Smart Electronic Guiding stick

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ABSTRACT

"Most human activities are carried on in particular places, and no matter how skillful a person may be in other respects, he or she will be excluded from participation in those activities by the inability to get to where they are carried on". Mobility for the blind is always a great problem. Here a cheap, user friendly, smart blind guidance system is designed and implemented to improve the mobility of both blind and visually impaired people for their routine life. The main concept of the system is to provide a smart electronic aid for blind people. The project is mainly intended to provide overall measures i.e. artificial vision and object detection. The aim of the project is to provide a low cost and efficient navigation aid for blind which gives a sense of artificial vision by providing information about the environmental scenario of static and dynamic objects around them. The significance of this project is to help the visually impaired people with appropriate voice commands that are played through the headphones connected to the device. Ultrasonic sensors are used to calculate distance of the obstacles around the blind person to guide the user towards the available path. An object recognition system can also be included to provide an additional virtual visionary to blind. Output is in the form of voice commands that the blind person can hear, for e.g. right, left etc. The hardware consists of raspberry pi, in build audio module and ultrasonic sensors. The code can be written in python.

Index Terms : visually impaired (VI), Mobility, Electronic Travel Devices, Acoustical process, Multisensory device, Object detection, Ultrasound

I. INTRODUCTION

Blindness is a state of lacking the visual perception due to physiological or neurological factors. The partial blindness represents the lack of integration in the growth of the optic nerve or visual centre of the eye, and total blindness is the full absence of the visual light perception.

In this system, a cheap, user friendly, smart blind guidance system is designed and implemented to improve the mobility of both blind and visually impaired people (VI)for their routine life. The proposed work includes a wearable three sensors fitted on a light weight blind stick on its front, left and right side. It is developed to help the blind person to navigate alone safely and to avoid any obstacles that may be encountered, whether stationary or mobile, and to prevent any possible accident. The distance measurement in ultrasonic in air includes continuous wave and pulse echo technique.

In the pulse echo method, a burst of pulses is sent through the transmission medium and is reflected by

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an object kept at specified distance. The propagation time from transmitter to receiver is proportional to the distance of object. For contact less measurement of distance, the device has to rely on the target to reflect the pulse back to itself. The target needs to have a proper orientation that is it needs to be perpendicular to the direction of propagation of the pulses. The amplitude of the received signal gets significantly attenuated and is a function of nature of the medium and the distance between the transmitter and high levels of signal attenuation when used in an air medium, thus limiting its distance target. The pulse echo or time-of-flight method of range measurement is subject to range. The echo signals are used as inputs to raspberry pi and the raspberry pi is then used to determine the direction and distance of the objects around the blind man. Each sensor senses objects in front of it and categorizes obstacle as moving or stationary targets depending upon the time taken by the echo signal to strike and return back to the sensor. For the both cases there is audio output which tells the user about the barrier object that is near to him. It provides the instruction for blind man whether to move left or right and front or back. Also turn on the red alarm light which placed on the stick that gives instruction to driver to stop the vehicle. The main objective of this project is to develop an application for blind people to live their routine without any external help

II. Literature survey

According to information from the World Blind Union (2009), in the word, there are almost 160 million of blind and partially sighted people. The majority of people with poor vision are in the developing world and are over the age of 50years.the loss of vision implies loss of independence, lack of communication and human contact which increase the limitation in mobility. Researchers invested many efforts for designing and developing Electronic Travel Devices which would help blind people to navigate safety and independently. Navigation means object detection and clear the path whiles the blind moving.

The Real–Time Assistance Prototype device is used for object detection [1]. The hardware of the device consists of a helmet fitted with a pair of Fire wire Flea2 stereo color cameras, and headphones which operate with a TOSHIBA Laptop under Windows XP Operating System. The software of the system includes the image and acoustical processing algorithms. The working principle consists of specifying for each detected object and free-path a specific acoustical signal, which travels through the image both in direction and time as the real object moves in the real environment. The difference of the developed system is that tactile information or human voice, which guides the blind user, is replaced by acoustic signals. A major difficulty in the use of multiple and different sounds for multiple objects simultaneously is that these objects cause interference. The problem of the stereo vision system is that for near fields has a low resolution in distance. The system detects the objects placed higher that 0.5m, i.e., it is unable to detect the objects at the

ground level.There must be well specified voice commands to provide artificial vision to the blind since the acoustic signals make confusion among the blind one.

An electronically guided walking stick for the blind [2] can be used inside a closed premise, specially organized with transmitters, which uses radio frequency signal for the operation. The device transmits radio frequency signals of different carrier frequencies to create path to a certain destination. The information in each carrier may be identical. The information may be in the form of square wave pulses that can be used to produce tactile vibration. This device is very simple, low cost and easy to use. In closed premises like school building blind students can move simultaneously and independently, by fitting the receiver inside the shoe and thus eliminating the requirement o f the external stick. Use to its low power output of the transmitter used in the device will not interfere with local radio communication system. More over the carrier frequencies may be properly chosen to avoid any interference with the local radio communication system. This device is very simple, low cost and easy to use.

The multisensory device [3], shown in fig consisting of two arrays of transducers (the emitting array and the receiving array) performing the required measurement. The target distance is encoded by combining the information given by the sensor network operating in the threshold mode .The end user is provided with information on the position of the target by using the target by using of a available interfacing systems. Each receiver processes signals coming from the object. Each receiver could collect signals coming from any transmitter and the signal generated by one of the emitters should be detected by one of the three receivers. Which of the emitted signals will be rejected and which receiver will detect it depend on the position of the target. In real cases, tolerance coming from both the target reelection angle and the sensor emission angle will introduce gaps that identify the target position. The device will furnish a distance range in which the obstacle is located. Moreover, for the same reason, the presence of one obstacle can cause one reûected signal to be detected by more receivers. This will increase the quantity of information about distance codiûcation given by the system but will require a more complicated decodiûcation procedure. Multi sensor strategy gives an image processing of object. High cost and hard characterization process is the main problem.

This paper presents the results of research work that aim to implement an electronic walking stick for blind. In this context this is an attempt to use the advanced technology for assist blind people. Now, from the above study it is clear that the usage ultrasonic sensors for object detection have better advantages. On the whole, the entire study was a visionary and inspiration for the advancement of technology for visually impaired people.

III. System Description

The aim of the system is to provide a low cost and efficient navigation aid for blind which gives a sense

of artificial vision by providing information about the environmental scenario of static and dynamic objects around them. As shown in fig.1, the architecture of the system consists of 5 essential components: Raspberry pi, head phones, LED, ultrasonic sensors, power supply. Raspberry pi is connected with regulated power supply. The raspberry pi takes the readings from the sensors, analysis the result and does the object detection according to the speed of echo. The result is given to the audio module which is connected to the head phone. The instructions are provided to the blind via ear phone. The LED is played to aware the driver.

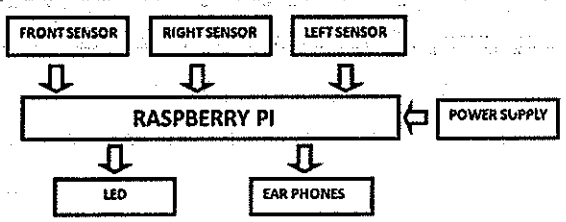

Figure 1 Block diagram representation of Smart Electronic Guiding Stick

A. Rasberry pi

Raspberry pi is the main component that controls the functioning of all other components with the help of software. The program code helps to work this system in a simple manner. The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. Raspberry Pi has the ability to interact with the outside world. Languages like Scratch and Python are used in raspberry pi. In this system python is used.

Raspberry pi model B is the proposed operating system. It has the hardware specifications like 512Mb Ram, two USB port, Ethernet port,3.5mm jack for audio out, HDMI etc. The Python language is used for programming in Raspberry pi. Python is high level, general purpose, and dynamic language.

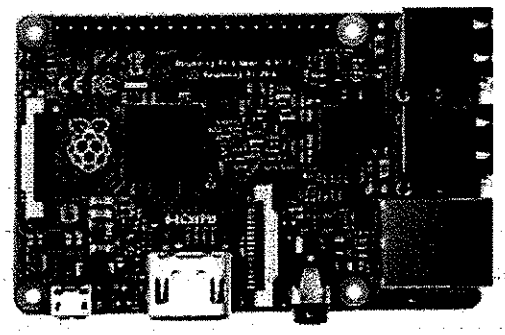

Figure 2 Raspberry pi model B

The output from the sensors is given to the raspberry pi. Analysis the result and does the object detection according to the speed the echo. Then the result is given to the audio module. The raspberry pi has two audio output modes. HDMI and headphone jack. We can switch between these modes at anytime. Instructions are provided to the blind through ear phone with the help of the audio module.

A. Ultrasonic sensors

Very low frequency sound below Acoustic is defind as 'Infrasound', with high frequency sounds above, called 'ultrasound'. As shown in Fig.3 Ultrasonic sensors are designed to sense object proximity or range using ultrasound reflection, similar to radar, to calculate the time it takes to reflect ultrasonic waves between the sensor and a solid object. Ultrasound is mainly used because it's in audible to the human ear and is relatively accurate within short distances. Ultrasonic sensors are used for distance

measurement. This sensor is perfect for any number of applications that require performing measurement between moving or stationary objects. We made connection of sensor to raspberry pi by connecting the +5V and Ground pins to Pin 2 and Pin 6 on the Pi's GPIO header. The input pin on the module is called the "trigger" as it is used to trigger the sending of the ultrasonic pulse. The module's output is called the "echo" and needs a bit more thought. The output pin is low (0V) until the module has taken its distance measurement. The pin is set high (+5V) for the time which is same as that it took the pulse to return. So the script needs to measure the time the pin stays high. The module uses a +5V level for a "high" but this is too high for the inputs on the GPIO header which only like 3.3V .

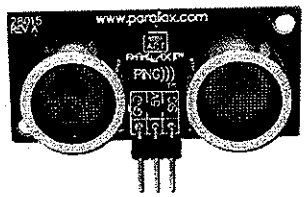

Figure 3 SRF05 Ultrasonic sensor

A. LED(Light Emitting Diode)

A light emitting diode (LED) is known to be one of the best optoelectronic devices out of the lot. The device is capable of emitting a fairly narrow bandwidth of visible light when its internal diode junction attains a forward electric current or voltage. The visible lights that an LED emits are usually orange, red, yellow, or green. The biggest advantage of this device is its high power to light conversion efficiency. In this system LED is used to aware the driver. If the vehicle is very close to the blind, LED will blink according to the instructions provided by the raspberry pi.

B. Earphone

The output from the audio module is given to the ear phone. Raspberry pi has an inbuilt audio module. Headphone provides an artificial vision for the blind with appropriate voice commands.

IV. PROPOSED CONCEPT

It's a raspberry pi based project to develop a cost effective and most efficient walking aid for blind as well as elderly people. The suggested walking aid helps in crossing the roads safely through appropriate voice commands corresponding to the echo signal from vehicles on either sides of user. The work is composed of various steps as under:

A. Object detection

B. voice commands

C. Warning system design

A. Object detection

Ultrasonic sensors are used to object detection. They are used to calculate distance of the obstacles around the blind person to guide the user towards the available path. An object recognition system can also be included to provide an additional virtual visionary to blind. A single input pin is used to trigger an ultrasonic burst and then "listen" for the echo return pulse. Fig.4 shows the working of ultrasonic sensor. The sensor measures the time required for the echo return and returns this value to the raspberry pi as variable width pulse via the same input pin.

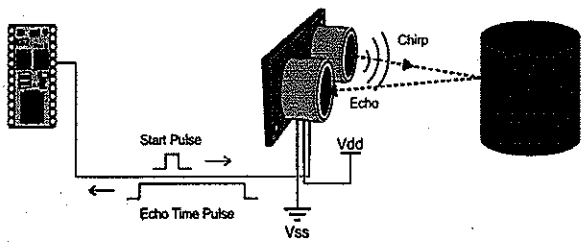

Figure 4 working of ultrasonic sensor

The return signal is then processed by the control circuit (raspberry pi) to calculate the time difference between the signal being transmitted and received. Along with clever math, the time can be used to calculate the distance between the sensor and the reflecting object. This result is then given to the audio module. Fig.5 shows the flow chart.

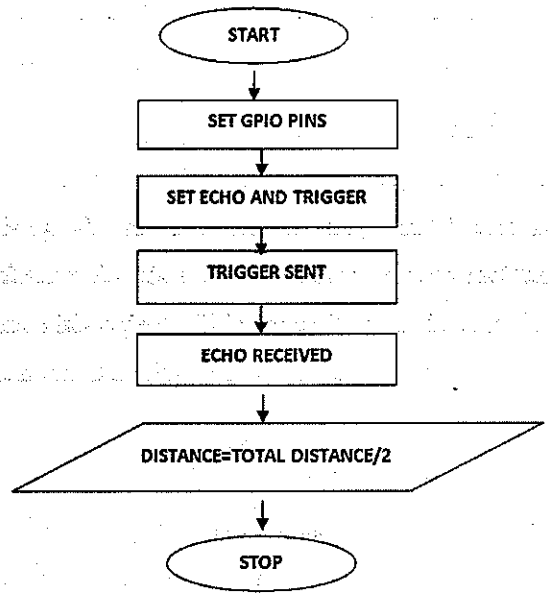

Figure 5 Flow chart: working of an ultrasonic sensor

In this system 3 ultrasonic sensors are used as left sensor, right sensor, and middle sensor to indicate the position of the object. The data from these sensor are given to the raspberry pi . Moving and stationary objects are classified by the output from these sensors and they also calculate the distance of these objects. The 3 ultrasonic sensors send trigger pulse to 3 directions for obstacle detection. The presence of target is indicated by an echo pulse received by sensor. Again the sensor calculate the distance of object corresponds to the first trigger signal. Then sensor sends trigger pulse to check whether it is moving or stationary. If the distance calculated by sensor is less than that of first one, the object is moving otherwise object is stationary.

B. Voice commands

Voice commands for the blind are provided by the head phones. The output from the sensors which is given to the audio module is converted into voice commands. Output is in the form of voice commands that the blind person can hear, for eg. "Right", "Left", "object is near" etc. This voice command gives a sense of artificial vision by providing information about the environmental scenario of static and dynamic objects around them and Provides confidence to blind people. The significance of this project is to help the visually impaired people with appropriate voice commands that are played through the speaker.

C. Warning system design

In this system LED is used to aware the driver. If the vehicle is very close to the blind, LED will blink according to the instructions provided by the raspberry pi.

Three LEDs are placed on left, right and front side of the user which corresponding to the three sensors

output. The LED will blink for giving awareness to driver to the sensor output. There is three LED corresponding to each ultrasonic sensor. If the object is detected on left side, the object will detected by left sensor and corresponding led will starts to blink. When output of the sensor become high, the corresponding LED will blink .The algorithm of the LED blinking program is shown below. First positive lead of LED is connected to vcc through resistor and negative lead is connected to ground.

Algorithm

Step 1 : Start

Step 2 : Import GPIO library

Step 3 : Use board pin numbering

Step 4 : Setup GPIO pin into OUT

Step 5 : Turn on LED

Step 6 : Wait for one second

Step 7 : Turn off LED

Step 8 : Wait for one second

figure shows the entire working of the system. If the object is on right, left or in the middle the corresponding sensor will detects. The data is given to the raspberry pi. After the processing of the data LED and headphone works according to the instructions from the raspberry pi

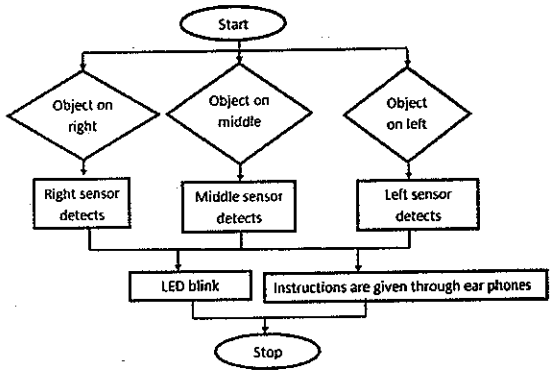

Figure 6 flow chart of the system

V. CONCLUSION

In the paper, a new concept of object detection-based smart electronic guiding stick for blind people was presented. The proposed method easily detects the objects around the blind using three ultrasonic sensors. The output from these sensors is processed using raspberry pi. The system Provides artificial vision through earphones with well specified voice commands. LED is used to aware others. This system provide a low cost and efficient navigation aid for blind which gives a sense of artificial vision by providing information about the environmental scenario of static and dynamic objects around them and ensures the safety of blind while crossing streets/ roads.

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