SMART CANE

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Abstract- Blind people all over the world need some guidance to navigate around the environment.The Smart Cane was designed as an enhancement for the traditional white cane used by the visually impaired people for navigation. This smart cane will provide such guidance effectively by using arduino and sensors. The traditional white cane has been effective device for the visually impaired person to make them independent.But it has some limitations that it doesn't detect obstacles above the knee.The smart cane can automatically detect knee level obstacles in front of the person and intimates through voice alert.Ultrasonic sensors with arduino is used for detecting obstacles.According to a recent report of the World Health Organization, 81.7% of all 39 million blind people worldwide are 50 years and older. These elderly blind people have an risk towards walking disabilities.This smart cane can provide better physical assistance to them.. In addition GPS and sms message system for identifying the location of the blind people and to send message to the saved numbers in case of emergency will also be included.

Keywords: Smart cane, visually impaired, Ultrasonic sensors

INTRODUCTION-I

According to world health organisation, around 285 million people are affected with visual impairment worldwide. Visual impairment is a severe disability that restricts an individual's ability to integrate into the society. Visual impairment simply led to institutionalization and discrimination from the society. The very nature of the disability is such that it forces the disabled person to depend upon external help even for basic actions.

The purpose of this project is to design a smart cane with ultrasonic sensor and global positioning system for the blind. For mobility system, it is equipped with ultrasonic sensor, HCSR04 and vibrating motor. Ultrasonic sensor will send the trigger pulse to detect obstacles. When an obstacle is detected, signals will be sent to vibrating motor and activate it. The vibrating motor will vibrate with different strengths according to the distance of the obstacle. The microcontroller used in this system is Arduino UNO. The prototype of smart cane was developed to increase the mobility of the blind people with navigation system.

Global positioning system (GPS) is a satellite-based navigation system that stands from satellites that orbit in the space. GPS offers the capability accurately to determine the location anywhere on earth. The GPS system is able to provide three dimensional positioning, time and location for navigation purpose. GPS is mainly used in five purposes: navigation, tracking, location, mapping and timing. Ultrasonic sensor works similarly to the principle of Radar which evaluates the attributes of a target by interpreting the echoes from sound waves. An ultrasonic sensor produces high frequency sound waves thereby calculating the echo which is received back by the

sensor. The distance is calculated by measuring the time interval between the sending signals and receiving signals.

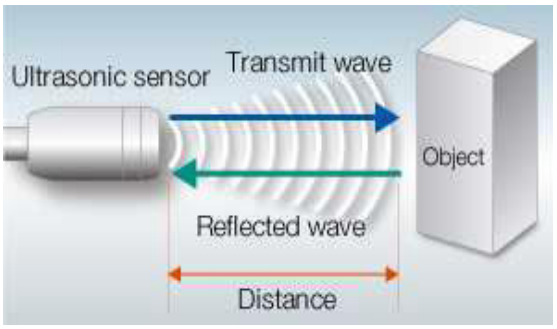


Figure 1

The preferred walking aid for visually impaired is the traditional white cane. It was recognised as the standard gear for the visually impaired. It can be used to detect holes, staircase, drop-off and slope of the ground or any objects around a person. When using the white cane, a person will hold one end of the cane and the other end is touching with the ground.

It has its own set of problems like it can't detect the obstacles over knee height and it cannot provide geographical surroundings. The limitation in white cane is that the information's are gained by touching the objects by the tip of the cane. The traditional length of a white cane depends on the height of user and it extends from the floor to the person's sternum.

White cane can only sense an obstacle up to 1 meter. It is unable to warn the user when there is an obstacle in their path until the user has touched it. Some incidents happen due to blind people did not sense the existence of an obstacle. The incidents might lead to serious injury on blind people. Blind people also face great problems in moving from one place to another in the town and only way for them is guide dogs which can cost about $20,000 and they can be useful for about 5-6 years.

An affordable knee-above obstacle detection named as smart cane was developed which provides an effective electronic travel aid for the blind people. This paper proposes the design and develops a portable stick for the blind people for easy use and navigation in public places. Using ultrasonic sensors it would be an efficient solution to detect the obstacles with maximum range of 7 meters and 45 degree coverage. Rechargeable batteries are used to make the device work for long time with minimum power. The goal of this project is to extend the existing Smart cane with GPS and sms message system for identifying the location of the blind people and to send message to the saved numbers in case of emergency.

LITERATURE SURVEY-II

This section describes the related works done on the development of smart cane for visually impaired.

Anu Thambi et al [1] proposed the smart device against the white cane which is difficult for visually impaired people. The smart cane is designed to provide better walking experience. Bluetooth enabled obstacle detection module is supported with heat enabled detection module. An ultrasonic range finder helps in detecting obstacles. Obstacle is identified using SRF05 ultrasonic sensor. The distance is measured in centimetres and according to the distance, the user hears 'stop and obstacle' for nearby and distant obstacles respectively. To warn the user from moving obstacles, haptics module is used. Smart cane consists of Bluetooth module, obstacle detection module and heat detection module.

Wolfram Burgard et al [2] found that the navigation in complex and unknown environments is a major challenge for the blind people. The most popular conventional navigation aids is the white cane. The technologies are developed in the field of robotics and have a potential to assist the blind

people in complex navigation tasks as they provide the information about the obstacles. The contribution of this paper is a smart walker that enables blind users to safely navigate. The experiments validated the technique to guide the users to their desired goal in less time and with a shorter travelling distance. The robotic techniques are applied for the purpose of navigating the users.

Sultanate of Oman et al [3] proposed the technology for improving the flexibility and safe movement for the people different aspects. This paper presents an ultrasonic stick for blind people so that they can live independently. When the ultrasonic sensor detects any object or obstacles, it will activate the buzzer and the vibration motor automatically. In addition, the stick is equipped with GPS and SMS message system for identifying the location of the blind people. On detecting obstacles the sensor passes the data to the microcontroller.The proposed system is economical and efficient in comparison with other systems so far.

Durbha Srikar et al [4] concluded that the white cane is the most successful and widely used travel aid for the blind. The main problem with the white cane is that users must be trained. The white cane is used to detect the obstacles on the ground, uneven surfaces, holes, steps and other hazards. This device focuses on bringing about an approach which would make a visually impaired person to walk through busy roads and help identify obstacles without any trouble.

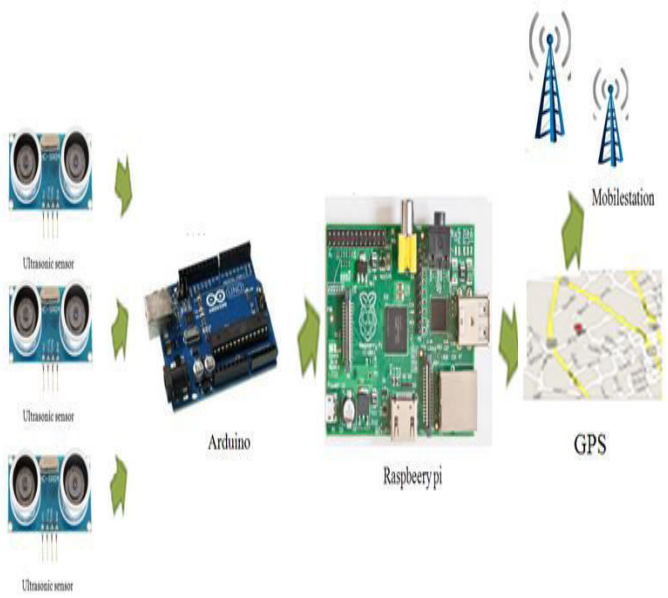
PROPOSED SYSTEM-III

Our proposed system consists of two main modules

- Obstacle Detection module
- GPS module

The obstacle detection module involves two major units. One is interfacing of Arduino Uno with three ultrasonic sensors to measure the distance between the obstacle and the user. The other is to produce an alarm using buzzer to intimate the user. Arduino Uno is a micro controller built based on ATmega328 in AVR 8 bit RISC architecture. It has a number of facilities for communicating with computers. The output of the arduino programming can be visible through the serial monitor of the Arduino IDE software which is a open source software.

Here the Figure below depicts the proposed design for the smart cane project.



SYSTEM ARCHITECTURE

I. Obstacle Detection Module:

Ultrasonic sensor is the most widely used sensor for measuring the distance between the obstacle and the user. The proposed system uses three ultrasonic sensors to calculate the distance .The sensors are fitted in left, right and front positions. The cane is designed in such a way that each time the obstacle moves, distance is measured.

The obstacle detection is carried out using HC-SRO4 ultrasonic sensor.

. **Figure 3**

Once triggered, the ranger produces an eight cycle sonic burst at 40 kHz frequency. Simultaneously, the echo pulse is raised high until the last sonic pulse sends back the reflected wave. Once the duration of this echo pulse is found, distance can be easily calculated using this time. Once the distance is calculated, piezo buzzer produces an alarm to the user. If a particular distance ranging from 2 to 30 cm is detected then the buzzer produces a sound and the user navigates accordingly.

A trigger pulse burst of 10µs is given to trigger pin of module from the Arduino. The module generates 40KHZ ultrasonic burst of 8 cycles which is transmitted by the Transmit Transducer. If any object detected, the burst returns back which is received by the Receive Transducer, sensed by Echo line and is used for distance calculation.

Warning alarm using buzzer

Buzzer

It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

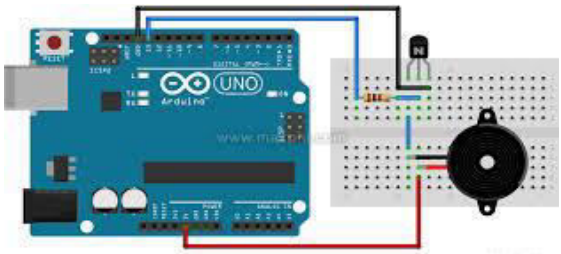
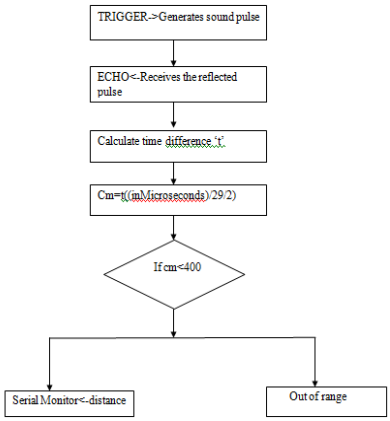


Figure 4

Buzzer Interface with Arduino

When there is an obstacle sensed using ultrasonic sensor,the piezo buzzer produces an alarm as an intimation to the user.If the three ultrasonic sensor is between the range of 2cm to 30cm,then the peizo buzzer alerts the user by means of alarm.

ALGORITHM FOR OBSTACLE DETECTION:



The time duration for which the echo pulse remains low gives the time takes by the ultrasonic pulse to travel twice the distance. As the range of ultrasonic sensor is between 2cm to 400cm, beyond that distance will be out of range.

Steps:

The algorithm of distance detection using ultrasonic sensor is:

Step 1: Send a predetermined number of pulses at a predetermined frequency.

Step 2: Wait for all the pulses to return without a significant change in frequency.

Step 3: Record the time taken as T.

Step 4: Determine the distance D between the user and the object using the given formula.

Step 5: Provide warning if necessary

The distance is calculated by the formula:

D = T/58.2

Where D = Distance in centimetres

T = Time taken by the pulse to return

II. GPS Module:

The location tracking is done by using the GPS (Global Positioning System).The GPS tracking unit is a device that uses the global positioning system to determine the precise location of the person, or other asset to which it is attached and to record the position of the asset at regular intervals. The recorded location data can be stored within the tracking unit, or it may be transmitted to central location database, or internet-connected computer, using a cellular (GPRSorSMS), radio or satellite modem embedded in the unit. Global positioning system is used to give direction and distance to the destination through audio output.

Figure 5

The information on the walking path is extracted and analysed to trace the location of the user. First, by fixing the latitude and longitude positions we need to determine the location of the user and to send message to the saved numbers in database in case of emergency.

EXPERIMENTAL RESULTS-IV

The distance is measured from three sensors through serial monitor of the Arduino IDE and analysed and intimation is made to the user.

Figure 6

While moving with the smart cane stick, the sensor fitted inside the stick will detect the obstacle as shown in the figure 6 by emitting the sound frequency waves.

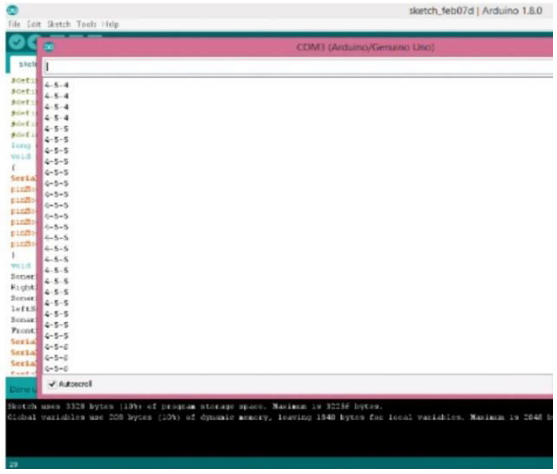
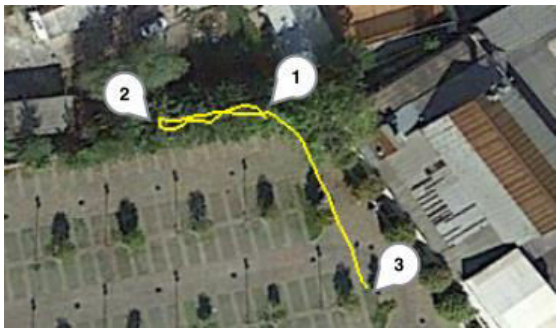


Figure 7

The distance is displayed as mentioned in the figure 7. It shows the distance measurement from three ultrasonic sensors.



The marked points in the above figure shows that the user moves with the stick and the location is identified using GPS. The results presented in this paper marks the beginning of our efforts to build an efficient travelling aid that allows the visually impaired to negotiate everyday environment.

CONCLUSION-V

In this paper, an efficient design for the development of smart cane is presented: the main idea of the project has been suggested by the visually impaired. The proposed design can able to detect the knee level obstacles and provides a better GPS navigation for the user. The sensors are mounted on the holding place of the user in the stick. In future, this smart cane prototype can be extended by adding Pit detection module to detect pits in the path and to detect fast moving obstacles.

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