Blind Man's Artificial EYE
An Innovative Idea to Help the Blind

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***Abstract*--This help's a visually challenged person to live like any other normal person on this planet without any personal guide. This device does not require any implant or surgery to enable vision, rather this is a piece of device that can be carried. Our nature has the answer for everything. This makes use the concept of echolocation used by bats.**

***Index Terms*- Microcontroller, Ultrasonic Sound Transmitter, Ultrasonic Sound Receiver, Doppler Effect.**

I. INTRODUCTION

Blindness

Blindness is the condition of lacking visual perception due to physiological or neurological factors. Various scales have been developed to describe the extent of vision loss and define blindness. Total blindness is the complete lack of form and visual light perception and is clinically recorded as NLP, an abbreviation for "no light perception". Blindness is frequently used to describe severe visual impairment with residual vision. Those described as having only light perception have no more sight than the ability to tell light from dark and the general direction of a light source.

Surviving as a blind is one of the most challenging issues on this planet. Vision is known to be the most important of five human senses. Not everyone is blessed with all five senses functioning normally. Few of them are born blind, dumb, deaf or even with abnormal limbs. And as a human it's our duty to help the society and make it a happier place to live in.

Bat's Echolocation

Our holy mother nature has an answer to every single problem that we face in everyday life. Similarly our nature has an answer to help the blind too. We all know the bats are blind and they sense objects using echolocation. This device has an answer to help the blind and ensures betterment of life.

II. PROPOSED WORK

Several components are used in developing this device so called the blind man's eye such as ultrasonic sound emitter, ultrasonic sound receiver, microcontroller, camera and a steel rod. The device is built using the architecture shown below in figure 1.0.

The ultrasonic sound emitter is used to emit sounds and the receiver to receive the incoming sounds. A microcontroller is used to manage and give timely signals. A small pinhole camera is used to capture the image and later the image is processed by the microcontroller using image processing techniques. The steel wand is used to calibrate the bent angle of the neck so as to produce the accurate result.

The circuit has an ultrasonic sound transmitter and receiver, a microcontroller (µc), ear phone, a camera, a simple goggles, 2 simple cylindrical steel rods and a cylindrical connector. The edge of the goggles is connected with collar bone of the person with the help of rods and cylinder to calculate the bent angle of head. Using the angles we can ignore the road as an obstacle unless µc finds ±4cms elevation or depression. The µc is programmed in such a way that it keeps emitting ultrasonic sounds, once it receives the ultrasonic sounds, it detects the objects close by and alerts the person wearing the earphones. It is also programed to detect objects and recognizing objects using camera, with the help of OpenCV package. People owning android are also given an app that will sms to 3 trusted contacts every 15min about the current latitude and longitude of the blind person.

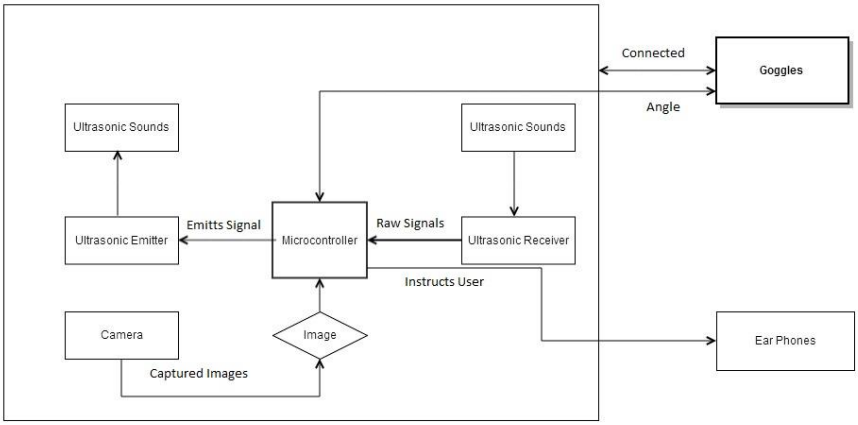

Figure 1.0- Architecture of the system

This fully makes use of the echolocation principle viz send the ultrasonic wave, analyses the time taken to reflect back by the object to determine the distance & direction to take corrective action (like changing the speed or direction)

Once the object is sensed, there are lots of challenges in understanding various aspects of the object, like:

1. Size of the object
2. Is it a static or moving object
3. If it is a moving object, is it moving closer to person or away from the person
4. What is the speed of the object
5. Trying to identify if there is a ditch
6. Adjusting the vision/sensing automatically when the person walking either looking down or keeping his head straight so that road is not treated as an object.

The above challenges can be solved using several techniques. To sense the size of the object, the intensity of returned ultrasonic wave is used- Higher the intensity bigger the object & vice versa. Using Doppler's Effect the objects speed, direction and motion (towards or away) of the object can be determined. Making use of angle detection technique the µc can determine if the person is walking looking down or keeping his head straight.

Dijkstra's algorithm is used to find the shortest path in order to direct the blind user from the current path. The Doppler's effect can be implemented as an algorithm to find the relative motion of the objects, towards or away from the user. This can help the µc decide upon which instruction to be given to the blind user.

For example, When a blind person is walking straight between 2 walls on both the sides (assumption).The device keeps emitting ultrasonic sounds. No sooner does the device encounters the reflected waves back the µc will make use of the Dijkstra's algorithm to calculate the shortest path between the two different walls, and then instructs the person wearing earphone to move converse to the result obtained(since we all know that Dijkstra's algorithm gives the shortest path as the result). Using the Doppler's effect the µc decides which direction the object is heading towards. The value obtained from the Doppler's effect can be vital because, if the object is moving towards the person is quick, the time to react will be far to less, therefore at that particular moment a beep from the earphone to the blind will be helpful than "A car is approaching you at 25 kmph.You are now instructed to move to your left" for instance say one beep is to indicate to move to his left and two beep to move to his right.

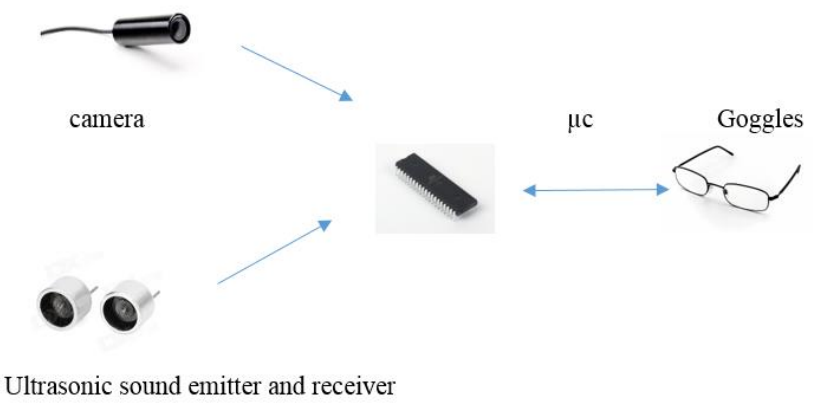

Figure 1.1-Pictorial Representation of the system

The Blind man's eye can not only detect objects but also recognize the objects since it has a camera and an image processing system embedded with it. Blind man's eye is quite affordable by everyone since the components used in the device are fairly cheap. It is cheap since this device does not require any surgical operation to be done on the human body or eye. The device is quite handy and portable with a great ease. Due to absence of surgery the effect of the device on human body is absolute zero. The ultrasonic sounds does not interfere with the normal sounds since the frequency of ultrasonic sounds are far too less compared to the audible rage of human ear which is 20Hz to 20,000Hz. Since the cost of the device is very less, even the government is capable of providing this device at a free or low cost. Since the device is omnidirectional, it can detect all the obstacles in different dimensions.

V. CONCLUSION

If there is any mechanism in this world which could help a visually challenged person to be Independent, then this would be one of the best inventions ever made by the mankind. In that way, this device will be boon to the visually challenged people. Since it is affordable and due to the absence of any kind of implant to the body, it makes the device risk free, and it could be used without any fear of damage caused to the body. We also hope to improvise on the system and make it much more feasible and stable in the near future. Hopefully this device can be a bench mark for most other devices yet to come in the future.

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