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Smart Cane Stick for Visually Impaired Persons Along with Geographical Location Tracing System

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Abstract

Most of us are blessed with an incomparable god gifted sense of vision but unfortunately some people are struggling with visual impairment. According to a survey done by WHO, 285 million people are estimated to be visually impaired worldwide: 39 million are blind and 246 have low vision. To make life a bit easier for such people, we came up with a design of an intellectual and smart blind cane stick linked with geographical location tracing system. This cane stick is incorporated with several sensors (such as ultra-sonic sensors and water sensors) for obstacle prevention and also provides a speech navigation output (by using ISD1820 recording and playback module in conjunction with Arduino UNO). This proposed device can be used to assist visually impaired persons to travel with the same ease and level of confidence as that of a sighted person. An extra facility of geographical location tracing system is integrated with cane stick so that in case of an emergency, tracking location of blind person would become very easy for their relatives. CAD model of cane stick is designed on CATIA V5.

Keywords: Arduino UNO, CATIA V5, GPS system, GSM/GPRS chip, ISD1820 Module, Ultra-Sonic Sensors, Water Sensors

I. INTRODUCTION

Since the evolution of human race, "vision" has been a very important sense amongst all the god gifted senses and will always be. Without vision, life changes drastically into difficulties and struggles and nobody knows it better than a visually impaired person. Most of us are blessed with this incomparable god gifted sense but unfortunately some people are struggling with daily routine works because of visual impairment. There are a wide range of tools, techniques and gadgets to help blind persons in navigating their ways with some reduced difficulties. One such most conventional help for person with visual impairment is the white cane stick (a white stick with a red end) made from seasoned wood (Figure 1). The main disadvantage of these guides is less scope of movement and further no information is passed on back to its user.

Fig. 1: Conventional white cane stick

Orientation and mobility specialists can also help blind people to practice travelling on regular routes which they use frequently, such as the route from one's house to a nearby grocery store. Familiarity with an environment or route makes it much easier for a blind person to navigate effectively and successfully. Main difficulty arises when blind person has to travel a completely new and an unfamiliar place.

So, "designing of intellectual and smart cane stick" comes out to be a very crucial area for research and development.

II. PROBLEM DESCRIPTION

With the rapid growth of cutting edge innovation, both equipment and programming front are able to give smart route abilities to a blind person. Lately, there has been a significant account of the use of Electronic Travel Aids (ETA) technology. ETA is an assistive technology, serving the purpose of enhancing mobility (along with safety and ease) for the blind pedestrian. However, many problems are associated with currently available devices. Firstly, the sound of various pitches and tactile vibrations being used to encode the information comes out to be esoteric for blind persons and they find it very difficult to understand. Secondly, most blind users find it worthless to invest thousands of dollars in cane stick and get just a slight improvement in navigation performance. Also, the additional worry of maintaining an expensive battery operated system checks the use of such ETAs.
So, all these problem calls for a device to be fabricated, that is highly efficient in mobility navigation and is affordable in cost as well.

Device proposed in this paper is comparatively very less costly and is also incorporated with a unique (also very easy to understand) feature of "voice playback module", which means that when an obstacle is detected, speaker will send a voice output as "obstacle ahead". Design is very light weighted as it contains light weighing components such as Arduino UNO board, ultrasonic sensors, etc.

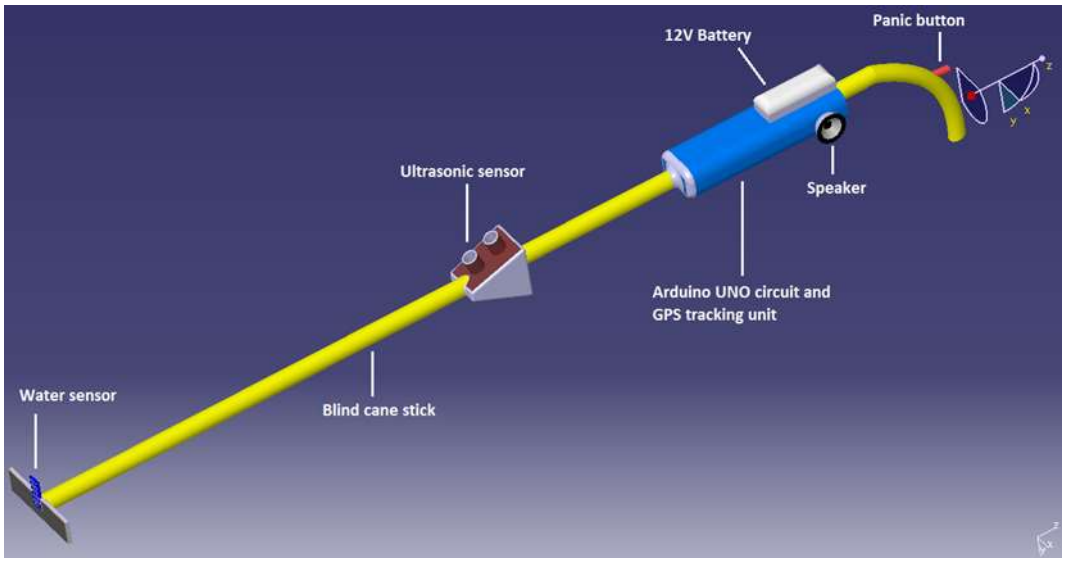

Fig. 2: CAD model of intellectual and smart cane stick

III. PROPOSED SYSTEM ARCHITECTURE

Following flow chart shows the flow of information from obstacle detection to the user end:

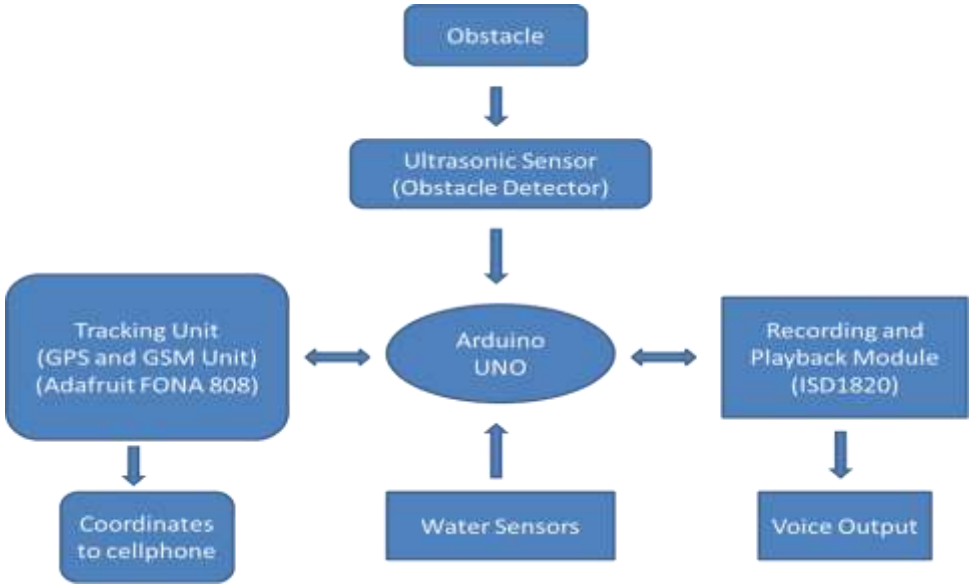

Fig. 3: Information flow from device to the user

A. *Components Used:*

1) Arduino UNO:

In simple words, Arduino Uno is a microcontroller board based on the ATmega328 chip, in which we give some input to get a desired output. It is developed by an open source hardware and software company "Arduino". It has 14 digital input/output pins, 6 analog inputs, a power jack, a USB connection, an ICSP header, a 16 MHz ceramic resonator and a reset button. It has got everything needed to make a microcontroller work; you just have to connect it to a computer with a USB cable or power it with a battery to start operating it. The Arduino project provides an integrated development environment (IDE) to load programs into it using a dialect of features from the programming language C++.

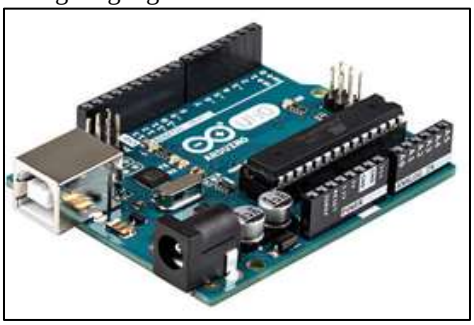

Fig. 4: Arduino UNO board

2) Ultrasonic sensor (HC-SR04 Ultrasonic Sensor Module):

This module has 4 pins viz. ground, VCC, trig and echo. The ground and the VCC pins of the module are to be connected to the ground and the 5 volts pins on the Arduino board respectively and the trig and echo pins to any digital I/O pins. It uses sonar to determine distance of an object like that of used by bats. It offers excellent non-contacting range detection with high accuracy and stable readings from 0.02m to 4m.

Fig. 5: HC-SR04 module

3) Recording and Playback Module (ISD1820):

This voice recording and playback module is a multiple-message record/playback device. It offers true single-chip voice recording with a non-volatile storage and has a playback capacity from 8 to 20 seconds. Use of this module is very easy which you could direct control by push button on board or by microcontroller such as Arduino. By using ISD1820 in conjunction with Arduino, we can easy control recording, playback and repeating of a voice message.

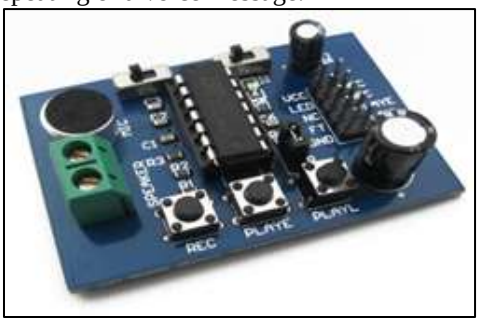

Fig. 6: ISD1820 module

4) Tracking unit (Adafruit FONA 808):

Adafruit FONA 808 is a mini breakout board that integrates GSM and GPS into a single package. It is an all-in-one cellular phone module which lets us track location, send voice messages, texts and SMS to a registered 2G GSM SIM card. It gives us the relaxation from using two separate units of GSM and GPS and really reduces weight and complications in the complete device.

Fig. 7: Adafruit FONA 808 module

5) Water Sensor:

Water sensor brick is designed for water detection. In conjunction with Arduino board, this sensor can be used to detect the presence, the level, the volume and the absence of water. Whenever this brick comes in contact with water, it gives an input to the Arduino board and then Arduino gives a voice message to the blind person through the speaker.

Fig. 8: Water sensor

IV. WORKING AND FLOW OF INFORMATION WITHIN THE DEVICE

A. Obstacle Detection:

This "intellectual and smart cane stick" is a complete guide path for a blind pedestrian and also ensures their safety in circumstances of emergency by sending their location to their relatives. Whenever an obstacle comes into the way of visually impaired pedestrian, ultrasonic sensor detects that obstacle and sends input information to the Arduino UNO board. Arduino board (in conjunction with ISD1820 recording and playback module) gives a voice output as "obstacle ahead" through the speaker and in this way blind user is informed about the obstacle. In case, there comes a watery surface in the way of blind pedestrian, water sensor comes into role and gives an input signal to the Arduino board. Again, Arduino sends a voice output (through the speaker) as "watery surface detected" to the user.

So, the problem of "confusion among various pitches and tactile vibrations" is fully solved by sending voice messages to the blind user as these voice outputs are easily fathomable.

B. Geographical Location Tracking System:

Arduino board in this device is integrated with a little breakout board (Adafruit FONA 808)) that consists of GSM and GPS in a single adorable package. This Adafruit FONA 808 is a mini cellular GSM+GPS module that tracks the location of blind person and in case of an emergency; a "panic button" is provided on the handle of stick. As this button is pressed, Adafruit FONA 808 module sends the recorded geographical coordinates to the relatives of blind person.

Relatives receive location coordinates in their registered 2G SIM number and then can trace the location using Google maps application.

V. FUTURE SCOPE

This proposed design of intellectual and smart cane stick can be further enhanced by attaching programmed guide wheels at its base. So, when an obstacle will come into its way, guide wheels will automatically turn aside assisting visually impaired pedestrian to reach his destination with more safety.

VI. CONCLUSION

This paper presents the proposed design of an intellectual and smart cane stick that assists a blind pedestrian to his destination with all safety and security. This device tries to eliminate the flaws and limitations of previously designed smart sticks and so the problem of "confusion among various pitches and tactile vibrations" is fully solved by sending voice messages to the blind user. A unique breakout board (Adafruit FONA 808) is used to enhance the accuracy and reduce the complexity of geographical location tracking system.

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