TRACK MANAGER FOR VISUALLY IMPAIRED PERSONS

Devika.R[1], Karthikkumar.S[2], R.Ramprakash[3], Dhivya.R[4]

[1,4]P.G. Student, ME Embedded System Technologies- EEE Dept
Angel College of Engineering and Technology/ Tamil Nadu (India)
[2,3] Assistant Professor, Department of Electrical and Electronics Engineering
Angel College of Engineering and Technology/ Tamil Nadu (India)

ABSTRACT

This paper describes an efficient methodology for aidingthe blind and the visually impaired in their navigation. Track manager is basically a pair of shoes along with a remote control, eyeglass, glove, Voice synthesizer, and Speaker or an ear phone. It works in two modes in a domestic environment respectively for both indoor and outdoor navigations. a) Track recorder mode helps in indoor navigation in which the track manager records the track initially and guides the blind from the next time with voice output. Recording tracks involves 2 parameters: number of steps taken and the direction. The number of steps is calculated with the help of a footswitch and the latter is found using a digital compass. These devices are connected to the microcontroller fitted in the shoes. b) GPS mode which helps the user to find the current location of blind persons and it guides reach the destination according to the input given by the user. & this system employs an obstacle detection unit using ultrasonic sensors. Sensing unit involves detecting the obstacles like pit, temperature, water and ground level objects and overhanging obstacles. Piezoelectric charger is used to charge the battery. Moreover this system will be used for both born blind and deaf people. For that vibration motors used to feel real sense about the path information.

Keywords: Eyeglass, GPS, Piezoelectric Charger, Sensor Shoes with Microcontroller, Sense of Feel, Ultrasonic Sensor, Visually Impaired, Voice Synthesizer.

I INTRODUCTION

The development and application of technology for orientation and mobility has a long history covering the post-war period. Although some early endeavors envisaged systems that might replace the cane or dog guide, more recent efforts have focused on devices and systems designed to supplement and provide a support for these basic mobility tools.

Mobility aids like walking stick and guide dogs are still used by the blind even today .With the advancement of technology, some different types of electronic travel aid have been developed to support the mobility of the blind. Most of the commonly used electronic travel aids use ultrasound. All such devices use the principle of reflection of the high frequency ultrasonic beam, and are available in different models. The most widely used primary mobility aid today is the long cane or a walking stick. Various types of canes have already been developed to aid the blind solve many problems for a navigation like white cane [1], smart cane[2], laser

cane[3]. This has several limitations such as a range limited to the length of the cane, typically one pace ahead of the user, difficulties detecting overhanging obstacles, and difficulties storing in public places. But all systems are focused on one particular problem and require the blind to carry a device along, difficulty in using, training the blind first to understand the outputs and give inputs. WICON [4] is a sensor based shoe that helps the blind person in obstacle detection only. But it does not help them face all their navigation problems. But there is no system so far that integrates the solution to all their problems, wherever they go, considering their ease to handle it.Long white cane is the traditional mobility tool used to detect obstacles in the path of blind person. On the other hand guide dogs are assistant dogs which are trained to lead visually impaired around obstacles. Mostly the technology advances interested in ETAs which are more specially used in obstacle detection systems, not emphasizing in GPS features.

ETAs can also categorize depending on how the information is gathered from the environment and depending on how this information is given to user. Information can be gathered with sonars, laser scanners, or cameras and the user can be informed through auditory and/or tactile sense. ETAs offer user free- hands since they are wearable but some others do not since the user is required to hold them.The most important factors, which enable blind users to accept these readily, are portability, low cost, and simplicity of controls. Hence, ETA device should be small in size and lightweight for portability. Since a blind person is not able to see the display panel or control buttons, the device should be easily controllable. The ETA device should be of low –cost so as to be affordable by a common man. Some of these ETA devices are vOICE, NAVI, Navbelt, Echolocation, etc which produce output as audio feedback, whereas Guide cane, Tactile Handle, Tactile Vision System (TVS) which produce output as tactile feedback. Mostly the indoor application uses Radio Frequency Identification Tag (RFID) method for blind navigation [3].

Track manager integrates different technologies and guides the visually impaired in all aspects wherever they go, be it their house or a hotel. The main advantage of track manager is that the person need not carry a cane or any such tool or device along. He can just wear the shoes just like others and a small earphone and microphone. Carrying a small remote control which is just like a mobile will surely not be an additional burden like carrying a big cane along.

This system presents a concept to provide a smart electronic aid for blind people. The system is intended to provide overall measures artificial vision and object detection, real time assistance via global positioning system (GPS). The aim of the overall system is to provide a low cost and efficient navigation aid for blind which gives a sense of artificial vision by providing information about the environmental scenario of objects around them.

In this system embedded system plays a major role. In this system we are using the Ultrasonic sensor, Pit sensor, Water sensor, GPS receiver, level convertor, Driver, Vibrator, Voice synthesizer, Keypad, speaker or headphone, Embedded system and Battery.

Ultrasonic sensors works on a principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. That signal is send to

the embedded systems. Pit sensor is used to analysis any dent or pit present in the path and this signal is also given to the embedded system and water sensor is used to sense any water present in the path. And this signal is also given to the embedded system.

GPS receiver is used to track the position of the human and given to the level converter; the level converter is used to change the logic of the signal from the GPS receiver which is acceptable by the embedded system. By using the keypad we can set the position of the destination and the voice synthesizer and speaker is used to produce the voice if the human goes out of the desired path Battery present in the system is used to give power to all the units present in the system.

II. DESCRIPTION

The system consists of a pair of shoes, eyeglass, ear phone and a small remote control with an alphanumeric key pad, vibration motors with gloves.

This system works in following modes.

2.1 Track Recorder Mode

To record the track for the first time the visually impaired should take the help of someone. Track manager shoes must be worn and a starting point must be chosen in the house from which the other destination tracks are recorded. For the first time the person should press the record key standing in the starting point. The system will ask him the name of the starting point and name of the track or the destination and the user records it with his/her voice or with a voice he can easily comprehend. The user also assigns a unique number to the track he records and can refer to this track later by typing out this number in the number pad.

For example say the starting point is bedroom and the destination to be recorded is kitchen, the person should give an input “bedroom; kitchen” and start walking from bedroom to kitchen. The track gets recorded and the 2 parameters get recorded: The number of steps moved and the direction in which the person has moved gets recorded. Once all the tracks in the house are recorded track manager is ready for use.

The blind can use it without anybody’s help from the next time just by pressing keys in the remote and giving inputs. He’ll be guided with recorded voice output as to how he must move, in order to reach the destination. The user can store the tracks for different houses (e.g. his relatives’, residences at different cities). This will also help the person to adapt to a new environment easily. Obstacle found in the recorded track will also be detected and it will be intimated. This system employe only in indoor navigation so for outdoor navigation we are going to GPS mode.

2.2 GPS Mode

The GPS based blind device with user input interfacing get alert the blind person when reaches destination by voice .It consists of microcontroller and GPS and one voice module to generate the voice.pic The Micro controller is the heart of the device. It stores the data of the current location which it receives from the GPS system. So that it can make use of the data stored to compare with the destination location of the user. By this it can trace out the distance from the destination and produce an alarm to alert the user in advance.

The Global Positioning System (GPS) is a U.S. space-based radio navigation system that provides reliable

positioning, navigation, and timing services to civilian users on a continuous worldwide basis -- freely available to all. For anyone with a GPS receiver, the system will provide location with time. GPS provides accurate location and time information for an unlimited number of people in all weather, day and night, anywhere in the world. The accurate timing provided by GPS facilitates everyday activities such as banking, mobile phone operations, and even the control of power grids. Farmers, surveyors, geologists and countless others perform their work more efficiently, safely, economically, and accurately using the free and open GPS signals.

2.3 Sensor Unit

It involves in the detection of overhanging obstacles and ground level obstacles like pit, wall, water and temperature, etc. Ultrasonic sensor is located at the shoe used to detect the ground level obstacles. And overhanging obstacles detected by using the ultrasonic sensor located at the sides of eyeglass at the angle 15 deg above the head.The sensor detects the overhanging obstacles up to 6m. When the obstacle is detected the sensor sends the information to the controller.

Pit sensor used to inform the person about the pit found in their path. Water indication sensor sensing water in their path and conveying information to the user. Temperature sensor senses the changes of temperature such as fire, etc in their environment.

The vibration motors are also attached to fingers of the users with different modes of vibration according to the obstacles detected in both methods. The obtained information is informed to user as audio messages and also as vibration for the users. It will be used for both born blind and deaf people.

III. TECHNICAL DESCRIPTION

In this section, the components of the proposed navigation aid are described in some detail.

3.1 Microcontroller system

The microcontroller is the brain and the main hub of the Track manager. Either PIC or ATMEGA microcontrollers can be used for our purposes. The main code is loaded onto the chip's memory. It will have access to external memory where the various sound tracks are stored.

The functions of the microcontroller will be getting inputs from various input devices, process the information according to the program and control the output devices accordingly. The functioning of the Track manager depends mainly on the program burnt in the microcontroller. The chip has enough main-memory and sufficient number of input/output pins. The algorithms / pseudo-codes for different purposes are given in the appropriate sections.

3.2 Foot Switch

The footswitch is placed at the bottom of both the shoes. We call the switch to be in ON state if it is pressed condition i.e. foot on the floor and OFF otherwise. The purpose of the footswitches is to count the number of steps.

3.3 Remote Control

Remote control is an input device that takes in the input from the user and sends it to the microcontroller. Remote consists of a RF circuit that will convert the button input into suitable RF modulation shown in Fig 1. It will be demodulated in the shoes and the signal will be sent to the microcontroller. Then the micro controller

will take the action accordingly. The keypad switches enable the user to select routes and to enter decision. These keys are of different shapes for easy recognition and to easily differentiate between the keys by touching. The remote control has keys of different shapes for easy identification and to avoid confusion. On pressing each key the system intimates the blind as to what key he has pressed.

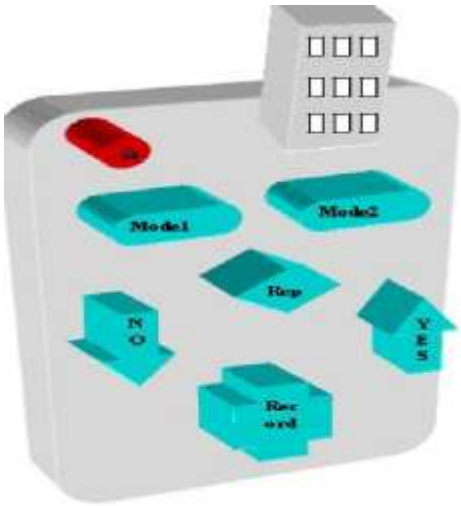

Fig 1. Remote control

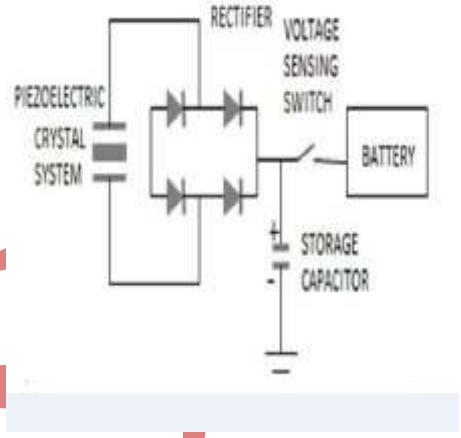

Fig 5. Circuit of Piezoelectric Charger

3.4 Speech simulator

The speech simulator device is used to generate audio output. The device is provided with sufficient digital storage capability to store a few minutes of high quality, audio record and playback functionality. The speech simulator is activated by output pins of the microcontroller. The output includes the instructions to be given to the user (e.g. right turn, left turn) and the options given to the user (e.g. list of locations). The list of instructions comes by default by the list of locations, which are numbered for convenient reference, are to be recorded by the user while the track to that location is being recorded. The remote control and the speech simulator will together act as the input and output devices.

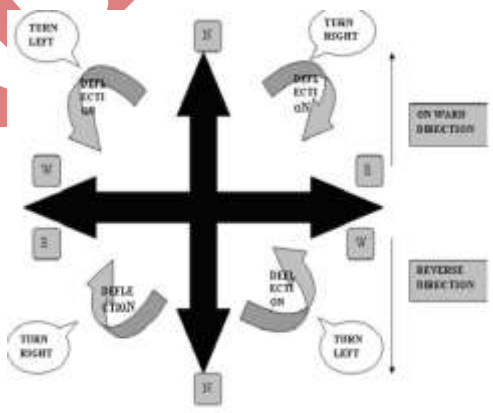

Fig 2. Manipulation of direction in Digital compass

3.5 Digital Compass

The digital compass is used to find out the direction in which the user walks and gives input to the micro-controller which makes the decision regarding which side to turn. Digital Compass Navigation PC Board can be used for this purpose. The manipulation of direction shown in Fig 2.The 1490 digital compass manufactured by Robson Company can be used on the PC board. This sensor is a solid-state Hall Effect device. It is sensitive enough to detect the Earth's weak magnetic field. So, when the user turns around, the compass can find out in which direction he/she is facing and signals the micro-controller. The microcontroller then computes the path to be taken, given a destination, breaks it into smaller instructions and guides the user.

3.6 Wireless communications

We have three distinct units in track manager that need to communicate with each other: the two shoes and the remote control. The earphones are connected to the remote control through a pair of wires. Each of these units has a wireless transmitter and receiver circuit in it. Each of them communicates with the left shoe where the microcontroller will be situated.

3.7 Ultrasonic Sensors

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

3.8 Piezoelectric charger

A quartz crystal is a piezoelectric material that can generate a voltage proportional to the stress applied upon it. For the application, a natural quartz crystal has to be cut in the shape of a thin plate of rectangular or oval shape of uniform thickness. The main principle of a piezoelectric transducer is that a force, when applied on the quartz crystal, produces electric charges on the crystal surface. The charge thus produced can be called as piezoelectricity. The generation of piezoelectricity flow is shown in Fig 3.

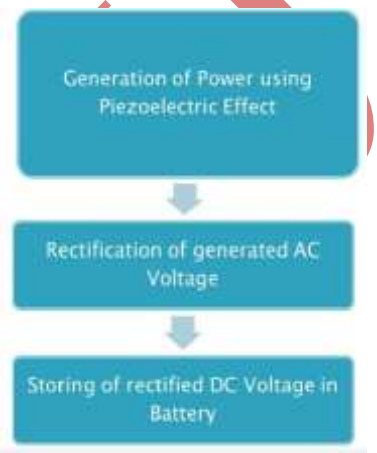

Fig 3.Working of Piezoelectricity.

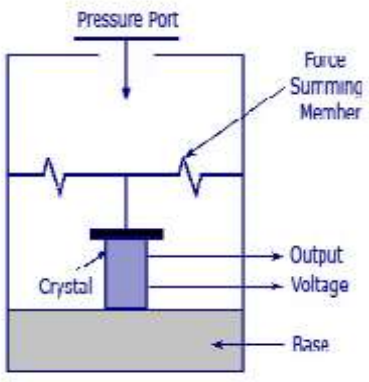

Fig 4.Piezoelectric effect.

Piezoelectricity can be defined as the electrical polarization produced by mechanical strain on certain class of crystals. The rate of charge produced will be proportional to the rate of change of force applied as input. As the charge produced is very small, a charge amplifier is needed so as to produce an output voltage big enough to be measured.

The Piezoelectric Charger is located at the top of the shoe. When the person walks due to piezoelectric effect charge is produced and Stored in the battery. The voltage generated by the piezoelectric crystal is AC voltage. This AC voltage can be rectified as DC voltage and Stored in battery. The Circuit for generating voltage shown in fig 5.

3.9 Software requirements

Basically PROTEUS is also a simulating software but it helps you attach many components with the 8051. Like resistors, capacitors, LEDs, LCDs, keypads, ICs etc. and these are just few that I have named in general. It has a complete library and you will find everything that you will ever need. You can design your complete circuit and then simulate it to view the final output. This means that after perfecting your project on the programming side in KEIL, you'll need to simulate it on PROTEUS to determine the output of the hardware PROTEUS is designed to be user-friendly and you will get the hold of it instantly. There is no need to worry about some complex configuration / settings prior to simulation. Here are the basic steps.

- Place your components from the library
- Connect them accordingly
- Load HEX file (if 8051 is involved)
- Simulate the circuit

IV. WORKING PRINCIPLE

Apart from the visible components the system consists of a microcontroller, a foot switch, four ultrasonic sensors and digital compass. The interconnection between different units are shown in Fig. 3

4.1 Track Recorder Mode

The tracks are recorded based on two parameters: the number of steps in each direction and direction itself. There is a switch attached to the bottom of the left shoe, connected to the microcontroller, which is fixed to the bottom of the left leg. Each time the leg is pressed down while walking the foot switch turns ON and when leg is lifted it is turned OFF. The number of steps taken in each direction stored in the memory of the micro controller. The direction is recorded with the help of a digital compass connected to the microcontroller.

This mode is further divided into two modes: tracks and sub-tracks. Tracks represent routes from door to door and sub-track includes the detailing within the room like fridge, sofa, etc. When record key is pressed, the person is asked to name the route and he walks through the route. The number of steps he moves straight along with the distance is store and the compass helps in deciding, as to which direction he has turned, right or left.

Each track is named with the starting point and ending point.

Few new tracks can be recorded by the system by manipulating existing tracks. For example bedroom is chosen

as overall source and we need to move from study room to dining hall. Study room to dining hall is not a pre-recorded track. The two pre recorded tracks involved are source to study room and source to dining hall. The manipulation of the number of steps and direction is automatically done by the system with the help of simple logic involving the pre-recorded tracks.

4.2 GPS Mode

GPS mode is for outdoor navigations only because it does not work inside the buildings. PS receiver is used for understanding the current location of the subjects and nearby landmarks.GPS based blind device is interfaced with the microcontroller and it records the current location of the user.

So that it can make use of the current location data it guides the user to the destination and it produce voice output when reaches the destination.

V. PROPOSED SYSTEM

Nowadays the blind peoples surviving in this world is too difficult. So we design this project for helping the blind peoples. This project contains PIR, ultrasonic sensor, step sensor, digital compass, microcontroller, keypad, display, voice synthesizer, mode switch, GPS, Piezoelectric charger, speaker and battery. The proposed block diagram is shown in Fig 7.

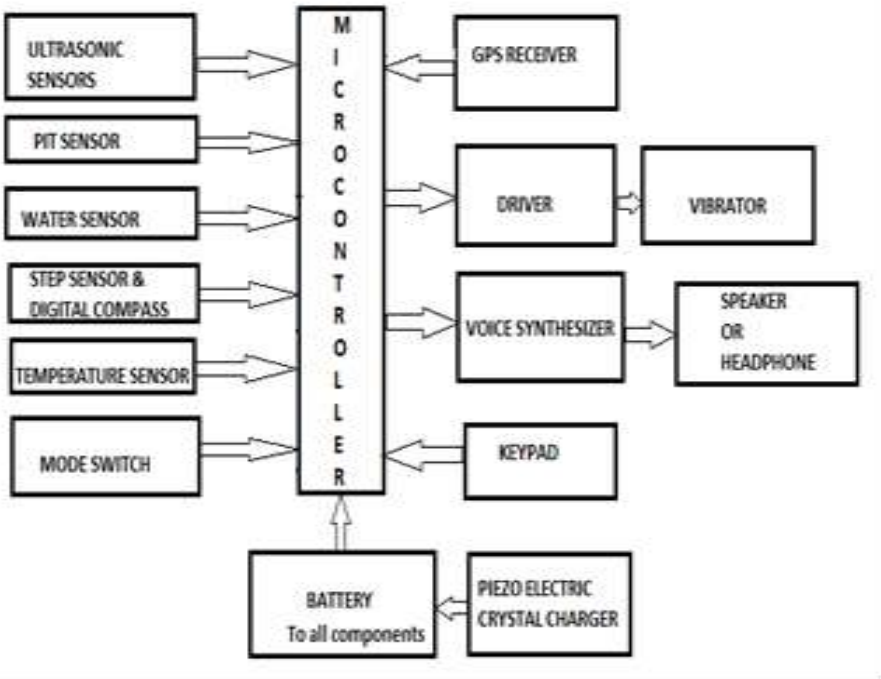

Fig 7.Block Diagram of the proposed system.

PIR (Passive Infra Red) and ultrasonic sensors is used to detect the obstacles. The step sensor is measure the steps, digital compass is device which is used to show the direction. Keypad and mode switches are used to enter the details and select whether the program mode or track mode. In the program mode the user walking direction and the step count has been stored in microcontroller. In the track mode the stored data's are retrieved. Display is used to show details of the user side. The voice synthesizer is used to store the voices and retrieve it

from the microcontroller signal. And these voices played through the speaker or headphone. The battery unit is used to give the essential power to the components. The ultrasonic spectacles shown in Fig 8.

Fig 8.Ultrasonic sensor with eyeglass

Fig 9. AT89S52 and APR600 interface circuit

Whenever the program mode is selected, the step sensor sense, how many steps walked by the user and at the same time digital compass give the direction of the user, these two data's are stored in the microcontroller. When we switch the program mode into track mode the ultrasonic and PIR senses the obstacles, if anything is sensed by these sensors means it indicate to microcontroller. If the user walk in the wrong direction or wrong steps means the controller indicate the path and direction through the voice synthesizer. If the GPS mode is selected the system works at outdoor navigation. So the blind peoples can easily move anywhere (Indoor and outdoor) with the help of this project. The integration of AT89S52 and APR600 is shown in Fig 9.

VI. RESULT

The systems were designed and implemented using Proteus tools. The circuit was designed to produce audio feedback as well as vibration output.

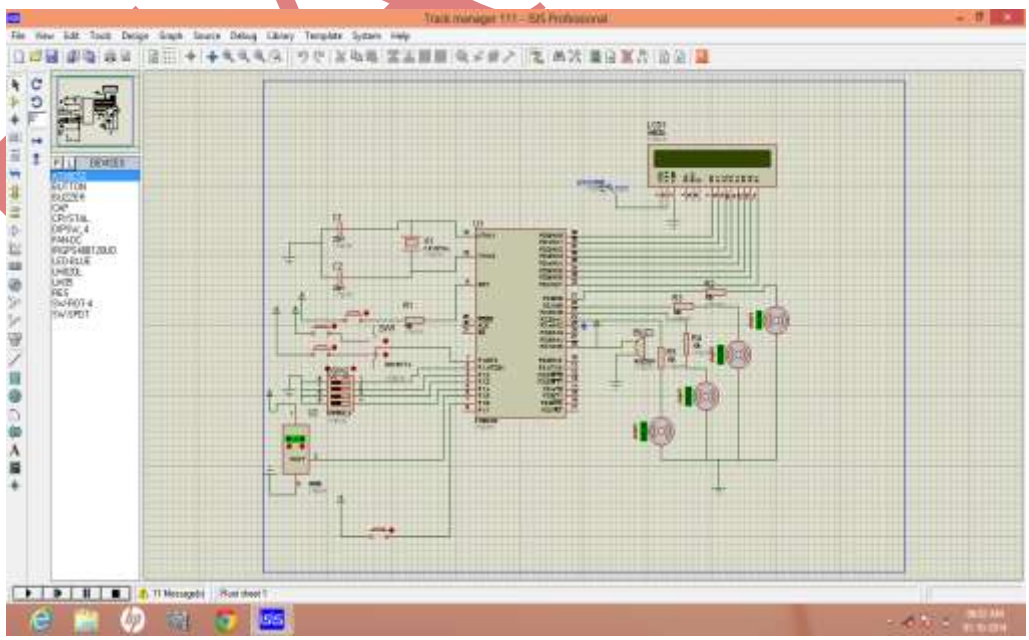

Fig 10.Output Screen Shot.

whenever the obstacle is detected, voice output was produced correspondingly rotation of motor gives out the vibration output. In eyeglass method, according to the distance of obstacle such as near and far, system gives out voice output. In Eyeglass a method ultrasonic spectacle is used to detect the overhanging obstacles. Two motors for different distance were used. According to the distance detected, corresponding motor starts rotation which gives out the vibration output. It makes users to identify the distance of obstacle and ensures a safe mobility. The Output screenshot of proposed system is shown in Fig 10**.**

VII. CONCLUSION

The proposed navigation aid has been developed in order to enhance the independent mobility of blind individuals. This system needs no additional huge device to be carried along and it also doesn't need any special training as the input output system is very simple. This system also focuses on most of the navigation problems faced by blind, within familiar indoors and outdoors. Its application is widened to any new environment which makes it advantageous. The error in direction made by the user is made note of and suitable corrective steps are suggested.

With the proposed architecture, if constructed with at most accuracy, the blind people will able to move from one place to another without others help. If such a system is developed, it will act as a basic platform for the generation of more such devices for the visually impaired in the future which will be cost effective. And as far as the localization is concerned it will be able to provide accurate details of the location of the blind if in case they lost with help from the GPS. It will be real boon for the blind. The developed prototype gives good results in detecting obstacles paced at distance in front of the user. The solution developed is a moderate budget navigational aid for the visually impaired. However minimizing cost leads to compromises in performance. It is advised that the design be improved before commercial production. Components and change it if need be. This will completely ensure your project's success.

System has following advantages:

Advantages:

- Accurate detection of obstacles in front left and right direction.
- Detection of waist level height to head level height obstacles.
- Minimum physical interface.
- Less training time.
- Very low cost.
- Low power consumption.

Certain improvements are required for following:

- Recognition of colours

To conclude, we would like to say that engineering does not just stop at gaining knowledge and innovating, it ends when you are able to use that knowledge for the benefit of your fellow human beings.

As the saying goes,

"If engineering is the application of science for human benefit, then the engineer must be a student of not only the application of science but of human benefit as well."

REFERENCES

[1] V.GangaBharani, R.Kevin, Arun K.J, N.Nityanandan.; "Track Manager for the blind and the visually Disabled",2011.

[2] Tahat, A.A. ,"A wireless ranging system for the blind long-cane utilizing a smart-phone", in Telecommunications, 2009. ConTEL 2009.

[3] Zhang, J.; Lip, C.W.; One, S.K.; Nee, A.; "A multiple sensor-based shoe-mounted user interface designed for navigation systems for the visually impaired" in Wireless Internet Conference (WICON), 2010 The 5th Annual ICST

[4] Jizhong Xiao; Ramdath, K.; Iosilevish, M.; Sigh, D.; Tsakas, A, "A low cost outdoor assistive navigation system for blind people," *Industrial Electronics and Applications (ICIEA), 2013 8th IEEE Conference on* , vol., no., pp.828,833, 19-21 June 2013

[5] Kumar, A; Patra, R.; Manjunatha, M.; Mukhopadhyay, J.; Majumdar, AK., "An electronic travel aid for navigation of visually impaired persons," *Communication Systems and Networks (COMSNETS), 2011 Third International Conference on* , vol., no., pp.1,5, 4-8 Jan. 2011

[6] Tanaka, M.; Goto, H., "Text-tracking wearable camera system for visually-impaired people," *Pattern Recognition, 2008. ICPR 2008. 19th International Conference on* , vol., no., pp.1,4, 8-11 Dec. 2008

[7] Amit Kumar, M.Manjutha, A.K.Majumdar, J.Mukhopadhayay and RushaPatra, "An Electronic Travel Aid for Navigation of Visually Impaired Persons", 3rd International Conference on Communication Systems and Networks, pp.1-5, January 2011.

.