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LOCATION BASED NAVIGATION AND OBSTACLE DETECTION SYSTEM WITH VOICE ALERTS FOR BLIND

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ABSTRACT

India is now home to the world's largest number of blind people. Of the 37 million people across the globe who are blind, over 15 million are from India. Visually impaired people find it challenging to go out independently. This paper is an attempt at a navigation device for the visually impaired which is focused on providing voice output for obstacle detection and navigation using ultrasonic sensors and android devices. The proposed device is used for guiding partially sighted individuals and the blind. On sensing obstacles the sensor passes this data to the microcontroller. The microcontroller then processes this data and calculates the obstacle distance. If the obstacle is detected the microcontroller sends a message to the user through the voice module. Whenever the user gets panicked and press the panic button, the location of the user is sent to the concerned person mobile phone (blynk app) through GPS and wifi module.

Keywords—navigation; ultrasonic sensor; voice alerts; emergency message; Emergency button

1. INTRODUCTION

Living even a single day without eyesight is unimaginable! But there are many people in the world who do not have proper vision. Some may be blind and some may have other visual disorders. Life becomes difficult for such people. They find it hard even to do their daily chores. For such people, working like any other ordinary person is nothing less than a dream.

285 million people are estimated to be visually impaired worldwide: 39 million are blind and 246 have low vision. About 90% of the world's visually impaired live in developing countries. The living conditions of blind people can be improved if they are educated and given an opportunity to earn their living. They will be benefitted if they are allowed to work in various industries, educational institutions and other work places. For this purpose an advanced blind stick is proposed that allows visually challenged people to navigate with ease. The blind stick is integrated with ultrasonic sensor, panic button, GPS module, Wifi module, voice module and arduino microcontroller.

2. PROPOSED SYSTEM

The system consists of the features such as obstacle detection, navigation aid using GPS, and Voice alerts for obstacle detection.

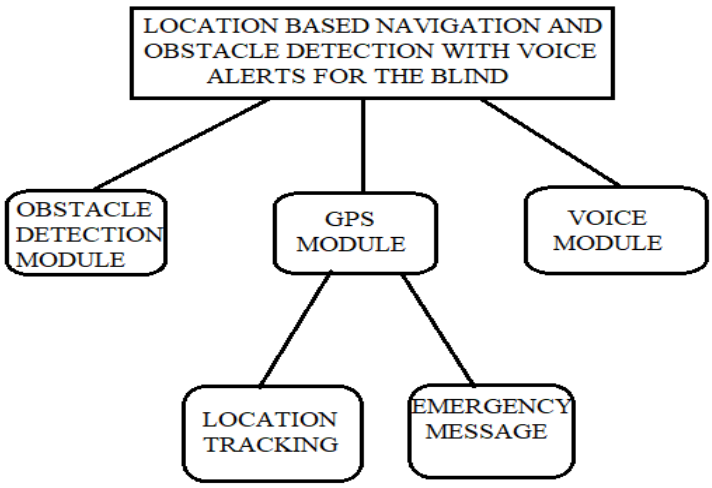

Fig: System Architecture

2.1. Obstacle Detectionfeature

This part of the system helps the visually impaired to avoid obstacles in the range of 0-4 feet. The ultrasonic sensors are used that transmit ultrasonic waves as well as receives the response that is reflected by the obstacles around continuously. The response is analysed by the microcontroller to measure distance between the user and obstacle. This triggers the corresponding output, which is a voice announcement that mentions the direction of the obstacle to alert the blind over the speaker.

2.2. Navigation using GPS

This component helps the visually impaired to navigate to the desired destination by alerting the person about the current location when the location announcement button is pressed. GPS is used to obtain the current coordinates of the user which is input to the microcontroller to compare with the data stored in the SD card. When a match of the coordinates is found, the location name corresponding to the coordinates is announced. These announcements are made using the Arduino.

2.3. Voice Announcements

Text to speech conversion is done using Formant synthesis method. This method gives a robotic voice as output. This is due to the alterations of the frequency or pitch that creates a waveform. Based on the waveform produced, the voice output is produced over the speaker.

3. IMPLEMENTATION

The system includes the following modules:

3.1. Obstacle detection

This module is built using ultrasonic sensors interfaced with an Arduino board. The reason why we use Ultrasonic Sensors is that infrared sensors can't work in dark environments whereas ultrasonic sensors can. Ultrasonic sensors work using sound waves and detecting obstacles is not affected by various factors like vapour, dust, smoke, light etc. Since, reliability is an important factor in this system, ultrasonic sensors that are more reliable than IR sensors are used. On sensing obstacles the sensor passes this data to the microcontroller. The microcontroller then processes this data and calculates the obstacle distance. If the obstacle is detected the microcontroller sends a message to the user through the voice module. The blind user is alerted using a speaker as to which direction the obstacle is coming from. For this purpose three ultrasonic sensors are used. One on the left, one on the right and one in front. All these are interfaced with the Arduino board. The speaker also is connected to the Arduino for alerting the blind person.

3.2. Caretaker's mobile application

This application is used by the care taker to track the location of the blind user. When the blind person moves from one location to another, his location will be updated on the blynk server. The caretaker has to first login to the application and then he can access the location of the user.

3.3. User's application

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User logs into the application and stays online. Whenever he needs to know his location, he presses a button on the Arduino board which will send signals via Wi-Fi to the android phone and a voice alert of his location will be provided.

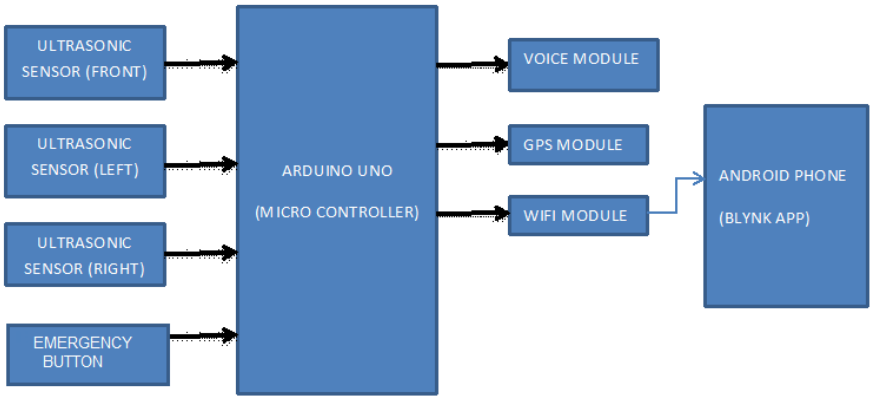
3.4. Location alerts

When the blind person moves from one location to another, he might want to identify his current location. For this, a button is provided on the Arduino. When button is clicked, the Wi-Fi module on the Arduino sends a signal to the android application of the user and GPS is contacted for the Location (Latitude and longitude) using Google APIs. Once the location is calculated, a voice output of the current location is given. This is mainly to increase the independence of the blind person when he travels from one location to another.

3.5. Emergency button

If the blind user feels that he/she is in need of help, a button interfaced on the Arduino can be clicked. When the button is clicked, an emergency message is sent to a caretaker or relative. The message will be sent to the caretaker's android application. The message will contain URL of the blind person's location. A notification is also received. This module is implemented so that if the blind person is confused with the location or feels presence of any danger, he/she can get help with ease.

4. ARCHITECTURE



4.1. Arduino

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. An Atmel 8- bit AVR microcontroller is fixed on the Arduino board along with some complementary components which are needed for programming and assimilate into other circuits. The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and derives from the IDE for the Processing programming language and the Wiring projects. It includes a code editor and is also capable of compiling and uploading programs to the board with a single click. Sketch is the program or code written for Arduino. Basic Arduino programs are written in C or C++. The Arduino IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. An Arduino program contains of only 2 functions : setup() and loop()

Features of Arduino involve:

(a)ATmega328 microcontroller
(b) 6 Analog Inputs
(c) 32k Flash Memory
(d) 14 Digital I/O Pins and 6 PWM outputs
(e) 16 MHz Clock Speed
(f) Input voltage - 7-12V

4.2. Ultrasonic sensors

Its features include:

(a)Easy to use 4-pin breakout.
(b)Range: 2cm-400cm non-contact measurement function.
(c)Ranging accuracy: ± 3cm (incremental towards maximum range).
(d)Separate inputs for trigger and received Echo.

3 of these are used.

4.3. Voice Module

APR9600 multi-section sound recorder/replay IC and experimental board is used for recording and output of voice alerts for direction of obstacle. APR9600 is a low-cost high performance sound record/replay IC incorporating flash analogue storage technique. Recorded sound is retained even after power supply is removed from the module. The replayed sound exhibits high quality with a low noise level. Sampling rate for a 60 second recording period is 4.2 kHz that gives a sound record/replay bandwidth of 20Hz to 2.1 kHz. However, by changing an oscillation resistor, a sampling rate as high as 8.0 kHz can be achieved. This shortens the total length of sound recording to 32 seconds.

4.4. GPS

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit. It works at a frequency of 1575.42 MHz A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and morning.

4.5. Wifi Module

Processor: L106 32-bit RISC microprocessor core
(a)Memory:
(i)32 KiB instruction RAM
(ii)32 KiB instruction cache
(b)External QSPI flash: up to 16 MiB is supported (512 KiB to 4 MiB typically included)
(c)IEEE 802.11 b/g/n Wi-Fi
(i)Integrated TR switch, LNA, power amplifier and matching network
(ii)WEP or WPA/WPA2 authentication, or open networks
(d)16 GPIO pins
(e)SPI
(f)UART on dedicated pins, plus a transmit-only UART can be enabled on GPIO2
(g)10-bit ADC (successive approximation ADC)

All these hardware components are interfaced with the arduino microcontroller and programmed using C language. Blynk server is used for the two applications.

5. ADVANTAGES

i. The distance of the obstacles is detected.
ii. The blind person location is tracked by using the GPS when he/she in dangerous conditions.

6. CONCLUSION

There are number of blind people in the world who use white cane, trained dogs to travel and to do their basic activities. This system helps to detect the obstacle around them, identification of location and the location details will be sent to the caretaker if the blind person is in emergency situation. So this system assures that the blind person can travel independently and safely in the society.

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