Smart Walking Stick for the Blind

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Abstract

The freedom and safety of the visually impaired is a goal every member of the community should engage in. integrating the blind into the society will no doubt overcome most of the challenges they face daily. The paper proposes an innovative remedy, the Smart Blind Stick, to address the difficulties that visually impaired people encounter when navigating their surroundings. The technologically advanced smart stick makes use of revolutionary sensing and navigational technology to improve the blind's navigation from one point to another. The Smart Blind Stick contains the ultrasonic and infrared sensors that gives real-time information about the path way of the blind. The embedded buzzers give different sounds notify the blind of an obstacle along his path.

1. Introduction

According to the World Health Organization (2021), more than 2.2 billion people globally have visual impairment ranging from a near or distance weakening vision. The data also reveals that 80% global unaddressed near vision loss is found in western, eastern and central sub-Saharan African where the leading causes of weak vison is prevalent because of poor living condition and deficient health care services. Sabut et al. (2021) states that the most prevalent causes o blindness includes traumatic injuries, infections of the retina, macular degeneration and diabetes. Mobility is essential for the blind destitute who most go out to look for alms in other to take care of themselves.
The greatest challenge facing the blind in most communities is the ability to move freely in the community from one location to another. Using their sense of hearing to walk around could be a threatening task for the blind. Subsequently, there is the urgent need to support the visually impaired in their quest to move around without their safety in jeopardy hence, the need to design and implement a smart walking stick to assist the blind to without restraint socialize with other people in the society.
The major objective of this research is to use technology to simplify the movement of persons who are blind or visually impaired. This paper proposes an ultrasonic stick for blind individuals to help them navigate safely either indoor or outdoor using light weight, low cost and easy to use blind stick.

This research proposed a smart blind walking stick that allows the blind in our society to move at will using an automated walking stick. The smart blind has ultrasonic sensors, Arduino UNO and a buzzer. The ultrasonic sensors are used for the detection using Arduino microcontroller.

2. Related Work

Loganathan et al. (2020) proposed a system where ultrasonic sensor with transmitter and receiver is used to detect objects within 4m. This system helps the blind to stay connected with their environment and move freely at will.

Grover et al. (2020) designed a smart stick for object and moisture detection using an Arduino device. The authors also made sure that safety measures were taken to ensure the protection of the blind in the society.

Romadhon and Husein (2019) used a combination of ultrasonic sensor, a water sensor, and a pulse heart sensor attached on a white cane to uncover changes in the surroundings. In their research, a smart stick can identify objects at a distance of up to 200cm.

Elsonbaty (2021) made use of Ultrasonic Esp8266 as its sensing agent and an audio jack connected to a headphone to alert the user if an object is detected.

Numerous such navigational aids for this topic can be obtained from works recommended in Ghosh et al. (2020), Bele et al. (2020), Agrawal and Gupta (2018), Manikanta et al. (2018), Jeevana et al. (2018), Sharma et al. (2017).

3. Proposed Smart Stick Model

The ingenious "blind stick" was created to help the vision impaired navigate more effectively. This study suggests a sophisticated blind stick that enables persons with vision impairments to navigate with ease utilizing cutting-edge technology. The blind stick incorporates an ultrasonic sensor used to detect obstacles from a distance of 100cm using ultrasonic waves. When an object is detected, the sensor sends this information to the microcontroller (see block diagram in figure 1).

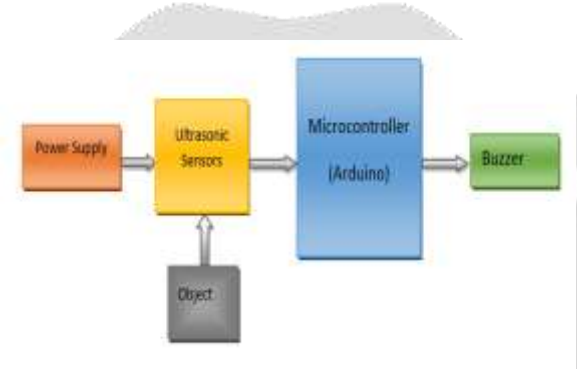

Figure 1: Block diagram of proposed model

This information is then processed by the microcontroller, which determines whether the object is close enough. If the obstruction is not immediately present, the circuit has no effect. The microcontroller sends a signal to the buzzer and vibrator to give alarm if the object is close. The uniqueness of this research is that as the sensor gets closer to the object, the sound from the buzzer keeps getting louder notifying the user he/she is very close to an object.

Hardware

Ultrasonic Sensor - Figure 2 depicts the HC-SR04 Ultrasonic Distance Sensor, which is a sensor used to determine an object's distance via sonar. The sensor covers a range of around 20 meters hence, the range is ideal for detecting any unexpected obstruction in the way.

Figure 2: Ultrasonic sensor

Power Supply - Figure 3 depict a 9V regulated DC for power supply. For power supply, two 9V batteries used and using the 7805-voltage regulator IC, the supply from the battery can be regulated to 5V.

Figure 3: 9V HW Battery

Buzzer - A common tool for producing sound is a buzzer (see figure 4). Once an obstruction is found, the buzzer is triggered and sound is emitted.

Figure 4: A Buzzer

Capacitor - As shown in figure 5, a capacitor is a passive two-terminal electrical device used to store energy electrostatically in an electric field. Many common electrical gadgets use capacitors in their electrical circuits.

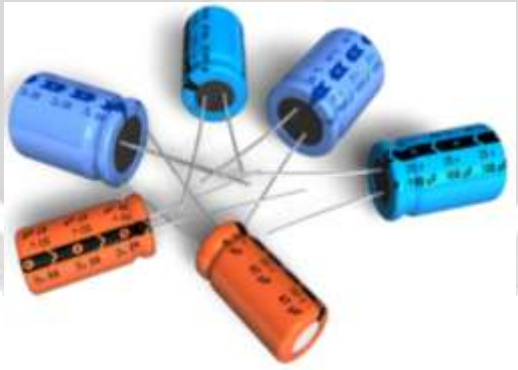

Figure 5: Capacitors

Resistor - An electrical resistor, such as the one depicted in figure 6, is a passive two-terminal device that implements electrical resistance as a circuit element.
Resistors reduces current flow, and, at the same time, act to lower voltage levels within circuits. Resistors may have fixed resistances or variable resistances, such as those found in thermistors, varistors, trimmers, photo resistors and potentiometers. The current through a resistor is in direct proportion to the voltage across the resistor's terminals.

Figure 6: Resistors

Vibrating Motor- A vibratory motor, as illustrated in figure 7, is essentially an unbalanced motor.
In other words, the motor wobbles because of a weight that is attached to the rotational shaft of the motor that is off-center. Depending on the amount of weight that can be added, how far it is from the shaft, and how quickly the motor spins, the degree of wobble can be altered (Satam et al., 2019).

Figure 7: Vibrator motor

Arduino Microcontroller - The Arduino Uno microcontroller is an accessible and effective single board computer that has grown significantly in popularity in both the hobby and professional markets. Since the Arduino is open source, its hardware is inexpensive and its development software is free.

Figure 8: Arduino

Software
The Arduino Software (IDE), which is free and open-source, makes it simple to create code and upload it to a board. The code was created using the C++ programming language and was built using Processing and other free and open-source applications.

4. Experimental Results

The proposed blind stick design with a full construction is shown in figure 9.

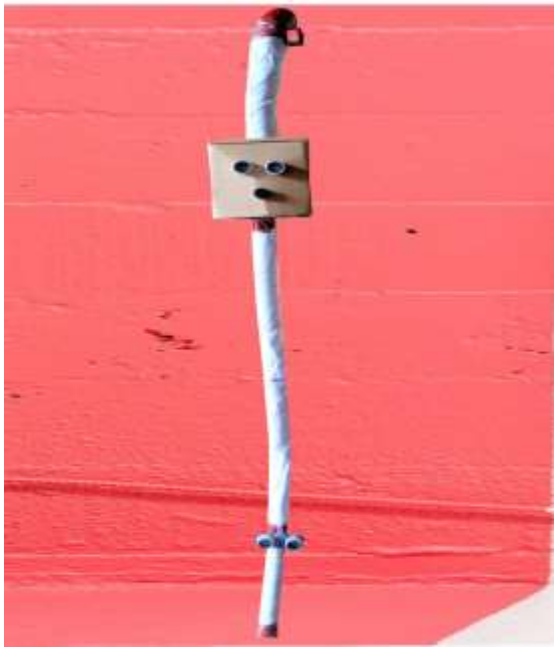

Figure 9a: Front view of the smart stick

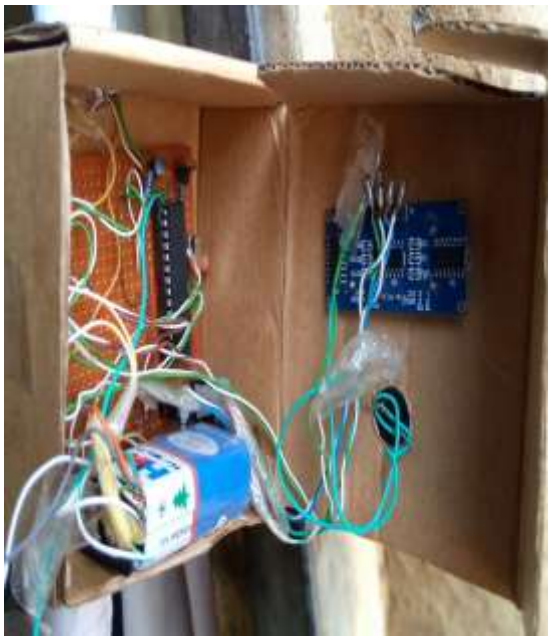

Figure 9b: Internal view of smart blind stick

5. Conclusion

This paper proposed a smart blind stick for people who are virtually impaired. The smart blind stick can be effectively used to curtail the numerous challenges the blind people go through in the community in terms of navigation from one point to another. The ultrasonic sensors can detect objects from 50cm and on the detection of an obstacle, the buzzer alerts the blind person and as the smart stick get closer to the obstacle the sound from the buzzer gets more and more louder. In future, this project will be upgraded to accommodate more features that will ease the life of the visually impaired people in the society. The Arduino used in this project will be replaced with a raspberry Pi for better efficiency, GPS will be added to get location and to add IOT devices to ease the blind mobility.

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