DEVELOPMENT AND TESTING OF PATIENT COMMUNICATION BOARD

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ABSTRACT

The ability to express ourselves with spoken words and writing makes us, as humans, unique. One of the major causes of communication disabilities in the elderly is stroke. People with severe disabilities are often unable to use spoken communication and so need additional means of communication such as Augmentative and Alternative Communication (AAC). To suit the patient need in Malaysia, the development of patient communication board project can help elderly people without ignore their need, cost estimation, culture and more. The performance of this product will be evaluated in two components which is product testing and product evaluation. As a conclusion, advantages in the development of this project is, it is design to meet the criteria which more suitable to the Malaysian elderly.

ABSTRAK

Keupayaan untuk menyatakan diri kita dengan perkataan yang disebut dan menulis membuatkan kita, sebagai manusia, adalan unik. Salah satu daripada penyebab utama ketidakupayaan komunikasi dalam golongan tua adalah strok. Orang kurang upaya yang mempunyai masalah komunikasi sering tidak dapat menggunakan komunikasi lisan dan sehingga perlu cara tambahan untuk komunikasi seperti Augmentatif dan Komunikasi Alternatif. Untuk disesuaikan dengan keperluan pesakit di Malaysia, projek pembangunan alatan komunikasi boleh membantu orang tua tanpa mengabaikan keperluan mereka, anggaran kos, budaya dan banyak lagi. Prestasi produk ini akan dinilai dalam dua komponen yang mana pengujian produk dan penilaian produk. Kesimpulannya, kelebihan dalam pembangunan projek ini, ia adalah reka bentuk untuk memenuhi kriteria yang lebih sesuai untuk warga tua dan golongan yang mempunyai masalah komunikasi di Malaysia.

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LIST OF SYMBOLS AND ABBREVIATIONS

AAC	Augmentative and Alternative Communication
ASD	Autism Spectrum Disorder
CVA	Cerebrovascular Accidents
IC	Integrated Circuit
LED	Light Emitting Diode
PPUM	University Malaya Medical Centre
QUEST	Quebec User Evaluation of Satisfaction with Assistive Technology
SLT	Speech and Language Therapist

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1.0 INTRODUCTION

1.1 BACKGROUND STUDY

1.1.1 COMMUNICATION DIFFICULTIES

The ability to express ourselves with spoken words and writing makes us, as humans, unique. Language (which represents the formulation, transmission, and comprehension of thoughts by verbal and nonverbal symbols) and speech (which refers to the actual verbalization) do not only facilitate interpersonal interactions but are also vital for cognition (Szofia S. Bullan, M.D.; Lyvia S. Chriki, B.A; Theodara A. Stern, M.D., May-June 2007) Therefore, when these fundamental brain functions are disrupted or lost, the result is devastating. Aphasia is a neurological disorder that affects language functioning, most often as a consequence of stroke or cementing illnesses (e.g., Alzheimer's disease) in the areas of the brain responsible for language. Moreover, aphasias may also coexist with speech disorders (e.g., dysarthria or apraxia of speech). Roughly 1 in every 275 adults, accounting for 1 million individuals in the United States, suffers from aphasia; with approximately 80,000 new cases occurring each year, representing more than one-third of new stroke patients. Among these patients, a variety of neuropsychiatric symptoms arise as a complication of cerebrovascular accidents (CVAs), but their diagnosis is often delayed by the presence of speech and language problems. Aphasia is also a source of frustration to patients, their family members, and their caregiver. These patients remain largely dependent on caregivers for all daily functions including leisure occupation and communication. Any effort to help them acquire some level of independent functioning requires the support of specific technology (Lancioni, Singh, & O'Reilly, 2014).

1.1.2 ELDERLY PATIENT WITH SPEECH DISORDER.

One of the major causes of communication problems in the elderly is stroke. According to the United Kingdom Stroke Association, it happen 1 to every 5 minutes for over 65 year population. Stroke can be defined as brain injury to the patient who may have it. The brain controls everything including interpretation and understanding of the speech. A stroke can cause problems with communicating if there is damage to the parts of the brain responsible for language. These functions are controlled by the left side of the brain in most people. As one side of the brain controls the opposite side of the body, many people who have communication problems after stroke also have weakness or paralysis on the right side of their body. Stroke can also cause communication problems if muscles in the face, tongue or throat are affected (Communication problems after stroke, April 2012). A stroke can affect communication in different ways. The main conditions that can happen after stroke are aphasia, dysarthria and dyspraxia. Aphasia (sometimes called dysphasia) is the name for the most common language disorder caused by stroke (Mieke E. van de Sandt-Koenderman, January 2012). Aphasia can affect how the patient speak, ability to understand what is being said, reading or writing skills. It does not affect intelligence, although sometimes people think it does. There are two types of aphasia; one is non-fluent aphasia which is associated with frontal lobe damage or also known as Broca's aphasia and the other one is fluent aphasia which is associated with temporal lobe damage known as Wernicke's aphasia.

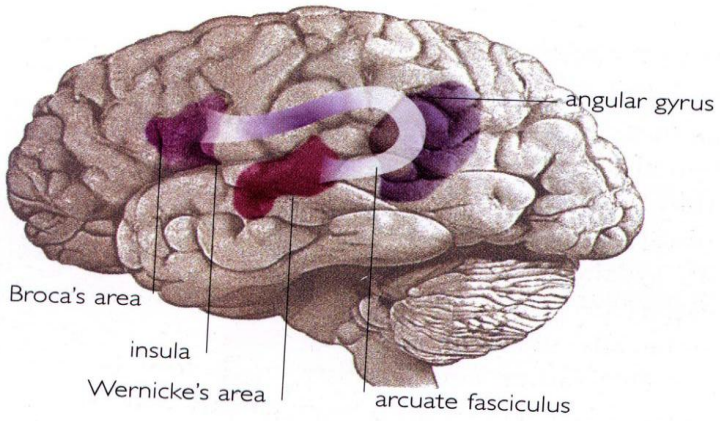

Figure 1.1.2: Location of Broca's area and Wernicke's area of the brain.

While Dysarthria happens when a stroke causes weakness of the muscles that used to speak. If a patient has dysarthria, their voice may sound different and they have difficulty to speak clearly. The other condition is Dyspraxia, the condition that affects movement and coordination. Dyspraxia of speech happens when people cannot move their muscles in the correct order and sequence to make the sounds needed for clear speech. Anyone who has communication difficulties after their stroke need to receive a full assessment for their difficulties from a speech and language therapist (SLT) that have specialist knowledge in stroke and rehabilitation. In hospital, this should be arranged by the multi-disciplinary stroke team as soon as possible after the stroke. If the person affected is at home, their GP can make a referral to community SLT services or they can contact their local hospital's Speech and Language Therapy Department directly. Any effort to help them acquire some level of independent functioning requires the support of specific technology. There is a wide variety of communication aids available and all of them is needed to support and improve patient daily life.

1.1.3 AUGMENTATIVE AND ALTERNATIVE COMMUNICATION

There has been a rapid growth in recent years of available technologies for individuals with communication difficulties. Augmentative and Alternative Communication (AAC) provides individuals special needs with the means to express ideas, thoughts, concerns, and needs (Shining a light on Augmentative and Alternative Communication, 2002). These devices have great potential to improve the lives of individuals with communication difficulties by promoting independence, the development of social relationships and enhancing education. While there has been a rapid growth in available options and technologies in recent years it has been reported that practitioners face challenges in successfully implementing AAC (Baxter, 2012). Separately defined, augmentative communication is any support system in a given situation that allows an individual to communicate independently, whereas alternative communication is specifically the use of non-vocal instruments and/or approaches.

There are some types of ACC that has been developed through research. One of AAC is unaided communication which refers to subset of AAC. This method of communication does not involve additional equipment, such as signing, body language, eye pointing, facial expression and gesturing. Another type of AAC is aided communication. Aided communication is a subset of AAC which refers to those methods of communication which involve using additional equipment, such as picture, symbol, letter or word boards or books and technology-based systems such as voice output communication aids. This may be used alongside speech and unaided communication.

Low-tech aided communication is one of the AAC types that have been developed through research. These systems do not require power to function such as picture, photo/symbol, letter or word boards or books. It can also include objects of reference, or the use of everyday objects that support communication.

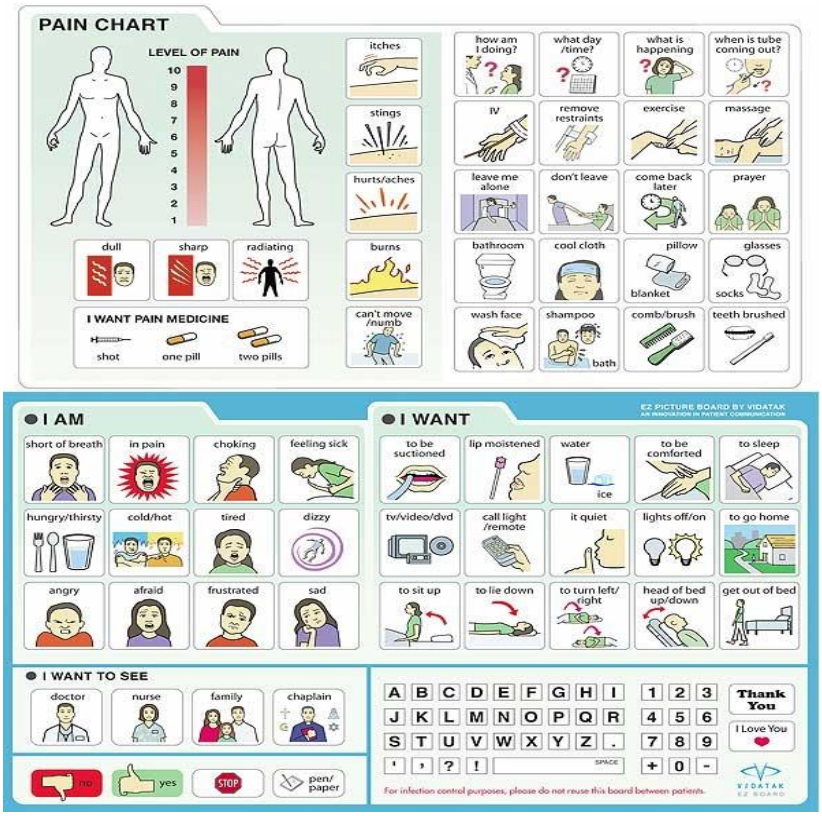

Figure 1.1.3: Example of Low-tech Augmentative and Alternative Communication Board.

Other is High-tech (powered) aided communication. These technology-based systems are those which require some power to function, ranging from systems such as single recorded message output devices to more complex systems which take text or symbol input and produce a speech output.

Figure 1.1.4: Example of High-tech (powered) Augmentative and Alternative Communication.

According to the American Speech Hearing and Language Association, the prevalence of people with communication impairments severe enough to require AAC ranges from 8 to 12 in every 1000. Individuals that most frequently benefit from AAC include those who are deaf or hard of hearing, have acquired neurological impairments such as TBI, cerebral palsy, aphasia, progressive neurological disorders such as autism spectrum disorder (ASD), person with motor speech disorder and neuro genetic disorders. Two distinct types of users include those with long term need and those with temporary need for AAC. Individuals that have suffered a stroke and have developed aphasia may need temporary assistance through AAC until spontaneous recovery allows them to regain their speech.

1.2 SIGNIFICANCE OF THE PROJECT

Speech is such an important and vital mode of communication without which many of our day to day activities will come to standstill. Earlier, people with difficulty in communicating through vocal speech had to depend on pictures, symbols or chart to communicate any news, ideas and their need. Being able to communicate is vital in preventing someone becoming depressed and to help them rehabilitate. It also greatly improves their quality of life.

Rapid developments in technology have resulted in lots of innovative new ways of communicating using aids, for example new software application which allow to use a smart phone as communication aids and exciting new technology that uses a person's eye-gaze or brain activity to control communication aids. There are many new communications application being develops for the popular smart phones and other electronic goods. But most of the device available now is not relatively simple and difficult to operate. So, for the elderly, it may be difficult for them to use. Besides, it is also very expensive and requires a lot of technical knowledge to maintain it. Most of the technology developed is not suitable for the Malaysian.

Therefore, there is a need to design a communication aid, especially for the elders who have speech problems. This can help them to communicate with people and let them to be again, social able. It can also help those who are in the rehabilitation stage to gain back their confidence. So, this project will develop a device which design more suitable for elderly, as simple as possible and yet have the fundamental functions.

1.3 OBJECTIVE OF THE PROJECT

The purpose of this project is to develop and test the electronic communication board for older people in Malaysia. Unlike other electronic communication board, this design is suitable for Malaysian based on language selectable and routine which is tailored specifically for the Malaysian elderly.

Most of the families in Malaysia is does not use English their first language. The available AAC in the current market mostly used English to operate. So, they found it difficult to use the aid at home because speaking voice was hard to understand. To overcome this problem, this project will develop an electronic communication board that produces voice in Mandarin (the most used dialect of people of Chinese descendant used in Malaysia) and Bahasa Melayu, apart from the common English language which are also represented by the symbol and icon on the board.

This board also will have a buzzer system to give an alert to the caregiver to facilitate the patient need. This system will allow the patient to select or press the button that contains most of patient basic need. It will present in symbol and picture on the board. Besides, this project will upgrade the current electronic communicator board in market to be cheaper and adapt to the Malaysian population.

1.4 DESIGN SPECIFICATIONS.

The systems consist of buttons with images which represent the basic daily activities of the patient. The objective of the design should be user friendly and simple because the target users are senior citizens. The button for this system must be easy to press due to their fingers restricted range of motion and some of them can only use their palms to press the buttons.

For the button, this board will have 8 buttons to be prebuilt into the communication board. The button will represent the activities like eat, drink, toilet, sit up, sleep, sick, yes and no. The communication board is also equipped with voice output preferred by the users through a design criteria survey. An alarm will be attached beside the board. This button will ring loudly when it is pressed. This can grab attentions from people around when the elderly feels himself is in danger and in needs.

Table 1.4: Design Specification

DESIGN SPECIFICATION	**(√/ X)**
Portable	
Voice Output	
8 Buttons for Basic Need	
Light Weight < 1Kg	
Low Cost < RM 500	
User- Friendly	
Thickness of the Board	
Language Selectable	
Buzzer	

2.0 LITERATURE REVIEW

People of all ages with severe communication impairments may be able to benefit from high tech communication aids. The range of technology is increasing rapidly and can assist more people but without support people cannot benefit fully. It is important to look at all the research that has been published about high tech communication aids to find out what is known. Communication takes place within a communication partnership and involves the exchange of ideas (Bartlett & Bunning, 2009)

All communication exchanges involve a degree of interpretation and, for people with severe communication disabilities, communication partners may need to take greater responsibility for the interpretation of communication acts, particularly when people have a limited range of communicative signals. People with severe disabilities are often unable to use spoken communication and so need additional means of communication such as AAC (Sigafoos & Schlosser, 2007).

2.1 CURRENT TECHNOLOGIES OF AUGMENTATIVE AND ALTERNATIVE COMMUNICATION (AAC)

2.1.1 AAC APPS

The development of apps for AAC is very rapid and as of August 2012, the web site AppsForAac.net listed 244 apps, of which 54 were free. This site was designed by an Occupational Therapist, at the ACE Centre in Oxford. The apps are described on this site and are divided into various categories according to their main function.

Some apps encompass more than one category. One of the categories of apps is Text to speech. These apps convert text to spoken communication and are probably the largest

category of apps for communication. It Symbols in grid-based system. A number of symbols are used within grid systems on the screen, with each symbol activating a spoken word or phrase (Colomer & Cabrera-Umpiérrez, 2012). These systems have a word predictor so that possible words are suggested when patient start typing. These words are then converted into speech. Meanwhile, some apps have set phrases, e.g. apps which have symbol sets of emotions. Some of these have set phrases, whilst others allow phrases to be changed. Other is eye pointing. These apps are designed for people who communicate using eye direction.

The communication partner then follows the direction of the eye point to the symbol. For photo story (or visual story), it offer the ability to take photos, use these in a slide show and then add in speech to tell the story. Picture exchanges communication system in Apps which use the PECS as a means of communication. The speech output used varies. Some apps use synthesized voices (e.g. choice of male, female, some regional accents and some children's voices available) and others have the ability to record a voice. Apps also use a range of different symbol systems, with the ability to use photos also commonly available.

2.2 BARRIERS TO THE IMPLEMENTATION AND USE OF HIGH-TECHNOLOGY AAC

Recent research reviews (Baxter, 2012) highlight the lack of evidence around the use of high-technology AAC devices, which make it difficult for practitioners to make decisions during the implementation of AAC interventions. There is also research suggesting that the functional use of devices may be limited, with evidence to suggest that though AAC users were able to demonstrate use of the communication aid in some settings (e.g. during

therapy sessions) these gains did not necessarily transfer to use in every day settings (JACOBS, 2004). In their thematic synthesis (Baxter, 2012) identified a number of factors which influenced the implementation and use of high-technology AAC.

These included the ease of use which more focuses on time taken to program the system (Bailey, 2006). This corresponds well with the technical competence described by Light. Parents also reported finding the AAC systems difficult to use ((Marshall, 2008). Other is reliability of the device where breakdown and length of time taken to repair it takes a long time (Kent-Walsh, 2003). Sometimes, it is difficult to access to a suitable technical support when breakdown happens.

For the voice and language of the device, investigated the perceptions of Mexican-American families and found that the language of the device was the primary barrier to use at home. Also, it was reported that the speech synthesizer was difficult to understand by some family members who did not speak English as a first language.

Lund and Light (2007) similarly highlighted cultural issues, with the lack of devices having two languages available being a limiting factor for some users. Bailey et al. (2006) reported limited vocabularies as being an obstacle to effective usage. Also, the frustration when spelled words were mispronounced by speech generating devices. Datillo et al. (2006) described the challenge of using devices out of doors when they cannot be heard above background noise.

Clarke et al. (2001) reported the perception of some young people that it was embarrassing when a device didn't use their own voice. Other is making decision time generating a

message where slowness of the device was often reported as problematic. Lund and Light (2007) point out that, to be really successful, the device needs to be able to ‘‘produce’’ the message in time with the thoughts of the person using it.

2.3 CONCLUSION

Based on the research above, augmentative and alternative communication systems require in-depth assessment, taking many factors into consideration when the patients want to use it. The use of a selected system requires acceptance by all individuals working on the diagnostic and intervention teams, along with users, caregivers, and significant others. Careful support and maintenance of the AAC system should be ongoing to meet the changing needs of the individual and patient environment. However, to suit the patient need in Malaysia, we proposed to develop the system which can help elderly people without ignore their need, cost estimation, culture and more. When designing the systems, we took into consideration about the shortcoming of the same systems done by other researcher.

3.0 METHODOLOGY

3.1 FLOW OF THE PROJECT

This chapter will described clearly about the method to be used in this project for the development until testing of patient communication board. The methodology part also used to define about how the project should be designed based on a few requirements. Therefore all the research and experimentation approach will be explain in this section.

This report was divided into three different parts. Part 1 will be focus on designing of communicator board that consists of alarm or buzzer, language selection in Malay, Cantonese and English, selection of symbols or icons that represent the daily life activities of the older people, icon YES or NO on the board. This icon and symbols will be link to the voice output.

The second part is development of the communication board. In this part, the explanation will be focused on the material used, Integrated Circuit (IC) and other. The third part is the testing part. The Geriatrics doctor and a few respondents will evaluate the communication board in order to determine the patient ability to press the button or symbol that present on the board. It just to make sure that the patient using the minimum energy to point the symbols based on their need. For every patient, they have different ability and condition.

One survey form will be given to the doctor and user as the feedback for this communicator board. One of the objectives of this project will be proved by this survey.

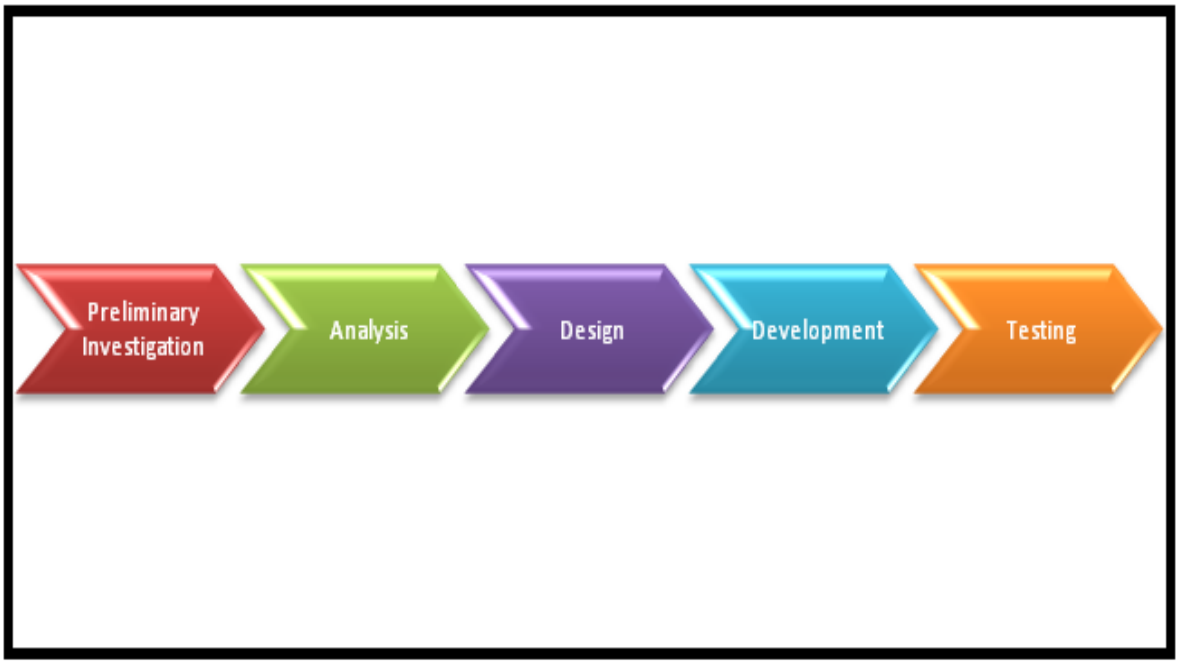

Figure 3.1.1: Flow of Development and Testing Of Patient Communicator Board.

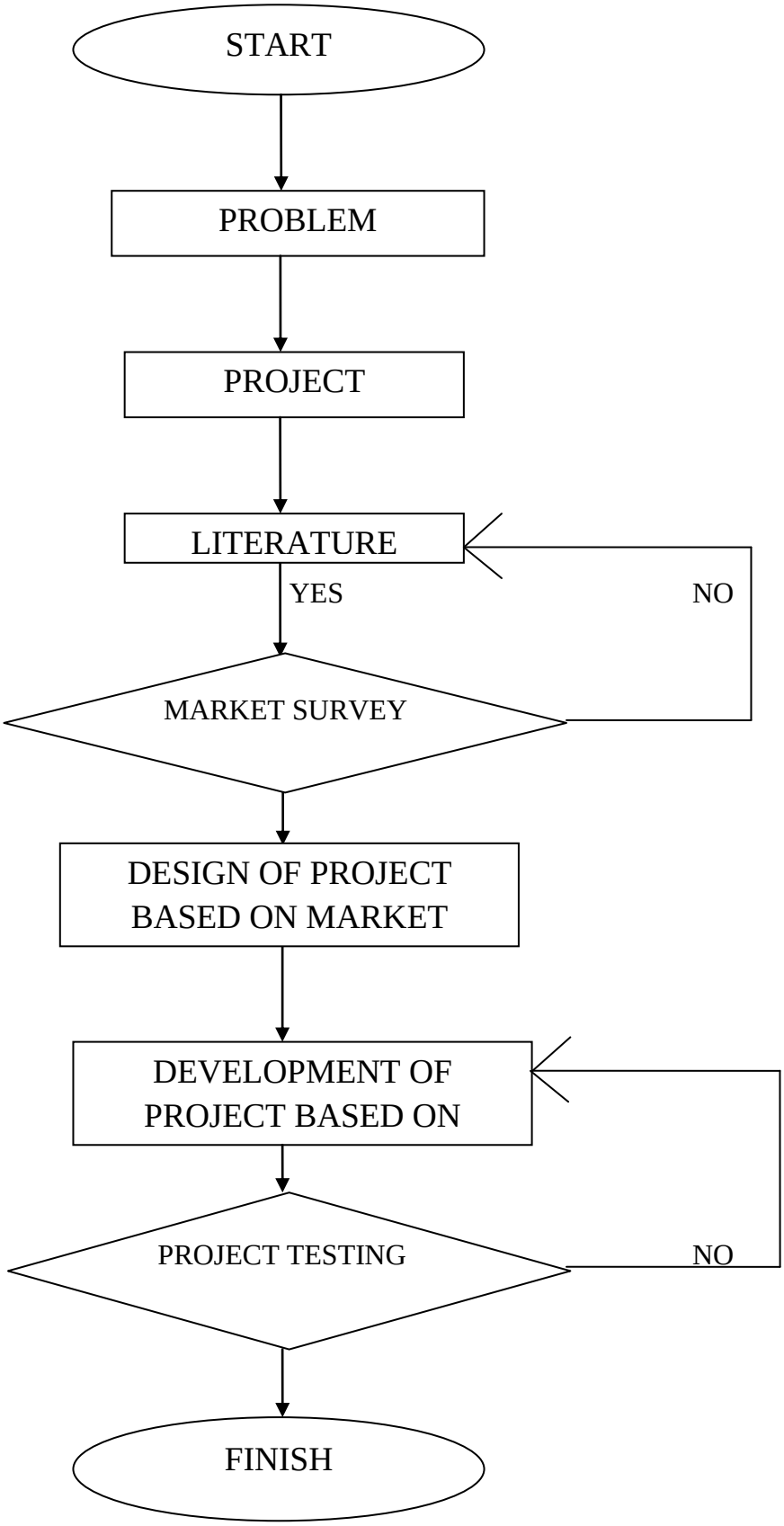

Figure 3.1.2: Flow chart of the Patient Communication Project

3.2 HOW IT WORKS

A communication board helps a patient to communicate more effectively with those around them. These devices start when patient switch on the device. The user will select the language that they prefer the most either in Bahasa Melayu, English or Mandarin.

After they select the language, they will press the push button inside the symbols that represent the daily life activities like eating, drinking, toilet, sleep, bath, stand up, yes and no. The caregiver around the patient will be alerted with what the patient need.

By touching or pressing the symbols on the board, this communication device will produce a voice based on the dedicated icon. When no one is around the patient, the patient can press the alarm on the device so that people or caregivers will notice about it. The system will stop when the patient turn off the device.

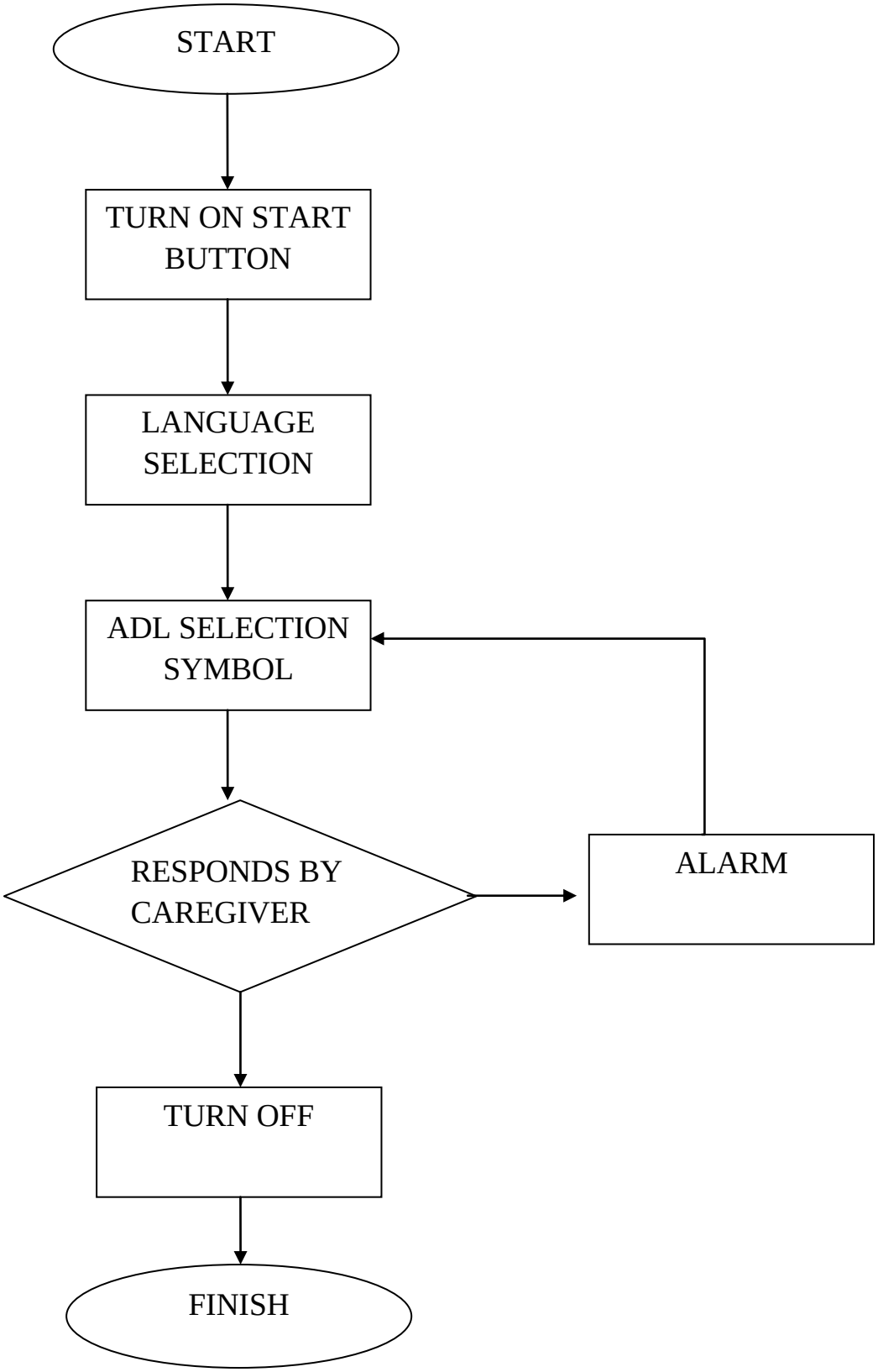

Figure 3.2: Flow chart how this systems work.

3.3 PRELIMINARY INVESTIGATION

In the first stage, the project requirement need to be determined based on the problem statements, objectives and scope that had been determined earlier. In order to get information related to the project, the following method was done:-

i. Find and investigate all documentation related this topic from books, journal, thesis, websites and others.

ii. Discuss with supervisor, specialist, lecturer, technician, medical doctor at PPUM and colleagues on improving the current system.

3.4 NEEDS OF ANALYSIS

Before we start designing the project, we had done some needs of analysis to the patient (Refers to the appendix 1). There is a list of design criteria's that we need to consider about before making the prototype. Below was the information from the survey form and acts as our design criteria:-

3.4.1 BUTTONS WITH IMAGES

Instead of using only words, the patient prefers to have a button with images compare to word. This is because we discovered that most of the patients have low level of education. From the chart below, we can observe that 57% of the patients only completed their primary school. From our interview, some of them could not understand English or Malay.

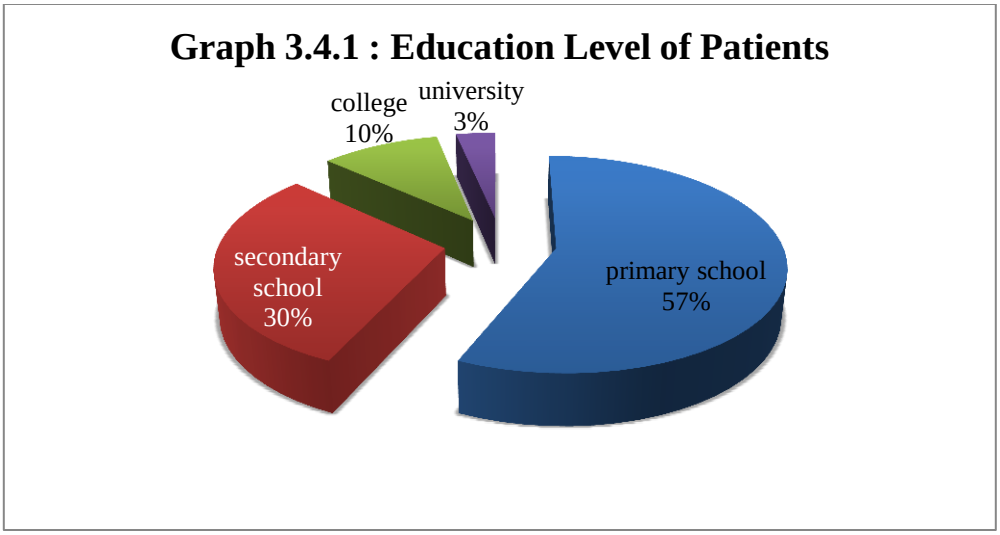

Figure 3.4.1: Graph of Education level of the patient.

3.4.2 TYPES OF BUTTON

Most of the patients are senior citizens, and when we interview them, we observed that their fingers had restricted range of motion and one of them can only use her palms to press a buttons. Therefore, these electronic boards should be built with solid buttons instead of (virtual buttons) touch screen. From graph 3.4.2, 80% of the respondents also preferred solid button over virtual button.

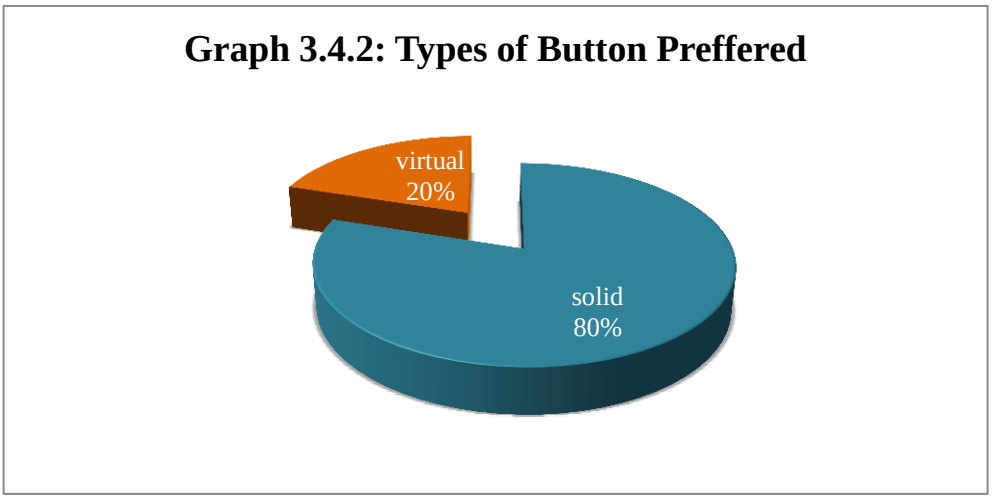

Figure 3.4.2: Graph of Types of Button Preferred.

3.4.3 VOICE OUTPUT

From the survey, most of the respondent prefers a communication board with voice compared to word in LCD form. This is due to their limitation on reading as an effect of a stroke.

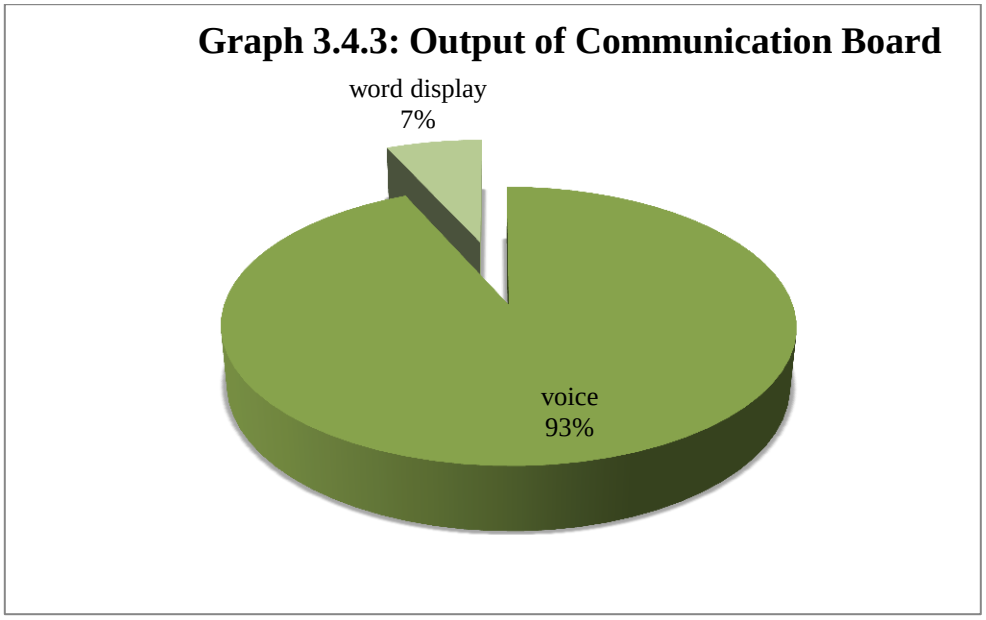

Figure 3.4.3: Graph of Output of Communication Board

3.4.4 ALARM BUTTON

An alarm button is a button which will rings loudly like a car alarm when it is pressed. This can grab attentions from people around when the elderly feels himself is in danger. 97% of the respondents think that the communication board should have an alarm.

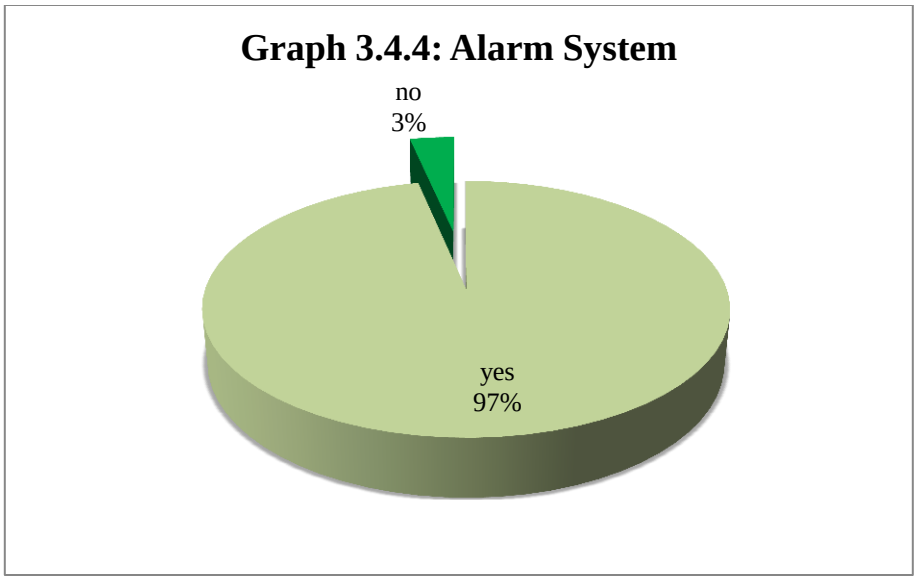

Figure 3.4.4: Graph of Types of Button Preferred.

3.4.5 DAILY LIFE ACTIVITIES SYMBOLS

Due to the size constraint, we can only have 8 buttons to be prebuilt on the communication board. From the surveys and consideration, the preferred buttons would be eat, drink, toilet, bath, sleep, sit up, YES and NO.

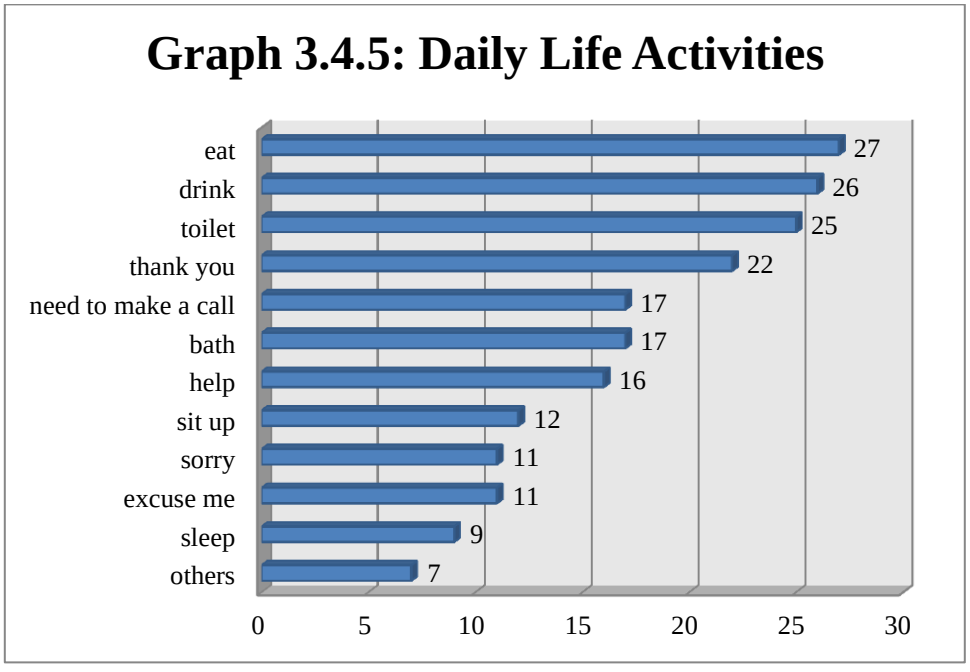

Figure 3.4.5: Graph of Daily Life Activities

3.5 SYSTEM DESIGN.

3.5.1 BLOCK DIAGRAM OF THE PROJECT

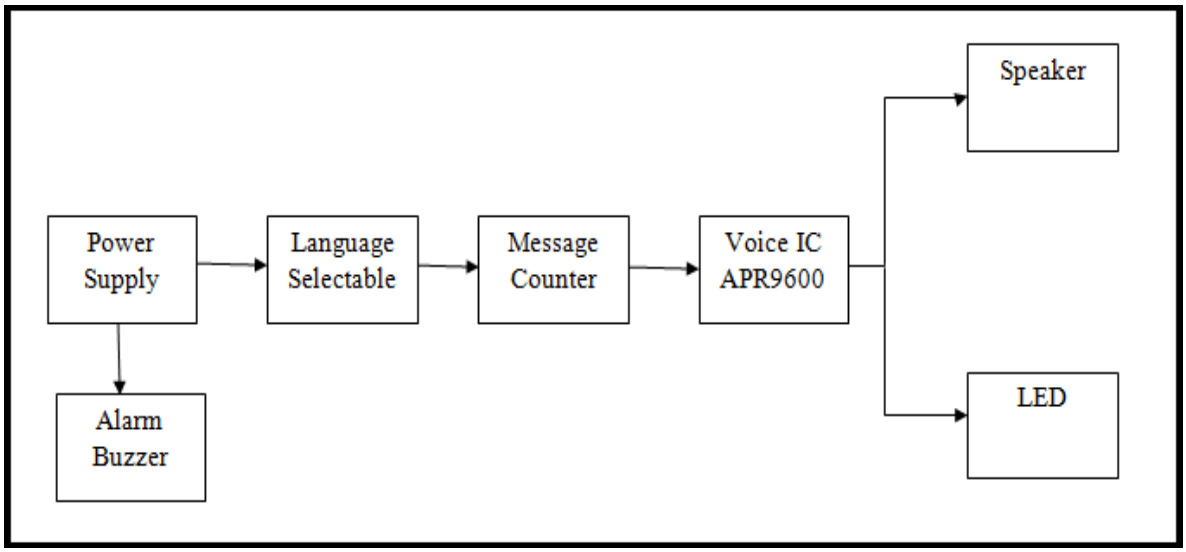

Figure 3.5.1: Block Diagram for Patient Communication Board.

Figure 3.5.1 shows the block diagram of the whole project. The design will starts from the power supply. The function of power supply is to supply the electrical energy to the circuit. For this circuit, the power supply that has been used is 5Volt. Then it goes to language selectable or selector. After one of the languages provided is selected, message counter will play its part. Once the user pushes the button on the board, the message or voice will be stored in the Voice IC APR9600. The output of this system is LED will be ON and the voice or message will be heard. Other is alarm buzzer. Alarm buzzer will work independently based on user need.

3.5.2 ELECTRIC CIRCUIT DIAGRAM

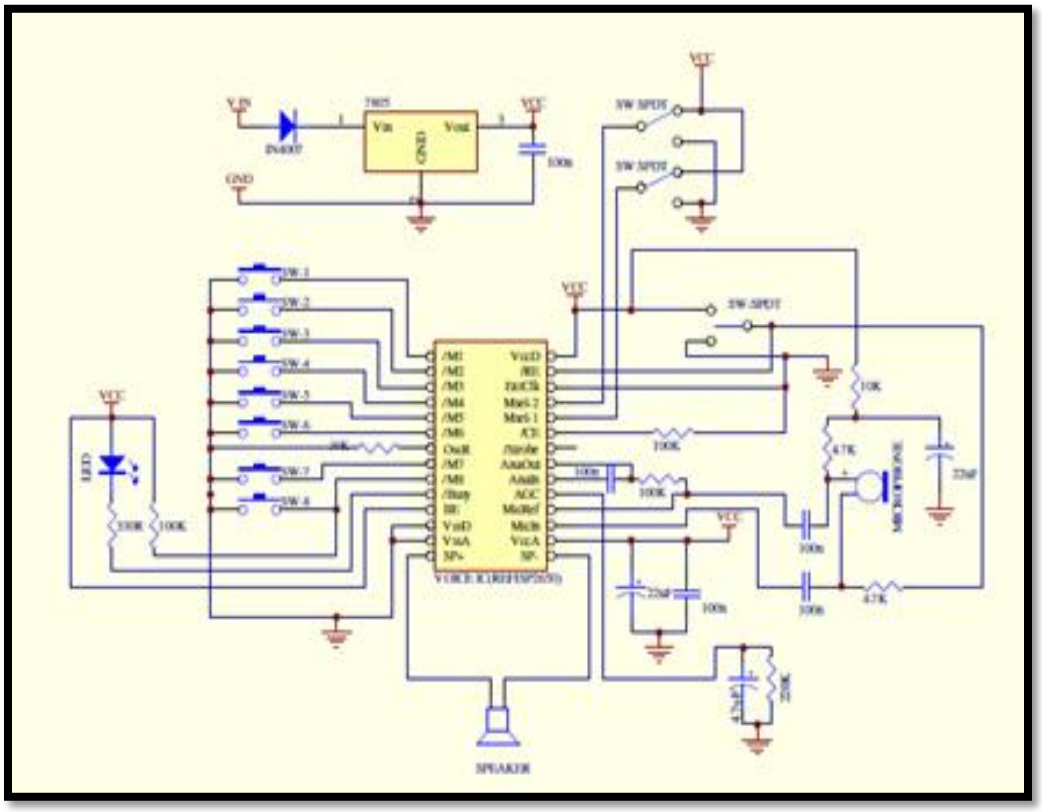

Figure 3.5.2: Circuit Diagram for Patient Communication Board.

3.6 HARDWARE AND DEVELOPMENT

In the purpose of developing the patient communication board circuit, there are few components involves. All these required items have their own functions in order to realize this circuit operation. The hardware consists of LED, Push Button, Switch selector, and microphones, Voice IC APR9600, Resistor and the Capacitor. Explanation on each part is provided in the next section.

3.6.1 ELECTRONIC COMPONENTS

3.6.1.1 INTEGRATED CIRCUIT APR9600

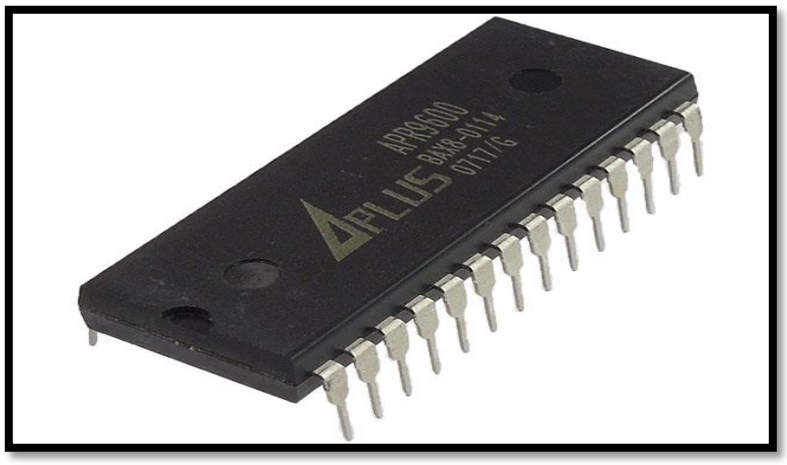

Figure 3.6.1.1: Integrated Circuit APR9600

An Integrated Circuits APR9600 is a single- chip Voice Recording and playback device. This IC offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. Integrated output amplifier, microphone amplifier, and AGC circuits greatly simplify system design. This device is used for this project because it ideal for use in portable voice recorders likes patient communicator board. An integrated achieves these high levels of storage capability by using its proprietary analog/multilevel storage technology implemented in an advanced Flash non-volatile memory process, where each memory cell can store 256 voltage levels. This technology enables the APR9600 device to reproduce voice signals in their natural form. It eliminates the need for encoding and compression, which often introduce distortion.

3.6.1.2 RESISTOR

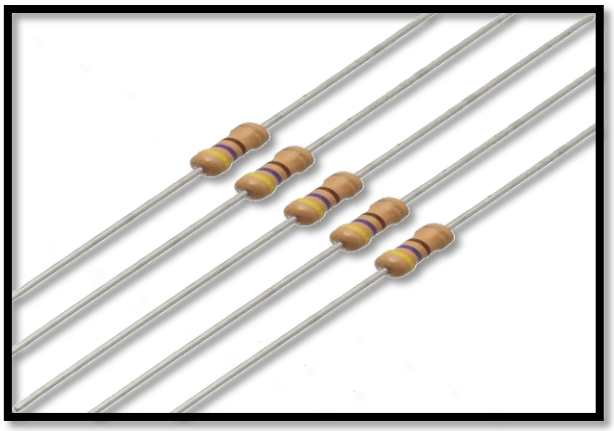

Figure 3.6.1.2: Resistor

A linear resistor is a linear, passive two-terminal electrical component that implements electrical resistance as a circuit element. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. Thus, the ratio of the voltage applied across a resistor's terminals to the intensity of current through the circuit is called resistance.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel-chrome). Resistors are also implemented within integrated circuits, particularly analog devices, and can also be integrated into hybrid and printed circuits.

3.6.1.3 MICROPHONE

Figure 3.6.1.3: Microphone

A microphone is a sensor or acoustics to electronic transducer which convert sound in air into the electrical signal. In this project, microphones act as a are used in many applications such as telephones, tape recorders, karaoke systems, hearing aids, motion picture production, live and recorded audio engineering, FRS radios, megaphones, in radio and television broadcasting and in computers for recording voice, speech recognition, VoIP, and for non-acoustic purposes such as ultrasonic checking or knock sensors. Most microphones today use electromagnetic induction (dynamic microphone), capacitance change (condenser microphone) or piezoelectric generation to produce an electrical signal from air pressure variations. Microphones typically need to be connected to preamplifier before the signal can be amplified with an audio power amplifier or recorded.

3.6.1.4 LED

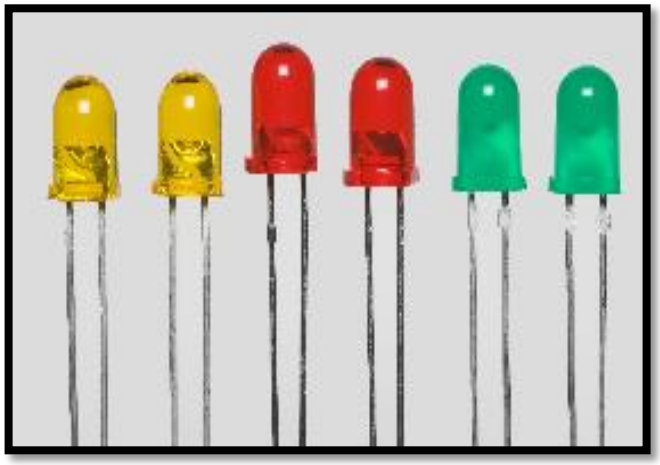

Figure 3.6.1.4: LED

A light-emitting diode (LED) is a two-lead semiconductor light source that resembles a basic pn-junction diode, except that an LED also emits light. When an LED's anode lead has a voltage that is more positive than its cathode lead by at least the LED's forward voltage drop, current flows. Electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

3.6.1.5 SPEAKER

Figure 3.6.1.5: Speaker

Speaker is an electroacoustic transducer that produces sound in response to an electrical audio signal input. In other words, speakers convert electrical signals into audible signals. Non-electrical loudspeakers were developed as accessories to telephone systems, but electronic amplification by vacuum tube made loudspeakers more generally useful.

3.6.1.6 SPDT SWITCH

Figure 3.6.1.6: SPDT Switch

A switch is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another. The most familiar form of switch is a manually operated electromechanical device with one or more sets of electrical contacts, which are connected to external circuits. Each set of contacts can be in one of two states: either "closed" meaning the contacts are touching and electricity can flow between them, or "open", meaning the contacts are separated and the switch is nonconducting. The mechanism actuating the transition between these two states (open or closed) can be either a "*toggle*" (flip switch for continuous "on" or "off") or "*momentary*" (push-for "on" or push-for "off") type.

3.6.1.7 PUSH BUTTON

Figure 3.6.1.7: SPDT Switch

A push-button is a simple switch mechanism for controlling some aspect of a machine or aprocess. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, though even many un-biased buttons (due to their physical nature) require a spring to return to their un-pushed state. Different people use different terms for the "pushing" of the button, such as press, depress, mash, and punch.

3.7 TESTING

3.7.1 PRODUCT TESTING

One of the important element to determine the quality of product development is a product testing. Product testing consists of several important parts which is measurement of the characteristics' of the product, measurement of performance of the product, measurement of the robustness of the product and measurement of

durability. After performing the product testing, the information and result from this is useful for the researcher to improve the product quality and for future recommendation.

3.7.2 PRODUCT EVALUATION.

Another important element in testing is product evaluation. Product evaluation differs from the product testing because it focuses more on the information from the customer or respondents. For this project, five respondents from different background likes rehabilitation officer from University Malaya Medical Centre (PPUM), Biomedical engineer from Ministry of Health Malaysia and Biomedical Engineer from PPUM were selected to give their feedback about the device. They need to answer the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST version 2.0) form. This QUEST was designed to evaluate a person's satisfaction with a wide range of assistive technology (Demers et al.2002)

4.0 RESULT

In this project, the performance of this product will be evaluated in two components which is product testing and product evaluation. Product testing is a testing and checks the availability of the overall system includes the architecture design, the performance of the whole project and fulfills the objective requirement. It involved in measurement of systems characteristics, measurement of performance, measurement of robustness and measurement of durability of the product. For the product evaluation, it more focuses on information or feedback from the user. This chapter will be the core chapter for the project as it is concerns with the performance and achievement of the project.

4.1 PRODUCT TESTING

4.1.1 MEASUREMENT OF SYSTEMS CHARACTERISTICS.

This product has been made to some tolerances and specification. All the item in design specification of this product has meet the objective. Below are the tables that show the design specification of the product.

Table 4.1.1 Design Specification

DESIGN SPECIFICATION	(√/ X)
Portable	√
Voice Output	√
8 Buttons for Basic Need	√
Light Weight < 1Kg	√
Low Cost < RM 500	√
User- Friendly	√
Thickness of the Board <8cm	√

Language Selectable	√
Buzzer	√

4.1.1.1 PORTABLE

Figure 4.1.1.1 show the patient communication board device. It is portable because this devices used rechargeable battery so that the user can bring it anywhere without power limitation by socket wall.

Figure 4.1.1.1: Patient Communication Board Symbols

4.1.1.2 VOICE OUTPUT

Figure 4.1.1.2 shows that when the push button is pressed, the output voice will be produced based on the symbol. For example, if the button “EAT” is pressed, the voice “EAT” will be heard. Before pressing the push button, language must be

selected first. Voice output is depended on the language selection.

Figure 4.1.1.2: Trial of the Output Voice.

4.1.1.3 EIGHT BUTTONS FOR BASIC NEED

Figures 4.1.1.3 show the push button and symbol that represent our daily life. It proves that this communicator board has eight common daily life activities for the older patient which is eating, drinking, toilet, sleep, showering and stands up.

Figure 4.1.1.3: Eight symbol of Daily life activities

4.1.1.4 THICKNESS OF THE BOARD <8CM

Figure 4.1.1.4 show the measurement of thickness of the box, which is 7cm. This device must have less than 8cm thickness due to the ergonomics factors. It cannot be too slim and not too thick for the elderly to hold this device.

Figure 4.1.1.4: Thickness of the patient communication board.

4.1.1.5 LANGUAGE SELECTABLE

Figure 4.1.1.5 show that the communication board has a language selector. The user can select which language they are preferred to used either in Bahasa Melayu, English or Mandarin. If the communication language between the patient and the doctor is English, they can select English language or between their families is Mandarin language; they just need to select that language.

Figure 4.1.1.5: Language Selector on the Board.

4.1.1.6 COST ESTIMATION

Table 4.1.1.7: Cost Estimation of the product

No	Material	Dimension	Price/unit (RM)	Quantity needed	Price (RM)
1.	Casing Box	-	18	1	18
2.	Switch SPDT	-	2	4	8
3.	LED		1	6	6
4.	Battery		18	1	18
5.	Printed circuit board (PCB)		10	1	20
6.	Speaker		3	1	24
7.	Voice IC (APR9600)		3	3	9
8.	Microphone		30	1	30

9.	Capacitor		1	24	24
10.	Resistor		0.30	24	7.2
11.	Diode IN4007		1	3	3
12.	Regulator 7805		1.5	3	4.5
13.	Push Button		2	9	18
				TOTAL PRICE /COST	189.7

Based on the table above, cost estimation for this project was calculated about RM 189.7. So it shown this prototype can be less than RM 500.

4.1.2 MEASUREMENT OF PERFORMANCE

Performance measurement is important to verify whether the designed system is working appropriately or not. This patient communication board has meets some form of safety and controllability standards. For the safety standard, this device has circuit protective in order to prevent patient or user from danger or leakage current. This circuit also prevent current to overflow thus the speaker cannot more function. Otherwise, this product is comfortable to the patient because they can use it independently and reliable to them.

4.1.3 MEASUREMENT OF ROBUSTNESS

The communication device has the potential to be resistance to user impacts, spills, heat and other. So it has been designed to withstand reasonable mishaps. The test has been made by pushing the button continuously for 15 minutes and it about 30 times. It found that the system still can operate well.

4.1.4 MEASUREMENT OF DURABILITY

Durability testing is the duration of time a product can meet its performance requirement. For the durability test, the product has been tested by switching ON the power of the device and its can stand for 24 hours without failure. This device also comes with the rechargeable battery so it makes the product user friendly.

4.2 PRODUCT EVALUATION.

4.2.1 SATISFACTION FOR PATIENT COMMUNICATION BOARD.

Figure 4.2.1: Graph of Item Satisfaction

Graph 4.2 above show the feedback analysis from QUEST form. From the survey, satisfaction for the dimension of the product is 3.6 which are between 3 or 4. It means between more or less satisfies and quite satisfied. For the weight of the patient communication board, the satisfaction scale is 3.8. It also between more or less satisfies and quite satisfied. Besides that, the item ease in adjusting the parts of

patient communication board is 3.8, same with the weight item satisfaction. In the QUEST form also, respondent has been asked on how safe and secure the communication board is.

Most of them agree when the item satisfaction scale show 3.6 and it between more or less satisfies and quite satisfied. Durability of the board also has been test by them. The average value for durability is 3.8. Another item satisfaction has been asked for the respondent is how easy it is to use this device. Average value for satisfaction scale for this item is 4. Is show that most of them agree and quite satisfied with the easiness of this device. Then, for the item how comfortable the communication device for them had shown the average scale about 4.2. It between the quite satisfied and very satisfied. The last item satisfaction has been asked to the respondent is how effective the patient communication board to them. The average value for this item satisfaction is 3.8. It shown most of them quite satisfied with this device.

4.2.2 IMPORTANT ITEM SATISFACTION.

Figure 4.2.2: Graph of Important Item Satisfaction.

The graph 4.2.2 shows the most item satisfaction for the respondent. For the dimension of the patient communication board, 60% (n=5) of them agreed that dimension is one of the important element for the patient communication board. Another important item satisfaction is weight of the device. One of them agreed that the weight of this device is quite important 20% (n=5). For the adjustment, none of them agreed that this item is important for the device. Besides that, safety is one of the important elements to one of them. It show 20% (n=5) agree for this item. It same goes to durability item satisfaction.

Most of them agreed 80% (n=5) that easy to use is quite important for the device because this devices will be used for the elderly who has stroke. For the comfort item satisfaction, only one of them 20% (n=5) agreed that this item important for the patient communication board. Last but not least is effectiveness of the device. 60% (n=5) of the agreed that effectiveness is one of the important element to be consider when designing this device.

5.0 DISCUSSION

5.1 DESIGN OF THE PATIENT COMMUNICATION BOARD.

Based on the respondent evaluation form, for the dimension of the communication board like size, height, length and width, most of them suggest that this device should be smaller than this prototype. The thickness of this device also needs to be reduced because of the ergonomics factors. Besides that, one of them suggest that there a need for LED to blink rather than only ringing.

It due to some of the elder cannot hear and they can only see blink LED. In order to make this device more effective, most of them suggest that the push button is embedded inside the symbol. It easier to the patient to press the button compare to the existing one. Furthermore, the adjustable volume is needed to make this device more effective.

5.2 IMPROVE QUALITY OF LIFE.

Patient with communication disabilities has broad range of feelings. It is hard for them to express their feeling and sometimes it can reduce their self-esteem among other. In order to increase their confidence and independence, alternative communication aids has been designed since many years ago. Several studies also show of young adults who had used alternative communication devices since childhood report a generally good quality of life, though few lived independently.

More positive quality of life outcomes often correlated with better quality of communication and interaction, as well as personal characteristics, family and community

support, and excellent alternative communication device services. By developing the patient communication devices, it can help the community in Malaysia to improve their communication thus improve quality of life. Compare to other communication devices that exist today, most of it is too complicated to used and very expensive.

Besides, it also need a skill to operate and not user friendly. In order to overcome this problem, patient communication board was design as simple as posibble but not ignore other important item that should have in common communication aids.

6.0 CONCLUSION AND RECOMMANDATION

6.1 INTRODUCTION

This chapter contains the problems encountered during this project and the recommendation to overcome the problem and to make the improvement for this project in the future. This project has been applied for the utility pattern and it approved.

6.2 CONCLUSION

i. This communication board which would be cheap manufactures and fairly efficient in the method in which it produces it. Available products in market usually use complex circuits with programming and costly. It also needs a lot of practice and technical knowledge to use the current communicator board. The advantages in the development of this project is, it is design to meet the criteria which more suitable to the Malaysian elderly. Beside it used APR9600 as a voice recording chip as to replace interface programming software and to simplify existing system as to reduce complexity circuit and cost.

ii. At the same time, the user or caregiver which used this communication board only need a minimal technical knowledge in order to used and operate it. Language selector available in this system makes this device differ from the existing board. For the application of this project, it will be able to use in gentries ward, rehabilitation center, home and other.

iii. In the other hand, this device is portable so that the user can bring it

anywhere especially when they have outdoor activities. Compare to the current communicator assistive, most of them are computer based and big in size. So it a bit difficult for user to bring it anywhere.

iv. This device also has been test in many aspects. In order to make this device safe for the user, one circuit protective has been put to avoid current to overflow and speaker to more function.

6.3 PROBLEMS AND LIMITATIONS

i. Time and analysis on circuit

The development of this project still required more research and need more time to achieve the target. The proper analysis need to be done to this board in term of standard safety, the robustness and more.

ii. Design

The actual design of this product should be smaller than this prototype. The prototype were complete but in a not real design. Limitations in finishing the prototype make this device look bigger and not commercial.

iii Voice Output.

The voice output produce is too slow and sometimes cannot be heard when the surrounding environment to loud.

6.4 RECOMMENDATION

The recommendations to upgrade the system described as below:-

i. By add the Light Emitting Diode (LED) under the push button so that the caregiver can know which button or symbols the patient is press if they cannot heard the voice or output.

ii. Increase the output speaker volume so that it can be heard loudly.

iii. The symbols that represent the daily life activities need to be print on the casing box.

iv. Moreover, the customize push button is prefer because this devices is mostly used by the stroke patient. The available push button that currently have only suitable for circuit development prototype.

v. The blink LED also can be put beside the emergency alarm so that when patient press the emergency button, blink LED also can be function.

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APPENDIX 1

Survey Form

Title: Electronic Communication Board for Senior Citizens

Introduction

This survey is carried out in fulfillment of the Biomedical Engineering Practices course KUEU 3150. Your cooperation in answering this questionnaire is greatly appreciated. All information will be strictly confidential and shall on used for the purpose of completing the assignment.

PART A: Demographic (please tick or circle)

1. Are you:
A senior citizen with speech problems ☐

A carer for a senior citizen with speech problems ☐

A nurse ☐

Allied health professional ☐ Please select: OT/Physio/Speech Therapist

A doctor ☐

Member of Public ☐

2. Gender : Male Female

The electronic communication board is designed to help older people with speech problems to communicate. It will have buttons which will talk when pressed by the elder.

PART B: Please Tick

The age of the patient (From your experience, how old usually is your patients?)

21 and above	☐
21-40	☐
41-60	☐
61-80	☐
80 and above	☐

Education level of patients (From your experience, what is the average education level of your patients?)

Primary School	☐

High School ☐

College ☐

University ☐

Communication board output (What type of output do you think is suitable for your patients?)

Word Display ☐

Voice ☐

Types of Buttons (What type of buttons do you think is suitable for you patients?)

Solid Button ☐

Virtual Button (Touch screen) ☐

Alarm Button (Do you think your patients need an alarm buttons?)

Yes ☐

No ☐

Cost consideration (Do you think your patients can afford to buy a PC tablet? Eg.iPad, Samsung Tab)

Yes ☐

No ☐

Which buttons do you think is important to be built-in with a communication board?

☐ Eat

☐ Drink

☐ Bath

☐ Toilet

☐ Sleep

☐ Sit up

	Excuse me
	Thank you
	Sorry
	Help
	Need to make a call
	Panic button

Others (please specify):

_____

Which of the following expression is important for you? (or your patients)

	I am happy today
	I am sad today
	I am worried
	How much is this?
	I want to have this
	I do not want this
	I want to watch TV
	I want to listen to the radio
	Can you speak louder?
	Can you read the newspaper for me?
	Can you accompany me?
	Can you sing for me?

Others (please specify):

_____

~Thank you for your cooperation~

APPENDIX 2

QUEST

APPENDIX 3

APR9600 DATA SHEET