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Pathfinder for the Visually Impaired People

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Abstract

The paper aims at designing and development of a smart cane which helps in navigation for the visually impaired people. The navigator system designed will detect an object or obstacle using ultrasonic sensors and gives audio instructions for guidance. The proposed navigation system utilizes ultrasonic technology, image processing and voice recognition system for obstacle detection, traffic light sensing and getting audio instructions respectively. Traffic signs recognition is a less studied field and here we are introducing a traffic light recognition system by image processing technique in open CV for the blind person to move freely. The entire system is interfaced in a raspberry pi module. Acquiring positional information and detecting directions outdoor is difficult, we confirm that using this system, positional information and travel direction can be obtained utilizing ultrasonic technology combined with GPS navigation system. The system can also detect potholes on the path.

Keywords: *GPS module, pedestrian light detection system, raspberry pi, ultrasonic sensor, voice recognition system*

INTRODUCTION

The visually impaired are having a considerable disadvantage because they often lack the information for avoiding obstacles and hazards in their path. They have very little information on position, objects, self-velocity and direction which is essential for travel. It is estimated by World Health Organization that there is a total of 253 million people who are visually impaired worldwide. Blind and partially sighted people often deal with some inequality in the performance of tasks or daily activities. They need assistance in detecting obstacles, finding locations, and getting directions while moving around to reach their specified destination without an external help.

The designed system helps the blind to walk easily in urban areas and avoid obstacles using special detection sensors. This system has been aimed at design and development of a smart and intelligent cane which helps in navigation for the visually impaired people. The navigator system designed have a voice recognition system to input voice and will detect an object or obstacle using ultrasonic sensors and gives audio instructions for guidance.

Here the ultrasonic sensor is interfaced with raspberry pi module. And the programming language inculcated is python and open CV. Current navigation device for the visually imparted people focuses on travelling from one location to another, this system focuses on designing a device for visually impaired people that help them to travel independently which is comfortable to use.This device is used to help blind people to move with the same ease and confidence as a sighted people. This device is linked with a GPS to identify the location of the blind person. Moreover, it provides the voice alert to avoid obstacles based on ultrasonic navigation.

LITERATURE REVIEW

Navigation for Blind Pedestrians

An assistive electronic travel aid is a form of assistive technology having the purpose of enhancing mobility for the blind. The

paper describes the development of a microcontroller based navigation system for blind pedestrians. Here, the device used is a portable, self contained electronic system that will allow visually impaired individuals to travel through familiar and unfamiliar environments without the assistance of guides. In addition, this system can supply the blind person with assistance about walking routes by using coded sounds to point out what decisions to make [1].

A Blind Navigation System Using RFID for Indoor Navigation

An RFID- based system for navigation in a building for blind people or visually impaired is designed here. The system the location on the tag, a user's destination, and a routing server where the shortest route from the other user's current location to the destination. The device communicates with the routing server using GPRS network. The system have three different modes: Blind RF-ID module, Room RF-ID tag and an IR TX sensor for object type and range sensing unit [2].

Smart Phone-Based Guiding System for Visually Impaired People

A simple smart phone-based guiding system for solving the navigation problems for visually impaired people and achieving obstacle avoidance to enable visually impaired people to travel smoothly from a beginning point to a destination with better awareness of their surroundings. In this study, an image recognition system and smart phone application were integrated to form a simple assisted guiding system. Two operating modes, online mode and offline mode, can be chosen depending on network availability [3].

Transceiver system for obstacle detection based on bat echolocation with air-coupled pulse-echo ultrasound

A system for the generation, emission and reception of ultrasonic pulses in air, which will be used in the detection of obstacles with ultrasound. The system consists of an amplifier, two transducers and an active filtering system. The time-of-flying of the ultrasound signals will provide the distance between the emitter and the object, while the time/frequency information will permit to determine the size, composition and shape of the object [4].

Smart Assistive Navigation System for Blind and Visually Impaired Individuals

A smart assistive navigation system for blind and visually impaired individuals is a safe and low-cost navigation. The developed model aims to guide the blind person and prevent them from unwanted collisions with the obstacles through pre-recorded voice commands hence providing an active feedback. The model consists of two modules- cane and shoe unit. Both are integrated together, working as a single unit facilitated by "Bluetooth" connectivity and offers solution for orientation through digital compass [5].

A Low Cost Outdoor Assistive Navigation System for Blind People

An off-line navigation device that uses 3-D sounds to provide navigation instructions to the user. The device relays directional information to the user through special Audio Bone headphones, which use bone conduction technology. Navigation processing is handled by a Raspberry Pi. Here, the user can input the address by speaking into a microphone. The entire system is mounted to a pack that sits on the user's waist [6].

THE COMPONENTS MODULE

There are four main modules in our system. They are Raspberry pi, Ultrasonic sensor, GPS module, web cam.

Raspberry pi

Raspberry pi is the microprocessor based system which is used to control different components in our pathfinder for the blind.The Raspberry Pi is a compact

computer board which offers endless opportunities. Simply plug in our TV, keyboard, mouse and power supply. In our experiment we use **Raspberry pi B+** model.The Model B+ is the final revision of the original Raspberry Pi. It has 512MB RAM, four USB ports, 40 GPIO pins, and an Ethernet port. An external power supply is need which can be a regulated 5V via the micro USB port on the side of it. The Raspberry pi effectively coordinates all modules in the system and they work together without any error.

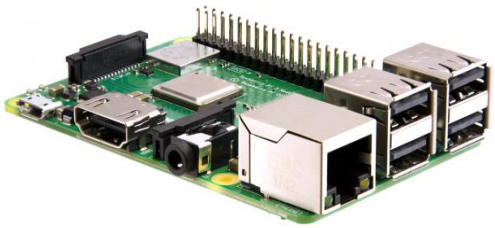

Figure 1: *Raspberry pi 3B+.*

Ultrasonic Sensors

Ultrasonic sensors used to detect the object in front of it. In our experiment the function of this module is to state the distance between the object in front of the sensor using Ultrasonic sound. The sensor have two parts, the transmitter and the receiver. The ultrasonic transmitter emits ultrasonic sound waves to the environment, and thus object is present it is reflected back, and the ultrasonic receiver receives the reflected waves. From this we can calculate the time it takes for the sound to reflect back. Then the distance can be calculated by using the speed of sound and the time it takes for the sound to reflect back. This is done by this formula.

Distance= time * speed

Here, we use HC-SR04 sensor, and it have 4 pins. One for VCC and another for ground and other two pins are called trig and echo.

GPS Module

This module is used for identifying the GPS coordinates of the person and is used to track the user's location. In this experiment, navigation for blinds is done by the help of GPS.A GPS satellite connection is to determine the user location, direction etc which is applied in the Google maps for external navigation.

Webcam

Webcam is a video cam that feeds the images in real time to through a computer and these images are saved in the computer. The webcam is generally connected by a USB cable into a computer. Here OpenCV is used to detect

PROPOSED SYSTEM

The design model of the proposed system which we have introduced is managed through Raspberry pi is as shown in Fig. 2.

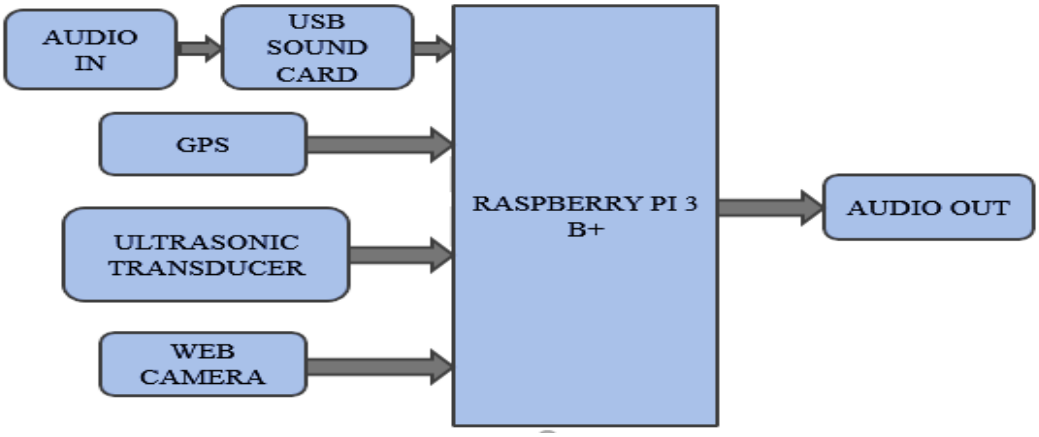

Figure 2: *Block diagram.*

Route for Navigation
The outdoor navigation is done with help of GPS navigation. The GPS receiver will receive the exact location of the user and sends the information to the map. By using this location, the map will guide through the routes.

The navigation system is operated by voice commands. When the voice command is given it checks with the related word in the library files and if the matched word is found given as a input to the search engine. The search engine responds according to the voice command.

Obstacle Detection
The ultrasonic sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back as shown in Fig. 3. Sound travels at approximately 340 meters per second. This corresponds to about 29.412 µ s (microseconds) per centimetre. To measure the distance sound has travelled we use the formula: Distance = (Time x Speed of Sound) / 2. The "2" is in the formula because the sound has to travel back and forth. First the sound travels away from the sensor, and then it bounces off of a surface and returns back. The easy way to read the distance as centimetres is to use the formula: Centimetres = ((Microseconds / 2) / 29). For example, if it takes 100 µ s (microseconds) for the ultrasonic sound to bounce back, then the distance is ((100 / 2) / 29) centimetres or about 1.7 centimetres [7].

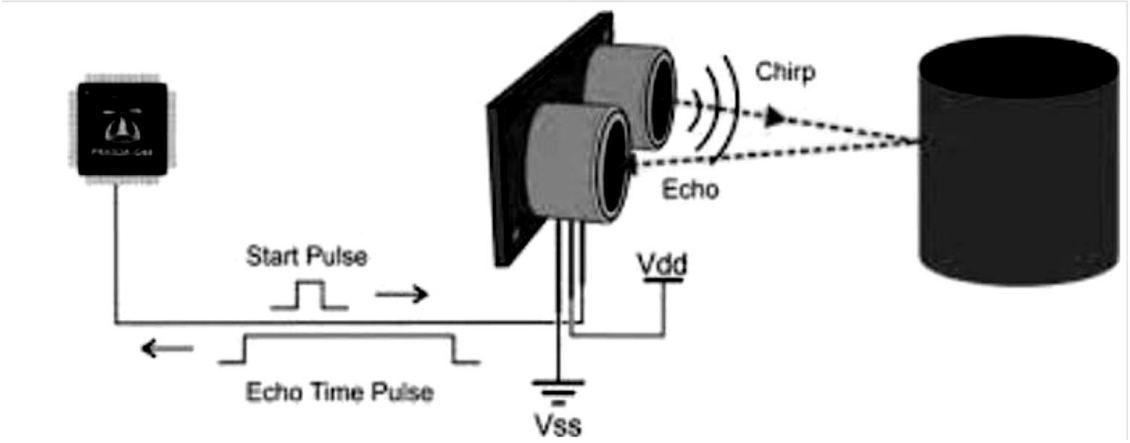

Figure 3: *Ultrasonic transducer working.*

In addition to obstacle detection, system also detect pit on the road by using ultrasonic transducer positioned downward in the cane. If distance to the road is greater than 5 cm.

Pedestrian Light Detection
In order to detect any pedestrian light, a training has to be performed. The training takes positive and negative examples of images and runs a learning algorithm. There are various concepts to recognize traffic lights, for example by learning process or by image processing. The learning process requires samples of traffic lights and non-traffic lights to teach the learning process algorithm the object it should detect. One learning process applied to traffic light detection could be the Haar algorithm, which often is evaluated in terms of performance and recall. Once the training is finished it will output a Haar cascade which is an XML file containing a lot of nodes with numbers that defines the Haar features [8].

EXPERIMENTAL RESULT
After successful connection to the

raspberry pi, the person is guided from source to destination along with correct turns to be taken. GPS will give the location of the person. It will take the destination place to be reached through voice command and give appropriate directions. The stick for blind is as shown in Fig. 4. Obstacles and pit are properly detected using the proposed system. The audio instructions about detection are sent to the blind person. Also, pedestrian signal detected using Haar algorithm. The result of pedestrian light detection is shown in Fig. 5.

Figure 4: *Pathfinder for the blind.*

Figure 5: *Result of pedestrian light detection.*

CONCLUSION

The pathfinder for the visually impaired is designed to move in unfamiliar environments avoiding obstacles and travelling with ease without depending on any one. The aim of this paper to design and construct a simple and cost effective aid for the blind. The blind aid will help them to move efficiently by receiving audio information. The ultrasonic sensor will detect any obstacle and pit on the way.GPS directions provided so that he can select any destination of his choice. Also, he can cross the road by detecting the pedestrian signal by using image processing in python.

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