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Smart Blind Walking Stick

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Abstract: A white cane is a device that aids blind or visually impaired person during walking. The white cane helps the user monitor their surroundings for obstacles or direction marks and also aids others in identifying that the user is blind or visually handicapped and providing proper care. This study aims to design a smart blind walking stick for blind people, in which numerous research has been carried out in this area. They were addressed and compared with each other such as a smart walking stick for the blind integrated with the SOS navigation system This system is anticipated to help blind people to walk with ease independently. There are buzzers on the system to alert the user if there is an obstacle. The circuit of the smart blind walking stick design is created using Proteus. The theory of the circuit is based on the emitting ultrasonic sound waves by the ultrasonic sensor to measure the distance of a targeted obstacle. The results show that the sensor would alert the user when the obstacle is detected. In conclusion, the walking stick works as intended, which are alerting users when obstacles present and sending SMS in an emergency situation.

Keywords: White Cane, Smart Blind Stick, Ultrasonic Sensor

1. Introduction

In Malaysia, the prevalence of blindness and low vision be 0.29 and 2.44 %, respectively, for all ages based on the [1]. According to WHO, a person is considered blind when their vision is worse than 3/60 in the better eye with the best possible correction [2]. Their visual field is also less than 10 degrees from fixation in both eyes to consider them blind. Blind people are one of the OKU (Malaysian disabled person designation) in Malaysia, and the OKU (Malaysian disabled person designation) policy is the basis of equality of rights and opportunities for the disabled for full participation in society. This policy also prioritizes the value of human rights such as dignity, honor, and freedom to enable them to live independently. The facilities that Jabatan Kebajikan Malaysia provided are public transport facilities. A 50% discount is given to OKU (Malaysian disabled person designation) and the elderly who are 60 years old or above for all public transport [3]. There is also rehabilitation/training being provided. Many facilities were provided, but there are no specific facilities just for blind people, such as walking paths for blind people.

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Previous work-related to smart blind walking sticks include smart walking sticks for blind integrated with SOS navigation system [4]. It is reported that this system could use ultrasonic sensors to identify obstacles, and it was also incorporated into the e-SOS (electronic Save Our Souls) scheme. Another work is developing a smart stick for blind people [5]. This system is for identifying obstacles and the precise position of the stick. The next work is related to ultrasonic blind stick for completely blind people to avoid any kind of obstacles [6] that detects any type of upcoming obstacles and potholes using the reflection properties of ultrasound. After that, the previous work-related is ultrasonic sensor based smart blind stick [7] that is using a 16F877A PIC microcontroller to detect the obstacles, and a buzzer is used to alert the user. The last related work is intelligent ultrasonic detection of walking sticks for the blind [8]. This system is to identify objects in fronts, and the wristband will vibrate to alert the user if there is an obstacle.

2. Methodology

2.1 Block diagram

The circuit required a 5 V power supply to operate. It could be powered via a power adapter or 9 V battery and power bank because it is easily detachable. The total power cost need can also be adjustable via a processor in the processing unit. Besides, Arduino Nano will process the GPS location and send a notification to the user's smartphone. The ultrasonic sensor will alert the user. Thus, Arduino Uno will become the main part of the system to work well while other components must function well and provide instant feedback to the system and the user. The block diagram of a smart blind walking stick is shown in Figure 1.

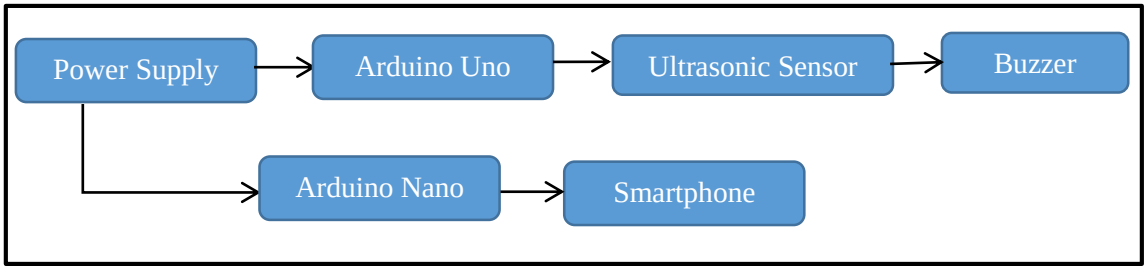

Figure 1: Block diagram of a smart blind walking stick

2.2 Flowchart

The flowchart of the system is shown in Figure 2. The process starts with the obstacle is detected by an ultrasonic sensor. Next, the Arduino will process whether the range is 40 cm or less than 40 cm. If the range is less than 40 cm, the LED lights up, and the buzzer will sound. Moreover, if the range is 20 cm or less than 20 cm, the LED will light up, and both buzzers will sound. Finally, the buzzer will alert the user.

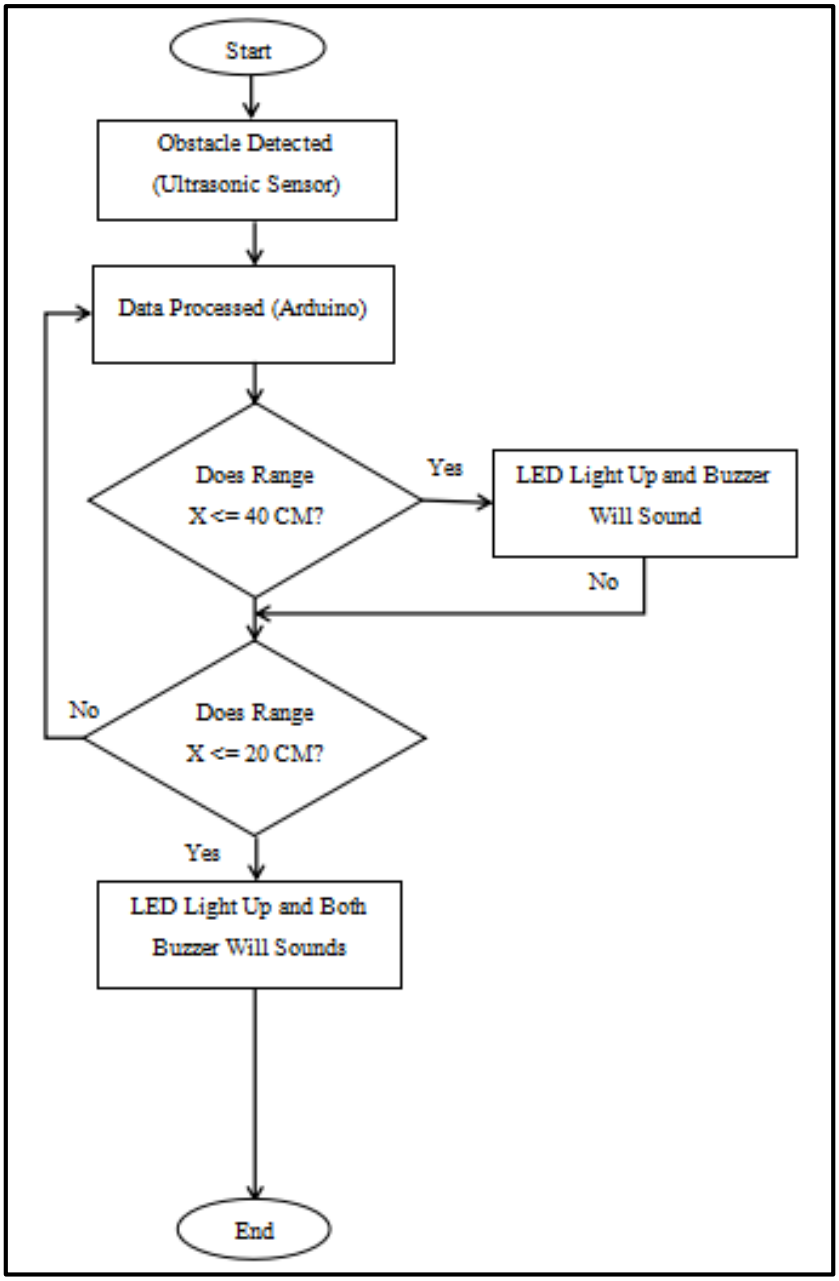

Figure 2: Flowchart of the smart blind walking stick

Figure 3 shown the flowchart system of GPS SMS Emergency. The process is started by pushing the switch button. Next, the Arduino and GPS NEO 6M will be detecting the GPRS/GSM and connecting the GPS. Finally, after the location is detected, it will send the notification to the guardian via SMS.

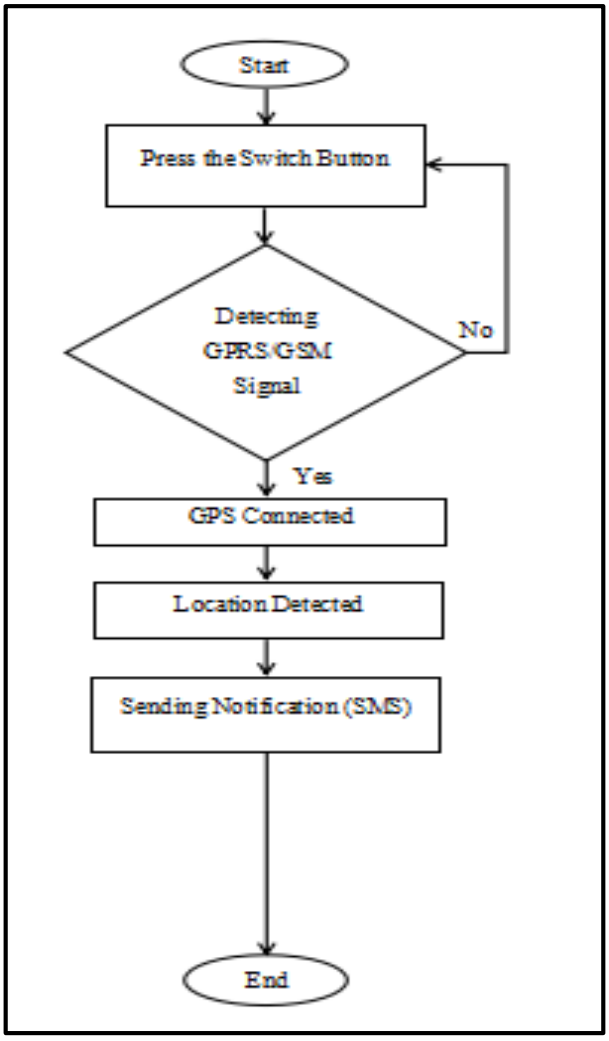

Figure 3: Flowchart of GPS SMS emergency

2.3 Design and development

2.3.1 Design

The component consists of Arduino UNO, ultrasonic sensor, buzzer, LED light, and 220 Ω resistor. In this hardware, if the distance is less than 40 cm, the LED will light up, and one buzzer will be sound to alert the blind people. Moreover, if the distance is less than 20 cm, the LED will light up, and both buzzers will be sounded. Figure 4 shows the view of Ultrasonic sensor hardware. Trigger of Ultrasonic sensor is connected to pin -9 of Arduino Uno and pin Echo of the sensor is connected to pin -8 of Arduino Uno while VCC of Ultrasonic sensor is connected to pin 5 V of Arduino Uno. The positive pin of the first buzzer is connected to pin -6 of Arduino Uno, and the positive pin of the second buzzer is connected to pin 4. The positive pin of LED is connected to pin -5 of Arduino while the negative pin is connected to 220 Ω resistor. For GND pin of Arduino Uno connected to pin GND of Ultrasonic sensor, the negative pin of both buzzer, and 220 Ω of the resistor.

For GPS Emergency SMS, the component consists of Arduino NANO, SIM900A GSM Module, buzzer, Neo6mv2 GPS Module, Push button, and 10K Ω resistor. In this hardware, when blind people need help from their guardian, they need to push a button, and the SMS will be sent to the guardian to alert them. Figure 5 shows the view of the GPS tracking circuit diagram of the. The TXD of SIM900A is connected to pin D7 of Arduino Nano, and pin RDX of Sim900A is connected to pin D6 of Arduino Nano while VCC of Sim900A is connected to pin 5 V of Arduino Nano. The GPS Neo 6m TX pin is connected to the D3 of Arduino, while the RX pin is connected to D2. The VCC of GPS NEO 6m is connected to then pin 5 V of Arduino. The positive pin of the buzzer is connected to pin 5 V of Arduino

Nano. The positive pin of the push-button is connected to pin D4 of Arduino and 10k Ω resistor. For GND pin of Arduino connected to pin GND of GPS Neo 6m, Sim900A GND, the negative pin of both buzzer, and push button.

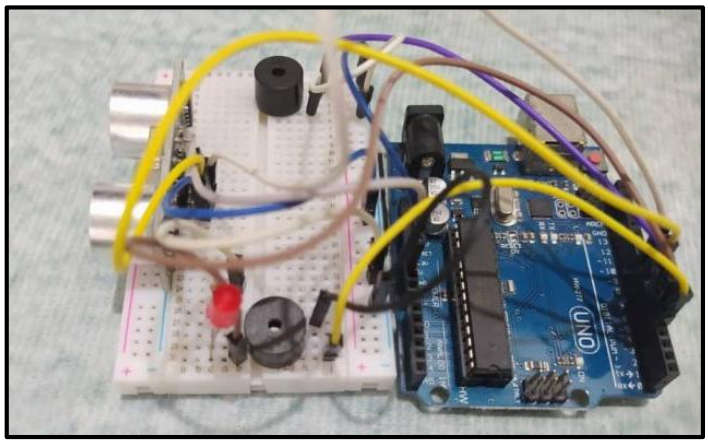

Figure 4: Design of smart blind walking stick

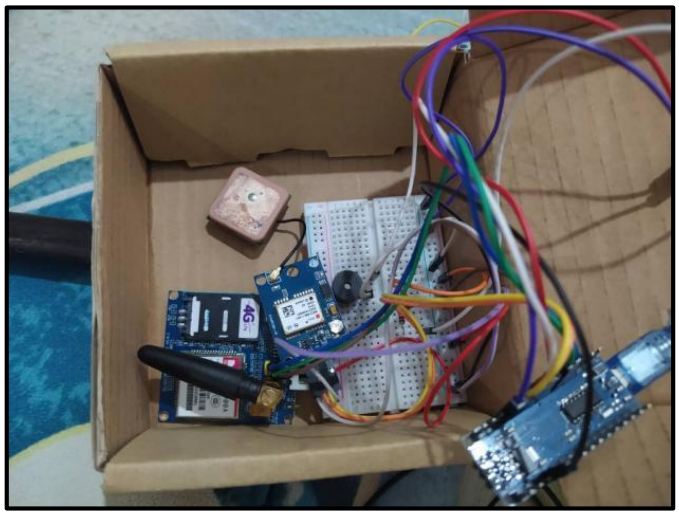

Figure 5: Design of GPS SMS emergency

2.3.2 Circuit component

Components used in this project are shown in Figure 6. These components are the major parts of the system developed in this project.

(a)

(b)

(c)

(d) (e)

Figure 6: Circuit components: (a) Arduino UNO (b) Arduino Nano (c) Ultrasonic sensor (d) SIM900A GSM GPRS Wireless Extension (e) GPS NEO 6M

3. Results and Discussion

3.1 Sensor Results

Figure 7 shows that the ultrasonic sensor is detecting the obstacle. If the distance less than 40 cm, the LED will light up and buzzer 1 will be sound to alert the blind people. And if the distance less than 20 cm, the LED will light up and both buzzer sound.

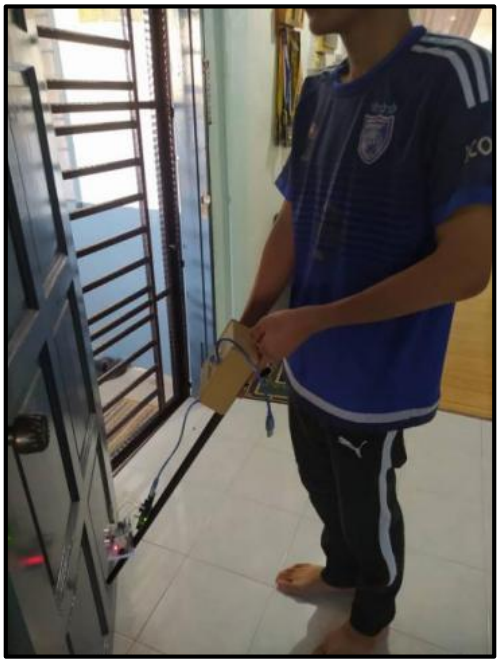

Figure 7: Sensor test on an obstacle

3.2 Emergency SMS Results

Toggle switches enable the SMS feature of this walking stick; thus, users do not need smartphone to send the emergency SMS. Firstly, the user would push the toggle switches. Next, the Arduino and GPS NEO 6M will detect the GPRS/GSM and connecting the GPS. Finally, after the location is detected, it will send the notification to the guardian via SMS. Figure 8 shows the message content with the link to the Google map guardian received.

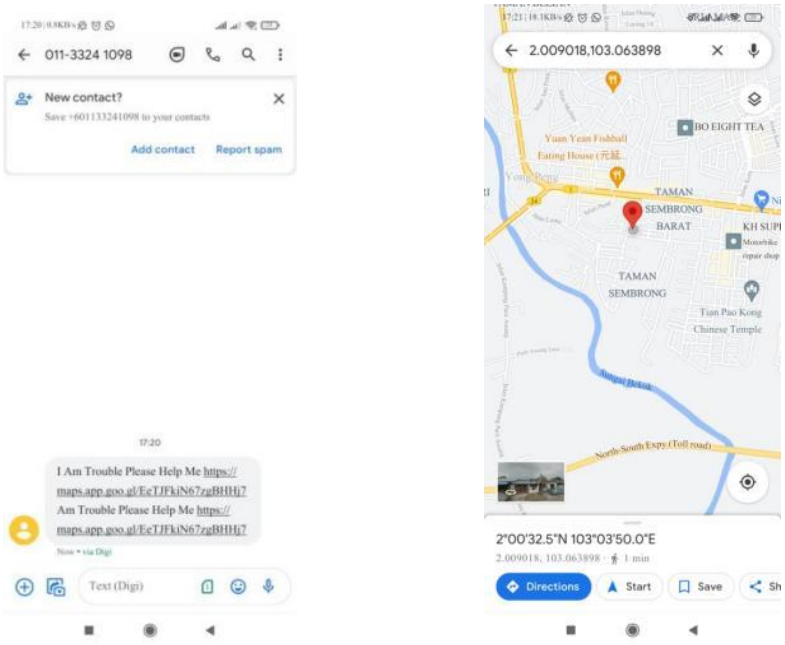

Figure 8: The message content that links to Google maps guardian received.

3.3 Analysis Testing

This experiment will focus on testing the prototype with the power durability and distance of the obstacle. If the distance is less than 40 cm, the LED will light up, and the buzzer will alert the blind people. Moreover, if the distance is less than 20 cm, the LED will light up, and both buzzer sound. After that, the prototype is lacked durability to stay longer in action if the power that has been supplying to the microcontroller board is around 7-10 V. It can be seen when the prototype is connected with a 9 V battery and only the board is actively working. Then, if more voltage than 15 V being supplied to it, the microcontroller will be damaged or crash due to the heat.

3.4 Discussion

Table 1 shows the results for a distance towards obstacles. Based on the results and the overall analysis obtained from this project, it was found out that the ultrasonic blind walking stick could detect the obstacle when the distance is less than 40 cm. If the distance is less than 40 cm, the LED will light up, and the buzzer will alert the blind people. Furthermore, if the distance is less than 20 cm, the LED will light up, and both buzzer sound. After that, when blind people need help from their guardian, they need to push the button, and the SMS will be sent to the guardian to alert them. The user will push the switch. Next, the Arduino and GPS NEO 6M will detect the GPRS/GSM and connecting the GPS. Finally, after the location is detected, it will send the notification to the guardian via SMS.

Table 1: Results for a distance towards obstacles

Distance towards obstacles (cm)	Sensor Testing
Less than 40	LED will light up and buzzer 1 will be sound
Less than 20	LED will light up and both buzzers will be sound

4. Conclusion

This project managed to build a smart walking stick with its intended feature. In this project, the Arduino UNO was the primary component. It acts as a microcontroller, reading the input from the

sensor and converting the output into a triggering of buzzers, and turning on an LED when having an obstacle. In addition, the GPS SMS also works in the case of emergency by sending out SMS message.

Acknowledgement

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