



Make Me Speak: A Mobile App for Children with Cerebral Palsy

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ABSTRACT

Cerebral Palsy is a common neurodevelopmental condition. The condition may present itself in many different kinds of classification. Cerebral Palsy is always showing many deficits such as mental retardation, speech, language and motor problems. This research was inspired from Elisya, a nine-year-old girl with Cerebral Palsy since born with an auditory and speech disorder including motor problem that affects her mobility. Her senses and brain do not fully coordinate and this creates a communication issue between Elisya and her parents. The aim of this research is to provide a mean for children with Cerebral Palsy who can't speak to communicate significantly with their parents and carers without using any sign language. There are plenty of assistive tools in the market and this includes the Augmentative and Alternative Communication devices for people with speech disorders. However, there is no app found in Malay language and the content can't be personalized. Make Me Speak is an Augmentative and Alternative Communication tool using mobile technology which is developed to help people with Cerebral Palsy to communicate with people around them. Make Me Speak is not just for Cerebral Palsy community but for anyone with speech disorder. It is developed in dual language – Malay and English with a personalized content. React Native mobile development platform is used to create the app. React Native helps in building cross platform mobile apps. Hence, it saves time and cost to build mobile apps on multiple platforms. Usability test was done on Elisya and it was found that she is able to manage the app and chose the right buttons to express her needs. This research is in line with the social innovation initiative for people with disabilities as described in the Eleventh Malaysia Plan (RMK-11).

Key words : Auditory Problem, Augmentative and Alternative Communication, Mobile Application; React Native

1. INTRODUCTION

Recently, in Channel News Asia, there was a coverage on Sayfullah, a boy who has been diagnosed with Cerebral Palsy (CP) when he was one month old. He is limited by his speech disorders that is giving him difficulty to communicate with the people around him. He would express his feelings through his body languages or by making some squeaky sounds. His parents have initiated a way to let him communicate with other people by implementing several Augmentative and Alternative Communication (AAC) technology or known as assistive tool in mobile platform so he can just tap his finger on the screen and talk with other people. A mobile app AAC has been a popular option among disabled people who are unable to speak [1]. Assistive tool made for Sayfullah are in English and as a Singaporean national, Sayfullah understands English better than Malay language.

On the other hand, Elisya, a nine-year-old Malaysian girl who was born with CP. She suffers from auditory and speech disorders as well as her mobility. This research has developed a sustainable app with a local content and personalization function. Whilst, in RMK-11, the social innovation is putting the government to focus more on streaming social services delivery by incorporating feedback from the community in line with the "whole-society approach instead of put higher investment in social services but delivery is ineffective". This initiative also encourages the Malaysian community to develop their idea into innovation instead of only remain dependent on the government. The awareness of CP in Malaysia is considered very low as this is evident by the public survey we have conducted. Less than 50% community have heard about CP and able to describe CP technically. Those who knows CP is due to the direct and indirect relationship they have with CP people.

2. RELATED WORK

CP is a term that refers to a group of disorders affecting a person's ability to move due to the brain damages that happens before and during the baby's birth or during the first three to five years of the child's life. It also affects muscle

tone, movement, and motor skills that can cause vision, hearing, speech problems and learning disabilities. In this kind of case, there are functional roadblocks that prevent effective communication between individual with CP and other people. When the child is nonverbal, it presents quite a challenge for people that are around them because the child cannot share their feelings, dreams or experiences through words [2]. For CP children who are non-verbal, a speech pathologist identified the way for the child to describe themselves and their desire that substitutes speaking and promotes communication between people. To make sure that the goals are accomplished, the therapist will rely on physical cues, movements, conventional tools, and current technology to help a child to compensate for their limitations [3]. Some of these tools include gestures, symbols and picture boards.

The introduction of mobile technologies such as iPad and Android Tablet has offered many potential benefits to people with complex communication needs who require AAC to communicate [4]. A qualitative research [5] by eight speech language pathologists has attempted a study on both AAC technique and natural speech technique for nonverbal children. It took six online focus groups with open ended discussion topics on clinical implications, advantages and disadvantages of practicing dual-paradigm approach as an intervention for children with speech problem. The discussion was facilitated by a moderator. The results suggested a visible evidence of the effectiveness of mixed AAC intervention as a therapy for non-verbal children.

A preliminary investigation with a local speech therapist at a public rehabilitation centre was conducted. The centre has already decided to implement three types of technology in their treatment for language development for CP children which are 1) Head Pointer Assistive Tools - Head pointer provides an alternative method of using equipment for people with limited ability to talk with other people. Figure 1 shows how the head pointer is used to tap on a screen [6] 2) Switch Access Scanning Assistive Tools - Switch access scanning is an indirect selection technique, used by an assistive technology user, including those who use AAC to choose option from the selection set. Scanning using technology has a good advantage that the user enables to be independent in controlling the assistive technology for those with only one voluntary movement. An example is shown in Figure 2 [7] and 3) Eye Gaze Assistive Technology – An eye-operated communication and control method that encourages people with speech disorder to communicate and interact with other people using their eyes. By looking at control keys or cells displayed on a screen, the user can generate speech either by typing a message or selecting pre-programmed phrases as shown in Figure 3 [8].



Figure 1: Head Pointer Assistive Tool



Figure 2: Switch Access Scanning Assistive Technology



Figure 3 : Eye Gaze Assistive Technology

Table 1 shows a review of existing mobile apps found for children with auditory problem. It is found that some are platform dependent, for commercial use only and all of them are not available in Malay language. There exists a need for local content to benefit local children.

Table 1 : Existing Applications

Apps	Platform	Strengths	Limitations
AVAZ	IOS and Android	Have consistent and research based technology. It can convert it into a book, so the application can be used offline and can personalize the picture and menu.	Complex interface e. Not available in Malaysia. No Malay language is available.
ACC Speech Buddy	Android	The interface is nicely organized and intuitive. The application also give the user the ability to create, customized, personalized speech sets with others.	Commercial app. Not available in Malaysia. No Malay language is available.
Tap To	IOS and	Simple pictures	Complex

Talk	Android	organized in a drill-down format help kids communicate specific messages.	interface. Not available in Malaysia. No Malay language is available
ICom	IOS	Available in free version.	Complex interface. Not available in Malaysia. No Malay language is available. Only available in IOS.
LetMeTalk	IOS and Android	The database contains more than nine thousand easy to understand images from online directory.	Complex interface. Not available in Malaysia. No Malay language is available

3. METHODOLOGY

Make Me Speak comes in dual language – English and Malay. The aim is to support the needs from the local parents especially those in the rural areas with poor English background and rehabilitation centres with Malay medium. The main page in Figure 4 shows a welcome page in two different languages.



Figure 4 : Language Selection Page

The pictures shown in Table 2 are available as options in the app and each picture plays a pre-recorded audio to express the CP child’s need. The CP child only require to tap on the pictures and the pre-recorded voice served as an audio to speak on behalf of the CP child. There are 2 modes available – Parents and Children. Parents will be given a login with a username and password. In Parents mode, a parent can personalize the picture and audio. Personalization feature gives sustainability to the app for long term use.

The mobile application is targeting CP children as user with a condition that they could manage a screen device such as iPad but are unable to speak. The apps can be applied on deaf children too. Survey on the public was conducted to test the

rate of awareness on CP issues and children with CP. An interview and observation were conducted on 9-year-old CP girl named Elisya, hence the name of this mobile application is suggested. The results are discussed in the next section.

Table 2 : Picture and Audio in Make Me Speak App

Type	Picture	Audio
Food		“Saya mahu makan.”
Drinks		“Saya mahu minum”
Sleep		“Saya mengantuk. Saya mahu tidur”
Talk		“Saya mahu bercakap dengan awak”
Toilet		“Saya mahu pergi ke tandas”
Play		“Saya mahu bermain dengan awak”

Make Me Speak app was developed using open source tools as follows:

A. React Native

React Native is a native scripting framework used for creating cross-platform mobile application that was first introduced in 2015. React Native implements principles and concepts of ReactJS which is a JavaScript framework. JavaScript is not a language that can be run natively on the mobile devices so a technique called bridging is used to allow JavaScript to run and to communicate with the processor of the mobile devices.

B. Node Package Manager (NPM)

NPM opens up an entire world of JavaScript talents for developers and the registry contain over 600,00 packages. NPM consists of three components which are the website, the Command Line Interface (CLI) and the registry. In this project, it requires NPM since the core language for Make Me Speak is JavaScript.

C. Expo SDK

Expo is one of React Native application which contain the Expo SDK. This type of SDK is a native-and-JS library which provides access to the device’s system functionality such as camera, contacts, or any other hardware in that device. Expo also provides user interface components to handle a variety of

use-cases that almost all mobile application will cover such as icons, blur views and many more.

D. Atom

Atom is a free and open-source text editor that available for Windows, MacOS, and Linux with support for plug-ins written in Node.js, and embedded Git Control, developed by GitHub. Atom also support a lot of programming languages such as Python, Ruby, C, CSS, Java, and JavaScript.

E. Canva

Canva is a website for graphic designing. It has huge repository of pictures, graphics and fonts with drag and drop features. Canva is a popular option by non-designers and professionals.

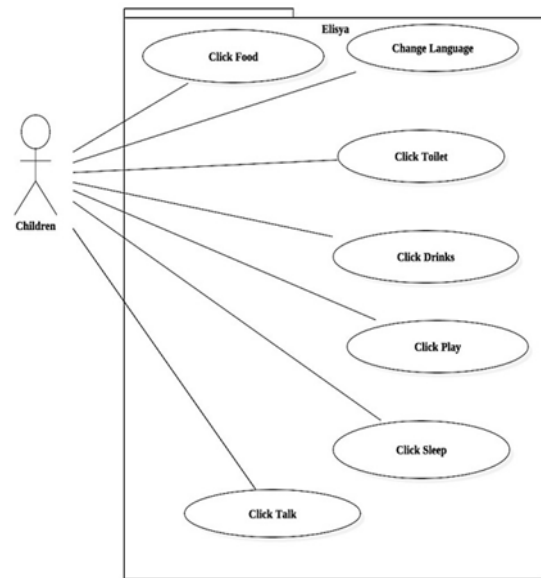


Figure 5: UML Diagram

Figure 5 shows the Unified Modelling Language (UML) Diagram for Make Me Speak app. It defines the functions available within the app that will be operated by the user including language selection.

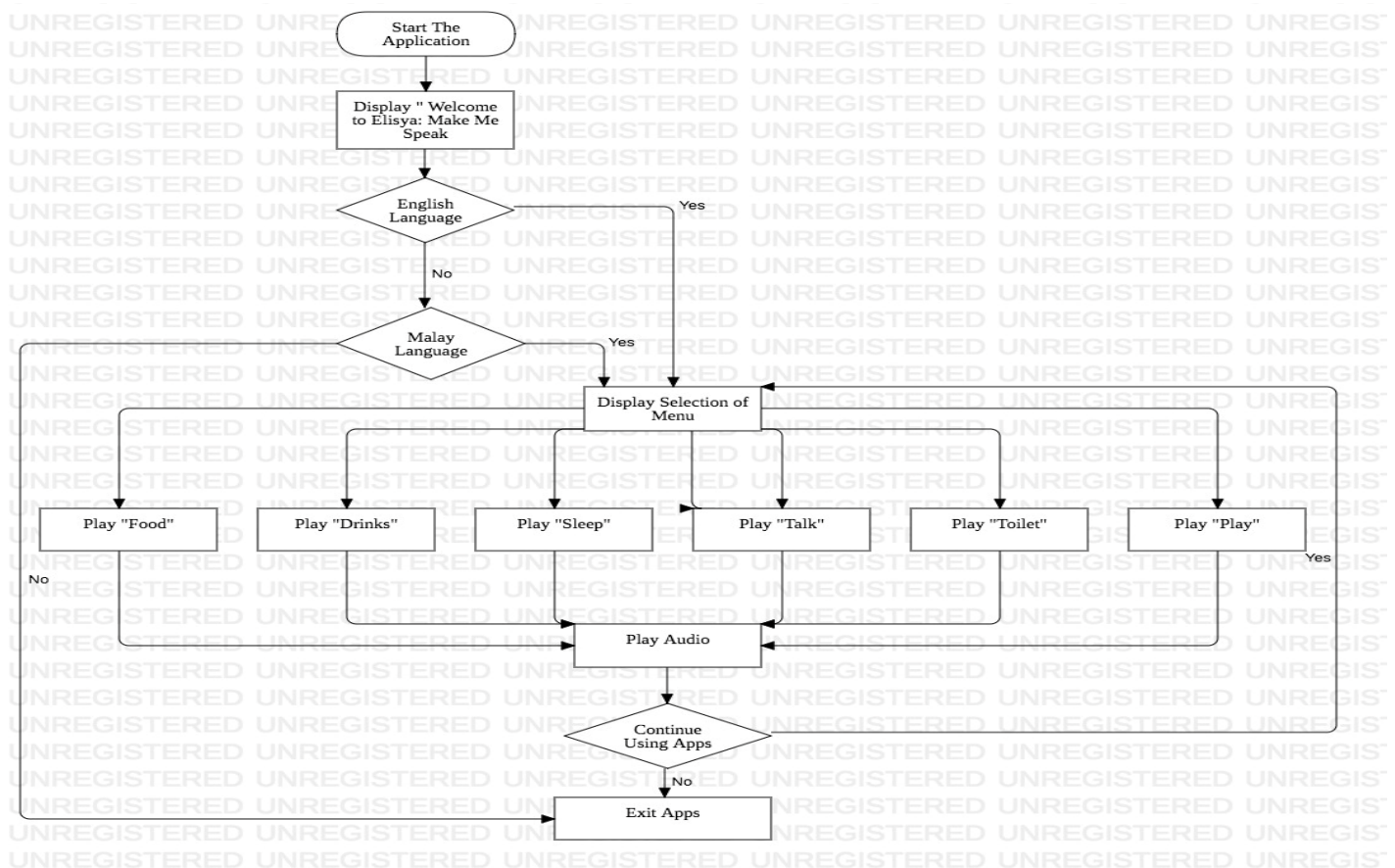


Figure 6: Flowchart

Figure 6 shows the flowchart of Make Me Speak app. The flowchart is translated into a pseudocode as follows:

1. The user requires to start the application by clicking on the icon of the mobile application.
2. The mobile application should display “Welcome to Elisya: Make Me Speak”
3. The user requires to choose language for the system either Malay Language or English Language.
4. The mobile application should display selection of menu.
5. The user requires to select any picture to play the audio according to their needs.
6. The mobile application shall play an audio that has been chosen by the user.
7. If the user wants to continue using the mobile application, the user can tap on another picture without press the back button on their device.
8. If the user wants to exit from the mobile application, the user just need to press the back button on the device.

4. RESULTS AND DISCUSSIONS

A survey was conducted on 100 publics to get their views and opinions about CP. The objective of the survey is to find out the awareness of the public on CP children and issues related to them. Some questions are asked and the results are shown below:

HAVE YOU HEARD OF CEREBRAL PALSY?

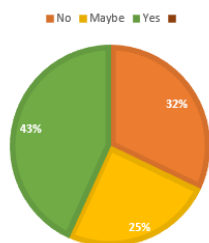


Figure 7: Survey Question 1

HOW WOULD YOU RATE THE AWARENESS OF CEREBRAL PALSY IN MALAYSIA

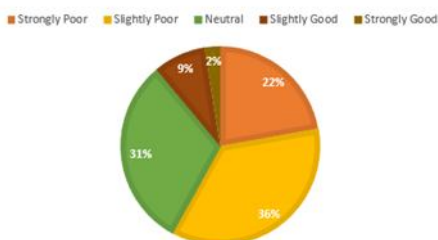


Figure 8: Survey Question 2

DO YOU AGREE THAT APPS CAN BE USED AS A MEDIUM FOR THE CP CHILD TO INTERACT WITH THEIR CARERS?

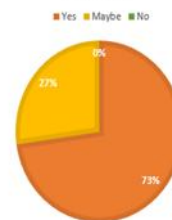


Figure 9: Survey Question 3

The survey results shown in Figure 7 and Figure 8 indicate that many people are unsure about CP. This is due to the lack of awareness on CP in Malaysia. It is found that the awareness on Autism is much higher than CP in Malaysia. There are many NGOs for autism community than CP community. Media coverage on CP is also low and almost none. In this survey, we educate the public with some information on CP. Then, we asked their thought whether they would be able to support the use of mobile apps in assisting CP children with auditory problem. The result is shown in Figure 9. Many people agreed with the use of mobile apps since almost everyone owns a mobile device such as tablet and smart phone. Among the feedbacks is they love the idea of having the apps available on the phone rather than purchasing a different device that serve a single purpose.

The functions of the developed mobile application are experimented on a CP child named Elisya was conducted. An interview with the child’s carer was also done to gain the info on the acceptance of the invention. Throughout the testing, Elisya was able to use the mobile application properly and she was excited with the application. Elisya was pretty much expressive and able to express how she felt through the app. Before the app’s usability test, we conducted a simple evaluation on Elisya’s language development using method define by Lenneberg and Lenneberg (2014). In this usability test, we asked Elisya to choose the correct shape and colour of the toy and she be able to choose and grab the correct toy by using her hand. This shows that Elisya has a good hand-eye coordination despite of her shaky limb movement. Then, a usability test was conducted, and the results were observed. We found that she was able to tap on the picture properly as compared to an existing mobile apps for CP children available on the market known as LetMeTalk (www.letmetalk.info). Our Make Me Speak apps has a wider screen display giving enough space for the CP child to tap on the picture. The usability test setup and results are as below:

A. Elisya’s hand movements test

The way how she holds her toys was observed to identify the hand movement or any motor pr joined problem. Through this observation, her hand was quite shaky and it was difficult for her to control the hand movement due to her motor’s disability.

B. LetMeTalk apps (commercial apps) test on Elisya
 Elisya has a difficulty to press the button on the application since the interface uses smaller buttons. The interface of LetMeTalk app is shown in Figure 10.

C. Make Me Speak app test on Elisya
 It is found that it was easy for Elisya to navigate between those buttons due to size of the buttons and attractive personalized pictures. A physical divider is suggested as additional accessory to control her fingers (Figure 11). The divider will prevent her finger to point to other picture button unnecessarily.



Figure 10: LetMeTalk



Figure 11: Physical Divider



Figure 12: Usability Test with Elisya

5. CONCLUSION

People with auditory difficulties need an assistive platform to communicate with the people around them. The tool can be used for them to express their feelings and describe their desire. People with CP who are unable to communicate properly need a platform for them to interact with other people. AAC technology helps them to communicate more easily and effectively. Make Me Speak is a mobile app for people with auditory and speech disorder. It is able to help to overcome the difficulty of speaking and increase the

independency level. Our studies found that the children who are unable to talk can enhance their speech and language development with the mobile apps technology.

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