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Guidance System for the Visually Impaired

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Abstract:
The idea of this project is to develop a guidance system for the visually impaired people, which will help them to commute independently. Sense of vision to the human being is an important aspect of one's life. But as per a survey conducted by the World Health Organization (WHO), it is estimated that approximately 217 million have moderate to severe vision impairment, and 36 million people are blind. These people face many hardships, especially while exercising the basic things in their everyday life. An ultrasonic sensor unit, using the sensor HCSR04, detects any obstacle that comes in the way of the user and provides a warning through a voice output module. A GPS unit, employing the LS20030 GPS module, enables live tracking of the blind person's location. Another main feature of this system is to give information regarding the buses arriving at the bus stop, by providing the bus number and route of the incoming bus as voice output. This feature is implemented using RF Transmitter and Receiver module. All these individual hardware units are integrated into a single system using the Arduino IDE software.

Keywords: Microcontroller, Ultrasonic Sensor, GPS, IOT, RF Transmitter and Receiver.

I. INTRODUCTION

Now-a-days, due to the increase in the number of vehicles, the blind people find it difficult to travel independently in the roads and may also encounter many risks. It also becomes hard for them to make use of public transport. Some of the already existing systems use technologies such as GPS, GSM, RF Communication etc to enable them to travel safely. Upon studying various such existing devices, it was seen that only a few of them provide outdoor navigation. One such system "An intelligent walking stick for the blind"[5], had used RFID tags for providing navigation. It sets up RF tags in rooms and building which the impaired user frequently visits. The stick section held by the blind user contains an RF reader, which will identify an RF tag whenever one comes within the RF reader's range. Fig 1 and Fig 2 show the working model of this system

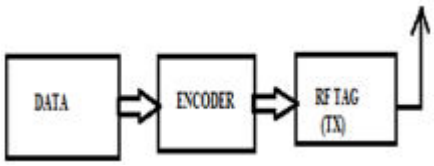

Figure.1. RF Tags section fitted in buildings

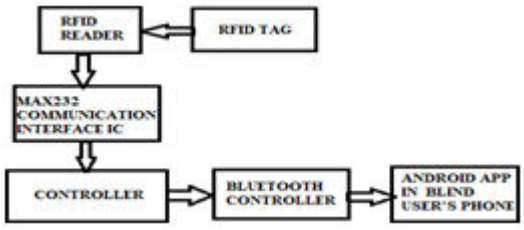

Figure.2. RFID Reader Section in the stick

This system has the drawback that it provides navigational access only to local places of limited area. If the user might want to travel to far off places or use any mode of transport such as public transport, this system becomes unhelpful. Another paper named "A Blind Guidance System for Street Crossings Based on Ultrasonic Sensors"[2]gave us an insight on how ultrasonic sensors can be used to detect an obstacle. This also helped us in understanding the distance measurement concept using ultrasonic sensors. The paper "Smart Walking Stick Using IOT" [7] proposed a system which uses GPS technology to enable continuous location tracking of the blind person. From this we obtained an idea how important is location tracking for the safety of the impaired user.

II. RELATED WORK:

On analysing the already existing models, our proposed system differs in the following ways:

EXISTING MODELS	PROPOSED SYSTEM MODEL
Used RFID tags to provide only indoor navigation.	Uses RF communication to enable travelling through public transport
Used infrared sensors for obstacle detection, which is less efficient as infrared sensors do not detect very dark colours accurately.	Uses ultrasonic sensors for Obstacle detection, which overcomes the drawback faced by infrared sensors.
Provided location tracking of the blind user through gps, by a mobile number registered during initial configuration. If the mobile is lost, location tracking becomes non-feasible	Also provides location tracking using GPS technology. However, the location is continuously sent to a server where it is stored and this information can be accessed by anyone with the login credential

III. PROPOSEDSYSTEMARCHITECTURE:

The proposed system focuses on the visually impaired people who cannot walk and travel independently in unfamiliar

environments. The main aim of our system is to enable the impaired people to move around safely and independently and also make use of public transport without depending on anybody else's assistance. Fig 3shows the basic block diagram of the proposed guidance system:

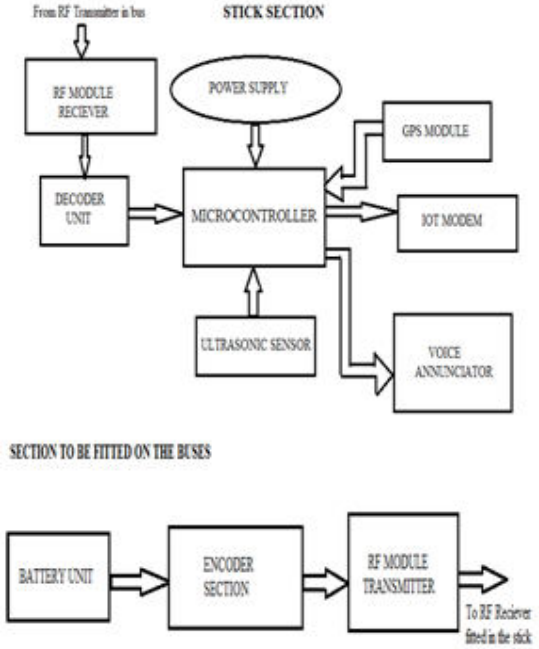

Figure.3. Block Diagram of proposed architecture

The system has three main individual units:

1. **Ultrasonic Sensor Unit:**

This unit of the guidance system performs the functions of obstacle detection and warning. It is made up of the HCSR04 ultrasonic sensor, arduino mega 2560 microcontroller board and the ISD1820 voice annunciator module. The ultrasonic sensor is used for obstacle detection. This emits ultrasonic rays and so when an obstacle occurs in the path of the impaired user, the rays hits the obstacle and is reflected back to the sensor.

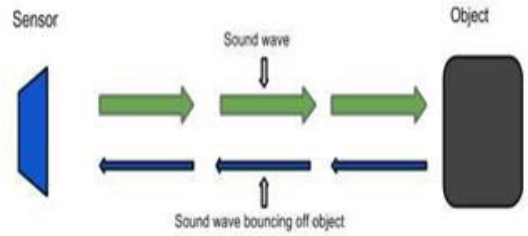

Figure.4. Operation of HCSR04 Ultrasonic Sensor

The sensor then uses the time taken (T) by the rays travel back and forth from the sensor and the obstacle, calculates the corresponding distance (D), in centimeters, using the formula,

D= (T/2) / 29.1

Whenever the distance between the impaired person and the obstacle is less than 50cm, a warning is given to the blind user through voice output.

2.GPS Unit:

The purpose of this unit is to provide constant tracking of the location of the blind user. Here, the GPS module LS20030 is used in association with the microcontroller. Once the system is turned ON, the current location of the system, which is used by the impaired user, is continuously transferred to the server, and the relative of the impaired user can access this location by logging into the server, where the location is given in latitude and longitude as well as displayed in a map.

3. **RF Transmitter and Receiver Unit:**

This unit is designed to provide bus number and route information of the bus that is approaching the bus stand where the impaired person is waiting. This is done with the help of RF Transmitter and Receiver modules. The RF Transmitter module consists of the HT12E encoder IC and the RF Receiver modoule consists of the HT12D decoder IC. Both these modules operate at 434 MHz. The transmitter module is fitted in the buses frequently used by the imapired user, while the receiver module is implemented in the guidance system. Whenever a bus comes within the range of this RF receiver, the guidance system identifies the bus and informs the impaired user about the corresponding bus number and route as voice output.

HARDWARE AND SOFTWARE TECHNOLOGIES USED:

The following technologies have been used in our proposed system:

- **Arduino mega 2560:** This is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.
- **IoT module using ESP8266 IC:** TheESP8266 module is an IoT device consisting of a 32-bitARM Micro processor with support of WIFI network and built- in flash memory. This is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications.
- **LS20030 GPS Module:** Thisis a complete set of GPS smart antenna receivers, including an embedded antenna and GPS receiver circuits, designed for a broad spectrum of OEM system applications.
- **HCSR04 Ultrasonic Sensor:** These sensors use sound to determine the distance between the sensor and the closest object in its path. Whenever any obstacle comes ahead of the ultrasonic sensor the sound waves will reflect back in the form of echo and generates an electric pulse. It calculates the time taken between sending sound waves and receiving echo and gives this data to the microcontroller.
- **RF Transmitter and Receiver:** The RF transmitter and receiver are small electronic devices which transmit and receive radio signals between them using Radio Frequency (RF) communication. An RF transmitter module (HT12E) is capable of transmitting a radio wave and modulating that wave to carry data. An RF receiver module (HT12D) receives the modulated RF signal and demodulates it.
- **ISD1820 Voice Playback IC:** The single voice playback ISD18B20 is a single-chip, single-message record/playback device. Time for recording is 8-20 seconds. This module has high quality voice recording and high fidelity replay. It can be used as a speaker module and can be controlled through microcontroller MCU.

Arduino IDE: The Arduino integrated development environment (IDE) is a cross-platform application that is written in the programming language Java. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

WORKING MODEL OF THE GUIDANCE SYSTEM:

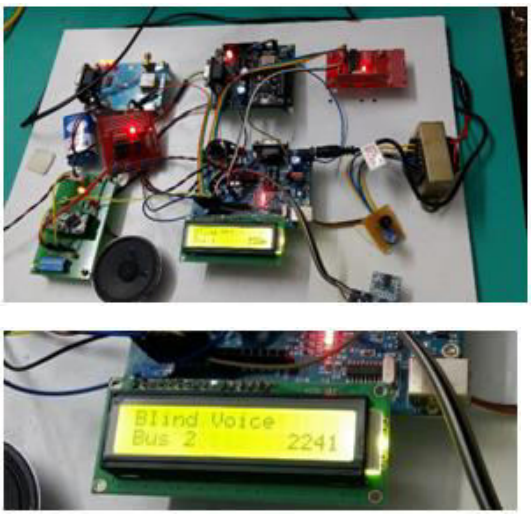

Figure.5. Working Model

HARDWARE AND SOFTWARE RESULTS

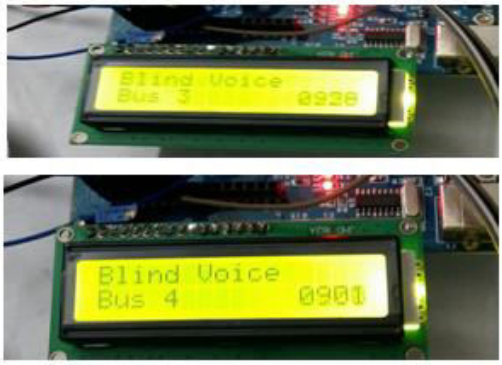

Figure.6. Output in the LCD module

Figure.7.Output of Ultrasonic Sensor in Serial Monitor

LogID	Latitude	Longitude	Logdate	LogTime
56	1303.392	08012.77	20-03-19	18:25:34
55	1303.392	08012.77	20-03-19	18:25:22
54	1303.392	08012.77	20-03-19	18:25:02
53	1303.392	08012.77	20-03-19	18:24:51
52	1303.373	08012.78	20-03-19	18:24:30
51	...0.00	0,200319	20-03-19	18:24:18
50	...0.14	0,200319	20-03-19	18:23:57

Figure.8.Location being stored as latitude and longitude in the server

IV. CONCLUSION:

A system has been designed to enable the visually impaired people to travel independently and safely. The obstacle detection and warning feature helps the blind user to avoid danger caused by obstacles lying in his way. The location tracking unit allows a kin of the impaired user to constantly monitor his movement and thereby provide help during any emergency situations. The RF section enables the impaired person to make use of public transport like buses without requiring others help.

FUTURE SCOPE:

The project can further be extended by implementing the bus identifying feature using RF technology on a larger scale. Here only four bus routes are considered and the system is designed in such a manner to provide information regarding only those four buses. This can be done on a larger scale by gathering data of more buses and installing the RF transmitter module in all the government buses after getting permission from the government. This will enable the impaired people to make use of different buses without any limitations. Another enhancement that can be made in this project is the addition of a temperature sensor along with the ultrasonic sensor. Error in the distance measured by the ultrasonic sensor may vary a bit, depending on the surrounding temperature conditions. This error can be reduced by interfacing a temperature sensor to operate the ultrasonic sensor according to the varying temperature conditions**.**

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