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Recognition of Impediments for Visually Impaired Using Open CV

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***Abstract*-Eye sight is one among the most vital senses for survival. Millions of individuals throughout the world suffer from vision impairment. People who are blind or visually handicapped have a more difficult time doing their regular duties. Even if they don't want to, the majority of them are dependents for assistance. A handful of technologies for visually impaired people's aid have been created. Because of its cost and accessibility, machine eyesight-based remedies are appearing as one among many effective technologies being used to help the blind. The suggested system attempts to provide a wearable visual aid that would allow visually impaired persons to move autonomously without the need for external support by utilising a live object detection arrangement. To detect hurdles uses a image processing (machine learning) mechanism and via the camera and notify visually impaired person about the obstacle and its position via voice output. On the Open CV platform, python programming language with Raspberry Pi 3 model – B is used to develop artificial eyesight. Proposed Classification accuracy of 80% in reading text and 90% in detecting the object is observed.**

Keywords — Computer vision, Wearable visual aid, Image Processing, Machine learning, Open CV, Raspberry Pi, Python

I. INTRODUCTION

Vision is an important aspect of existence. Blindness is a worldwide condition that affects millions of individuals. When it comes to conducting daily tasks, blind persons confront a variety of challenges. They mainly rely on expertise, smart sticks, or the assistance of others to walk and avoid hazards. They don't have a sense of sight, thus they rely heavily on their memories. Furthermore, they are unable to detect unexpected changes in their environment, making it nearly hard for them to react to a situation in real time. According to a World Health Organization study and information sheet on visual impairment revised in October 2017, 253 million people estimated with disability of eyesight and approx completely blind with 36 million peoples, severe vision impairment with 217 million moderate blindness [1]. Chronic eye illnesses are the leading cause of vision loss worldwide, whereas in-corrected refractive errors and untreated cataracts are the major two reasons of visual impairment. Visually challenged persons are left behind in today's fast-paced society and are not treated equally. Today, there is a need for a solution that will not only assist these differently abled individuals in avoiding obstacles and completing their everyday tasks, but will also assist them in seeing the world around them. This will assist them in leading a more fulfilling life. Traditional approaches, such as using a cane, assist individuals in avoiding impediments in their path but do not assist them in identifying and locating items. As a result, aid for the blind is essential to assist him or her in identifying items in an interior setting. Our answer to the problem is to develop a gadget that can recognize obstacles using a camera and also tell if a traffic light is red or green using an audio alarm. The device is powered by a battery and employs a small compact arm computer called the Raspberry Pi. The module's design is tiny and compact, making it easy to transport.This device will constantly record video of its surroundings and transform it into frames. After analyzing these frames, the system will notify the user of an impending barrier or a change in the environment. The key benefits are that the system is portable, inexpensive, and accessible, and it may assist visually impaired persons by applying image processing technology. This device will assist visually impaired persons in navigating their way around obstacles and will provide them with a feeling of visualization of the environment around them.

II. LITERATURE REVIEW

A complete literature analysis on machine learning approaches is conducted in this study, and an unique machine learning-based self-localization methodology is presented. In a WSN, sensor nodes are often dispersed at arbitrary, therefore adding a GPS module to each node increases the cost of implementation. However, in other applications, such as forest fire detection and wildlife monitoring, pinpointing the exact location is critical. In this regard, a machine learning method might be useful.[2] Using dogs to aid navigate through their walks or walking canes to keep oneself away from any impediments is a classic strategy that has been utilised by sight impaired persons for years. [3] One more conventional method was to employ real-time visual recognition, in which the endpoints were translated to 3-D audio. This system employs a consumer server technique in which video is collected on the client side using a camera tool that incorporates "GoPro" and transmitted to server to get image real-time popularity with current object identification algorithms. The biggest downside of using this type of device is the delay that it causes, which makes it unsuitable for real-time applications. [4]Authors have used NS2 to develop WSN in this article. They also tested the line of communication with the AODV routing algorithm. Graphs are used to grasp AODV's effectiveness. The paper explained how to locate theoretically specified defective node and establish a problematic node in WSN. For locating the malfunctioning node, they use two separate parameters: based on residual and end-to-end latency[5].The suggested work is focused

with security of WSN. Detecting bogus node in the network. System can sight an intrusion and a fraudulent in network using typical circumstances. The packet loss, performance, and remaining energy are calculated. These are proven in NS2, and as a result, the suggested technique aids in the detection of false nodes. Security, such as identifying attacks and malicious nodes in the network, is addressed in this study. This is one of its security risks.[6].Assisting Blind People using Real-Time Objects Recognition Approach [7] - This research presents a technique to assist sight-impaired persons in detecting objects in their neighbourhood. They achieved it by utilising instruments such as GPS service, ultrasonic sensors, and cameras mounted on a sight-impaired person's spectacles. These apparatus are used to gather particulars about the environment. They employed a Real-Time technique to detect things in their environment. The achieved accuracy is 90 percent. As a result, we may find it advantageous to detect things with that level of precision.For visually challenged persons, real-time object detection is used. Furthermore, users are informed of the directions they should walk in order to circumvent any obstacles in their route. Because directions are crucial for sight-impaired persons in situations such as escalators, whether travelling up and down the pathway, moving through the stair-case, this suggested method toils in all conditions except bright sunshine. [8]Blind stick is used GPS and maps for navigation and sensors for obstacles key points are identified with the help of SURF algorithms.[9]The Ultrasonic Blind Walking Stick is outlined to provide artificial eyesight and hurdle sensing in the eyesight impaired person's environment. The system detects the existence of the hurdle using an ultrasonic sensor. A moisture sensor is also included to disclose the existence of water. A microcontroller is a miniature microprocessor on a sole integrated circuit that is utilised in this project. When the device exposes an item, a signal is dispatched to the microcontroller, which sounds a buzzer to alert the user. [10].The guide cane, also known as an advanced blind stick for eyesight impaired people, is used to aid the sight-impaired person in all kind of environment. It has a GPS navigation arrangement and hurdle detection arrangement. The GPS navigation arrangement is pre-programmed to assist the user in reaching their destination. The hurdle detection and GPS navigation applications are collected in a Raspberry Pi. For navigation and hurdle sensing, the user gets auditory input. [11].Smart rehabilitative shoes and spectacles are proposed to help blind people navigate and move about securely. Ultrasonic transducers are installed on each shoe to disclose things at various levels. The glasses are outfitted with two of ultrasonic transducers located centrally over bridge, as well as a buzzer in temple. [12] The proposed framework uses the Modified-CNN with the deep learning capability to recognise the events and obstacles that affect the smooth movement of people who are visually impaired and the elderly in the indoor environment because the making out of the indoor environment is still complex in the CV.[13] The suggested method for assimilating sensor data storage of smart campus indoor environment makes real-time issue detection possible. In order to analyse past data about the facility's indoor needs, real-time sensors readings can be employed to record information about the indoor environment. In this work, Internet of Things infrastructures and environmental-based condition monitoring are merged [14].

III. PROPOSED WORK

Identifying the appropriate camera module that can permit quick picture capture and also state whether the traffic light is red or green via audio alert is one of the numerous processes in the device's development. The device is battery operated and employs a small compact arm computer raspberry pi. This device will constantly record video of its surroundings and transform it into frames. After analyzing these frames, the system will notify the user of an impending barrier or a change in the environment. In real-world contexts, sensing a optical character and transformation of text-to-speech software is evaluated for effectiveness. Image processing is achieved by setting the resolution to 320. Finally, create and run experiments on the prototype to evaluate its versatility in real-world circumstances. The module's design is tiny and compact, making it easy to carry. This device will assist visually impaired persons in navigating their way around obstacles and will provide them with a feeling of visualization of the environment around them.

A. Raspberry Pi 3 Model - B

The Raspberry Pi has gone through several iterations since its launch in 2012. The Raspberry Pi 3 Model - B .It is available for 3200 INR. It has a ceaseless computer that includes an HDMI output, up to four USB ports, Wi-Fi, and Bluetooth. For our project it was best suited compare to other raspberry models. A single-board Raspberry Pi computer that runs on the system-on-chip Broadcom BCM2837. It features a 1.2GHz processor, 1GB of RAM, ARMv8-based 64-bit quad-core CPU and OS is stored on an SD card. It contains a USB connector for connecting a USB microphone and receiving speech input. It features a CSI port, which is used to attach the Pi camera. For audio output, the Raspberry Pi 3 model - B has a 3.5 mm ubiquitous headphone port. The Raspberry Pi takes video input and converts it to frames performs image processing using open CV platform using Python.

B. Pi camera

The camera on the Raspberry Pi 3 model - B is used to capture still photos and high-resolution video. It boasts an 8-megapixel resolution and shoots at 30 frames per second (fps). The camera's output is sent to the Raspberry Pi for additional processing.

C. Ultrasonic Sensor

Using sound waves with ultrasonic sensor calculates the inter space to the hurdle. It accomplishes this by discharging a sound wave at a set down frequency and waiting for it to return. The space connecting the sonar sensor and the hurdle is estimated by noting the duration connecting the sound propagation emitted and wave reflecting back. That employed in this system to alert the user of any obstacles that are in front of the person.

D. Open CV and Python

It is a programming function library geared mostly at live computer eyesight. It is utilized for a variety of things, including augmented reality, detection of gesture, and matching feature. All the datasets are pre-trained in the

open C V library are used in our project. The instruction "import cv2" in Python is used to bring it. This supports many programming paradigms, counting object-oriented, imperative, functional, and procedural programming running on Raspberry PI.

E. Pytesseract Library

It is a OCR tool for python.which can identify and read the text which is in the image. Google's Tesseract-OCR Engine is wrapped in Python-tesseract. It can read any picture types supported by the Pillow and Leptonica imaging libraries, including jpeg, png, gif, bmp, tiff, and others, making it handy as a standalone invocation script to tesseract.. This is automated tessseract which will remove all the background distortion, and it accepts only the clear images.

F. eSpeak Library

It is a open source text to speech synthesiser that supports many languages and accent. In our project we have used eSpeak to convert text to speech for reading books as well as detecting the objects.

IV. METHODOLOGY

The brain of our Raspberry Pi 3 model - B system and it controls all of the procedures. The system is made up of a camera that takes live video footage. Raspberry Pi then processes the video.

To create blind assistance utilizing image processing and machine learning, we have two parts in our project.

The steps are as follows:

1) Creating and training a neural network for object recognition: A convolution neural network is made up of numerous thick layers and activation functions like Rel u and Sigmoid. This neural network was trained with tens of thousands of photos of everyday items. The photos used in the training are gathered from free source data sets on the internet. The neural network that has been trained is stored and utilized to recognize objects.

2*) Object identification and Audio conversion:* The first step is to capture live footage with a camera. The video will be transformed into picture frames that will be used to identify objects. Using the Open CV library, which are pre-trained in Open CV library, the picture is then pre-processed to attain the appropriate resolution. To identify and detect objects, the pre-processed picture will be passed to a Convolution Neural Network. The item that has been discovered is subsequently announced through the speaker.

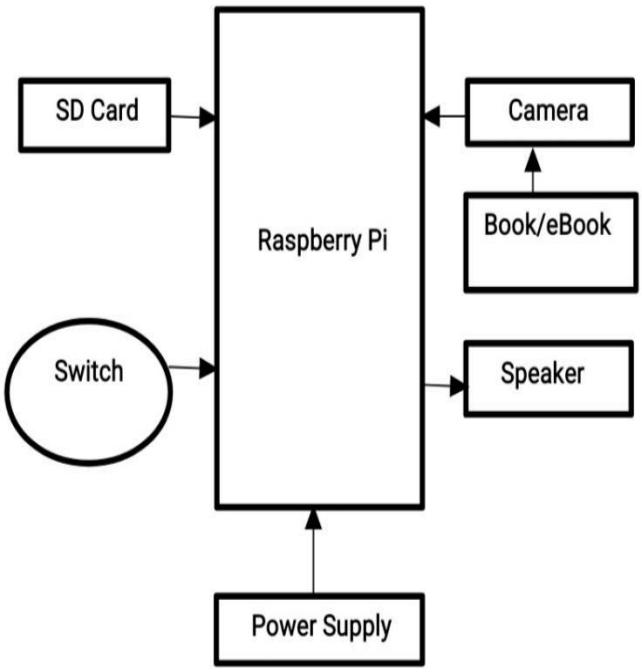

Fig.1 Prototype Block Diagram

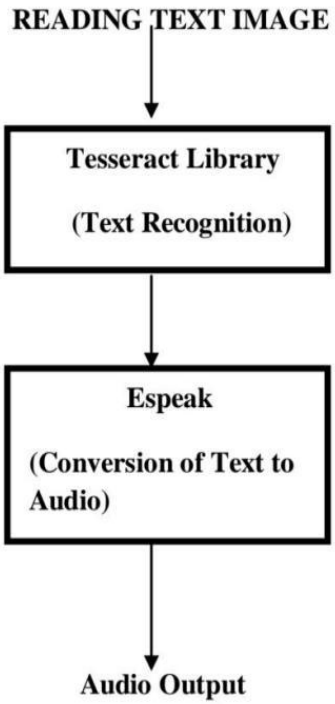

Fig.2 Conversion of Detected Text to Audio form

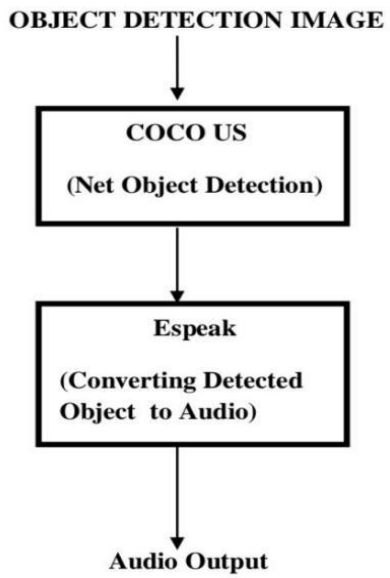

Fig.3 Conversion of Detected Object to Audio Form

V. IMPLEMENTATION

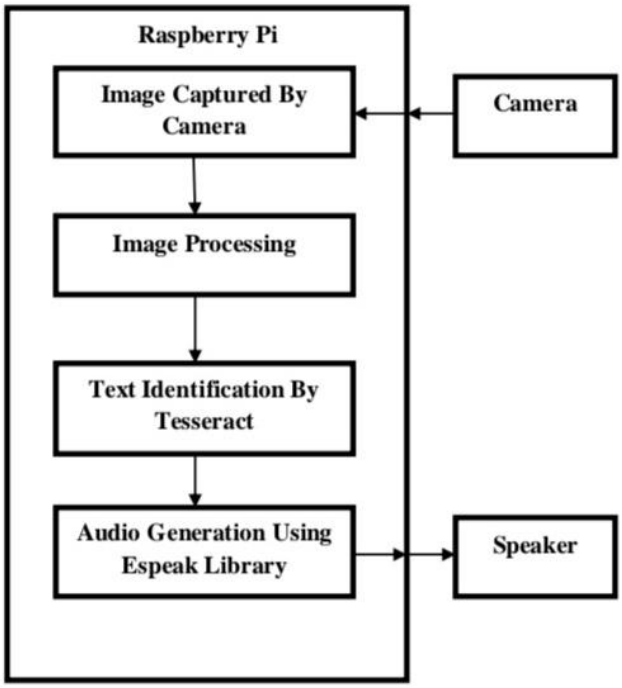

Fig.4 System Architecture

A camera is used to seize the video, which is then separated into a series of frames/images and converted to grey scale. The Pi's coding is done utilizing the Python programming language and Open CV. The grey scale image is cleaned up by removing the superfluous noise. The edges of the picture are acquired using an detection of edges approach. The built-in python tools contours are determined using once edges have been sighted. The corners of the image will be the image's greatest contour; this point will serve as the foundation for further improvements. The identified contour's area is examined. We have set the resolution to 320 for image processing. The picture will be analysed for text if the detected region is larger than the threshold value, which is fixed more than the area of the biggest contour. The picture may be input into Tesseract for optical character recognition once it has been twisted and adjusted with proper threshold settings. Tesseract is an OCR engine that can recognise more than 100 languages and supports Unicode. [15] The Tesseract library extracts text from a picture. The collected text is then used to feed into the eSpeak text-to-speech conversion programme. eSpeak is a free and open-source speech synthesiser.[16]Both Tesseract and eSpeak need libraries, which are loaded into the software. The prototype's last component is text to speech transformation using eSpeak software. The created audio is sent to the listener through the speaker.

VI. RESULT

From the experiments that we have done, we came to know that the font size of the characters should not be less than 8. We have tested the module in different lengths that will give the readings as shown in table1.Performance of our proposed model is high enough and it achieves readability tolerance of less than 1.25% and with average processing time is less than 10 seconds .

TABLE 1 Accuracy testing output

Distance in cm	Total Words	Errors	Processing Time in Seconds	Percentage of Errors
15	87	1	9	1.14
18	175	1	9	0.57
20	234	4	8	1.70
24	245	5	7	2.04
25	286	2	7	0.69
26	339	3	8	0.88
30	297	5	9	1.68

Below fig.5 represents the percentage error comparison between proposed method and existing method.

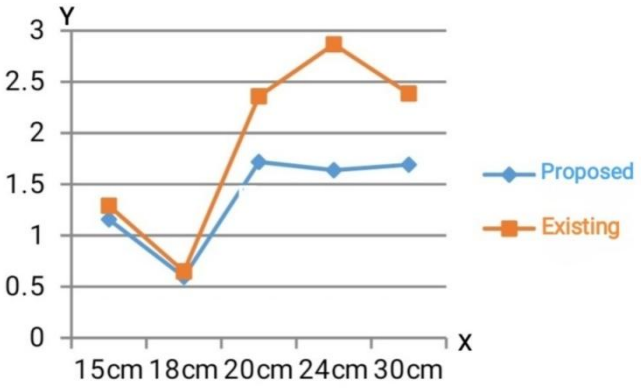

Fig.5 Percentage error comparison line chart

Object detection is the process of validating and tracking things in pictures and movies. Face sensing, vehicle sensing, pedestrian totaling, self-driving automobiles, security arrangement, and more applications use object detection. Object detection has two major goals: 1) identify all items in an image, and 2) detect all hurdles in an image/frame. Remove the focus of your concentration. In this project, we'll use Python to recognize objects using ImageAI, which uses deep learning algorithms. The average accuracy in detecting the object is 90%. Smaller objects accuracy will remain same unless the object is not clearly visible to the camera. The aspect ratio is 1:1 and we have set the size to 320x320 resolution to the COCO object detection.The utilization of technology to read printed or handwritten textual words present in digital images of physical documents or eBooks, such scanned books or eBooks, is known as OCR (Optical Character Recognition). It is method that examines a text and transforms the characters into code that may be utilized for information processing. OCR arrangements consist of a hardware-software blend that converts current documents into computer-readable text. This model utilizes push buttons to define distinct modes or to activate each piece of code in order to avoid feature overlap.

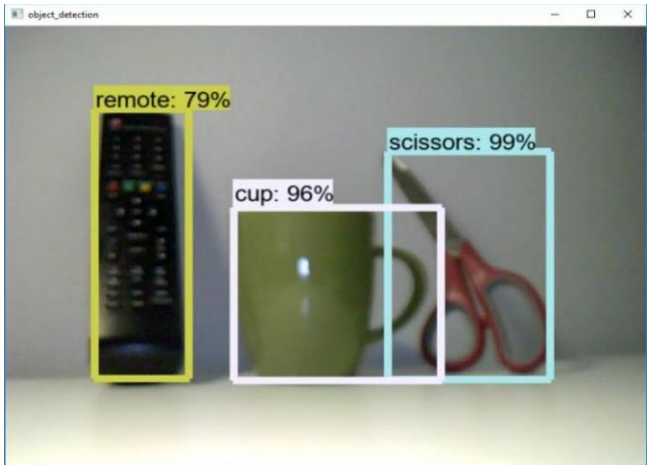

Fig.6 Object is identified and announced through speaker

VII. CONCLUSION AND FUTURE ENHANCEMENT

This study proposes a system that can read aloud both text and graphics. The input to the Raspberry Pi 3 model - B processing unit is tiny camera system and output device speaker is the produces output to the user. To start the text identification and text-to-speech conversion procedure, a push switch was used. The system is installed in the collar that the user may wear around. The key problems of ease of operation and minimizing weight have been addressed. The push button removes the confusion that would otherwise emerge from the system's constant feeds. The basic goal of the proposed work is to aid the eyesight impaired in recognizing impediments in their path and reading eBooks/books, which will enable them to make educated decisions when commuting. In future we will also add smart navigation system for blind people to navigate easily and go wherever they want without the help of maps.

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