A smart sensing stick to assist blind persons for their daily activities

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Abstract

Blindness is a lack of vision that cannot be corrected with glasses or contact lens. Visually challenged people faces lots of problems including navigation from one place to another. In this paper we introduced a smart walking stick which includes ultrasonic sensors, water level sensor and GPS module. Webcam is used to capture a short duration video of the present location of the blind people and is sent to the receiver. GPS tracking is done via blynk mobile application which uses latitude and longitude to locate. This smart stick is too easy to handle and very convenient to use

Keywords: *Ardiuno, GPS, Blind, Ultrasonic sensor, Vision, Wi-Fi, Buzzer, blynk app*

1. Introduction

Each typical person sees, tunes in and after that responds to the circumstances by talking himself out. Individuals, fundamentally the hard of hearing and the imbecilic, depend on some kind of gesture based communication for imparting their emotions to others. For the most part idiotic individuals utilize gesture based communication for correspondence, yet they discover trouble in speaking with other people who don't comprehend communication via gestures. Thus, there is a boundary in correspondence between these two groups. This venture intends to lower this obstruction in correspondence.

It turns into the issue for two people who knows two diverse dialects, so it turns into an issue to chat with each other thus they require an interpreter physically which may not be constantly helpful to orchestrate and this same sort of issue happens in the middle of the Normal Person and the Deaf individual or the Normal Person and the Dumb individual. The fundamental point of the venture is to build up a financially savvy framework which can offer voice to voiceless. With the proposed work is signaled are changed over into discourse. It implies that correspondence boundary between two unique groups can be made productive.

Blindness means the inability of visual perception due to physiological or neurological factors. Many blind people have trouble maintaining a proper circadian rhythm due to the lack of visual input to their brains. In one's life navigating from one place to another is one of the most important and fundamental functions. Visually challenged people face this problem on a day to day basis. Many blind people are dependent on others for navigation.

To be categorized as blind, there is a total loss of vision. Blindness cannot be corrected by simple visual aids such as glasses.

The Assistor is a smart walking stick that has two types of input sensors: ultrasonic sensors and image sensors, which continuously feeds information to the smart phone. The ultrasonic sensors are used to detect how far the objects are from the person and the image sensor finds what those objects are with precision. The data from the sensors are transmitted to the Smartphone through Bluetooth communication. A servo motor is used for the mobility of the stick. A microcontroller is used to interface the hardware components with the smart phone.

The power of vision is one of the most significant parts of human physiology. Our eyes are the key to our surroundings. Unfortunately, approx 285 million people are estimated to be visually impaired worldwide, of which 39 million are blind, according to a report published by the World Health Organization (WHO).82% of blind people are of the age of 50 and above. Moreover, 90% of visually impaired people belong to the developing countries. The earliest form of navigation tool for the blind has been in the form of a walking stick. But the drawbacks of using it are the lack of necessary skills, Cost and training period. With the advances in technology, it has become possible to design and develop technological solutions that can help a visually impaired person to navigate freely. Various research works have been carried out for developing such smart blind stick.

A navigation tool was developed that uses GPS, voice module and an ultrasonic sensor for obstacle detection. It guides the person using the stick by providing directions. It uses an ARM processor which contains more memory and has a high operating speed. But, this system cannot be used indoors since there will be no GPS detection. Another proposes a navigation tool using proximity sensors, ultrasonic sensors, GPS module, stereo cameras and dual feedback system- auditory as well as vibratory circuit. The stereo cameras are mounted on a helmet to inform about the height of the objects in the path. The proximity sensor and ultrasonic sensor unit are for the detection of obstacles. The GPS module determines the location of the obstacle with respect to the blind. The drawback with this system is its cost, which is not affordable for people living in developing or underdeveloped countries. A smart stick has been developed where the hardware consists of a microcontroller incorporated with ping sonar sensor, proximity sensor, wet detector, a micro pager motor and additional equipment. This system has a new innovation for wet sensing circuit that makes it unique yet complicated and somewhat unnecessary. The Infrared Smart stick that has been developed uses IR sensors to detect the presence of staircases in the path of the blind man within a range of two meters. An earphone has been connected for voice warnings on detection of obstacles.

The problem with this tool is the noise inclusion that makes it difficult to assure the authenticity of its functionalities. A sound and touch based smart cane has been developed using ultrasonic rangers to detect obstacles or blocking object. The distance between the blocking object and the visually impaired person is sent to an Android device using Bluetooth in the form of voice notifications and warnings. Haptics module is used to notify the user of the presence of any moving object. The problem with the project lies in its cost and complexity.

2. Related Work

Prof. R. RItkarkar presents a system that will automatically identify the hand gestures and also convert them into respective voice output which helps the dumb people to communicate easily. Skin colour segmentation is used to for gesture to voice conversion. An camera is used to capture the image of hand gesture in which Image segmentation, feature extraction algorithm are implemented to recognize the hand gesture. According to recognized hand gestures, corresponding pre-recorded sound track will be played.[1] Aarthi M Developed a flex sensor-based gesture recognition module to recognize English alphabets and few words and a Text-to-Speech synthesizer based on HMM is built to convert the corresponding text which helped the dumb people to communicate with others.[2] Vijayalakshmi P Proposed an vision based approach in which they recognize 26 gestures from Indian sign language using MATLAB. This signs are captured and preprocessed using HSV color model and comparison is done using PCA algorithm. Thus gestures are converted into text and voice format. [3].Qutaishat Munib developed Hough transform and neural networks are trained to recognize the signs. Here the

image is converted into feature vectors which are compared with the trained set feature vectors. Using this system 92.3% accuracy is obtained in recognizing selected ASL signs. Using this system 92.3% accuracy is obtained in recognizing selected ASL signs.[4] V.Padmnabhan, proposed artificial speaking mouth for dumb people which includes motion sensor connected to the hand. Template database is fed into the microcontroller and it matches the signal produced from motion sensor and speech signal is given as output. They have also included TTS method for conversion [5].Nasser H. Dardas they are using skin detection and hand postures contours comparison algorithm along with PCA for recognizing hand gestures. Training weights are calculated from training images and compared with test weights from which shortest Euclidean distance is determined to recognize the hand gestures.[6] Shraddha R Ghorpade and Surendra K Waghamare, developed a system which converts the speech of a normal person to text and corresponding texture is displayed on display. [7]

Ahmed, S.F. Ali, designed an Electronic speaking Glove which has multiple flex sensor made up of bend-sensitive resistance elements. For particular gestures these sensors produce a change in resistance based on which a set of signal is send to AVR microcontroller and speech output is produced.[8]Ankit Agarwal, proposed an ultrasonic stick which has an ultrasonic sensor and camera. In addition to this GPS system along with SMS system is also used to know about the current location. [9] Gurubaran, designed a system called voice aided electronic stick using ultrasonic technology, GSM, GPS.[10] RuxandraTapu, they used multiscale Lucas - Kanade algorithm for tracking along which homographic transforms are used to find the camera and background motion and agglomerative clustering technique to find other movements. The obstacle classification is done by incorporating HOG descriptor into Bag of visual words retrieval frame works. [11]

3. Hardware Section

3.1. Power Supply: A power supply is nothing but an electrical circuit which is used to supply the electrical energy. Sometimes these are stated to as electric power converters

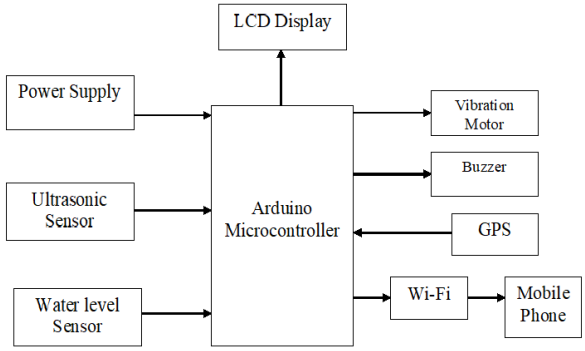

Fig 3.1 Block Diagram for Hardware section

There are different types of power supplies are available. Some supplies are stand-alone whereas some supplies are assembled into larger devices. Here the proposed system uses 5V DC power.

3.2 Transformer: A transformer is an electrical device which transfers electric power through electromagnetic induction. It is a fixed device. Electromagnetic induction generates an electromotive force. These are used to increase or decrease the irregular voltages.

3.3 Liquid Crystal Display (LCD): The term LCD stands for liquid crystal display. It is a dot matrix liquid crystal display which displays alphanumeric numbers and some symbols also. In the proposed system, the temperature of the room is displayed in a 16X2 LCD.

3.4 Ultrasonic Sensor: An ultrasonic sensor uses high-frequency sound waves. Those are evaluated when the sensor receives the reflected wave back. To determine the distance between the object, the elapsed time between sending and receiving the waves is measured by the receiver. These sensors are ideal for measurement in different environments. These measurements cannot be affected by the surface, material, light, dust, or other noises. Ultrasonic sensors are used to measurement of distance or to detect the position of an object.

3.5 Wi-Fi: The Wi-Fi Module is integrated with TCP/IP protocol stack. It can give any microcontroller access to Wi-Fi network. The performance of this can be increased by using integrated cache. The Wi-Fi module is used for the communication between the controller and the mobile unit. ESP8266 can be integrated with various sensors because of its on-board processing and storage capabilities.

3.6 Vibration sensor: vibration sensing element module is intended to research linear rate, displacement and acceleration. It is basically a spring type vibration sensor module thus it detects vibration in any direction.

3.7 Microcontroller: A microcontroller (or MCU for microcontroller unit) is a little PC on a solitary coordinated circuit. In present day phrasing, it is like, however less modern than, a framework on a chip or SoC; a SoC may incorporate a microcontroller as one of its parts. A microcontroller contains at least one CPUs (processor centers) alongside memory and programmable information/yield peripherals. Program memory as ferroelectric RAMS, NOR blaze or OTP ROM is likewise regularly included on chip, and in addition a little measure of RAM. The ArduinoMege is a microcontroller board based on the ATmega2560. It is a single chip microcontroller created by Atmel. This chip works well with Arduino IDE. It has 54 digital input/output pins, 16 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. To get started simply connect it to a pc with a USB cable or power it with a AC to DC adapter or battery.

3.8 Global Positioning System (GPS): It is a space-based wireless steering scheme. GPS notion is founded on interval and identified location of GPS focused outposts. The outposts bring actual steady nuclear timers that are corresponding with one extra and with the pounded timers. GPS out posts always diffuse data about their present interval and location.

3.9 Water Level Sensor: Water Level sensors are used to detect the level of substances that can flow. Such substances include liquids, slurries, granular material and powders. Level measurements can be done inside containers or it can be the level of a river or lake.

3.10 Vibration motor: There are two types of vibration motor. An eccentric rotating mass vibration motor (ERM) uses a little unbalanced mass on a DC motor once it rotates it creates a force that interprets to vibrations. A linear resonant actuator (LRA) contains a little internal mass hooked up to a spring, that creates a force when driven.

3.11 Webcam: A webcam is a video camera that feeds or streams its image in real time to or through a computer to a network once captured by the pc, the video stream is also saved, viewed or sent on to different networks travelling through systems such as the internet, and e-mailed as an attachment. When sent to a remote location, the video stream is also saved, viewed or on sent there. In contrast to an IP camera (which connects using Ethernet or Wi-Fi), a webcam is mostly connected by a USB cable, or similar cable, or designed into constituent like laptops.

4. Experimental Output

4.1 Detection and Mailing System Project

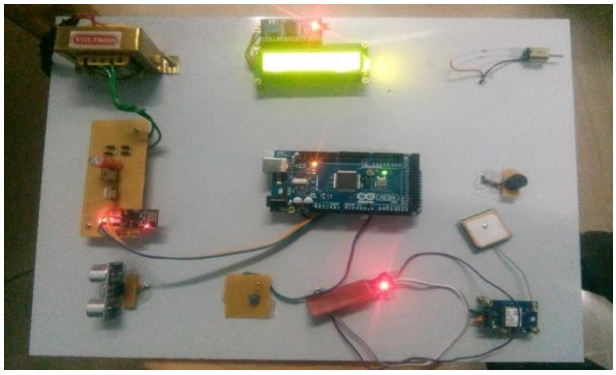

Fig. 4.1 Autonomous Walking Stick for the Blind Using Ultrasonic Sensor Detection and Mailing System

The smart walking stick two types of sensor are used Ultrasonic sensor and water sensor. The ultrasonic sensor is used to detect the solid obstacles in its path and produce vibration in vibration motor. The water sensor is used to detect the liquid obstacles in its path and makes beep sound in buzzer. Here, the ultrasonic sensor and water sensor are connected to Arduino MEGA board based on ATmega2560. The Autonomous Walking Stick for the Blind Using Ultrasonic Sensor Detection and Mailing System Project Kit as shown in fig 4.1.

Fig. 4.2 LCD Display for Blind people alert system

Fig. 4.3 LCD Display for Object detected alert

The ultrasonic sensor is used to sense the objects in front of the blind people. This signal is given to the Arduino mega board and produce the vibration with the help of vibration motor. The LCD Display for Object detected alert as shown in fig 4.3.

4.2 GPS tracking window using blynk app

In case of an emergency, the user of the stick will press the push button and the signal from the button will go to the Arduino ATmega2560 microcontroller which will get the location from the GPS modem and transmit the location of the latitude and longitude to the Wi-Fi modem which will send a location to the saved mail in the system. The LCD Display for Latitude and Longitude reading the Blind person as shown in fig 4.4.

The GPS tracking window using blynk app as shown in fig 4.5. This blynk app is used to display the blind person location with latitude and longitude value.

Fig. 4.4 LCD Display for Latitude and Longitude reading

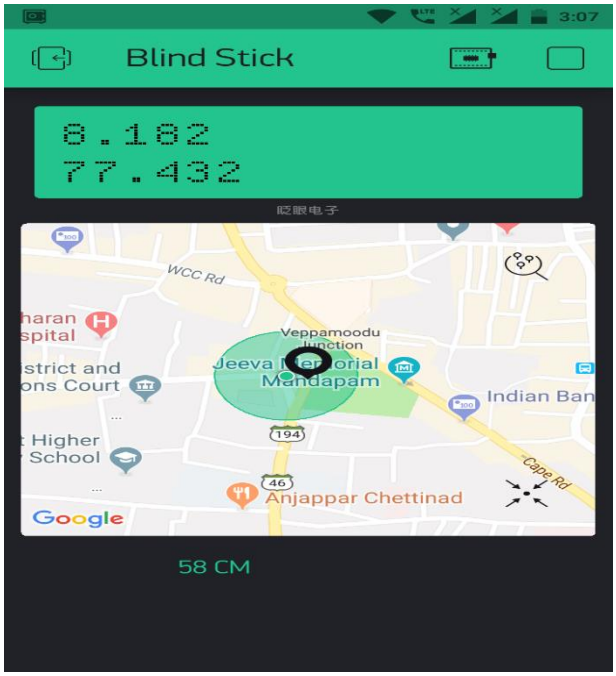

Fig. 4.5 GPS tracking window using blynk app

4.3 Video alert using webcam in mail

In case of emergency condition the blind person will press the push button, which activates the GPS and Webcam. GPS identifies the location of the blind person immediately and is sent to Wi-Fi module. An alert message will be sent along with the precise location of the blind to the receiver.

A Webcam is used to identify the objects in front of the user and for mail by capturing runtime images and it will send to the saved email in the system. The Video alert using webcam in mail as shown in fig 4.6.

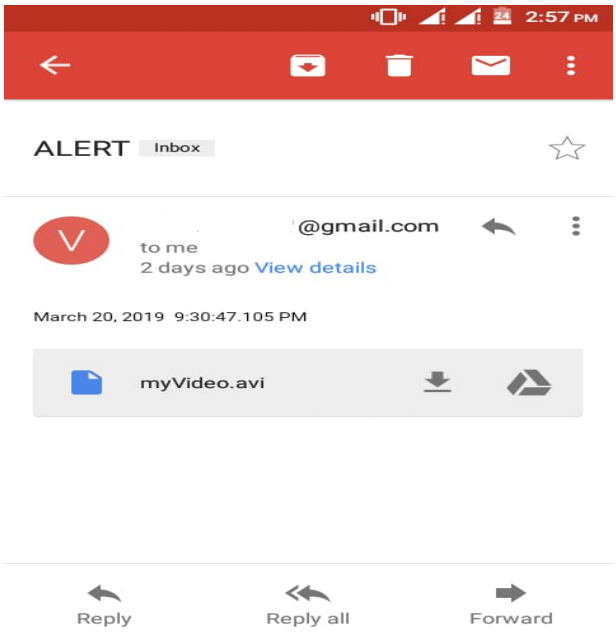

Fig. 4.6 Video alert using webcam in mail

5. Conclusion

Thus, the smart walking stick, the Assistor, helps visually challenged people to identify obstacles and provide assistance to reach their destination.The Assistor works based on the technology of echolocation, image processing and a navigation system. The Assistor may serve as a potential aid for people with visual disabilities and hence improves their quality of life. There is a lot of work and research being done to find ways to improve life for visually challenged people. There are multiple walking sticks and systems which help the user to move around, indoor and outdoor locations but none of them provide runtime autonomous navigation along with object detection and identification alerts. The Assistor uses ultrasonic sensors to echo sound waves and detect objects. Water level sensor is used to sense the water level in the particular path area can be detect and produce a buzzer sound and for navigation by a Smartphone app is used to navigate the user to the destination using GPS (Global Positioning System) and provide the latitude and longitude map regions. Finally, PC will have the MATLAB Programming running which has program to click the hand gestures by capturing the video through web cam and sent it in to mail.

6. Future Work

Our future work will focus on enhancement of object recognition system so that it can detect and identify objects better in challenging environmental conditions. It will also include improving the charge capacity of the device. The object identification can be improved by enhancing the image object database. Better algorithms could be formulated for the device to navigate using dynamic image recognition.

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