Electronic Travel Aid for Visually Impaired People Along with aPanic Alert System

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ABSTRACT: There are many issues over which humans have no control. Blindness is one of such issues. It snatches the vivid visual beauty of the world from an individual's life.But missing the beauty of nature becomes one of the last worries of such people as they have to face numerous difficulties in order to perform even the most basics of tasks in their day to day life. One of their most important problems is of transport, such as crossing roads, traveling in trains, or in any other public places. A visually impaired person to survive the fittest in this world, the person must go through all the obstacles without the guidance of others. One of the most important measures to avoid the obstacle by the blind is to provide an assistive implementation, which can help to wander on their own. The main aim of this project is to provide an assistive technology used for the purpose of enhancing the mobility of the blind pedestrian which is commonly referred to as Electronic Travel Aid (ETA) and to motivate the blind without having the inferior feeling of their problem and pay away the blind to move on their own . In this project, a smart guiding ETA is used to guide the user to sense the obstacle before them. This device eliminates the requirement of human assistance for blind while traveling outside. It will identify all obstacles in the path with the help of various sensors installed in it. The microcontroller will retrieve data and pass it on as vibrations which will notify the user about hurdles.

Keywords: Electronic Travel Aid, Visual impairment, Obstacle detection, Blindness, Assistive technology, Human detection.

1. Introduction

Watching the surroundings scenario of this planet through vision is such an ability gifted by Almighty Creator. Due to lack of vision, the existence of human life seems to be incomplete and meaningless [1]. But it is a matter of sorrow that there are lots of people in the world are living their lives without having the ability to visualize the beautiful things of this world. The situation is very difficult for a visually impaired person in every aspect of the life especially outside of the home and in working place. It is quite impossible for a blind person to move into a busy road or crowded place especially unfamiliar areas without others help or any equipment [2].

With the advancement of the technology the world is adopting many smart techniques which are working as a helping hand for those visually impaired people. Blindness or visual impairment is a state of devoid of the visual notion owing to physiological or potentially neurological factors. The partial blindness implies the lack of integration in the growth of the optic nerve of the eye, and complete blindness is the total deficiency of the visible light perception [2]. Partial blindness can happen in different ways resulting from

disease, injury, congenital or degenerative conditions which cannot be corrected by traditional means, such as refractive modification, medication, or surgery.

Total blindness is often due to severe trauma or injury, complete retinal detachment, end-stage glaucoma, end stage diabetic retinopathy, severe internal eye infection, vascular occlusion (stroke in the eye)[3].

According to the last updated information in 2017 of World Health Organization (WHO), almost 285 million people are approximated to be visually impaired, globally 39 million are completely blind whereas 246 million have low vision. Out of this 82% are of 50 years old and above. Latest report by Times of India states that India is now home to the world's largest number of blind people. Of the 36 million people across the globe who are blind, over 15 million are from India. According to a Non-Governmental Organization (NGO) survey 98% blind people have met with accidents while traveling.

In order to address all above-defined problems and to empower 36 million blind people worldwide, a solution of what is christened as "Electronic Travel Aid" is introduced

[4]. As the ETAs getting popular day by day, researcher has been working on this field to make the device even more light, portable, safe and low cost for better service. The main aim of this proposed system is to improve the mobility of blind in terms of safety and to detect obstacle. This proposed ETA is integrated with various sensors like ultrasonic sensor, light sensor, Passive Infrared (PIR) sensor along with a panic alert button and GPS-GSM module to pin-point the location of the visually impaired person and to establish a two way wireless communication path [5].

2. Existing System

The main travel aids that blind people use are trained dogs, guiding canes or walking stick as simple. The guiding dogs are restricted to certain limits to go with the humans and also they are very expensive and not very reliable [5]. On the other hand canes are used by touching/poking obstacles in their way. But it is considered as a disturbance or an inconvenience for a visually impaired to carry it everywhere it is needed. This conventional cane stick causes a lot of accidents and hence is dangerous for them and others. Later canes with either lasers or infra-red waves are used. As time passes, the canes are used with electronic components with a voice command to indicate the obstacle before the user but it can be also an inconvenient to other people due to the sound.
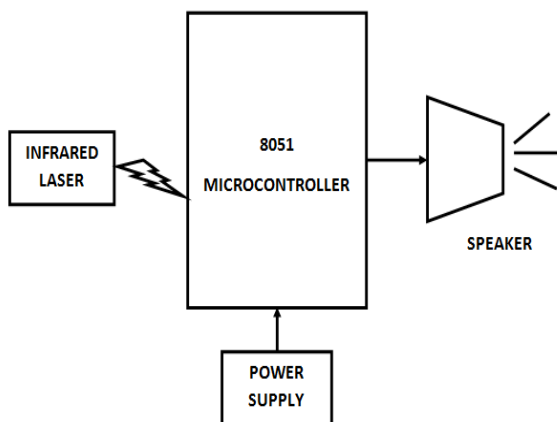

Figure1. Block diagram for obstacle detection

In the existing technology, infra-red or laser sensors are used to detect the obstacles. After the detection of the obstacle, the signal is sent to the microcontroller with flash memory and Static Random Access Memory (SRAM). This experimental set up is subjected with the power supply from a non-rechargeable battery. The output is given as an audio or simply a sound from a Mylar cone speaker. Another method uses a rechargeable battery which is really vast in size to accommodate. Since it is necessary to recharge the battery, an adapter is provided with it. The infra-red sensors have blind-spots so that it does not cover a wide range in vertical as well as horizontal planes.

Later days a wearable belt is developed. This device gives acoustic feedback in two distinct modes of operation: the guidance mode and the image mode. But the limitation of these devices is that they only do a specific task [6]. There is another prototype having the basic argument that human hearing system is quite capable of learning to process and interpret extremely complicated and rapidly changing sound patterns. It consists of a digital camera attached to the prototype, headphones, and a portable computer with the necessary software. Many individuals tried the system returning very promising feedback, but they required highly extensive training because of the complicated sound patterns.

Several prototypes have been developed for aiding the indoor and outdoor navigation of blind people using Radio Frequency Identification (RFID) based solution in and a Wi-Fi based solution but they are short in range that results in high costs [7]. R.Kozik proposed a prototype of mobility aid system in 2010, which can detect and extract the obstacle by the depth map. But it is not suitable to navigate the blind to travel outside the room, and the object recognition is limited.

3. Proposed System

The block diagram of the system includes a Advanced Version RISC (AVR) ATMEGA16 microcontroller, ultrasonic sensor, light sensor, PIR sensor, panic alert switch, buzzer, LED indicator, vibrating motor, motor driver, record and play IC for audio output and a GSM-GPS module for obstacle detection. It also has a real time text to speech conversion using Raspberry pi processor, Raspberry pi camera and a headphone [8, 9].
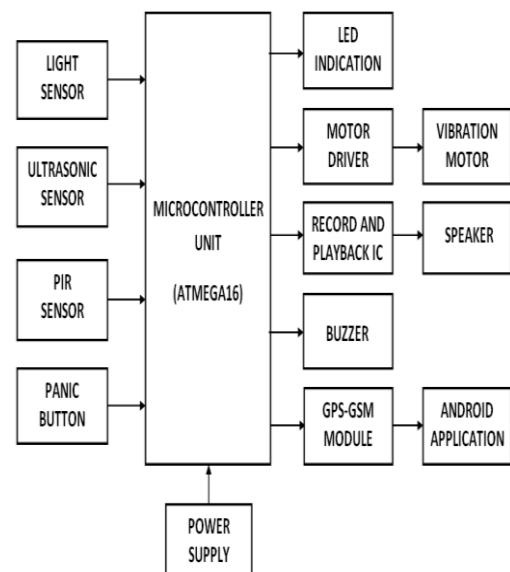

Figure 2. Block diagram for obstacle detection

The text to speech conversion is done using e-speak tool.

The ultrasonic sensor will detect the obstacle using ultrasonic wave. The measured signal is then transmitted to

the ATMEGA16 microcontroller after processing the signal it will send the signal to the motor and the vibrating motor will vibrate in response with the sensor. The light sensor is used in the device for the blind to walk in public place during night time because others peoples will not notice that the person is blind and chances of accidents are high. The PIR sensor will detect the presence of human and an audio output will be produced using the playback IC. When the user press the panic button the buzzer will make a beep sound to alert the people around that user is in danger and also a message with location will send to the saved numbers using a GSM-GPS modem. Location tracking is also done using an android application.

*Working-*When the user goes in and power ON the device a buzzer will sound and ultrasonic sensor starts to send the ultrasonic waves out and measures distance by sending out a sound wave at a specific frequency and listing for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the ultrasonic sensor and the object. Then the signal is sent to the microcontroller where the signal is filtered, processed and calculates obstacle distance. If the obstacle is close then the microcontroller sends a signal to the driver circuit. Thus the corresponding vibrating motors vibrates in response to which ultrasonic sensor is sensed. While using the audiometric output, the device becomes limited to the blind only. So acquiring a vibrating output can serve the purpose to both deaf-blind users.

A PIR Sensor is used for the human detection. Sensor does not actively take part in the process that is it will not emit IR signal itself but it passively detect the IR radiation coming from the human body [8]. The detected signal is then given to the microcontroller and the sensered signal is given to a playback IC for an audio output.

A Light Dependent Resistance (LDR) sensor or light sensor is used in the device because walking in public place during night time is one of the challenging tasks for visually impaired peoples because others peoples will not notice that the person is blind and in rush they may met with accidents. The resistances of LDR change due to change of the light intensity. During night the LDR will have high resistive path and no current pass through it but through a LED connected parallel with it. Due to this flow of large current the LED connected in front of the device illuminates brightly and acts as a Flashlight which can be easily noticed by others.

In case of an emergency, user can press the emergency button or panic alert button then the microcontroller will send signal to the buzzer to sound and also access the location from the GPS modem and transmit the location to the GSM modem. It will send a Short Message Service (SMS) messages to the all saved numbers in the microcontroller. An android application is used for receiving

the message. The GPS will update the location of the device and automatically save the location in microcontroller Electrically Erasable Programmable Read Only Memory (EEPROM).

*ATmega16-*ATMEGA16 is an 8-bit high performance microcontroller from the Atmel's Mega AVR family which is developed using Complementary Metal Oxide Semiconductor (CMOS) technology. It has high noise immunity and low power consumption. It is similar to any other AVR controller [10]. It is made of a single chip computer that comes with Control Processing Unit (CPU) , Read Only Memory (ROM), Random Access Memory (RAM) , EEPROM, Timers, Counters, Analog to Digital Converter (ADC) and four 8-bit ports called PORT A, PORT B, PORT C, PORT D where each port consists of 8 I/O pins.

LDR- The LDR is used in this device because walking in public place during night time is one of the challenging tasks for visually impaired peoples because others peoples will not notice that the person is blind and chances of accidents are high. The resistances of LDR change due to change of the light intensity. During night it will have high resistive path and no current pass through it. When a LED is connected parallel with it there will be a flow of large current through the LED which illuminates brightly and acts as a Flashlight which can be easily noticed by others.

Ultrasonic Sensor- Ultrasonic sensors measure distance by using ultrasonic waves. The sensor will emit an ultrasonic wave and receives the wave reflected back from the target using ultrasonic transmitter and receiver. It measure the distance to the target by measuring the time between the emission and reception of waves. The HC-SR04 ultrasonic sensor is used here .The Ultrasonic sensor transmits an ultrasonic wave using the transmitter ,this wave travels in air and when it gets objected by any obstacle it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module using the receiver. It has 4 pins whose pin names are Vcc, Trigger, Echo and Ground.

PIR Sensor- PIR sensor is used to check whether a human has entered in or out of the sensor range. Human body emits heat in the form of infrared radiation which is a region of the electromagnetic radiation spectrum whose wavelength range from about 700nm to 1mm This Radiated energy is invisible to human eye. These IR Signals can be detected by using PIR sensor. These IR Signals can be detected by using PIR sensor. In Passive Infrared Sensor the word "passive" indicates that Sensor does not generate or radiate any energy for detection purposes. They detect the infrared radiation emitted or reflected from the human body.

Vibrating Motor- The vibration motor used in the project is a compact size coreless Direct Current (DC) motor. It is used to informs the users of receiving the signal by vibrating, no sound.

Motor driver- The motor driver circuit used in the project is L293D. Here the motor drivers act as current amplifier since they take a low current control signal and provide a high current signal. This signal is used to drive the motors. This motor driver circuit consists of two inbuilt H-bridge driver circuits therefore two motors can be connected.

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GSM-GPS Module- In this system SIM808 Modem is used as the GPS-GSM module.SIM808 is a high performance quad band module, which can be controlled via Attention (AT) command set. This compact design integrates General Packet Radio Service (GPRS) and GPS in a Surface Mount Technology (SMT) package will significantly save both time and costs for customers to develop GPS enabled applications. This module can be used to make or receive calls, to send and to receive SMS messages. Moreover, it is used to send and to receive data after connected to the network. Position with GPS tracking system. It has a GSM chip and RS232 interface which enables easy connection with the computer or laptop or to the microcontroller.

4. Software Description

In this system the ATmega16 microcontroller is programmed using Embedded C under a Integrated Development Environment (IDE) called Code Vision software. To receive the location send by the user an android application is developed using Eclipse software.

CodeVision AVR- It is a C cross-compiler, Integrated Development Environment and Automatic Program Generator designed for the Atmel AVR microcontrollers that runs under the Windows 95, 98, NT 4, 2000 and XP operating systems. It has standard C libraries. Apart from the

C libraries it also has dedicated libraries. These dedicated libraries are for SPI, delays, gray code conversion, power management, temperature sensor, RTC, I2C, etc. it also contains Code Wizard AVR Automatics Program Generator to write the code in minutes. It supports data types like bit, bool, char, int, short, long, 64 bit long, float. The EEPROM and flash memory can be easily accessed by this AVR compiler. The I/O registers can access at its bit level and it also supports interrupt.

*Eclipse-*Eclipse is an integrated development environment used in the computer programming. It is widely used as a Java IDE but it is also used in other programming languages like C, C++, C#, Ada, Python, R, Ruby, PHP, Java

script, COBOL, D, Lua etc. It has an extensible plug in system and a base workshop. Primary use of eclipse is for developing java application. Operating systems supporting this software are Windows, Linux, macOS and Solaris. Platform used are Java SE, Standard Widget Toolkit, x86-64.

5. Results and Discussion

The below figure shows the electronic travel aid for visually impaired people using sensors like ultrasonic sensor, light sensor, PIR sensor along with a panic alert switch and GSM-GPS module which is used for tracking the location of blind. The ultrasonic sensor will detect the obstacle using ultrasonic wave and output is given to the vibrating motor. The PIR sensor will detect the presence of human and an audio output will be produced using the playback IC. LDR is used to get noticed by the public during night time.

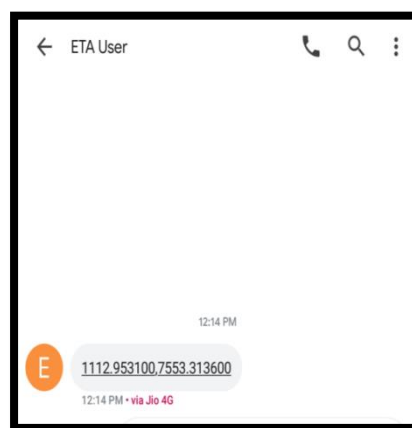**Figure 3.** Electronic Travel Aid for blind

Figure 4. Received message

Figure 4 shows the message received to the saved numbers using a GSM-GPS modem. It has the latitude and longitude coordinates of the location. Figure 5 shows the tracked location in map using an android application.
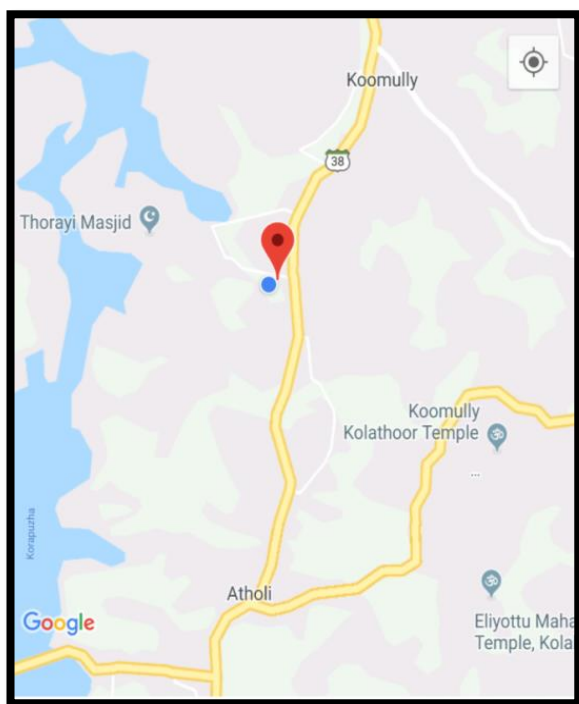
Figure 5. Tracked location

6. Conclusion and Future Work

This proposed system presents a smart guiding device for visually impaired people, which can help them to move safely and efficiently. It 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 static and dynamic objects around them. There are a variety of future scopes available for the visually impaired people to improve their navigation independently. The advancement in mobile technology will further help in developing better application for continuous assessment of surroundings. By using GPS current location and guidance to the destination will be given to the user by voice. A wall following indoor navigation can also be added so that the user can walk straight along a corridor. It can be further improved to have more decision taking capabilities by employing various types of sensors and thus could be used for different application like vehicle detection, slippery floor, on-coming vehicle detection and fire or smoke alarm etc. It can also contain special arrangement to connect the system to the aadhar card of blinds so that government can serve the physically disabled even better.

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