Raspberry Pi Based System for Object Detection and Recognition for Visually Impared People

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Abstract

Nowadays the demand of low cost well-trained embedded devices that can be applied in real world is increasing.Our efforts in this project are determined to achieve a system which can render one of such application to benefit the blind people. In this project video detection and recognition is presented based on a single board computer represented by Raspberry PI as an embedded solution. The aim is to make a smart system which detects the object for the blind user, measures its distance , and report the output in the form of audio signals to alert the blind user of the obstacle ahead. This entire work is done on raspberry pi with operating system ported on it.

Literature Survey

S.no	Title	Year Published	Authors	Abstract	Terms Used
1.	Implementation of Object Detection and Recognition Algorithms on a Robotic Arm Platform Using Raspberry Pi	2018	Cagri KAYMAK, Aysegul UCAR	It is aimed to implement object detection and recognition algorithms for a robotic arm platform.With these algorithms, the objects that are desired to be grasped by the robotic arm are recognized.In the experimental setup that established,OWI-535 robotic arm with 4DOF and a gripper.	SIFT,SURF,FAST Algorithm
2.	A Smart IoT Interaction System with Object Detection and Gaze Estimation	2019	Jung-Hwa Kim ; Seung-Ju ne Choi ;	In this paper,they proposed a system how to interact with IOT devices by doing simple gestures The proposed system mainly consists of: 1)object detection module; 2)gaze estimation module; 3)hand gesture recognition module; And 4)IoT controller module.	Gaze estimation module,Controller module

3	Real-time object detection and tracking in an unknown environment	2011	Shashank Prasad ; Shubhra Sinha	This paper is the result of our research where our research team developed and implemented object detection and tracking system operational in an unknown background,using real-time video processing and a single camera.	Object, detection, recognition, tracking, unknown environment, changing image, real-time, computer vision
4	Internet of Things (IoT) based Object Recognition Technologies	2020	K. Srinivasan ; V.R. Azhaguramyaa	This paper aims at the development of a solution that can be adopted by the visually impaired for identifying and locating household objects in their daily life. The solution includes a wearable device that listens for the user's voice, understands the user's command and locates the object in the surrounding environment. Once the target object is located, it gives user the information about the object and the maximum possible distance of the object from the user.	voice, vision, visually impaired, IoT, object recognition

5	Object Recognition for Dental Instruments Using SSD-MobileNet	2019	Hashir Ali, Mahrukh Khursheed, Syeda Kulsoom Fatima, Syed Muhammad Shuja, Dr. Shaheena Noor	In recent technological developments, robot-assisted surgery has become popular due to its tremendous prospects in enhancing the capabilities of surgeons performing open surgery, yet very little effort has been made to make these tools available to dental surgeons. This paper addresses the problem of identifying the problem of real-time object recognition of dental instruments by utilizing deep learning techniques. For this reason, the Single Shot MultiBox Detector (SSD) network was considered as the meta structure and joined with the base Convolutional Neural Network (CNN) MobileNet to shape SSD-MobileNet.	object recognition, SSD-MobileNet, deep learning, CNN, computer vision
6	A hybrid active vision system for real time application running object recognition	2019	Duy Nguyen Phuong	Computer vision is developing fast and be applied to robotics. Active vision system has been researched recently to address problems with saccade movement and real-time realization. The paper proposed the use of a hybrid system consisting of an object recognition model built with MobileNet SSD and an object tracker running Median Flow. This system has proven to work well in real-time application, with an average 15 frames per second and angular speed of 75 degree per second. The system remains stable and robust throughout all experiments.	active vision, robotics, object recognition, object tracking, Median Flow, TensorFlow, MobileNet SSD.

7	IoT Devices Recognition through Object Detection and Classification Techniques	2019	Argyro Mavrogiorgou ; Athanasios Kiourtis ; Dimosthenis Kyriazis	This paper proposes a mechanism for recognizing heterogeneous IoT devices of unknown device type, by applying specific computer vision techniques. This mechanism implements four (4) stages to successfully recognize a device of unknown nature. Initially the discovery and the connection of both known and unknown devices occur, followed by the online search of their images, so as to categorize and map the unknown devices' images with the images of the known devices.	IoT, heterogeneous devices, unknown devices, device recognition, object detection, object classification

Introduction

People are witnessing the dawn of the new era of Deep Learning and embedded devices. Real life applications whether it be in the domain of Image recognition, Driver less cars, better preventive health care are all here today or on the horizon. The primary motivation which drives our team is how we can build a real-world application, in a cost effective manner which can benefit a section of society namely-”blinds”.

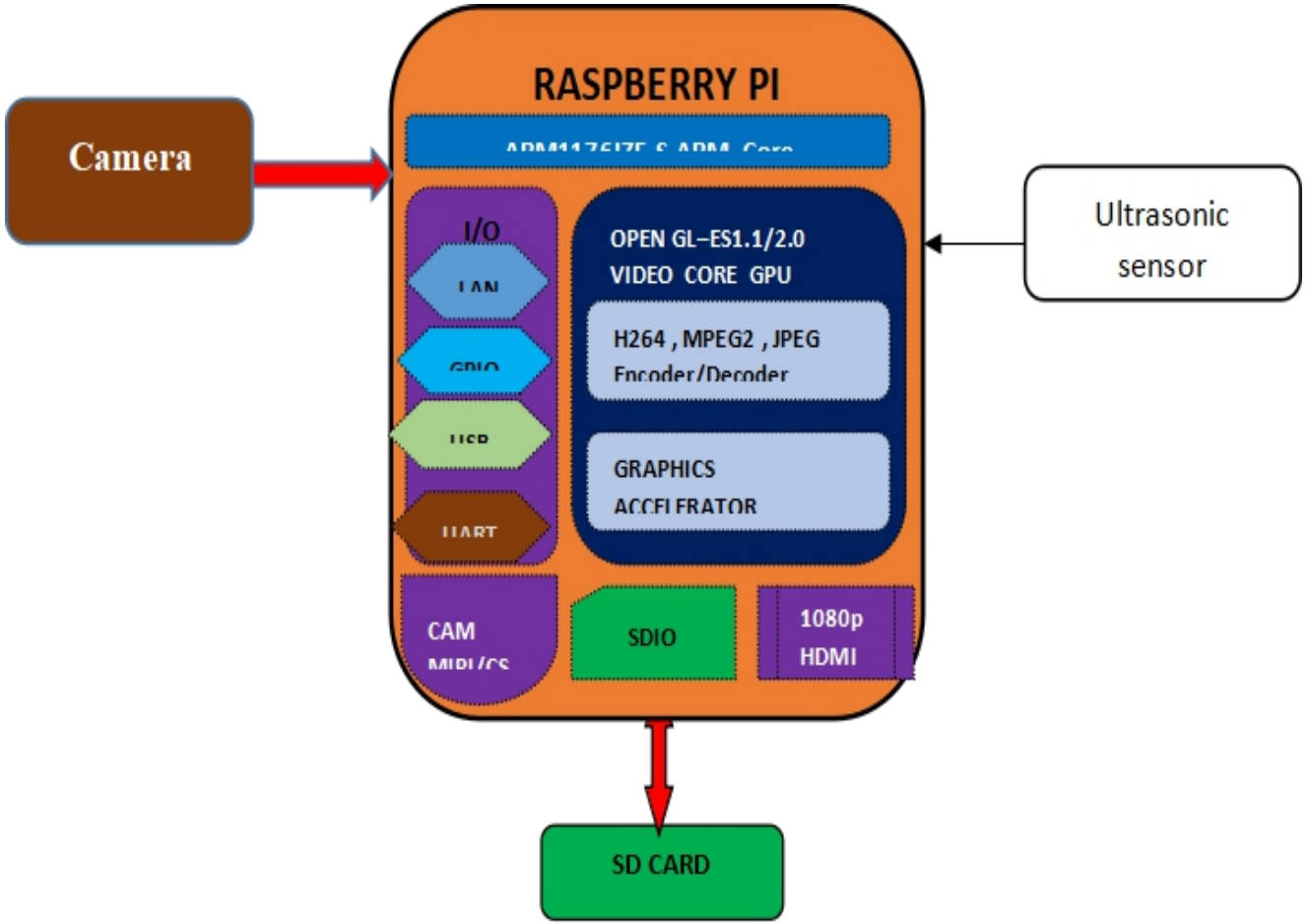
Problem Statement

One of the major problems faced by Blind people is detecting and recognizing an obstacle in their path. The projects approach lies in developing a system based on Raspberry Pi 3 , which is capable of labeling objects with the help of OpenCV and TensorFlow libraries and converting the labeled text to speech and producing output in the form of audio signals to make the blind person aware of the object in front of him. The scope also includes measurement of the distance of the object from the person and reporting the same. Most of the Object Detection algorithm has been tested on GPU with high computation abilities and are less likely to achieve same speed and accuracy with less powerful devices with microprocessor only, which are in high demand in current scenario. We choose Raspberry Pi 3 as our platform because it is a standard representative of embedded device and is widely being used for devising low cost-system. We would like to have a prototype that can successfully perform real-time detection in about 5-10 fps onPi, with decent accuracy.

UML Diagram


start system
stop instruction
a blind person
request self location
<<include>>
gps location tracker
<<include>>
conversion to speech
video capturing
<<include>>
processing and extracting an image
<<include>>
obstacle detection using ultrasonic
<<extend>>
<<extend>>
the system
<<include>>
buzzer sound
face recognition using opentace
use image for object recognition using some algorithm like yolo
<<include>>
conversion of information to speech
apply convolution neural network
batch normalisation
Activation function

Block diagram



Algorithm and Methodologies

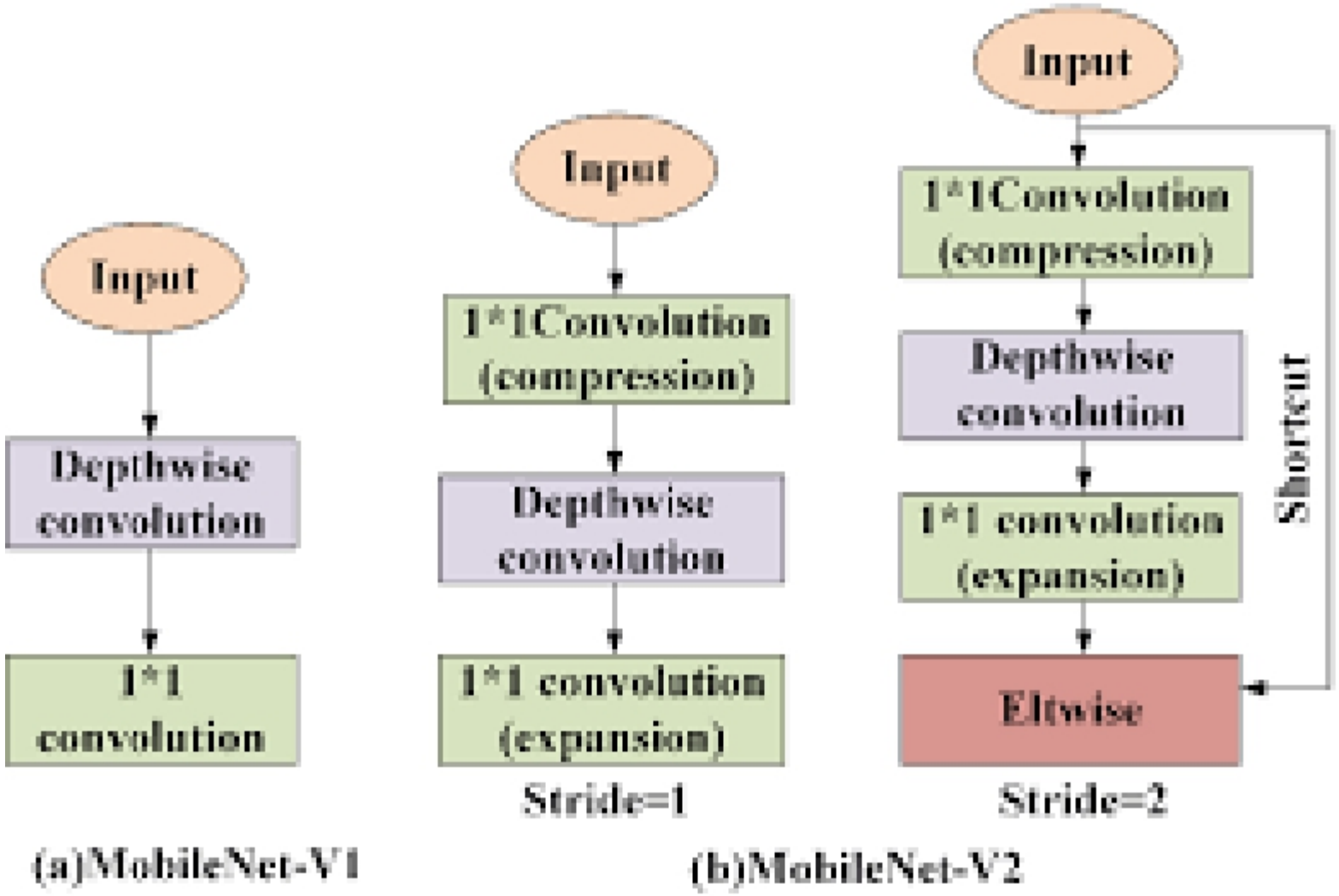
In this project, the Pre-trained model is used, Its accuracy is more than 90%. It can also be customized to recognize other objects using Transfer learning. The MobileNet is depth wise separable convolution, reduces the number of parameters. It is more suitable for vision-based applications where there is less performance power of the system.

MobileNets are the latest offering from Google. They are suitable for embedded and mobile devices because they have a small size, low latency and need low power. They can be used on platforms with resource constraints for various use cases. They can be used like some popular, but large scale, models such as Inception Net for the tasks of classification, detection and segmentation.

Usage of deep neural networks for object detection is also explored while keeping in mind the issue of porting the model to Raspberry Pi. Single Shot Multibox Detector (SSD) is also tested on the same dataset. It gives around 97% precision, but recall is low. The number of false positives reported is much less than that in traditional Computer Vision approaches explained before. But, the model needs a lot of memory to run.

MobileNets are the latest offering from TensorFlow that is suitable to be run on embedded and mobile devices. TensorFlow object detection API can be used to train and test such models with reduced memory requirements. It is shown that object detectors like SSD can be utilized for object detection task when coupled with MobileNets. Porting MobileNet model to a platform such as Raspberry Pi is the next logical step in that direction. This task is work in progress.

Algorithm Diagram



Code

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File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?

new 1

```
import RPi.GPIO as GPIO
import time
TRIG=21
ECHO=20
GPIO.setmode(GPIO.BCM)
while True:
    print"distance measurement in progress"
    GPIO.setup(TRIG,GPIO.OUT)
    GPIO.setup(ECHO,GPIO.IN)
    GPIO.output(TRIG,False)
    print"waiting for sensor to settle"
    time.sleep(0.2)
    GPIO.output(TRIG,True)
    time.sleep(0.00001)
    GPIO.output(TRIG,False)
    while GPIO.input(ECHO)==0:
        pulse_start=time.time()
    while GPIO.input(ECHO)==1:
        pulse_end=time.time()
    pulse_duration=pulse_end-pulse_start
    distance=pulse_duration*17150
    distance=round(distance,2)
    print"distance:",distance,"cm"
    time.sleep(2)
```

Code Description

Input from a Sensor via GPIO:

The HC-SR04 distance sensor measures distance based on emitting a sound burst, and timing how long it takes to receive the echo back. Using the known constant that is the speed of sound, we can mathematically determine the distance of any object in front of this sensor by simply measuring how much time passed while the sound waves were emitted, hit the object in front of the sensor, bounced back, and came back to the sensor.

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