Smart Cane Navigation for Visually Impaired

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Abstract: ***The smart walking stick helps the blind people to perform navigation and to do their work easily and comfortably. In normal stick, the detection of the obstacle is not done and normal stick is not efficient for visually impaired person, because the blind person does not know what type of things or what type of the objects come in front of them. The person cannot recognize what is the size of that object and how far it is from the object. It is difficult for the blind person to move here and there. In smart walking stick, ultrasonic sensor is used to detect the obstacle. When the obstacle becomes detected camera becomes on and the object is detected with the help of a camera. If any obstacle comes in front of blind person, they can know about the obstacle by hearing the sound generated by the microphone. This is implemented using RaspBerry Pi 3 Model B.LDR sensor is used to detect the brightness of the environment ie to detect whether the environment is bright or dark. The system is very useful for people who are visually impaired and are often need help from others.***

Keywords: Raspberry Pi, Ultrasonic sensor, LDR, camera

I. INTRODUCTION

According to the survey of World Health Organization (WHO) in 2017,about 285 million people are visually impaired worldwide. Out of this, 39 million people are blind and 246 million people have low vision. India has around 12 million people which contributes about one third of the population around the world. Most of these people have low income and they are not able to buy a tool which are not affordable to them.

Without any support they find it difficult to communicate with the crowded environment. In todays scenario, several aids and softwares were introduced in which some of them are in use or not. But each of them has atleast a disadvantage in one way or the other.

casBlip is a wearable aid system for blind people. Its objective is to provide object detection and smooth navigation for visually impaired people. It is a wearable helmet. The disadvantage of this project is that small range detection of this system can cause a serious accident.

A low cost outdoor navigating system was developed using Raspberry Pi,GPS receiver, and 3D sound system. The user is able to select a recorded sound of their own to receive the navigation steps as an recorded format.

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The navigation process is controlled by Raspberry Pi. They work well within the residential area. But its performance degrades in the civilian area where tall buildings exist due to the low accurate performance of the GPS. To improve the navigation RaspBerry Pi is used to assist the blind people. The obstacle is detected using ultrasonic sensor and the image is captured using camera. This is intimated to user using microphone.

II. IMPLEMENTATION COMPONENTS

- Raspberry Pi 3 Model B
- Ultrasonic sensor
- LDR sensor
- Microphone
- Web camera

III. HARDWARE DESCRIPTION

A. Raspberry Pi 3ModelB:

The latest version of the credit card sized computer from the Raspberry Pi 3 foundation is the Raspberry Pi 3.Combination of Wireless LAN and Bluetooth connectivity forms a single-board computer. The Third Generation of Raspberry Pi is the Raspberry Pi 3 Model.

For any applications powerful credit card sized single-board computer is used. Comparing the first generation, Raspberry Pi3 is 10 times faster. For maintaining the popular board format it acts as more powerful processor.

Moreover the size of the Raspberry Pi 2 and Raspberry Pi 3 boards are same.64-Bit Quad core proceesor, On-board WIFI, Bluetooth and USB board capability are some of the features of Raspberry Pi 3 released in february 2016.When compared to Raspberry Pi 2 ,the Raspberry Pi 3 is 80% faster in parallelised tasks. The main advantage of Arduino over Raspberry Pi is that multitasking is possible in Raspberry Pi while it is limited in Arduino.

Fig. 1 Raspberry Pi 3 Model B

B. Ultrasonic Sensor

It is used for measuring the distance. It sense the obstacle nearby and intimate it to the user. Contactless and wear-fear reduction of a variety of targets by means of sonic waves Ultrasonic sensors are designed.

High frequency sound waves is generated by Ultrasonic sensor evaluates the echo which is received back by the sensor.

The distance to an object is calculated by the time interval between the sending and receiving the echo. The range of an Ultrasonic sensor when it above 20000Hz,turning electrical wave into sound waves while receiving the echo again it turns the sound wave into electrical wave. It is one of the popular module in market because of its stable performance and high ranging accuracy.

Ultrasonic waves is transmitted from an Ultrasonic sensor head and receives the ultrasonic wave reflected from an object. In order to cover maximum size the sensors are placed in five locations with minimum usage of the sensors. The five locations are Top, Bottom, front, right, left respectively. Generally, the objects present on the ground cannot be seen by visually impaired person. So by providing necessary security measures bottom keeps track of the ground clearance.

Fig. 2 Ultra Sonic sensor

C. LDR Sensor

Most of the light sensing circuits use Light Dependent Resistor (LDR).LDR has a resistance that changes with the light intensity that falls upon it. The light is detected by an electronic device called Light Sensor. A small sensor such as Photocell or Photo resistor changes its resistance when light falls on it. One of the popular material used for making Photo resistors is Cadmium Sulfide, CdS. The sensitivity of LDR- towards light can be changed by adjusting potentiometer knob in the sensor. LDR is also called Photoconductor. The principle of photoconductivity is used for working of Photocell. LDR is a passive component whose resistance value decreases when light intensity decreases. Light varying sensor circuit, Light and Dark activated switching circuits in which optoelectronic device is mostly used. Applications include Camera light meter, Street lights, clock radios, Light beam alarms, reflecting smoke alarms and outdoor clocks, etc.

Fig. 3 LDR sensor

D. Microphone

It is the method of converting sound waves into electrical waves which is amplified, transmitted or recorded. Most of the audio recording devices is enabled by microphone for purposes including communication, music as well as speech recording. Microphone is of different types for converting energy in many ways but all shares one thing in common. Voice recognizer is used for converting received data in the headset to Text form. Once the input is taken from the Microphone the diagnosis of speech will be done. The voice recognition unit takes the input and process these voice signals. Based on the transducer principle the Microphone is categorized such as condenser, dynamic etc. ,Dynamic microphone is one of the most commonly used microphone in which magnetic field is suspended by a coil of wire. Converting the air pressure variations of a sound wave to an electrical signal by using different Microphone and by different method. For building Microphones a variety of mechanical techniques were used. When a Microphone is overdriven by a loud sounds there produce distortion, it is due to various factors Perfectly linear Microphone were not founded. So, we need to find a Microphone which produce distortion that complements the sound we are trying to record. Generally Microphone produces an output which is very weak the range is around 60dBm.

E. WEB Camera

It is used to detect the obstacle and nearby path and notifying it to the user. The black-and-white QuickCam is the first commercial webcam that entered in market in 1994. The combination of ‘web’ and ‘video camera’ makes a term called web cam. The web camera is also called as video camera in which it streams the picture in real time through the pc to the pc network connection. Web cam is most popularly used for establishing the video links, and allowing to act as a video phones or video conference stations. Security surveillance, computer vision, video broadcasting, and for recording social videos or popularly used. For security purpose webcamera is used. Video clips and still pictures can be taken by using webcam, Laser beam profiles are suitably recorded by using webcam, after removing of lens. Lens, an image sensor, support electronics are typically included in webcam and also included a Microphone for sound waves. Built-in hardwired LED indicators presents in webcam that light up whenever the camera is active. By using simple algorithmic trick most modern webcam are capable of capturing arterial pulse rate. For monitoring security and general activity webcams are installed at places such as child care centres, offices, shops and private areas.

IV. BLOCK DIAGRAM

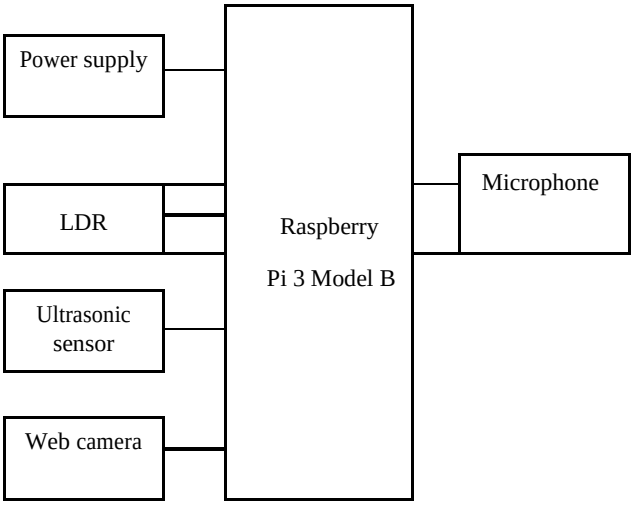

Fig. 4 Block diagram for smart cane

V. WORKING PROCEDURE

The block diagram consists of Raspberry Pi 3, Ultrasonic sensor, LDR sensor, webcamera, microphone. The Raspberry Pi is the central controller of the system. The Raspberry Pi allows the ultrasonic sensor to continuously measure the distance of the obstacles appearing across it. The ultrasonic sensor calculates the distance by using the time taken for the ultrasonic waves to reach and reflect from the obstacle. If the obstacle is within 50cm range then the ultrasonic sensor sends the signal to the Raspberry Pi.

When obstacle is detected, the Raspberry Pi enables the web camera attached to it. When camera is activated, the image is captured. This image is also send to the Raspberry Pi at the same time and Raspberry Pi contains image dataset which consistsof many sample images of different obstacles.

Microphone is connected to the Raspberry Pi to give the voice based communication to the user. When the captured image and the stored image is same, it gives the output of the object name as voice through the headphone to the user. LDR sensor is used to identify the day time or night time.

VI. EXPERIMENTAL RESULTS

Fig. 4 Image captured by web camera

Fig. 5 Image captured by web camera

VII. CONCLUSION

The smart walking cane, with most accuracy is constructed. It is also considered as crude way of giving blind a sense of vision. Dependency of visually blind people on other family members, friends, and guide dogs is reduced by using this stick. By detecting objects in front of user through smart cane and feeds warning back like voice message. It is considered to be a low cost solution to millions of blind person worldwide is one of the major advantage.

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