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ULTRASONIC OBJECT SENSING GLOVE FOR BLIND USERS: A WEARABLE SOLUTION WITH ARDUINO

Pankaj[*1], Harshith Nair[*2]

[*1,2]Student, Dept. Of MCA, Shree Devi Institute of Technology, Mangalore, India.

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ABSTRACT

Many blind people experience personal suffering as a result of their eyesight loss. Among the five senses that are vital to the human body is vision. Individuals who lose their vision are disabled. These individuals require particular help from several nations in order to improve their quality of life as much as possible. In order to enhance their quality of life on a daily basis, they give them specialized equipment such as an electronic stick that guides them when moving about and voice messaging services. This article outlines a project idea to create and supply blind individuals with ultrasonic gloves so they can find their way without assistance from others. This can be accomplished by using ultrasonic pulses, which will be sent to the environment, where it will be gathered by a glove-mounted detector and transmitted to the blind as vibration or audio signals so they can be aware of their surroundings and make their own decisions about which path to take without assistance from others.

Keywords: Ultrasonic Sensor, Pit Sensor, Global Positioning System (GPS), Programmable Interface Controllers (PIC) And Lilypad Arduino.

I. INTRODUCTION

Suffering From blindness is not temporary for certain time it's being blind the whole day the whole time every second and every minutes. Once the blind person wakes up from his bed in the morning his suffering start and his daily needs start. Blind people need more care to avoid risk of injuries and that affect people around them; people need to be near for them to avoid being injured. People around them will be exhausted from being attention to them and giving them all what they need. So Blind people must depend on themselves, this paper proposes gloves which helps Blind people to depend on themselves.

Blindness can be caused by physiological dysfunction, anatomical or neurological dysfunctions. Each blind person has his own blindness type. Many scores have been established to assess the extent of blindness [1]. Total blindness is the complete absence of vision in the person mainly neuronal blindness because of defect in the NLP.

Some researchers believe that blindness may positively affect the audio capability in the blind person, so their sense of hearing will be more accurate. So, they can distinguish sounds and musical tones. Scientifics define people with small percentages of blindness is the person who have score of 200/20 at the best eye. Also, the person who use eyeglasses or who have shortness of vision or have decrease in the visual fields less than 20 degree. Therefore, many countries are helping the development of researches and studies seeking to improve the lives of blind people with special needs to make them feel they are part of the surrounding community through associations and different courses that are giving to learn the mechanism of dealing with blindness and ignore the inability of weakness and inability to move around [1].

II. PROBLEM STATEMENT

Around the world, Blind people face real problems. Their major problem lies in their sense of disability and sees what around them. Also, they face a problem with other people hesitate in their service or assistance to them. In addition, many people do not know how to deal with blind person. Blind people need a boost of confidence in their self and their ability to achieve anything and rely on their self without the needs of others [3].

Many countries developed many mechanisms of services that contribute to make life easier for the blind, where they developed some rules and laws in the art of dealing with the blind without notifying disability and some companies and organizations are training and recruiting people with the ability to deal with blind. In addition, there are a lot of companies have developed special equipment used by the blind to help them [2].

There are a lot of emotions a blind person hides behind his eyelids that we cannot see them.

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Many of them feel embarrassed to talk about their suffering in front of others or feel upset at their inability to see because of their illness or old age or the events that he suffered and caused him to lose sight. Some diseases that cause weakness in sight are listed (Fig.1), according to the World Health Organization in 2012 for the most common reasons of blindness (except for refractive errors):

1. Cataracts (47.9%),
2. Glaucoma (12.3%),
3. Macular Degeneration (8.7%),
4. Corneal opacities (5.1%),
5. Diabetic retinopathy (4.8%),
6. Childhood blindness (3.9%),
7. Trachoma (3.6%)
8. Onchocerciasis (0.8%) [4].

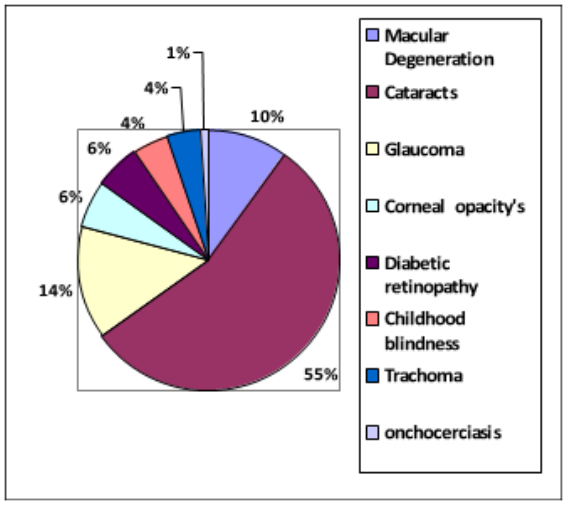

Figure 1. Chart of Percent of types of blindness

Blindness can be divided into several types [4]:

1. Partial blindness.
2. Blindness as a result of the incident.
3. Color blindness.
4. Psychological blindness.

Therefore, the prevalence of different types of blindness is difficult to assess because of the retinal differences between people this led to a lot of scientists to try to find different ways to solve this crisis. And this suffering as blindness varies by categories as mentioned some of them is suffering from blindness only in old age. Some of them is infected since the births and other are blind in addition to deafness and inability to listen even for high voices. Since the Industrial Revolution in Europe still people trying to find and solve this problem. Some of blind people hires someone to be his assistant and assist him in his movement. In addition to using stick to navigate or use trained dogs for this purpose.

Thus, it is do not hide the extent of the suffering blind face behind their inability to see or the suffering of people around them. Many of those who help people blind feel bothers with the blind people and their special needs. Therefore, they should be finding new style to help blind and rely on their self without resorting to other people [2].

III. HISTORY OF BLINDS AND STICK

Since ancient times, man used the stick and leaned on it. Also, it used by a blind person in avoiding obstacles while walking and movement. The evolution of the idea of the white cane. In 1921 the process of James Biggs, who was living in Bristol County, England stick to become a new form of white form, after he

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was blinded in an accident wiped his eyes.

He has to live with his new environment, and he was horrified passers-by from tankers steam around his home.

Aftly white cane, he pays attention to the tanker drivers, especially at night and were keen to help him. And it became more pronounced stick to them, and felt the difference is clear. Here the White cane idea was started [1].

In America 1930, George Lyon developed the shape to make the lower end of the stick red color to be distinctive.

In 1931 decrement way of walking stick taught and learned in France. Then this event was spread in British newspapers, which helped to spread the idea.

In May 1931 BBC radio, broadcast White cane code for each world who are, and must be used by all blind. After that most of the blind rehabilitation centers embraced the idea and learn how to walk out of a lot of blind people in the world [1].

IV. RELATED WORKS

Chun-Ming Tsai explains Shopping Card interactive. The idea of interactive card love (Love Card) is to integrate slice of identification using radio waves (RFID) in the electronic card attached to the neck of the blind, the reaction after this card with existing products in the market and to pronounce the name of a blind product and its price [5].

Hyun Ju Lee, Mun Suk Choi and Chung Sei Rhee are considered that Braille credit card ATM cards whether credit or other are non-usable by blind category. The proposed solutions work credit card points Braille prominent with built-in audio system, so that the blind case to make a purchase and when you pass the card to pay your amount withdrawn and introduced braille pronunciation [6].

Wang Guolu, Qiu Kaijin, Xu hai and Chen Yao explained that Phone screen for the Blind Can blind interaction with mobile phones panel dedicated in Braille touch called (B-Touch). This phone contains the advanced capabilities, such as the existence of a system of direct and reader of books and a system to identify the objects, and the touch screen is formed in Braille by the content displayed [7].

Nguyen, Kennedy, and Cornwall demonstrate that Color recognition audio voice is one of the problems facing the blind specifically in defining colors of objects. The touch alone is not enough to determine the color of the body, so the proposed technical solutions is a device (Bright-F), which specifies the color and depth and then translate them into spoken words [8].

Balachandran, Cecelja and Ptasinski were explained GPS for the blind. Perhaps the best technical developments in the field to help the blind was the launch of «GPS» navigation devices which you can see the blind site and notified acoustically close to the intersection and tell him about the restaurants or the nearby bus from sites. However, this technique cannot reach a high accuracy in determining the user's location, which is important for the Blind, where the closer the user to place about 3040 meters [9].

Chaurasia and Kavitha's paper was about electronic stick. And it is an electronic rod designed as a long white stick for exports are really offering a blind frequency ultrasound feel them under his hand when he hit a snag in a certain way. They are able to detect obstacles in all directions at a distance of five meters. The made parties to this stick of lead material [10].

V. HARDWARE REQUIREMENTS

Any system, application or device requires some of available equipment to work efficiently and properly, so that this system requires a selection equipment and taken into consideration that every part, which will provide to the system must be an occasion for the service to be useful and activity for the meant category [6].

System contains several tools, including Ultrasonic sensor which works as input data source, vibration motor which work as output reaction, microcontroller called Lilypad Arduino board that programming by C++ language, fabric gloves worn by the user and superconductor fibers which connect all hardware parts together [6].

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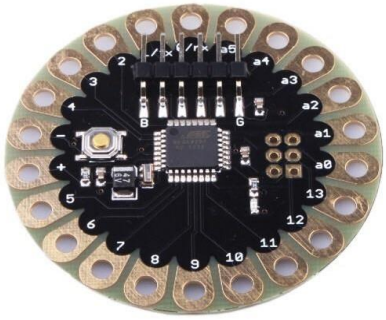

Figure 2 LilyPad Arduino Board

Figure.2 shows LilyPad Arduino Board. Arduino is an intelligent microcontroller, which can sense the environment around it by receiving inputs from various sensors then affects surroundings by controlling motors, lights and actuators [5].

It is an open-source board used to run electronic parts, it featuring with low cost as well as freedom Add electronic parts which connect with Arduino board through USB to connect it to a computer to program it by C++ programming language. Moreover, it can be linked with any other electronics part using electric Breadboard and has a port of power and needs a simple electrical energy can saved it by using normal batteries [7].

There are a lot of Arduino types that according vary to their functions and sizes, in blind gloves was selected Lilypad Arduino which featuring with small size, light weight and flat shape so that it can be stitched above the gloves.

Figure 3 Ultrasonic sensor

Ultrasonic sensor works on a principle similar to radar systems, it converts high that intuit objects presence and it distance from the sensor via generate high-frequency waves around it. Then compute the time taken between sending waves and receiving its echo, that shown in figure.3.

Ultrasound waves longer such as IR that reflecting on the surface of the body out, but considered it performance higher and better because of the optical dispersion. Ultrasound has the best collection of readers were proved effective in a lot of robots and sensors industries, as well as a weak negative impact on the human body comparing with the infrared. In addition, ultrasound can measure the distance and angles where it is reliable and gives precise results and the margin of error is negligible, so they are suitable for the Blind and Visually Impaired [5].

The controller is a single chip containing a simple processor performs inputs processing and issued it in the form of output through (CPU). It contains non-volatile memory to process the results received in it work as an act (RAM). In addition, it contains a Read Only Memory (ROM) of the input and output (I / O) to control the time and distance, which is designed to perform and to control certain system preprogrammed.

In this system, the input, which is here the waves it is processed and analyzed estimate the time. It takes to issue Special Sensor Microwave ultrasound, the distance traveled, the time and the extent of return echo waveform them to issue the results of the analysis in the controller to be sent to the e-vibration installed on the

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gloves [7].

Figure 4 the vibrator device of the project

Figure.4 shows Vibration motor. It is a small electronic device gives a simple vibration to alert blind people to objects presence around him to avoid the collision, it is work with 5 voltages.

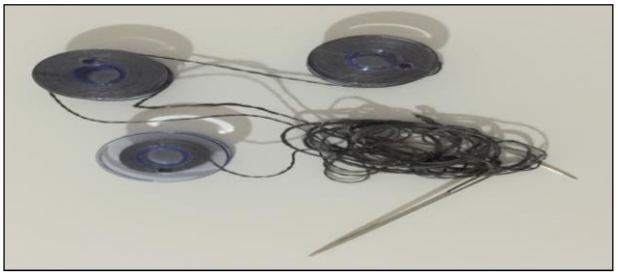

Figure 5 Electrically conductive wires

The connection between all hardware parts was be via simple electrically conductive wires (Fig.5) which sewing carefully above a fabric gloves.

Figure 6: Fabric gloves

All hardware parts are stitching and installing above fabric gloves that wore by users, it shown in Figure 6.

VI. IMPLEMENTATION

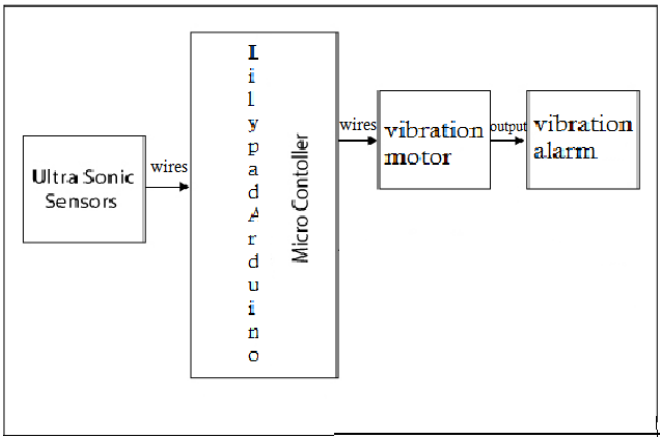

Figure 7. System Block diagram

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The project consists of right and left gloves worn by the user. To begin the gloves activity user, need to direct his hand to know if there were handicap objects around through feeling vibration from gloves. Gloves alarm when any object is on its side. In addition, it alarms when any object is in front of the user.

The work of electronic parts distributed in figure.7. Ultrasonic sensor works as input device which sends data of objects around to Lilypad Arduino microcontroller for processing and sentencing which respond should give Lilypad Arduino command vibration motor, which work as output device to respond through, gives vibration alarm.

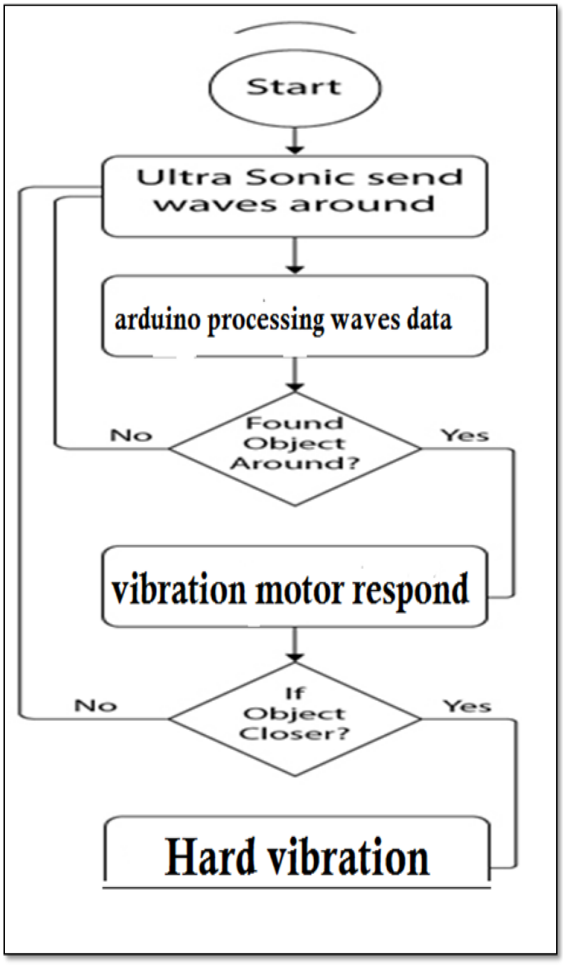

Figure 8 data flow diagram of the project

As shown in figure 8, the proposed device is divided into two main parts:

- Ultrasonic sensor (input device)
- Vibration motor (output device)

Ultrasonic sensor exports inputs data about objects distance around it to a Lilypad Arduino to process this data then commanding vibration motors to give output in form of vibration in accordance with programming of Lilypad Arduino.

As shown in Figure.8, Lilypad Arduino will give vibration motor order to alarm with continuous vibration when the object is close from the user. When the object keeps away “few” from the user, the Lilypad Arduino will give vibration motor order to alarm with intermittent vibration. When the object keeps away “more” from the user, the Lilypad Arduino will order a vibration motor to give not vibration. Ultrasonic will back to send waves to find objects. Then repeat the process [9].

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VII. RESULTS

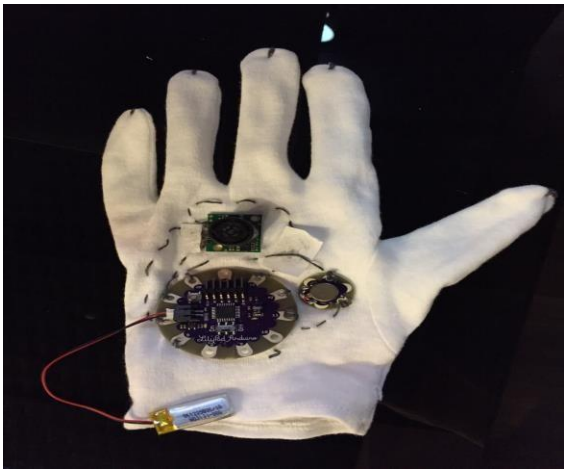

Figure 9. The gloves with the parts

Figure 9 shows the hardware parts that works out this proposed system implemented above the glove with the finally shape.

Many experiments dedicated to blind gloves was conducted to know the quality of performance expected of them. It has been tested on more than one way, to make the visually impaired more capable of dealing with the surrounding environment and negotiate with them properly. As mentioned earlier, the circles sensor gives information about objects surroundings and the environment around the user and alerting through vibration, where it made about the accuracy of 1 meter, from the user's real surrounding areas.

The overall result of the experiment gloves, came as follows:

i. The highest response was whenever it is closer to the object.

ii. Middle respond was found in middle distance from the object.

iii. No respond was found on far distance.

Table.1 contains numerical minutes of the experience on the gloves and it shows the results in cm unity:

Table 1: Test Results of the Gloves

Obstacle	Test
From 0 to 30 cm	Hard vibration
From 30 to 60 cm	Intermittently vibration
From 60 cm to 100 cm	Intermittently vibration
From 100 cm and up	Vibration not work

Befits of using the blinds gloves

Wearing blind glove can make the user feel more secure from of the difficult things facing him. The blind person walks without knowing what are the hidden risks in the next step? It may be a hole or ladder or wall in front of him, the gloves here have a significant role in securing the next step for him.

Also to feel blind person that he independent; he can go anywhere without waiting for someone facilities. That making him feel a degree of independence and self-reliance. On the other hand, it is easy to use and that because of the simplicity in its size.

In addition, it will be developing more models, which comes with the modern models.

VIII. CONCLUSION

This paper proposed Ultrasonic sensors gloves for blind people using Lilypad Arduino. That it is a solution for the visually impaired and those who do not wish to carry on his stick give them the instructions of places and surrounding objects. The blind will be able to move from side to side and from one place to another without the need to help others to learn about the highs and surrounding objects.

This system would be more setups sophisticated and assistant for the visually impaired around the world, and so high for his efficiency. In addition to the low-cost of manufacture it, and according to the accuracy of the sensor.

In spite of this, it is recommended to restructure the pieces added or commercial quality to its requirements to lead properly. In the future, some improvements will be improved to the system in order to meet approbation of users such as:

- Increasing other type of sensors as pulse and temperature sensors.
- Increasing navigation system and an internal memory to store all places and coordinates experienced by the user
- Adding automatic synchronization between the gloves and mobile phones to be identified on the site by a person other relative or theirs.
- Adding voice guidance property to make it easier to stay away from the process of risk if the vibration were unavailing.

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