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GPS AND DIGITAL COMPASS BASED NAVIGATION STICK FOR BLIND PEOPLE

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Abstract: **visually impaired have limitations in terms of mobility and they have a deficient vision. According to WHO, there are 285 billion visually impaired and 30 million permanently blind people in this world. To help visually impaired Blind sticks support in scanning their environment. For better support, to the subject, the current Blind sticks need technological advancement. Hence, with the accession of a microcontroller, buzzer and ultrasonic sensor, this paper proposes a modification to Blind sticks. In order to know the current location of the user, this model encompasses a GPS and GSM module which transfer the location details to the Kith and Kins of the user. The device is aimed to be a cost-effective and user-friendly model for aiding Visually impaired people which guarantees high-performance reliable navigation and an even better user experience.**

Index Terms – **Microcontroller, Ultrasonic sensor, GPS, GSM and Buzzer**

1. Introduction

Blind is someone who is limited by their vision. While doing their daily activities they encounter a lot of obstacles. In obtaining new information and forming new experiences vision impairment certainly causes problems. Traumatic incidents, infections and diabetes are major causes of blindness. The main reason for this initiative is to enable the visually impaired to navigate with confidence and be informed if their path becomes obstructed by any mass. The main feature of this device is the ultrasonic sensor. It transmits a high-frequency signal when any obstacle is detected.

1.1. Related works

Yusro et al. proposed a model of GPS enabled smart environment explorer stick (SEES). This helped the users to move freely both indoors and outdoors. Jameson et al. designed a wearable which warns the user when there is a possible collision, the sensors pick up the environment data and process it to warn the user. In comparison, to other features, this device also puts out a notification when a possible hazard is detected through the sensors. The author also optimized the performance of the system in identifying the obstacle using an ultrasonic sensor and the GPS which helps in pinpointing the location of the user for the concerned subject while maintaining stability and low power consumption. Liarokapis et al. use a variety of computer vision technology to produce AR/VR interface which offers a very user-friendly experience to both user and the concerned subject. They also interfaced with a motion detector module to identify the head movement. A GPS enabled audio system is also interfaced so that the user can know their current location. Laurent et al. made use of SONAR utilizing the echolocation property used by the bats to identify the surroundings.

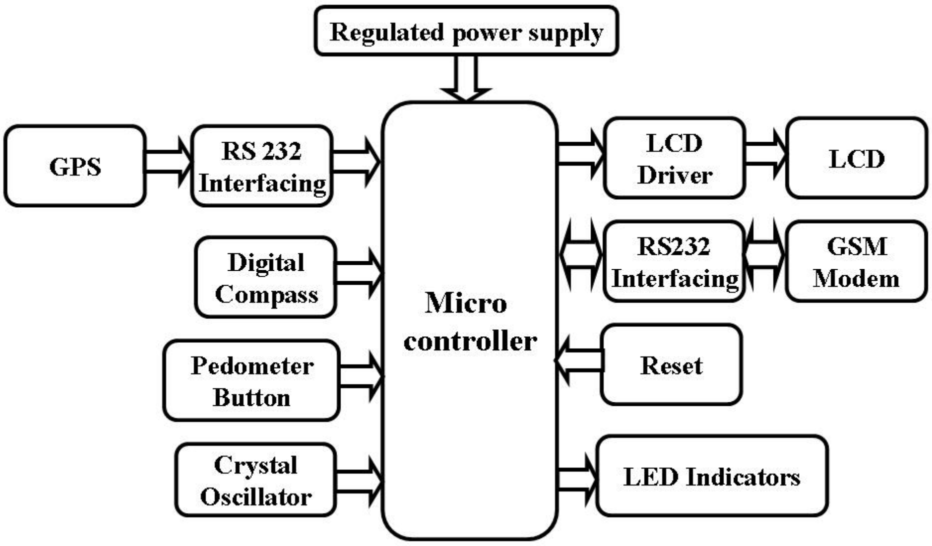
The above systems have proved to offer reliable support to the visually impaired but due to their heavy computational requirements and the financially exorbitant nature of the model employing them was infeasible.

1.2. Contributions of the paper

The models which have been developed earlier were incompatible in terms of cost-effective medium and lesser features thereby causing ineffective performance and compromising the accuracy of the device. This paper introduces concepts as follows.

1. Development of smart Blind stick by interfacing microcontroller, buzzer, ultrasonic sensor, GPS and GSM modules.
2. The prototype of this proposed model is developed using an Arduino microcontroller and software while the simulations are performed to demonstrate the performance of the stick in different conditions.
3. To automate the stick functionality Arduino board is used as a microcontroller, which is tested in real-time.
4. The proposed model is cost-effective and is incorporated more features compared to previously developed blind sticks.

A Handheld Inertial Pedestrian Navigation System With Accurate Step Modes and Devices Poses Recognition



2. Proposed smart stick model

This section gives details about various components and how they are interfaced to obtain the final model. The first component is the sensor that provides real-time data about different parameters. The sensor is the ultrasonic sensor which captures the reflected rf waves which it transmits to identify the presence of any obstacle. The microcontroller which is used is Arduino, Arduino is used due to its reprogrammable nature and its cost-effectiveness compared to other microcontrollers. The sound system is always limited to the users hearing as the user needs to be focused on the audio commands while outdoors or when in use.

2.1. Components

The components that are shown in the above diagram have diversity in their path of useability which has been explained further

Sensors: Sensors pick up the changes in the environment surrounding the sensor due to external stimulus and send it to the microcontroller for further processing.

1. Ultrasonic Distance Sensor: It transmits ultrasonic waves into the environment and pickups up the reflected waves to calculate the effective distance from the sensor to the object. This sensor helps in identifying the distance between two objects. It is similar to SONAR and other such devices. Since it is ultrasonic its waves travel faster than normal sound and it is not affected by external noise. With a range of 20 meters, it can be used to detect any sudden obstruction in the path in real-time.
2. Passive Infrared Sensor: This sensor detects when there is a sudden emission of light in the users path. This sensor can be used to detect any sudden appearance of vehicles. This sensor detects by collecting environmental light data.
3. Digital Compass Sensor: This sensor is used to obtain the Directional data of the user. This sensor gives the data about the direction in which the user is heading, this can be used for navigation purposes. A digital compass consists of an electromagnet which helps it in identifying the direction it is in now.

Buzzer and notification receiver: Buzzers are mechanical, electromechanical or piezoelectric devices which have been used for notification typically, hence they are used for notification purposes here as well. It is used to generate different frequency sounds for different sensors in different conditions.

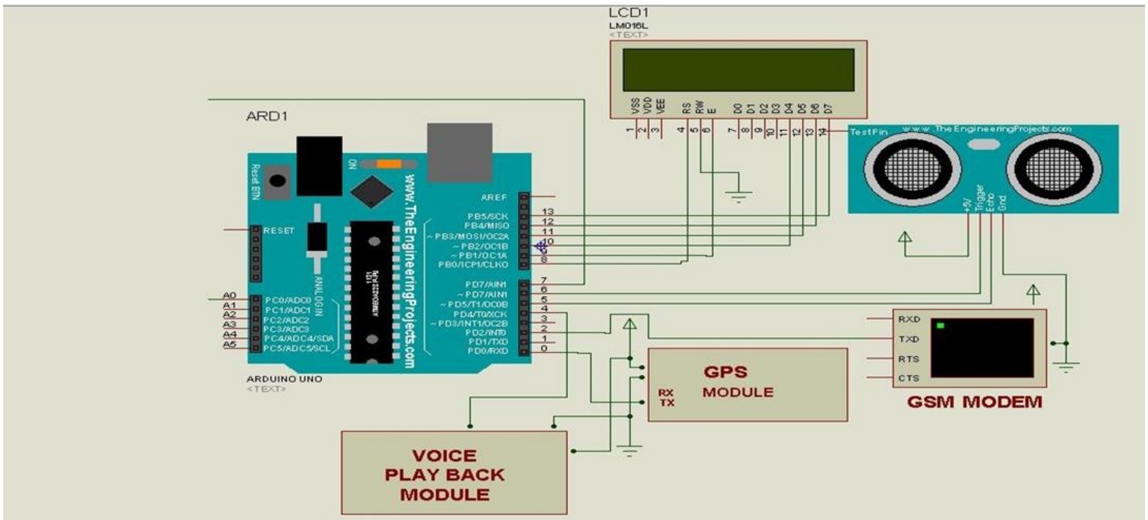
GSM and GPS module: GPS module is used to obtain the location data of the user and store it, this stored data is sent to the microcontroller for further processing, which is sending it to the GSM module where the GSM module is used to send the location data of the user to the concerned subject via SMS.

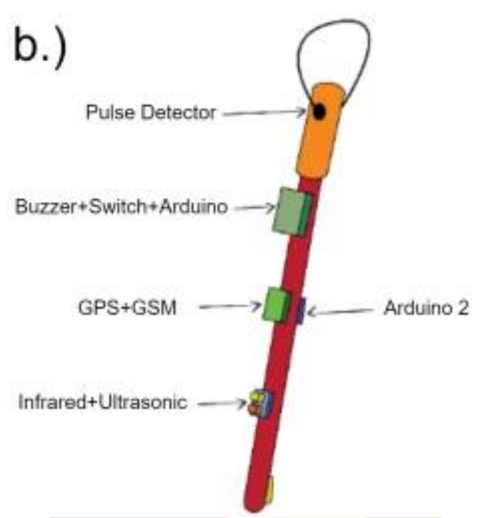
Audio module: This module is connected to the Digital compass, it announces the direction the user is headed in terms of (North, South, East and West). This is interfaced so that the user can use these inputs for navigation.

Microcontroller: The microcontroller used here is a standard Arduino UNO microcontroller. It is an Atmega328p microchip-based open-source board. It had 14 I/O ports which are both analogue and digital. It has a very extensive function in commanding GPS and GSM in one module and the buzzer in another module. It receives responses from different sensors and commands the other components to act accordingly. Since the Arduino is reprogrammable it comes in handy for a large range of usage. This is why Arduino was considered, a sustainable microcontroller available at our disposal. And since other microcontrollers contain built-in RAM it makes them more expensive.

GPS and GSM Enabled Smart Blind stick:

a.



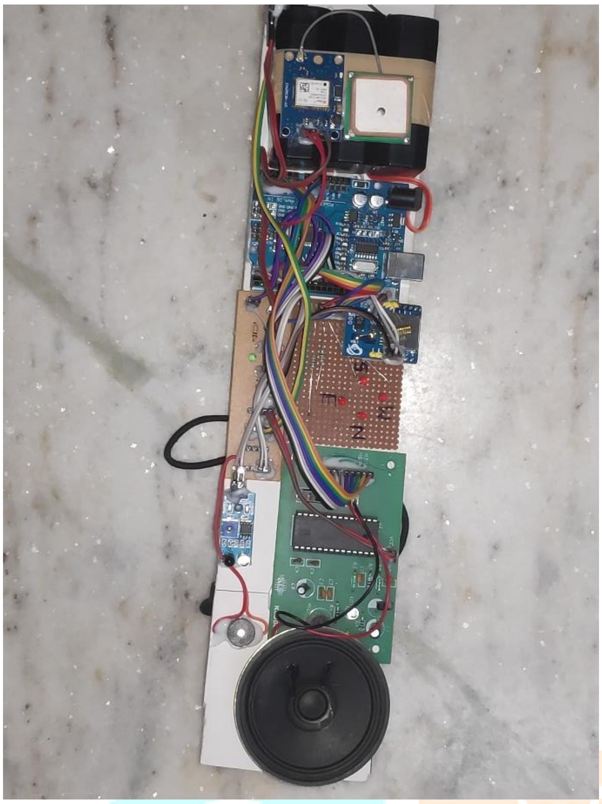


a. Circuit diagram for the proposed system b. Smart stick prototype.

2.2. System Integration

The whole system can be divided into two modules. Each module consists of an Arduino microcontroller. The first module contains an ultrasonic sensor, IR sensor, Digital compass sensor, microcontroller and Buzzer. Here these components are interfaced in such a way that whenever the ultrasonic sensor detects any obstacle or the IR sensor detects any vehicle coming in the users direction the microcontroller commands the buzzer to beep in different tones for different sensor outputs. The second module contains GPS, microcontroller and GSM modules. Here these components are interfaced in such a way that the GPS module obtains the location of the user and stores it once the location of the user is obtained then the microcontroller transfers it to the GSM module and commands it to send the data to the concerned subject via SMS. The SMS is sent to the concerned subject twice every minute and whenever the signal is lost the last known location of the user is sent to the concerned subject. Hence the system proves to be more accurate and advanced when tested in real-time scenarios. The modules are arranged in such a way that they allow the components to be put in the correct position which would facilitate cost reduction.

Smart Blind Stick:



Conclusion

A smart walking stick for visually challenged people has been proposed in this paper. This proposed model consists of sensors, microcontroller, GPS, GSM and buzzer components. The prototype of this device is presented which shows its comfortable design and efficacy for its usage by the needy people.

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