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SMART CAP USING RASPBERRY PI AND TENSORFLOW

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Abstract— Science and technology always try and make human life easier. Those who are having complete blindness or low vision faces many difficulties during their navigation. Blindness can occur because of many reasons including disease, injury or other conditions that limit vision. The most purpose of this paper is to develop a navigation aid for the blind and also the visually impaired people. In this paper, we design and implement a system using Raspberry Pi which helps the blind and also the visually impaired people to navigate freely by experiencing their surroundings. This work aims to help the visually impaired people for detecting objects within the surrounding environment using TensorFlow and for reading text using OCR.

Keywords— IoT, TensorFlow, OCR, Raspberry Pi, Pi-Camera

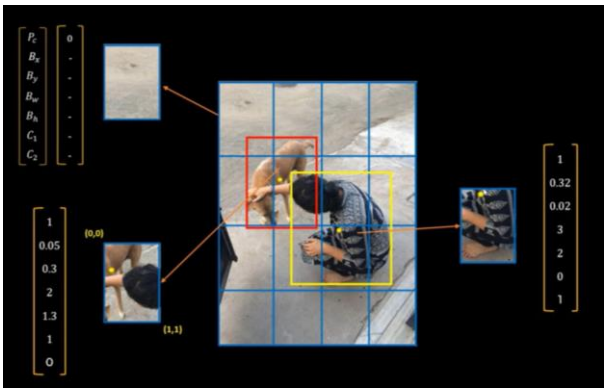
I. INTRODUCTION

Vision is one amongst the very essential human senses, and it plays the important role in human perception about surrounding environment. The aims to help the blind in object detection 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 proposed system consists of a Raspberry Pi-3 processor which is loaded with a pre-trained Convolutional Neural Network model (CNN) developed using TensorFlow. The processor is connected to a PI camera. The processor is coded in python. The PI camera captures the image in real time and may be provided to the Raspberry Pi-3 processor for processing it.

The python code uses the COCO model to detect and classify the objects. It'll draw boundary boxes around the detected and may also show the category index of the thing. The category index of the detected objects are visiting be stored within the text file document. The category index consists of the class name and ID of the detected object. The contents of the text file are converted to voice using the Text to Speech Synthesizer (TTS) software eSpeak. This method is portable, and so the user can easily carry it.

YOLO (You only look once) is a state of the art object detection algorithm that has become main method of detecting objects in the field of computer vision. Previously people used techniques such as sliding window object detection, R CNN, Fast R CNN and Faster R CNN. But after its invention in 2015, YOLO has become an industry standard for object detection due to its speed and accuracy. In this video we will understand the theory behind how exactly YOLO algorithm works. In next video we will write code to detect objects using YOLO framework.



II.RELATED WORKS

PAPER 1:
An Implementation of an Intelligent Assistance System for Visually Impaired/Blind People.
Abstract: In this paper, an intelligent assistance system is proposed for visually impaired/blind people, which consists of wearable smart glasses, an intelligent walking stick, mobile device's application, and on-line information platform. When visually impaired/blind people wear the proposed smart glasses and holding the proposed intelligent walking stick, thus the obstacles will be detected. If a visually impaired/blind person is sink, then the related information (GPS, fall down, etc.) are recorded and uploaded to the on-line information platform. Related information can even be viewed by the proposed mobile device's application.

PAPER 2:
Advanced Indoor and Outdoor Navigation System for Blind People Using Raspberry-Pi
Abstract: This system uses a camera and Infrared sensors to induce input from the environment. The camera is utilized to capture a video of the environment and sends it to the Raspberry Pi 3 module, where image procession detects certain objects in each frame. The system also has an Infrared sensor attached to the stepper motor, which scans for nearby objects all-around and produces vibration using the vibrating motor on the left and also the right-hand sides. However, this method has processing power limitations within the Raspberry Pi 3 module, which is restricted to the processing power of 1.4GHz CPU and 1GB LPDDR2 SDRAM, and thus having limited processing power.

PAPER 3:
Objects Talk - Object Detection and Pattern Tracking Using TensorFlow.
Abstract: Objects in household that are frequently in use often follow certain patterns with regard to time and geographical movement. Analyzing these patterns can help us keep better track of our objects and maximize efficiency by minimizing time wasted in forgetting or looking for them. In our project, we used TensorFlow, a relatively new library from Google, to model our neural network. The TensorFlow Object Detection API is utilized to detect multiple objects in real-time video streams. We then introduce an algorithm to detect patterns and alert the user if an anomaly is found. We consider the research presented by Laube et al., Finding REMO-detection relative motion patterns in geospatial lifelines, 201-214, (2004).

PAPER 4:
Smart Walking stick for visually impaired.
Abstract: to help the visually impaired people, this study that helps those people to steer more confidently is proposed. The study provide a wise walking stick that alerts visually-impaired people over obstacles ahead that help them to navigate safely. It outlines an improved navigational tool for the visually impaired. It consists of a simple walking stick equipped with sensors to provide information about the environment. GPS technology is integrated with pre-programmed locations to determine the optimal route to be taken. The user can choose the situation from the set of destinations stored within the memory and can lead within the right direction of the stick. During this technique, ultrasonic sensor, pit sensor, water sensor, GPS receiver, level converter, driver, vibrator, voice synthesizer, keypad, speaker or headphone, PIC controller and battery are used. The main aim of the device is to provide a convenient and safe method for the blind to beat their difficulties in daily life.

III.METHODOLOGY

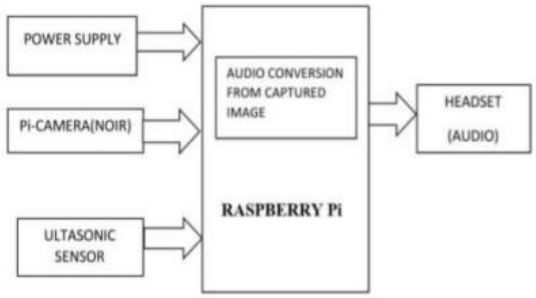


Fig: Methodology of Smart Cap Model

The processor is connected to a Pi camera. The processor is coded in python. The Pi camera captures the image in real time and will be provided to the Raspberry Pi-3 processor for processing it. The python code uses the COCO model to detect and classify the objects. It will draw boundary boxes around the detected and will also show the category index of the object. The category index of the detected objects will be stored in a text file. The category index consists of the class name and class id of the detected object. After the process of Object detection, the ultra-sonic sensors measure the distance of the object detected. This information is stored in a text file. The contents of the text file is converted to voice using the Text to Speech Synthesizer (TTS) software eSpeak. This system is portable and the user can easily carry it.

IV.IMPLEMENTATION

The implementation of Smart cap for visually impaired People is finished with the assistance of components like Raspberry Pi, ultrasonic sensors, Pi camera earphone. All the components are placed in secure manner which is simple for the person to use it. The person can anytime wear or remove the model. The Raspberry Pi could be a low cost, credit card size computer which is employed for running the programs (processing)

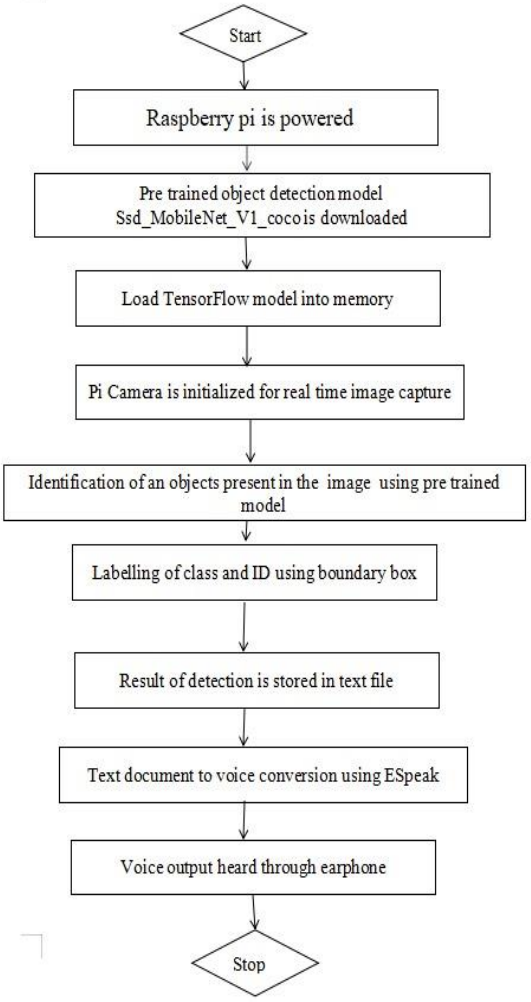


Fig: Flowchart

The Ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic sensor measures the distance to the target by measuring the time between the emission and reception. it has a range to detect the objects within the range of 2cm to 80cm. The sensors are placed on the model which are used to detect any obstacle and alert the user with a beep sound. The pi camera is employed to capture a picture and is processed by Raspberry pi to extract text from the image using the OCR (optical character recognition) technology.

V. RESULTS

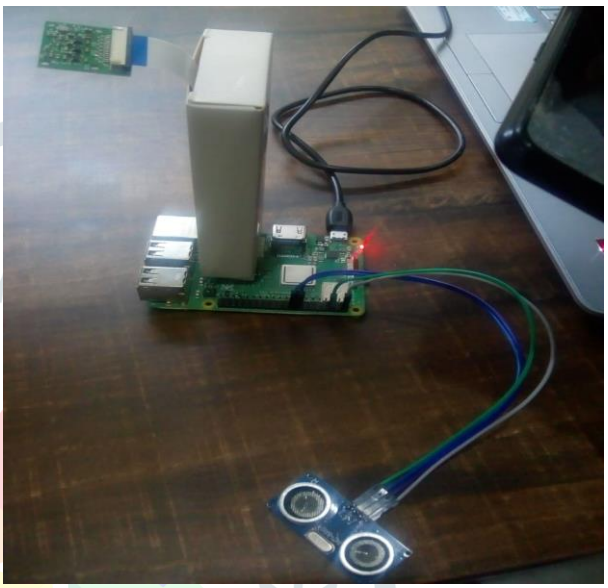


Fig: Project model

The Pi camera captures the image in real time and will be provided to the Raspberry Pi-3 processor for processing it. The python code uses the COCO model to detect and classify the objects. It will draw boundary boxes around the detected and will also show the category index of the object. The category index of the detected objects will be stored in a text file. The category index consists of the class name and class id of the detected object. After the process of Object detection, the ultra-sonic sensors measure the distance of the object detected. This information is stored in a text file. The contents of the text file is converted to voice using the Text to Speech Synthesizer (TTS) software eSpeak. This system is portable and the user can easily carry it

Fig: Detecting the mobile phone

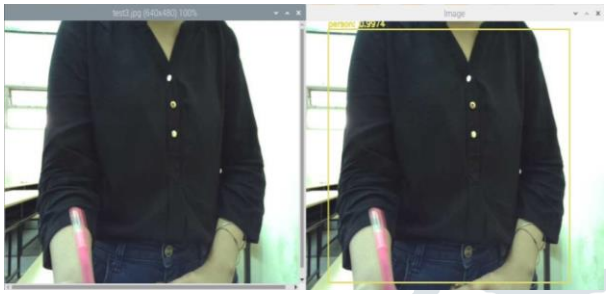


Fig: Detecting the person

Fig: Recognizing text from the image

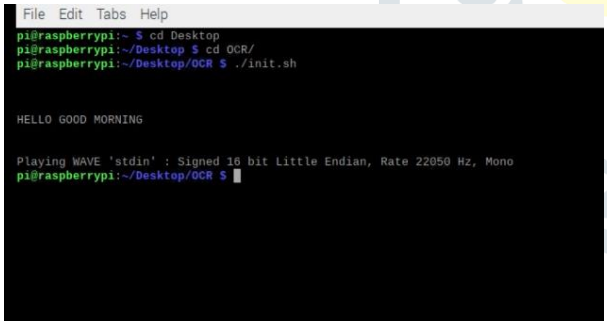


Fig: Text to Speech Output

VII. FUTURE SCOPE

Smart cap can be improved in the future for blind people and people who have vision difficulties by adding new techniques. For instance, direction and warning messages to prevent expected accidents, messages to tell the user about the battery level, video detection to provide a full healthy life for people with vision difficulties, develop mobile application to control Smart cap's camera to have more wider view angle, provide with GPS notification and develop the cap design to have little, small and light components so the user can wear it easily.

VIII. CONCLUSION

The system has a simple architecture that transforms the visual information captured using a camera to voice information using Raspberry Pi. Unlike other systems available in the market, the subject needs only to wear the cap and doesn't require any particular skills to operate it. The proposed system is cheap and configurable. The person who uses it does not require any particular skill to operate it. Any blind or visually impaired person can use it simply since he/she has to only power up the device. The system helps in clear path indication and environment recognition. The device is a real-time system that monitors the environment and provides audio information about the environment making his/her navigation more safe and secure.

The system will be really helpful for the blind people in their navigation. The number of objects can be increased by training the model by ourselves. Face detection can be also incorporated so that the blind person can easily identify his/her family members and friends.

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