Smart Glasses for Indoor Object Detection to Assist Visually Impaired

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***Abstract*—The project aids the visually impaired to navigate independently using real time object detection and identification. The proposed system consists of a Raspberry Pi-3B+ processor and an OpenCV-Deep Neural Network model (DNN). The processor was connected to a camera and the camera is mounted on the glasses. The processor was coded in python, a high level programming language, needed to process images in real time. The camera captures an image in real time which was processed by the Raspberry Pi-3B+ processor. The python code uses the DNN model to identify the obstacle with boxes and category index. The processed data of identification of object is conveyed to the user using Linux based text to speech convertor. This system is extremely flexible and can be used in any environment.**
Keywords-OpenCV, Object Detection, Raspberry Pi, RPi-Camera ,Text to Speech.

I. INTRODUCTION

The ability to navigate from place to place is a significant part of daily life. Human beings process the world around them mostly via the sense of sound and vision. Many would have difficulty in visually identifying the surroundings. To facilitate safe and efficient navigation, blind individuals should have a technology based system to assist. We made visually impaired easy to navigate in extremely familiar places. The vision to visually impaired means providing the details about what is in front of them like objects ,faces and giving them details using text-to-speech conversion so that blinds can easily hear it with help of earphones and get idea about what's happening around. With advancement in technology a lot of object identification systems have come up to aid the visually impaired. This paper highlights the indoor object detection technique available for blind individuals to support independent living.In this project, we propose a smart system which will help the blind identify the surrounding objects easily and will give a clear audio output.This system is low cost and would be focusing on blind in large-scale. Additionally, it can also be used by people with both low vision and low hearing ability.

II. PROPOSED METHODOLOGY

Smart Glasses system for visually impaired is based on Deep Learning method and text to speech system synthesizer Festival. Mobilenet is a neural network that is used for classification and recognition whereas the SSD is a framework that is used to realize the multibox detector. Only the combination of both can do object detection. It is possible to classify multiple classes present within an image. The system uses TensorFlow API for the object detection and classification.A simplest and fastest pre-trained object detection model COCO SSD MobileNet v1 offered by Tensor Flow to detect various objects present within our image is used. OpenCV helps in the image processing operations and 'Festival' performs the text to voice conversion. A bounding box framing of object is detected on the video frame of laptop. The project is able to detect objects which come under 90 various classes. The camera is mounted on the glasses and the Raspberry Pi is powered securely and kept in a backpack.

III. SYSTEM DESCRIPTION

A. RaspberryPi 3B+

Raspberry Pi 3 Model B+ has 1.4 GHz processor and a three-times faster gigabit Ethernet. Other features are Power over Ethernet (PoE), USB boot and network boot. Raspberry 3B+ is a processor,processing the real time data and analysing it further.

Fig. 1. Raspberry Pi.

B. *Raspberry-Pi-NoIR-Camera-Module-v2-2*

The Raspberry Pi Camera Module v2 is a high quality 8 megapixel camera based that allows creating HD video and still photographs. It is a custom designed add-on board for Raspberry Pi, featuring a fixed focus lens. It's capable of 3280 x 2464 pixel static images, and also supports 1080p30, 720p60 and 640x480p90 video. It attaches to Pi by way of one of the small sockets on the board upper surface and uses the dedicated CSi interface, designed especially for interfacing to cameras. It captures the real-time images and videos and thus, the real-time data is available for processing to the raspberrypi.

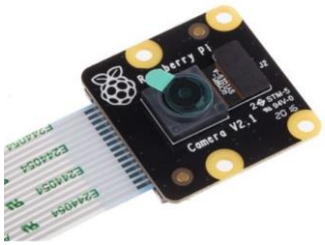

Fig. 2. Raspberry Pi NoIR Camera v2.2

C. *Festival*

Festival is an open source, software speech synthesizer for Linux, Windows, and other platforms. It is multi-lingual.Festival is in the package manager for the Raspberry Pi making it very easy to install. The speech is made available by the earphones to the user.

D. *Open CV DNN*

OpenCV uses c/c++ library functions which directly provides the computer with the machine language code and hence helps in faster execution. Using OpenCV results in more utilization of time and resources in image processing and less in interpreting. It implements a large set of state-of-the-art computer vision algorithms, including a DNN module.

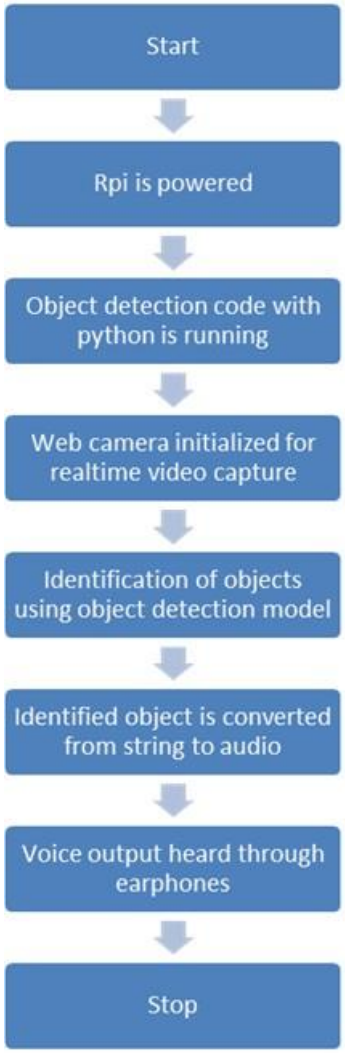

Fig. 3. Flowchart showing working of the system.

IV. Flowchart and Working

The working of the system starts by powering the raspberry pi processor appropriately and is securely kept in a backpack. Thus, the web camera mounted on the glasses.is interfaced through the USB ports of pi. Python Opencv code for object detection is uploaded continuous running.Real time video is started using the Raspberry Camera Module. Here, a faster pre trained object detection COCO SSD MobileNet v1 offered by TensorFlow to detect various objects present within our image is used.

This can be displayed when the raspberry pi is interfaced with a display system. The output of the detected object is given to the visually impaired using earphones. By using the text to speech synthesis system Festival, the text like detected object name is converted to voice output. The earphones connected to audio jack of raspberry pi provides voice description corresponding to the objects present in the image. The output we can see on the laptop contains a box representing a part

of the image where a particular object was detected where the camera video can be seen. The system helps visually impaired to identify respected objects in the surroundings and to access it easily.

V. Results and Discussions

Prototype of the proposed system is as shown below.

Fig. 4. Prototype of the System Proposed.

The figure shows the image of the output screen. It shows that in a single frame objects like backpack, bottle and couch is detected. Anyway the disadvantage of the system is that it has left many objects in the frame undetected. Also sometimes there will be error in the object classification that the system will misinterpret one object as another.

Fig. 5. Output for bottle.

Fig. 6. Output for couch.

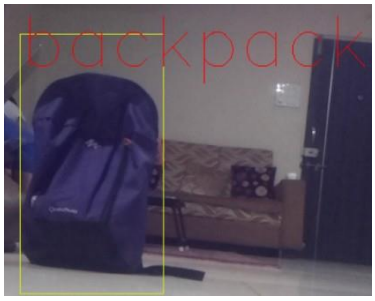

Fig. 7. Output for backpack.

VI. Conclusion

The system has a simple architecture that transforms the visual information captured using a camera to voice information using Raspberry Pi. The subject needs to wear the glasses and a backpack to keep the raspberry pi and earphones for the provision of audio output to identify the object. One doesn't require any particular skills to operate it. The proposed system is cheap and configurable. The device is a real-time system that monitors the environment and provides audio information about the environment .The smart glasses will be really helpful for the blind people in their day-to-day movement. In this paper, the COCO model is used to train the SSD MobileNet which can detection only 90 classes of objects.

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