Tajweed Rules Haptic Application with Sound for Visually Impaired People

by

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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Approved by,

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(Dr Suziah Binti Sulaiman)

UNIVERSITI TEKNOLOGI PETRONAS
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CERTIFICATION OF ORIGINALITY

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

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ATIQAH SHAHIRAH BINTI AZMAN

ABSTRACT

Every Muslim in this world needs to read Quran as one of religion activities in Islam. Quran can be read in a book and even in digitalized form of Quran such as in mobile phones and also electronic type of Quran. However, blind people are unable to read Quran in book form and digitalized form. Therefore, this project aims to address the problems faced by blind people and partially impaired people to learn on how to recite Quran with right Tajweed which synchronizes audio and haptic. Interview session with blind people and partially impaired people will be done to determine what are the limitations and problems faced by them during reciting Quran. Respondents from Malaysian Association for the Blind (MAB) will be the main focus group for this project. Hence, this research study will discover ways to help blind people and partially impaired people to read Quran with right Tajweed and right pronunciation. This project is hoped to successfully help blind people and partially impaired people to teach and learn on how to recite Quran properly with the help of Braille Line 20 haptic and audio application.

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CHAPTER 1

INTRODUCTION

1.1 Background of study

According to Shamimi, F. (2014) in her study: Interfacing Quranic Verses with Tajweed Rules using Braille Line device, a survey question was raised to determine whether the respondents have any frustration or difficulties in learning and reading Quranic verses. Surprisingly, 50% of 6 answers from the respondents mentioned that they need assistance to read or pronounce the words correctly to them. It shows the fact that half of the respondents are comfortable relying on audio when learning and reading Quranic verse to make sure that they can pronounce it with right Tajweed. Due to this, it is important to add audio elements to the current Quranic verse reading technology, especially for people that are partially impaired. This is because people who are partially impaired just started using Braille line when they are losing their vision compare than people who are blind from birth, and this makes it difficult to use Braille line for Quranic verse without help of audio elements. People who are full blindness have been using Braille line from the beginning and it makes it easier to use Quranic verse Braille line.

Therefore, this project aims to address the problems faced by blind people and partially impaired people to learn on how to recite Quran with right Tajweed which synchronizes audio and haptic. The system would aid blind people and partially impaired people to read Quran and at the same time provides the users effective audio help that pronounce Quran Tajweed with right way. The author aim this project is hoped to help those who really need this system and enhance Tajweed knowledge in Muslim users.

1.2 Problem Statement

Societies including those who are disabled such as blind or visually impaired people also want to learn and gain knowledge about Tajweed rules. Recently, there is an existing project that presents a new technique in reading Quranic verse using Braille Line 20 by matching each letter to its associated Tajweed rule. It helps blind and partially impaired people to read Quranic verse using haptic exploration on Braille Line 20. However, one of the method that can improve the blind user's knowledge about Tajweed rules is to add another element which is audio elements so that blind users will hear the right pronunciation of each Tajweed rules. This is missing in the existing project i.e. audio elements have not been created and used. It focuses on the haptic application rather than audio elements. This may confuse the blind users and partially impaired users since they do not know how to pronounce each Surah sentence correctly. Hence, this project is to add a special feature to optimize the knowledge of blind users about Tajweed rules.

1.3 Objectives of the Project

The main objectives of this project are as follows:

i. To develop an audio-haptic application of Tajweed rules for visually impaired people.
ii. To test and measure the effectiveness of the audio-haptic application to visually impaired people.

1.4 Scope of Study

- Visit Malaysia Association for the Blind (MAB) Kinta, Ipoh, Perak to do data gathering and user testing. The system will be tested to the teacher and students (blind and partially impaired) in MAB.
- Visually impaired people are divided into people that are blind from birth (full blindness) and people that are partially impaired (losing sight due to some causes).
- The surah that will be focused is Surah Al Fatihah.

1.5 Relevancy and Feasibility of the Project

This project is relevant to business information system and information technology section because it includes the technology to enhance the haptic application to help blind users to read and recite Quran with right pronunciation. This project may require improved technologies in the audio elements. This project also helps the society that needs help. Other than that, this project is very relevant due to the technology and methods used nowadays to improve the knowledge of society. The outcome of this project will benefit society especially the one who really needs it such as blind users to read and recite Quran with right Tajweed.

This project is feasible because it can be programmed by computer and software designed to add audio elements in the application of Tajweed for blind users. An audio part can be programmed to help blind users to read and understand the Tajwid rules. This project is developed to synchronize audio and haptic to read Tajweed rules with right pronunciation and eventually will test the system with the target users. Zainal Abidin et. al (2012) reported that there is a significance improvement in performance when audio and haptic feedback are being used while accessing information for blind users.

This project was completed according to the time frame allocated by the university. The research and development of the system were discussed and completed in two semesters which were approximately eight months duration. Final year project is divided into two semesters. The first semester focused on the planning, research, analyze the data and documentation. Second semester focused on the development and user testing. Some limitations and challenges occurred during the process as the time period for the project was short.

CHAPTER 2

LITERATURE REVIEW

The word ‘Haptics’ are refers to the human tactile (cutaneous - nerves in human body) and kinaesthetic (muscle movement) senses. In the last decade, haptic applications have received enormous attention in the world of technology. The diversity of haptic interfaces, rendering algorithms, and virtual environment modelling have made the development of haptic-visual applications a time consuming and tedious task that requires significant programming skills. This ongoing project focuses on the developing an audio elements based on real-time, virtual reality haptic application.

Many researches in the world already conducted a research project on electronic devices and software to help blind people to read documents and written communication. Braille device is the main and worldwide known system for blind people in the world. Braille device is a system of touch (haptic) reading and writing for blind people in a way dots in the device will rise and sink to represent the alphabet. Braille device also contains punctuation marks and symbols to show letter groupings. This device also can help blind people and visually impaired people to read Quran. There will be raised dot and sink dot that represent Quran alphabet and will help them read Quran. Saad (2010), in his work proposed a system called eBraille which is an electronic Braille panel for reciting Quran. Special vibration from the eBraille will help blind people to read Quran. Meanwhile, Khoni (2010) proposed a portable electronic Braille that can be connected to a computer or laptop and helps blind people and visually impaired people to learn and read Quran.

Adding audio elements will help blind people to read and learn Tajweed with right pronunciation and right meaning. It was prove to be right when Mssraty (2012) also mentioned in his research that audio elements or speech recognition will help blind people read Quran as it should be. Msssraty (2012) and Hamid (2006), both discussed a multimedia type of system with pre-recorded Quran recitations, recitation teaching text materials and some animations will help students to learn on how to recite Quran and correct their mistakes in Tajweed pronunciation. All those proposed research would help boost learner's skills in reciting Quran with right Tajweed, change their attitude, motivation, grade and knowledge. Unfortunate group of people such as blind people, visually impaired people and others desperately need Quran Braille system that can help them recite Quran.

2.1 Haptic Application

Touch is very important to human, as demonstrated by any child who, when asking to 'see' an item, will reach out its hand to palpate and get the 'feel' of the object of interest. The ability to stimulate sense of touch, using computers, has finally arrived (Vahora, n.d.). Sense of touch can also be called as human haptics while computer haptics is simulating human haptics with a device. Haptic interface aim is to provide access for blind people to the graphics-based computer interfaces and also connected to digital sound element. According to Sarkar (2012), he mentioned that due to the lack of vision, the blind people cannot access the latest technologies and information which can provide them an alternating communication expertise. New and modern technological enhancements cannot be easily affordable to the visually impaired people and also blind people because of their high cost and the less portability. It is important and become necessary nowadays to develop a low cost, portable and a fast Braille system for the blind people and visually impaired people.

Haptic application is a new communication channel for the blind people and visually impaired people who consist of three different sub systems that provide different facilities to help and improve the communication skill of the visually impaired people. With a haptic interface, screen objects such as sliders, pull down menus, and also buttons are presented mechanically to the user's haptic senses

(kinesthetic and tactile) but in this project it is referred to the Braille device. According to Gillespie, he mentioned that haptic interface device should become standard computer interface tools, supplementing the visual presentation with haptic presentation for all users. A haptic interface is a computer-controlled motorized device that will be held in the hand by a blind user, and it will displays information to that user's haptic senses. One of the advantages of using haptic application is it can reduce the burden on other information channels such as vision and audition, thereby freeing these channels for other tasks.

2.2 Existing Technologies to Improve Reading Document among Visually Impaired and Blind Users

Some technologies that help blind people and visually impaired people to read actually exist in the world. The assistive technology being used for the visually impaired is much dependent on the degree and type of visual impairment. Technology makes computers accessible to people who are blind or visually impaired, or even people who have trouble seeing the keyboard and monitor. Some existing technologies enable computers to talk, scan and even read any documents. It also can make items on the screen bigger and easier to see for visually impaired people. Braille device also one of the technologies that help blind users gain information and knowledge. Those existing technologies are Braille device, screen reader, screen magnifier, optical character recognition (OCR) and others.

2.2.1 Braille device

As stated by Sarkar, 2012, the visually impaired people and also the deaf-blind people faces different predicament to communicate with the world, because the vision is the most important sense through which we get maximum information from the world. A man named Louis Braille was the one who invented a Braille device. (Braille is a device which is a series of raised dots that can be read by the human fingers who are blind or whose eyesight is not sufficient for reading printed material. Parents, teachers, and others who are not visually impaired or blind will read Braille with their eyes. Braille is not a language. It is a code by which languages such as

English or Malay may be written and read.) American Foundation for the Blind. Braille symbols in the device are formed within units of space known as Braille cells.

A full set of Braille cell consists of six raised dots arranged in two parallel rows each having three dots. The dot positions are identified by numbers from one through six. Sixty-four combinations are possible using one or more of these six dots. A single cell can be used to represent an alphabet letter, punctuation mark, number, or even a whole word. People who are completely blind are not able to interact with the computer without any assistive technologies (Tom, 2009). In order to help blind people to use the computer, they mostly use screen reader software and Braille device. Screen reader software is software that has an audio element that speaks all the information in a human voice which comes on the screen as well as the text which is typed on the keyboard. A Braille device makes the same exactly information appear on a Braille dots which will help blind people read with their own fingers. When every letter of every word is expressed in Braille, it is referred to as Grade 1 Braille.

This Grade 1 Braille is very useful for labelling personal or kitchen items. For example, (using any of the household or office supply materials to create raised or tactile markings such as safety pins, rubber bands, furniture protectors and others). Blind people can make a specialty labelling products to identify such above products. Braille Clothing Identifiers is a durable and washable white plastic tags with Braille and corresponding black print. They can be sewn or pinned on to the garment. They can pin it to the clothes and blind people can just touch the label and identify what is it that they holding. Another example for Grade 1 Braille is Touch-To-See-Labels. It is a label that have Braille and tactile adhesive labels to identify medication and food. Each label contains a raised number or letter with corresponding Braille. Meanwhile for Grade 2 Braille, the system used for reproducing most textbooks and publications. There are different dots in Grade 1 and Grade 2. For example, in Grade 1 Braille the phrase ‘you like’ will requires more cell spaces than Grade 2 Braille**.**

Grade 1 Braille:

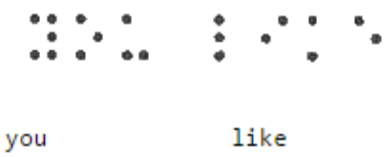

Figure 1: Grade 1 Braille

Grade 2 Braille:

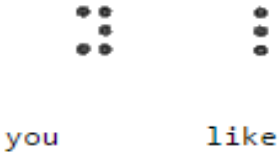

Figure 2: Grade 2 Braille

If it is written in Grade 2 Braille, this same phrase would only take a few spaces to write. These ‘short cuts’ are used to reduce the volume of paper needed to producing books in Braille and to make the reading process easier. Braille also can be written in several ways such as in the stylus and slate. This consists of a slate or template with evenly spaced depressions for the dots of Braille cells, while a stylus used for creating the individual Braille dots. With paper placed in the state, tactile dots are made by pushing the pointed end of the stylus into the paper over the depressions. The paper has some curves on its other side that forming "dots." Because of their portability, the stylus and slates are especially helpful for taking notes during lectures and for labelling such things as file folders.

A Braille display is usually an addition to a screen reader. It is a small unit which lies by the keyboard and displays one line of information in Braille, mostly the same which the screen read announces with speech. This Braille Line will helps blind people to more understand the layout of the screen better, and enable them to read texts which is hard to understand with speech, for example when they need to read documents or articles in different language that they does not familiar with.

2.2.2 Screen Reader

Screen reader is a software application that transforms textual display into auditory output. It is used to converts components of Windows operating systems and applications into synthesized speech to make the information on the screen are accessible to blind and visually impaired people. Screen reader can also transform graphical user interface (GUI) into an audio interface and provides keyboard shortcuts or hot keys that allow navigation of the content to be rendered to the screen in a non-visual way (Borodin et. al, 2010). The screen reader allows users to read everything in the Website from top to bottom, and from left to right (Sandhya and Devi, 2011). The most widely used screen access programs include *Job Application With Speech (JAWS)*, *Thunder Screenreader WindowEyes*, *COBRA Professional*, *SuperNova* and *Seortek System Access to Go.*

Job Application with Speech (JAWS)

Freedom Scientifics' JAWS for Windows screen reader has been providing speech access output, enabling users who are visually impaired greater access to the computer and information, since 1990s. JAWS application maintains numerous refreshable Braille displays and several languages. A standard version of JAWS can be used with Windows 98, ME, and XP Home. JAWS Professional also works with Windows NT 4.0, 2000, and XP Professional.

2.2.3 Screen Magnifier

Screen magnifier is a program that enlarges what is on the monitor to be seen to visually impaired people. Most of the screen magnifier programs will adjust the colour, the brightness, and some other elements to enable partially impaired people to define it. Screen magnifier can enlarge the image by zoom out and in with a keyboard command. One of the examples of screen magnifier is ZoomText. It can speaks out loud what is on the screen and displays the text in a separate window in large print while highlighting sentences and words as they're read aloud in high-contrast colours.

2.2.4 Optical Character Recognition (OCR)

Optical Character Recognition (OCR) is a program that can scan and convert printed words into electronic text. Then, the blind users can read it with a screen reader or Braille device. This is a solution to the situation where a blind student has to read a book or handout that is not on their computer. Blind users can just read the document on their computer with the help of Braille device or screen reader.

2.2.5 Text-to-Speech (TTS) or speech synthesizers

Text-To-Speech (TTS) is a program that receives user input in the form of text keys and synthesizes information on the screen into an audio element. Blind users and visually impaired users can use this program to hear what they are typing in the keyboard.

2.3 Educational System for the Holy Quran and Its Sciences for Blind People

According to Samir, 2013, for Muslims, the best science ever are learning Quran which includes memorization, recitation, narration, interpretation and others with the help of highly qualified Quran's reciters. Many scientists actually wrote many books on different narration, Quran's recitations, interpretations, and the scientific Mutoons (rules and regulations for the correct recitation and reading of the Holy Quran). One of the examples is Imam Ibn Aljazari that collected in his book "publishing in ten recitations" fifty-eight books which are about the recitations. It shows the importance of right recitation when read Quran. Because of the importance to recite Quran with right way, great efforts in recent years were conducted to adopt and adapt information technology and computer applications, particularly in the use of websites and other Web pages in religious sciences and provided to all categories of Muslims worldwide in all forms, whether it is printed, in audio, or even in a video to benefit all classes of Muslim society.

That actually encourages those interested in servicing the Holy Quran to collect and constructs several libraries of audio, text and video materials for the Holy Quran. Not everyone is lucky like normal people. Some unfortunate people cannot make use or access this knowledge. These unfortunate categories include our valued brothers and sisters with blindness, illiterate people, handicapped people with manual disabilities, and children who not yet able to read. These unfortunate people also may

be eager to learn the Holy Quran. For this project, a system will be develop to allows these categories of people in addition to the normal people to take full advantage of the available scientific materials, such as the Quran interpretations, the Quran recitations, the scientific materials which is the Tajweed rules. This will be done through the interaction with the system using voice commands by speaking directly without write or use the mouse or the keyboard.

Results of these commands will be played through the audio instead of displaying the text to the screen which will be very useful to blind users. The text will be displayed on the screen as well to help normal people also use the system. Some work and researches were conducted and there are some electronic devices and also software was built to help blind users to read words, documents and written communication as well. Braille is a device developed specially for blind people. Braille is a device that read touch reading and writing for blind people in which raised dots that represent the letters of each alphabet. Punctuation marks and symbols to show letters of the alphabet are also contain in Braille device. According to Saad, (2010), Muslim people who are blind also use this system to help them read Quran. Some experts proposed an eBraille like in (A System Architecture of Electronic Braille Panel for Reciting Al-Quran) which is an electronic Braille device for reciting Quran. This system will helps blind people to read Quran with the special dots related to Quran. Besides, according to Abdallah, 2009, he mentioned that it is important to build a Quranic Braille system translating Quranic verses to Braille symbols, by using Visual basic coding. This proposed project will help blind users to increase and improve learners' skills, motivation, grade, attitude and knowledge while learning how to recite the Quran. With all contributions in science and technology, we should take into considerations for several categories which are blind people and visually impaired and disabled manually, that desperately needs the system that will help them recite Quran.

2.4 Audio elements

Nowadays, modern technology prepares wondrous ways for us to use our senses and brains. People whom are unfortunate like blind people, visually impaired people, and their care-givers have difficulty in reading information. For this project, the focus is their difficulty in reading Quran with right Tajweed and pronunciation. “They need software that speaks computer screens, including buttons and texts, hand-held devices that read specialty formatted books, online libraries that provide books and module for disabled people, standard smart phone that interact by voice, speak directions, practise listening to synthetic speech and others” (Susan, 2013). Based on ‘As Your World Changes’ article, it is important to calibrating hearing and seeing action. The goal is to find opportunities for shifting from vision to hearing. If users are losing vision, they will need to prepare or adapt technology originally for blind people such as Braille device. If he or she is a care giver, they will need help to assess and use device for adapting to vision loss. Below is the statistics of hearing versus seeing factors that help blind users and visually impaired users:

- 100% audio, no usable vision, all keyboard and text to speech
- 80% audio for reading and interacting, sneak a peek to screen colours, and also graphic pictures
- 60%dominant audio, depends on mouse and screen
- 40% magnifiers but more audio for reading
- 20% heavily magnifiers, high contrast themes, some text to speech
- 0% all vision, even if some audio would help

It shows that adding an audio element in this project will help blind people and partially impaired people to listen and know the right pronunciation of each Quranic verse. Based on the percentage above, without any vision at all, means people who are totally blind from birth, they can learn and understand Quranic verse even though with some audio.

2.5 Multimodalities

Multimodalities can be defined as an approach to identify communication and representation is more than a language. Combination between audio and haptic is what people call as multimodalities. Multimodalities and assistive technology can clearly help blind people and partially impaired people to read Quranic verses. Maryanne (2008) mentioned that human brain is not made to read text. People who have inability to read text can use sound and image to help them read the text. This shows the importance and advantages of multimodalities as an aid to help blind people and partially impaired people to read text, in this context to read Quranic verse. Based on Institute of Education University of London, basically there are three theoretical assumptions regarding multimodalities. First theoretical assumptions is communication and representation draw on a different ways of modes. Many assume multimodalities are focuses on describing and analyze communication based on visual, language spoken, gestural, written text, audio and others. Second assumption is multimodalities are a combination of many resources to define a meaning of something. In this assumption, it stated that communication works in distinct ways, by interaction with people and the meaning by all resources gathered, the choices can be made. Third assumptions in multimodalities are people define meaning by selection and configuration of modes. It means that by interaction between people, discussion and sign making, the decision can be made. Below are the differences of multimodalities between haptic textures and haptic-auditory textures.

2.5.1 Haptic Textures

There is a need for the society to develop perceptive and efficient non-visual feedback to enhance exploration and learning process of interfaces. For example, on Web sites, a code is used to produce an image and also enlarge the image. A force-feedback mouse can be used to enlarge or resize the image on the screen. Research has shown that the force-feedback mouse may benefit blind people to achieve a multimodal representation through the haptic application (cutaneous and kinesthesic). Communicate using the force-feedback mouse is an interesting experience to blind people. Based on existing reading Quranic verses with tajweed rules using Braille Line 20, it use haptic textures to read the Quranic verses. This application use Braille Line that enable blind people and partially impaired people to

touch the dots that represent each Tajweed rules in Quranic verses. The dots will sink and rise due to Tajweed rules in the verses.

2.5.2 Haptic-Auditory Textures

The author proposed to add an audio element to the existing reading Quranic verses with Tajweed rules using Braille Line 20 device. Haptic and audio applications have been used widely to enhance the traditional practice of using audio as the main modality to assist the visually impaired (Sulaiman et. al, 2014). Adding an audio may help blind people and partially impaired people to better understand the pronunciation of each verses. Before blind users and partially impaired users touch the dots on the Braille Line, an audio will pronounce the Quranic verses to the users first. The users will listen to the audio and have a clear picture on how to pronounce the Quranic verses in a right way. Then they will start to touch the dots (haptic textures) that represent the Tajweed rules. It will combine the haptic textures and auditory textures. Based on example regarding Web sites pages, audio element are used when the user enlarge or resize the image using force-feedback mouse, to enhance the haptic textures. There will be a sound when the user clicks on the link or any movement in the Web site pages.

CHAPTER 3

METHODOLOGY

3.1 Development Methodology

The author will use Rapid Application Development (RAD) for the development methodology. RAD methodology was being selected to be use for the implementation phase for this haptic-audio blind project. RAD is a new and improved type of System Development Life Cycle (SDLC) phase. System Development Life Cycle usually consists of seven (7) phases such as:

1. Project initiation
2. Requirement definition steps
3. Functional design steps
4. Build the system or interfaces
5. Verify the system or interfaces
6. Run the system or interfaces
7. Maintenance and review part

But there are some limitations of SDLC such as, fail to meet the objectives of the project due to difficulty of estimating cost and resources in the project. Besides, there is insufficient time involved in each steps in the SDLC. Some projects are too big to handle and maybe the time required for the development phase is long, but using SDLC, they need to finish up the tasks within the time frame given. It might affect the quality of the project since there is not enough time and need to finish the project quickly and rushing. In SDLC, users should follow all steps listed and there is a time allocated in each steps. Users should follow the time and phase allocated and should proceed to the next steps even though current process is not completed. This might lead to quality problem and performance of the

product later. Because of the limitations, the author choose Rapid Application Development (RAD) phase for the methodology.

According to Christian Egli (2002), "Rapid Application Development (RAD) is a programming system that enables programmers to build working programs very quickly." Rapid Application Development (RAD) is similar to the SDLC but it only has a few steps compared than SDLC. SDLC have seven (7) steps, while RAD has only four (4) main steps. The four (4) steps are requirements planning phase, user design phase, construction phase and cutover phase. Figure below shown is the steps in RAD phases:

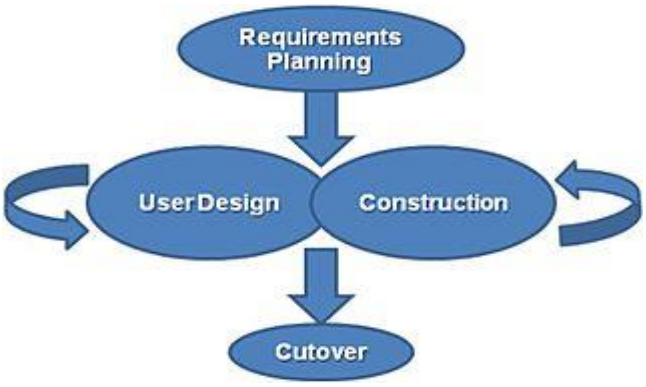

Figure 3: Phases in the James Martin approach to RAD

Sources: http://en.wikipedia.org/wiki/Rapid_application_development

RAD is like a prototyping, it uses iterative development phases that enable any task to be done. Since this haptic-audio for blind people project will be done in a short time frame, then it is recommended to use RAD type of methodology. Normally, RAD systems will provide some tools to assist users build Graphical User Interface (GUI) in a short time. There are two common tools that people always use in RAD systems which are Visual Basic and Delphi. Below are the phases of RAD approach:

1. Requirements planning phase
2. User design phase
3. Construction phase
4. Cutover phase

3.2 Research Methodology

3.2.1 Observation

Data from the respondents were gathered by observation and also by interview process. Observation process can be more reliable because the author able to see the process of how the respondents use the product. In this project, the author was able to observe how the blind and partially impaired people use Quran Braille Line 20 to read Quran verse. By observation, the author can determine which approach is better to help blind and partially impaired people to learn on how to read Quran verse with right Tajweed and pronunciation. This result will motivate the author to enhance the previous project by adding an audio element to the Quran Braille Line 20 device system.

3.2.2 Interview

This interview objective is to investigate how the respondents teach and learn Quran using haptic-audio application device in their daily life. The question will be asked to the respondents to determine whether audio element in haptic application device (Braille 20) will help them in teaching and learning process or not. Besides, this interview was conducted to gain any additional knowledge and information regarding current project for them (blind and partially impaired people). Teacher and students from Malaysian Association for the Blind (MAB), Ipoh is the respondents for the interview prepared by the author. The age of the respondent are ranged from 20 years old to 53 years old. The type of questions prepared is closed-ended question. It means all questions have answers to be chosen by the respondents. There are a few focused scope of interview such as:

- The role of audio elements in reading Al-Quran
- Usability of the device
- Recommendations to improve the project
- Type of assistive technology used in daily life

The interview was conducted with two types of respondents. One is with the teacher and another one with the students in MAB.

i. Session with the teacher (Ustaz)

There is only one teacher that teaches blind and partially impaired students on how to read Quranic verses. The question that been asked to the teacher is about his experience teaching at MAB, Ipoh. How to conduct Quran class and what are the aids to help him teach the students also been asked in the interview session. The author also asked his recommendation towards this project and what is his opinion about this project.

ii. Session with the students

There are about eight (8) students involved in answering the question prepared by the author. The students was asked about the type of assistive technology being used in their daily life such as Braille device, screen readers, audio players and text-to-speech (TTS) software. Students also were asked on how they read and learn Quranic Tajweed. Any additional information or students recommendations also were asked during the session to gain their opinion towards the project as this project was developed for them. The question mainly focused on the additional of audio elements in Braille 20 device besides haptic activities which is the rise and sink of the dots that represent each letters in Quranic verses.

Both interview session with teacher and students was been done in a day. All the questions prepared was been answered perfectly by both teacher and students. They gave a big cooperation with the author. The interview session was successful and the author gets all the information that she needed. To make sure there is no missing information, the author recorded the session using a voice recorder for later reference.

3.2.3 Tools used

i. Hardware

Braille Line 20

There are four (4) types of Braille-Line that normally used by blind and partially impaired people which are Braille-Line 20 Cell standard, Braille-Line 40 Cell standard, Braille-Line Flat 20 and Braille-Line P20 40 Cell. For this project, the author used Braille-Line 20 Cell standard as it suitable, easy to understand and use. Usability and effectiveness of the product are important to determine the success of this product. Braille-Line 20 was building on a rugged metal tray for safe installation and fixes the problem. The following are the detailed specification of the Braille Line 20 Cell:

- Dimensions (w x h x d): 130 x 81.5 x 23.5mm
- Dot spacing: 2.45mm
- Dot height: ca. 0.7 mm
- Cell spacing: 6.42mm
- Tactile force: min. 17 cN
- Connector: SIL 2.0 mm, 8 Pins
- Drive electronic: low-power ASIC electronic mounted on the cell

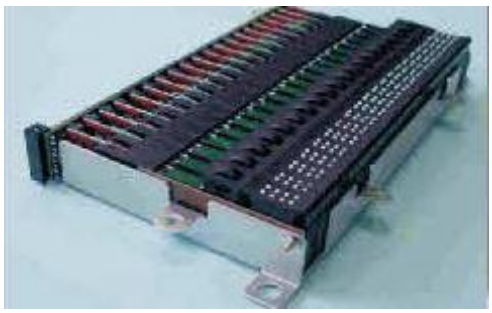

Figure 4: Braille Line 20 Cell

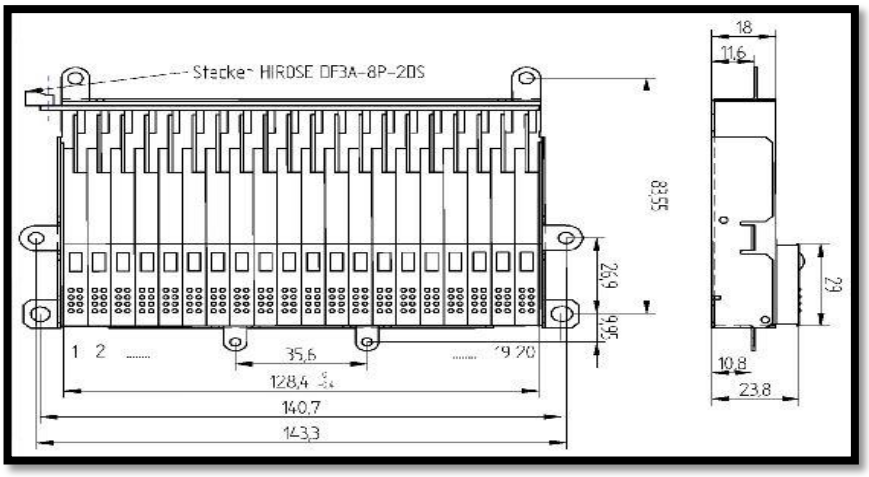

Figure 5: Technical sketch of the Braille Line 20 Cell.

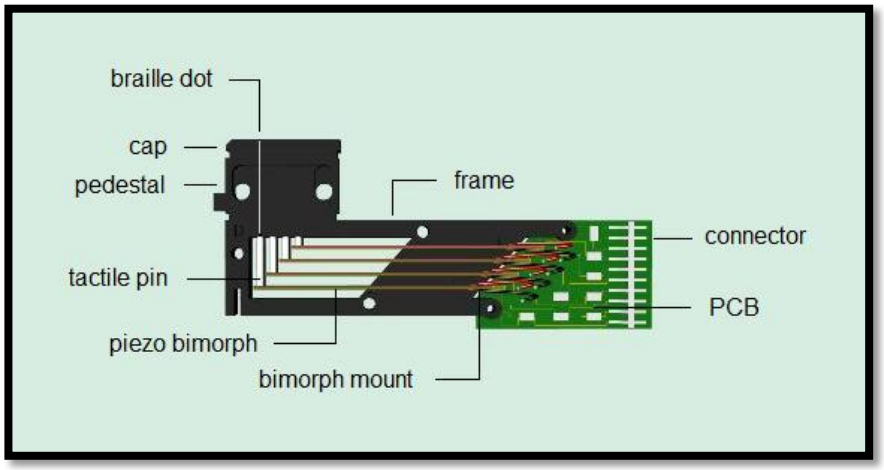

Figure 6: The basic parts of a Braille cell.

ii. Software

VMware Workstation

VMware Workstation is a platform to enable the connection between a device to another device. In this project, the author used VMware Workstation to set up the current 32-bits Windows XP computer with Braille Line 20 device to enable the program to be run. Below is an example of screenshot of VMware Workstation 11.1 on Windows 7:

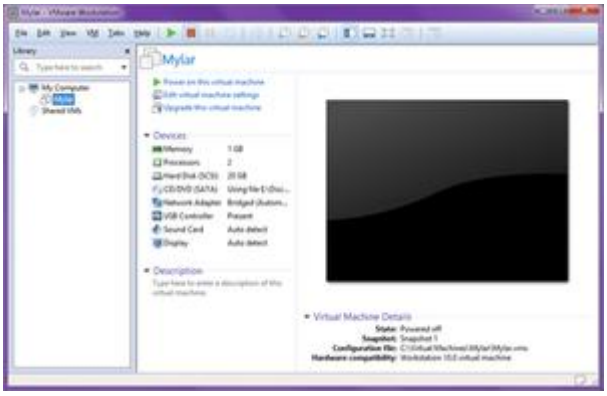

Figure 7: Example of VMware Workstation 11.1 on Windows 7

Sources: http://en.wikipedia.org/wiki/VMware_Workstation

Microsoft Visual C# 2010

Microsoft Visual C# is implementation of the C# specification that included in the Microsoft Visual Studio. Visual C# is the most commonly use compared than others language. There are many languages and compilers other than Visual C# such as Visual Basic, Visual Basic.NET, Visual C++ and others. The author uses Microsoft Visual C# because it is easy to understand the languages and this language tend to be simple, modern, general-purpose and object-oriented programming language.

3.2.4 Flow Chart

Figure below shown the flowchart or the work flow of Quran Braille 20 system with audio element:

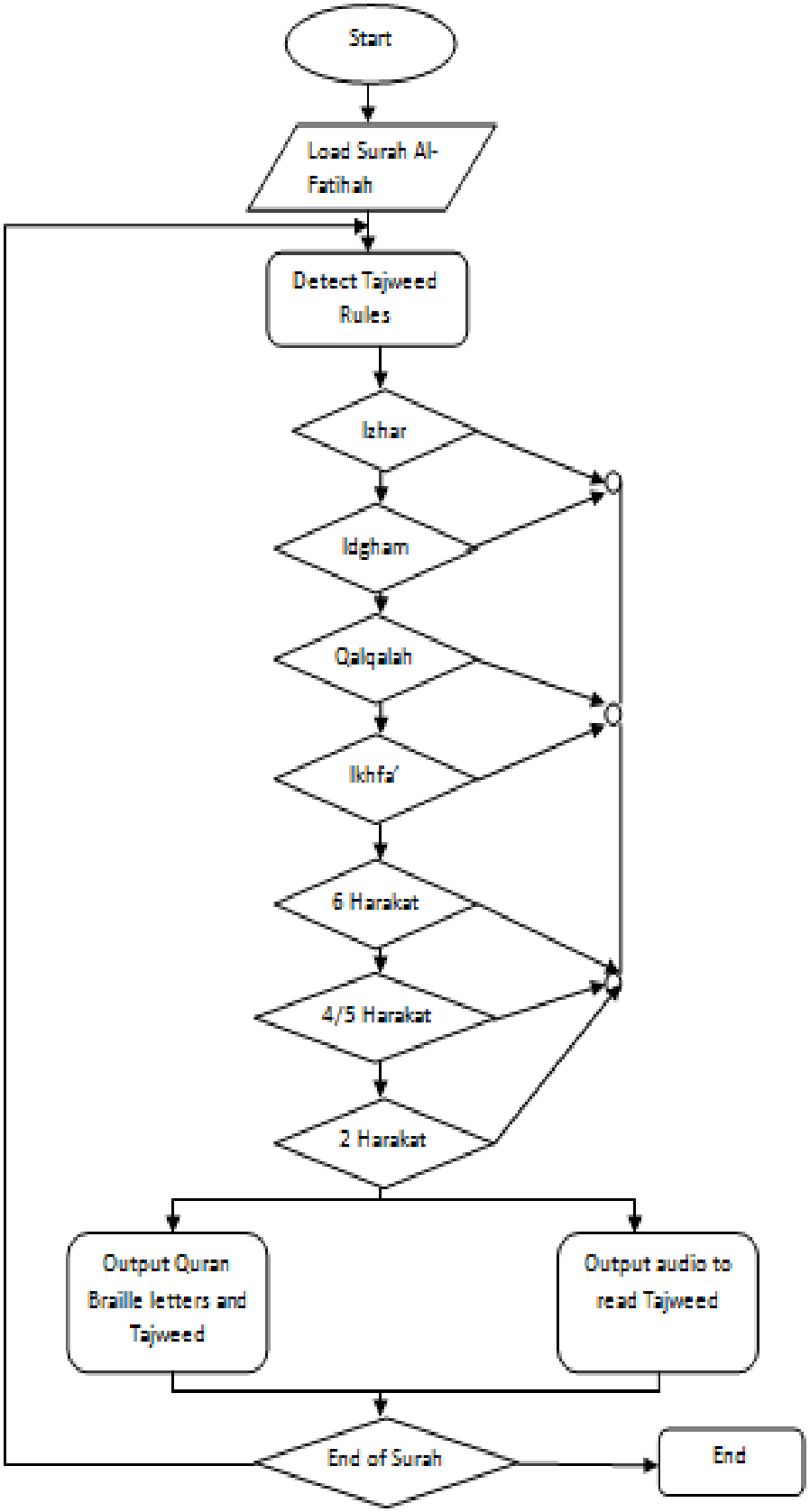

Figure 8: Flowchart of the device system

3.2.5 Arabic and Quran Braille Symbols

In order to recite Quran using Braille dots, readers should be able to learn and memorize all Arabic character and Braille symbols. Arabic and English letters are the same and can be applied to a same Braille dots. For example, letter ‘B’ and ‘Ba’ can be applied to the same Braille dots. Below is the table show all the list of Arabic and English letters with its Braille dots as well:

ARABIC CHARACTER & BRAILLE SYMBOLS

Braille	Arabic	Braille. Dots	Dot	English	Braille
⠁	ا	1	100000	a	⠁
⠃	ب	12	110000	b	⠃
⠞	ت	2345	011110	t	⠞
⠹	ث	1456	100111	؟	⠹
⠚	ج	245	010110	j	⠚
⠓	ح	156	100011	:	⠓
⠭	خ	1346	101101	x	⠭
⠙	د	145	100110	d	⠙
⠮	ذ	2346	011101	!	⠮
⠗	ر	1235	111010	r	⠗
⠵	ز	1356	101011	z	⠵
⠎	س	234	011100	s	⠎
⠩	ش	146	100101	%	⠩
⠯	ص	12346	111101	&	⠯
⠫	ض	1246	110101	$	⠫
⠾	ط	23456	011111	)	⠾

Table 1: Arabic character and Braille symbols

⠿	ظ	123456	111111	=	⠿
⠷	ع	12356	111011	(	⠷
⠦	غ	126	110001	<	⠦
⠯	ف	124	110100	f	⠯
⠿	ق	12345	111110	q	⠿
⠅	ك	13	101000	k	⠅
⠇	ل	123	111000	l	⠇
⠭	م	134	101100	m	⠭
⠽	ن	1345	101110	n	⠽
⠓	ه	125	110010	h	⠓
⠺	و	2456	010111	w	⠺
⠊	ي	24	010100	i	⠊
⠕	ى	135	101010	o	⠕
⠌	ة	16	100001	*	⠌
⠾	لا	1236	111001	v	⠾
⠁	أ	34	001100	/	⠁
⠮	!	46	000101	.	⠮
⠜	آ	345	001110	>	⠜
⠄	ء	3	001000	'	⠄
⠾	ؤ	1256	110011	|	⠾
⠿	ئ	13456	101111	y	⠿
⠂	ـً	2	010000	1	⠂

Table 2: Arabic character and Braille symbols (continue)

3.2.5 Development

i. Using the MetecBDNet library to use the object from the library.

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;
using System.Threading;
using MetecBDNet;
using System.Media;
using System.IO;
```

ii. Determining the raised pins for each cell.

```
device.Write(0); //sink all pins
            for (int i = 2; i < 3; i++) //B
            {
                device.Write(i, 3); //write on cell3
                device.Flush();
                Thread.Sleep(3000);
```

iii. Play the Quran verse audio.

```
class MediaPlayer
        {
            System.Media.SoundPlayer soundPlayer;
            public MediaPlayer(byte[] buffer)
            {
                MemoryStream memoryStream = new MemoryStream(buffer,
true);
                soundPlayer = new System.Media.SoundPlayer(memoryStream);
            }
            public void Play() { soundPlayer.Play(); }
            public void Play(byte[] buffer)
            {
                soundPlayer.Stream.Seek(0, SeekOrigin.Begin);
                soundPlayer.Stream.Write(buffer, 0, buffer.Length);
                soundPlayer.Play();
            }
        }

        private void PlayMyFile()
        {
            string file1 =
@"C:\BrailleQuranWithTajweedSystem\BrailleQuranWithTajweedSystem\BrailleQ
uranWithTajweedSystem\bin\Release\Fatihah_converted3.wav";
            List<byte> soundBytes = new
List<byte>(File.ReadAllBytes(file1));
            //create media player loading the first half of the sound
file
            MediaPlayer mPlayer = new MediaPlayer(soundBytes.ToArray());
            //begin playing the file
            mPlayer.Play();
        }
```

3.2.6 Prototyping

This project will use Braille Line 20 for the students and teacher to learn and teach on how to read Quranic verse with right Tajweed and right pronunciation. A simple working prototype will be build according to the flow chart of this system. The prototype will be working on rise and sink of dots and also sounds feedback that represent the letters in Braille 20. There is no interface for this project since the haptic and audio activities only applied in the Braille 20 device. Audio elements will

be one of the most important elements and the prototype will be focused on the audio feedbacks.

3.2.7 User Testing

Testing process is where the author will get the feedback regarding her project. It will be test to the teacher and students from Malaysian Association for the Blind (MAB) to get their feedback and opinion. Any recommendation will be noted and can give the author some ideas and opinions to enhance her project. Since this research is about the enhancement of adding an audio element into haptic application, the testing will be test for both in haptic activities (the dots rise and sinks according to the letters) and haptic-audio activities (the system pronounce the Quranic verses).

CHAPTER 4

RESULT & DISCUSSION

4.1 Interview Session with Respondents from Malaysian Association for the Blind (MAB)

Interview session with the respondents was held on Friday, 13th March 2015 from 9 am until 12 pm. There are seven (7) respondents involved in this interview including a teacher that teach Quran in MAB. Tajweed Rules Haptic Application with Sound for Blind and Partially Impaired People project was develop to fulfil blind people needs and the main objective is to help Muslim students to learn on how to read Quran verse with right Tajweed and right pronunciation. Because of that, the interview session need to be done at MAB since they will become the main users for this project. One set of questionnaire consists of nine (9) questions. Figure below shown the author was doing the interview with one of the respondents:

Figure 9: Interview session with the respondents

All respondents were given their full cooperation and commitment during the session. The author recorded and takes note of all the answers given from the respondents. Figure below shown all respondents and staff from Malaysian Association for the Blind (MAB) and a few of UTP students:

Figure 10: UTP students and respondents from Malaysian Association for the Blind

4.2 Respondent's Background

The main respondents for this project are blind and partially impaired people from Malaysian Association for the Blind (MAB). All respondents have a different background form each other. The teacher who teaches Quran subject has been a teacher for four (4) years at MAB. He also worked at a Tahfiz (religious school) and conducted online private Quran courses via Skype prior to teaching at MAB. The teacher mentioned that the Quran class at MAB is for basic writing and reading as the students are just learning to use Braille device. Currently there is no usage of Quran software to aid in learning Quran at MAB. Students are introduced to the letters and Tajweed rules from the beginning of lesson. Quran in Braille have limited symbols as indicator for the Tajweed rules and it is difficult for them to read Quran verse.

Meanwhile for the students, they mentioned that they need some time to learn on how to read Quran using Quran Braille Line. Respondents who are blind from birth feels more comfortable to use Quran Braille as they already learn it early, however for those respondents who are partially impaired have difficulty in using Quran Braille as they just learning to use it. Most of them also feel more confident and comfortable when there is assistance to help them learn and read Quran. The students mentioned that they would prefer to have assistive technology or the teacher to assist them in reading Quran.

4.3 Assistive Technology Device

From the interview session conducted at MAB, the author analyse that the students there use a few types of assistive technology to help them do activities in their daily life. They use screen reader to read documents in computer. For people who are fully blind, they really depend on the screen reader as the audio will help them read the documents in computer or to browsing the Internet. Meanwhile for students who are partially impaired, they still can read documents in a computer without assistance of screen reader. Quran paper Braille was used by Muslim students for them to read Quran. One main problem and limitations of using Quran paper Braille is that the bulge on the paper Braille will vanish from time to time. Touch from our fingertips will give a pressure to the bulge and it will lose its curve.

This will make the students and also the teacher feel difficult to use Quran paper Braille.

4.4 The Need for Audio Feedback

Students at MAB came from a different background. Some of them are blind from birth and some of them are blind or partially blind since some age. Based on the interview, there are a few reason of their blindness such as involve in accident, genetic problem, health problem (Diabetes, nerve problems), tumor growth in the eyes and others. Mostly for students who are blind or partially blind from birth, they had learn on how to use any assistive technology device such as Braille Line, screen reader, audio player and any software that help blind people to read. But for students who are not blind or partially blind from birth, they need to learn and familiar with these assistive technology device. Some Muslim students that use Quran paper Braille have difficulty to use it due to unfamiliar with the Braille Line. This is why adding an audio element will help them to learn and read Quran with right pronunciation and Tajweed. When the students touch across the Braille Line device, the dots will rise and sink according to the letter and Tajweed rules of Quran verse. Adding audio feedback will enable the students to know which letters and how to pronounce it. Three (3) out of six (6) students at MAB said that audio elements are very important and will help them to read Quran since they are still learning on how to use Quran Braille.

One of the students mentioned that he would prefer to have assistance to read or pronounce the Quran verse correctly to him. It shows that audio is likely to be the most important aspects when learning a new things, which is learn on how to read Quran using Quran Braille. Another student said that using Braille is kind of difficult since they are just learning to use it not from early stage. He said that he would prefer to learn Quran using website together with his friends. His friends will also try to pronounce Quran verse correctly and it might help each other rather than just using the Braille. He and also his friend will learn faster if they try to pronounce it to each other and know the right pronunciation and Tajweed of any Quran verse. Another student also agrees with audio elements to help them read Quran. “Audio element will really helpful for me when I’m reading Quran because sometimes I am

not sure if my Tajweed is correct or not" said one of the respondents. She mentioned that it is easier for her to learn Quran using Internet as Internet has an audio to pronounce the letters and Tajweed correctly.

4.5 Usability Testing

Usability testing was done to ensure the device is easy to use for all users. During the interview session, teacher and the students were asked to use Quran Braille Line 20 which is an existing project done by a Final Year student at Universiti Teknologi PETRONAS. After the briefing session to the respondents on how the testing will be done, they were asked to repeat back the steps on how to use the device. It is important to determine whether the device is easy to use and user friendly to all type of users. After the testing with all respondents was done, the respondents were asked about their experience using Quran Braille Line 20 and all answers were recorded for analysis. All of the respondents including the teacher mentioned that using the device will help them to read Quran verse and the bulge on the Quran paper Braille will never vanish. It is more convenience to use for a long term instead of using Quran paper Braille that the bulge will lose time to time. The students also mentioned the problem or the limitations of using the device. One of the issues is that the pace of rise and sink of Braille dots are too fast. They could not follow the pace because it is too fast and they just learn to use Braille device. Another issue is there is no audio to assist them in reading Quran verse. They prefer to have an audio feedback to pronounce the Quran verse with right Tajweed and right pronunciation. Thus, this project was developed to fulfil their needs. They also were asked whether they feel comfortable or not using Quran Braille Line 20. The respondents said that they feel more comfortable and convenience to use Braille device than Quran paper Braille. Figure below shown Quran Braille Line 20 and Quran paper Braille:

Figure 11: Quran Braille Line 20

Source: http://web.metec-ag.de/braille%20line%2020%20e.html

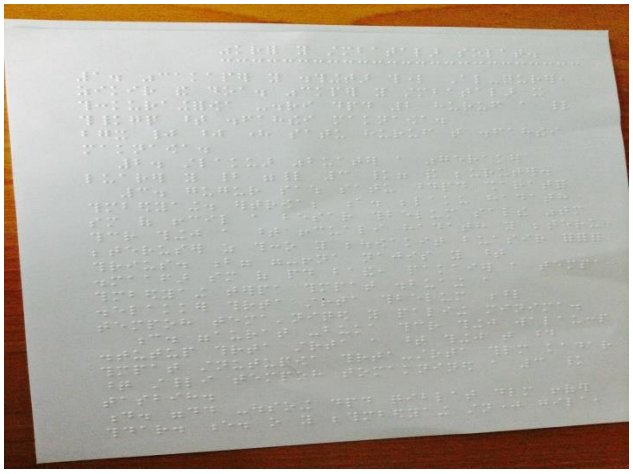

Figure 12: Quran paper Braille

4.6 Experiment

In order to test the effectiveness and usability of the audio-haptic Tajweed rules application for visually impaired reader, a series of experiments are conducted. The experiments are divided into two part; experiment with the sighted users (pilot testing) and experiment with the visually impaired users (user testing).

4.7 Pilot Testing with the Sighted Users

Pilot testing is a small-scale testing which a few users (examinees) take the test and give some comment on the test provided. It is conducted to test the effectiveness and overall usability of the audio-haptic Tajweed rules application for visually impaired reader in representing Quranic letter and

assist them in read Quran. The performance of this project will then be compared to the previous project to verify for its strength, weaknesses and future enhancements. This pilot testing is also be conducted to test the experimental framework design, so that it can be improved and adjusted later in the user testing with the actual population - the visually impaired users (MAB participants).

Five participants from Universiti Teknologi PETRONAS (UTP) aged between 22 and 23 years are recruited to participate in the pilot testing. These five participants do not have any experience using screen reader or any other assistive technology for the visually impaired. Besides, they also have no knowledge on reading Braille codes. The participants are blindfolded for all tasks to assimilate the visually impaired users. The attributes being tested in the pilot testing are some Quran letters and Tajweed on Braille dots. There are five questions been asked to the participants and below is the analysis of their answers.

Before the testing session begins, the author introduces them with the Braille device and its function. The author also explains on what activities she will conduct in this testing session. The participants were given some training to understand and memorize the Braille dot in Arabic letters. Then, the participants will be asked to use the blindfolded and start the system. On the first activities, the participants will be test on the haptic feedback which means they only use their fingertips to detect the Braille dots. When they finish on the first part, they will proceed to the second part. On the second part of the testing session, the participants will be test on their haptic and audio feedback which means the participants use their fingertips just like the first part, and they will hear audio that sounds on what actually represent the Braille dots. In this testing session, the author uses one sentence from Surah Al-Fatihah. After the participants have finished both of the activities, they will answer some questions to analyze the testing sessions.

First question is about the using of Braille device in their daily life. The participants were asked whether they have ever used the Braille device before. All five participants have answered no because they are all sighted people and does not have any experience using Braille device. Below is the analysis of the answers from the participants.

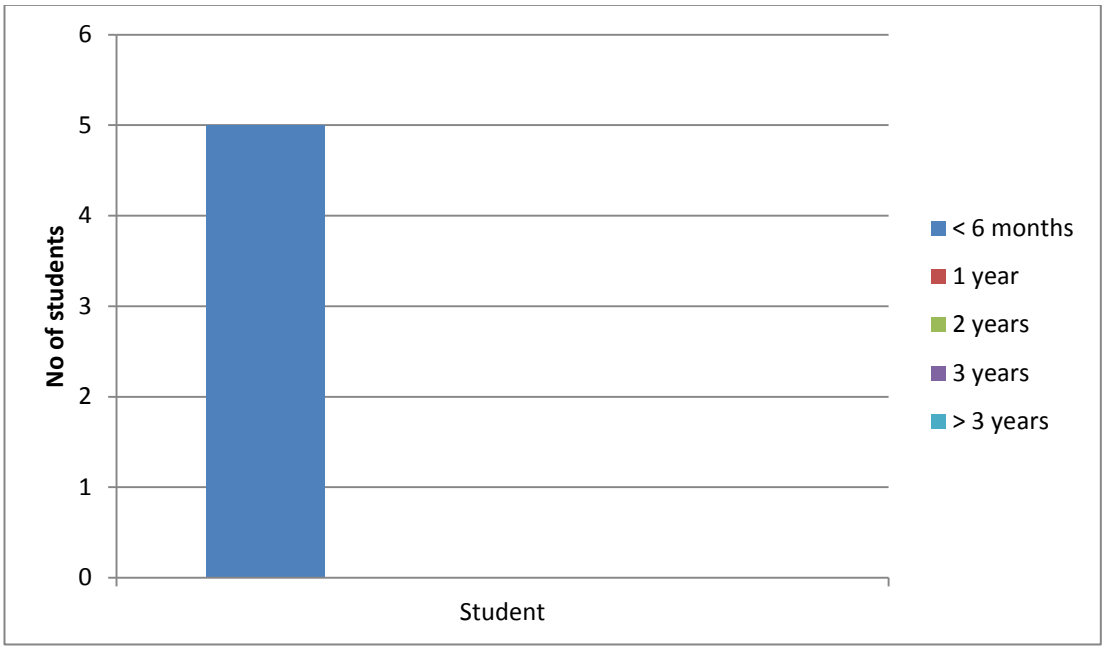

Figure 13: Use of Braille device in daily life

Next question asked is about the easiness of using Braille device to read Quran. All five participants answer no for this question because they are sighted people and they can read Quran using Quran itself not with any assistive devices. When this question been asked at MAB with people who are partially impaired and also blind people, all of them answers yes for this question because they absolutely need assistance and help when reciting Quran. They find that using Braille device in reciting Quran is very helpful because the bulge or the Braille dots in paper Quran Braille will vanish time to time. The Braille device dots will not vanish since it is a high technology device created for blind and partially impaired people. Below is the analysis of the answers form the participants.

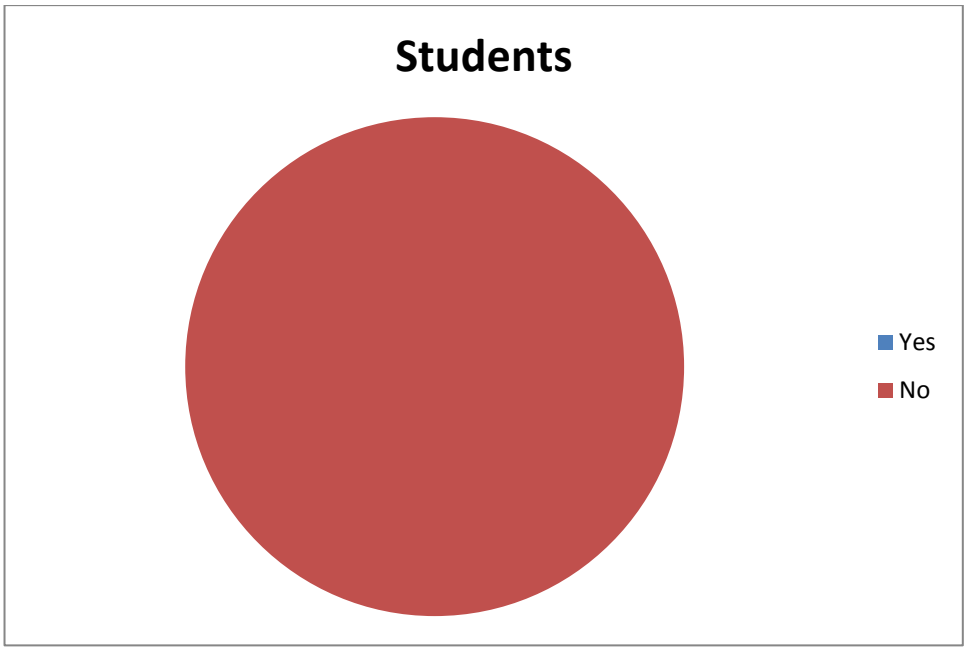

Figure 14: Easiness of using Braille device to read Quran

The session was continuing with the third question asked to the participants. The question was what device that the participants used when reciting Quran. Choices answers for these questions are Paper Braille, Braille device and others. All of the participants answer “Others” because all of them use Quran as a medium to recite Quran. When these questions been asked at MAB, some of them answer using paper Braille and some use others. Below is the analysis of the answers form the participants.

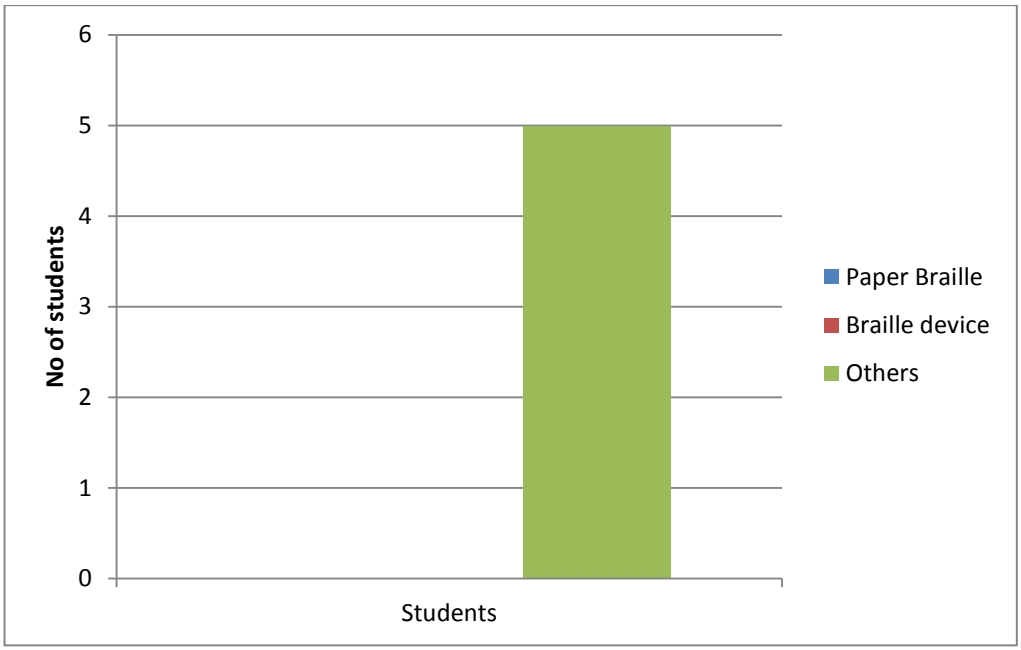

Figure 15: Device used when recite Quran

Fourth question is about the easiness of users using what tools when reciting Quran. Choices answers for these questions are Paper Braille, Braille device and others same like previous answers. All of the participants answer "Others" as "Others" means Quran itself. All of them feel comfortable in using Quran when reciting Quran. Below is the analysis of the answers form the participants.

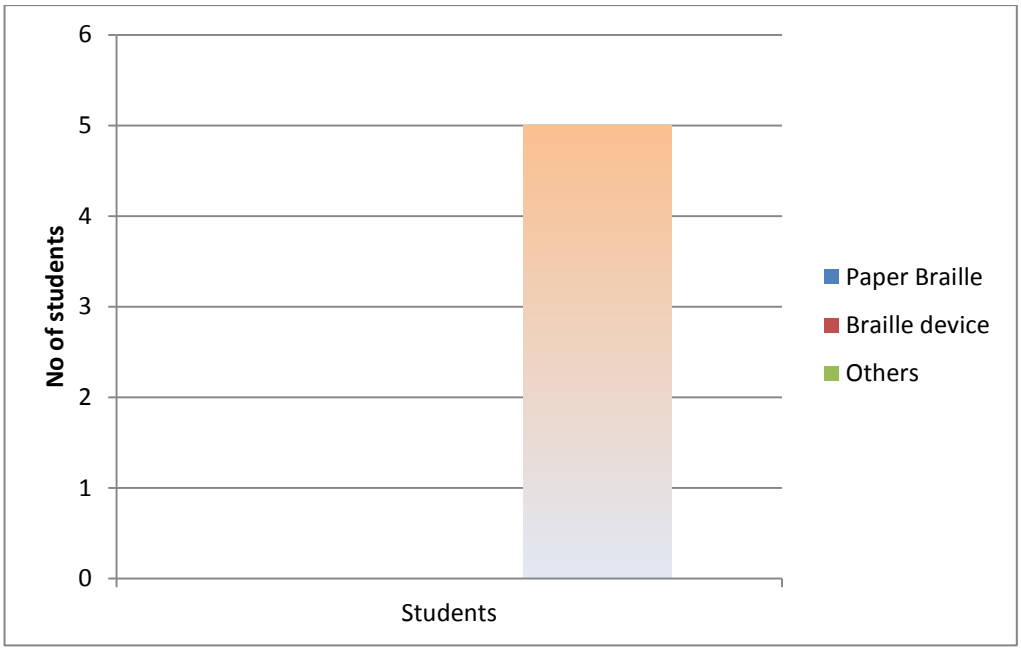

Figure 16: Most preferable device

The last question which is the five questions is about the audio elements. The participants were asked if the addition of audio element that read the Quran verse is helpful for them or not. All of the participants answer "Yes". This is because; they are not familiar with the device as they are not blind or partially impaired people. They feel the audio element will really helpful for them as well as for blind and partially impaired people. This project has meet the objectives which is to develop an audio-haptic application of Tajweed rules for blind people and partially impaired people, and to test and measure the effectiveness of the audio-haptic application to blind people and partially impaired people using audio and without audio. Below is the analysis of the answers form the participants.

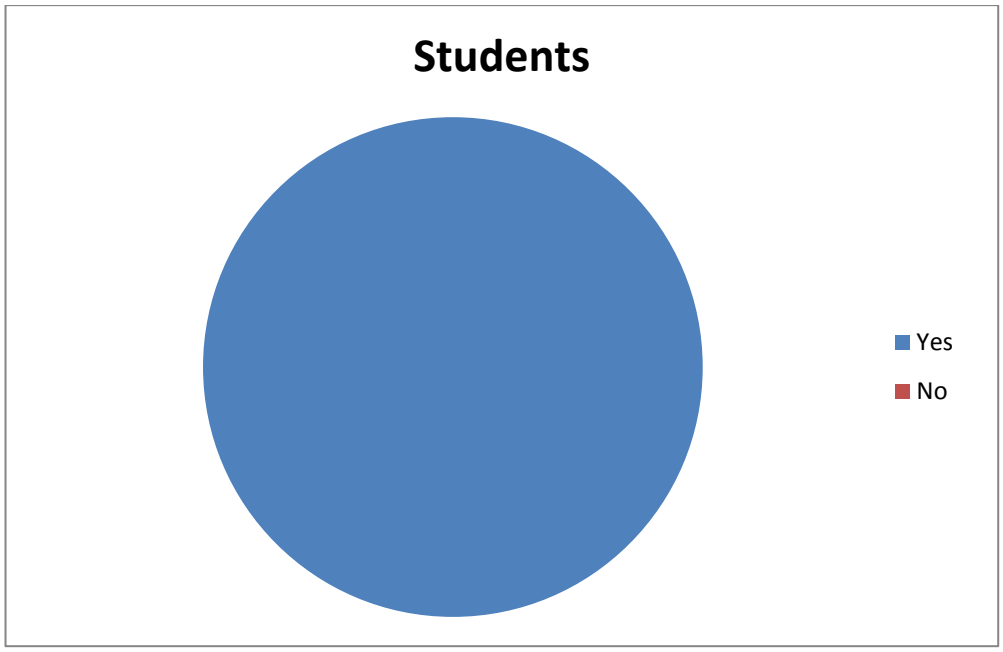

Figure 17: Does the addition of audio element helps?

Figure 18: The participants were blindfolded to do the pilot testing.

Figure 19: The participant is answering the questions regarding the test.

Figure 20: The participants were blindfolded to do the pilot testing

4.8 User Acceptance Test

The same procedure has been done with the real user which is participants from Malaysian Association for the Blind (MAB) located in Ipoh. Number of participants involved is less than ten (10) people. In this testing, number of participants was three (3) participants. This is because, some factors and requirements should be meet to be a participant and to prevent any bias in the results. Factors that should be concerned are the knowledge of using Braille, Muslims and know how to recite Quran. User acceptance test was conducted on 30th July 2015 (Thursday).

There are three participants included one Ustaz (teacher) that teach them to recite Quran using Braille paper. These participants have basic knowledge on using Braille and they are able to use Braille Line 20 to do the testing.

Figure 21: User testing with MAB student

The testing session started with explaining what the system is all about, how it works and how to read the Braille line on the device. The testing will be done after all of the participants understand on how to use the device and the purpose of this testing.

The time taken for each tester using the Braille device was recorded. The testing was divided into two section which is using haptic application only (without audio) and with audio. Below is the result obtained from user testing:

Participant	Visual Function	Time taken (without audio) (m.s)	Time taken (with audio) (m.s)
Participant 1	Total Blindness	1.28	1.19
Participant 2	Total Blindness	1.40	1.30
Participant 3	Low Vision	1.50	1.39

Table 1: Result obtained from user testing

From the result of the testing, it could be seen that some participants finished reading verse faster than the others. Time taken for each participant to finish the whole verse with audio and without audio was recorded. For participants 1 which is the Ustaz (the teacher) obviously an expert compare with another two participants. First participants have the shortest time to complete the verse compare to others. As shown above in the table, there is a difference between time taken using audio and without audio. For the first session which is without audio, the participants were only focus on the Braille dots and tries to predict what is the letter appeared in the cell. Because of that, time taken using the device without audio took a longer time compare than using an audio. For the second session, the participants were asked to use the device along with the headphone to play the verse. The participants took a shorter time when they use the headphone to play the verse. This is because; the verse play will assist them and notify them on what verse that is currently works in the Braille device. This result has proof that there is a need of audio elements to help them recite Quran with right Tajweed and right pronunciation.

After they have done the testing, each participant was asked a few questions as a post-test interview. First question was asked is whether they find the system would be easy to use if there is an audio. All of them answered yes because they just learn on how to use Braille and with audio element, it really helps them in reciting Quran with confidence. For the first participant which is Ustaz, he found that this system will easily help him in teaching sessions with the students. The next question asked is about whether the system can enhance their pronunciation in reciting Quran.

All three participants answered yes because the verse play will pronounce the verse correctly and they can refer to it rather than read it alone without audio. However, Ustaz mentioned that the rise and sink of the dots should be slower and not too fast. An audio played also should be match with rise and sink of the dots to avoid any confusion for the students.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

Based on some research and study that have been done during Final Year Project 1, the author achieved the objective of this project. Main objective and aim of this project is to help blind people and partially impaired people to teach and learn Quran Tajweed in their daily life. There are two objectives of this project which is to develop an audio-haptic application of Tajweed rules for blind people and partially impaired people. Second objective is to test and measure the effectiveness of the audio-haptic application to blind and partially impaired users using audio and without audio. Besides using Braille Line 20 that have the dots that rise and sink represents the letters and Tajweed in Quran verse, this project also enable audio feedback to help blind and partially impaired users become easier to read Quran. Interview session with teacher and also the students were conducted and all information needed was successfully gathered during the session conducted in Malaysian Association for the Blind (MAB) located in Ipoh, Perak. All respondents were satisfied with this proposed project as this will really help them to read Quran since before this they just use Braille paper for read Quran. With Braille Line 20 device and audio elements that will pronounce the verse along with the rise and sink of the dots, the author sure that this project will help the users to read Quran with right Tajweed and right pronunciation.

Suggestion and recommendation for future work is to add another element that recognize user's voice and give an alert when the users pronounce it wrongly. For the future work, device for voice recognition need to be built to detect user's voice if they pronounce it wrongly so that users know their mistakes and improve their reading. Another recommendation from Mr Hairil (external examiner), he suggested that the author make an Iqra' Braille to cater the need of children that are visually impaired from early age.

Gantt chart:

No	Activities	FYP I				FYP II			
		Jan	Feb	March	April	May	June	July	Aug
1	Selection of FYP Topic								
2	Preliminary Research								
3	Submission of Project Title Proposal	*							
4	Approval of Project Title Proposal	*							
5	Data gathering								
6	Report writing								
7	Submission of Interim Report (27 March 2015)			*					
8	Preparation for Proposal Defense			*					
9	Proposal Defense			*					
10	System Development								
11	Report writing								
12	User testing								
13	Pre-SEDEX							*	
14	Technical Report Submission							*	
15	1st Draft Dissertation							*	
16	VIVA							*	
17	Final Dissertation & Hardbound								*

Figure 21: Gantt chart

References:

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APPENDICES

Interview Questions for the Respondents

Name:

Age:

1) Do you read Quran alone or with the assistance from ustaz or ustazah?

   Alone ( ) With ustaz/ustazah ( )

2) Which one do you prefer or comfortable with?

   Alone ( ) With ustaz/ustazah ( )

3) How long did you use the Braille?

   Less than 6 months ( ) 1 year ( ) 2 years ( ) 3 years ( ) More than 3 years ( )

4) Did you feel comfortable using Braille device when read Quran?

   Yes ( ) No ( )

5) What tools that you use when you read Quran?

   Paper Braille ( ) Braille device ( )

6) Which tools that you feel comfortable to use when read Quran?

   Paper Braille ( ) Braille device ( ) Others ( )

7) With addition of audio that also reads the Quranic verse, did you feel it will help you in read Quran with right Tajweed and right pronunciation?

   Yes ( ) No ( )