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The Smart Guide Cane an Enhanced Walking Cane for Assisting the Visually Challenged for Indoor

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ABSTRACT: -This paper presents a theoretical model and a system concept to provide of a smart electronic cane for the visually challenged person while walking. It facilitates the user with the artificial vision and object detection, also the real time assistance via. Global Positioning. Here the cane is consisting of the RFID, GPS module, sensors for obstacle detection, moisture and fire detection in their environment and to guide them towards their destination. The Atmega328 microcontroller is used for the hardware development of the Smart Cane. The overall aim of the device is to provide a low cost and efficient smart cane that alerts the visually challenged people over the obstacles with audio alerts. Also the outputs are display on the LCD.

KEYWORDS: Smart cane, Ultrasonic sensor, RFID, Atmega328.

I. INTRODUCTION

One of the most important part of human physiology is vision, as he gets the 83% of information from the environment via sight. According to the World Health Organization (WHO) statistics there are 285 billion people in world are visually challenged. While 39 billion are blind and 246 having low vision. Being visually challenged is one of the sever disability that restricts an individual's ability to integrate into the society. Due to this disability he has to depend on the external help even for the basic needs. Every day they have to ace numerous difficulties. The tasks that seems to be very simple for us becomes extremely difficult or even impossible for them. There are many rehabilitation programs for the visually challenged people but having limited success.

Normally the visually challenge people uses the walking cane. Another option that provides the best travel aid is the guide dogs. But guide dogs are still far from being affordable, also they exist for few years and somewhat difficult to take care of them. As a result only few visually challenged people have the guide dogs for guidance while walking.

Nowadays the rapid use of technology has led into the dramatic increase in the demand of its usage in our daily life. There are large number of visually challenged people that led us to develop such system in order to help them to avoid the obstructions. To provide a friendly environment our basic aim is to help the visually challenged people in visualization of an environment at ease. Keeping all this in mind we are working on the cane to make it even smarter to improve the safety of the visually challenged people and also to easy their lives. This system presents a concept to provide a smart electronic aid for visually challenged. It facilitates the visually challenge person with the object identification, obstacle avoidance, water and hot object detection, real time assistance via global positioning system (GPS) and tracing the person during emergency conditions. This prompts the user of its detection through voice indications.

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II. SYSTEM DESCRIPTION

In the following subsections we will describe the system architecture, Hardware component and software required.

2.1 SYSTEM ARCHITECTURE

The system architecture is consisting of the smart cane and the embedded pocket which will completely work as the smart guide for the visually impaired person.

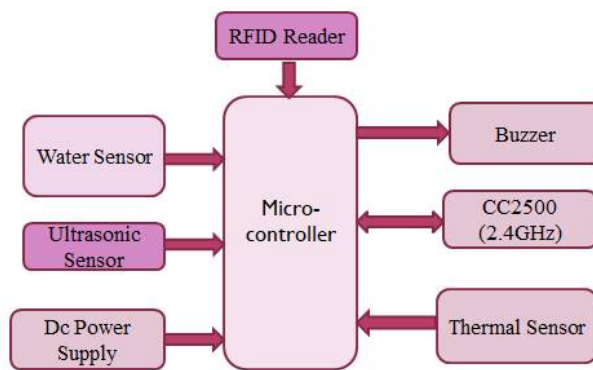


Fig 1: Block diagram of Smart Cane Module

- A. Smart Cane Module - The power supply is applied to the system is the regulated DC. Generally we preferred the microcontroller here to process all the things going in system which is the heart of the embedded system. The water sensor is connected with the microcontroller for sensing the water on the floor. The ultrasonic sensor is connected for the obstacle avoidance, the thermal sensor for sensing the fire and the hot objects. And the RFID reader for the object detection. The transceiver CC2500 is also connected to the microcontroller for the wireless transmission of the signals to the embedded pocket module. Buzzer is also connected it to help the use to find the cane if the cane is away from the user by creating the buzzing sound. This whole system is on the smart cane module.

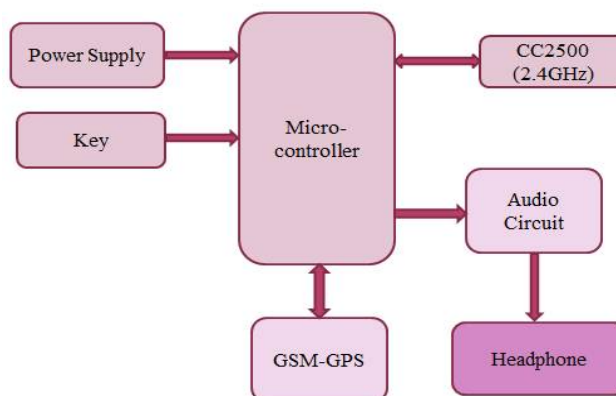


Fig 2: Block diagram of Embedded Pocket Module

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- B. Embedded Pocket Module - The power supply applied here is the regulated DC. Generally we preferred microcontroller to process all the things going in the system which is the heart of the embedded system. Key is connected with the microcontroller to make the buzzer sound from the smart cane module, the transceiver CC2500 is connected for the wireless receiving of the signal transmitted from the smart cane module, the GSM-GPS system is connected to the microcontroller and also to the headphone for the audio clues. This whole system is on the embedded pocket module.

2.2 HARDWARE COMPONENTS

- A. Atmega328 microcontroller - Atmega328 is 8bit AVR microcontroller with 131 powerful instruction. Many instructions execute in one machine cycle. It is a 28 pin microcontroller with 32KB ISP flash memory, 2KB SRAM, and 1 KB EEPROM. 23 programmable I/O pins divided into three ports named as Port B, Port C and Port D. The maximum operating frequency is about 20 MHz.
- B. Ultrasonic sensor – here we are using the HC SR04 as ultrasonic ranging module that provides 2cm to 400cm non-contact measurement. The ranging accuracy reaches to 3mm, it is powered by 5v power supply. The module consisting of transmitter, receiver and control circuit. It has a high pulse of 10 us and operates at 40 KHz.
- C. Temperature sensor -LM 35 is the temperature sensor used for temperature sensing. It is consisting of 3 pins name as Vcc, Vout and GND. Operates from 5V. The o/p voltage can be easily interpreted to obtain a temperature in Celsius.
- D. RFID reader –EM-18 reader module is used for the object identification. It has a baud rate of 9600 bps. Operating frequency of 125 KHz. It requires the supply voltage of 4.6V to 5.4V DC. It reads the distance about 6 to 10 cm.
- E. GSM-GPS module –SIM900 is the high quality GSM/GPRS that works on 850/900/1800/1900 MHz. Consisting of 3 wires Tx, Rx and GND. Consisting of built in sim card holder. Requires the voltage of 12V. Having the configurable baud rate of 9600-115200 bps.
- F. Voice kit –TTS circuit used to convert the text into speech form. Normally it is used for all embedded audio applications. Play high quality audio of 4.41 KHz. Works on 5V DC and having a baud rate of 9600 bps.
- G. CC2500 –CC2500 is a 2.4 GHz transceiver. This RF module can be used for the two way or multiple way wireless data transmission. Works on 4.5 to 5.5 volt. Operating range is 30m. The baud rate of 9500 bps.
- H. 7805IC –7805 is a voltage regulator IC that maintains the output voltage at a constant value. It provides +5v power supply.
- I. LCD -16x2 LCD means it can display 16 characters per line and there are 2 such lines. Here the o/p is display on the LCD.

2.3 SOFTWARE REQUIRED

- A. Arduino IDE - This software is used for programming the Arduino firmware microcontroller.
- B. PCB Artist– It is used for designing printed circuit board.

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C. Embedded C Software - This software is used for programming in embedded application.

III. IMPLEMENTED SYSTEM



Fig 3: Implemented system

Above figure shows the implemented system consisting of the smart guide and the embedded pocket module.

IV. WORKING

Here the working is divided into the smart cane module working and the embedded pocket module working.

3.1 WORKING OF SMART CANE MODULE

The basic working principal of the guide cane is detecting of obstacles by the use of ultrasonic sensors, detecting the water on the floor, sensor temperature of the objects, detecting the furniture at indoor side and transmitting the signal to the receiver kept at the person.

There are three sensors placed at the bottom positions for the guide cane which are connected by a circuit consisting of the microcontroller, power supply, sensors and output circuits. The ultrasonic sensor gives out a pulse of ultrasonic waves collides with the obstacle in front of the user and sends an echo back as happened with the Bat. This echo triggers the receiver and gives out a high output. The controller measures the time for this travelling and calculates the distance of the obstacle from the speed, time and distance relationship. The controller then gives an output to buzzer, display the message on LCD with transmitting the signal to the small pocket kept with the person wirelessly.

The other two sensors are moisture sensor and the temperature sensor works on the analog principals. Temperature sensor used is LM35 which converts the temperatures as physical quantity to the analog voltage. The calibration for temperature sensor is as, for 1 degree Celsius it will give an output of 10mV. The analog voltage is converted into the digital form. The controller then takes the decision according to the program to give an output to buzzer, display the message on LCD with transmitting the signal to the small pocket kept with the person wirelessly. The moisture is sensor by the conductivity in the two probes connected right at the bottom of the cane, hence it will give an analog value. The analog voltage is converted into the digital form. The controller then takes the decision according to the program to give an output to buzzer, display the message on LCD with transmitting the signal to the small pocket kept with the person wirelessly.

RFID is an acronym for "radio-frequency identification" and refers to a technology whereby digital data encoded in RFID tags or smart labels (defined below) are captured by a reader via radio waves. RFID is similar to barcoding in

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that data from a tag or label are captured by a device that stores the data in a database. RFID, however, has several advantages over systems that use barcode asset tracking software. The most notable is that RFID tag data can be read outside the line-of-sight, whereas barcodes must be aligned with an optical scanner. The RFID cards will be applied on the furniture and the tag is on the cane at the middle. The RFID will detect the card and then provides information to the controller. The controller then takes gives an output to buzzer, display the message on LCD with transmitting the signal to the small pocket kept with the person wirelessly.

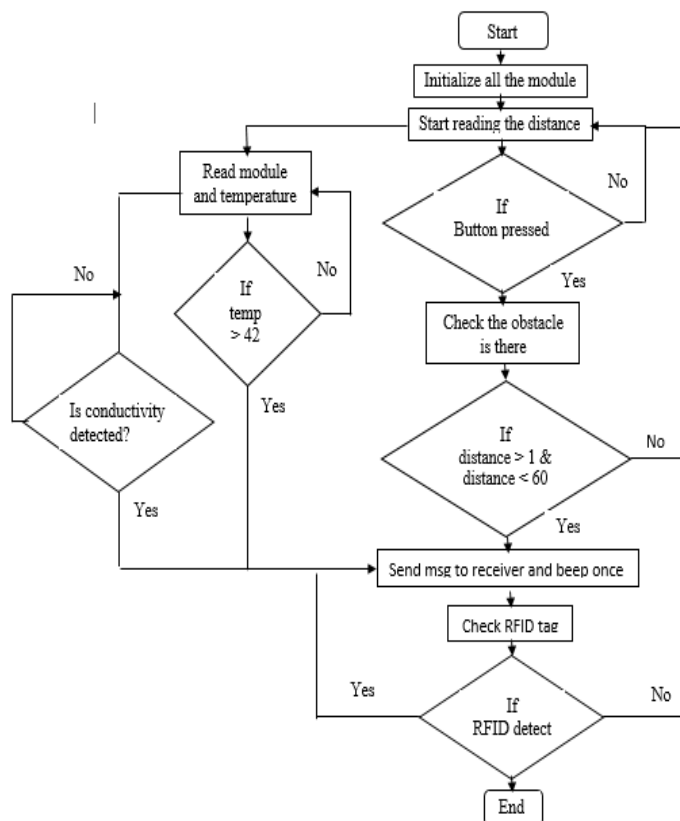


Fig 4: Flowchart of Smart Cane Module

3.2 WORKING OF EMBEDDED POCKET MODULE

Here, in this module the working principal is tracing of the location of the blind man using GPS and sent that location when ask by the remote user. Also this module includes the voice alert on the signals receives from the cane. The transmitter and receiver used here are the CC2500 module which is works as both transmitter and receiver. All the signals sent by the cane is receives by the CC2500 module on the receiver and gives the output to the microcontroller. The microcontroller read that data and gives output to the text to speech converter module and also displays the message on the LCD.

The system is basically functions in decoding the data sent by the satellites into GPS which contain the position, speed etc. of the device. Here we only need the position; we can obtain them via latitudes and longitudes. In this module we had designed a system for sending the location of the blind person via SMS to his/her relative. We have used a GSM system, and to make it function we need to program it and will be making use of certain algorithm for GPS, GSM based system. The remotes person say the relative of the blind person would have to send the message as

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'Location' via his own cell-phone. The system receives that SMS and then checks the SMS is liable or not. The controller then takes the decision according to the program to give an SMS output to the remote user with Location.

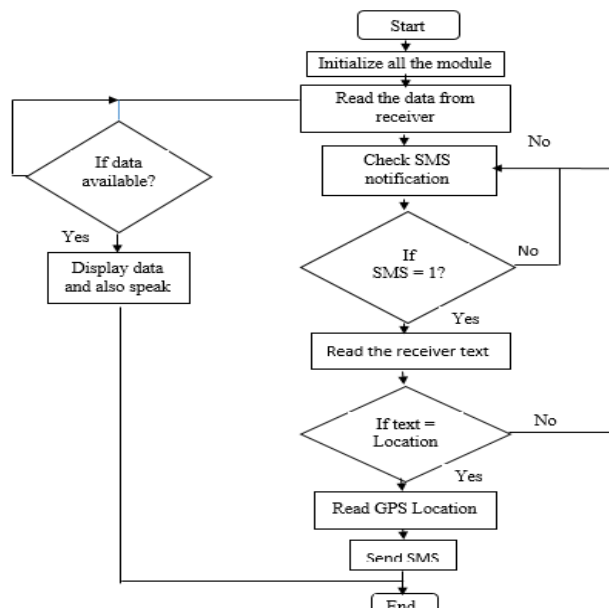


Fig 5: Flowchart of Embedded Pocket Module

V. RESULTS



Fig 6: Obstacle is detected

Above figure shows the obstacle detection through the HC SR-04 ultrasonic sensor. The ultrasonic sensor generates the high frequency waves and evaluate the echo which is received by sensor. It calculates the distance of the obstacle and display on LCD.



Fig 7: Moisture is detected

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Above figure shows the moisture detection through water sensor. Here the electrodes are fitted at the bottom of the stick for the water indication. These electrodes give the information of water sensing to the visually challenged.



Fig 8: Hot object is detected

Above figure shows the hot object detection through the LM 35 temperature sensor. LM35 is a temperature sensor that outputs an analog signal which is proportional to the temperature. The calibration for temperature sensor is as, for 1 degree Celsius it will give an output of 10mV.



Fig 9: Table is detected

Above figure shows the particular object detection with the RFID reader. Here the digital data encoded in RFID tags are captured by a reader via radio waves and provides information to the visually challenged person on the LCD and voice alert.



Fig 10: The results from GSM/GPS module

The figure shows the location of the visually challenged person by GSM/GPS. Here the controller sends SMS output to the remote user with Location in the form of latitudes and longitudes.

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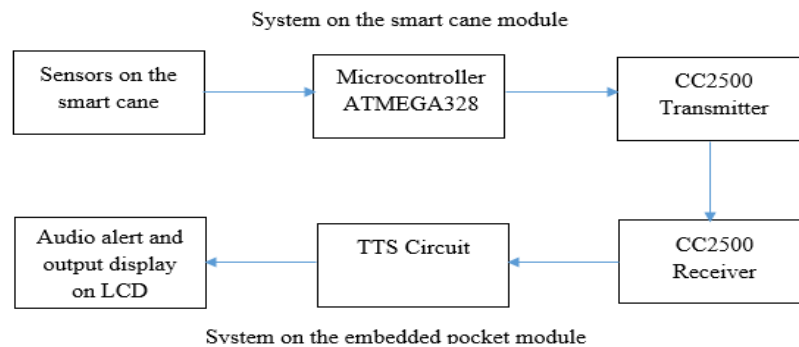


Fig 11: Data flow diagram of smart cane

The figure shows the dataflow diagram for smart cane system. Here the smart cane module transmit the message of the sensors to the embedded pocket module via. CC2500 transceiver in text form. While these messages from the sensors are received by the embedded pocket module and it displays the results on LCD and also guides the visually challenged person with the voice alerts.

VI. LIMITATIONS

There may arise difficulties in adjusting to a new system like guide cane as they are quite different from the existing white cane. Range limitation of the RFID cards as we are using passive cards here. ultrasonic sensor not having the wide angle. There may arise Beginner can face difficulty in detecting the voice output. Also the user must be well trained and know the functions of smart cane.

VII. CONCLUSION AND FRUTURESCOPE

The implementation of this system can bring about the great changes in the daily lives of the visually challenged. This system has the prototype that can detect object and obstacle and feeds warning back in the form of message and voice. The cost effectiveness and the versatility of this system make it more adaptive and easy to use. Our smart cane will allow them to move freely and can be useful to cut down many problems from their daily life. Once adopted smart cane pose the wonderful medium of assistance for the visually challenged. Besides the satisfactory achievement of this goal, we have certain recommendation involve in our future scope like increasing the range and angle of ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles. Also improvement of the voice quality and voice rates. This device can be extended for the total campus.

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