Proceedings of the
International Conference on Mechanical Engineering and Renewable Energy 2017
(ICMERE2017) 18 – 20 December, 2017, Chittagong, Bangladesh

ICMERE2017-PI-372

SMART HELMET FOR VISUALLY CHALLENGED PERSON

Mohammed Saifuddin Munna, Syeda Nishat Tasnim, Mithun Kumar Nath

Department of EEE,Premier University,Chittagong,Bangladesh
munna.puc@gmail.com, nishattasnim495@yahoo.com,mimithun09@gmail.com

Abstract: *Blindness is a state of lacking the visual perception due to physiological or neurological factors. In this proposed work, a simple, cheap, friendly user, virtual eye is designed and implemented to improve the mobility both blind and visually impaired people in a specific area. This project includes a wearable helmet to help the blind person to navigate alone safely. The main component of this project is ultrasonic sensor which is used to scan a predetermined area around blind by emitting-reflecting waves. The reflected signals received from the barrier objects are used as input to Arduino Mega 2560. The Arduino Mega 2560 carried out the issued commands and another Arduino Uno is interfaced with it. Then the Arduino UNO communicates the status of a given appliance r device back to the earphone using MicroSD card Breakout board. The proposed system is cheap, fast and easy to use and an innovate affordable solution to blind and visually impaired people*.

Keywords: Ultrasonic Sensor, Arduino Mega 2560,Arduino UNO, MicroSD card Breakout Board, Earphone.

1. INTRODUCTION

The World Health Organization (WHO) reported that there are 285 million visually-impaired people worldwide. Among these individuals, there are 39 million who are blind in the world. More than 1.3 million are completely blind and approximately 8.7 million are visually-impaired in the USA. Of these, 100,000 are students, according to the American Foundation for the Blind and National Federation for the Blind. Over the past years, blindness that is caused by diseases has decreased due to the success of public health actions. However, the number of blind people that are over 60 years old is increasing by 2 million per decade. Unfortunately, all these numbers are estimated to be doubled by 2020.Around 7.6 million people in Bangladesh are visually impaired and approximately 1.1 million are blind. People who are visually impaired still struggle every day in performing actions that can be as simple as moving from one point to another without falling down, or knocking against obstacles.

Hence Blind people need an assistive device that will allow blind user to navigate freely. There have been several systems designed to support visually impaired and blind people. Unfortunately most of these systems are limited in their capabilities.

We present a comparative survey of the wearable and portable device in order to show the progress in assistive technology for this group of people. The fundamental goal is to give an ease or financially savvy approach that will permit visually impaired individuals to explore freely or independently in the outdoor environment. Based on this real context or condition we focused the work on developing assisting technologies that may help blind individuals bringing them back to the society.

2. RELATED WORKS

Some early examples about those systems can be illustrated by the C-5 Laser Cane [5] based on optical triangulation to detect obstacles up to a range of 3.5 m ahead. It requires environment scanning and provides information on one nearest obstacle at a time by means of acoustic feedback. The laser system measures the distance to the obstacle and a sound tone proportional to this distance is played. This system developed in the 70's is the precursor of a large series of devices trying to remove the cane of the blind user. More recent development using stereoscopic cameras coupled with a laser pointer and audio system have been developed at the University of Verona [6]. On other recent project, CyARM [7], is also based on wearable low cost devices but using slightly different approach. It uses ultrasonic transducers to detect the distance to the nearest obstacle. This information is passed to the user through variation of tension of the fixation wire attached to the belt. Higher tension means the proximity of the obstacle. The CyARM application offers an interesting solution. By using sonar sensing and tactile feedback it creates a new portable interface for navigation. However it is still not hand free and needs the user to constantly move the device to sense the environment. Some new commercial devices appear on the market, like the UltraCane [8] which uses a build-in sonar system and sends back vibrations through the handle according to the presence of obstacles. The ultra cane enhanced the traditional white cane by giving information about the obstacles before direct contact. But it doesn't provide any new functionality to the traditional cane and the localization is still done by movement of the cane and it doesn't detect objects at head height. A Radio Frequency Identification Walking Stick (RFIWS) was designed in [9] in order to help blind people navigating on their sidewalk. This system helps in detecting and calculating the approximate distance between the sidewalk border and the blind person. Radio Frequency Identification (RFID) is used to transfer and receive information through radio wave medium [10]. RFID tag, reader, and middle are the main components of RFID technology. Wearable jacket-type scheme is proposed in [11]. Sonar sensors and vibrators are attached on a jacket, and are used to let a consumer know the direction from which an obstacle is coming. low cost outdoor assistive navigation system: A navigator with 3D sound system was developed in[12] to help blind people in navigating .The device is packet on the user's waist with Raspberry pi, GPS receiver. Cognitive Guidance System (CG System) Landa et al. proposed a guidance system for blind people through structured environments [36]. This design uses Kinect sensor and stereoscopic vision to calculate the distance between the user and the obstacle with help of fuzzy decision rules type Mandani and vanishing point to guide the user through the path. The smart stick, as shown in is basically an embedded system integrating the following: pair of ultrasonic sensor to detect obstacles in front of the blind from ground level height to head level height of the stick in the range of 400 cm ahead, infrared sensor to detect upward and downward stairs, water sensor for detecting puddles. The sensors collect the real-time data and send it to the microcontroller for processing. After processing, the microcontroller invokes the right speech warning message through a Bluetooth earphone. The system is powered by a rechargeable battery. In our system, we detect obstacles in the right, left, front, back and feet of the user so that they can walk safely. In our project, we successfully detect obstacles around the user and also send a voice based warning message to the user so that they can become conscious about their position.

3. Proposed Design

3.1 System Overview:

Our main objective is to make a compact, self-sufficient system that will permit these blind people to travel through an environment. The system that has to be designed is a portable system. Therefore the design must be considered user's movement. It helps visually impaired people to move in a right way (e.g. takes a right direction, take left, move forward, move backward) and avoid obstacles. The proposed system is composed of two modules obstacle detection and obstacles warning. The main aim of obstacle detection is to determine the presence of interested obstacles around the user. The ultrasonic sensor(HCSR04) detects obstacles around the user and provides navigation instructions to the user by giving audio instructions through female jack socket which is connected to the Arduino UNO interfacing with MicroSD card from where interested audios are played. Thus This navigation system will detect an obstacle using HC-SR 04 ultrasonic sensor and guide blind person by providing an audio instructions.

3.2 Block Diagram:

The block diagram of our Proposed system consists of ultrasonic sensor, Arduino Mega 2560,Arduino UNO, MicroSD card breakout board, female jack socket and earphone. Ultrasonic sensor senses the obstacles in its path by continuously transmitting the ultrasonic waves and sends this information to Arduino Mega2560 for processing and Arduino UNO is interfaced with it. Then the Arduino UNO communicates the status of a given appliance r device back to the earphone using MicroSD card Breakout board. The proposed system is cheap, fast and easy to use and an innovate affordable solution to blind and visually impaired people.

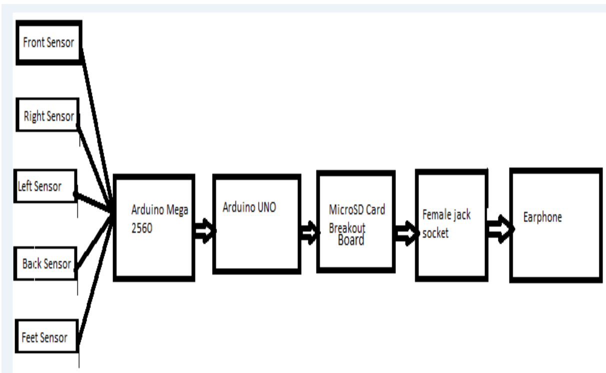

Fig.1 : System Block Diagram

4.HARDWARE DESCRIPTION

4.1Ultrasonic Sensor:

Ultrasonic transducers convert ultrasound waves to electrical signals and vice versa. These devices work on a principle similar to that used by transducers in radar and sonar systems, which evaluate the attributes of the target object by processing the echo signals from radio or sound waves, respectively. Ultrasonic sensors consist of two parts(Shown in fig.2): transmitter and receiver, which create a transducer that converts ultrasound waves into electrical signals (A/C) or vice versa. The transceiver vibrates and creates an ultrasonic wave that is transmitted and travels until it hits an object and is reflected back to the receiver. The interval between the signal being sent and received is typically referred to as time-of-flight (ToF) and depends on the distance the ultrasonic wave travels until it is reflected. The basic equation: time is equal to distance divided by speed, can be used to measure fluid level, fluid identification concentration and distance.

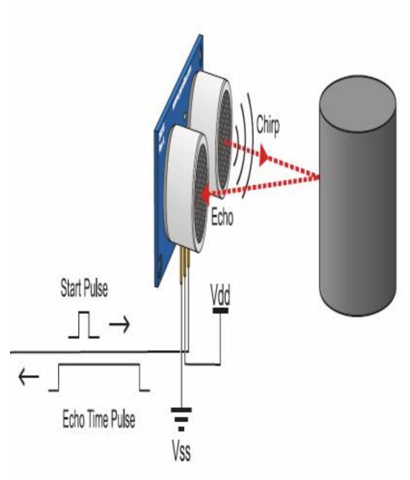

Fig.2 :Working of Ultrasonic Sensor

4.2 HC-SR04 Timing Chart & Working

The working of the ultrasonic sensors is quite simple and they are easy to interface with the microcontroller. From fig.3 the sensor module has 4-pins out of which Pin-1 and Pin-4 are +Vcc and Gnd respectively.Pin-2 is Trigger and Pin-3 is Echo pin.The working of sensors can be described from the below figure

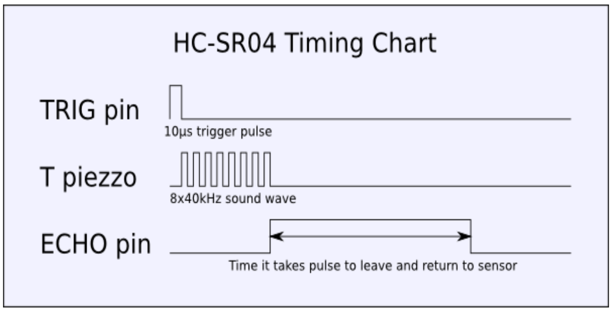

Fig.3: Timing chart for HC-SR04

When a High pulse of 10us is applied at TRIG pin, the ultrasonic transmitter sends 8 consecutive pulses of 40kHz frequency. As the Eighth pulse is sent the ECHO pin of the sensor becomes HIGH. Now when the ultrasonic waves reflect from any surface and are received by the Receiver, the ECHO pin becomes LOW. The time it takes to leave and return to sensor is used to find the distance from the reflecting surface.

Distance in centimeters = (Time/58) cms

In Inches = (Time/148)

Distance can also be calculated by taking into account the speed of Sound (=340m/s)

4.3 Arduino Mega2560:

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; we simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

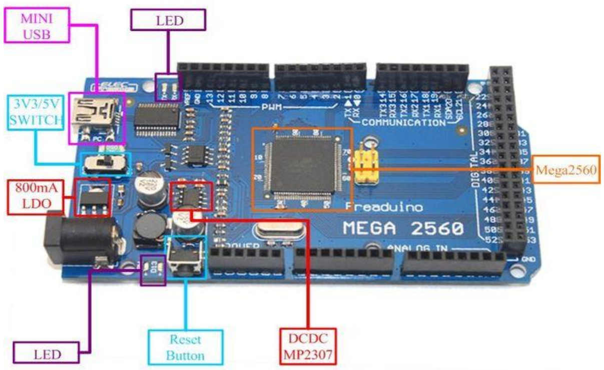

Fig 4.: Arduino Mega2560

4.4Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 . 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; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

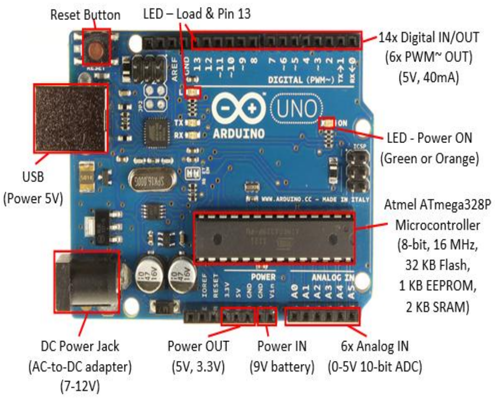

Fig.5 : Arduino UNO

4.5 MicroSD Card Breakout Board:

In this System, for voice processing & recoding we proposed to use MicroSD Card Breakout Board. In this board we can add up to 32GB MicroSD card. In MicroSd card voice recording are stored and it can be used while we need. Here Author used the standard SD card libraries that come with the Arduino IDE.

Fig.6: MicroSD Card Breakout Board

4.6 Female jack socket

Female Jack socket is used to receive external sound sources. Earphone is connected with this through which we hear the warning message. There are many types of it .In our project, It has three terminal..we shorted two terminals and used it as positive terminal connecting digital 9 pin of the Arduino UNO And the other terminal is connected to the GND of the Arduino UNO.

Fig.7: Female jack socket

5.ALGORITHM & CIRCUIT DIAGRAM

Authors here presents a Smart Helmet for Visually Challenged Personnel for the detection of obstacles. Our project includes ultrasonic sensors for the detection of obstacles around the user and it also includes voice based obstacle warning system through which the user can get a warning message through the earphone. Author explain it clearly in the following flow chart & Circuit Diagram.

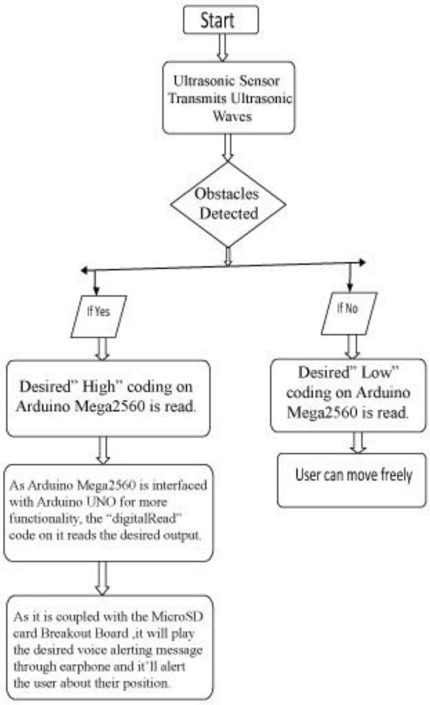

Fig.8: System Block Diagram .

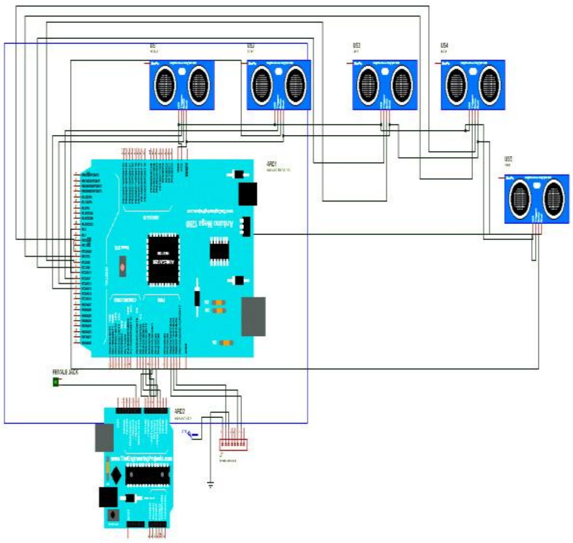

Fig.9: Circuit Diagram.

6. FINAL DESIGN:

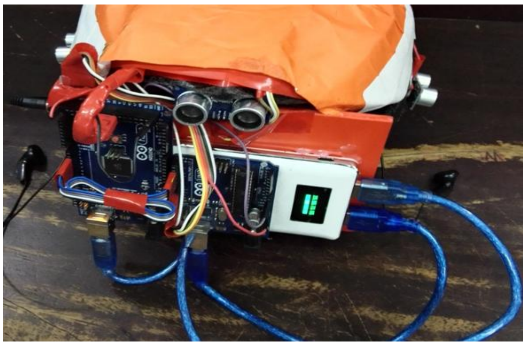

Fig.10: Final Design

Fig.11: Front View While testing by visually disable people

Fig.11: Front View While testing by visually disable people

7. CONCLUSION

This paper presents the implementation of a smart Helmet that assists a visually impaired person to his destination safe and secure. We make use of multiple ultrasonic sensors to detect the obstacles around the user and warn the blind person about the obstacle through earphone. This project provide efficient and a economical security system. A model helmet for blind people to navigate freely without the use a guide or stick.

8. REFERENCE

[1] Dakopoulos, D.; Bourbakis, N.G. *Wearable obstacle avoidance electronic travel aids for blind*: A survey. IEEE Trans. Syst. Man Cybern. Part C 2010, 40, 25–35. [CrossRef]

[2] Renier, L.; De Volder, A.G. *Vision substitution and depth perception: Early blind subjects experience visual perspective through their ears.* Disabil. Rehabil. Assist. Technol. 2010, 5, 175–183. [CrossRef]

[3] Tapu, R.; Mocanu, B.; Tapu, E. A survey on wearable devices used to assist the visual impaired user navigation in outdoor environments. In Proceedings of the 2014

[4] 11th International Symposium on Electronics and Telecommunications (ISETC), Timisoara, Romania, 14–15 November 2014.

[5] Blasch, B.B.; Wiener, W.R.; Welsh, R.L. Foundations of Orientation and Mobility, 2nd ed.; AFB Press: New York, NY, USA, 1997

[6] Benjamin J. M., Ali N. A., A laser cane for the blind In Proceedings of the San Diego Biomedical Sy

[7] Panuccio A., A Multimodal Electronic Travel Aid Device, ICMI 02: in proceedings of the 4th IEEE International Conference on Multimodal Interfaces, page 39, IEEE Computer society, Washington, DC, USA, 2002

[8] K. Ito, M. Okamoto, J. Akita, CyARM: an alternative aid device for blind persons, CHI '05: CHI '05 extended abstracts on Human factors in computing systems, pages 1483—1488, Portland, OR, USA, 2005

[9] UltracaneTM, www.soundforesight.co.uk

[10] Saaid, M.F.; Ismail, I.; Noor, M.Z.H. Radio frequency identification walking stick (RFIWS): A device for the blind. In Proceedings of the 5th International Colloquium on Signal Processing & Its Applications, Kuala Lumpur, Malaysia, 6–8 March 2009.

[11] Harrison, M.; McFarlane, D.; Parlikad, A.K.; Wong, C.Y. Information management in the product lifecycle-the role of networked RFID. In Proceedings of the 2nd IEEE International

Conference on Industrial Informatics (INDIN’04), Berlin, Germany, 24–26 June 2004.
[12] Sylvain Cardin, Daniel Thalmann, and Fr´ed´eric Vexo. A wearable system for mobility improvement of visually impaired people. The Visual Computer, Vol. 23, No. 2, pp. 109–118, 2007.
[13] Xiao, J.; Ramdath, K.; Losilevish, M.; Sigh, D.; Tsakas, A. A low cost outdoor assistive navigation system for blind people. In Proceedings of the 2013 8th IEEE Conference on Industrial Electronics and Applications (ICIEA), Melbourne, Australia, 19–21 June 2013; pp. 828–833.
[14] Prudhvi, B.R.; Bagani, R. Silicon eyes: GPS-GSM based navigation assistant for visually impaired using capacitive touch braille keypad and smart SMS facility. In Proceedings of the 2013 World Congress on Computer and Information