MJIT 2017 Malaysian Journal of Industrial Technology

BLIND STICK NAVIGATOR

Sri Banu Munisamy[1,a], Diyana Ab Kadir[2,b], Mohammad Hazmi Elias[3,c], Shahidatul Arfah Baharuddin[4,d], Adidah Lajis[5,e]

[1,2,3,4,5]Universiti Kuala Lumpur, Kuala Lumpur, Malaysia

[a]sribanu@unikl.edu.my, [b]diyana@unikl.edu.my, [c]mohammadhazmielias@unikl.edu.my, [d]shahidatularfah@unikl.edu.my, [e]adidahl@unikl.edu.my

* Corresponding author : sribanu@unikl.edu.my

Abstract

Nowadays, there are so many types of blind assistance tool created such as pedestrian navigation system, Google glass for blind people and electronic long cane. Unfortunately, not all blind assist tools have GPS and GSM features integrated together and each part of it need to be bought separately. Besides, the equipment are costly to maintain and also difficult to be monitored. Thus, one small device known as Blind Stick Navigator using Arduino Uno along with 1Sheeld is developed in order to solve the problem mentioned. The idea of this project basically came from the traditional white cane. It's an enhancement from the previous project where people with blindness will be assisted during their travel. The prototype can detect obstacles using vibrating mechanism as well as messaging system to alert others in case of emergency. The accuracy of the ultrasonic sensor to work with two sensors on a stick does increase the awareness for the blind people. The new method of implementing current technology component likes 1Sheeld will help lessen the difficulties of the blind community in achieving greater feedback of their surroundings.

Keywords: Blind stick; Navigator; Ultrasonic sendor; GPS

1.0 INTRODUCTION

Based on World Health Organization (WHO) statement in 2014, about 285 million people are estimated to be visually impaired worldwide and 39 million are blind and 246 million have low vision. Thus, about 90 % of the world's visually impaired live in low-income economy while 82% of people living with blindness are aged 50 and above [1]. Thus, the demand of blind assist tools that designed with a good feedback and less maintenance for every day uses are hardly to be found in the market.

Traditionally, the white cane or also known as Hoover cane provides mobility tools to assist blind people but its focus on manual obstacle detection and has at least five types which serve different needs of blind people. A few have tried to use glove for the blind to feel shapes and navigate obstacle. For example is the Handsight which connect over Bluetooth to switch modes and visualize sensor readings. Several studies have shown that a glove with ultrasonic sensor is only suitable to be use in indoor rather than outdoor environment. However, feedback shows the time consumed during and after the use of the glove affects the effectiveness of this device. An electronic long cane in the market called UltraCane can detect obstacles at ground and head level using two ultrasound sensor [2]. Moreover, it has two ranges of detection; 4 meters to the front and 2 meters for short range. However, it is very high in cost at about RM3407.96 (£635.00) each [1]. Another concept reviewed is the pedestrian navigation system which is designed to guide the user from current location to new destination. The drawback of the design is there are wires cover the body of the users which anytime can lead to short circuit. It's a bit bulky and quite a hassle to handle such device [3].

Based from the existing products reviewed, an efficient blind assist tool must be able to guide the blind thanks to the feedback received from the system and to alert the people around them about their condition. Thus, as the consequence, this project is about designing a traditional white cane that is integrated together with the current technology such as ultrasonic sensor and GPS tracker to assist the blind navigate their way to reach the destination.

2.0 EXPERIMENTAL

Blind Stick Navigator is a prototype that has two main features which will help blind people to acknowledge and aware more of their surrounding and alerts their closest one in case of unpredicted incident struck them. The stick will be able to measure distance towards the obstacles by using ultrasonic sensor. The vibrator motor that is placed inside the blind stick holder will immediately vibrate when the person approaches the obstacles. Besides, the features of GPS (Global Positioning System) inside the smartphone will be used to pinpoint the location of the person. Then, the Short Message Service (SMS) is sent to the nearest contact person with the information of longitude, latitude and Google Map link. Their guardian will be able to locate them easily and rescue them as soon as possible. In addition, this navigator prototype is also designed to assist the blind on their journey by giving feedback about the surrounding and helps them to alert closest people when they are in emergency situation.

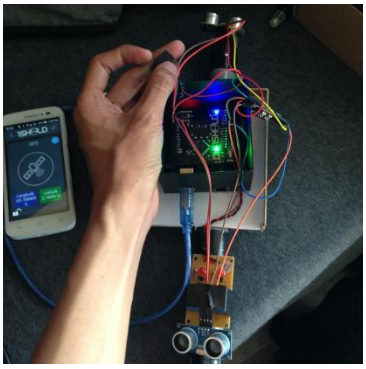

Fig. 1. Prototype.

Figure 1 shows the prototype for blind stick navigator. The Arduino Uno R3 board can operate on an external supply from 6 to 20 V. If supplied with less than 7V, and 5 pin may supply the board unstable. If using more than 12V, the voltage regulator may overheat and damage the board. Thus, the recommended range is 7 to 12 V.

1Sheeld sits on top of the Arduino board and communicates over Bluetooth to Android app to transfer data between it and the smartphone. 1Sheeld app is used along with the hardware shield to either control Arduino, read smartphone sensors in Arduino sketch, post on social media, or even controlling the Android device. A relay help the DC motor to be on and off according to specific command and measurement. A 6V DC motor with an operating range of 3-9V is used. Toggle switches are actuated by a lever angled in one or two more positions. It's used to interrupt the flow of the electrons in a circuit.

The ultrasonic module (HC-SR04) measures the distance accurately within 0cm to 400cm with a gross error of 3 cm. Its compact size, higher range and easy usability make it a handy sensor for distance measurement and mapping. Four pins used to make connection. VCC is to connect with +5DVC, Trig which Trigger input of sensor, Echo which is Echo output of sensor and GND to connect with ground. To start measurement, Trig of SR04 must receive a pulse of high (5V) for at least 10 µs and will initiate the sensor will transmit out of 8 cycle of ultrasonic burst at 40 kHz and wait for the reflected ultrasonic burst. When the sensor detected ultrasonic from receiver, it will set the Echo pin to high (5V) and delay for a period (width) which proportion to distance.

Figure 2 shows the placement of sensor component to get an appropriate coverage between the person's head and ground level.

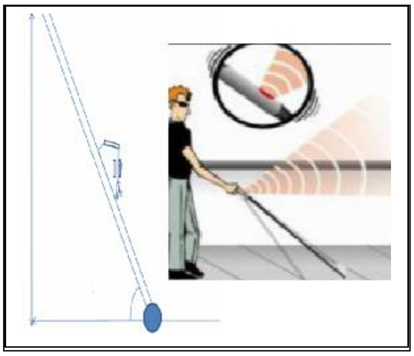

Fig. 2. Sensor.

Figure 3 shows an overview of the prototype which displays the reaction of sensor signals when there's an obstacle and the feedback sent to mobile device.

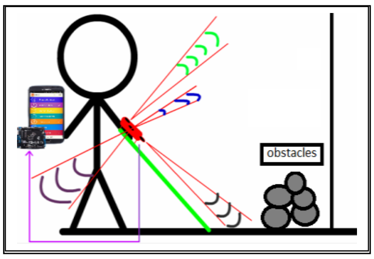

Fig. 3. Overview.

Figure 4 explains the flow of the blind stick navigator prototype. The first function of the blind stick is to detect an obstacle via ultrasonic sensor. If the distance of the obstacle is less than 80 cm, there will be a feedback in the form of vibration. So the blind stick will vibrate when it detects any obstacle within 80cm distance. This will alert the blind person to be more careful while moving around.

Another function of the navigator is to identify the location of the blind person. Since the stick can detect the GPS location, it will process the longtitude and latitude location of the person when the button on the stick is pressed. Once the location coordinates is detected, the device will send a Short Message Notification (SMS) to the contact person's mobile device.

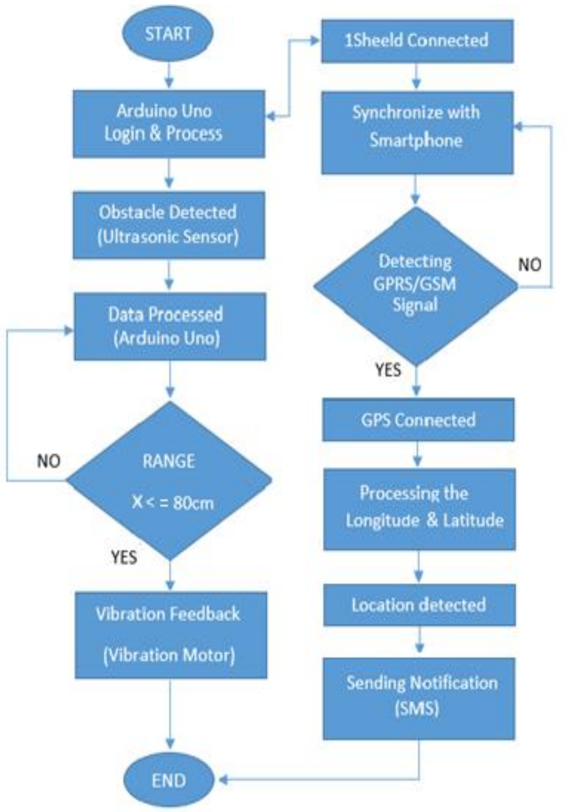

Fig. 4. Blind Stick Navigator Procedure.

Figure 5 shows the block diagram where it explains about the connection of each module of the prototype. The circuit requires 5V of power supply to function. Arduino Uno is used to process the feedback sent by the sensor as well as to send notification to mobile device.

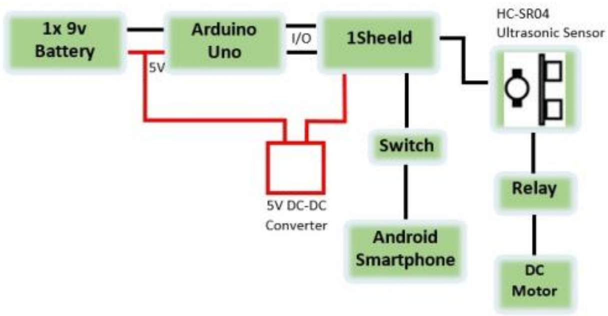

Fig. 5. Block Diagram.

3.0 RESULTS AND DISCUSSION

Sensor Testing

The sensor can detect stairs and loophole on the road and will vibrate continuously until the person move away from it. The detected obstacles are at body level and will partially vibrate every 2sec and stop vibrating when it cannot detect any obstacles.

Figure 6 illustrates the testing done with the blind stick navigator prototype to detect the obstacles.

Fig. 6. Distance towards obstacles.

Two sticks with different length are used to measure the specific distance the sensor reacts towards obstacles. The measurement result for first blind stick is about 85 cm and when blind people approach obstacles, the body level will detect obstacles at 100cm and ground level is at 40cm for the steep and stairs. While the second blind stick that cut with length of 45cm detects obstacles 85 cm for body level and 55 cm of ground level. In term of mobility, this comparison is conducted because for this project, the stick used is not easily fold like the traditional white cane.

Figure 7 shows the exact measurement for the sensor to detect the obstacles and stairs at body and ground level. The obstacles will be detected when the blind people sweep right and left or in steady hold.

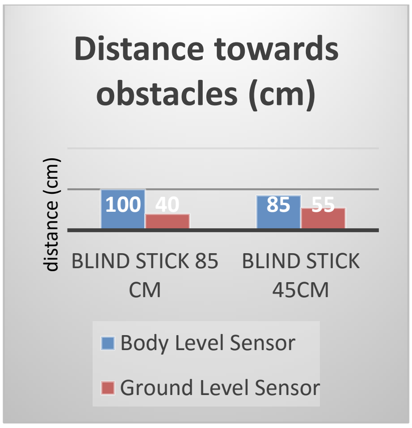

Figure 7 Distance towards obstacles

Vibration Feedback

Figure 8 and Figure 9 show the differences of vibration pulse. When the obstacles are detected it will send the output to the microcontroller. After the process, it will send the feedback to the relay which will result to DC motor being turned on. If the obstacles are detected at body level phase, DC motor will vibrate according to this pulse which consists of 200 milliseconds or 0.2 sec delay. For the obstacles detected at ground level phase will automatically vibrate continuously until the distance from the stick increases.

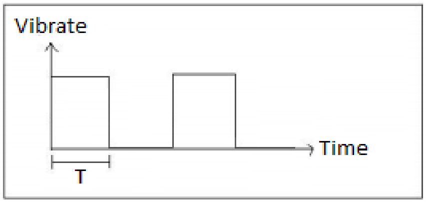

Fig. 8. Pulse response for body level.

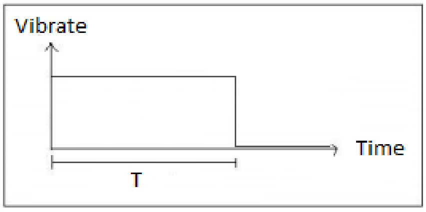

Fig. 9. Pulse response for ground level.

Emergency SMS

Emergency SMS is embedded to the prototype to ensure that the blind person can send a SMS to their family or friend in case of emergency. By turning on the Bluetooth and GPS function in the Android smartphone widget menu, the 1Sheeld can detect the location of the person. When the button is pressed, an emergency SMS is triggered.

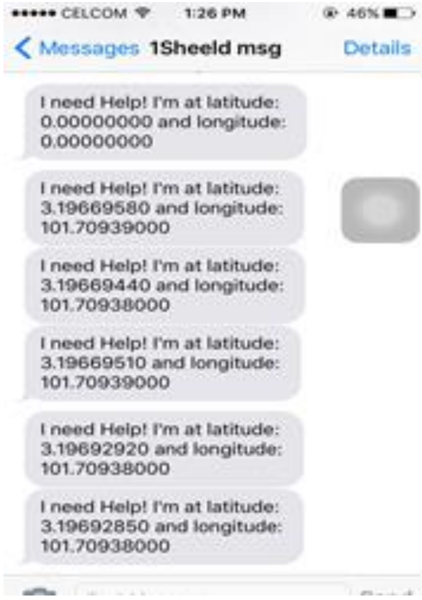

Fig. 10. Message content without Google Maps.

Figure 10 below shows the original message received by the recipient. The recipient need to manually process the information by taking the data number of latitude and longitude thus consume a lot of time for the recipient and authority. Hence the message is embedded with Google Maps so that the location of is known thus decrease the time taken for the recipient to locate the sender.

Figure 11 shows the message content with Google Maps.

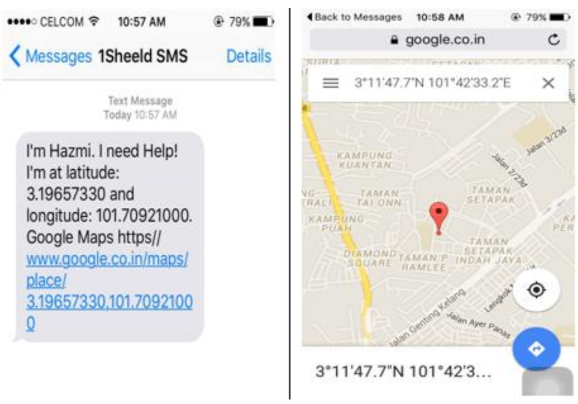

Fig. 11. SMS Content.

Field Testing

Field testing is done by taking measurement involve with line of sight between upper and lower sensor. The upper sensor been set with 100 cm line of sight to detect obstacles that lies from the upper body of a person. While the lower sensor been set with 40 cm of line of sight to from lower body to detect road holes and etc.

Figure 12 explains the test done of different environment using the prototype. The rating displays that at dry surface area; the prototype can operate well and receive a rating of 10/10.

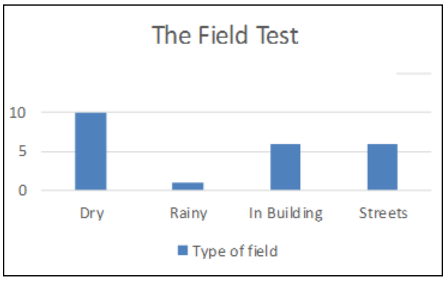

Fig. 12. Field Test Results.

4.0 CONCLUSION

This study introduces a tool to help the blind to move around independently. The prototype can detect obstacles using vibrating mechanism as well as messaging system to alert others in case of emergency. The accuracy of the ultrasonic sensor to work with two sensors on a stick does increase the awareness for the blind people. Thus, it helps blind people to get better information while they are walking on street or going through hilly surface and stairs.

In order to improve the project function and implementation in the future, several suggestions are proposed. The power source can be changed to rechargeable via solar technology for a better mobility and durability. Besides that, a good solid and waterproof case or wrapper thus helps this stick to work on rainy situation and drop test. The advance technology of Virtual-Reality (VR) can be done as future research and development to enhance more the alert and awareness of the blind people.

References

[1] UltraCane - Pricing." www.ultracane.com. Sound Foresight Technology Ltd. Web. 09 Oct 2013. <http://www.ultracane.com/ultracanecat/ultracane>

[2] UltraCane." www.ultracane.com. Sound Foresight Technology Ltd. Web. 09 Oct. 2013.

[3] V. Renaudin, O. Yalak, and P. Tome, "Hybridization of MEMS and Assisted GPS for Pedestrian Navigation," Inside GNSS, vol. 2, Jan. 2007.