ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology(IJRASET)

Review of Voice Interface and GPS based Blind man's Stick for Visually Impaired People

Shriya Tawarawala[1], Milind U. Nemade[2], Komal Vageria[3], Dinkal Solanki[4]

[1,2,,3,4] *Department of Electronics and Telecommunication, University of Mumbai*

Abstract— Blind man's stick is a novel device designed to help blind or visually impaired users navigate safely and quickly among obstacles and other hazards. This review paper presents new thought a theoretical model and a system concept to provide a smart electronic aid for blind people. Mobility training uses a white cane for the blind or the visually impaired. Such cane, which enhances their own walking ability, is different from an approach that enables them to walk with mechanical equipment. When the stick's sensors detect an obstacle, the embedded computer determines a suitable direction of motion that steers the stick and the user around it. The steering action results in a very noticeable force felt in the handle, which easily guides the user without any conscious effort on his/her part.

Keywords-- Electronic Travel Aid (ETA), Infra-Red Sensors, Global Positioning System (GPS) modem, Speech Recognition module, PIC Microcontroller.

I. INTRODUCTION

Infrared sensors will allow you to detect an obstacle at a particular distance. Attaching these sensors on the stick will help the user to navigate through any predefined path. Another promising improvement consists of adding a localization module to the Blindman's Stick. This would allow the user to enter a desired target location to the system and then this stick will automatically guide him/her to that location. Speech output could be a very helpful feature if used appropriately. It would allow the blind man to not only guide the user to a desired location, but also to provide additional information about the environment. One useful function could be the instant presentation of location and orientation data. Another useful function would be to warn a user if he/she gets too close to an obstacle, and even telling him/her on which side the obstacle is. Speech output could also be used instead of the brakes to ask the user to slow down or stop. Year 2013 statistics by the World Health Organization (WHO) that there are 285 million people are estimated to be visually impaired worldwide, 39 million of which are blind and 246 have low vision. The traditional and oldest mobility aids for persons with visual impairments are the walking cane (also called white cane or stick) and guide dogs. The most important drawbacks of these aids are necessary skills and training phase, range of motion and very little information conveyed. With the rapid advances of modern technology, both in hardware and software front have brought potential to provide intelligent navigation capabilities. Electronic Travel Aid (ETA) has been designed and devised with the aim to navigate independently and safely. High end technological solutions appends the device to be user-friendly.[1]

II. RELATED WORK

From the past few decades, surveys have been conducted for new devices to design a good and reliable system for visually impaired persons to detect and alert them from various obstacles. There are some systems which has some deficiencies.

Shoval et. al [2] developed a Navbelt, an obstacle avoidance wearable portable computer which is only for indoor navigation. Navbelt was equipped with two modes, the first one the system information was translated to audio in different sounds. One sound for free for travel direction and other for blocked, it was difficult for the person to differentiate the sounds. Other problem was the system would not know the user momentary position**.**

S. Innet and N. Ritnoom [3] have introduced a stick for distance measurement using infrared sensors, which is a complex and time wasting process. The stick has different vibration modes for different range which is difficult for a blind to differentiate, it needs time for training. The stick informs the person clearly at dangerous stage which conveys less information and safety. The stick has no location and positioning features.

J.Na [4] proposed an interactive guide system for indoor positioning, which can't detect the obstacles and hurdles. The system is not suitable for the outdoor activities.

Benjamin et al. [5] introduce a laser cane with three photo diodes and three laser diodes function as receiver making an optical triangulation. The laser cane detects the obstacle in three different directions. One is 45^0 to the ground for overhanging

obstacles, the second one is parallel to the ground and third one is for sharp deepness. The laser cane has no system for determining location and position.

N. Muhammad and Engr. Ali [11] developed intelligent stick equipped with GPS navigation system, which detect the obstacles in path and gives information about their location using GPS coordinates. The combination of ultrasonic sensors and GPS will detect the obstacles and determine the position and will gives information about location through Bluetooth.

The main disadvantage of the commonly used ultrasonic devices is that high degree of operator skill and integrity is needed hence, the need for trained and certified NDT personnel. In most examinations, there is no permanent record of the inspection as there is in radiography. In certain materials, like austenitic steel, the large grain size found in welds can cause attenuation and this may mask defects. Spurious indications and the misreading of the signals can result in unnecessary repairs.

III. SYSTEM DESCRIPTION

The system, Voice processor and GPS based blind man's stick for visually impaired people is consists of the following components: IR Sensor, LCD Display, Voice Processor (Detection and Processing), GPS Modem, and PIC Microcontroller (PIC16F877A).

A. System Architecture:

Fig. 1 shows block diagram of voice processor and GPS based blind man's stick system.

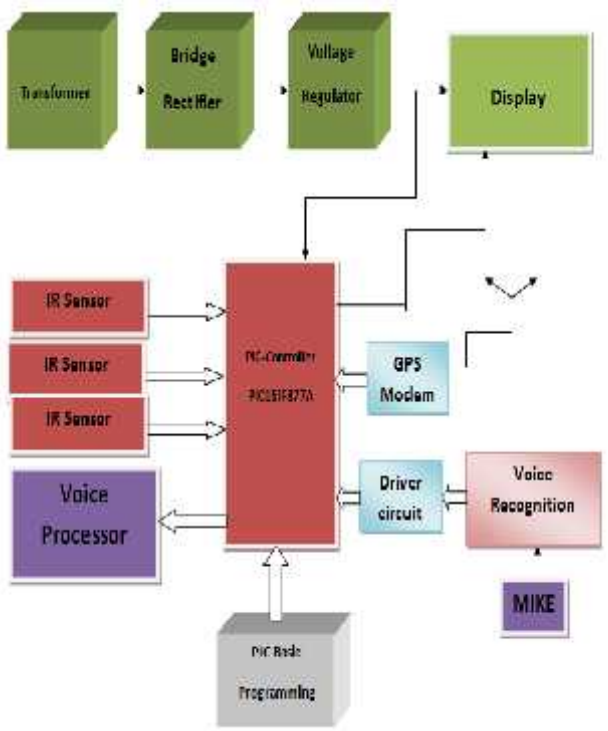

Fig. 1 Block diagram of voice processor and GPS based blind man's stick system

In white cane model, the user holds the stick in front of himself / herself while walking. To detect obstacles, the blind man's stick is equipped with three sensors. Based on the encoder data, the embedded computer instantaneously determines an appropriate direction of travel. If an obstacle blocks the desired travel direction, then the obstacle avoidance algorithm prescribes an alternative direction that clears the obstacle and then resumes in the original direction.

In practice, the user's walking trajectory follows the trajectory of the blind man's stick similar to the way a trailer follows a truck. Because of the handle's short length, the user's trajectory is very close to the blind man's stick trajectory. Once the obstacle is cleared, the path will be re-routed to the earlier desired location. Finally, with the use of this device, the user can reach his/her destination without any complexity. Table 1 show in brief the various parameters which are to be kept under consideration prior to design implementation. The most important parameters being cost as 90% of the blind population of the world live in the developing countries. So an affordable and convincing design has to be put forth for world-wide acceptance [7].

TABLE I
Design parameters for implementation of system

Sr. No	Parameters	Task
1	Size	Compact and strong design
2	Weight	Around 3-3.5KG
3	Speed (Digital + Analog)	0-0.5 m/s
4	Handling	Maximum support force & forces in X and Y directions for stability and guidance
5	Battery Charging	Around 8-10 hrs between charges at duty cycle
6	Computing (On board)	Requirement for major area like planning, control, health monitoring and communication
7	Sensors aid for navigation	Ultrasonic sensors acceptable for obstacle avoidance
8	System Inputs	Forces and voice commands
9	Production Cost	Around INR 25000

B. Proposed Design Components:

The proposed design for blind man's stick distinctly consists of the following units:

a) Sensor Block
b) The GPS unit
c) Voice Processor (Detection and Processing)
d) PIC Controller (PIC16F877A)

Sensor block will have infrared sensor. An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings by either emitting and / or detecting infrared radiation. It is also capable of measuring heat of an object and detecting motion. Infrared waves are not visible to the human eye.

In the electromagnetic spectrum, infrared radiation is the region having wavelengths longer than visible light wavelengths, but shorter than microwaves. The infrared region is approximately demarcated from 0.75 to 1000µm. The wavelength region from 0.75 to 3µm is termed as near infrared, the region from 3 to 6µm is termed mid-infrared, and the region higher than 6µm is termed as far infrared.

There are two types of infrared sensors; thermal infrared sensors use infrared energy as heat. Their photo sensitivity is independent of wavelength. Thermal detectors do not require cooling; however, they have slow response times and low detection capability.

Quantum infrared sensors provide higher detection performance and faster response speed. Their photo sensitivity is dependent on wavelength. Quantum detectors have to be cooled so as to obtain accurate measurements. The only exception is for detectors that are used in the near infrared region [9].

Fig. 2 Block diagram of a typical system for detecting infrared radiation

Working principle for a typical system for detecting infrared radiation using infrared sensors includes the infrared source such as blackbody radiators, tungsten lamps, and silicon carbide. In case of active IR sensors, the sources are infrared lasers and

LEDs of specific IR wavelengths. Next is the transmission medium used for infrared transmission, which includes vacuum, the atmosphere, and optical fibers. Thirdly, optical components such as optical lenses made from quartz, CaF_2, Ge and Si, polyethylene Fresnel lenses, and Al or Au mirrors, are used to converge or focus infrared radiation. Likewise, to limit spectral response, band-pass filters are ideal. Finally, the infrared detector completes the system for detecting infrared radiation. The output from the detector is usually very small, and hence pre-amplifiers coupled with circuitry are added to further process the received signals.

In GPS Based blind man's stick device with user input interfacing, the blind person will get voice alert when reaches his destination. GPS unit consists of microcontroller, GPS and one voice module to generate the voice clip. 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 PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5x, PIC12Cxxx and PIC16C7x devices. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture /compare /PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

The Global Positioning System (GPS) [8] 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.

Voice processor APR is a low cost, high performance sound record / replay IC, incorporating flash analogue storage technique. The device offers true single chip voice recording and play back capability for 40 to 60 seconds. The IC is non-volatile; recorded sound is retained even after the power supply is removed from the module. The device offers true single chip voice recording and play back capability for 40 to 60 seconds. The replayed sound exhibits high quality with the low noise level. Sample rates are user selectable which allows the designers to customize their design for unique quality and storage time needs [7].

The microcontroller used in GPS based blind man device with user input interface can be preferably a PIC16F877A. Some of its characteristics are:

- Only 35 single-word instruction to learn.
- Operating system – DC = 20MHz clock input
  DC = 200ns instruction cycle
- Upto 8K x 14 words of Flash Program Memory
- Upto 368 x 8bytes of RAM
- Upto 256 x 8 bytes of EEPROM
- 40-44 pin Microcontroller
- Low power, high speed technology
- Wide operation voltage range(2 – 5.5V)
- Commercial and Industrial Temperature range.

IV. DISCUSSION

Till now, we have used AM transmitter and receiver [10]. For the experimental purpose the carrier frequencies considered were 600 KHz, 700 KHz, 800 KHz and 900 KHz. The size and the power consumption of the transmitter are not very important as it is a stationary device and is powered from the supply mains. The receiver should be small enough to be fit inside the walking stick. Again the receiver is being battery operated should consume less power. Fortunately in this device the transmitter and the receiver are very close to each other and thus a low power transmitter is quite sufficient. The required tactile output can be produced by driving an electromechanical relay (with suitable transistor like CL 100) from the output of the receiver. The relay may be operated from 6V DC supply.

V. CONCLUSION

The paper proposed the design and architecture, of voice processor and GPS based blind man's stick system for visually impaired people. The advantage of the system lies in the fact that it can prove to be very low cost solution to millions of blind person worldwide. One main limitation of such system is due to the principle of measurement; we are in fact measuring the distance to the "closest" obstacle in range, which could be an inconvenience when we are trying to map the environment. The problem becomes obvious when the system is used to sense the entrance to a room. We still have obstacle from both the left and the right and it can be interpreted as a continuous wall. The proposed combination of various working units makes a real-time system that monitors position of the user and provides dual feedback making navigation more safe and secure.

REFERENCES

[1] Amit Kumar, Rusha Patra, M. Manjunatha, J. Mukhopadhyay and A. K. Majumdar, "An electronic travel aid for navigation of visually impaired", Third International conference on Communication Systems and Networks (COMSNETS), 4-8 Jan 2011.
[2] S. Shoval, J. Borenstein, Y. Koren, "Mobile robot obstacle avoidance in a computerized travel aid for the blind", Proceedings of the IEEE International Conference on Robotics and Automation, May 1994.
[3] S. Innet 1, N. Ritnoom, "An Application of Infrared Sensors for Electronic White Stick", *International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS2008) Swissôtel Le Concorde* , Bangkok, Thailand, 2008.
[4] J. Na, "The blind interactive guide system using RFID-based indoor positioning system," *Lecture Notes in Computer Science, Springer Publications*, vol. 4061, pp. 1298-1305, 2006.
[5] J. M, Benjamin, N. A. Ali, and A. F. Schepis, "A laser cane for the blind," *Proceedings of San Diego Medical Symposium*, 1973.
[6] Niranjan Debnath1, Zul Azizi Hailani, Sakinah Jamaludin and Ir. Dr. Syed Abdul Kader Aljunid, "An Electronically Guided Walking Stick For The Blind", University Tenaga Nasional, Malaysia, vol II, November 2011.
[7] Shruti Dambhare and Prof. A Sakhare, "Smart Stick For the Blind: Obstacle Detection, Artificial Vision, and real-time Assistance via GPS", *International Journal of Computer Application* (IJCA), G.H.R.C.E. Nagpur, 2011.
[8] Shamsi, M.A., Al-Qutayri, M., Jeedella, J., "Blind assistant navigation system" 1st Middle East Conference on Biomedical Engineering (MECBME), 21-24 Feb. 2011.
[9] http://www.azosensors.com/Article.aspx?ArticleID=339
[10] Benson K. B., "Audio engineering hand book", McGraw-Hill book company, New York, 1986.
[11] Naseer Muhammad and Engr.Qazi Waqar Ali, "Design of Intelligent Stick based on Microcontroller with GPS using Speech IC", International Journal of Electrical and Computer Engineering (IJECE), Vol.2, No.6, pp. 781-784, December 2012.