Smart Navigation System for Visually Impaired

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Abstract— The life of blind and visually impaired people is very different. They face many challenges when moving in unfamiliar public places. In this paper, we introduce a smart stick system for assisting blind people. The system consists of ultrasonic sensor, proximity sensor, infrared sensor, water detector, GPS and GSM module, buzzer as well as vibratory and audio signal circuits. An obstacle detector is used to help the user to avoid obstacle by sending an audio message. The system design uses GPS and GSM module through which their family members can track their location easily if they are lost.
Key words: Arduino Uno, Sensors, GPS, GSM, Buzzer, Vibration motor, Voice Synthesizer

I. INTRODUCTION

In India there are around 15 million people are visually impaired. There are many guidance systems for visually impaired travellers to navigate quickly and safely against obstacle and other hazards faced. The traditional and oldest mobility aids for persons with visual impairments are walking cane and guide dogs. The most important drawbacks of these aids are necessary skills and training phase, range of motion and very little information control.

Everyday people visit many places like shopping mall, industries etc. if that places are unknown then they follow up map which are present at entry. People can see that map but visually impaired people cannot see that map. This project is solution for blind people; using this proposed system visually impaired people can easily move.

In this system we are going to interface a obstacle sensor and a buzzer with arduino Uno which will be attached with blind stick. So whenever the blind will detect any obstacle, (up to a distance of 6.5 m) automatically a buzzer will indicate about it to the blind people and give instruction to them by using voice recognizer (synthesizer) and in this system we are going to interface GPS and GSM to detect blind person location and send SMS of "I am in trouble" to particular family member along with correct latitude and longitude.

II. REVIEW OF EXISTING DEVICES

Many ETAs and robot technologies have been applied, to guide the blinds that aimed at improving their mobility in terms of safety, to detect obstacles on the ground, uneven surfaces, holes, steps, and puddles.

A. C-5 Laser Cane

It was introduced in 1973 by Benjamin. It is based on optical triangulation with three laser diodes and three photodiodes as receivers. The Laser Cane can detect obstacles at head-height, drop-offs in front of the user, and obstacles up to a range of 1.5 m or 3.5 m ahead of the user.

B. Sonic Torch

It is a battery operated hand held device basically operates by transmitting the ultrasound in the forward direction and receiving the reflected sound beam from the nearest object.

C. Mowat Sensor

It is a commercially available hand-held ultrasonic-based device that informs the user of the distance to detected objects by means of tactile vibrations. The frequency of the vibration is inversely proportional to the distance between the sensor and the object. D. Sonic Path Finder It alarms the blind when detecting the obstacle by the acoustic difference. However, it does not provide the accurate path and the position of an obstacle.

D. Meldog

It uses the artificial intelligence, unlike in the sonic pathfinder. It can provide the accurate position of an obstacle using the ultrasound and laser sensors. But, in general, it is relatively large and heavy.

E. Navbelt (1989)

It is a portable device equipped with ultrasonic sensors and a computer. It produced a 120o-wide view of the obstacles ahead of the user (similar to a radar screen image). This image was then translated into a series of directional audio cues through which the user could determine which directions were blocked by obstacles
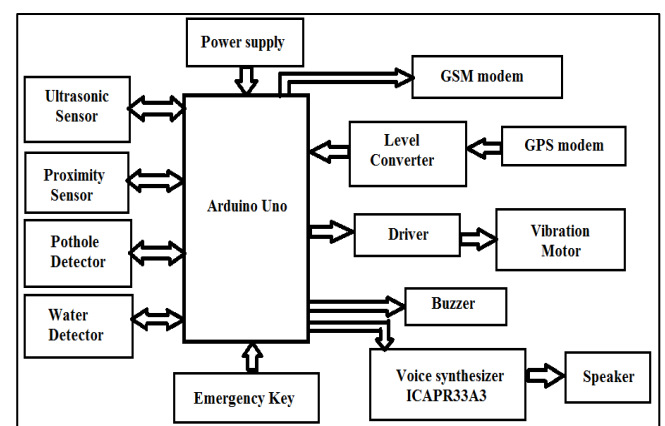
III. SYSTEM DESCRIPTION

Fig. 1: Block Diagram

The figure above depicts the proposed design of an arduino smart navigation stick. The sytem consists of various units
- Sensor unit
- GPS and GSM unit

IV. THE PROPOSED METHODOLOGY TO DEVELOP THE ASSISTING TOOLS

A. Arduino Uno (ATMEGA16)

Atmega16 is an 8-bit high performance microcontroller of Atmel's mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more about RISC and CISC architecture) Architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum Frequency of 16 MHZ. Atmega16 has 16KB programmable flash memory, static RAM of 1KB and EEPROM of 512 bytes. The endurance cycle of flash memory and EEPROM is 10000 and 100000 respectively.

Atmega16 is 40 pin microcontrollers.

There are 32 I/O lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD.

Atmega16 has various in-build peripherals Like USART, ADC, SPI, JTAG, analog comparator etc. Each I/O pins has an alternative task related to in-build peripherals.

B. Sensors

1) Ultrasonic and IR Sensor

An ultrasonic sensor is a device that can measure the distance of an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening 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 sensor and the object. The distance can be calculated with the following formula

$$Distance = \frac{speed\ of\ sound\ *time\ taken}{2}$$

The level detection is done by using infrared sensor. It operates by detecting the distance from the target by reflection of an infrared beam. On changing level the LED of infrared glows. This is used to for the stair case detection. In case while travelling on the road if the blind person fined a sharp ending edge like down staircase. It work based on the pair of sonic sensor based on the reflected signal the distance of obstacle known.

Type of Obstacle	Sensor outputs		
	IR sensor	Ultrasonic Sensor-I	Ultrasonic Sensor-II
Down Stair	off	Not considered	Not considered
Up stair	on	D<15 cm	D>136 cm & D<160 cm
Wall	on	D<15 cm	D>106 cm & D<130 cm
Vehicle	on	D>400 cm	D>300 cm & D<450 cm
Small stone	on	D<15 cm	D>400 cm

Table 1: Sensor Outputs

2) Water detector

A water detector is an electronic device that is designed to detect the presence of water and provide an alert.

3) Pothole Detector

When the stick is on flat ground the stone will have zero to minimal deflection. However when the stick is on a pothole the deflection of the stone is increased thus detecting the pothole. Vibration or inclination can be measured using this device. Acceleration along three perpendicular axes can measured using the accelerometer sensor. Acceleration of up to 6g can be measured. Vertical (z) axis readings are generally a measure of pothole induced vibrations. The pothole can be characterized based on the magnitude of change in reading of the accelerometer sensor. The severity of the pothole can be measured directly using the reading of the accelerometer sensor, hence no calculations are required in this method.

C. Driver IC (L293D)

L293D is a typical motor driver or Motor drive IC which allows DC motor to drive on either direction. It is a 16-pin IC which can control a set of two DC motor simultaneously in any direction. It means that you can control two DC motor with a single L293D IC.

D. Vibration motor

Vibration motor is driven by driver IC which is used to make vibrations when the obstacle is detected by sensors in very nearly. It has the voltage rating of (3V-4.5V).

E. Buzzer

A buzzer or beeper is an audio signaling device, which include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Here the piezoelectric buzzer (AI-3035) is used with the rating of 2-5volt, 9ma.

F. Voice Synthesizer (ICAPR33A3)

It is also called as the speech computer or speech synthesizer. Voice synthesizer is used to converts normal language text into speech. It has voice recording length is 340-680 seconds and operating voltage range is 3-6.5v. It has single chip solution with minimum external components.

G. Speaker

The Speakers are one of the most common output devices. Speakers are transducers that convert electromagnetic waves into sound waves. It is connected with APR33A3IC for control the sound level.

H. Emergency Key

This project has an Emergency key which is used by visually impaired person to send emergency messages to the pre-programmed family or friend's numbers.

I. GPS (Global Positioning System)

EM-411 GPS receiver technology is used to find the location of any object to monitor a person continuously. It is a receiver or simply device that receives the information from GPS satellite and then calculates the devices geographical position. It's varying in sensitivity, speed, vulnerability to multipath propagation and other performance parameter. In the GPS technology, the communication takes place between GPS transceiver and GPS satellite. It needs to use6MB of data for 10 minutes, 18MB of data for 30 minutes and 36MB of data for 1Hour.

J. GSM (Global System for Mobile Communication)

The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module GSM is the technology that used with mobile phone networks. It is hugely successful wireless technology and world's fastest growing communication

technology. GSM operated in the 900MHZ and 1.8GHZ with allowing the transmission of basic data services such as SMS. The SIM900A GSM module has an operating voltage of 3.4 to 4.5 volt. It draws high current up to 2A when transmitting data.
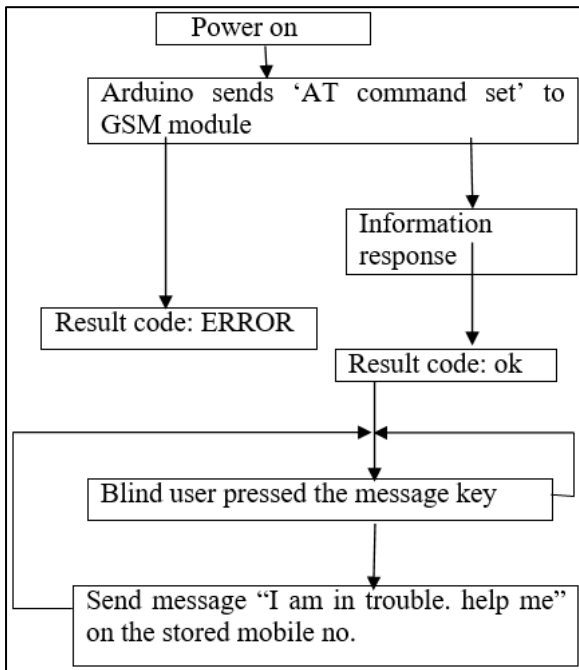
Fig. 2:

K. Voltage Regulator (LM7805)

It is a circuit that is connected between the power source and a load that provide constant voltage despite vibrations in input voltage or output load. It has the voltage range of 7 to 35 volt and current rating of 1A.

L. Power Supply Unit

The power supply unit has to provide a regulated DC supply to all sections of the system. As it is essential to operate the instruments on batteries since it is used with the person while moving. It consist of rechargeable batteries, filter capacitors and voltage regulators.

V. EXPERIMENTAL RESULT

Fig. 2: Shows the Latitude of the Location Crime

Fig. 3: Shows the Longitude of the Location Crime

A. Applications
− Can be used for the safety of blind.
− Can be used for the safety of visually impaired.
− Can be used to find exact location of the blind.

B. Advantages
− Fast Response
− Simple & Cheap
− User Friendly

VI. CONCLUSION

The paper reviewed the navigation system which is helpful for blind people when they travel independently. The objective of this project is to develop a low cost system which can store the data of the members in the particular locality and provide immediate alert. With this proposed architecture the blind people will able to move from one place to another without other help. It is able to provide accurate details of blind with the help of GPS and GSM if in case they lost their way. It will act as a bone and a perfect guide for blind.

Hence, it can conclude that this project is able to play a great contribution to the state of the art and will play a great role to assist the blind to walk easily.

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