ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 10, October 2017

An Affordable Hand-glove for the Blind using Ultrasonic Sensors

Abhishek Kanal[1*], Prajakta Chavan[2]

[1, 2] Thadomal Shahani Engineering College, Mumbai, Maharashtra, India

E-mail: abhishek.kanal18@gmail.com[*1], prajakta.j.chavan@gmail.com[2]

Abstract: This paper presents the implementation of an assistive glove for the blind. The basis of this glove is a technology that helps the visually impaired in detecting any obstacles that may appear in their path within 100 cm in any direction of the glove. When the user of this glove encounters an object within 100 cm, the glove alerts the user with a loud beeping sound and heavy vibrations. One of the key USPs of this glove is its extremely low manufacturing cost as against the technologies used in other gloves which cost almost ten times of what the glove presented in this paper does. The technology used in this glove involves heavy communications between the Arduino UNO and Ultrasonic Sensors like the HC-SR04. This glove can easily be marketed as a social impact project considering its ease of use and a very competitive price.

Keywords: Visually challenged; Arduino; Ultrasonic sensor; Social impact; Wearable device; Obstacle identification; Microcontroller

I. INTRODUCTION

It has been ever since those technologies have been developed time and again for the physically challenged. From the use of sensor devices for monitoring a prosthetic device of an amputee [1] to the development of a communication device for the mute/deaf [2], the amalgamation of hardware and software concepts have never been in any better symbiosis. WHO estimates a total of 285 million visually impaired human beings around the globe, out of which close to 90% live in low income settings [3]. The combination of being financially humble and visually impaired allegedly challenges the already developed many aids for the blind. The main objective of this project revolves around creating a sterling blind-assist device irrespective of their financial background. The proposed system helps the visually impaired in the following two ways:

1) The buzzer in the device starts beeping loudly when the user wearing the glove approaches the obstacle that falls within the 100 cm range.
2) The vibrational motor in the device starts vibrating as the user wearing the glove moves closer to the obstacle.

II. LITERATURE REVIEW

Time and again there have been innovations in the wearable technologies for the blind. The field of Biomedical Robotics has been around for a really long time now. Out of the many gloves developed for the blind, one of the most convincing designs is that of an electronic glove for both, the blind and the deaf [4]. The design here makes use of LCD screens and gestures for conveying ideas to the deaf. The cost associated with this design is definitely low. However, this cost can be significantly reduced further by designing a separate glove altogether exclusively for the blind which would plummet the cost by a large extent by getting rid of the concept of displaying gestures on screens.

Another design [5], makes use of only the vibrational motor sans the buzzer mechanism that is used in the design presented in this paper. The effect of a combination of a beeping sound and a vibration is more impactful than only vibrations. Another Visual Impairment Aid [6] makes use of a similar concept. We have tried to build on this existing glove by making it less complex and easily constructible so as to be marketed on a large scale. The glove presented in this paper also happens to be much cheaper than the Visual Impairment Aid [6] with little to no depreciation in its performance.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 10, October 2017

III. HARDWARE COMPONENTS

The following set of hardware components have been used to implement the system.

3.1 Arduino UNO Board

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. The Arduino's hardware and software consists of a circuit board that can be purchased at low cost or assembled from freely-available plans; and an open-source development environment and library for writing code to control the board. [7] Arduino allows users to develop different working electronic prototypes, either devices tethered to a computer or stand-alone objects. It can read from a wide range of sensors, control a broad spectrum of output devices, and communicate with software running on a computer or talking over a network. In this work, Arduino UNO is used which has a removable Atmega328 as microcontroller, responsible for performing various functions, which can be easily replaced if broken or removed from the board for use in a custom circuit. Along with that it includes extra peripheral components that enable it to communicate with the computer via a USB cable. The board can be powered directly from the USB connection or using an external power supply. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a USB connection, a 16 MHz ceramic resonator, an ICSP header, a power jack, and a reset button (Figure 1).

Figure 1: Arduino UNO.

3.2 Ultrasonic Sensor HCSR04

The HCSR04 Ultrasonic sensor is a device which is used for the measurement of distance to the object by the means of sound waves. It is also called a SONAR sensor as it is based on the principle of SONAR which is used for detection of hurdles. It can provide long distance measurement up to 2cm to 4 cm with measuring angle of 15 degrees. It has 4 pins and can be easily interfaced with Arduino. It measures the distance by transmitting a sound wave at a specific frequency and constantly detecting for that sound wave to bounce back. By recording the elapsed time between the transmission and reception of the sound signal, it is possible to calculate the distance between the sonar sensor and the object. The accuracy of Ultrasonic sensor can be affected by the temperature and humidity of the air it is being used in. These are important factors to consider when designing and programming a prototype using an ultrasonic sensor (Figure 2).

Figure 2: HC-SR04 ultrasonic sensor.

3.3 Buzzer HYDZ

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 10, October 2017

This is a piezo buzzer that has built in circuitry that produces the audible buzzer tone. The feedback from the sensor is used in order to ring the alarm tone of the buzzer as soon as an object comes within the range of the sensor. The buzzer tone is an indication that a hurdle lies along the way, thus navigating the blind person successfully. In this circuit, the positive lead of the buzzer is connected to pin D8 of the Arduino, the negative lead of the buzzer is connected to GND. (Figure 3).

Figure 3: Buzzer HYDZ.

3.4 Vibration Motor

Vibration motor is a compact size coreless DC motor used to inform the user of receiving the signal by vibrating, with no sound. It along with the buzzer acts as an indicator by providing vibration pulses to the user wearing the glove. In the prototype, the pin 1 of the motor is connected to pin D7 of the Arduino and pin 2 is connected to the GND pin of the Arduino. An offset counterweight is fitted to the end of the motor shaft. When the shaft turns, the imbalance in the counterweight causes the handset to vibrate. This turning of the shaft occurs when a certain object is experienced within the path of the user, thus prompting him to change the course through means of vibration (Figure 4).

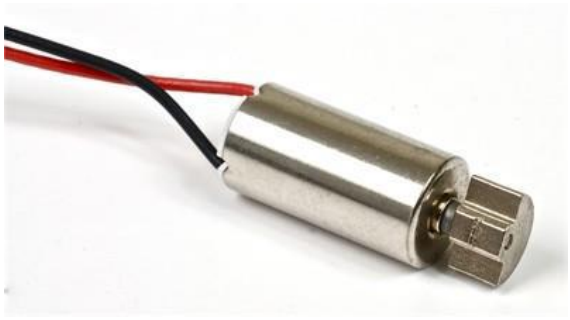

Figure 4: Vibration motor.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 10, October 2017

IV. PROPOSED SYSTEM

The block diagram below shows the flow of the system proposed in this design.

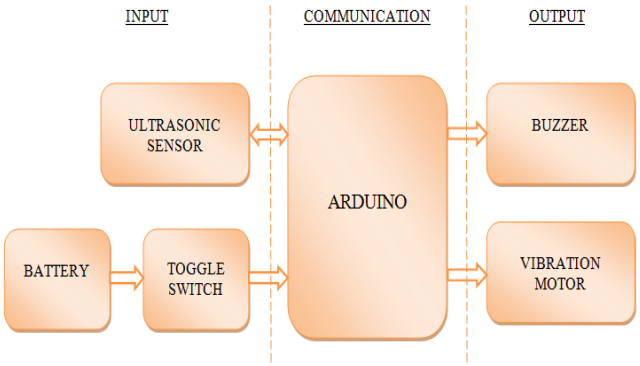

Figure 5: Block diagram for proposed hand glove for the blind.

The circuit uses Arduino as the central microprocessor which is responsible for processing the detection experienced by the sensor and provides feedback through the means of buzzer and vibration motor. Arduino provides 5V DC to the VCC pin of the ultrasonic sensor. The controlling data is sent from the Arduino's SPI pin no D11 to the trigger input of the sensor. Pin no D11 is called as MOSI (Master out Slave In) pin which acts as a master line to send data to peripherals connected to the Arduino. Similarly, the output which is provided when the sensor detects the presence of an object within its range is sent in the form of a signal to the Arduino's pin no D10 from the output Echo pin of the sensor. Both pin no D8 and pin no D7 of the Arduino act as the output pins which sends the signals to the buzzer and motor, thus initiating them once an object is sensed by the sensor. The power supply is given to the Arduino from a 9V battery by using a toggle switch and a DC male power jack. The toggle switch is used to check whether the buzzer and the vibration motor are working properly once the connections are made (Figures 5 and 6).

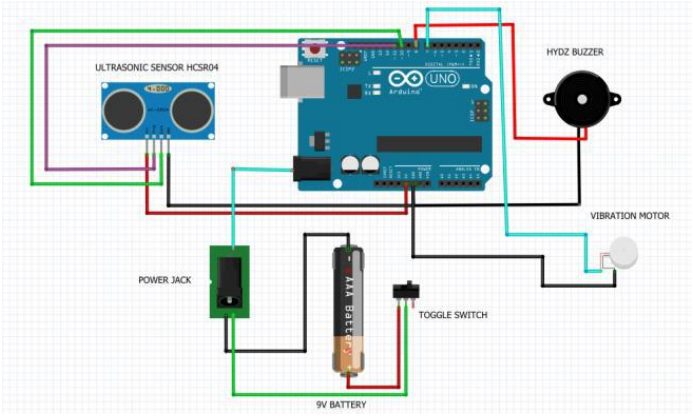

Figure 6: Circuit design for proposed hand glove for the blind.

V. FINAL PROTOYPE

The Final Working Prototype is shown in the image given below. It beeps and buzzes for any obstacle that may fall within 100 cm of its range (Figure 7).

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 10, October 2017

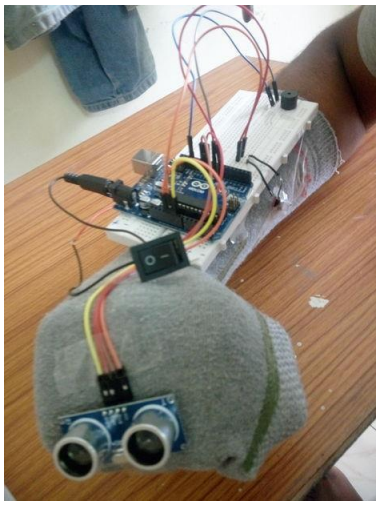

Figure 7: Final working prototype.

VI. CONCLUSION

This paper presents an extremely cost effective wearable technology for the blind. With the help of a simple circuit consisting of an Arduino and Ultrasonic Sensors, the glove can easily detect any obstacle within 100 cm of its range. This design can be made better in performance through the introduction of sensors higher in quality. The use of Raspberry Pi may also increase the explorable avenues for this project.

VII. REFERENCES

1. SE Joan, DH Colin, et al. A Measurement Device to Assist Amputee Prothetic Fitting. Journal of Clinical Engineering 1994; 19: 63-72.
2. PT Brunet, AP Ittycheriah, et al. Method and apparatus for a communication device for use by a hearing impaired/mute or deaf person or in silent environments. US Patent US5995590 A issued Nov 30, 1999.
3. World Health Organisatio. Visual impairment and blindness. 2014.
4. G Dhiraj, S Pankhuri, et al. Design and development of a low cost Electronic Hand Glove for deaf and blind. International Conference on Computing for Sustainable Global Development. 2015.
5. AM Kasim, MH Jamaluddin, et al. Design and development of MY 2nd EYE for visually impaired Person. IEEE Symposium on Industrial Electronics and Applications. 2011.
6. RHT Syed, A Junaid, et al. Visual Impairment Aid Using Haptic And Sound Feedback. International Conference on Communication, Computing and Digital Systems (C-CODE), Islamabad, Pakistan. 2017.
7. MA David, B Massimo, et al. Arduino: An open electronic prototyping platform Proceeding CHI. 2007