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# Study of Construction a Technical Device Named Walking Stick for the Blind Using GPS

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***Abstract :*** **Generally, blind people use a traditional cane (known as white cane) for moving from one place to other. Although, white cane is the international symbol of blindness, it could not help them to detect place and to avoid obstacles. In this paper, we represent a model of walking stick for blind people. It consists of GPS module, GPS Antenna, Arduino, IR sensor and buzzer. This stick can detect place and obstacles. Position detection part is done with GPS module and GPS antenna. IR sensor is used for detecting obstacles. Here, the buzzer produces two types of sound. When the blind reaches to his destination, buzzer buzzes continuously. When the blind faces any obstacles, buzzer buzzes discontinuously. By hearing this two types of sound, blind can be confirmed about his destination and also can avoid obstacles in front of him. The whole system is designed to be small, light and is used in conjunction with the white cane so that it could ensure safety of the blind.**

***Keywords*****: Arduino, Buzzer, GPS Antenna, GPS module, Walking stick.**

## I. INTRODUCTION

### 1.1 General

Eyes are the most important sense of organ of human. We perceive up to 80 per cent of all impressions by means of our sight. According to the 2014 statistics of World Health Organization, 285 million people are estimated to be visually impaired worldwide, 39 million are blind and 246 have low vision. The people with low vision or no vision suffer from various problems. Mobility and orientation are two of them [1]. The traditional and oldest mobility aids for the blind are the white cane and guide dog. As white cane is the international symbol of blindness, the visual presence of white cane helps to understand others that the user is blind. It also helps the blind to reach destination and avoid obstacles in ground but it could not protect him from all level of obstacles. On the other hand, Guide dog is able to detect and analyze complex situations: cross walks, stairs, potential danger, know paths and more. But guide dogs are still far from being affordable, around the price of a nice car, and their average working time is limited, an average of 7 years. So these traditional mobility aids have many drawbacks. For improving this traditional walking aid, here, GPS based walking stick with obstacle detecting sensor for the blind is proposed and developed.

### 1.2 Previous Work

A number of navigation systems for aiding the blind have been developed already. This developed system can be categorized into two groups. The first group is Electronic Travel Aids (ETAs) and the second group is Electronic Orientation Aids (EOAs). ETAs are designed to create a safe journey by detecting obstacles using ultrasonic and proximity sensor [1]. EOAs are designed to detect place using GPS and location based service.

A GPS based blind stick with ultrasonic and proximity sensor for detecting obstacle was developed [2]. It used stereo camera and dual feedback system. A mobility aid for the blind and partially sighted people which is linked with a GSM-

GPS module to pin point the location of the user was also created [3]. This aid also used ultrasound sensor for detecting obstacles. A GPS navigator with audio guides for the blind walking in campus was developed [4].Another system for detecting obstacles was created [5]. It was a wheeled stick. When it detected obstacles, it automatically steered around and made the user to follow the obstacles free path without any conscious effort.

### 1.3 Purpose of GPS based walking Stick

The purposes are as follows:

- To detect place with the stick.
- To detect obstacles with the stick.
- To ensure safe walking of the blind.
- To help the blind to reach his destination safely and securely.
- To create a cheap and comfortable mobility aid for the blind.

### 1.4 Contribution of the paper

In this present study, a GPS based walking stick is developed. It is developed as a place detecting device. By using this stick, blind person will be confirmed that, he has reached the place where he wanted to go. It is easy to maintain and very comfortable to use. Power consumption of this stick is low and can be operated easily. Moreover, it is fully automated. This stick also enables to detect obstacles in user's way by using an IR sensor. So, it is very helpful for the blind to reach his destination safely.

## II. SYSTEM DESCRIPTION

In the following section we will describe the system of architecture, hardware components and software architecture.

### 2.1 System architecture

As shown in fig. 1, the architecture of the system consists of 5 essential components: Arduino [2], GPS module with GPS antenna, IR sensor, buzzer and battery. The longitude and latitude of the final destination of the blind are programmed on the arduino. Arduino is connected with regulated power supply. When the blind walk with the stick connected GPS module continuously shows his current longitude and latitude. So, the Arduino has the programmed value and connected GPS module shows the current value of the user's location. When these two values become equal to each other, buzzer buzzes continuously. It means that, blind has reached to his destination. By hearing this type of continuous sound from the buzzer, blind person will be confirmed that he has reached to the place where he wants to go.

At the tip of the stick, there is an IR sensor. If there is any kind of obstacles in front of the user, sensor detects it and makes the buzzer to beep discontinuously. Thus, blind can avoid any kind of obstacles in his way.

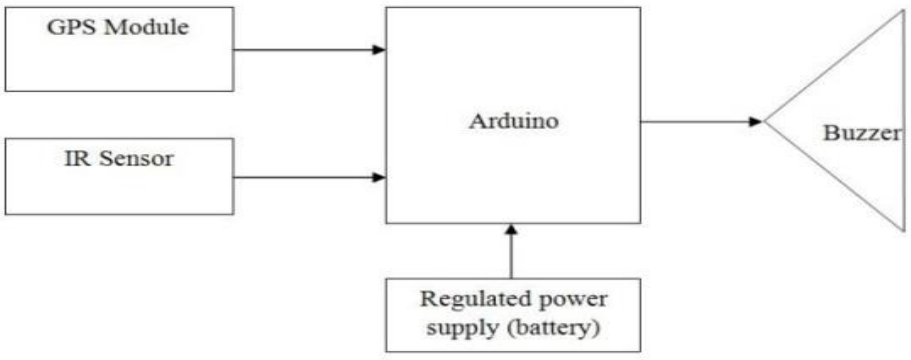


**Fig. 1: Block diagram of the system**

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**2.2 Hardware components**

The entire system is developed to provide blind people with a greater degree of independence in their daily life. It includes Venus GPS with SMA Connector, GPS antenna, Arduino UNO, Electromechanical buzzer, IR sensor and 12 Volt Duracell batteries. Each component performs a specific job and can be explained as follows:

Venus GPS with SMA Connector is the GPS module which calculates user's position by precisely timing the signals sent by GPS satellites high above the Earth. Each satellite continually transmits messages that include:

- The time the message was transmitted and,
- Satellite position at time of message transmission.

The module uses the messages it receives to determine the transit time of each message and computes the distance to each satellite using the speed of light. Each of these distances and satellites' locations defines a sphere. The module is on the surface of each of these spheres when the distances and the satellites' locations are correct. These distances and satellites' locations are used to compute the location of the module using the navigation equations. This location is then displayed with longitude and latitude.

The GPS antenna helps boost the reception signal to a GPS module. It helps the GPS "see" the sky without having to be moved.GPS signal which comes from the satellite is very weak. Antenna amplifies this signal and transmits it to the module. It is connected with the GPS module.

Arduino UNO is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. The GPS module, IR sensor and buzzer all are connected with it.

Electromechanical buzzer is used for creating two different types of buzzing sound. It is an audio signaling device which is identical to an electric bell without the metal gong. It functions by means of an electromagnet. When an electric current is applied, it produces a repetitive buzzing or clanging sound. A relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board.

For detecting obstacles, IR sensor is used. The IR LED transmits the IR signal on to the object and the signal is reflected back from the surface of the object. The reflected signals are received by an IR receiver (LDR). Both the LED and LDR consume 3.5 volt power. Working principle of IR sensor is shown in fig. 2.

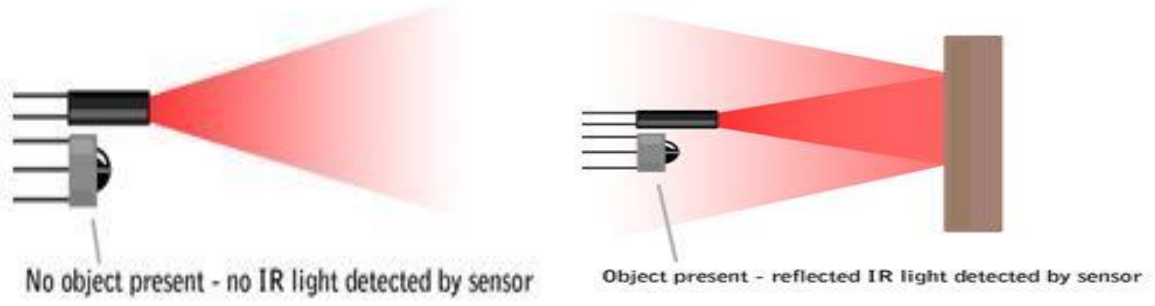
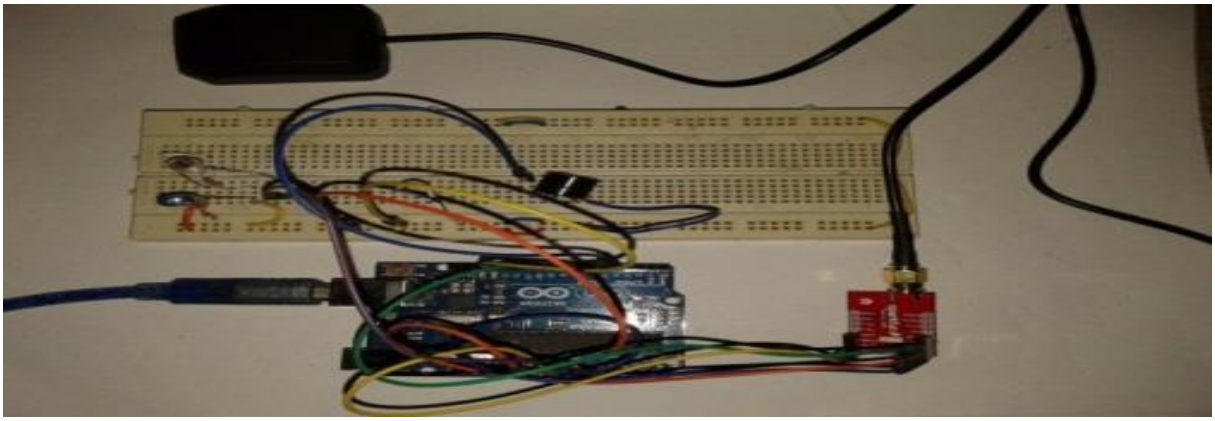



**Fig. 2: Depiction of the operation of an IR Sensor**

Finally the power supply is done with using a 12 volt Duracell battery which is connected with the Arduino.

The GPS module, GPS antenna, Arduino UNO, electromechanical buzzer, IR sensor and battery all are connected as shown in fig. 3.



**(a)**

**(b)**

**Fig. 3: Hardware components of the system: (a) fabricated circuit diagram, (b) fabricated stick**

### 2.3 Software architecture

The software for the system has been developed in the C language. Flowchart for displaying current longitude and latitude of any position on computer screen using GPS module is shown in fig. 4.

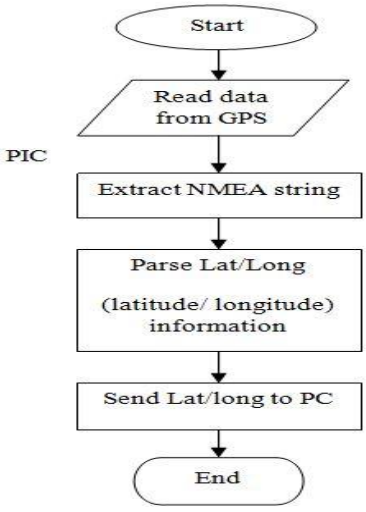



**Fig. 4: Flowchart for displaying current longitude and latitude of any position**

The current value is compared with predefined values and if these values are same, immediately Arduino gives instruction to the buzzer to buzz continuously. Fig.5 shows flowchart of this process.

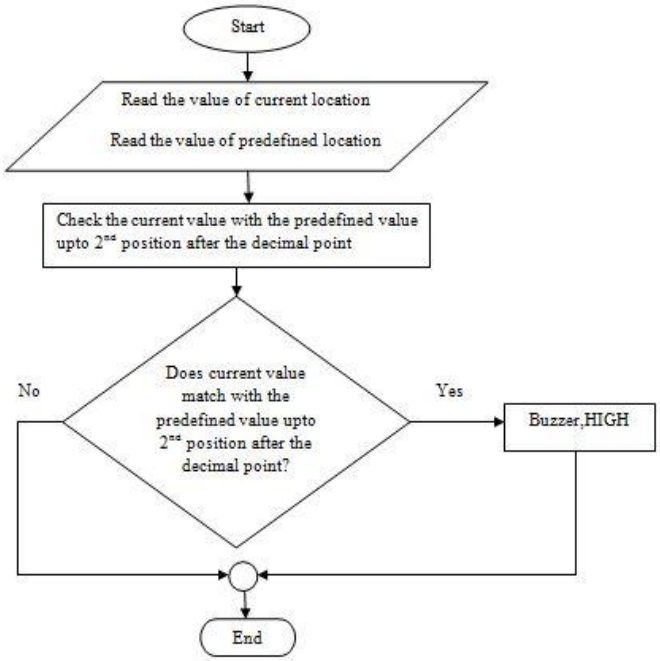



**Fig. 5: Flowchart of comparing current location with predefined location**

If the user faces any obstacles, it increases the resistance of the LDR, which in turn decreases the sensor value. When sensor value decreases and falls in between the ranges of the programmed value, the buzzer buzzes discontinuously. If the blind hears discontinuous beep from the buzzer, he has to understand that he is going to face an obstacle. Thus blind person can detect and avoid obstacles in his way. Flowchart of programming the sensor for detecting obstacles is shown in fig. 6.

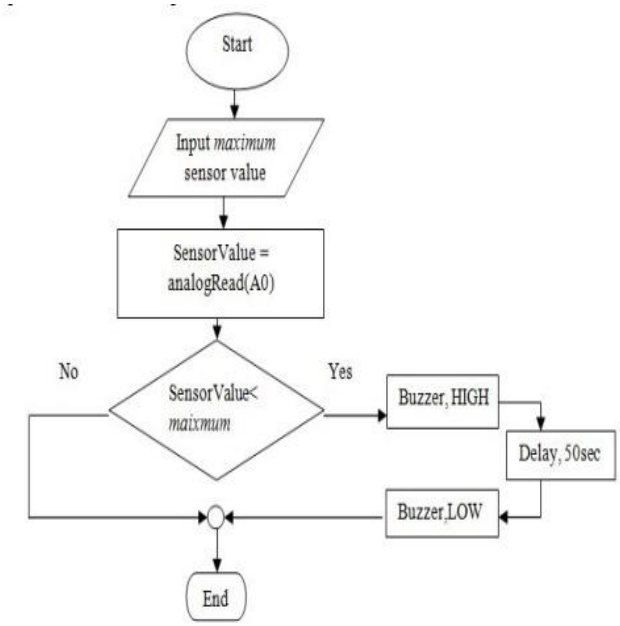



**Figure 6: Flowchart of programming the sensor for detecting obstacles**

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## III. EXPERIMENTAL RESULT AND DISCUSSION

Final destination of the blind is programmed on the Arduino. Our first testing is whether the buzzer buzzes at the pinpoint of the programmed location. The result that we got is given in the Table 1.

**Table 1: Result of testing if buzzer buzzes at the predefined location**

| Serial number | Location of destination (longitude and latitude) | The point at which buzzer starts to buzz | Distance of the point at which buzzer buzzes from the final destination |
|---|---|---|---|
| 1. | Long: 09150.3533E<br>Lat: 2222.6035N | Long:09150.3576E<br>Lat: 2222.6023N | -280 cm |
| 2. | Long: 09158.3382E<br>Lat: 2227.8670N | Long: 09158.3398E<br>Lat: 2227.8676N | +200 cm |
| 3. | Long: 09150.3684E<br>Lat: 2222.6039N | Long:09150.3695E<br>Lat: 2222.6074N | +160 cm |
| 4. | Long: 09150.3127E<br>Lat: 2222.6542N | Long: 09150.3113E<br>Lat: 2222.6521N | -120 cm |
| 5. | Long: 09158.3564E<br>Lat: 2227.8542N | Long: 09158.3586E<br>Lat: 2227.8538N | +320 cm |
| 6. | Long:09158.3342E<br>Lat: 2227.8619N | Long:09158.3322E<br>Lat: 2227.8613N | -200 cm |
| 7. | Long: 09150.3547E<br>Lat: 2222.6067N | Long: 09150.3523E<br>Lat: 2222.6048N | -360 cm |
| 8. | Long: 09158.2131E<br>Lat: 2227.1092N | Long: 09158.2144E<br>Lat: 2227.1090N | +280 cm |
| 9. | Long: 09158.2455E<br>Lat: 2227.1064N | Long: 09158.2430E<br>Lat: 2227.1023N | -120 cm |
| 10. | Long: 09150.3645E<br>Lat: 2222.6134N | Long: 09150.3678E<br>Lat: 2222.6185N | +240 cm |

Our second testing was whether the buzzer buzzes discontinuously by detecting any obstacles. Here, buzzer buzzes discontinuously when obstacles remain at a distance of 16 cm.

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## IV. CONCLUSION

From the performance of the developed blind stick, the following conclusions are drawn:

- The value of latitude and longitude after 2 spaces from the decimal point changes frequently. GPS module gives different values for the same location at different times for the 3rd and 4th position of the decimal point. As we programmed to match the location up to 2nd position of the decimal point, buzzer starts to buzz before reaching the destination point. Sometimes, it starts to buzz after a few distances from the predefined location. But it does not a problem because the error is only a few centimeters. The area of the location point can be easily detected with it.
- Obstacles detection zone is very small. It can't detect obstacles which are out of 45° from the direction of the stick.

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