Bangladesh University of Engineering and Technology

Dept. of Electrical and Electronic Engineering

SECTION C1

Course No: EEE 310

Project Name: Smart Cap for Blind

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Abstract:

Eye is the greatest gift gifted to mankind by God. Those who don't have this of pair of eyes they face a great many problems in their casual life. Therefor in this project we develop a device to minimize their struggles.

Introduction:

In this project we use array of sonar sensor as the eye of the user. A comfortable structure made with cap was used. Normally people without eyes are using stick for their daily life. Usually, to work outdoor, the blind people face difficulties. Therefore, many of them use a guide cane as cheap and helpful to them. This purely mechanical device is usually used to detect the surface of the ground, obstacle in front, holes, staircase and many more. A guide cane is so economical and light that it can be folded and can be brought to any places without any difficulty. However, a guide cane must be used many times in order for the user to detect any change to the ground or to avoid obstacle. Therefore, only trained users will be able to use the guide cane defiantly. Besides that, blind person needs to scan the walking area continuously while walking. Another drawback is that a guide cane cannot detect any obstacle within the range of two to three metres and can only detect an object when it has a contact with it. If there is no contact, the user will eventually bump to it. Electric assistive technologies (EATs) provide the blind people spatial information about the environment in assisting for navigation. Early technology uses ultrasonic to detect the obstacles. Later, due to the developments in high speed computer and sensors, the efforts are directed to develop sophisticated and more intelligent ETAs. Most of the early ETAs were used ultrasonic and sonar sensors for obstacle detection. The technology used is relatively inexpensive; ultrasound emitters and detectors are quite

small and they can easily be mounted without the need for more complex and costly additional circuitry. With the advanced development of the high sensitive sensors and computing devices, the research had been focused to new directions. Even though the complete performance satisfaction is not achieved, the inventers were able to tackle the limitation of the early ETAs (Ifukube et al., 1991). Few sonic sensors are attached on normal eyeglasses, and their data, using a microprocessor and A/D converter, are down converted to a stereo audible sound, and headphones are being used to get feedback signal. Borenstein and co-workers developed Navbelt at University of Michigan (Shoval, 1993, 1994; Borenstein and Koren, 1985, 1988; Borenstein and Ulrich, 1997; Ulrich and Borenstein, 2001) as a guidance system, using a mobile robot obstacle avoidance system. Another patented device, the taking cane, has the ability to give speech output (Lofving, 1998; Hsieh, 1992). Smart shoe can detect an object a metre away by using an infrared sensor located on the shoe (Castle, 2003). Meijer started a project having the basic argument that human hearing system is quite capable of learning to process and interpret extremely complicated and rapidly changing sound patterns (Meijer, 1992). Sonic Eye works with the concept of mapping of image to sound (Reid, 1998). Kamel and Roth developed a GUESS system (graphics and user's exploration via simple Sonics) that provides interrelational representation of objects in a nonvisual environment. Sainarayanan from University Malaysia Sabah developed an ETA to assist blind people for obstacle identification during navigation, by identifying objects that are in front of them (Sainarayanan, 2002). Similar robotic recognition related research has been done. Zhao et al. (2010) presents a new method for mobile robots to recognise scenes with the use of a single camera and natural landmarks.

Apparatus:

- Cap
- Arduino mega
- Ultrasonic sensor
- Connecting wires
- MPU-6050(gyroscope)
- Breadboard
- Buzzer
- Earphone
- Capacitor
- Inductor
- Resistor
- Potentiometer
- Led

Problem statement:

This paper addresses how to overcome those raised issues and propose an alternative cap-for-blind with design analysis, experimental analysis and implementation analysis. To assist blind person, correct technology could be used to overcome of the mentioned issues. Some of the technological achievements are already available in the market like laser cane, Mowat sensor, talking sings, sonar system and so on. However, each of them possesses some drawback. In an unfamiliar environment, a mobile robot uses sensors in order to avoid any obstacle. The technology can be used for a blind person to walk safely and reduce the danger when walking without a guide cane. When multiple sensors are installed on the blind person, they do not need to scan their area to walk in front. The transfer of mobile robot technology is actually a new development in order to help this type of community. In the past, robots have been used to aid the blind person to walk. But this new technology assists the user to walk without having any difficulty. It is more economical to apply the technology directly to the person rather than buying a complicated robot. In this case, it becomes difficult to mimic nature in its entirety of human vision system. Having with modern technology, the walking support systems for blind are still not sophisticated in terms of mobility, safety and cost; this problems lead to motivation of designing a prototype of smart walking support system for visually impaired people. A belt for blind is proposed, developed, tested and implemented for visually impaired people. Appropriate design parameters are identified accordingly. The walking support system will help the blind user to avoid obstacles in the way of his destination.

1 Ultrasonic sensor

Ultrasonic sensor is a sensor which is used to measure the distance using the ultrasonic wave. It has two main part named trigger and echo. Function of trigger is to send a ultrasonic wave synchronizing the signal given through Arduino. And function of echo is to receive the reflected signal which is sent by trigger. The main function of ultrasonic sensor is to measure the distance. So for measuring distance it first measure the time when echo received the reflected signal. We use a built in function at Arduino named pulseIn to measure the time. Then we convert the time to distance using formula given below:

$$\text{Distance} = \frac{time \times speed\ of\ light}{2}$$

2 MPU-6050:

The cap which we used for our project isn't work for each and every angle so we made sure the angle of our cap is in position using gyroscope or MPU-6050. This device gives relative value of three axis to give the three dimensional position of the cap. But we don't use the three dimensional quantitative value. We rather convert the axis value to angle value to make sure all sonar sensor are in position. Since our main appliance in this experiment is sonar sensor, so it is important if all sonar sensor in position or not. Because if sonar sensor are not in position then they gives erotic result that causes lower the accuracy of the cap.

3 Earphone (single ear):

To give the proper signal to the blind we use sound system using earphone. If sonar can detect a hole in front of user, then Arduino send specific sound signal to the user using earphone. And if user faces an obstacle then Arduino will send another specific sound signal to the user. Here we use one ear system. Because blind people use ear to sense the environment as they don't have the eye. We differentiated the sound signal for different situation. Like we send one type of signal for deeper place, and another type of signal for obstacle in front of the blind. And we also added sound system for the situation when cap is not in desired angle as well as array of sonar sensors is not in desired angle.

So, using our designed when blind faces obstacle then they hear a specific sound

signal and when they faces deeper place then they hear another specific sound signal and another specific sound when angle of cap is not in our desired angle. In our project we use a buzzer to differentiate the sound signal. Moreover we use built in function named analogWrite in Arduino code to differentiate sound signal using frequency of bits.

4 Amplifier:

Sound system can not be heard using our typical earphone. So we used an amplifier to amplify the sound signal to make the sound signal hearable. We used LM386 IC circuit to amplify the sound signal. We used a potentiometer within which volume of sound can be controlled.

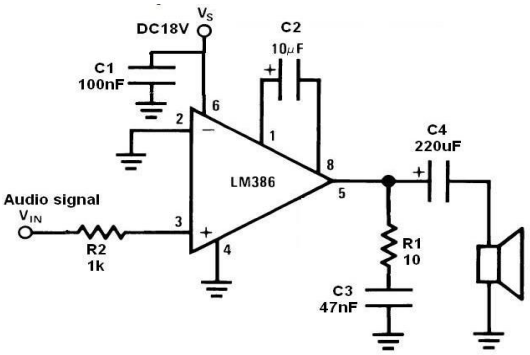


Fig: amplifier circut

Design guidelines:

In the design process of the experimental setup it is assumed that the setup should be very similar to the prototype of the walking support system as demanded by the blind people, so that after finalising strategy of identifying obstacles it can be converted into the prototype of the system. The walking support system, was designed following their guide lines that are listed below:

- cost: affordable
- size and weight: less than 300 gm
- capability: able to detect hole, drop off, etc.
- user friendly: easy to learn the system
- comfort: does not need much change of current practice
- hands free: requires less involvement of hands
- adaptable to all types of blind people(blind by birth, blind due to age or accident).

National Society of the Blind and Partially Sighted (NSBP) Bangladesh's guidelines are also taken into consideration in the design process. Their guide lines are listed below:

1. Detection of obstacles in the travel path from ground level to head height for the full body width

2. Travel surface information including textures and discontinuities

3. Detection of objects bordering the travel path for shore lining and projection

4. Distant object and cardinal direction information for projection of a straight line

5. Landmark location and identification of information

6. Information enabling self-familiarization and mental mapping of an environment

7. In addition: ergonomic, operate with minimal interface with natural sensory channels, single unit, reliable, user choice of auditory or tactile modalities, durable, easily repairable, robust, low power and cosmetically accepted.

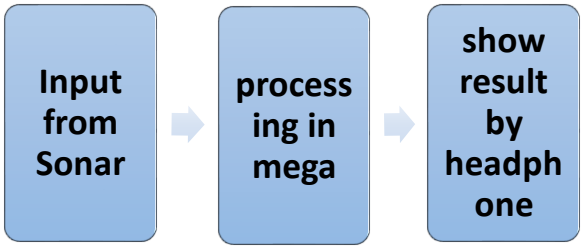
We had some limitations. So we could not cover all kinds of requirements. We need more time to develop the design & we will work further on it.

Implementation

The ultrasonic sensor detects objects by emitting a short ultrasonic burst and then 'listening' for the echo. By using microcontroller, an input is given to the ultrasonic by using a trigger pulse. The ultrasonic sensor emits a short 40 kHz ultrasonic burst. This burst travels through the air at approximately 344 ms-1, hits an object and then bounces back to the sensor. The ultrasonic sensor provides an output pulse to the microcontroller that will determine when the echo is detected; hence the width of this pulse corresponds twice the distance to the target. We have used 5 sonar sensors. 3 sonars for detecting objects of our height. We have used 3 sensors in 3 directions, one in straight front, one slightly right & another slightly left from the straight front for detecting objects of left & right sides. By these if a man comes from front side or a thing of our height & greater than our height can be detected. In roads there may be many types of obstacle whose height is less than ours such as dogs, cats etc. and also small bags are also seen put on the road. So overall in roads there can be obstacles of smaller height. For this we have used another sonar. There can be found manhole & many holes in the road. These must be detected andso we have used another sonar sensor.

We have used a gyroscope to control the rotation of angle of cap. Sonar has many types of limitation. Sonar performs it's best in specific angle. We need to limit the angle. For the first 3 sonars we need to set the cap such that it detect the front obstacles. Else the ray will go infinity and we won't be able to detect object. For the sonar we used for smaller distance need to be within specific angle. From experiment we have noticed that if the angle is greater than 30 degree than the result shows error. So to control the angle of cap we have used a gyroscope.

Our overall process was:



Input:

It was easy part. We have set up 5 sonar sensors & it takes input by the process of measuring the distance. How it measures distance was given before. So in 5 sonars we took 5 distances as input.

Processing:

In the Arduino Mega we have took input from 5 sonars. Then we set up the logic when to give warning in the earphone.

The sonars we set up for our heighted obstacle's, we set the distance 200 cm. If the measurement shows that the distance is less than 200 cm, that means that there is an object within 200 cm straight from ours & we will show warning in the output.

The sonar we set up for small height obstacle, we set the distance 210cm. This 210 cm is dependent on the blind man's height. As we set up the sonar at (90-30)=60 degree from the cap axis the height showing for normal plane is around 195/205 cm as we took the blind man's height 160cm taken as average. It's according to Pythagoras's Law. If the distance shown here is less than 210 cm, it means that there is a small object which was not detected in other 3 sonars because of height & we will then send the result as output.

The sonar we set up for detecting holes, we set the distance 180 cm. As we set the reference as 160 cm height & the angle for the sonar was (90-15)=75 degree from the cap axis & it showed around 170/180 cm distance from plane ground. If there is a manhole or some kind of holes then the ray must travel more distance then usual & it will show more distance than 180 cm. By which the will understand that there is a manhole in front & we will send it as output. And also if there is distance less than 160cm, we will understand than there is an object of low heighted.

Output:

We have 3 kinds of sound as output. One for maintaining the angle. If the angle is very low or very large then the result may show false value which is not expected. And also we set up the condition for sonars will not work. So we fixed up the angle between -5 & +25 degree. If the result is not in region it will hear a sound.

One type of sound for front our heighted obstacles which is controlled by 3 sonars. Last one for small heighted sonars which is measured from last 2 sonars and also it shows the result if there is any kind of manhole.

Result:

For working procedure the angle must be between -5 & 25 degree, so if the angle not in range we will hear u a sound to reset the system in particular angle range. If there is any kinds of large heighted object (man, tree etc.) within 200cm, we

will hear a sound. If there is any types of object of small heighted within 50 cm, we will get noticed by earphone. At last if we have manhole within 30 cm front we will get noticed.

Benefits of using the blinds cap:

Wearing blind cap 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 caps 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 develop more models, which comes with the modern models.

Conclusions:

The cap for blind system developed through this research aids visually impaired peoples navigate smoother in outdoor. A new walking support system for the visually impaired people, as per the definition of visually impaired provided earlier where the term blindness refers to people who have no sight at all as well as to those considered as blind have limited vision, was proposed, and the objectives of designing this walking aids for blind are fulfilled. 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 caps and mobile phones to be identified on the site by a person other relatives or theirs.

Adding voice guidance property to make it easier to understand which type of obstacle is present.