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Smart Travelling Guide For Visually Challenged

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ABSTRACT: Mobility is one of the major problems encountered by the visually impaired people in their daily life. So they need assistance for their mobility. The main aim of this project is to provide an economical smart travelling guide for the visually impaired. This device is designed in the way that it will detect the static obstacles, moving obstacles such as human and vehicles by the use of array of ultrasonic sensors and camera. Haar cascade classifier is used to detect the moving obstacles from the camera. The intimation about the obstacles are given to the visually impaired by the use of buzzer. Various devices are available in the market which are designed in a way that are to be held in the hands. The advantage of this project is to provide a smart travelling guide for the visually impaired with hands free environment.

Key words: Visual impairment, Ultrasonic sensor, camera, Haar Cascade classifier, Moving obstacle.

I. INTRODUCTION

Mobility plays the important role in everyone's life. By the gift of vision people are able to move from one place to another in both familiar and unfamiliar environment. Through the vision people are able to do their chores and duties in precision. People with visual impairment faces difficulty in mobility and daily duties. Visual Impairment is the reduced vision which are not fixable by usual means such as glasses or contact lenses. There are many causes for the visual impairment which includes, cataracts, injuries in eye, glaucoma, diabetic retinopathy, amblyopia, retinoblastoma and genetic defects in brain due to stroke or trauma.

The statistics by the World Health Organization (WHO) in 2011 estimates that there are 285 billion people in world with visual impairment, 39 billion of people are blind and 246 billion are with low vision, and around 15 million people are blind in India [i]. An Assistance should accompany the visually impaired people because most of them feel insecure to move even in familiar places such as home and office. It is not possible for a person to accompany the visually impaired always. Visually impaired people may feel inconvenient to be in need of a person. Assistive devices are introduced for the use of visually impaired such as white cane or walking cane for the navigation. The walking cane is a simple and mechanical device which helps in differentiating static obstacles, uneven surfaces, holes, steps and it provides a tactile-force feedback to the user. This device is light and portable, but cannot be used for dynamic components due to the limited range [ii]. Guide dogs can also be of restricted assistance for finding the way to a remote location [vii] Most of the commercial available walking guide fails to provide a hands free environment to the visually impaired. Since these people are more sensitive than normal people in tracing sounds, buzzers are used as the feedback instead of voice output through a headset. [v].

II. METHODOLOGY
III.

a) BLOCK DIAGRAM

This project provides a hand free environment by incorporating all the sensors into a belt rather than a walking cane. The module provides information about the obstacles that are present in front of the user with the help of ultrasonic sensor and Raspberry-pi camera. The distance between the obstacles and the user are measured by interfacing ultrasonic sensor with Raspberry Pi module. A raspberry camera is used in detecting the human and vehicle and the output is intimated through the buzzer (Fig 1).

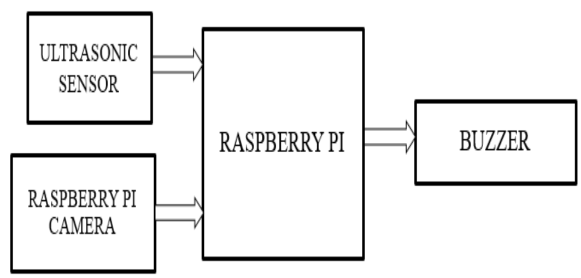

Figure 1: Block Diagram

b) HC-SR04 ULTRASONIC MODULE

HC-SR04 ultrasonic sensors are used for the obstacle detection and distance measurement. This sensor modulus contains ultrasonic transmitter circuit, receiver and control circuit (Fig 2). This sensor has 0.3 resolution with a ranging distance of 2 cm to 500cm [vi, viii]. It drives from a 5V DC supply and the current is less than 2mA [xi]. The sensor is triggered by 10µs high level signal. The basic principle of ultrasonic sensor is, when the sensor is triggered, it sends eight 40 kHz pulse and waits for the echo pulse [x]. If there is no obstacles present, no echo pulse is received. On the other hand, if there is any obstacles detected, then the echo pulse is received in the receiver circuit. The time for sending pulse and the echo pulse are noted. The formula for distance calculation is,

Distance= (Speed of Ultrasound*Time of Flight)/2.

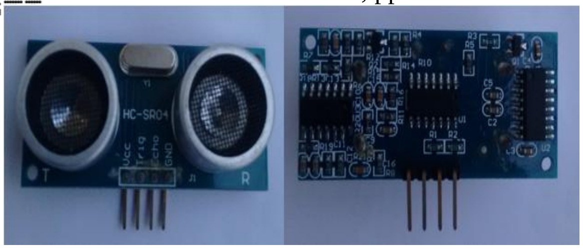

Figure 2: HC-SR04 Ultrasonic Sensor

Three ultrasonic sensors are used to cover front, right and left side of the user gives the respective information. Along with the ultrasonic sensors three buzzers are connected which gives feedback to the user. A python script is written to measure the distance. The distance is calculated when the time of flight is known. This module can be used within the range of 2 cm to 300cm.

c) RASPBERRY PI MODULE

Raspberry Pi is a series of credit card-sized single board computers and designed to plug into a TV or HDMI monitor. Raspberry Pi, Model B has a Broadcom system BCM2836 SoC (system on a chip) which includes an ARM Cortex A-7 compatible CPU and a VideoCore IV graphics processing unit (GPU) (Fig 3). The speed of the CPU ranges from 900MHz and 1 GB RAM memory range is available on board. The secure digital SD cards helps to store the operating system and program memory in either the SDHC or MicroSDHC sizes. It consists of 4 ports namely HDMI, composite video output and audio output is given through 3.5mm phono jack. In Raspberry Pi model B the Ethernet port is provided by a built-in USB Ethernet adapter using the SMSC LAN9514 chip. The Raspberry Pi commonly uses Linux-kerel based operating systems. Raspberry Pi2 can also run the Windows IoT operating system. The board takes fixed 5V DC input and 700-1500mA current.

Figure 3: Raspberry Pi 2, Model B.

d) RASPBERRY PI CAMERA

The Raspberry Pi camera is a five megapixel fixed-focus camera used to capture high-definition photographs and video and can be controlled programmatically (Fig 4). The 15cm ribbon cable is inserted in to the connector which is located between the Ethernet and HDMI ports. By pulling the tabs on the top of the connector firmly, the ribbon cable is inserted into them with the blue side facing the Ethernet port and silver. The ribbon cable and camera should be handled with care, not to bend the ribbon to any angle that may damage the camera module. After installation the camera module is enabled.

Figure 4: Raspberry Pi Camera

e) Haar Cascade Classifier

Haar feature-based cascade classifiers is a machine learning approach which is extremely rapid in detecting the objects in an image and video [iii]. Basically it needs hundreds of positive images (image which contains area of interest) and negative images (image without area of interest) to train the classifier. Each feature is a single value which is obtained by subtracting sum of pixels under black rectangle from sum of pixels under white rectangle. The rectangular features provide excellent image representation for effective learning. For rapid full body detection Haar features are like rectangle feature [iv]. The features are grouped into different stages of classifier and apply one by one. For full body detection Haar classifier starts scanning the image from the top left corner and ends in the bottom right corner. If the window passes the first stage it will pass to the next stage. If it fails, it won't pass further. The window where all stages are passed are the region we like to detect.

Haar cascade classifier is trained using hundreds of positive and negative images and the trained images are saved in a XML file. When the video is captured with the camera, the Haar classifier is applied and detects the human and vehicles (Fig.5)

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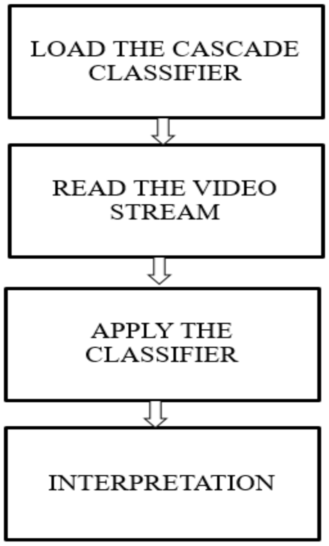

Figure 5: Human and Vehicle Detection Algorithm.

IV. RESULTS AND DISCUSSION

Python script is used to calculate the distance of the obstacles from the user. Three ultrasonic sensors are used to cover three sides of the user (right, front and left). Trigger pin of ultrasonic sensor is made high for 0.00001 seconds and then made low. If echo pulse is received, time taken between the trigger pulse and echo pulse is calculated to measure the distance (in cm) among the user and the obstacle. Three buzzers that connected along with the ultrasonic sensors are used as a feedback to intimate about the static and dynamic obstacles such as human, vehicles to the user. Range for the obstacle is set for 2cm to 300cm and the obstacles that are found above this range is consider as “out of range”.

Humans and vehicles are detected by the use of Raspberry Pi camera. Haar cascade classifier file is loaded and applied to the input video. If humans or vehicles are detected then that information will be intimated to the user through buzzer. Raspberry Pi is used to interface both HC-SR04 ultrasonic sensor and Raspberry Pi camera. The output of the Raspberry Pi camera in which humans and vehicles are detected (Fig 6, 7).

Figure 6: Human detection.

Figure 7: Vehicle detection.

V. CONCLUSION

Thus the ultrasonic sensor and camera are interfaced with the raspberry pi. User will get intimation about the presence of human, vehicles and obstacles in front of them. Buzzers are used as the feedback to the user. With this proposed model, the user may move from one place to another without the use of walking stick. The model can be improved by adding GPS system and emergency alert system.

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