ELECTRONIC TRAVEL AID SYSTEM FOR BLIND PEOPLE NAVIGATION AND MONITORING

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ABSTRACT

The visually impaired have to face many challenges in their daily life. The problem gets worse when they travel to an unfamiliar location. The proposed system consists of hardware and software. This paper presents the architecture as well as the implementation of the system that helps the visually impaired person to navigate autonomously in the indoor environment. An embedded system integrating three ultrasonic sensor, with PIC76F877A microcontroller. The proposed system for visually impaired and blind navigation. The system consists of ultrasonic sensor, Sonar sensor, GPS Module, GSM Module, The location of the blind is found using Global System for Mobile communications (GSM) and Global Position System (GPS).

KEYWORDS- *Electronic travel aid (ETA), Ultrasonic sensor, Global System for Mobile Communications (GSM), Global Position System(GPS), IDE(Integrated Development Environment)*

I. INTRODUCTION

Walking safely and confidently without any human assistance in urban or unknown environments is a difficult task for blind people. Visually impaired people generally use either the typical white cane or the guide dog to travel independently [1].
Although the white stick gives a warning about 1 m before the obstacle, for a normal walking speed of 1.2 m/s, the time to react is very short (only 1 s). The stick scans the floor and consequently cannot detect certain obstacles (rears of trucks, low branches, etc.). Safety and confidence could be increased using devices that give a signal to find the direction of an obstacle-free path in unfamiliar or change in environments. Electronic travel aids (ETAs) are devices that give off a warning by auditory or/and tactile signals when an obstacle is in the way and allow the user to avoid it [1], [2].
In this system we are going to use an obstacle detection sensor as the heart of the system. In this module we are going to interface an obstacle sensor that will keep on emitting a signal generated by the Microcontroller. This signal after hitting the obstacle will be received back. This echo signal collected by the sensor receiver and based on computing signal thus alerting the person well in advance about the obstacle [3]. And in this system we are going to interface GSM and GPS to detect the blind person location. The proposed architecture consists of a GPS signal receiver and GSM connected to PIC76F877A. This complete setup will be fixed to stick. The GPS will be sending the location information to the controller continuously. The same will be routed to the GSM modem through the controller. GSM will forward this information to the pre fed mobile numbers the user after receiving the message. In this system we are using PIC76F877A microcontroller [4]. It is an 8 bit microcontroller that consist of 8KB memory, 512 byte EPROM and 1KB Static RAM. Here we are using Obstacle sensor, this will be interfacing with ADC. The GSM module and GPS will communicate using RS232 protocol with microcontroller. If the person want to know the location of

the blind person, he has to send one message like LOCATION, immediately he will get the blind person location coordinates.

II. RELATED WORK

Many interesting proposals have been done in the area of location and mobility assistance for people with visual disabilities. These works are mainly focused on three types of environments [5]: outdoor [6], indoor [7], and some mix of the previous ones [8].

The studies focused on indoor environments have proposed several *ad hoc* technologies and strategies to deliver useful information to the user. However, just some of them are suitable to be used by visually impaired people.

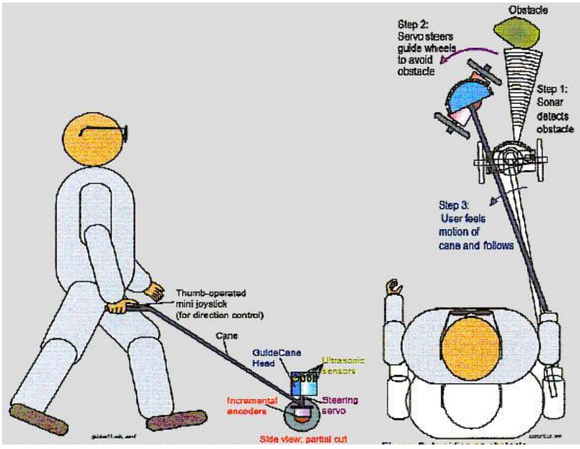

Figure 1 Functional components of the Electronic Travelling Aid System [14]

In the diagram figure 1 [14] shows the functional components of the Electronic Travelling Aid System and shows how the device detect and avoid an object.

Treuillet and Royer [8] proposed an interesting vision-based navigation system to guide visually impaired people in indoor and outdoor environments. The positioning system uses a body mounted camera that periodically takes pictures from the environment, and an algorithm to match (in real-time) particular references extracted from the images, with 3D landmarks already stored in the system. This solution has shown very good results to locate people in memorized paths, but it is not suitable to be used in environments that are visited for the first time.

There are also several research works in the robotic and artificial intelligence fields, which have studied the recognition of indoor scenes in real-time [10]. Some of these solutions allow for creating the reference map dynamically. Although they have shown to be accurate and useful in several domains such as robotics, wearable computing and the automotive sector, they require that the vehicle (in our case the blind person) carry a computing device (e.g., a laptop) to sense the environment and to process such information in real-time. Since they must carry the white cane with them all of the time, the use of extra gadgets that are not particularly wearable, typically suitability of such solutions.

Radio Frequency Identification (RFID) is a technology commonly used to guide the visually impaired in indoor environments. a system based on smart phones that allows a blind person to follow a route drawn on the floor. This solution combines a cane with a portable RFID reader attached to it. Using this cane, a user can follow a specific lane, composed by RFID labels, on the floor of a supermarket [11], replacing the white cane with a robot that is in charge of guiding the visually impaired person.

III. LIMITATION

Blind Navigation system using virtual mapping method is very costly. The manufacturing time is very high since the virtual mapping has to be carried out throughout the indoor environment. This method is applicable only for short distance. Once this method is designed to use in a particular area, it can be used only in that area, this system cannot be relocated to use in any other place. This system cannot be used in public places like airports, hospitals, malls and public parks since the construction and design for the entire system cannot be carried out in such a big places and this method is used only for a single user. Once the virtual mapping is used throughout the indoor environment and if there exist any change in the value, then the whole system and design has to be reconstructed. If the proximity sensor sends the signal towards any object, that object will be informed to the user unnecessarily since it creates the Confusion and it increases the panic level of the user to move forward. The destination setting is quite difficult, since the comparison takes a long time.

IV. SYSTEM DESIGN

In order to overcome the difficulties in the existing method and to provide the cost effective and user friendly system for blind navigation, the following designed is carried out. An embedded system integrating three ultrasonic sensor, with PIC76F877A microcontroller. The proposed system for visually impaired and blind navigation. In this wearable system, three ultrasonic sensor. Subject can detect obstacles from ground level in the range of 100 cm in any direction.

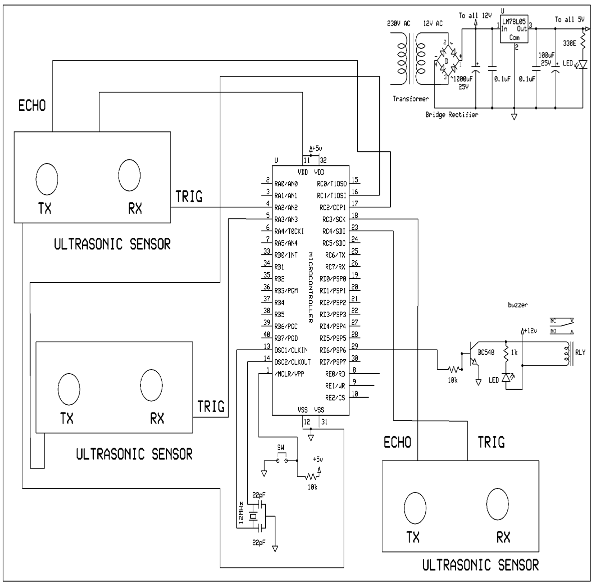

Figure 2: Circuit Diagram of Electronic Travelling Aid System

These ultrasonic sensors collect real time data after every 20 msec. and send it to PIC76F877A microcontroller. After processing this data, microcontroller invokes the direction of the cane handle caused by the movement of the wheelbase and is thereby steered along the desired path. The wheels can be steered to the left or right relative to the cane by a servomotor controlled by the built-in computer. Encoders on the wheels determine their relative direction. The user can indicate a desired direction of motion.

Microcontroller:

The Microcontroller used in this system is PIC76F877A microcontroller since it is necessary to provide the dual serial communication which is possible using this controller. It is an 8 bit microcontroller that consist of 8KB memory, 512 byte EPROM and 1KB Static RAM. This controller provides the High performance and it consumes very less power.

GSM and GPS modules:

The Global Positioning System (GPS) [12] and Global System for Mobile communications (GSM) are interfaced to the microcontroller to detect the blind person location .The proposed architecture consists of a GPS signal receiver and GSM, vibratory circuitry connected to PIC76F877A. This complete setup will be fixed to stick. The GPS will be sending the location information to the controller continuously. The same will be routed to the GSM modem through the controller.

Object detector:

The sensory systems emit ultrasonic waves to the environment, which are reflected by the object; the system calculates the distance from the object according to the time difference between the emitted and received beam. The stereo-vision systems use the object tracking algorithms and calculate the distance by using gray scale method. Ultrasonic sensors are used for obstacle detection and calculation of its adaptive distance from the visually impaired person. Ultrasonic sensors are used in pair as transceivers. One device which emits sound waves is called as transmitter and other who receives echo is known as receiver. These sensors work on a principle similar to radar or sonar which detects the object with the help of echoes from sound waves. An algorithm is implemented in C-language on PIC76F877A microcontroller. The time interval between sending the signal and receiving the echo is calculated to determine the distance to an object. As these sensors use sound waves rather than light for object detection, so can be comfortably used in ambient outdoor application.

Software used:

The software we use here is Keil µ(micro) vision 4 IDE (Integrated Development Environment). This is a virtual platform where we can execute code and check our desired results. For executing the code we have to choose the controller PIC76F877A. After checking the results virtually we will dump the code into controller to verify results.

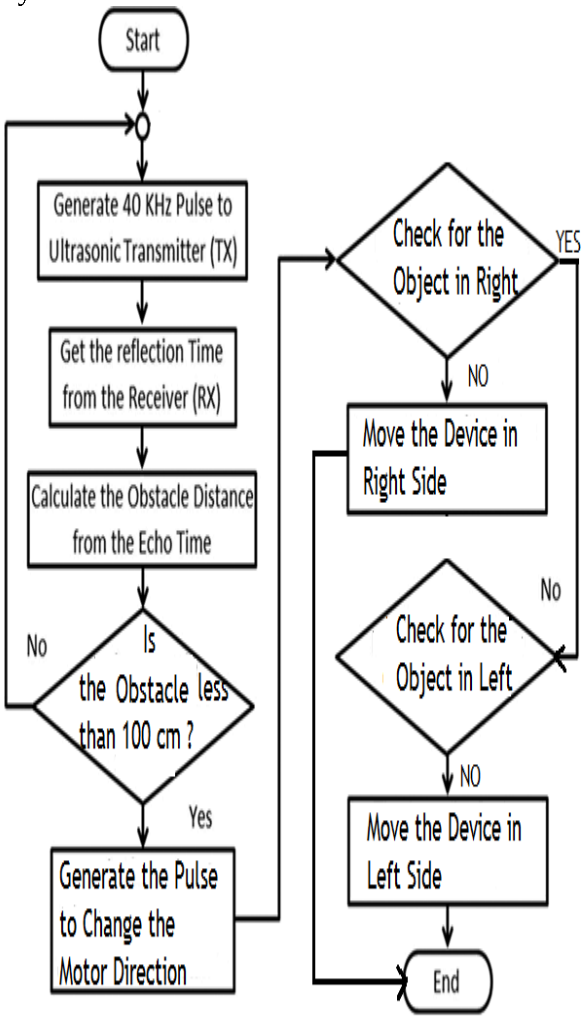

Figure 3: Flowchart of proposed system

Figure 3 clearly shows the flowchart of how the electronic travelling aid system works. It consist of 3 ultrasonic sensor which continuously check for obstacle within a range of 100 cm. If it detects an obstacle within the range it will follow a free path.

V. RESULT

The ETA (Electronic Travelling Aid) system when faces an obstacle, within 1 meter distance it will sense the obstacle through ultrasonic sensor if there is an obstacle in the desired travel direction, the obstacle avoidance algorithm provides an alternative path around the obstacle and then resumes in the desired direction. When the wheels turn sideways to avoid an obstacle, the user almost automatically changes orientation to follow the cane, so the walking trajectory follows that of the cane. Once past the obstacle, the user can continue to walk along the new line of travel or use the Guide Cane's dead reckoning capability to return to the original line of travel.

VI. CONCLUSION

The paper intended the blueprint and architecture of a smarter concept of SMART WALKING STICK for blind and disable people. This blind aid system can be rendered a fresh dimension of useful assistance and gives a sense of artificial vision along with dedicated obstacle and hollow detection circuitry. This cost effective and light weight device can be designed to take of pattern of a plastic and portable device, which can be unconditionally mounted on an ordinary white cane or blind stick. The aimed combination of several working sub-systems makes a time demanding system that monitors the environmental scenario of static and dynamic objects and provides necessary feedback forming navigation more precise, safe and secure.

VII. FUTURE WORK

If a visually impaired person wants to go to a city location, they can walk along a road or corridor using an ETA system in the local area. However, it is difficult to know one's position globally. Hence, a global positioning method will be the subject of further research. The global position of' the user is obtained using the global positioning system (GPS), and their current position and guidance to their destination will be given to the user by voice. A wall-following function will also be added so that the blind can walk straight along a corridor in an indoor environment [13].
This includes some more application like metal detection, depth measurement, and fire detection.

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