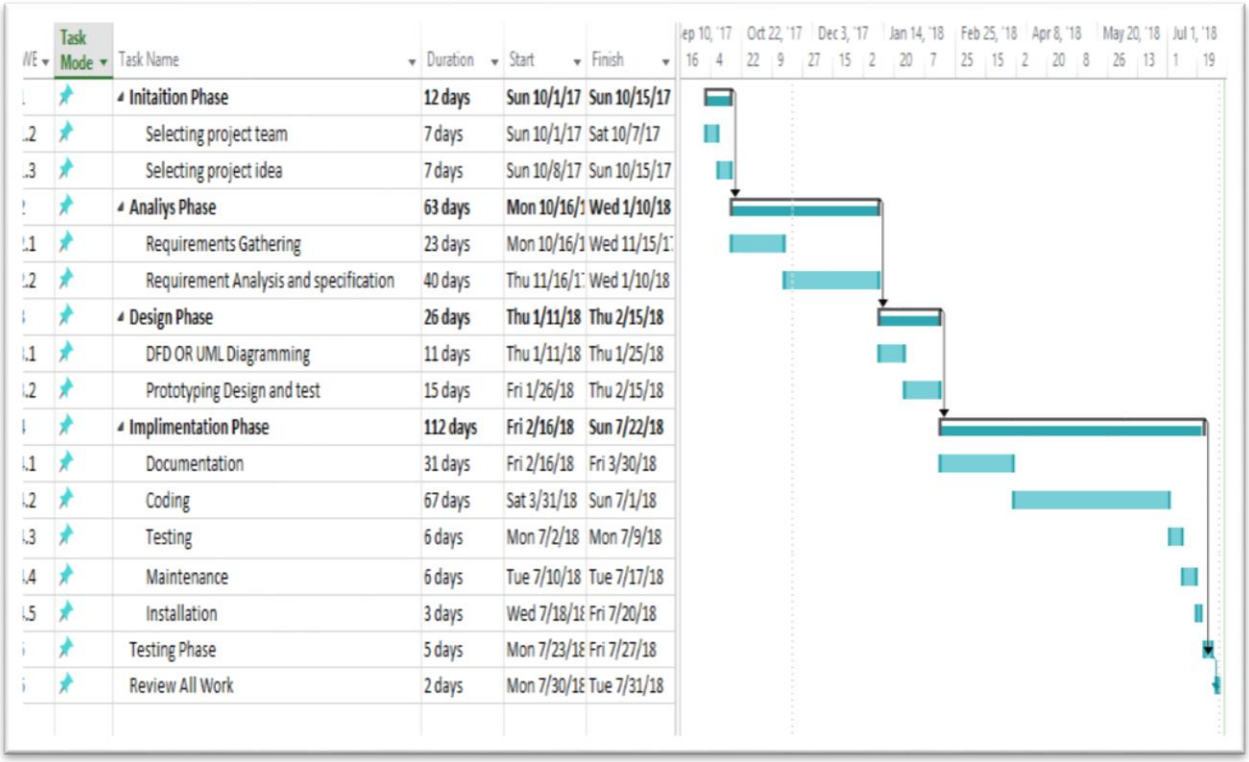


Figure 1.1 Project Plan

1.14 Feasibility Study

AR EduVision has some requirements to make project work probably that described as following:

1.14.1 Financial Feasibility

AR EduVision has Financial Feasibility, as showing in Table 1.2.

Requirements	Cost	
	System	
	Build	Buy
HR:		
Analyst	1x500$x12m	1x600$x12m
Designer	3x200$x4m	2x800$x4m
Developer	4x250	2x700$x10m
Programmer	$x10m	2x850$x8m
Team leader	3x350$x8m	1x900$x10m
	1x300$x12m	
HW:		
Laptop core i5 RAM 4GB	2x200$	2x200$
Laptop core i7 RAM 8GB	3x400$	3x400$
Android device	5x150$	5x150$
SW:		
Windows 10	5x100$	5x100$
Antivirus Kaspersky	2x50$	2x50$
Unity 2017.2	1x90$	1x90$
3D Max	1x120$	1x120$

Vuforia	Free*	Free*
Visual studio 2013	1x85$	1x85$
MonoDevelop	Free*	Free*
Adobe Suit (Photoshop, InDesign and AfterEffect)	3x70$	3x70$
Wireframe Sketcher	Free*	Free*
E-drow Max	1x120$	1x120$
SAP Power Design	3x45$	3x45$
SketchUp	1x10$	1x10$
Microsoft Office 2013: Word, PowerPoint, Excel, and Project.	5x80$	5x80$
Stationary:		
Printer's Papers	200x.1$	200x.1$
Files	3x10$	-
Others:		
Maintenance	200$	500$
Total :	34770$	54840$

Table 1.2 Financial Feasibility

* *Using a trailer edition for those applications.*

1.14.2 Operational Feasibility

- According to PIECES standard, we can talk about:
  - **Performance:**
    - **Throughput:**

      Supposed that AR EduVision have the highest performance, so any operation has not been taken process for more than microsecond.
    - **Response Time**:

      The time taken between one operation and another are less than microseconds.
  - **Information:**
    - **Input:**

      The application accepts only the necessary and right data as an input to get the required performance of operations, rather than stopping the system because of erroneous inputs.
    - **Stored Data:**

      The data are stored in a manner that ensures its safety, security, accuracy and integrity, moreover receiving the data in the right place without mistakes according to the user requirement.

- Output:

The application are able to return accurate and readable data in the right place easily in short time according to the user requirement.

- **Economic:**

- Cost:

The cost of the application explained in detail in the Financial Feasibility section (1.15.2).

- Profit:

Schools, Institutes and Universities will have more benefits if they present this application to their students, because it reduces the purchases of hardware resources for their laborites by providing visual laborites.

- **Control/ Security:**

Security is not a matter in AR EduVision because AR EduVision does not store any data about users.

- **Efficiency:**

- Waste Time:

AR EduVision work were divided into 4 phases, and each phase has specific time to complete it, for that about 9 months was needed to complete it, so there will not be waste of time.

- Waste Materials:

All the materials that mentioned in needed hardware and software points above are used, so there will not be any wasted of material.

- Effort:

For user, the application is clear and easy to use. For devices, the application are light so there will not be any effect on them.

- Required Materials:

Explained in detail in the Technical Feasibility section (1.15.1).

- **Services:**

  - Accurate, consistent and reliable result:

  The application accept only the necessary and right data also it will be able to return the accurate and readable data in the right place.

  - Easy to learn/to use:

  The application is usable, to make sure that users feel comfortable when they use it.

  - Inflexible:

  The application is flexible, to meet new changes and has ability to response to the new requirements in the future.

  - Incompatible:

  The application is compatibility with Android platform witch will be installed on.

- **Available Human Resources:**

The application has include human resource (teachers) who used to teach using traditional ways before making the application available.

- **Users and New Application:**

The application may be rejected by some people such as teachers or institutes whose teach hardware maintenance, so clarification are importance and usefulness of the application will presented to them and how it will safe their efforts.

- **Satisfying of Users About Current System:**

Users are not satisfied about current system, because it does not convince students to understand subject well and take effort from them by using traditional system.

- **Legal System:**

AR EduVision will not conflict with law.

1.14.3 Scheduling Feasibility

The work on AR EduVision are divided into 4 phases so we will need about 216 days to

complete it as below:

- **Initiation Phase: 1/10/2017 to 15/10/2017**

The description of initiation phase steps depends on waterfall life cycle is shown in Table 1.3.

Task	**Period**
Problem	4 days 01/10/2017 to 04/10/2017
Team Members	2 days 05/10/2017 to 06/10/2017
Goal	3 day 07/10/2017 to 10/10/2017
Scope	3 day 11/10/2017 to 13/10/2017
Time	2 day 14/10/2017 to 15/10/2017

Table 1. 3 Initiation Phase

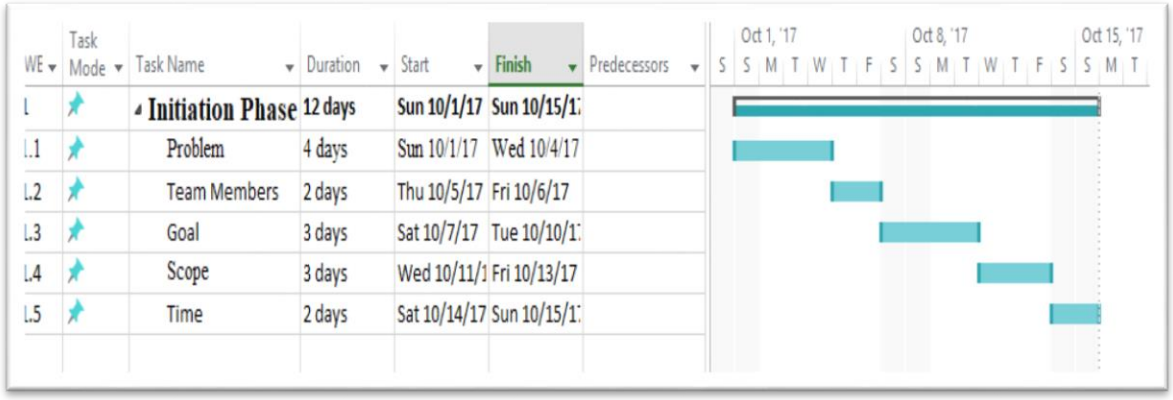


Figure 1. 2 Initiation Phase

- **Analysis Phase: 16/10/2017 to 10/01/2018**

The description of analysis phase steps depends on waterfall life cycle is shown in Table 1.4.

Task	**Period**
Requirements Gathering	23 days 16/10/2017 to 15/11/2017
Requirement Analysis and specification	40 days 16/11/2017 to 10/01/2018

Table 1. 4 Analysis Phase

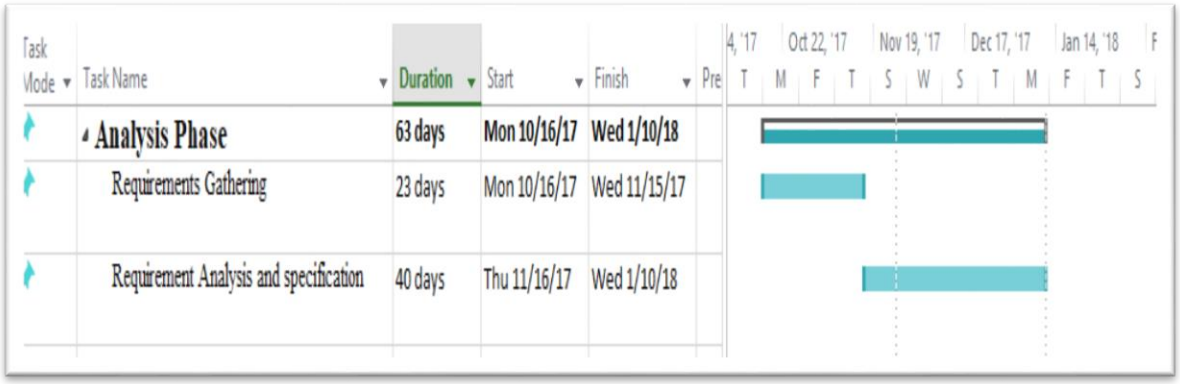


Figure 1. 3 Analysis Phase

- **Design Phase: 11/01/2018 to 15/02/2018**

The description of design phase steps depends on waterfall life cycle is shown in Table 1.5 .

Task	**Period**
UML Diagramming	20 days 11/01/2017 to 07/02/2018
ERD	5 days 08/01/2017 to 25/01/2018
Prototyping Design	15 days 26/01/2018 to 15/02/2018

Table 1. 5 Design Phase

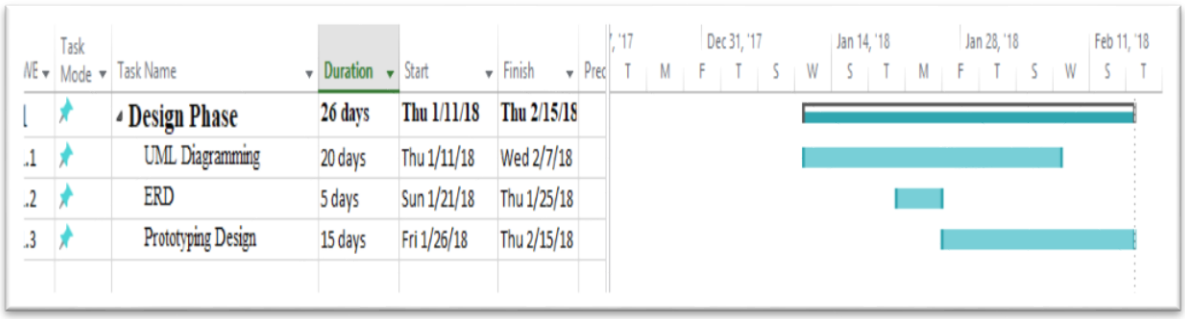


Figure 1. 4 Design Phase

- **Implementation Phase: 16/2/2018 to 22/7/2018**

The description of implementation phase steps depends on waterfall life cycle is shown in Table 1.6.

Task	**Period**
Documentation	31 days

	16/02/2018 to 30/03/2018
Creating User Interface	5 days 31/03/2018 to 05/04/2018
Coding	67 days 06/04/2018 to 09/07/2018
Testing	6 days 10/07/2018 to 17/07/2018
Maintenance	3 days 18/07/2018 to 20/07/2018
Installation	2 days 21/07/2018 to 22/07/2018

Table 1.6 Implementation Phase

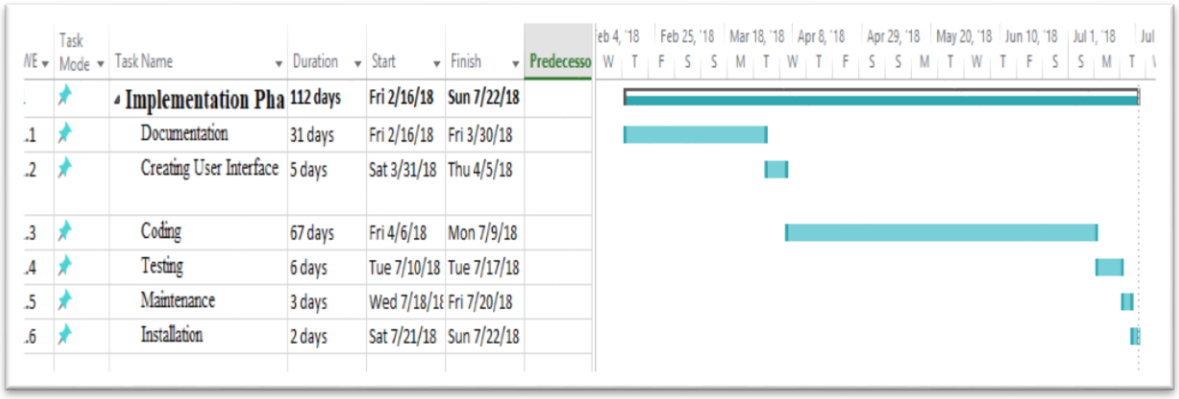


Figure 1. 5 Implementation Phase

1.14.4 Identifying Benefits and Costs

A. Tangible benefits

Increasing the number of users.

B. Intangible benefits

Users' satisfaction.

C. Tangible costs

Minimizing the need of buying hardware components.

D. Intangible costs

Transportation cost and communications cost.

CHAPTER 2

CURRENT SYSTEM

2.1 Overview

This chapter include brief history of AR technology and current system. The brief history of AR includes the born, current state of play, and the future of AR.

2.2 Current System

Education is an important issue that affects the development of a country. In Yemen, many educational problems need to be solved. The current situation is very poor education. There is huge overseas from the government and department of education. Starting with the problem of our current education system. There is no motivating for students. For example, most educators have used traditional teaching method to conduct the teaching and learning activities in the classroom by using face-to-face method via verbal communication. Second problem, Yemen is one of the most countries that needs laboratories to make students deal with subjects that students have studied. Third problem is that educator give their students books that contains 2D images and plain text, that make difficulties for students to understand subjects well.

2.3 A brief history of AR

The first appearance of Augmented Reality (AR) dates back to the 1950s when Morton Heilig, a cinematographer, thought of cinema is an activity that would have the ability to draw the viewer into the onscreen activity by taking in all the senses in an effective manner. In 1962, Heilig built a prototype of his vision, which he described in 1955 in "The Cinema of the Future", named Sensorama, which predated digital computing [2]. Next, Ivan Sutherland invented the head mounted display in 1966. In 1968, Sutherland was the first one to create an augmented reality system using an optical see-through head-mounted display [3]. In 1975, Myron Krueger creates the Videoplace, a room that allows users to interact with virtual objects for the first time. Later, Tom Caudell and David Mizell from Boeing coin the phrase Augmented Reality while helping workers assemble

wires and cable for an aircraft [4]. They also started discussing the advantages of Augmented Reality versus Virtual Reality (VR), such as requiring less power since fewer pixels are needed [3]. In the same year, L.B Rosenberg developed one of the first functioning AR systems, called Virtual Fixtures and demonstrated its benefit on human performance while Steven Feiner, Blair MacIntyre and Doree Seligmann presented the first major paper on an AR system prototype named KARMA [4]. The reality virtuality continuum seen in Fig. 1 is not defined until 1994 by Paul Milgram and Fumio Kishino as a continuum that spans from the real environment to the virtual environment. AR and AV are located somewhere in between with AR being closer to the real world environment and AV being closer to the virtual environment. In 1997, Ronald Azuma writes the first survey in AR providing a widely acknowledged definition of AR by identifying it as combining real and virtual environment while being both registered in 3D and interactive in real time [3]. The first outdoor mobile AR game, ARQuake, is developed by Bruce Thomas in 2000 and demonstrated during the International Symposium on Wearable Computers. In 2005, the Horizon Report [5] predicts that AR technologies will emerge more fully within the next four to five years; and, as to confirm that prediction, camera systems that can analyze physical environments in real time and relate positions between objects and environment are developed the same year. This type of camera system has become the basis to integrate virtual objects with reality in AR systems. In the following years, more and more AR applications are developed especially with mobile applications, such as Wikitude AR Travel Guide launched in 2008, but also with the development of medical applications in 2007. Nowadays, with the new advances in technology, an increasing amount of AR systems and applications are produced, notably with MIT 6th sense prototype and the recent and future release of the iPad and its successors and competitors, notably the Eee Pad, and the next iPhone, the iPhone 4, which promises to revolutionize mobile AR.

2.4 Current AR Applications fields

While there are many possibilities for using augmented reality in an innovative way, we have cornered two types of applications that are most often being used for AR entertainment and education, and medical application for iPhones. Below, we study why AR could bring a better solution to some areas, a cheaper solution to others, or simply create a new service. We also discuss the challenges augmented reality is facing to go from the laboratories to the industry. Note that it was decided here to replace the

navigational and informational domain application that was encountered in the AR systems section by a study of the augmented reality mobile applications as these applications most often have navigational and informational use.

2.4.1 Entertainment and education

Entertainment and education applications include cultural apps with sightseeing and museum guidance, gaming apps with traditional games using AR interfaces, and some smart-phone apps that make use of AR for an entertainment and/or educational purpose. In cultural application, there exists a few systems that uses AR for virtually reconstructing ancient ruins .

There are also a few systems that exploit AR for museum guidance, also uses a mobile phone as an interface, the benefits of using augmented reality as an interface for their cultural applications as: efficient communication with the user through multimedia presentations, natural and intuitive technique and low maintenance and acquisition costs for the museum operators' presentation technology in the case of smart-phone being used as an interface. And indeed, using a smart-phone or even another hand-held display is a more intuitive and natural technique than looking up a number randomly assigned to the object in a small written guide, especially when the user can simply make use of his/her own phone in a world where everybody already possesses one. Similarly, users can relate easier to multimedia presentations brought to them and will more willingly listen, watch and/or read about information that they can acquire by simply pointing at an object using their phone rather than have to look it up in a guide. AR gaming applications present many advantages other physical board with, for example, the ability to introduce animations and other multimedia presentations. The ability to introduce animations can not only add excitement to a game, but it can also serve a learning purpose with, for example, indication to help players learn the game or know when they are making an invalid move.

Beyond Reality [6], which was the first to introduce a marker less magazine, presents two board games, PIT Strategy and Augmented Reality Memory. In PIT Strategy, the player is the "pit boss" in a NASCAR race and must act according to given weather condition, forecast and road condition. In Augmented Reality Memory, the player turns a card and sees a 3D object, turns a second card and sees another 3D object. If they match, a celebration animation will appear; otherwise, the player can keep looking for matches. These two games are still under development and further information can be found on

[6]. Here again, augmented reality has not fully reached its potential to enter the industrial market. Once again, this is mostly due to technological advances such as tracking system. For example, we saw that the few museum guidance systems developed were only applicable to the museum or exhibition they were developed for and could not be utilized for other museums. This is due to the fact that both these systems relied on the organization of the museum or the exhibition to recognize the artifacts as opposed to detecting the artifacts solely using computer vision. So why hasn't computer vision been used to recognize the objects instead of relying on knowing the user's position in the museum? As was seen in the Computer Vision Methods in AR section, some objects have irregular forms and although it might seem easy for us to recognize them, it is very hard for a computer to detect what these objects are, and this is the case of most artifacts. Paintings do not present such a big trouble for system such as Google Goggles [7].

2.4.2 Medical applications

Most of the medical applications deal with image guided and robot-assisted surgery. As a result, significant research has been made to incorporate AR with medical imaging and instruments incorporating the physician's intuitive abilities. Significant breakthrough has been provided by the use of diverse types of medical imaging and instruments, such as video images recorded by an endoscopic camera device presented on a monitor viewing the operating site inside the patient. However, these breakthroughs also limit the surgeon's natural, intuitive and direct 3D view of the human body as the surgeons now have to deal with visual cues from an additional environment provided on the monitor [8]. AR can be applied so that the surgical team can see the imaging data in real time while the procedure is progressing. Bichlmeier et al. [8] introduced an AR system for viewing through the "real" skin onto virtual anatomy using polygonal surface models to allow for real time visualization. The authors also integrated the use of navigated surgical tools to augment the physician's view inside the human body during surgery. Teleoperated robot-assisted surgery provide the surgeons with additional advantages over minimally invasive surgery with improved precision, dexterity, and visualization [9, 10]; however, implementing direct haptic feedback has been limited by sensing and control technology and thus is restricting the surgeon's natural skills. The lack of haptic feedback has been proved to affect the performance of several surgical operations [11]. In [12], the authors propose a method of sensory substitution that provides an intuitive form of haptic feedback to the user. The force applied by the surgeon is graphically represented and

overlaid on a streaming video using a system of circles that discretely change colors across three predetermined ranges (Low Force Zone (green), Ideal Force Zone (yellow) and Excessive Force Zone (red)) according to the amount of bending forces detected by strain gages. The need to reduce surgical operations is not the only one to depend upon seeing medical imaging data on the patient in real time; the necessity to improve medical diagnosis also relies on it. In this research field, the ICAR-CNR group of Naples [13, 14] is working on an AR interactive system for checking patient's hand and wrist for arthritis by overlaying in real time 3D MR imaging data directly on top of the patient's hand. Since arthritis disabilities are strongly associated with pain intensity and so require a direct manipulation of the hand and wrist region to be diagnosed, the system may support physicians by allowing them to perform morphological and functional analyses at the same time [15]. AR could also be used to manage clients' medical history. Imagine if all a doctor had to do to check a patient's medical history was to put on a head mounted display and look over the patient to see virtual labels showing the patient's past injuries and illnesses. The use of AR in the medical field to provide better solutions to current problems than already existing solutions is infinite. In [16], the authors use AR to provide a low cost and smaller in size solution to the post-stroke hand rehabilitation problem, which has the potential to being use in clinics and even at home. In [17], the authors use AR to help patients fight against the phobia of cockroaches and thus show that AR can be used to treat psychological disorders as well. Unfortunately, on top of facing a few technological advances issues such as displays and tracking issues, medical applications also face privacy concerns. Displays challenges mostly arise from the fact that the preferred type of display to use for medical applications is a HMD as it allows the physician not only to use both hands, but it is also easier to track where the doctor is looking to augment the right surfaces; however, it is challenging to implement HMD to medical applications. There are challenges that arise because of the HMD itself, such as accurately placing and applying depth perception to 3D models, and challenges that are due to the medical field itself, such as for a surgeon to still be able to see his tools through the projected images. Another possible type of display that could be used would be spatial display to allow the whole surgical team to see the same thing at the same time; however, it is then very hard to track where the surgeon is looking and what the desired place for augmenting is.

Privacy concerns always arise in the medical field, especially when discussing the treatment of the very confidential medical history of patients. Another type of issues that

medical application in augmented reality will most likely have to face is the problems that arise with retraining the medical staff for using new tools. Most AR applications aim at simplifying the use of AR tools such that they correspond to what the physician is used to; for instance in [12], the feedback system developed by the authors did not require the surgeons to truly learn how to use it as the application was easily integrated onto the da Vinci Surgical System that most surgeons know how to use. Even with this system, the surgeons still have to get use to this type of haptic feedback system, although the training is rather short and inexpensive. However, there are some systems that will require a complete retraining of the staff to interact with the application. For example, applications that will require the user to interact with a 3D input device as opposed to 2D input devices such as a mouse, will present some training problems as they might be too costly for the medical field to judge them viable.

2.5 Future of AR applications

AR is still in infancy stage, and as such, future possible applications are infinite. Advanced research in AR includes use of head-mounted displays and virtual retinal displays for visualization purposes, and construction of controlled environments containing any number of sensors and actuators [4]. MIT Media Lab project "Sixth Sense" [18] is the best example of AR research. It suggests a world where people can interact with information directly without requiring the use of any intermediate device. Other current research also include Babak Parviz AR contact lens [19] as well as DARPA's contact lens project [20], MIT Media Lab multiple research applications such as My-Shopping Guide [21] and TaPuMa [22]. Parviz's contact lens opens the door to an environment where information can only be viewed by the user. Of course, this can also be done by using glasses as opposed to contact lens, but the advantage in both cases over using a cell phone, for instance, is that no one else but the user can see the information projected, making it very personal. Cisco has imagined a world where AR could be used for replacing the traditional fitting rooms by trying on virtual clothes, thus saving time and providing the ability to try on more clothes, increasing the chance for stores to sell. Augmented reality also brings the possibility of enhancing missing senses for some users. For example, AR could be used as a sense substitution device. Hearing-impaired users could receive visual cues informing them of missed audio signals and sightless users could receive audio cues notifying them of unknown visual events. We believe that new

mobile devices, such as iPhone, Android-based devices, and iPad are not well used in AR. Indeed, most of the current applications include gaming, entertainment and education, and while most already believe that these are “amazing apps” [23]… Even the future is not far from challenges for augmented reality. We see social acceptance issues, privacy concerns, and ethical concern arising with the future of augmented reality applications in the industry. Social acceptance mostly arise from mobile devices with the need for the devices to be subtle, discrete and unobtrusive as well as fashionably acceptable as was discussed in the Augmented Reality Mobile Systems section, but also with systems that will require retraining of the personnel and staff in order to be utilized. We have seen that this might be the case with some medical applications and that the health system might decide against the use of augmented reality if they decide that the retraining is too costly. A system for easy integration of such system will have to be developed to avoid such issues.

2.6 Researches and related works

Several projects and applications were proposed using AR environments. Interactive Learning using Augmented Reality (iLar) application [24] was proposed by Aisha et al, the application has been developed to help educator in teaching process. The advantage of this application to give a chance for school students to study in more interactive way by markers using AR technology that allows them to see planets in 3D model, also for teachers to ease teaching the planets; the application serves them by saving their time, effort and improve their teaching skills. However, the application were display 3D models without moving models using normal markers.

The Treat Roach Phobia [25] application were developed by Che N. et al, the application has been developed to handle the cockroach phobia among people by using AR. It helps people to reduce their anxiety toward this insect and can avoid from danger in the future. It gives a chance to people to display a virtual 3D cockroach model and use AR technology to solve health problems especially to treat the phobia towards cockroach. Moreover, the application provides a result that based on people anxiety level, which can be sent to the psychiatrist for analysis. However, it focused in the medical side.

Recently, BMW Company introduce BMW i Visualiser application [26], which use Google Tango to visualize the AR environment, the application were developed to enable people using their smartphones to view lifelike 3D models of certain BMW cars (the

BMW i3 and the BMW i8) against a backdrop of the real world. This application has so many advantages and features, such as it lets people explore a full-scale 3D version of the BMW i3, i3s or i8 - any time, any place. Walk around and inside to view the finer details of the car from any angle. Switch on the radio and headlights and open the doors and boot to explore the interiors of the car, also allows them to design the i3, i3s and i8 by changing the exterior colors, interiors, and wheels. Even with all these features, the disadvantage of this application is that; it still aims to BMW customers who want to see BMW cars with all its components, so it does not support any side of computer science, for that reason, improving AR EduVisoin application will be good idea to over computer science side.

CHAPTER 3

PROPOSED SYSTEM

3.1. Overview

AR EduVision covers computer hardware components to display those components in interactive environment. It facilitates studying techniques and make it easy to be understood. This chapter includes the methodology that be used to developed AR EduVision application, the application prototype, fact finding tools, functional and non-functional requirements of the application, system models and application scenarios.

3.2. Life Cycle Model

The Waterfall Life Cycle model were proposed to be used in this project.

3.2.1. Waterfall model

The waterfall model is a project management methodology based on a sequential design process. Much like a waterfall filling lower level pools, phases in the waterfall model flow from one to another, this model were chosen because of the following:

- There are no ambiguous requirements in the proposed project; requirements are so clear and understood.
- The required time to build the application is enough.

For those reasons, using Waterfall model as shown in Figure 3.1 will make the implementation simple, easy and manageable enough to complete it in short time.

- Advantages of using waterfall model.
  - This model is simple and easy to be understood and used.
  - It is easy to be managed due to the rigidity of the model
  - Phases are processed and completed one at a time.
  - Clearly defined stages.
  - Processes and results are well documented.

- In this model phases are processed and completed one at a time, so phases do not overlap.

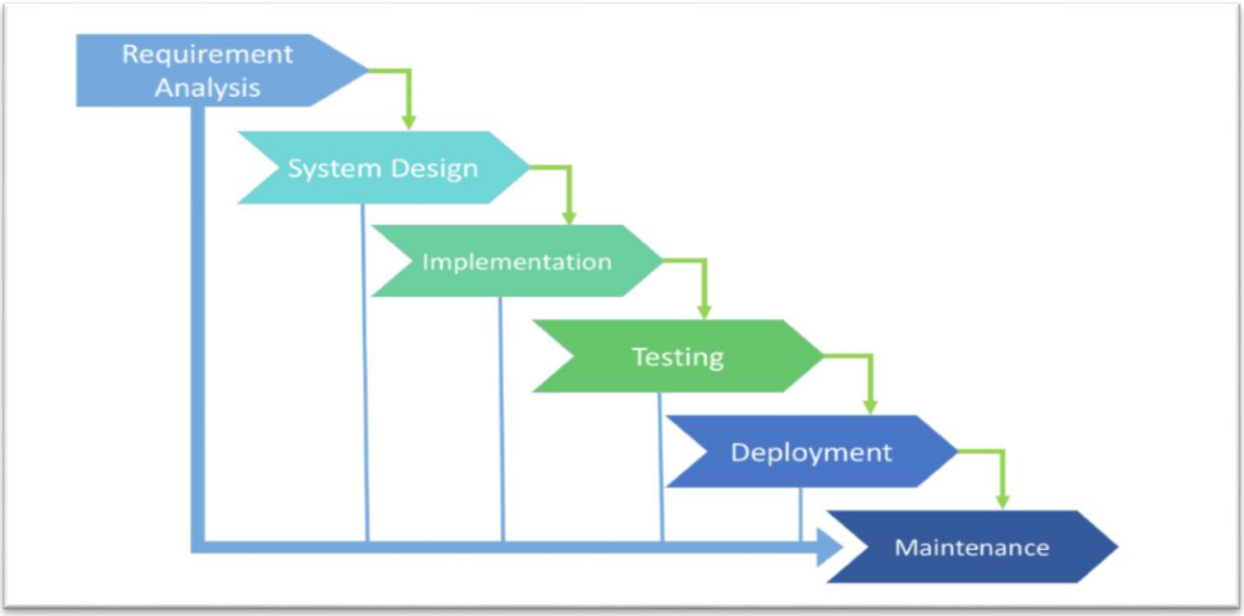


Figure 3. 1 Waterfall Model

3.3. Fact Finding Tools

3.3.1. Sampling of existing documentations, forms, and database or file.

The traditional way of studying used in Yemen is the theoretical way, which needs to be done by teachers, students, and the materials, such as books, or by students themselves and books. Books are the joint between teachers and students. They need them for teaching and studying, which contain plain texts and static 2D pictures. To show the ways that is used to describe the information in the books as a sample, the *"Introduction to Computer"* subject for first level students in FCIT will be taken, especially hardware components part witch is focused of the proposed application.

The hardware components part contains 2D pictures with texts that explain those components. Sometimes, students find it difficult to understand the real architectures of those hardware components from those 2D pictures and do not have any idea about the correct places that where those components should be plugged in computer. So usually, they just memorizing the definitions of those hardware components without knowing how actually it looks like in the real world. A sample from *"Introduction to Computer"* subject are showed in the Appendix A.

3.3.2 Questionnaire

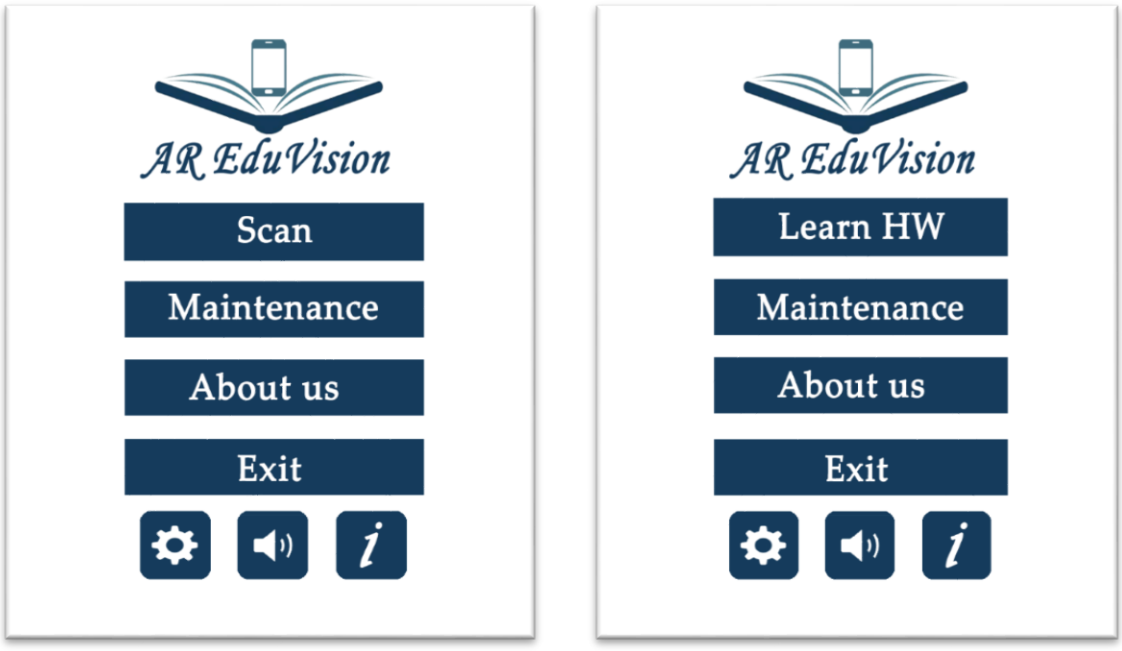
Questionnaire was distributed to different users, students, from different qualified environments. The number of replied Questionnaire 56 responses, a sample of the questionnaire will be shown in the Appendix B.

3.3.3 Interviews

The interview was done on Sunday 10/12/2017 at 2:30 pm at FCIT it took 35 minutes; the period of the interview was from 2:30 pm to 3:05 pm with Mr. Mohammed Fara as he works as a lecturer at FCIT for "*Introduction to Computer*" subject. As showed in the Appendix C.

3.3.4 Prototyping

A prototyping demo design was presented to the end users. The end users feedbacks about prototype design were such as button "Scan" as shown in Figure 3.2.a to be replaced with "Learn HW" as shown in Figure 3.2.b.



(a) (b)

Figure 3. 2 Interface of Main Menu

In addition, some of the prototype design that display the 3D model is shown in the Figure 3.3 this design is proposed to be changed. The help screen displayed when *"Screen Button"* pressed from the main menu as shown in Figure 3.4.

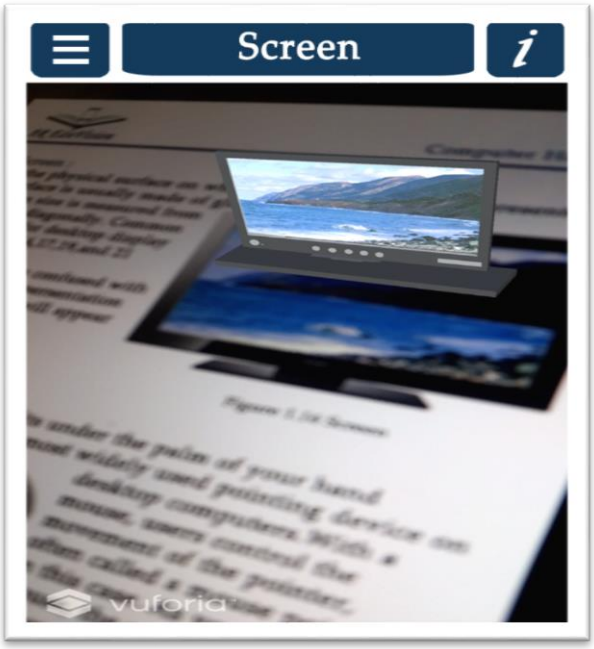


Figure 3. 3 Display 3D Model

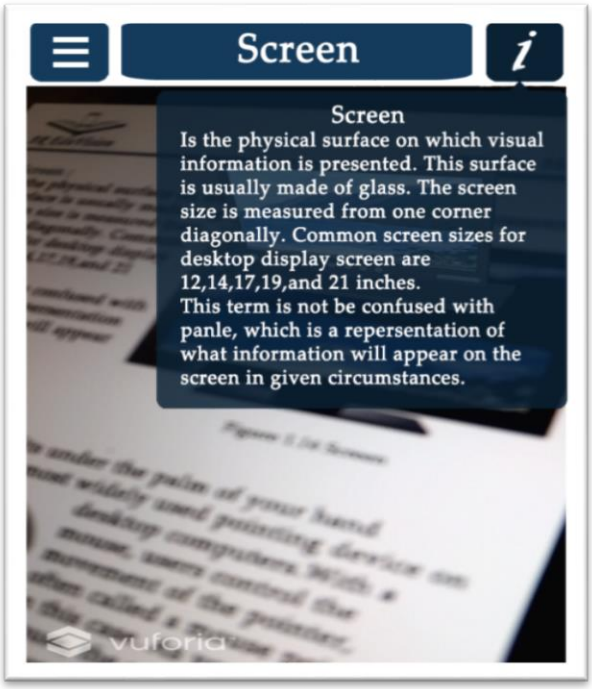


Figure 3. 4 3D Model Information

3.3.5 CASE Tools (Computer Aided Software Engineering)

- **Upper-Case Tools**
  - **Requirement Tools**
    - Microsoft office (Word, Microsoft Project, Power point)
    - E-drew Max
    - SAP PowerDesgin
  - **Design Tools**
    - Adobe Suit (Photoshop CS6 ,InDesign and ProShow Producer)
    - SketchUp
    - 3D MAX
- **Lower-Case Tools**
  - **Programming and Debugging Tools**
    - Unity
    - Vuforia Package
    - Android package
    - Visual Studio
    - MonoDevelop

3.4. Requirements Specification

3.4.1. User Requirements

The user requirements in AR EduVision are to make the education easier, more enjoyable, saving time, and cost effective.

- Students and casual users requirements
  - AR EduVision application should provide more information about the computer hardware components.
  - The application should save user cost, because the user does not need to use real hardware components for learning process.
  - User interfaces are easy to be used.
  - Students will have enjoyed interactive with the AR environment.
  - AR Eduvision has clear font and suitable size.

- **Teachers Requirements**

- They need techniques that facilitate their works and reduce their effort.
- AR EduVision application should include computer hardware components that mentioned in the "*Introduction to Computer*" Subject's book.

3.4.2. Functional Requirements

- **Scanning**

Users scan hardware 2D pictures by their smart phones cameras from the applications' attachment book, the application identifies the 2D picture and matches it with its 3D model. Then it will show the 3D model on the screen. After that, users will have other choices either to display basic information about the model and convert those information into speech, show the model's correct place in the computer or to make screen shot for the model and share the pictures via social media. If users do not have attachment book, AR EduVision gives them special feature that they can download all target pictures from the application to their gallery in their smart phones without needing for network connection.

- **Maintenance**

Users choose the 3D model that they want to know its correct place in the computer from the menu, and then they can drag the model and drop it into its place in computer hierarchy. AR EduVision application will help them to find the correct place of the 3D model in computer hierarchy by lighting the correct place of the 3D model.

3.4.3. Non-Functional Requirements

- **Usability**

AR EduVision application is usable, so anyone can use it easily from the first time without needing for training. In addition, it has clear and simple icons that everybody can understand and it will be attractive because of its special work that reflects physical world in interactive 3D environment, which can attract users. Developers can develop AR EduVision application and add more features so the application will be reusable.

- **Dependability**

  - **Reliability**

  AR EduVision is reliable, because the users scan a specific marker (2D pictures) then display its related information after processing function in a timely manner, so the probability of having wrong results will be very poor.

  - **Safety**

  AR EduVision has safe usage that will not affect users or the environment.

  - **Security**

  AR EduVision application does not receive personal information from users.

- **Performance**

  - **Response time**

  AR EduVision has fast response. Therefore, the taken time between one operation and another will be less than microseconds.

  - **Throughput**

  Supposed that AR EduVision will have the highest performance, so any operations will take less than microsecond.

  - **Availability**

  AR EduVision has been available for all users at anytime and anywhere.

  - **Accuracy**

  The 3D models with its information displayed accurately according to their 2D picture.

- **Supportability**

  - **Adaptability**

  AR EduVision can be installed only on versions of android devices that has 4.2 Jellybean version or later.

  - **Maintainability**

  AR EduVision is maintainable and developers can be able to add additional features to it any time.

- **Internationalization**

AR EduVision application language is English only

- **Portability**

Users only need to install AR EduVision application on their android mobile devices then they can use the application anytime anywhere without needing for network connection.

- **Validation**
  - **Complete**

AR EduVision must meet the requirements specification and insure that they are completed successfully.

  - **Consistent**

The data consistent does not contradict in design and performance because the operations done by series of steps.

  - **Unambiguous**

There is no ambiguity. AR EduVision achieves predefined requirements.

  - **Correct**

AR EduVision requirement specification represent accurately those computers' users need and correct output and report.

- **Other**
  - **Realistic**

AR EduVision works within predefined constrains and its 3D models will be presented depending on 2D marker.

  - **Verifiable**

After AR EduVision application is build, it takes several tests to ensure that it performs all functions according to the predefined requirements.

- **Traceable**

Each interfaces' buttons in AR EduVision application has been joined to specific object oriented code, so if there is any button that doesn't work well. Developer can go directly to its specific code and correct the mistake.

The main work of AR EduVision application depends on the compensation between the scanning inputs and data, which stored in the application database, so if there is an unaccepted result, developer in most of time will go directly to the database to discover the mistake.

3.5 System Models (UML)

These subsections describe models that developed during analysis phase:

3.5.1 Scenarios

AR EduVision application has two scenarios, one for scanning and the other for maintenance.

3.5.1.1 Scenarios 1 - Scanning

Users scan hardware 2D pictures by their smart phone cameras from the applications' attachment book, the application identifies the 2D picture and matches it with its 3D model. Then it will show the 3D model on the screen. After that, users will have other choices either to display basic information about the model and convert those information into speech, show the model's correct place in the computer or to make screen shot for the model and share the pictures via social media. If users do not have attachment book, AR EduVision gives them special feature that they can download all target pictures from the application to their gallery in their smart phones without needing for network connection.

3.5.1.2 Scenarios 2 - Maintenance

Users choose the 3D model that they want to know its correct place in the computer from the menu, and then they can drag the model and drop it into its place in computer hierarchy. AR EduVision application will help them to find the correct place of the 3D model in computer hierarchy by lighting the correct place of the 3D model.

3.5.2 Use Case Model

AR EduVision application use cases as shown in Figure 3.5 and Figure 3.6. Those two use case diagrams are Scanning and Maintenance, respectively.

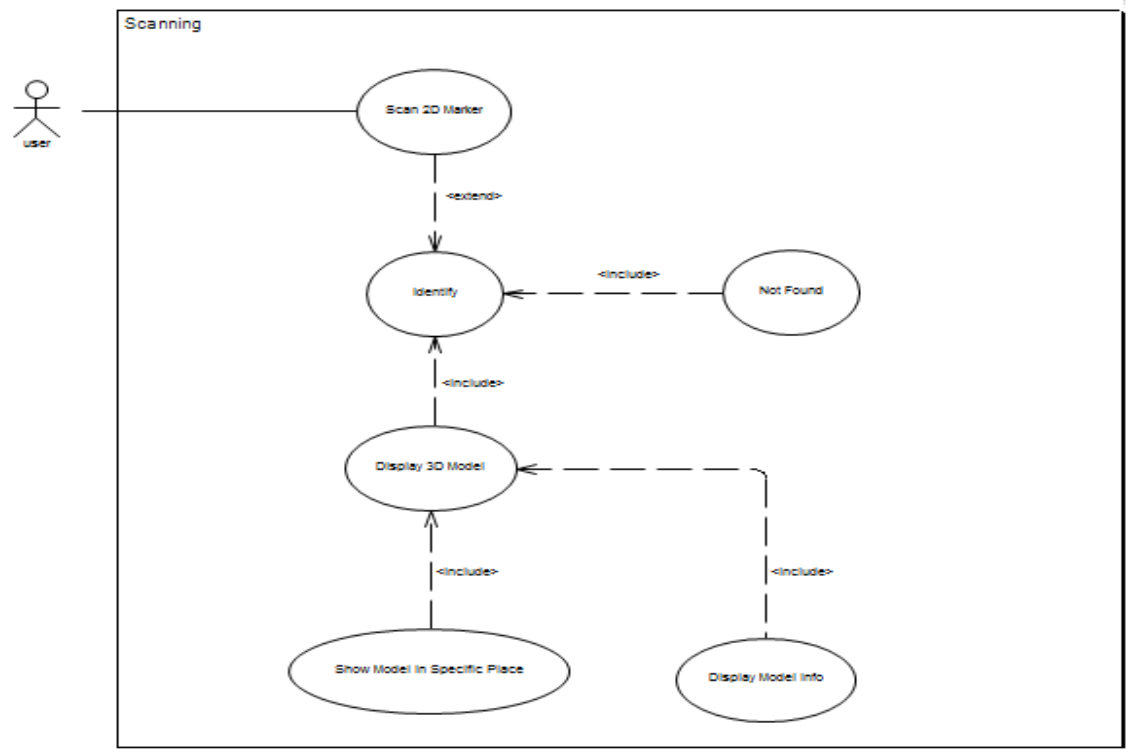


Figure 3. 5 Scanning Use Case

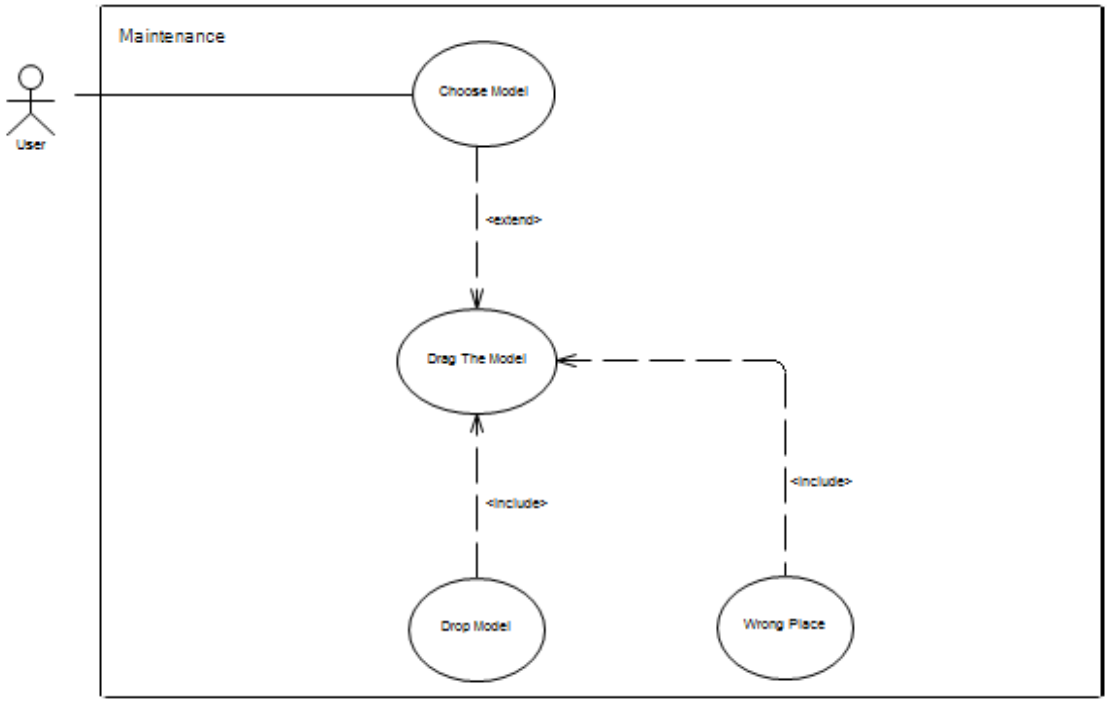


Figure 3. 6 Maintenance Use Case

3.5.2.1 Actors

AR EduVision application has one actor (student, teacher, or casual user), as shown in Table 3.1:

Actor Name	Actor Type	Access Type needed	Comments
Users (student, teacher, or casual user)	Primary Actor	Scan Maintenance	Scan the marker; Drag and drop components of computer

Table 3. 1 Actor Information

3.5.2.2 Use case details:

Table 3.2 shows AR EduVision scanning use case details.

<table>
<tr><td colspan="2">Use case name: Scanning</td><td>Unique ID: 001</td></tr>
<tr><td colspan="3">Area: AR EduVision application</td></tr>
<tr><td colspan="3">Actor: User</td></tr>
<tr><td colspan="3">Stakeholder: FCIT sponsor , AR EduVision users</td></tr>
<tr><td colspan="3">Level: Blue</td></tr>
<tr><td colspan="3">Description: After user scans 2D marker, the application will identify() the marker and match it with its 3D model. Then it will show the 3D model on the screen.</td></tr>
<tr><td colspan="3">Trigger Event: Scanning the marker</td></tr>
<tr><td colspan="3">Trigger type: ■ External □ Temporal</td></tr>
<tr><td colspan="2">Steps performance (Main Path)</td><td>Information for steps</td></tr>
<tr><td colspan="2">1- Running the application
2- Choosing the "learn HW" button from main menu
3- The application will open the camera of the device automatically
4- The user need to scan 2D marker
5- Identify 2D marker
• If found
Display 3D Model after that there are other chooses either to show model in specific place in computer hierarchy , display model's information and convert those information into speech, or to take screen shots for models and share the pictures via social media
• Else
Download all markers into users gallery in their smart phones</td><td>- None
- None
- None
- Scanned 2D marker
- 2D markers
• 3D Model, Information, Place pictures, and sound
• Markers</td></tr>
<tr><td colspan="3">Pre-condition: Scan 2D marker</td></tr>
<tr><td colspan="3">Post-condition: Display 3D model</td></tr>
<tr><td colspan="3">Assumption: The application runs in android environment</td></tr>
<tr><td colspan="3">Success guarantee: Show 3D model</td></tr>
<tr><td colspan="3">Minimum guarantee: The camera will be opened</td></tr>
<tr><td colspan="3">Requirements met: Android smartphone provides camera</td></tr>
<tr><td colspan="3">Outstanding issue: Providing attach book that include high quality images</td></tr>
<tr><td colspan="3">Priority: Medium</td></tr>
<tr><td colspan="3">Risk: Low</td></tr>
</table>

Table 3. 2 Use Case Details (Scanning)

Table 3.3 shows AR EduVision maintainance use case details.

<table>
<tr><td colspan="2">Use case name: maintenance</td><td>Unique ID: 002</td></tr>
<tr><td colspan="3">Area: AR EduVision application</td></tr>
<tr><td colspan="3">Actor: User</td></tr>
<tr><td colspan="3">Stakeholder: FCIT sponsor , AR EduVision users</td></tr>
<tr><td colspan="3">Level: Blue</td></tr>
<tr><td colspan="3">Description: user will choose 3D model from the application menu then drag the model and drop it into its specific place in computer hierarchy.</td></tr>
<tr><td colspan="3">Trigger Event: Drag and drop the model</td></tr>
<tr><td colspan="3">Trigger type: ■ External □ Temporal</td></tr>
<tr><td colspan="2">Steps performance (Main Path)</td><td>Information for steps</td></tr>
<tr><td colspan="2">1- Running the application
2- Choosing the maintenance button from main menu
3- Open the maintenance menu and virtual computer hierarchy
4- Drag the model from maintenance menu
• If right place
Drop the model
• Else
Model will return to its place in the menu</td><td>- None
- None
- None
- 3D model
• 3D Model and Place
• None</td></tr>
<tr><td colspan="3">Pre-condition: Drag 3D model</td></tr>
<tr><td colspan="3">Post-condition: Display 3D model in its specific place in computer hierarchy</td></tr>
<tr><td colspan="3">Assumption: The application runs in android environment</td></tr>
<tr><td colspan="3">Success guarantee: Show 3D model in its specific place</td></tr>
<tr><td colspan="3">Minimum guarantee: The applications' 3D models menu will be opened.</td></tr>
<tr><td colspan="3">Requirements met: Android smartphone provides touch screen</td></tr>
<tr><td colspan="3">Outstanding issue: Refusing the wrong 3D models dropping</td></tr>
<tr><td colspan="3">Priority: Medium</td></tr>
<tr><td colspan="3">Risk: Low</td></tr>
</table>

Table 3. 3 Use Case Details (Maintenance)

3.5.3 Object Model

3.5.3.1 Class diagram:

Figure 3.7 shows AR EduVision class diagram.

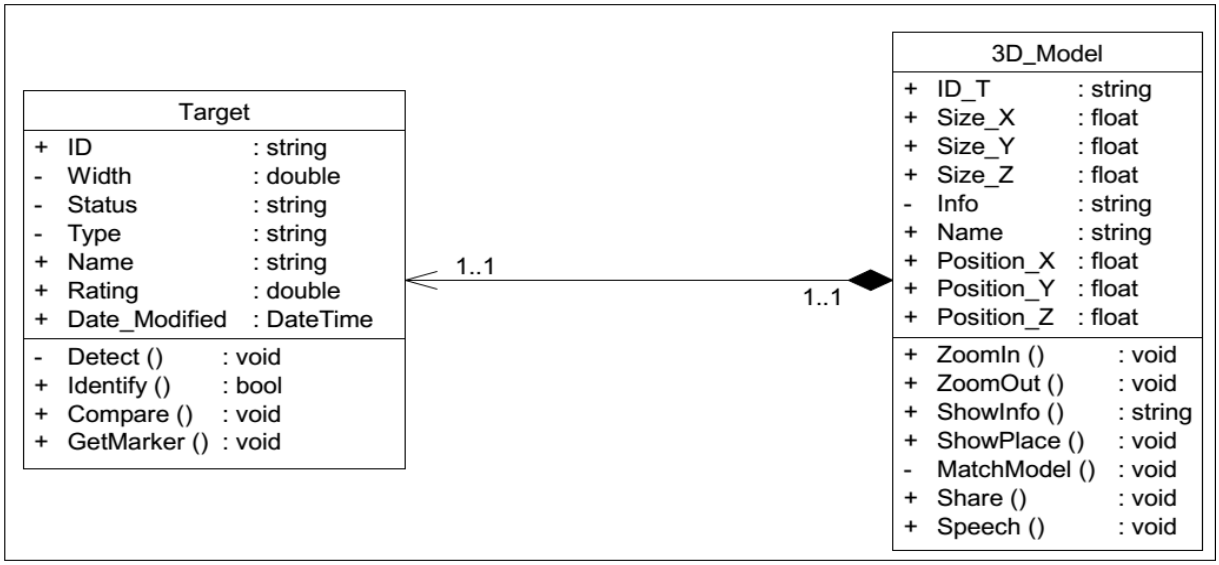


Figure 3. 7 Class Diagram

Table 3.4 Shows AR EduVision class diagram description.

Class Name	**Description**	**Stereotype**
Target	All markers in the attached book will be included within this class. This class will identify the marker which be detected by the smart phone camera using the identify() function. After that, the class will compare the detected marker with markers, which stored in the Database, if the marker is valid; the class will call the MatchModel() function that will match the marker with its appropriate 3D model and finally downloading all targets' pictures into smart phone gallery using GetMarker() function.	Entity
3D_Model	This class contains all the 3D models that will be displayed according to the detected marker, once the 3D model is displayed users will be able to make some actions such as; zoom in the model to see it in more clear vision using ZoomIn() function, returning back the model to its normal size using ZoomOut() function, knowing basic information about the model using ShowInfo() function, Converting those basic information to speech using speech()function, seeing the model in its specific place in the computer hierarchy using ShowPlace() function , taking screen shots for 3D models and share the pictures via social media using Share() function .	Entity

Table 3. 4 Class Diagram Description

3.5.3.2 Sequence Diagrams

- **Scanning Sequence diagrams**

Figure 3.8 shows AR EduVision Scanning Sequence diagrams.

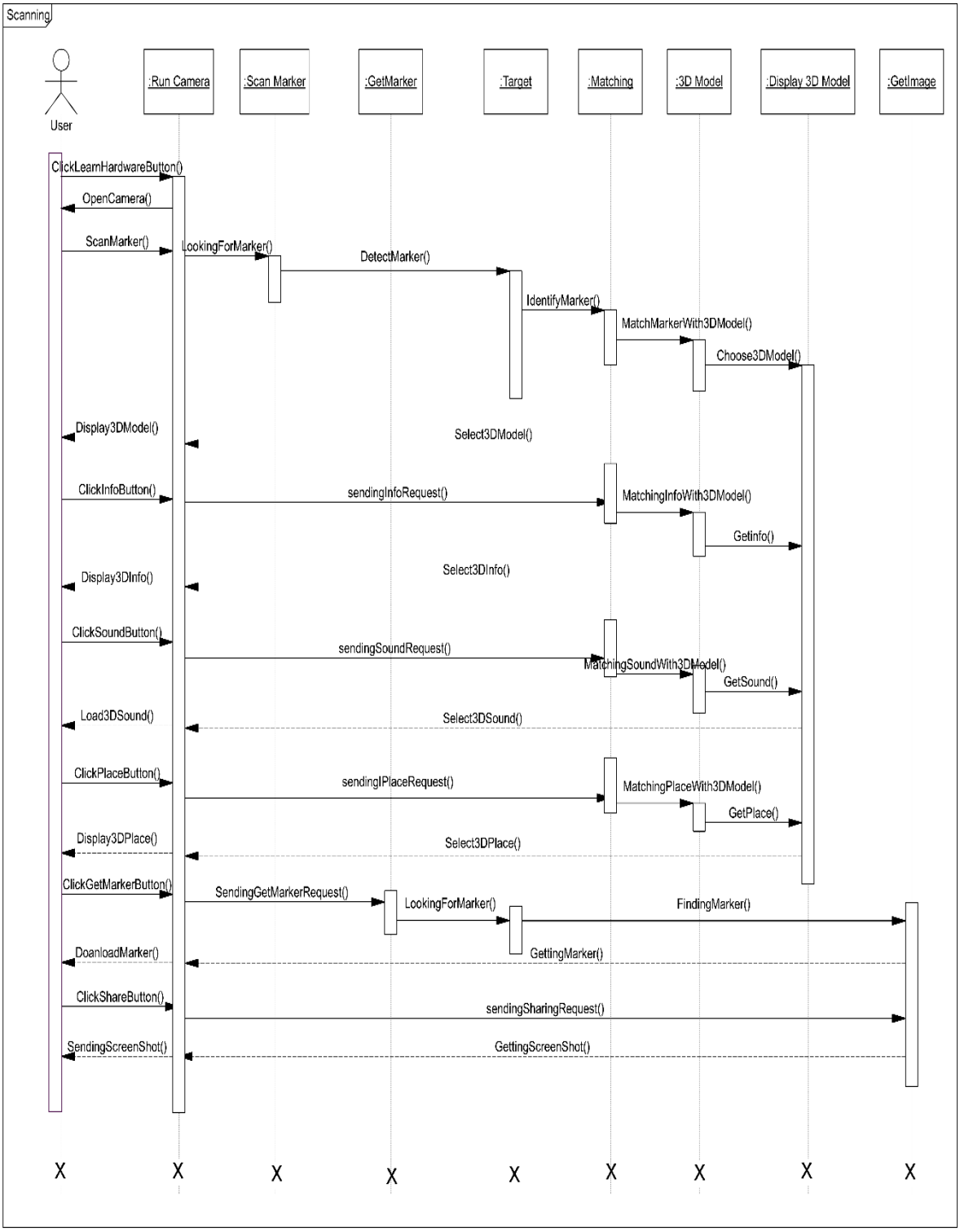


Figure 3. 8 Scanning Sequence Diagram

- **Maintenance Sequence diagrams**

Figure 3.9 shows AR EduVision Maintenance Sequence diagrams.

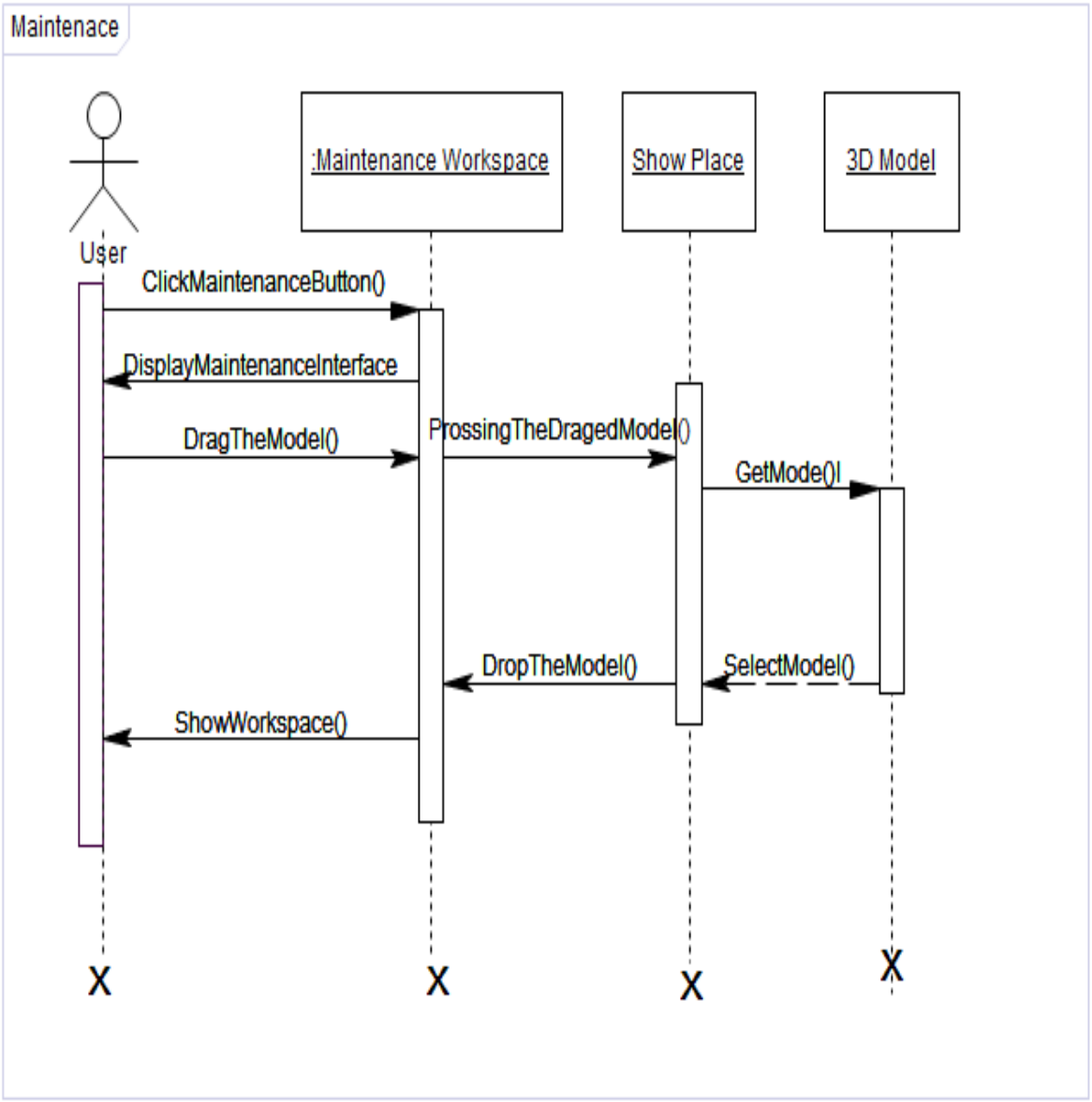


Figure 3. 9 Maintenance Sequence

3.5.4 Dynamic model

3.5.4.1 Activity diagrams

- **Scanning Activity diagram**

Figure 3.10 shows AR EduVision Scanning Activity diagram.

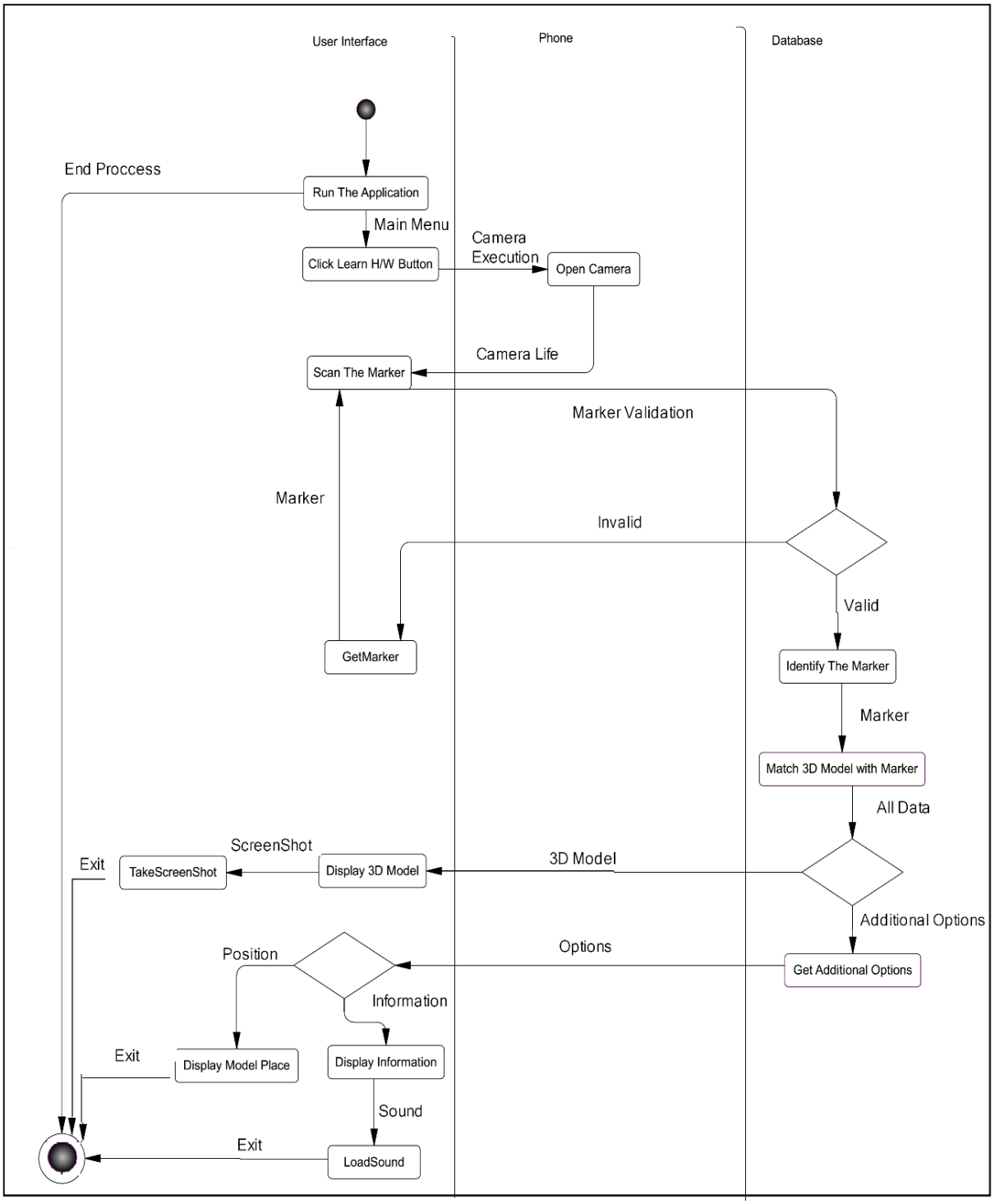


Figure 3. 10 Scanning Activity Diagram

- **Maintenance Activity diagrams.**

Figure 3.11 shows AR EduVision Maintenance Activity diagram.

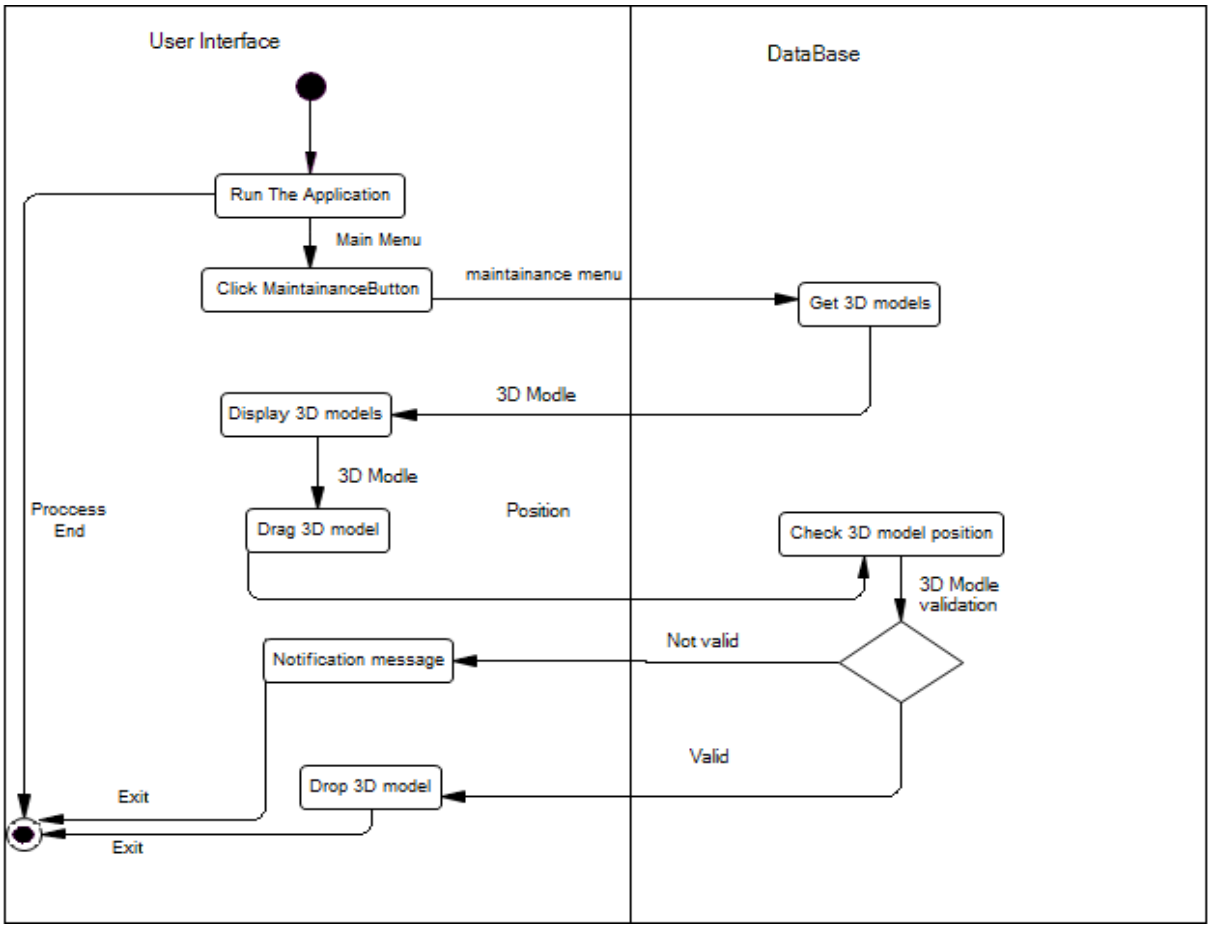


Figure 3. 11 Maintenance Activity Diagram

3.5.5 Database Model

AR EduVision works with Vuforia database that contents Target entity that stores data of markers. The target entity contents some attributes such as ID, width, Status of active, Target Type, Date Modified, Name, and Marker. The Target entity has one to one relationship with 3D model entity (one Target has one 3D model) the relationship is “scan” that identifies the marker and will show 3D model. The 3D object entity has one to one recursive relationship, the relationship “has” has a position attribute for maintenance process. The 3D model entity has some attributes such as Name, Size, Position, Information, and Speech.

3.5.5.1 ER schema

Figure 3.12 shows AR EduVision ER schema.

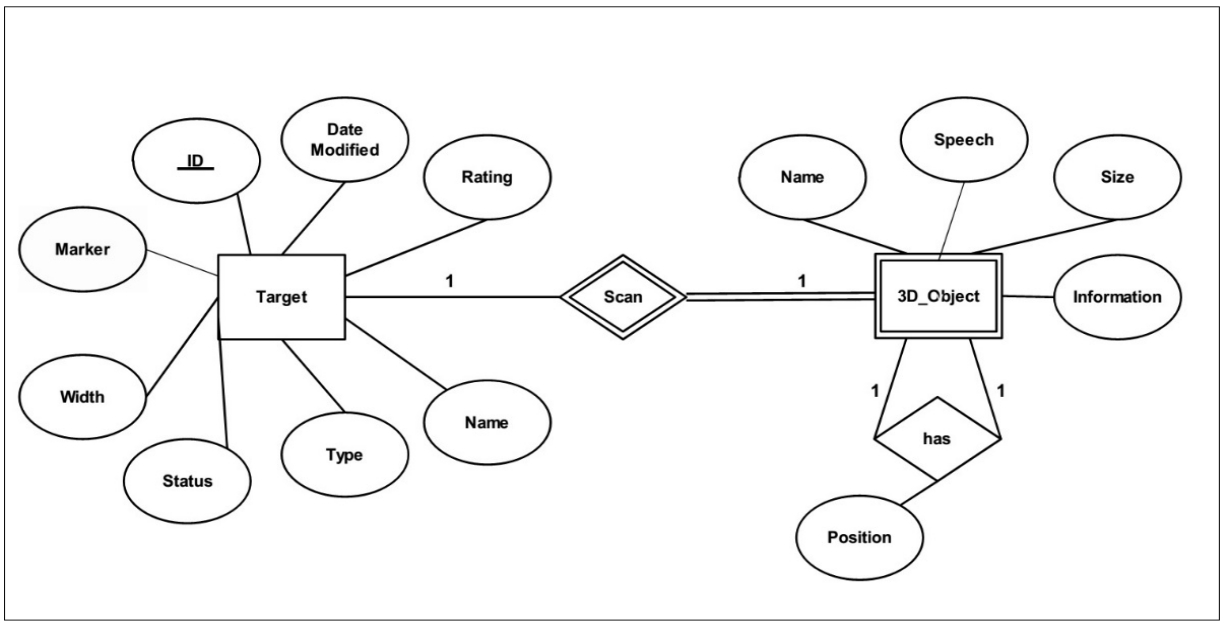


Figure 3. 12 AR EduVision ER Schema

3.5.5.2 ER diagram

Figure 3.13 shows AR EduVision ER diagram.

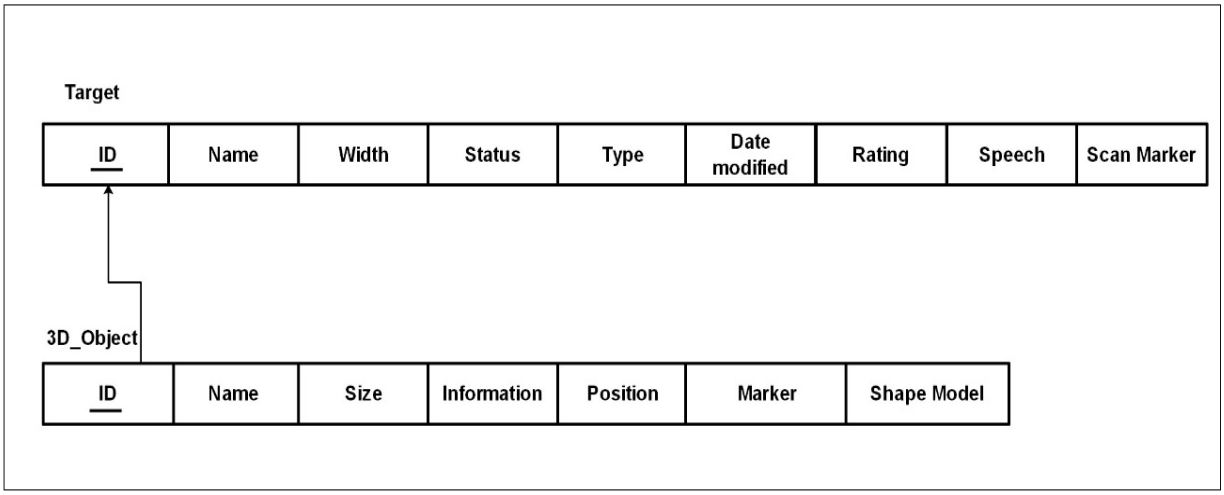


Figure 3. 13 AR EduVision ER Diagram

CHAPTER 4

SYSTEM IMPLEMENTATION

4.1 Overview

AR EduVision application were developed using several authoring tools. Unity environment was the main tool that they use to develop AR EduVision application, which is an android application that displays hardware components in 3D interactive environment. This chapter will describe the application design and each step that you need to deal with it easily. The design have been changed from the one in the prototype also, this chapter includes the application evaluation.

4.2 Application Design

Figure 4.1. show the main interface, which contain basic definition for AR EduVision application, the application logo, and five main buttons, which are help, learn HW, Maintenance, About Us, and exit.

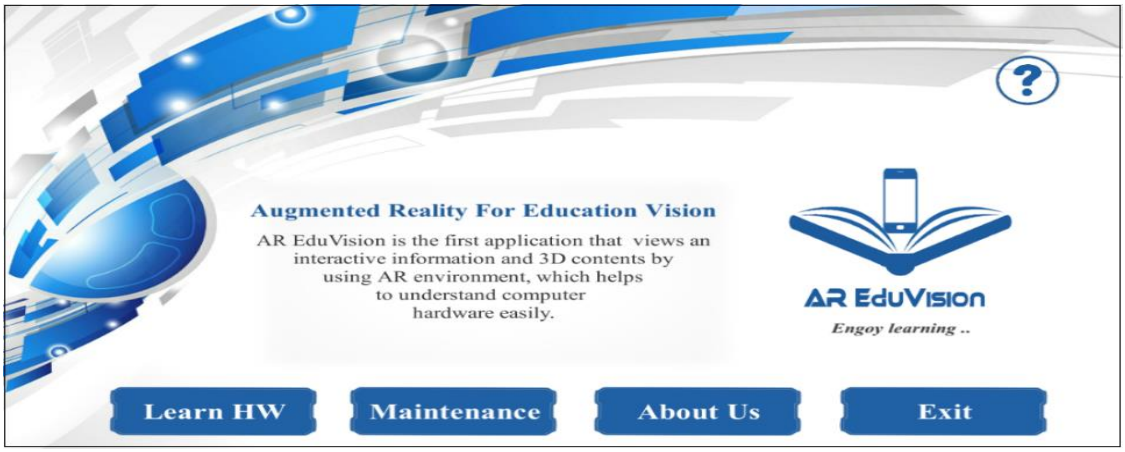


Figure 4. 1 Main Interface

Firstly, help button, which allows users to get a help about each step that they need to use AR EduVision. Help menu includes a welcome message and two buttons (Learn HW button, and Maintenance button) as shown in figure 4.2.

Learn HW button, which allows users to get into learn HW help section, which helps to understand the way of using scanning operation, by showing an animations that describe the operation. A simple interface shown in Figure 4.3.

Maintenance button, which allows users to get into Maintenance section, which helps to understand how to use Maintenance operation, by show them animations that describe the operation as shown in figure 4.4.

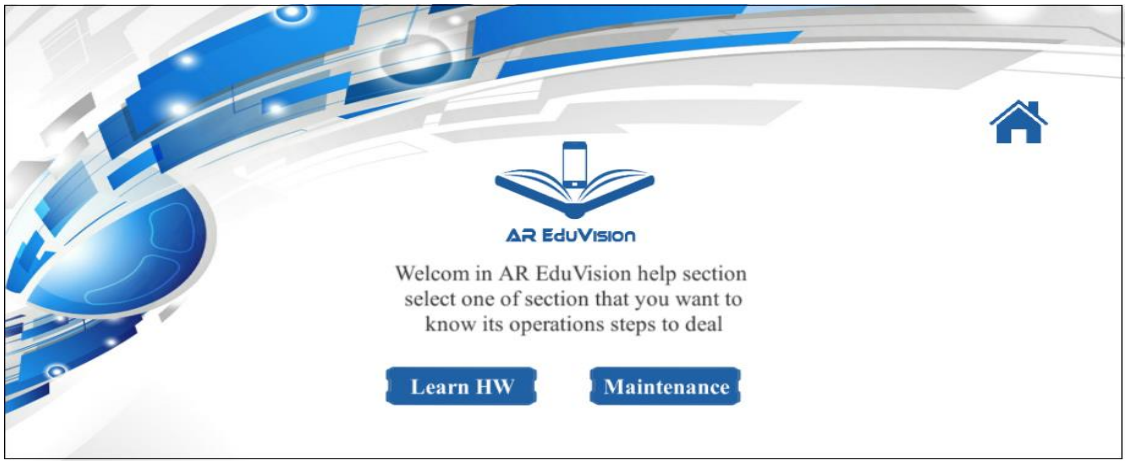


Figure 4. 2 Help Section Interface

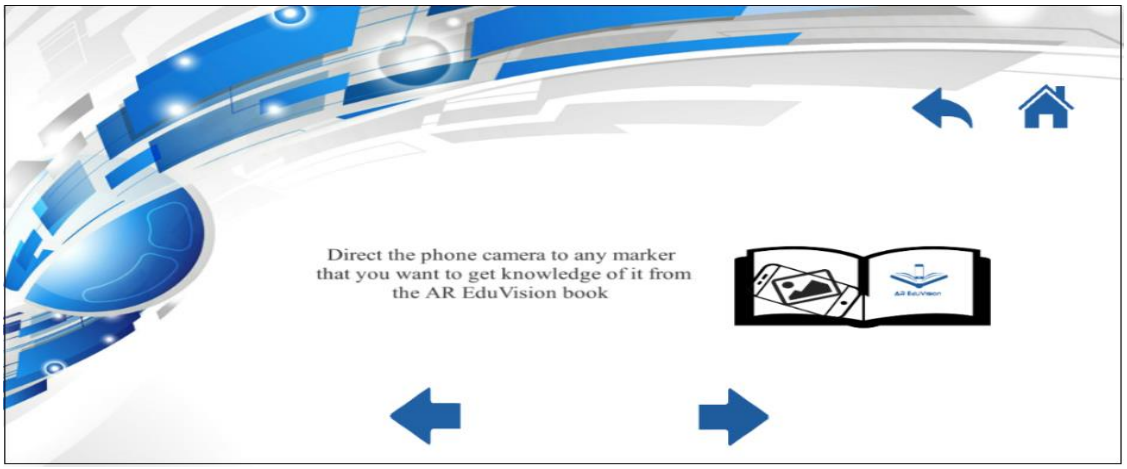


Figure 4. 3 Learn HW Help Section

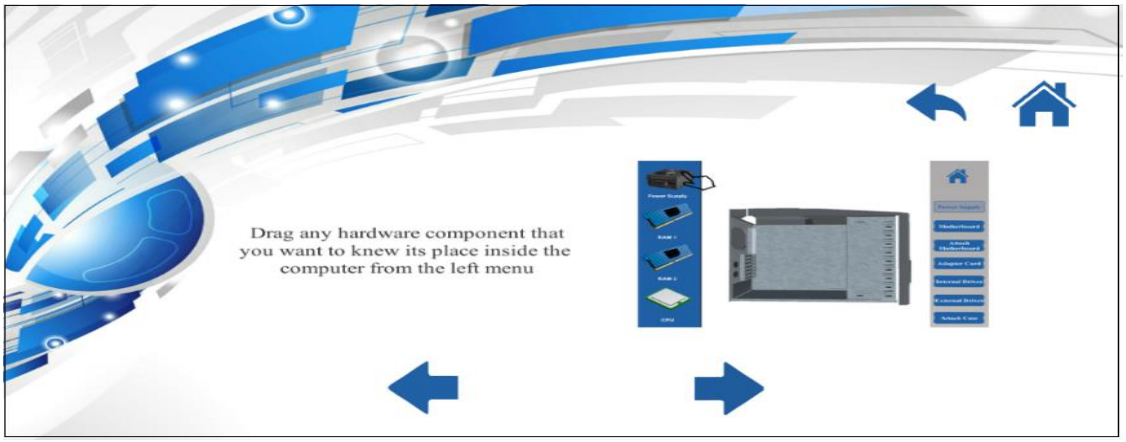


Figure 4. 4 Maintenance Help Section

Secondly, *Learn HW* button that lets user access to scanning section to start scanning operation. When user press *learn HW* button the scanning screen will be opened and the camera will run directly as shown in figure 4.5.

When direct the phone camera to the 2D markers, which are in the attached book the 3D model, will show up at the screen as shown in figure 4.6. A demo from the attached book will be shown in Appendix D.

More information about the 3D model can be shown when user press the *info* button in the right side menu of the screen, the information will appear on the screen. Furthermore, a *sound* button appear under the information, which will convert texted information to speech as shown in figure 4.7.

To know the place of the 3D model that you have chosen before, by clicking *show place* button from right side menu and it will show the place of that model in the computer as shown in figure 4.8.

Right side menu also contains others buttons, which are *share*, *home* and *exit* buttons:

- *Share* button takes a screen shoot for the 3D model and allows you to share a screen shoots with social media.
- *Home* button Return to the main interface.
- *Exit* button close the application.

In case the AR EduVision attached book not available with user, the application allows user to download the markers picture into phone gallery by pressing *Get Marker* button Get Marker that shown down side of the scanning screen as shown in figure 4.7.

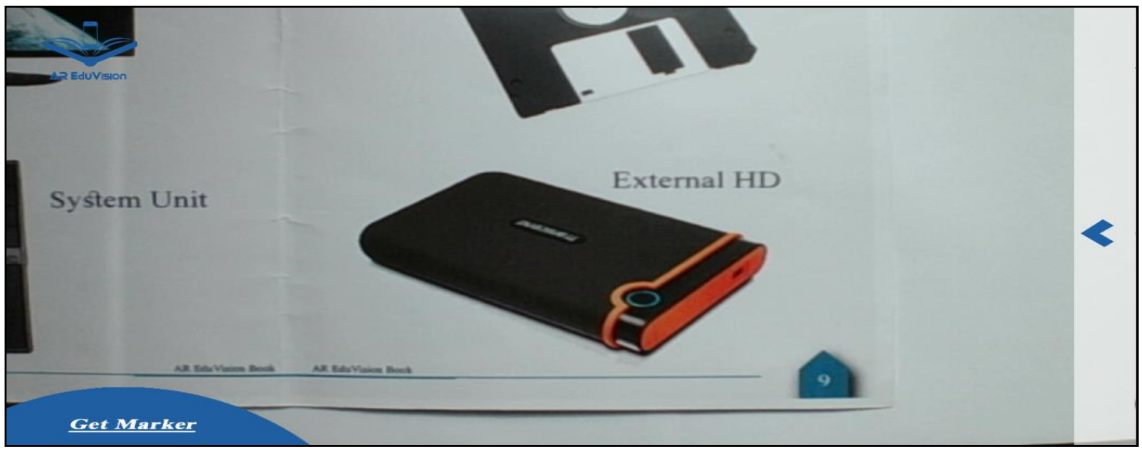


Figure 4. 5 Camera Open Directly

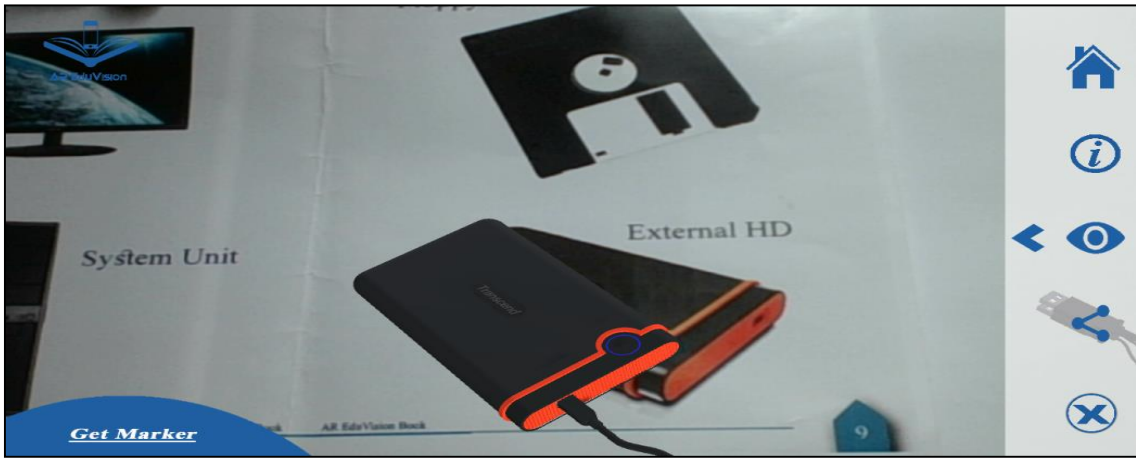


Figure 4. 6 3D Model Shows Up

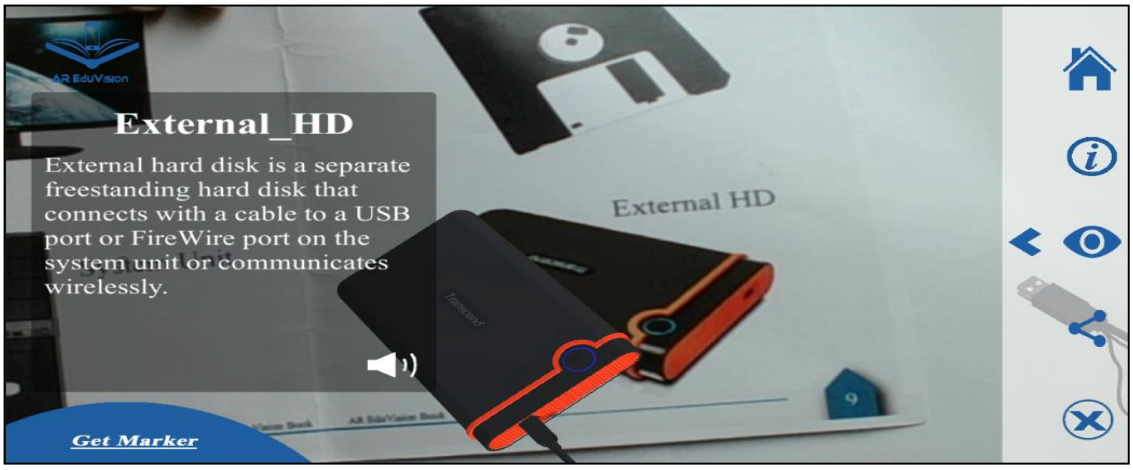


Figure 4. 7 Display 3D Model Information

Figure 4. 8 Scanning Section, HW Component Place

Thirdly, *Maintenance* button when user presses this button he/she will can try placing computer hardware components in their appropriate places in computer hierarchy.
Figure 4.9 describes the maintenance main interface, the left side scrolled par menu that includes internal HW 3D models.
Right side menu, which contains seven button and contains *home* button that return you back to the main interface.
When you press any button from the right menu, pop up message will appear in the middle of the screen and the related steps will be shown in the right side menu. This message contains a description about the 3D model that is included in the chosen step and contains *Next* button.
When press *Next* button, the inner side of the computer will be shown in the middle of screen and 3D models, which described before will be shown in left side menu as shown in figure 4.9.
Drag the showed 3D model and drop it into its highlighted specific place inside the computer as shown in figure 4.10.
Then *Step Back* and *Next Step* buttons will be shown automatically on the screen that let users go to the next step or return back one-step as shown in figure 4.11.

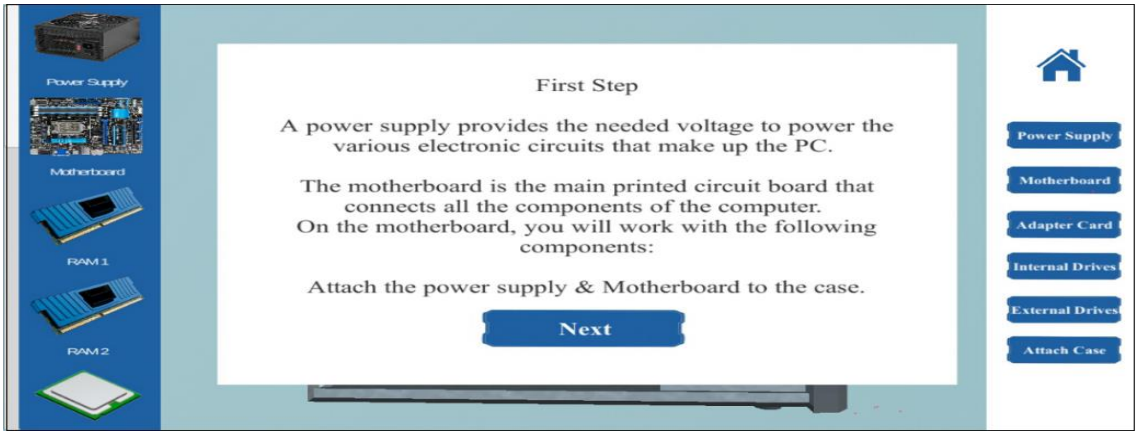


Figure 4. 9 Maintenance Main Interface

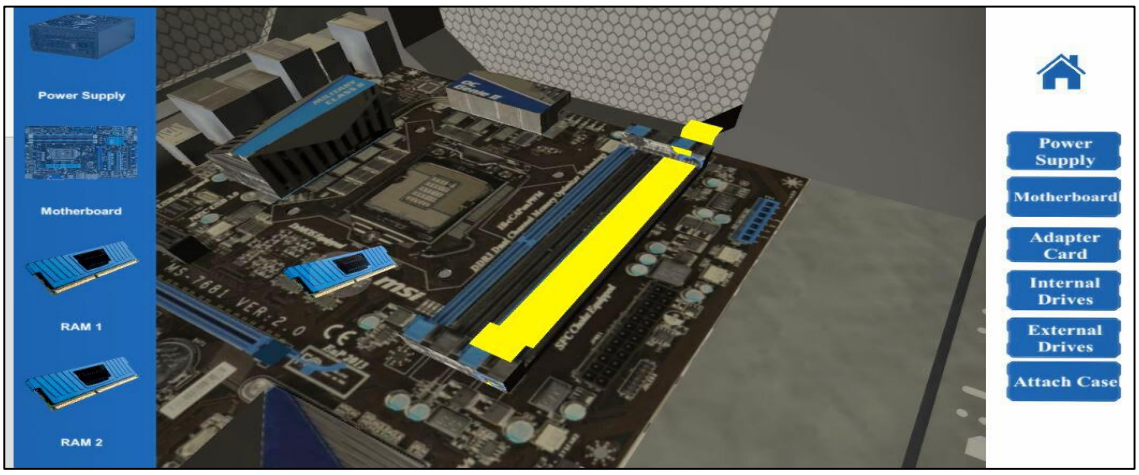


Figure 4. 10 Dragging and Dropping Operation

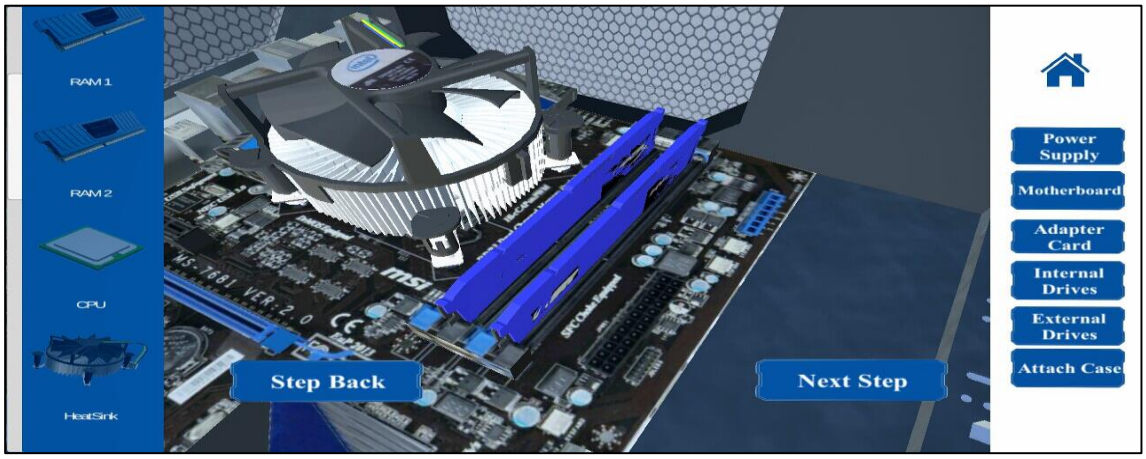


Figure 4. 11 Step Back and Next Step Buttons

Finally, *About Us* button, which allows users to get information and contact with the application developers.
This section contains basic information about the application and application developers. Users can find developers emails in this section to get contact as shown in figure 4.12.

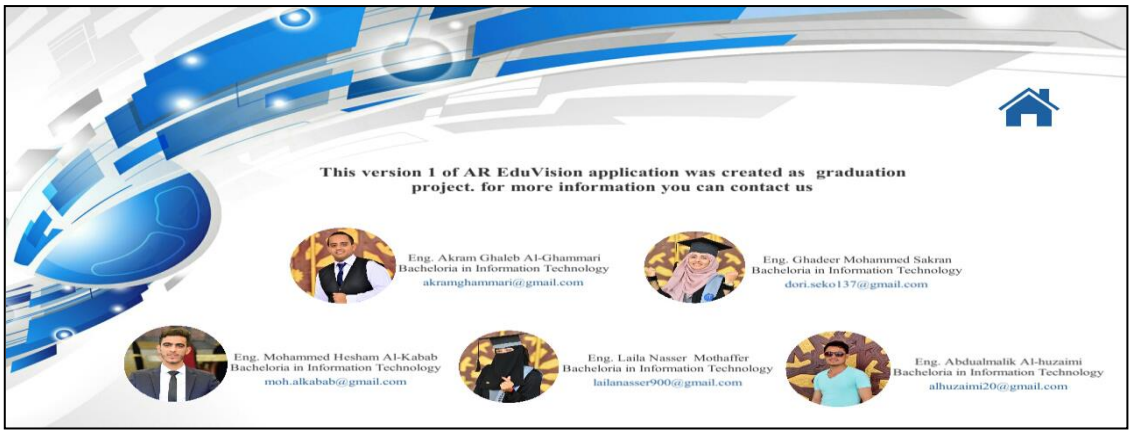


Figure 4. 12 About Us Section

4.3 Application Evaluation

The AR EduVision application were evaluated by end users. The result showed that, most users said that the application is flexible and easy to be used. Some of the users, mentioned that a bit difficulties since it first time to use.
Interesting and memorable test. The users like the interface design, which are interesting and easy to remember. They said that the application facilitates studying in learning computer hardware components. Some of them said that the application can be useful in self-studying, it could be as an alternative of the needing of opening computer hierarchy, and others do not agree with that opinion, since they need to see the physical components. The evaluation questionnaire shown in Appendix E.

- **End users recommendation**
  They suggest that to extend the application in other fields beside computer field such as mobile phones and other electronic devices.

CHAPTER 5

CONCLUSION, FUTURE WORK AND RECOMMENDATIONS

5.1 Conclusion

AR EduVision an educational application that gives users special chance to know and understand computer hardware components in more interesting way by using AR technique that reflect physical world in more interactive environment. This application views computer hardware components in 3D mode, display basic information about these components and let users practice their knowledge about the right places for each component in computer also it has more features as described in the upper chapters. AR EduVision application is also will have features that supposed to be in the future work. This chapter includes the future work points and recommendation.

5.2 Future Work

- Gives users more information to understand how each component works inside the personal computers.
- Let users know more about the real connections inside the personal computer and know the type of connection media and external cables.
- Support other platforms such as iOS.
- Add different languages to make AR EduVision international.

5.3 Recommendation

- Apply the application in the FCIT faculty.
- Study and practice AR technique to add special experience to your acknowledgment.

APPENDICES

APPENDIX A

A sample page of the *"Introduction to Computer"* book that was teach in FCIT, as shown in Figure A.1.

ACTIVE HELPDESK
Evaluating Your CPU and RAM
In this Active Helpdesk, you'll play the role of a helpdesk staffer, fielding questions about what the CPU does and how to evaluate its performance. You'll also field questions about how memory works and how to evaluate how much memory a computer needs.

SOUND BYTE
Installing RAM
In this Sound Byte, you'll learn how to select the appropriate type of memory to purchase, how to order memory online, and how to install it yourself. As you'll discover, the procedure is a simple one and can add great performance benefits to your system.

How much RAM do I need? At a minimum, your system needs enough RAM to run the OS. Running the 64-bit version of Windows 8.1 requires a minimum of 2 GB of RAM. However, because you run more applications at one time than just the OS, you'll want to have more RAM than just what's needed for the OS. For example, Figure 6.12 shows how much RAM is recommended for the OS, a web browser, and some software.

It's a good idea to have more than the minimum amount of RAM you need now so you can use more programs in the future. Remember, too, that "required" means these are the *minimum values* recommended by manufacturers; having more RAM often helps programs run more efficiently. New systems today ship with at least 4 GB of RAM, and high-end systems can come with 24 GB. The rule of thumb: When buying a new computer, buy as much RAM as you can afford.

FIGURE 6.12
Sample RAM Allocation

APPLICATION	RAM RECOMMENDED
Windows 8.1 (64 bit)	2 GB
Microsoft Office Professional 2013	2 GB
Internet Explorer 11	2 GB
iTunes 11	1 GB
Adobe Photoshop Elements 12	2 GB
Total RAM recommended to run all programs simultaneously	**9 GB**

Adding RAM

Is there a limit to how much RAM I can add to my computer? The motherboard is designed with a specific number of slots into which the memory cards fit, and each slot has a limit on the amount of RAM it can hold. To determine your specific system limits, check the system manufacturer's website.

In addition, the OS running on your machine imposes its own RAM limit. For example, the maximum amount of RAM for the 32-bit version of Windows 8.1 is 4 GB, whereas the maximum memory limit using the 64-bit version of Windows 8.1 Pro is 512 GB.

Is it difficult or expensive to add RAM? Adding RAM is fairly easy (see Figure 6.13). Be sure that you purchase a memory module that's compatible with your computer. Also be sure to follow the installation instructions that come with the RAM module. Typically, you simply line up the notches and gently push the memory module in place.

RAM is a relatively inexpensive system upgrade. The cost of RAM does fluctuate in the marketplace as much as 400% over time, though, so if you're considering adding RAM, you should watch the prices of memory in online and print advertisements. ■

FIGURE 6.13 Adding RAM to a computer is quite simple and relatively inexpensive. On a laptop, you often gain access through a panel on the bottom. *(Editorial Image, LLC/Alamy)*

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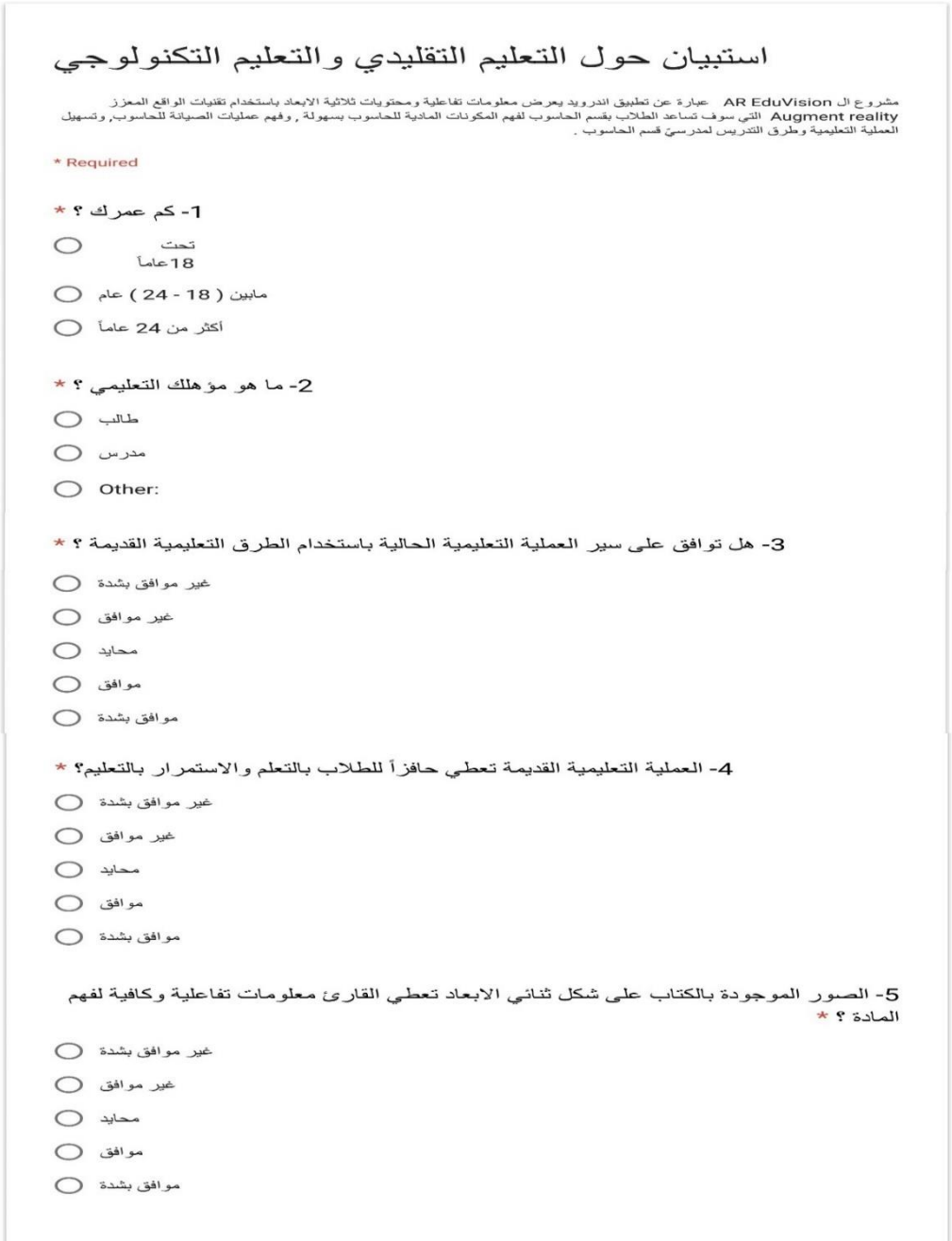
Figure A. 1 Sample from subject

APPENDIX B

Sample of questionnaire that contains a brief introduction of AR EduVision questions as shown below:



استبيان حول التعليم التقليدي والتعليم التكنولوجي

مشروع ال AR EduVision عبارة عن تطبيق اندرويد يعرض معلومات تفاعلية ومحتويات ثلاثية الابعاد باستخدام تقنيات الواقع المعزز Augment reality التي سوف تساعد الطلاب بقسم الحاسوب لفهم المكونات المادية للحاسوب بسهولة , وفهم عمليات الصيانة للحاسوب, وتسهيل العملية التعليمية وطرق التدريس لمدرسيّ قسم الحاسوب .

* Required

* 1- كم عمرك ؟

- تحت 18عاماً
- مابين (18 - 24) عام
- أكثر من 24 عاماً

* 2- ما هو مؤهلك التعليمي ؟

- طالب
- مدرس
- Other:

* 3- هل توافق على سير العملية التعليمية الحالية باستخدام الطرق التعليمية القديمة ؟

- غير موافق بشدة
- غير موافق
- محايد
- موافق
- موافق بشدة

* 4- العملية التعليمية القديمة تعطي حافزاً للطلاب بالتعلم والاستمرار بالتعليم؟

- غير موافق بشدة
- غير موافق
- محايد
- موافق
- موافق بشدة

* 5- الصور الموجودة بالكتاب على شكل ثنائي الابعاد تعطي القارئ معلومات تفاعلية وكافية لفهم المادة ؟

- غير موافق بشدة
- غير موافق
- محايد
- موافق
- موافق بشدة

6- استخدام الطرق التعليمية القديمة تسهل عملية الفهم لدى الطالب ؟ *

- غير موافق بشدة
- غير موافق
- محايد
- موافق
- موافق بشدة

7- طرق التعليم المستخدمة في اليمن تحتاج الى إضافة طرق جديدة وتقنيات الكترونية اليها ؟ *

- غير موافق بشدة
- غير موافق
- محايد
- موافق
- موافق بشدة

8- من فضلك قم بإضافة ملاحظاتك عن العملية التعليمية المستخدمة حالياً :

Your answer

9- هل توافق على استخدام تقنية الواقع المعزز Augment Realit في العملية التعليمية والتي تزود المستخدم بمعلومات تفاعلية على شكل ثلاثي الابعاد؟ *

- غير موافق بشدة
- غير موافق
- محايد
- موافق
- موافق بشدة

10- اختر كل طرق التعليم التي تريد ان تستخدم بكثرة في الطرق التعليمية و التي تساعد الطالب على فهم المادة ؟ *

- [ ] اللوحة والقلم
- [ ] الصور والأوراق
- [ ] الشاشات
- [ ] الاشكال
- [ ] استخدام تقنية الواقع المعزز Augment reality المجسمات الثلاثية الأبعاد
- [ ] Other:

11- تقنية الواقع المعزز Augment Reality ستساهم في عملية تطوير العملية التعليمية والارتقاء بها ؟ *

- غير موافق بشدة
- غير موافق
- محايد
- موافق
- موافق بشدة

12- تقنية الواقع المعزز Augment Reality ستوسع مدارك الفهم لدى الطالب ومساعدته في معرفه المعلومات بشكل اسرع ؟ *

- غير موافق بشدة
- غير موافق
- محايد
- موافق
- موافق بشدة

13- عملية الصيانة الوهمية بالواقع المعزز Augment Reality باستخدام أجهزة الهواتف الذكية ستساهم في عملية تعليم الصيانة للحاسوب وتقليل الخسائر لعمليات الصيانة بالطريقة اليدوية ؟ *

- غير موافق بشدة
- غير موافق
- محايد
- موافق
- موافق بشدة

14- إضافة ملاحظات عن العملية التعليمية الحديثة وتقنية الواقع المعزز Augment Reality :

Your answer

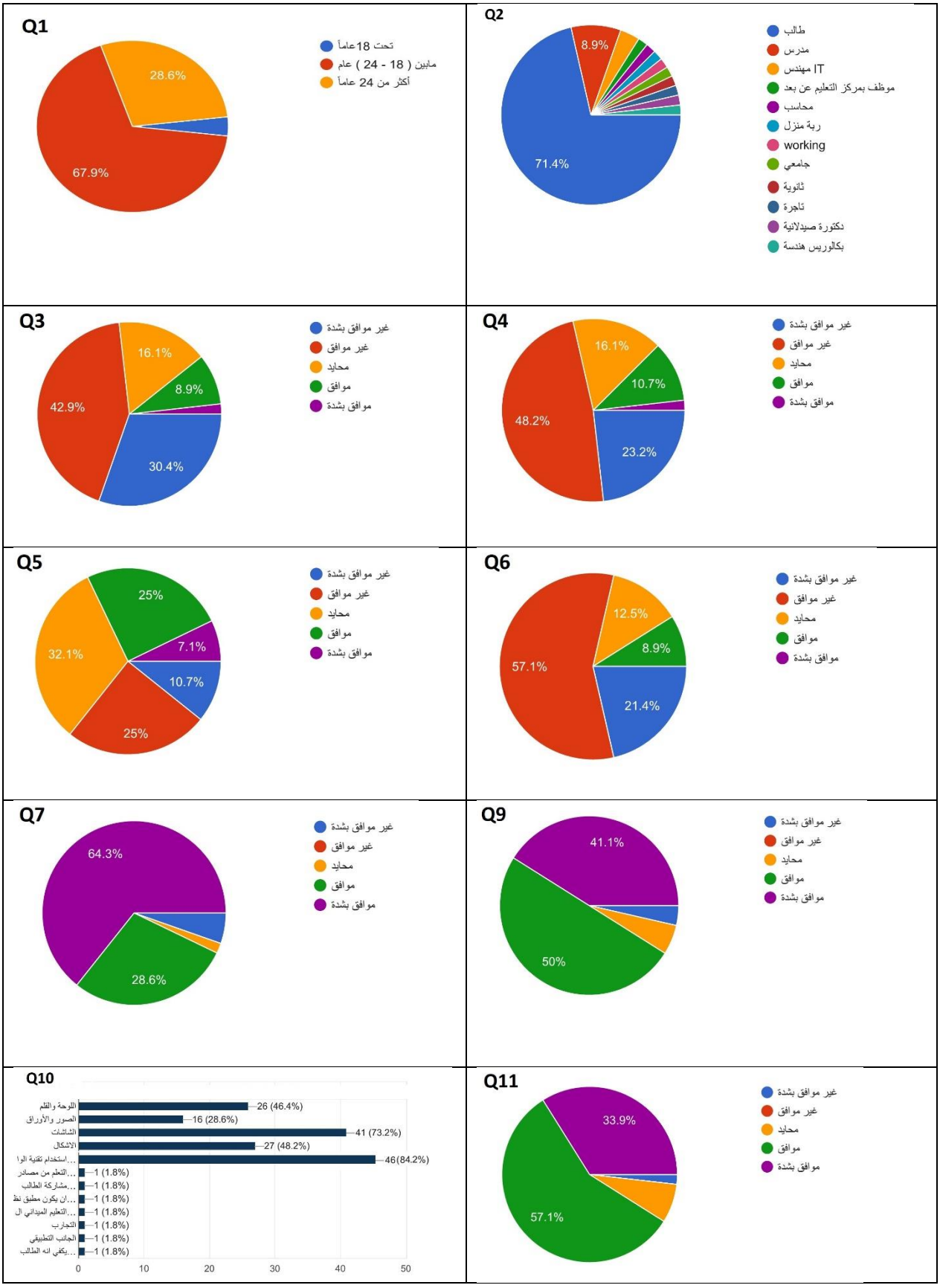
15- إضافة مقترح عن تطبيقنا AR EduVision :

Your answer

SUBMIT

Never submit passwords through Google Forms.

The rate of response Questionnaires shown in Table B.1.



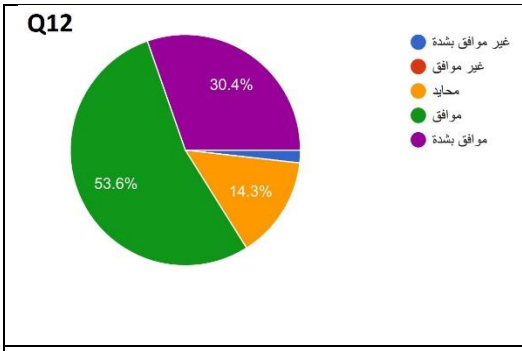
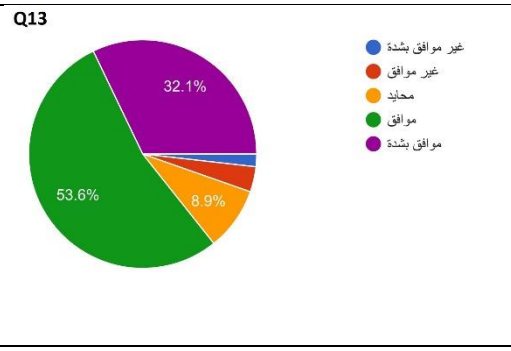
	
Q8 - Almost all the answers were that traditional education is boring and does not motivate students because they do not understand it well. So they need technology to facilitate education techniques.	
Q14 - Using this technique will motivate students and facilitate studying for them by adding interactive environment.	
Q15 - All of answers for this questions were agreeing that AR EduVision will facilitate the understanding of hardware components and knowing their correct places in computer except one answer was disagree with that.	

Table B. 1 Response Questionnaires

APPENDIX C

Sample of interview questions and interviewe answers as shown below

Ministry of Higher Education and Scientific Research
Sana'a University
College of computer & IT
IT Department

وزارة التعليم العالي والبحث العلمي
جامعة صنعاء
كلية الحاسوب وتكنولوجيا المعلومات
قسم تكنولوجيا المعلومات

Date: 10 / 12 /2017

Simple of Interview

1- هل سبق وقمت بتدريس مادة " اساسيات حاسوب"؟ وهل واجهت أي صعوبات في شرحها للطلاب؟

نعم، قمت بتدريسها مرتين في كلية الحاسوب وثلاث مرات في مركز الحاسب الالي بجامعة صنعاء. الصعوبات التي عادة ما تواجهنا في شرح المادة للطلاب هو ان الطالب ما زال مبتدئ في تعلم الحاسوب ولا يمتلك خلفيات سابقة عن مكوناته لذلك عادة ما يحمل بداخله تساؤلات كثيرة عن بنية المكونات المادية والداخلية للحاسوب وعن كيفية عملها وما مدى التفاعل بين مختلف مكونات الجهاز ولهذا السبب يريد رؤية هذه المكونات على ارض الواقع لتعزيز وترسيخ المفاهيم لديه.

2- هل جميع مكونات الكمبيوتر المادية متوفرة في المعامل؟ وهل هي كافيه ليقوم كل طالب بالتطبيق بمفرده؟

من الصعب توفير جميع مكونات الحاسوب المادية اللازمة في شرح المحاضرة للطلاب، قد يرجع ذلك لارتفاع تكاليفها او ندرة الحصول عليها في وضع شبة تالف لتقليل كلفة فكها وتركيبها من جديد اثناء الشرح. وفي حال توفرها جميعا قد تكمن الصعوبة في ان عددها غير مساوي لعدد الطلاب كي يتمكن كل طالب من التعرف عليها عن قرب وعن أماكن تواجدها في الحاسوب وقد يتطلب الامر الى عمل محاضرات إضافية كي يتمكن الجميع من التطبيق.

3- كيف ترى سير العملية التعليمية الحالية باستخدام الطرق التعليمية القديمة من وجهة نظرك؟

للأسف طريقة التعليم الحالية تعتمد على الجانب النظري فقط ولا توفر الفهم الكامل للطالب، على سبيل المثال المحاضرات المقامة في مجال الحاسوب قد تعلم الطالب مثلا ان هناك من مكونات الحاسوب قطعة تسمى (المعالج)، فكل ما يترسخ في عقلية الطالب هو اسم القطعة وتعريفها بشكل نظري، دون المعرفة بكيفية تركيبها او موقعها داخل جهاز الحاسوب.

Figure C. 1 Sample of interview page 1

4- ماهي الحلول والتقنيات التي تقترحها لخلق بيئة تفاعلية ومحفزة للطلاب لرفع مستوى استيعابهم ومستواهم الدراسي؟

من الحلول التقليدية والتي تتبادر الى الاذهان في مثل هذه المواقف هو توفير أجهزة حاسوب خاصة بكل معمل لكي تتيح الفرصة لأكبر قدر ممكن من الطلاب لمعرفة مكونات الحاسوب عن قرب ومعرفة اماكنها داخل جهاز الحاسوب، ولكن بسبب تكلفة هذه الطريقة واهدارها للوقت والجهد قد نفترض حلول أخرى بمساعدة التكنولوجيا وما تقدمة لنا من خدمات على سبيل المثال يمكن الاستعانة بالفيديوهات التي تقوم بشرح شامل وواضح عن كيفية تركيب مكونات جهاز الحاسوب خطوة بخطوة، هذه الطريقة ستساعد الطلاب على تكوين صورة واضحة عن طريقة تركيب قطع الحاسوب مما يسهل لهم تطبيق ذلك على ارض الواقع عند الحاجة الى ذلك.

5- من وجهة نظرك، كيف ترى استخدام تقنية الواقع المعزز Augment reality في العملية التعليمية والتي تزود المستخدم بمعلومات تفاعلية على شكل ثلاثي الابعاد؟

تقنية الواقع المعزز تعتبر من الطرق الأكثر افادة لإيصال المعلومة للطالب بشكل واضح وسلس، وذلك لان الطالب عادة ما يتفاعل مع المعلومات التي تكون على هيئة صور وحركات تفاعلية أكثر من تفاعله مع المعلومات التي تكون على هيئه نصوص نظرية، من فوائدها أيضا تقوم مثلا بعمل محاكاة لواقع بيئة الحاسوب مما يسمح للطالب بمعرفة جميع مكونات جهاز الحاسوب واماكنها الصحيحة بطرية سهلة ترسخ المعلومات في عقلية الطالب.

6- من وجهة نظرك هل سيقوم تطبيق AR EduVision بتقديم حلول فعالة في تطوير العملية التعليمية والارتقاء بها؟

من وجهة نظري، هو ان تطبيق AR EduVision سيقدم خدمات وتسهيلات للطلاب، أولا من حيث نقل المعلومات النظرية الى معلومات تصويرية ثلاثية الابعاد وعالم متحرك يساعد على ترسيخ المعلومات بشكل أسرع وأكبر، ثانيا انه سيوفر آلية تجريب للطلاب توضح لهم آلية وضع قطع الحاسوب المادية بشكل واضح ودقيق، ثالثا من الأشياء التي تميز التطبيق هو إيصال المعلومة للطالب مهما اختلفت اللغة التي يتحدث بها لأنه يعرض المعلومات على هيئة اشكال وصور معروفة مما يعطي إمكانية تجاوز اللغات لدى الطلاب، أخيرا فوائد التطبيق ستشمل أيضا الطلاب ذوي الاحتياجات الخاصة الذين لديهم قصور في السمع او النطق (الصم والبكم) لأنه يعتمد في شرح المعلومة على الصور والاشكال.

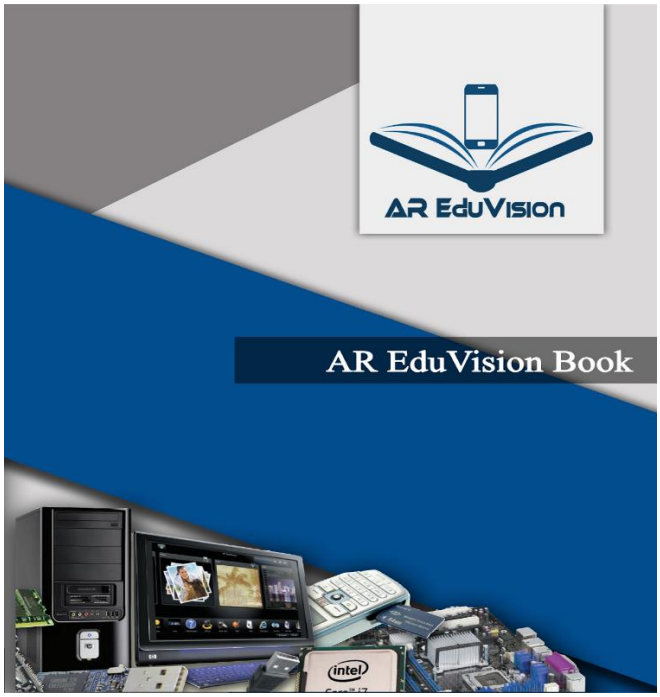
الأستاذ/ محمد فارع التوقيع /

2017-2018

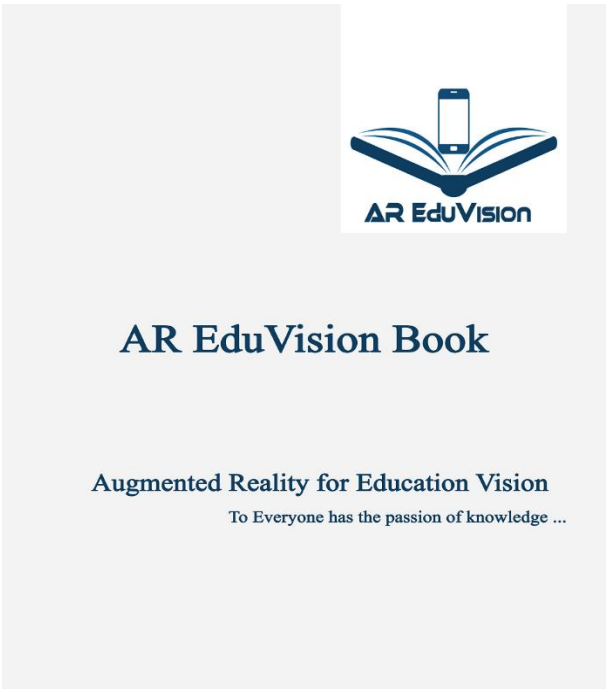
Figure C. 2 Sample of interview page 2

APPENDIX D

Sample of AR EduVision book is shown in Table D.1.

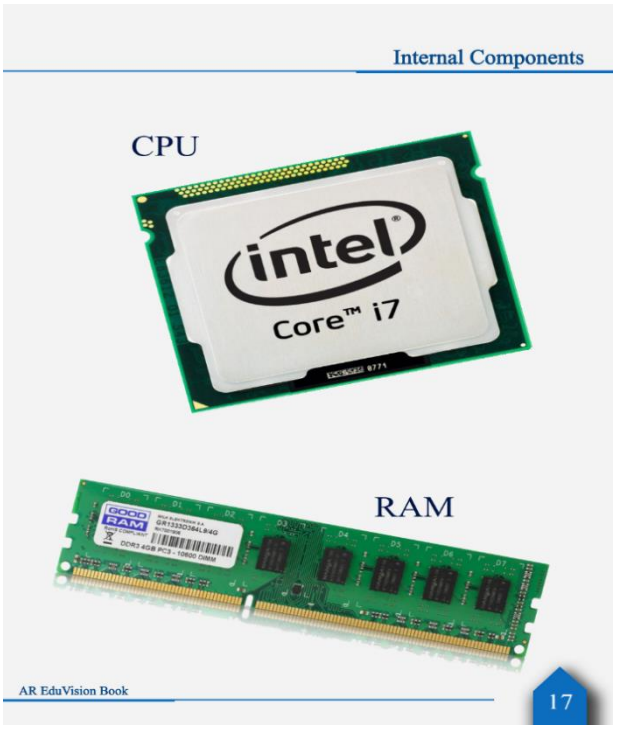


(A)



(B)

(C)



(D)

Table D. 1 AR EduVision book

APPENDIX E

Simple of AR EduVision evaluation questions as shown below.

AR EduVision

تقييم تطبيق AR EduVision

: (AR EduVision) Augmented Reality for Education Vision

هو تطبيق اندرويد يعرض معلومات تفاعلية ومحتويات ثلاثية الابعاد باستخدام تقنية الواقع المعزز Augmented Reality والذي سوف يساعد طلاب قسم الحاسوب لفهم المكونات المادية للحاسوب بسهولة وفهم عملية الصيانة للحاسوب . لتسهيل العملية التعليمية وطرق التدريس لمدرسي قسم الحاسوب.

1- من خلال استخدامك تطبيق AR EduVision هل وجدته مرن وسهل عند قيامك بتجربته؟

O موافق بشدة ✓ O موافق O محايد O غير موافق O غير موافق بشدة

2- من وجهة نظرك هل سهل التطبيق طريقة معرفة القطع المادية لجهاز الكمبيوتر؟

O موافق بشدة ✓ O موافق O محايد O غير موافق O غير موافق بشدة

3- من وجهة نظرك, هل وجدت تصميم واجهات التطبيق مناسبة من ناحية الألوان وحجم الخط وما الى ذلك؟

O موافق بشدة ✓ O موافق O محايد O غير موافق O غير موافق بشدة

4- التطبيق قد يغنيك عن الحاجة الى فتح جهاز الكمبيوتر للتعرف على القطع المادية مما قد يؤدي الى تلفها في حالة عدم معرفتك الصحيحة بطرق فتح الجهاز واعادته كما كان. هل توافق هذا الرأي؟

O موافق بشدة ✓ O موافق O محايد O غير موافق O غير موافق بشدة

5- هل وجدت التطبيق ممتع بحيث يجعك ترغب في استخدامه عدة مرات ؟

O موافق بشدة ✓ O موافق O محايد O غير موافق O غير موافق بشدة

6- من وجهة نظرك هل ساهم التطبيق في تطوير عملية التعليم الذاتي؟

O موافق بشدة ✓ O موافق O محايد O غير موافق O غير موافق بشدة

7- من خلال استخدامك للتطبيق هل وجدت أي قصور فيه؟

لا يوجد اي قصور تطبيق رائع ومهم لحاجة الطلاب في مجال الحاسوب والهندسة والتكنولوجيا بشكل عام

8-هل توجد لديك اي مقترحات اضافيه؟ ماهي؟

لا يوجد حالياً

Figure E. 1 Application Evaluation

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