

A Digital Eye Navigators for the Visually Impaired

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Abstract— Digital Eye Navigators is developing for the visually impaired community in Malaysia. The device is used to help the visually impaired community, where it will be used as a navigator by having a combination of object recognition platform and voice assistant application. The implementation of the object recognition platform is use to detect the object at the front or based on the surrounding and the data will be send to the algorithm for the process. After that it will process a response data, where it will translate the information into a voice through a speaker to inform the user either to go to the right side or to the left side. The development of the smart digital navigators must be affordable, so that it can be commercialize in the market to help the visually impaired community as the third party to guide or navigate while walking.

Keywords—Smart Digital Navigators, visually impaired, object recognition platform, voice assistant application

I. INTRODUCTION

Assistive technology need to be affordable since not all people have money to buy expensive technology in a way to help them to do something for those who need it [1]. The affordable assistive technology is a problem to the user, where most of the technology is expensive and most of the assistive technology is not from Malaysia, the user need to buy it from overseas and that will cost a lot of money not just for the technology but also for the shipping process and all. Assistive technology not just been used by the disable person but also for student. Assistive technology is a best tool for learning experience. It been used for reading and writing and math, besides that it can be use as another alternative communication tool [2],[16-20].

In another terms, assistive technology must be ergonomic [3] so that the user can understand the functionality on how to use it, in another way the technology must be easy to be use by the user. As for the visually impaired for them to understand something they used a braille commands to understand the direction such as lift number or at traffic light for crossing the road, while reading the book.

The use of object recognition application platform in the digital device is able to accumulate several type of recognition algorithms. The digital devices that is develop

will provide a user friendly operation and it is affordable for every level society to purchase it. In a meanwhile, the algorithms that is produce in this research where it will combine recognition and voice assistant program will become a crucial work and become a fundamental of this research[21-22].

In this paper, by introduce the smart digital glasses with embedded of object recognition platform and voice assistant application to assist a person with visually impaired. The use of embedded object recognition platform is to identify the object in front of the user, where it can help the user to know what kind of object is in front of them.

Besides that, by using the object recognition platform together with the combination of Artificial Intelligence (AI) [14] include together in the program that require an effort to develop it, will make the devices become more accessible for the object recognition platform to identify the object. The scan of the object have many option such as size, color, and also a movement of the object. All of the combination is based on the requirement of the devices that is required to be developed.

The smart glasses consist of build in camera and speaker, and it will communicate with the object recognition algorithm and voice assistant program which will develop in the devices itself so that visually impaired users know what is around them.

II. PROJECT BACKGROUND

Smart digital navigator is a good implementation, where it can help the visually impaired community by helping to navigate the user while walking. There is few reason why the Smart Digital Navigator is been develop.

Firstly, there a several existing smart glasses device are not customizable to be user friendly for the visually impaired person [3]. Some of the device got so many function that make user having some difficulties to understand all the function and on how to operate the device.

Secondly, most of the visually impaired devices are unaffordable and not available in Malaysia. The price might

exceed to more or less than \$10000. Thirdly is, some of the visually impaired assistant devices are not designed to be mobility aid and it involved a third party to assist the visually impaired person to walk.

Lastly, the object recognition platform with collaboration of voice assistant application in the smart glasses is not yet introduced to be commercializing to the market. So, to solve the some issue that is identified is by developing the smart digital navigator by enhances the object recognition algorithm to contribute in assisting visually impaired person. Besides that, it also has a combination of voice assistant program to assist the user.

As the summary the development of smart digital navigator must be easy to use for the visually impaired user to understand the function easily. Besides that, the algorithm must be able to process the data from object recognition platform so that the information will be transfer into a voice assistant application.

III. LITERATURE REVIEW

Assistive technology of smart digital navigators is embedded with object recognition platform and voice assistant application, which is consist a built in camera and speaker. Based on the research, there is some paper that is introducing the development to improve the devices to help the visually impaired community, where most the development is not at Malaysia.

There is an improvement of walking cane, where the devices is use to detect the obstacles in front of the user while walking. The implementation is by attach devices that using a sensor detection that is place at the bottom of the cane [11]. The result for the sensor is responding by having a speech-warning message and vibrator motor.

Device that is used to develop the Smart Cane is using many components and have many dependency between the components itself. The microcontroller will have three dependencies, which are ultrasonic sensor, infrared sensor, and water sensor.

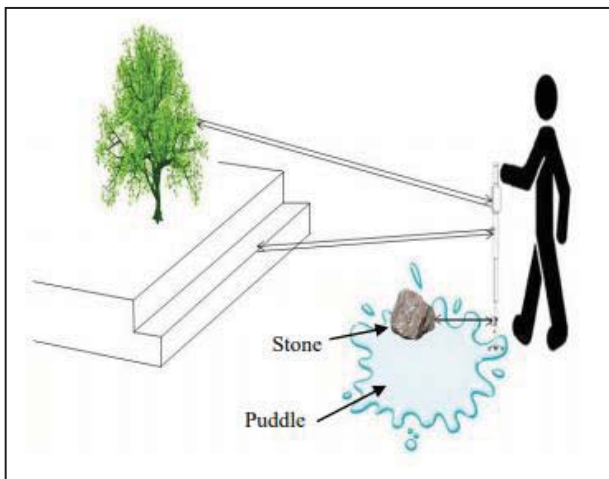


Fig. 1. Detection of obstacles using Smart Cane

Based on Figure 1, it shows how the Smart Cane detects the obstacles, where it also have water detection. The difficulty of the Smart Cane devices is that the voice message responds. As an example, if the surrounding is to crowd and it will be difficult for the visually impaired user to

hear the respond and the user might be walk straight to the obstacle at will cause minor accident.

The use of raspberry pi will process all the data and send the voice respond to the speaker. The algorithm will take place when the camera manages to scan the object. After that the data will be transfer into a voice or a speech to the user. The attachment of the component for the smart digital navigator will be attach on the spectacles. The attachment will be arranging in a proper way so that the smart glasses navigator can detect the object and the voice to be hear by the user.

A. Object Recognition Platform

The component of device that is use to scan the object at the front is by using the camera that is suitable to be integrated with Raspberry Pi 3 model B+. The suitable camera to be use is Raspberry Pi 8MP Camera Module V2, where the camera have a capability to capture a video and the lens of the camera also come with fixed focus lens that enable the 8 megapixel camera to be operate.

B. Voice Assistant Application

The use of voice assistant application is to send a respond to the visually impaired user by mentioning through [14] the speaker either the user should go to right or left side. The component that will be use in the development of smart digital navigator is the Speaker Phat. This component can be easily integrated with the Raspberry Pi 3 Model B+ and the voice is not too loud.

Based on the components it shows that the Raspberry Pi 3 Model B+ will be attach together with Speaker Phat and Raspberry Pi 8MP Camera Module V2, and the device will be attach at the spectacles so that the visually impaired user can wear and not using any other tool such as walking cane to walk.

IV. METHODOLOGY

The framework that is proposed consists of qualitative data analysis and conceptual framework. The used of conceptual framework because the development of smart digital navigators required a pattern [8] for the object recognition platform to be process through an algorithm and sending the information to the voice assistant application to be process. In a meanwhile, the process of voice assistant application will send the voice to the visually impaired user so that the user can know which direction to go based on the navigator of the devices.

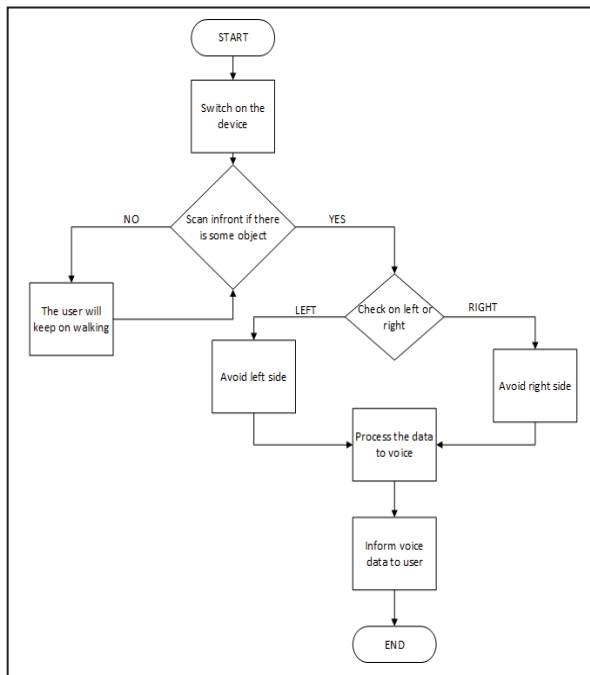


Fig. 2. Flowchart for smart digital navigator

Based on figure above, it shows a flowchart on how the smart digital navigator works. The first process is to turn on the devices. After that it will scan the surrounding to check if there is any object that can be identify. If there is objects it will send yes respond to another process to check either the object is on the right side or on the left side.

Meanwhile, for the no respond it will keep on looping the first selection. So the visually impaired user can keep on walking. To identify the object either the object is on the right side or on the left side will go to the next process, which is it will process the information into a data. After that it will send the data into another platform, which is voice assistant to inform the user to go to the right side or to the left side. The process will keep on looping until the user switch off the device.

Based on the framework, the qualitative is been measure through the quality of the devices to process the data and how to deliver the information to the visually impaired user. The smart digital navigator algorithm will be developing using Java programming language.

To get the data gathering there is two type is been use, which is interview and observation. Interview session between the visually impaired users is done face to face to understand their situation. There is some sample question that will ask to the interviewer.

TABLE I. THE QUESTIONS FOR THE INTERVIEWER

| No. | Questions |
|-----|------------------------------------------------------------------------------------------------------------------|
| 1 | Is there any tools besides the walking cane to help while walking in public? |
| 2 | Is there any difficulties to walk using the walking cane? |
| 3 | Are you willing to have another person to help u walking or a device that can give u a direction on where to go? |
| 4 | Would you think that having a voice to inform the user is a good approach to navigate the user? |
| 5 | Would you like to have a device that able to inform the user to go either to the right or left side? |

Based on Table I above, there are three questions that will be ask to the interviewer during the interview sessions. There will also an observation been conducted to observe the behavior on how the visually impaired user walk in the public. The requirement for the observation is to ensure that during the development of the smart digital navigators will cover the deficiency or consent of the visually impaired user.

TABLE II. THE REQUIREMENT DURING THE OBSERVATION

| No. | List of Requirement |
|-----|----------------------------------------------------------------------------------------------------|
| 1 | Is the some third party to help while walking? |
| 2 | How the visually impaired user walk in the public while having the walking cane? |
| 3 | How the Malaysian people see when they saw someone using walking cane to walk? |
| 4 | How the visually impaired user facing the difficulties when there is a hole or fall while walking? |

A. Raspberry Pi 3 Model B+

The algorithm will be process through the microprocessor, where the data to be process will be getting by using the camera and the algorithm will process the data into information to the visually impaired user. There some advantages by using this component, where it consist a 1.4GHz 64-bit quad-core ARM Cortex-A53 CPU. It also has dual-band 802.11ac wireless LAN and Bluetooth. Besides that, this component also supports fast Ethernet, which is Gigabit Ethernet over 2.0 and also power-over-Ethernet support with separate PoE HAT [8]. By using this component that combine together with Speaker Phat and Raspberry Pi 8MP camera module V2, will able to develop the smart digital navigators.

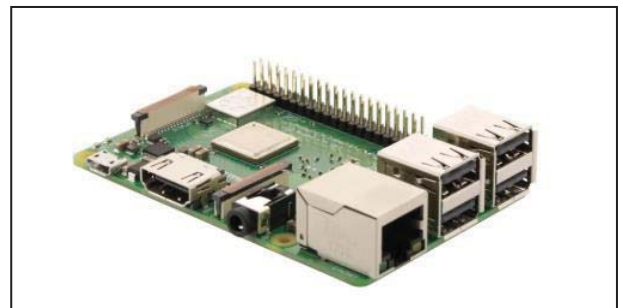


Fig. 3. Raspberry Pi 3 Model B+.

B. Speaker Phat

The speaker is use to send the information that already been process by the algorithm. The sound of Speaker Phat is like a tinny transistor radio and it offering a little bass. It's suitable to be use notification sound. The component will be attach at Raspberry Pi 3 Model B+ and will produce the sound to inform the visually impaired user.

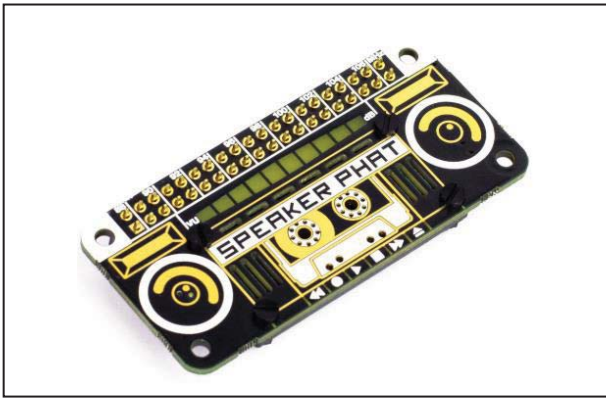


Fig. 4. Speaker Phat.

C. Raspberry Pi 8MP Camera Module V2

The camera is used to scan the object at the front of the user and the information will be sent to the algorithm. The processing of the data is to ensure either the user should go to the right side or to the left side. The camera will be connected directly to the Raspberry Pi 3 Model B+. The advantages of using this component, where it has 8 megapixel camera capable with fixed focus lens and all software is supported within the latest version of Raspbian Operating System.

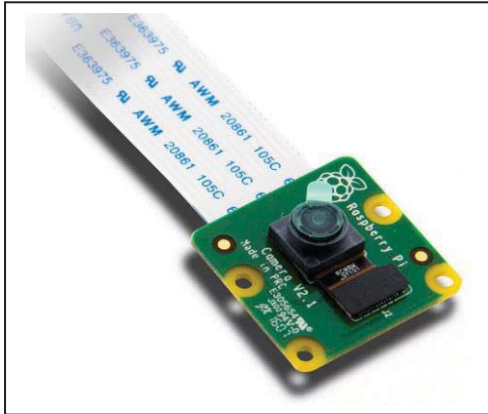


Fig. 5. Raspberry Pi 8MP Camera Module V2

V. CONCLUSION

As the conclusion, the development of the smart digital navigators will help the visually impaired community, where it has two important flows which are object recognition platform and voice assistant application. These two flows will be processed in an algorithm, where it will process the data from the camera and send it to the speaker so that the device can navigate the user in a proper route or way.

The implementation of a smart digital navigator is also affordable and it's safe to be used, so that all groups of the visually impaired community can afford to buy the device. Besides that, this innovative digital assistant technology will be able to help special needs and make a contribution in the visually impaired community.

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