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Autonomous Detection for Visually Challenged People

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Abstract: - Visually challenged people face lot of difficulties in their daily routine life, they seek others help in their daily activities. To aid the visually impaired many technologies have been developed. Different technologies have been utilized to assist the blind, but due to the affordability and accessibility of computer, in today's trend emerging and most promising ones are vision-based solutions. The proposed system in this paper is to aid the visually challenged people to identify what type of object or obstacle and notify them by voiced recognition and help the people to migrate safely both indoor and outdoor. This will help them to manage their day-to-day life. Using python language in OpenCv and raspberry pi to implement the aid device.

Key Words:— Vision-based, Visually challenged people, OpenCV, Raspberry pi.

I. INTRODUCTION

Blindness is a major problem in today's society. Blindness occurs from children to aged people in this era. They face lots of hurdles in performing their daily routine life. In their homes also they need others to help to navigate from one place to another place and to identify objects in front of them. Blindness is caused due to the damage of the retina and older people get affected by various eye disorders because of aging. WHO (world health organization) released a report that 253 million people live with visual impairment over that 36 million people are blind and 217 million people have a moderate visual impairment. In olden days they use training dogs to guide them for navigating from one place to another, then after canes where help to avoid an obstacle in their pathway but they are not used to identify the type of obstacle in their surroundings and hence they assistance for identifying the objects in his/her surroundings. Here we proposed a system that assists the blind person to navigate on their own both indoor and outdoor activities. Raspberry pi is used to implement the assistive system on the open CV platform using python language.

The proposed system provides a solution to assist the blind. The system provides an audio output of what type of obstacle and identifies the text and converts it into speech and it uses GPS and GSM technology where the relatives can able to find their location using latitude and longitude by SMS alter and they can able assist independently in indoor and outdoor. The device is capable of detecting the images and matching them with the trained images and give the user as an audio output of what the image is exactly.

To read the text document from the captured image OCR (Optical Character Recognition) is used and give the content as a speech output for the visually challenged people. The OCR is the process of converting scanned images of machine printed into computer process able format. The technology tools for blind is built using two fundamental building block is OCR software and Text-to-Speech(TTS) engines.

This paper consists of section1 has the brief introduction of the proposed work, section 2 consists of the existing work which is known as literature survey, section3 consists of the proposed work explanation, section 4 has the implementation and algorithm used in the proposed work, section5 consists of the required images and detected images snapshots, section6 consists of conclusion and finally the section7 has the reference papers for the proposed.

II. LITERATURE SURVEY

An assistive method that has been used for decades as assistance for visually challenged people is that are train dogs for the safe navigation and the walking cane to avoid an obstacle in their pathway. Smart rehabilitative shoes and spectacles are designed to facilitate safe navigation and mobility [1] for blind. The device has the three pairs of ultrasonic sensor in the various positions of the shoe to detect the holes, pits, and obstacles. Vibrating motor and buzzer are used as the alter for the blind [1] This system is regarded as the step forward towards the advancement of electronic aid and the betterment of the life of blind.

The proposed cane assistive system [2] uses Arduino where it detects the obstacles, holes, and give them the information about wind direction. The PING sensors are used for the holes and obstacle detection and the (CMP) compass sensor is used to find the eight wind direction and the information is given as sound to the blind [2]. The buzzer will intimate them that the obstacle is around 3cm-150cmand the speed will be faster from 1.1 until it becomes 0.3 seconds.

This system will provide long-distance navigation and it is not helpful in indoor navigation [2].

In the past decades, only the sensor-based approach was used to detect the objects rather than recognizing the obstacle [3] and thus the image processing proves to alter the method in these situations. A stereo image processing is the technique used for the system assistive the blind people where it includes a wearable computer stereo cameras as vision as a miniature on the end of eyeglass [3] for stereo imaging and here they use FPGA and FIFO buffers to synchronize and combine stereo images and it uses series of parallel programming technique and real-time stereo matching on embedded processor [3].

The real-time visual recognition has the result converted to 3D audio [4] in which it comprises several modules where for real-time image recognition video is captured using a portable camera in the client side where it is streamed to the server and existing object detection models[4]. The system requires a long time to process the data which doesn't make it into real-time. The paper proposes a complete pipeline of efficient and low cost where it constructs the 3D text-driven audiovisual which was gained from face image of the 2D frontal view of any person who faces them [4]. In this paper they introduce 3D emotive audio-visual avatar in real time which has the advantage of convert 2D image into the audio of 3D.

For Haar like features as a week classifiers used for hardware structure for object detection AdaBoost learning Algorithm is used. [5] For the hardware implementation, this paper proposes the parallelism in the detection algorithm where they exploit the cascade structure and locate near the beginning of the cascade using a partially execution model and is used more frequently. Without a great increase in the circuit area the total processing speed is increased. Adjusting the balance parallel processing it acquires flexible performance [5]. The virtex-5 FPGA architecture shows the that real time object detection is achieved at 30fps without candidate extraction in VGA video.

In this paper, they use the technology of color-based identification which has the feature of identifying the based color of object and tracking the object [6]. This paper gives the solution for video capturing object detection and when the video is moving fast we cannot change the frames which are used for matching [6] object detection. By tracking the color of the object in the video images we can recognize and track the object and they develop the algorithm where it uses color feature for object detection [6]. Here they focus on the algorithm which is dissected features in the video frame and yields the motion between the frames.

This paper proposes the RFID technology [7] for the recognition of obstacles for blind people. The RFID covers the insight features of the technology, DGPS are used before RFID where it is used for localizing the position [7] of object or obstacle in a different situation. The signal can be transmitted tactically through the contact between the cane and the detector floor, this is the idea behind the RFID technology. This paper focuses on the cane that uses the braille system where the canes are made of different components that interact with each other to produce a message in the braille form [7].

This paper combines the principle of spatial hearing and ultrasonic echolocation to provide [8] available sonar cues and human auditory system for other aid devices. With the affixed artificial pinnae the device is a wearable headset consists of stereo microphones and an ultrasonic emitter. It uses the echoic information provides. In interacting with their environment the device has the potential to aid blind people. [8] for the vision ineffective animals have evolved echoloctions, they have much higher the sound frequencies for their echolocation. Microbats use sound frequencies ranging from 25-15khz their echolocation, they are broadband call, narrowband call where it is for detection and classification of objects. [8].

The paper proposes the character detection and recognition system for visually impaired people to aid [9] them the problem of recognizing text in images where detecting text from scene images was more difficult as compared to a printed text document. Nowadays computer vision is one of the emerging that can be used for the aid of visually challenged for their navigation and accessing the printing materials and it converts recognize text to speech to develop electronic travel aid [9] for visually impaired people. To obtain the characters from the image they follow the pattern recognition algorithm developed on MATLAB which is used for text to extract text and save as text file and the text to speech process produces the output through speech output [9].

An affordable solution for blind to navigate for unknown environments and performs image classification using Raspberry pi[10] and it provides feedback for the person using vibrating motors for the signal of the presence of an obstacle in their direction. The training phase was performed off-line while the on-line phase classifies image on 1.12 seconds on average by using this technique they showed that they have achieved 79% precision [10]. The paper provides the solution of notifying only the presence of obstacles instead of full semantic analysis and this to make their project cost down. In this they use image classification technique using two very different high-level approaches they are, first one defines the model based on the color, shape, and luminosity

of the objects or class and the second on is that labelling the image with the best fitting model [10].

III. PROPOSED SYSTEM

The Fig.1. Shows The Block Diagram of the Proposed System.

The below proposed system is used for the identification of what type of object or obstacle in front of them, and it gives as the audio output through headset for the blind person. This device is also used for the text identification using the Optical Character Recognition(OCR). This methodology is used for recognition of sequence of characters and lines of reading. The tools built for accessing technology for blind are built using two fundamental blocks are OCR software and Text-to-Speech (TTS) engines. The GPS and GSM are used to send location of the person to their relative using the message alter, that message is send to the number registered with GSM module. Thus proposed system has the following components for function of different modules.

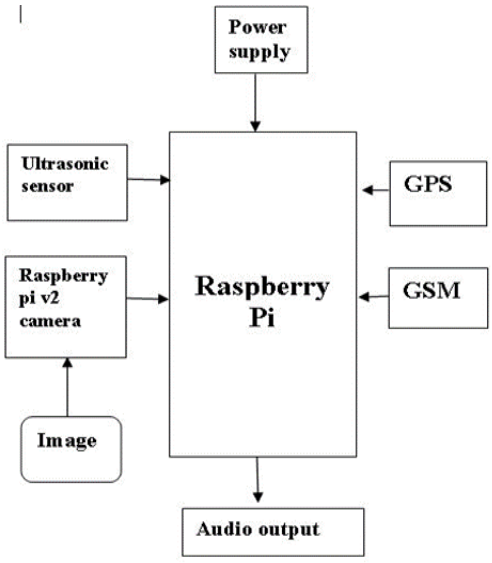

Fig.1. Block diagram of the proposed system

A. Raspberry pi:

The foundation of Raspberry pi is UK charity developed a small, barebone computer called Raspberry pi which has the intention to provide free software and low-cost computers for students. The raspberry pi is a credit card-sized computer has the Broadcom BCM2853 system-on-chip(soc). It includes 32-bit ARM1176JZFS processor which clocked at 700MHZ and a video core 4 GPU. The raspberry pi also in a package of POP is has 256MB of RAM above SOC, it is powered at least 4AA batteries or a charger of %v micro USB. For several high definition video formats ARM CPU delivers a 300MHZ Pentium 2 which is similar to the real-world performance and the Boardcom GPU is capable of graphics core and hardware decoding.

Fig.2. Raspberry pi

B. Ultrasonic sensor:

A device which used for the measurement of object detection by using sound waves is known as Ultrasonic sensor, the measurement of distance is transmitting the sound wave at a specific frequency and receive the sound that is bounce back to the original point. Recording the elapsed time between the wave begin generated and the sound wave reflected back is calculated for the distance between the sonar sensor and the object detected.

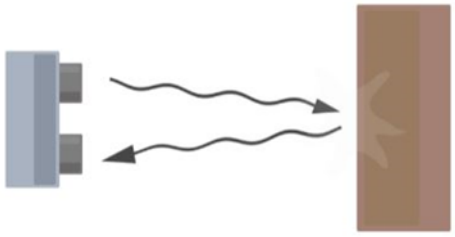

Fig.3. Diagram of basic ultrasonic sensor operation

C. Raspberry pi v2 camera:

The main object of this proposed system is the camera module which is used for capturing the image to detect what type of obstacle is it. Here we use the camera module of Raspberry pi V2, where it is the second version of raspberry pi camera modules. Including camera, the module of this device is connected to RPI 3 model B, it will monitor the PIR sensor for any motion in its range, if detects then it will send a trigger signal to the RPI 3 model B then the signal is processed and the photo is taken using RPI camera. Through a flexible ribbon cable the raspberry pi's camera serial interface(CSI) is connected to the camera module which is of

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a small circuit board. The camera module is the main part of the proposed system.

Fig 4. Raspberry pi camera module v2

The sensor used in camera module is Sony IMX219 which has the pixel values of 1.12µm*1.12µm with the optical size of ¼". The still resolution of this camera is 8Megapixels which has a video mode of 1080p, 720p, and 640*480p60/90. It has a view in two ways one is horizontal field view of 62.2 degrees and another is a vertical field view of 48.8 degrees.

D. Global Positioning System (GPS):

Global Positioning System is a satellite based system that uses satellites and ground stations to measure and compute its position on earth. It has to receive at least four satellites data for accuracy purpose and it will not transmit any data or information to the satellite. Over a radio frequency of 1.1 to `1.5 GHZ GPS satellites transmit information to the receiver, the position and time is computed by the information received to GPS module.

Fig.5. GPS module

The GPS receiver module has the output in the format of standard NMEA (National Marine Electronics Association) string format. The NMEA output from GPS receiver contains parameter like longitude, latitude, altitude, time etc. and each string starts with '$' and ends with carriage return / line feed sequence.

E. Global System for Mobile communication (GSM):

The Global System for Mobile communication is used to describe the protocols for second generation digital cellular networks.

It is used by mobile devices such as mobile phones and tablets. GSM networks operate in a number of different carrier frequency ranges, the 2G GSM network operates under 900MHZ or 1800MHZ bands and for 3G networks it operates under 2100MHZ frequency band. The transmission power maximum of 2watts is limited in GSM 850/900 and 1 watt in GSM 1800/1900.

Fig.6. GSM module

The Subscriber Identity Module is the main feature of the GSM module, which known as SIM card. After switching the handsets, it will allow the user to recover the information. It also restricts handsets sometimes for mobile network.

F. Audio output:

The output of this proposed work is the audio output which will give the command of the object detected through the camera module with an accuracy of the image. The system and the user interact with this voice feedback where the light weight hear piece is connecting to the 3.5mm jack of the raspberry pi. The text identification is given as scanned image to the raspberry pi where it will process and give as voice feedback of the content of image scanned.

G. OpenCV and Python

The OpenCV is mainly aimed at real time computer vision and it is the library of programming functions, also it is used for various application such as augmented reality, gesture recognition, feature matching etc. To import the program, we

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use the command “import cv2” in python, where it is a high level program language which as an automatic memory management and dynamic type system. Multiple programming paradigms are support in python and it’s procedural styles, it is also a light weight programming tool which has many inbuilt functions and don’t consume more resources while operating on the raspberry pi module. OpenCV is used for the sorting of all type images and video, and it is also fast and efficient as compared to other libraries for computer vision. The computer vision has a task for digital images like gathering, processing and analyzing the information of the images, where it closely linked with machine learning and artificial intelligence, it sees and analyze the image in the same way as human see. In the OpenCV is free to analyze and modify the source code and edit according to the individual needs, for efficient performance of operation and data it makes use of NumPy arrays.

IV. Implementation And Algorithm

The image is captured using a camera module where it is divided into sequence of frames for object detection is done using Haar cascade classifiers. The python in OpenCV library has functions specific for object detection technique. Haar training is where delivers a software package which are used to train classifiers for the object detection. Based on on cascade classifiers Haar like features are used for object detection, where it uses machine learning based approach, it is trained from lots of positive and negative images of the object detected. For several white and black rectangles interconnected haar like features is considered as a template for object detection, this features are used for different size and rectangles. They are just like a convolutional kernels where each feature is a single value obtained by subtracting sum of pixels under white rectangles and sum of pixels under black rectangles.

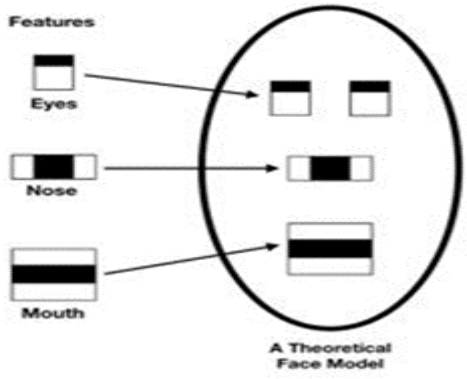

Fig.7. Theoretical face model

The above figure shows the theoretical model for how the algorithm detects the face of person captured in the camera module. The algorithm shows how it detects the I age captures under the sequence of frames of lots of positive and negative images which is differentiated as a white and black rectangle.

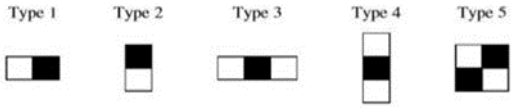

Fig.8. Type of detection in shapes

In case if large number of features is there for detection, we need to find the sum of pixels in black and white rectangles and to solve this we use integral images which can simplifies the calculation of sum of pixels.

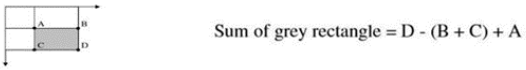

Fig.9. Calculation of pixels

The specific order in which the training samples along with their names are arranged in the text file of positive and negative images are generated which contain the coordinates Text files are used to obtain vector file where this file contains compact information of the positive instances of objects and the negative images as a back ground and the classifiers are trained using the vector file. The final classifier is the file which converted from these files into a single xml file, where the same classifier is used in python code to detect and track the object using the voice feedback system. The captured images are resized into gray scale using the below formula,

Gray Value = 0.2989R + 0.5870G + 0.1140B.

R, G and B are the red, green and blue components in the pixel of an image.

The text to speech convertor is the scope of the module with receding character recognition, this performs the task of converting the transformed text into audible form, where the raspberry pi has the on board audio jack it is generated by a PWM output. Then if the recognition is completed the character code in the text file is processed by Raspberry pi device using a Tesseract algorithm and python programming.

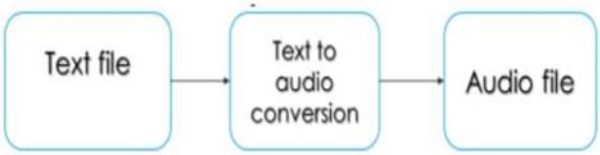

Fig.10. Block diagram for TTS

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Then the image to text convertor is recognized the characters in the image using the ASCII values of the characters processed by raspberry pi board, where each character is recognized using the corresponding templets and it is saved as a normalized text transcription and this is further to an audio output. The image is placed under the camera module is captured and processed by the above process and the quality of the image captured is high and has a fast and clear recognition because of the high resolution of the camera.

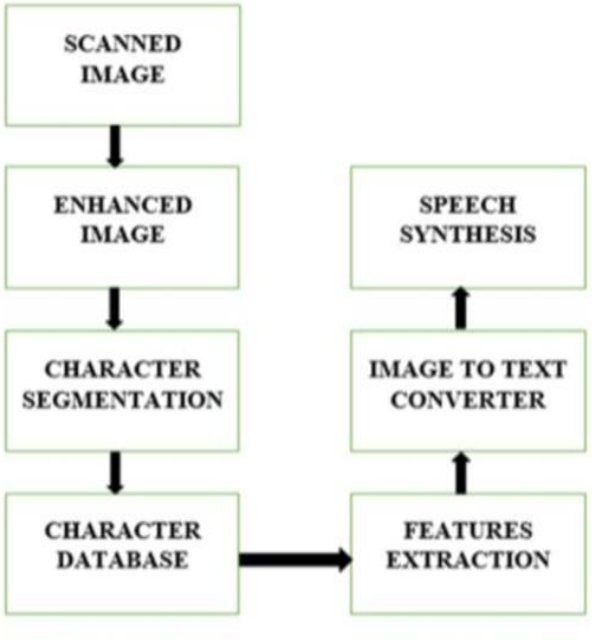

Fig.11. Flow process

V. Results Of The Proposed System

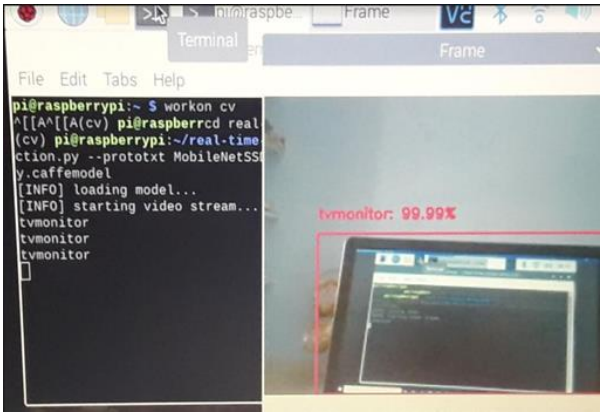

Fig.12. Detects as TV monitor with accuracy

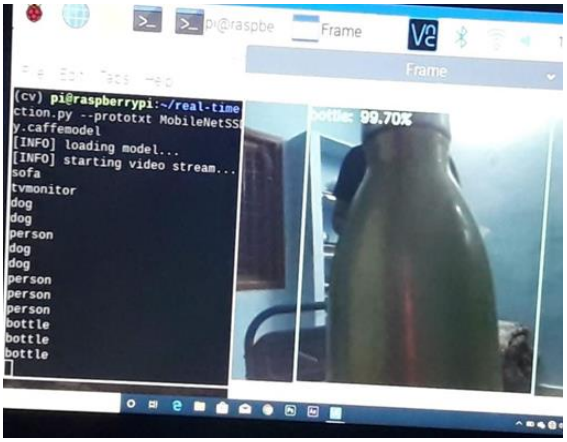

Fig.13. Detected object of bottle

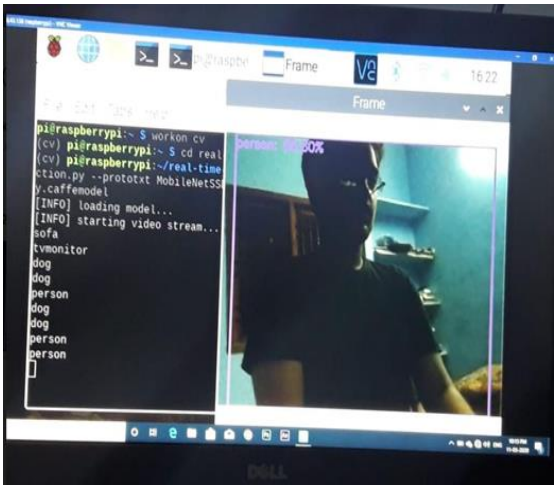

Fig.14. Detection of person

VI. Conclusion

This paper contains the solution for the blind people to do their activities in a daily routine with identifying the object or obstacle in their pathway and it is easier to identify how accurate the image captured. Thus the system is used for the safe navigation in his/her home and surroundings and move independently for their own requirements. This system provides the advanced audio aid system for interact between the blind and the device, it also useful for text identification and it is given in the voice feedback. This proposed system is a user friendly and its cost effective, where it will make some important changes in the blind person's life.

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