May - June 2020
ISSN: 0193-4120 Page No. 5081-5085

Smart Lightweight Wearable Device for Partially Impaired and Blind People

[1]H. Manoj, [2]G. Yogi Venkat Chandu, [3]Kavyashree M. V, [4]Kiran M

[1,2,3,4]School of Computing and Information Technology, REVA University
Bengaluru, India
[1]r16cs146@cit.reva.edu.in, [2]r16cs141@cit.reva.edu.in, [3]r16cs184@cit.reva.edu.in
[4]kiranm@reva.edu.in

Article Info
Volume 83
Page Number: 5081-5085
Publication Issue:
May - June 2020

Article History
Article Received:*19 November 2019*
Revised: *27 January 2020*
Accepted: *24 February 2020*
Publication: *16 May 2020*

Abstract

Being able to live independently is everyone's goal but there are many people among us who are incapable to live independently just because they are not gifted with the senses a normal person has. This paper outlines state-of-the-art solution that enables the blind person to perceive the world in a way very much similar to a normal person, by enhancing the effectiveness of the senses they have, with the aid of technology, to sense the surroundings and to make sudden reflexes. Conventional white canes simply detect obstacles at a certain distance with the help of ultrasonic sensors, but do not give information about the type of situational surrounding they are in or how to counter sudden unexpected obstacles. Our state-of-the-art proposed system works on Arduino Nano which in turn consists of various sub-modules including Ultrasonic Sensor, Vibration Motor, Buzzer, Wi-Fi Module, Linode Cloud. A simple, cost-effective, configurable, easy to handle to device. This device will be effective, efficient, and unique in its capability in specifying the source and the distance of the obstacles that may encounter the partially impaired and blind people. By wearing this device, blind people can full avoid the use of blind stick (white cane) and such other tools. This device will help the blind people to navigate without holding a blind stick that makes more convenient.

Keywords: *Arduino Nano, Ultrasonic Sensor, Vibration Motor, Wi-Fi Module, Linode Cloud*

1. Introduction

Vision is a beautiful gift to human beings by GOD. Vision allows people to perceive and understand the surrounding world. According to the survey made by World Health Organization (WHO) in recent years, estimated 285.389 million people with visual impairment across the globe. These visually impaired people face the problems of orientation and mobility in an unknown environment. Many efforts have been made to improve their mobility by use of technology.

Total blindness is the complete lack of form and visual light perception and is clinically recorded as "No Light Perception (NLP)". Therefore, blindness is frequently used to describe severe visual impairment with residual vision. Blind and impaired persons always depend on other people for their locomotion.

2. Literature Survey

Many people suffer from serious visual impairments preventing them from travelling independently. Accordingly, they need to use a wide range of tools and techniques to help them on their mobility. One of these techniques is "Orientation and Mobility Specialist" who helps the visually impaired and blind people, and trains them to move on their own independently and safely using White Cane (Blind Stick) depending on their other available senses.

Another method is the “Guide Dogs”, which are trained specially to help the blind people on their movement by navigating around the obstacles to alert the person to change his/her way.

However, above mentioned techniques and technologies developed in the papers [2], [3], [4], [5] that are surveyed, are not suitable for a longer period of time, level of independence, cost effective, necessary care and so on.

In the relevant paper, Suraj D. M. et. al. [1], developed an obstacle detection device for the visually impaired using Arduino that helps the visually impaired in the form of a mobility aid. The designed model detects the closest obstacle using the sonar principle and in turn generates a vibro-tactile feedback that alerts the user about the direction of the object.

3. State-of-the-Art Proposed System

This paper outlines state-of-the-art solution to resolve the problems associated with existing techniques and technologies. The proposed system is based on a special wearable device based on the Arduino Nano Board which can be worn similar to the wrist band. This device is equipped with ultrasonic sensors, vibration motor, buzzer, and Wi-Fi facilities. When the ultrasonic sensor detects the obstacle from a certain distance, the device will notify the user via vibration and sound beeps. The intensity of vibrations and the rate of beeping increases with the decrease in the distance from the obstacle. This wearable device will help partially impaired and blind person to move around (or navigate) without holding a stick or taking the help others. These people only need a very little training on how to use this light-weighted device to wear and operate.

4. System Design and Analysis

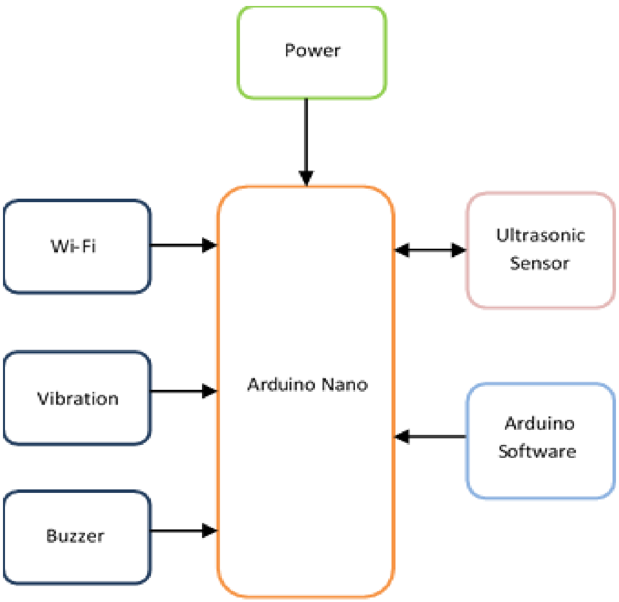

Figure 1: Block Diagram of the Proposed System

5. System Requirements

A. Arduino Nano

Figure 2: Arduino Nano Board

B. HC-SR04 Ultrasonic Sensor

Figure 3: HC-SR04 Ultrasonic Sensor

C. Breadboard

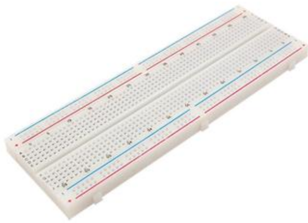

Figure 4: Breadboard

D. Vibration Motor

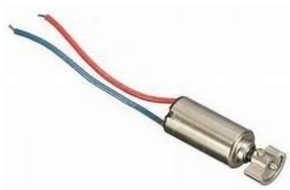

Figure 5: Eccentric Rotating Mass (ERM) Vibration Motor

E. Buzzer

Figure 6: Buzzer / Beeper

TEST Engineering & Management
May - June 2020
ISSN: 0193-4120 Page No. 5081-5085

F. Hi-Watt Battery

Figure 7: Hi-Watt Battery

G. ESP8266 Wi-Fi Module

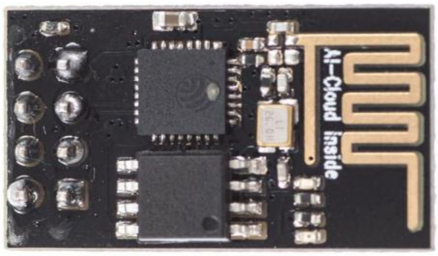

Figure 8: ESP8266 Wi-Fi Module

H. Arduino IDE (Software)

Figure 9: Arduino IDE

I. Linode Cloud

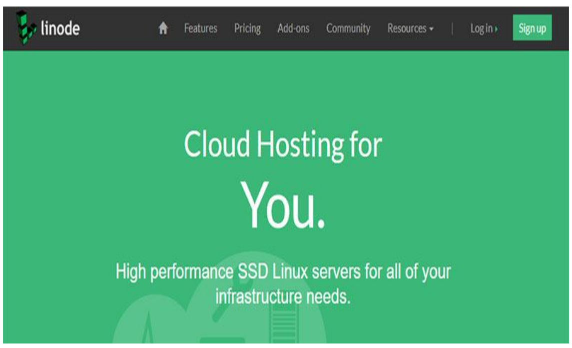

Figure 10: Linode Cloud

6. Methodology

This state-of-the-art method is mainly developed in the following steps:

Step 1: From Ultrasonic Sensor to Vibration Motor, Buzzer

Ultrasonic Sensors, made with piezoelectric crystals, use high frequency sound waves to resonate a desired frequency and convert electric energy not acoustic energy, and vice versa. Sound waves are transmitted to and reflected from the target/obstacle back to the transducer. As the ultrasonic sensor senses the distance then *input* taken in the form of pulses. Arduino Nano receives the signal, then the logic calculations are carried out (Whether obstacle is less than 1 meter) and it gives the signal that is considered as the *output*, which in the mechanical forms such as vibration through vibration motor and beep sound through buzzer. As the obstacle approaches very much near to the ultrasonic sensor, then vibration and the buzzer sound increases.

Step 2: From Ultrasonic Sensor to Wi-Fi Module

After receiving the data from ultrasonic sensor, then by using serial communication to interface with Wi-Fi module. Next, using some AT commands to send the data on website. Here, two-way communication means, first we want to log data on website and control some interfaces or I/O’s, then we go for MQTT protocol. Arduino Nano along with ESP8266 Wi-Fi module have *pubsub* codes (Publish/Subscribe) available in library to get started. In this, we need to design a website which support MQTT protocol. Thus, we opted for Linode Cloud.

Step 3: From Wi-Fi Module to Linode Cloud

We connect the Arduino Nano to the computer through USB cable, Open Arduino IDE and flash the code, Open a serial terminal. We should see Arduino handles AT commands with the ESP8266 to Wi-Fi networks and sending data to the Ask Sensors cloud over HTTP requests.

Step 4: From Linode Cloud to Event Notification

Linode is a cloud hosting provider that focuses on providing Linux powered virtual machines to support a wide range of applications. You can easily create Linode instances, deploy One-Click Apps, track event notifications and more. Whenever a *min* deviation happens or emergency button is pressed, the value in the Linode Cloud changes and according to the updated value, an alert message (event notification) is sent from the cloud to the registered mobile number of the blind person’s care-taker or relative to know status of the person when the emergency button is pressed.

May - June 2020
ISSN: 0193-4120 Page No. 5081-5085

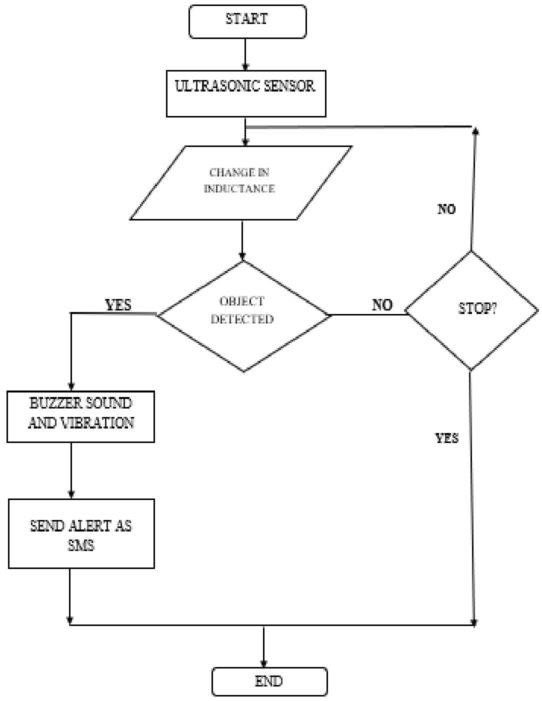

Figure 11: Flow Diagram of State-of-the-art Model

7. Experimental Results

The state-of-the-art device was successfully tested with respect to different scenarios by keeping in mind of partially impaired and blind people. Here, field1 represents emergency button and field2 represents *min* deviation.

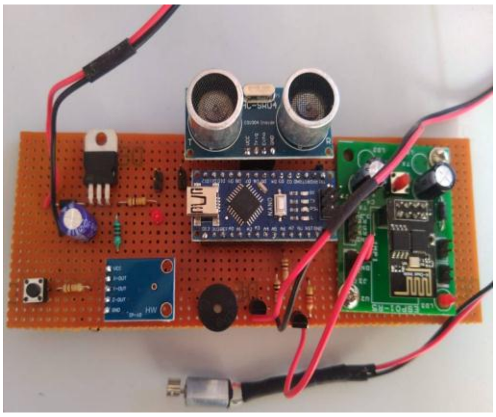

Figure 12: State-of-the-art Working Model.

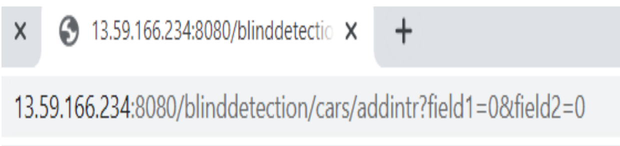

Figure 13: When both field1 = 0 and field2 = 0. This means, when there is no *min* deviation (represented as field2) or any emergency button is pressed (represented as field1).

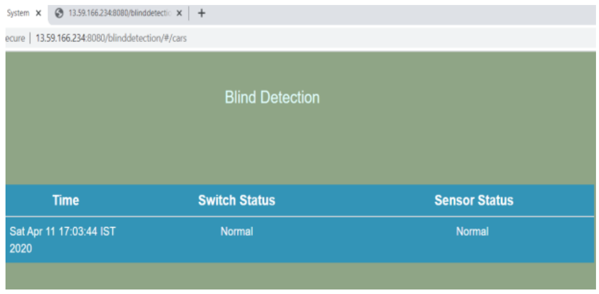

Figure 14: Output of Switch Status will be *Normal* and Sensor Status will be *Normal* when field1 = 0 and field2 = 0.

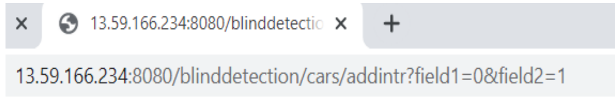

Figure 15: When the person falls, the *min* deviation from the ground varies, field2 = 1, but emergency button is not pressed, field1 = 0.

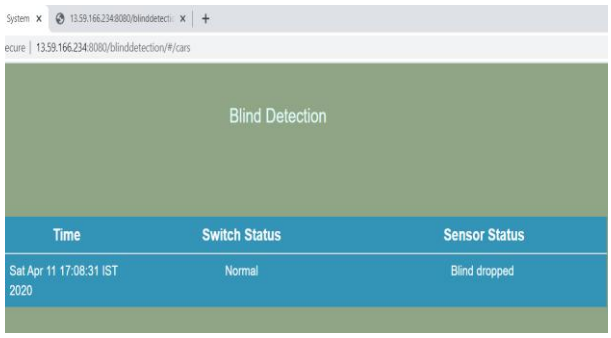

Figure 16: Output of Switch Status will be *Normal* and Sensor Status will be *Blind dropped* when field1 = 0 and field2 = 1.

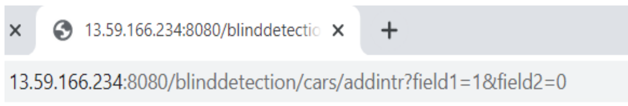

Figure 17: When the person presses emergency button due to fear, field1 = 1, but he/she is safe, no change in *min* deviation, field2 = 0.

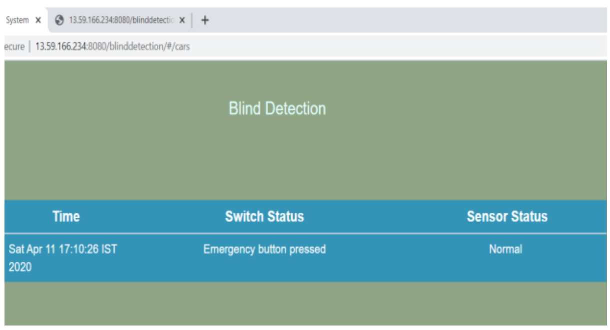

Figure 18: Output of Switch Status will be *Emergency button pressed* and Sensor Status will be *Normal* when field1 = 0 and field2 = 0.

May - June 2020
ISSN: 0193-4120 Page No. 5081-5085

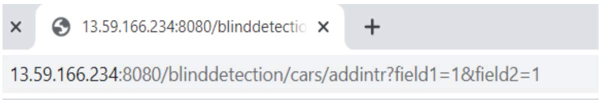

Figure 19: When the person presses emergency button and falls or accident occurs, both field1 = 1 and field2 = 1.

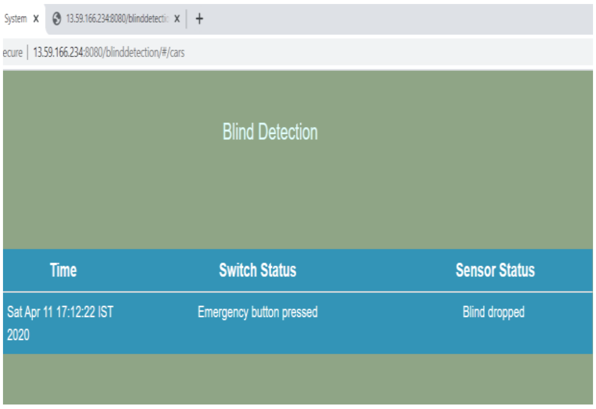

Figure 20: Output of Switch Status will be *Emergency button pressed* and Sensor Status will be *Blind dropped* when field1 = 1 and field2 = 1.

Figure 21:Alert Messages (Event Notifications)

8. Conclusion and Future Enhancement

The aim of this state-of-the-art paper work is to provide a smart lightweight wearable device for partially impaired and blind people. A simple, cost-effective, configurable, easy to handle to device. This device will be effective, efficient, and unique in its capability in specifying the source and the distance of the obstacles that may encounter the partially impaired and blind people. By wearing this device, blind people can full avoid the use of blind stick (white cane) and such other tools. This device will help the blind people to navigate without holding a blind stick that makes more convenient.

The future implementation and extension of thisstate-of-the-art model can go step further to develop a optimized device to be attached with the jacket, that makes even more comfortable and convienence for the blind people to wear it. Also, by using high quality ultrasonic sensors that gives faster response, which makes the device capable of working effectively in crowded places.

References

[1] Suraj D. M., Varun A. Prasad, Shwetha Lokesh, Sudhanva G. Hebbale, Dr. Vimuktha Evangeleen Salis, "Obstacle Detection for the Visually Impaired using Arduino", Third International Conference on Trends in Electronics and Informatics (ICOEI 2019), ISBN: 978-1-5386-9439-8, 2019, pp. 260-265.

[2] Arathi T R, Adarsh J M, Aparna V S, Sreepriya C K, Lija Thomas, "Virtual Eye for Blind – A Multi Functionality Interactive Aid using Pi", International Research Journal of Engineering and Technology (IRJET), vol. 6,issue. 5, 2019,pp. 5503-5506.

[3] Andrea Donna Vora, Ashmitha J, Brahma Kumar K, Charchitha N. Behura, G. Seshikala, "Development of Virtual Eye for Blind People", International Journal of Advance Research in Science and Engineering, vol. 7, issue. 7, 2018, pp. 283-289.

[4] Pooja Sharma, Mrs. Shimi S. L.,"Design and Development of Virtual Eye for the Blind", International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, vol. 3, issue. 3, 2015, pp. 26-33.

[5] Pooja Sharma, Mrs. Shimi S. L., Dr. S. Chatterji, "Design of Microcontroller Based Virtual Eye for the Blind", InternationalJournal of Scientific Research Engineering and Technology (IJSRET), vol. 3, issue. 8, 2014, pp. 1137-1142.