An Assist System for Visually Impaired People to Recognize Massive Obstacles (Within one meter)

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Abstract— Visually impaired individuals are growing segment in this era. Developing tools for visually impaired people is not a recently emerged problem. However, developing computer aided tools are still developing area for visually impaired people. Assist system for visually impaired people refers to system that is able to assist or guide people with vision loss, ranging from partially sighted to totally blind, by means of sounds of commands. Our sophisticated system involves detecting massive obstacles within one meter based on Ultrasonic sensor. This combination of insights laid out in audio format to assist with identifying massive obstacles.This innovated system can use instead of traditional way of identifying obstacles. Traditional ways are, they use white cane for mobility and get assist from second person. To overcome the white cane mobility challenge, this proposed system "Assist system for visually impaired people" could be a solution for constraints in independent mobility in efficient manner. Twenty-five percent of the visually impaired people travel through public locations without assistance other than white cane. It is difficult to hang white cane while moving. Nevertheless, our proposed system fixed on a glove. They can wear hand glove and conveniently can move place to place. The system is to identify massive obstacles using HC-SR04 Ultrasonic sensor and Arduino Board. Ultimate goal of this system is to uplift the life style of visually impaired people by making them more independent and aware of their surroundings by hearing sound. This paper presents an assist system based on low cost and physically obtrusive sensors. While moving visually impaired person can wear glove on hand & use his/her android phone with earphones. System identify massive obstacles which harmful to the user and retrieves the sound (tone). That particular tone will increase when visually impaired person reach near to the obstacle. Hence, he/she may avoid step into another way. The system has tested in real time by both blindfolded and blind people at different indoor and outdoor locations, demonstrating that it operates adequately.

Index Terms— Arduino, Bluetooth app, Chip programming, HC – SR04 Ultrasonic sensor, Massive obstacles, One meter, Visually Impaired People

1 INTRODUCTION

Mobility of visually impaired people restricted by their incapability to recognize their surroundings and imported goods such as clothes, medicine. According to World Health Organization (WHO) in 2012, out of 7 billion global population there were over 285 million visually impaired people and 39 million were totally blind out of which 19 million are children (below 15 years). Visualise can be classified by four categories: normal vision, moderate visual impairment, severe impairment, and complete blindness. Legally blind refers to a person who has less than 20/200 vision in either eye, or a limited field of vision3. While not all visually impaired individuals are completely blind, most of them use white cane and use dogs as assistants to navigate from place to place and to gain a sense of their surroundings. Visually challenged people face constraints in independent mobility. Mobility means the possibility of liberally moving, without support of any supplementary person, at home and unfamiliar scenarios. People with visual impairment tackle enormous limitations in terms of mobility. Many researchers conducted to build navigation system for blind people. Most of these technologies have limitations as it challenge involves accuracy, usability, interoperability, coverage which is not easy to overcome with current technology for both indoor and outdoor navigation.

Traditional white cane is the most popular, simplest tool for detecting obstacles due to its low cost, probability. It enables user to effectively scan the area in front and detect obstacles on the ground like holes, steps, walls, uneven surfaces, downstairs etc. However, it can only use to detect obstacles up to knee level. Its detection range is limited up to1-2 feet only. Primary objective of this project to explore autonomously outdoor and indoor navigation. The proposed system consists of hardware and software.

Based on studies & advices from medical offices, hearing sensitivity of visually impaired people is differ from sighted people. Due to that along with Bluetooth module sounds fixed with particular range, which can conveniently hear to visually impaired people.

Even though proposed systems for mobility and safety better solution but they are more expensive. Because for those particular systems consists of expensive camera etc. However, for this proposed system we had used Arduino sensors that is less expensive.

1.1 Related work

Mobility & navigation systems available using RFID (Radio Frequency Identification). Radio-frequency identification (RFID) is a wireless technology that uses low frequency radio fields to transfer small bits of data between RFID devices, usually consisting of

chips attached to tags and a receiver with an antenna. However, due to environment issues such systems cannot practically apply [1].

Most of existing systems based on expensive sensors and higher technologies. Hence, middle level incoming people cannot achieve that proposed methods [2].

Many complex systems involve with great number of unessential sensors such as colour sensors & established such sensors on shoes. While moving sensors may get collapsed. Ultimately, visually impaired person may face an accident [4].

In order to overcome these complexities, systems proposed with sensors that can identify obstacles so far. Even though it can identify obstacles voice will produce commands without identifying proper range of the obstacle [11].

An indoor navigation system for visually impaired people constantly tracks the user through an RFID unit and communicated the user to obtain desired destination safely via wireless connection and through a tactile compass. [12]

"Blind audio Guidance system" based on embedded system, uses ultrasonic sensor for distance measurement, IR sensor for object detection and AVR sound system for audio instructions. The main functions of this system are environment recognition and path detection. Ultrasonic sensors receive visual information and this visual information transformed into auditory information. To represent the information about the position of obstacles audio components of intensity, frequency, binaural phase difference are used. This signal transformation system reduces the training time required to use a white cane. However, signal it used IR sensor. Hence, signal intersection and barrier will occur [13].

A navigation system designed for blind people using RGB-D sensor with range expansion. System uses a consumer RGB-D camera for range and visual information, which support range based floor segmentation. RGB sensor supports in object detection and colour sensing. User interface is given through audio instructions and sound map information. However, sensor is expensive. Due to that practical implementation is not fair [14].

1.2 Objective

In this paper, we address the problems faced by visually impaired people for mobility and navigation. In particular, the specific contributions of this paper are

- A novel approach to identify massive obstacles within one meter.
- Visually impaired person can conveniently identify the distance from particular obstacle through "beep" tone via mobile phone.

2 Methodology

We developed "Assist System for Visually Impaired People" as a glove, which can wear on hands of visually impaired people. Initially, created circuit for Ultrasonic sensor by using Arduino board. We used C and java (Chip programming) programming languages to fulfil code implementation. Finally have completed a glove with fixed circuit, which can wear without any disturbances (electronic part to complete glove as outcome). This system consists of following hardware components.

- Arduino UNO board
- HC-SR04 Ultrasonic Sensor
- 9v battery
- DC Jack plastic
- Push on switch round mide
- Solderless bread board
- Jump wire

2.1 Establish circuit to identify obstacles within one meter HC-SR04 sensor (ultrasonic sensor) and Ardunio board

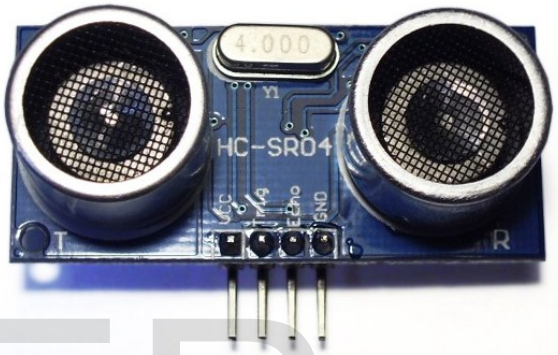

Fig 1 HC-SR04 Ultrasonic sensor

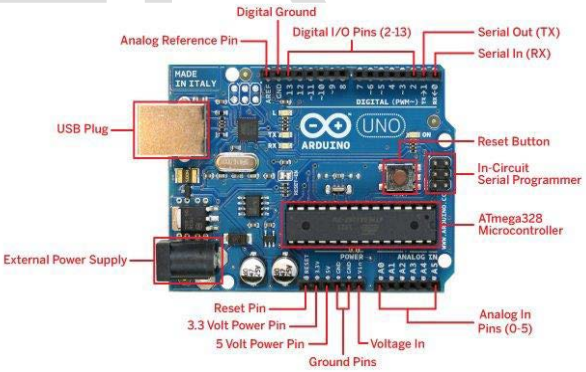

Fig 2 Arduino board

We connected SRO4 terminals with digital pins of Arduino board as follow

- VCC terminal of sensor connected to Arduino +5V pin
- GND terminal of sensor connected to Arduino GND pin
- Trig terminal of sensor connected to Arduino digital Pin 2
- Echo terminal of sensor connected to Arduino digital Pin 4

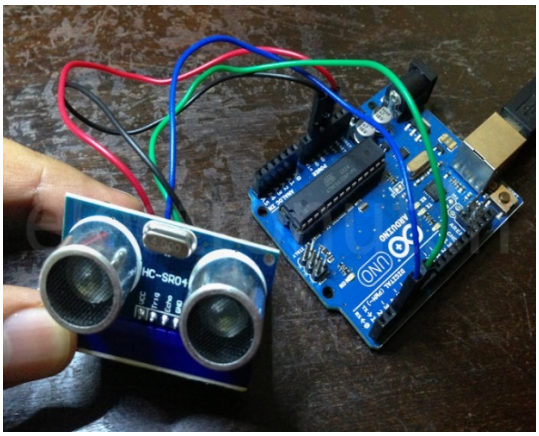

Fig 3 Ultrasonic sensor circuit (HC-SR04 sensor and Arduino unit)

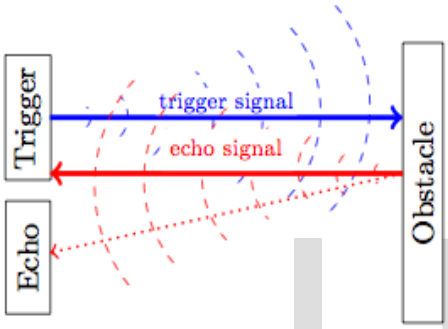

Fig 4 The way of ultrasonic sensor identifies obstacles & sending signals

The ultrasonic sensor sends out a high frequency sound pulse and then times how long it takes for the echo of the sound to reflect back.

The sensor has two openings on its front. One opening transmits ultrasonic ways, the other receives them.

The speed of sound is approximately 341m per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound. Sound pulse determine the distance to an object.

Distance=Time*speed of sound/2

Time = time between when an ultrasonic wave is transmitted and when it is received.

2.1 Chip programming to identify obstacles within one meter

Through USB connector, we connected computer and established ultrasonic sensor circuit. For code implementation, we used combination of C and java programming languages that called as "Chip programming". Through USB connector particular programming codes had passed to Arduino system. Based on equation implementation had done.

2.3 Testing impleted codes using obstacles (support with serial monitor)

Complied with 100 iterations to find maximum range that Ultrasonic sensor detects obstacles. To test implemented code initially disconnected USB connection and used various obstacles within one meter. Through serial monitor (like command line), we can see the result with distance. Sometimes it shown results, which we were not accepted. Then again and again, we had done programming. By clicking reset button on circuit, implemented code can delete and again can implement a new code. Using that technique, we implemented several codes to recognize massive obscles within one meter.

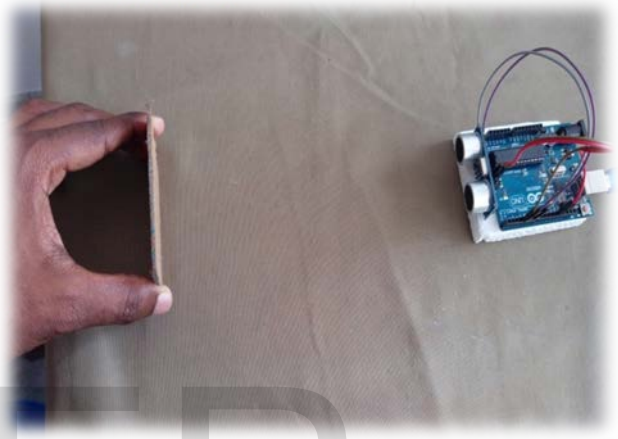

Fig 5 Identifying obstacles within long distance

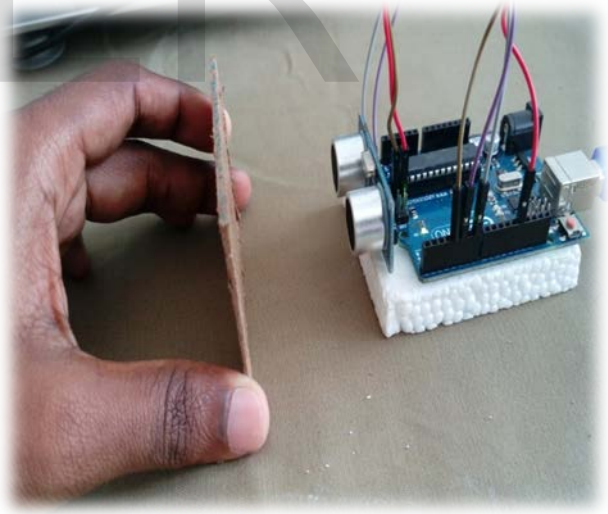

Fig 6 Identifying obstacles within short distance

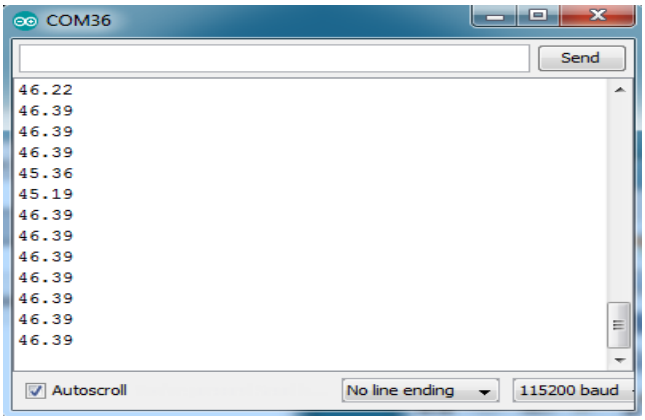

Fig 7 Tested output with short distance

2.4 Connect speaker and implemented codes to retrieve sound to tell about obstacles

We defined different frequency of sound in the program. Hence, if there are massive obstacles within one meter the system will produce a sound and according to distance frequency. Sounds retrieve from speaker. It easy to recognize obstacles, which situated far or not.

In contrast, alerts can send to blue-tooth devices such as android phone, tablets using blue-tooth module.

2.5 Testing

We had done unit testing with the support of serial monitor. Apart from that tested whether particular sounds (indicating the distance from the obstacle. If sound is high it means the obstacle is near to the person) can hear or not. Final test has covered by visually impaired people.

3 RESULTS

The Bluetooth module developed here to identify massive obstacles within one meter range based on HC-SR04 Ultrasonic sensor & provide "increasingly beep sound" via mobile phone.

Fig 8 Final product (glove)

Fig 9 Bluetooth App

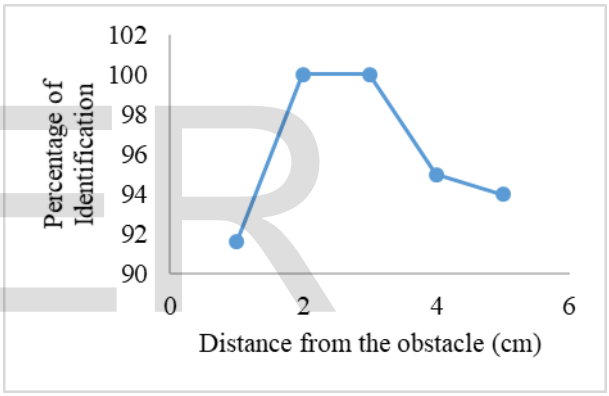

Fig 10 HC – SR04 Ultrasonic sensor's obstacle identification against with the distance

Fig 11 Analysis of the final testing by visually impaired people

4 Future Work

As a future work, we plan to

- Work on ways of verbal sounds like artificial robot voice instead of beep sounds (tones).
- Apply GPS for navigation.

5 Evaluation

In order to assess the practical value of the proposed system, it is necessary to benchmark its performance discussion with visually impaired people who tested this system. Thus, the evaluation effort focuses on the following questions.

5.1 Question1: It is difficult to ware glove (assist system)?

No. It can easily wear as normal glove. Nicely covered all circuits. Therefore, it can wear without any disturbances. No need to handle glove like white cane. Hands can take as free.

5.2 Question2: How does this system help you for mobility?

While moving place to place when obstacle detect within 100 centimetres through earphone we can hear sound and when its reach to closer automatically increases the tone. So, we can easily identified the distance to the obstacles.

6 CONCLUSION

In this paper, we propose a sophisticated method as assistance for visually impaired people, regarding mobility and navigation. Even though various assist systems available for visually impaired people, due to high valuable sensors those products are very expensive. But for this proposed system we used Arduino board and sensor (HC-SR04 Ultrasonic sensor). Thus, it may use all type of economical substitutions.

We can emphasize following major advantages of this this when compare to existing systems.

- Free hands: not requiring from the user to hold them. Nevertheless, they have to wear the glove. Remember that the users will still hold the white cane, the most undisputable travel aid.
- Simple
- Through mobile phone, visually impaired people may hear sounds that indicate barriers.

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