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SMART HAT OBJECT DETECTION FOR BLIND PEOPLE USING MACHINE LEARNING ALGORITHM

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Abstract :The people who are having complete blindness or low vision face many types of hurdles in performing every day routine works. Blindness can occur due to many reasons including disease, injury or other conditions that limit vision. Our aim is to develop a navigation aid for the blind and the visually impaired people. We design and implement a smart cap which helps the blind and the visually impaired people to navigate freely by experiencing their surroundings. The scene around the person will be captured by using a NoIR camera and the objects in the scene will be detected. The headset will give a voice output describing the detected objects. The architecture of the system consists of Raspberry Pi 3 processor, NoIR camera, headset and a power source. The processor collects the frames of the surroundings and convert it to voice output. The device uses TensorFlow API, opensource machine learning library developed by the Google Brain Team for the object detection and classification. TensorFlow helps in creating machine learning models capable of identifying and classifying multiple objects in a single image. Thus, details corresponding to various objects present within a single frame are obtained using TensorFlow API. A Text to Speech Synthesiser (TTS) software called eSpeak is used for converting the details of the detected object (in text format) to speech output. So the video captured by using the NoIR camera is finally converted to speech signals and thus narration of the scene describing various objects is done. Objects which come under different classes like mobiles, vase, person, vehicles, couch etc are detected.

IndexTerms **- Raspberry Pi 3 processor, TensorFlow API, TTS, eSpeak, NoIR camera, Ultrasonic sensor.**

I. INTRODUCTION

Blindness is a condition in which individuals lose their vision perception. Mobility and self-reliability for the visually impaired and blind people has always been a problem, they are not familiar with and usually require someone to help them navigate. They often bump into the obstacles present in their way thus hindering their free movement. According to WHO (World Health Organization), it is estimated that approximately 1.3 billion people live with some form of vision impairment. With regards to distance vision, 188.5 million people have mild vision impairment, 217 million have moderate to severe vision impairment, and 36 million people are blind. The conventional methods adopted like cane helps in avoiding the obstacles in their way but they do not help them identify and locate the objects. Hence, assistance is required for the blind that helps him/her in locating objects in an environment. This project aims to help the blind in object detection with the distance of the object and to provide an audio information about the object detected. The system helps the blind to navigate independently using real time object detection and identification. The System consists of use of devices such as Raspberry Pi-3, Pi camera, Ultrasonic sensors and power supply. For object detection, TensorFlow is used. The Proposed System generates a audio output which is the result of object detected and distance measured. The visually impaired man hears the audio output through the earphones connected to the cap and hence, it helps him in navigation.

II. . EXISTING SYSTEM

The existing embedded system employs the extra hardware to provide the guidance for the people. It is not a mobile system. If it is not movable it can't be used broadly. Technology can help in minimizing many barriers that people with visual disabilities face. These technologies are known as assistive technology (AT). Many ATs have been proposed to help the visually challenged. The following section describes existing proposals or systems to be helpful for the blind. The blind Cane is one of the assisting tools for the visually challenged and it is important. It was intended for testing the visually challenged to utilize their brain to memorize a set of objects. It aids its user to understand their surroundings but, if the user walks into a new environment, they will find it difficult to memorize the locations of the object or obstacles. The blind cane cannot detect any obstacle which is present in front of the person. There is no possibility of a practical application of this cane due to its requirement of extensive training. The Guide Cane was designed to help the visually challenged people navigate safely and quickly among obstacles and other hazards, but it is considerably heavier than the white cane. It consists of wheels that are equipped with encoders to determine the relative motion.

The servo motor, controlled by the built-in computer, can drive the wheels left and right relative to the cane. To detect obstacles, it is decked with ten ultrasonic sensors. A joystick fixed at the top handle allows the user to specify a desired direction of motion. The Smart Cane consists of a sensor system. Ultrasonic sensors detect and avoid obstacles located in front of the user. A fuzzy controller is required to determine the instructions that will be executed. It uses purely ultrasonic sensors for its operation, which can detect very short distances, and there is no knowledge about the obstacle ahead. It cannot help the user in recognizing the object in front of him. Another Smart Cane using Radio Frequency Identification (RFID), was designed by students from Central Michigan University. RFID is used to detect objects or obstacles in front of the visually challenged person. This device is similar to a normal stick but it is equipped with a bag, worn by the person. This bag supplies electricity to the stick and informs the user through speakers inside the bag. However, this invention has several drawbacks and is only suitable for small areas. This is because it only detects the area with RFID tag otherwise this only works as a regular blind cane.

III. PROPOSED SYSTEM & IMPLEMENTATION

Smart Cap is based on Tensor Flow and text to speech synthesizer software. With a single object detection model, it is possible to classify multiple classes present within an image and also it can specify the exact position of the image (if monitor provided) with a bounding box framing the object. The project is able to detect objects which come under 90 various classes. The working of the system starts by suitably powering the raspberry pi processor. Thus, the web camera interfaced through one of the USB ports of pi is initialized. Real time video is captured using the NoIR camera which in turn is converted to a set of frames using python command. Here, we are using a simplest and fastest pre-trained object detection model 'ssd_mobilenet_v1_coco' offered by Tensor Flow to detect various objects present within our Page 6 image. Identification of various objects present in the image is done using detection graphs and weights. The output contains a box representing a part of the image where a particular object was detected, score representing level of confidence for each of the objects and class label. This can be displayed when the raspberry pi is interfaced with a display system.

3.1METHODOLOGY

Under normal circumstances, blind people use walking sticks, which assist them to navigate around and avoid obstacles.
However, the limitation of this method is that it cannot help the blind person detect objects that are further away, and cannot alert the blind person of other objects. This system is designed to help the blind person to be more knowledgeable of other objects and their estimated distance.

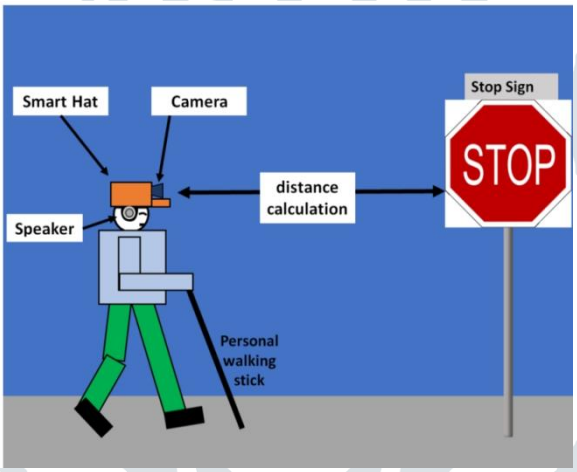

Figure1:System operation overview

3.2 System Operation Overview

This smart cap is based on TensorFlow Lite and speech output. The SSD-MobileNetV2 used in this system can detect multiple objects that are present in one image or frame. The model detects the position of each image and outputs the name of the object and its bounding boxes. This pre-trained SSD-Mobile model can classify 90 different objects. This can be a problem when outputting the results if too many objects are detected at the same time as it will take too long to notify the user of each object. To avoid this, the output has been fine-tuned to output only the most common objects, such as a person, car, television, computer, dog, cat, stop sign, and traffic lights. As illustrated in Figure 3, the working of the systems is initialized by the powering of the Raspberry Pi 4 microcontroller, and therefore the microcontroller powers on the camera module. The camera module captures a real-time video and feeds the frames into the Raspberry Pi. The Raspberry Pi, with TensorFlow Lite running the Python code, is loaded with the pre-trained SSD-MobileNet-V2 model to detect objects and output the results of the detected object and its estimated distance through the speaker.

The output of each object depends on the threshold, which is set at 0.5. Any object detected with a higher level of confidence is listed in part of the output, and any object with less than 0.6 level of confidence is discarded. The bounding box and the results can be displayed when the raspberry pi is connected to a display. The speaker, or headsets, are connected to the audio jack of the Raspberry pi 4 used to output the soundresults of thedetected object and their estimated distance to the user.

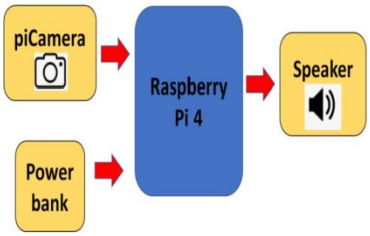

Figure2: Block diagram

3.2 Systems Description

3.2.1 TensorFlow Lite API: TensorFlow Lite is an opensource deep learning framework designed for resource constraint devices such as the Raspberry pi modules and mobile devices. TensorFlow Lite makes it possible to run TensorFlow models on mobile, embedded, and IoT devices. It enables on-device machine learning inference with low latency and small binary size. Therefore, it improves latency, and power consumption gets reduced.

3.2.2 Single-Shot Multibox Detector (SSD): A SingleShot Multibox Detector is an architecture that has no delegated region proposal network and predicts the boundary boxes and the classes directly from feature maps in one single pass. The SSD makes 8732 predictions for better coverage of location, scale, and aspect ratios, more than many other detection methods. Many predictions will contain no objects, therefore, any predictions with class confidence scores lower than 0.01 will be discarde. For 300×300 input image, SSD achieves 74.3 per cent mean average precision (mAP) on the VOC2007 test dataset at 59 FPS on an Nvidia Titan X and for 512×512 input, SSD achieves 76.9 % mAP, outperforming a comparable state of the art Faster R-CNN model. Even with smaller input image size, SSD has much better accuracy, even with a smaller input image size when compared to other single stage methods such as YOLO.

3.2.3 OpenCV: OpenCV is an open-source library for realtime computer vision. 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.

3.2.4ESpeak: eSpeak is a compact, open source, software speech synthesizer for Linux, Windows, and other platforms.

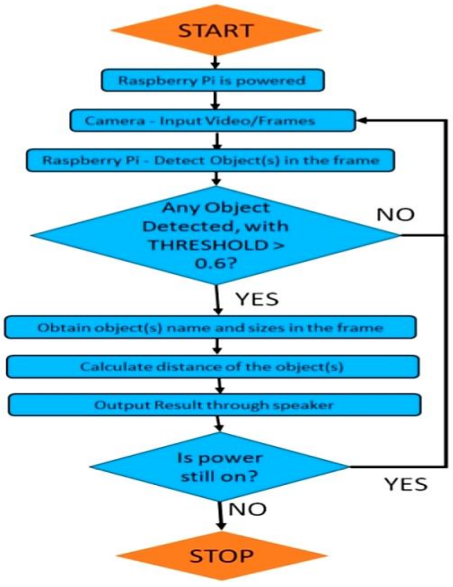

Figure3: Process Flowchart

IV. RESULT AND ANALYSIS

Sufficient development implementation provides adequate performance. Almost any point in the context can be observed. The detection of tensor flow objects helps to identify and detect objects. The output of tensor flow is expressed through the text of the espeak.

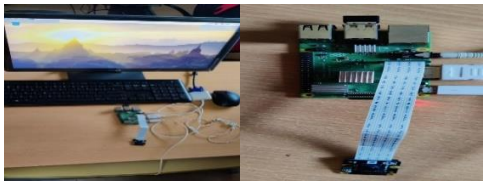

Figure4: Proposed Outcome

V. CONCLUSION

This project suggests assisting the visually impaired in their day to day routine, and protecting them from accidents using raspberry pi, pi camera tensor flow object detection. With project implementation we conclude that having this device with the visually impaired their safety can be assured. The objective is to assist these people and create a healthy, safe and helpful

environment. The system has a simple architecture which transforms the captured visual information from a Raspberry Pi camera to voice information. Contrary to the other systems on the market, the subject only needs to wear the cap and does nothing to operate it. No particular ability is required of the person using it. Any blind or visually disabled person may use it since the system just needs to be charged up.

VI. REFERENCE

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