A Mini Project Report on

"**OBJECT DETECTION USING MACHINE LEARNING**"

Submitted

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Signature of the Faculty

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1.Abstract

Real time object detection is a vast, vibrant and complex area of computer vision. If there is a single object to be detected in an image, it is known as Image Localization and if there are multiple objects in an image, then it is Object Detection. This detects the semantic objects of a class in digital images and videos. The applications of real time object detection include tracking objects, video surveillance, pedestrian detection, people counting, self-driving cars, face detection, ball tracking in sports and many more. Convolution Neural Networks is a representative Deep learning to detect objects using OpenCV(Opensource Computer Vision), which is a library of programming functions mainly aimed at realtime computer vision.

This project was an attempt at developing an object detection and tracking system using modern computer vision technology. The project delivers an implemented tracking system. It consists of a hybrid of optical and modern infra-red technology and is applicable to areas such as unsupervised surveillance or semi-autonomous control. It is stable and is applicable as a stand alone system or one that could easily be embedded into an even larger system.

Object detection is **one of the most basic and central task in computer vision**. Its task is to find all the interested objects in the image, and determine the category and location of the objects. Object detection is widely used and has strong practical value and research prospects.

Keywords: Computer vision, Deep Learning, Convolution Neural Network

2.Introduction

Object detection and tracking is one of the areas of computer vision that is maturing very rapidly. It allows us to identify and locate objects in an image or video. With this kind of identification and localization, object detection and tracking can be used to count objects in a particular scene and determine and track their precise locations, all while accurately labeling them.

In this project, we have made use of two of the most popular Python libraries for object detection, **OpenCV** and **ImageAI**.

Every supermarket nowadays has at least one CCTV camera installed. And the data is stored in a centralized repository with a timestamp. Our end goal was to identify the people coming in and going out of the supermarket or retail store, and categorize them under the labels “customer” or “not a customer”. By achieving this goal we could calculate the actual cost per customer.

Object Detection is the process of finding and recognizing real-world object instances such as car, bike, TV, flowers, and humans out of an images or videos. An object detection technique lets you understand the details of an image or a video as it allows for the recognition, localization, and detection of multiple objects within an image.

It is usually utilized in applications like image retrieval, security, surveillance, and advanced driver assistance systems (ADAS).Object Detection is done through many ways:

- Feature Based Object Detection
- Viola Jones Object Detection

- SVM Classifications with HOG Features
- Deep Learning Object Detection

Object detection from a video in video surveillance applications is the major task these days. Object detection technique is used to identify required objects in video sequences and to cluster pixels of these objects.

The detection of an object in video sequence plays a major role in several applications specifically as video surveillance applications.

Object detection in a video stream can be done by processes like pre-processing, segmentation, foreground and background extraction, feature extraction.

Humans can easily detect and identify objects present in an image. The human visual system is fast and accurate and can perform complex tasks like identifying multiple objects with little conscious thought. With the availability of large amounts of data, faster GPUs, and better algorithms, we can now easily train computers to detect and classify multiple objects within an image with high accuracy.

The human visual system is fast and accurate and can perform complex tasks like identifying multiple objects and detect obstacles with little conscious thought. With the availability of large amounts of data, faster GPUs, and better algorithms, we can now easily train computers to detect and classify multiple objects with an image with accuracy.

3.Methodology

Our workflow was divided into two main segments,

1. Optimization of the videos.
2. Human Object Detection and tracking on videos.

3.1 Optimization of the videos

Optimizing the video to make it as light as possible for the algorithm to work smoothly and achieve speed. A video is nothing but a sequence of images, hence achieving the objective of identifying the object at the lowest-most level of an image will result in achieving the same on a video by iterating the process on all the images that the video is made up of.

Optimization includes :

- Turning the image/video into grayscale
- Reducing the image/video to the pure black white form
- Masking the image/video
- Reading video frames

3.2 Human Object Detection & Tracking on videos

For object detection and tracking, we used OpenCV and ImageAI. The object detection and tracking work for recorded videos as well as a live feed directly from different types of cameras.

Object detection and tracking include:

- Using the camera for live-feed video
- Using existing video footage
- An in-out tracker using opencv and object detection and counter method

- Finally a web app as a GUI for the analysis of the detection and tracking results of the supermarket and retail stores that is done using streamlit.

Object detection and tracing method.

We are accepting a set of bounding boxes of a person and compute their respective centroids and then compute the Euclidean distance between any new centroids and existing centroids to track the movement.

When centroids intercept the gate line from the top of the frame the IN counter is incremented and when the centroids intercept from down the frame OUT counter is incremented. And hence we can count the number of people in the defined zone.

3.3 Tools and Technologies Used in the Project

- **Numpy:** The fundamental package for scientific computing with Python.
- **OpenCV:** " Open Source Computer Vision Library " is an open-source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications.
- **ImageAI:** It is a Python library built to empower developers, researchers, and students to build applications and systems with self-contained Deep Learning and Computer Vision capabilities using simple and few lines of code. ImageAI provides the three most powerful models for object detection and tracking – RetinaNet, YOLOv3, and TinyYOLOv3.
    - In our project, we have used **YOLOv3** as it gives a moderate performance with accuracy and moderate detection speed and time.

- ``**Streamlit:** It is an open-source Python library that makes it easy to create and share beautiful, custom web apps for machine learning and data science.

Step-by-Step Implementation

1. Install the requirements
    0. pip
    1. Opencv-python
    2. Tensorflow 2.4.0
    3. ImageAI
    4. streamlit
    5. Other dependencies: keras==2.4.3 numpy==1.19.3 pillow==7.0.0 scipy==1.4.1 h5py==2.10.0 matplotlib==3.3.2 keras-resnet==0.2.0
2. Download YOLOV3 model
3. Clone the repo already pushed to github
4. Run the code to stream the webapp

3.4 APPLICATION OF OBJECT DETECTION

The major applications of Object Detection are:

FACIAL RECOGNITION

"Deep Face" is a deep learning facial recognition system developed to identify human faces in a digital image. Designed and developed by a group of researchers in Facebook. Google also has its own facial recognition system in Google Photos, which automatically separates all the photos according to the person in the image.

There are various components involved in Facial Recognition or authors could say it focuses on various aspects like the eyes, nose, mouth and the eyebrows for recognizing a faces.

PEOPLE COUNTING

People counting is also a part of object detection which can be used for various purposes like finding person or a criminal; it is used for analysing store performance or statistics of crowd during festivals. This process is considered a difficult one as people move out of the frame quickly.

INDUSTRIAL QUALITY CHECK

Object detection also plays an important role in industrial processes to identify or recognize products. Finding a particular object through visual examination could be a basic task that's involved in multiple industrial processes like sorting, inventory management, machining, quality management, packaging and so on. Inventory management can be terribly tough as things are hard to trace in real time. Automatic object counting and localization permits improving inventory accuracy

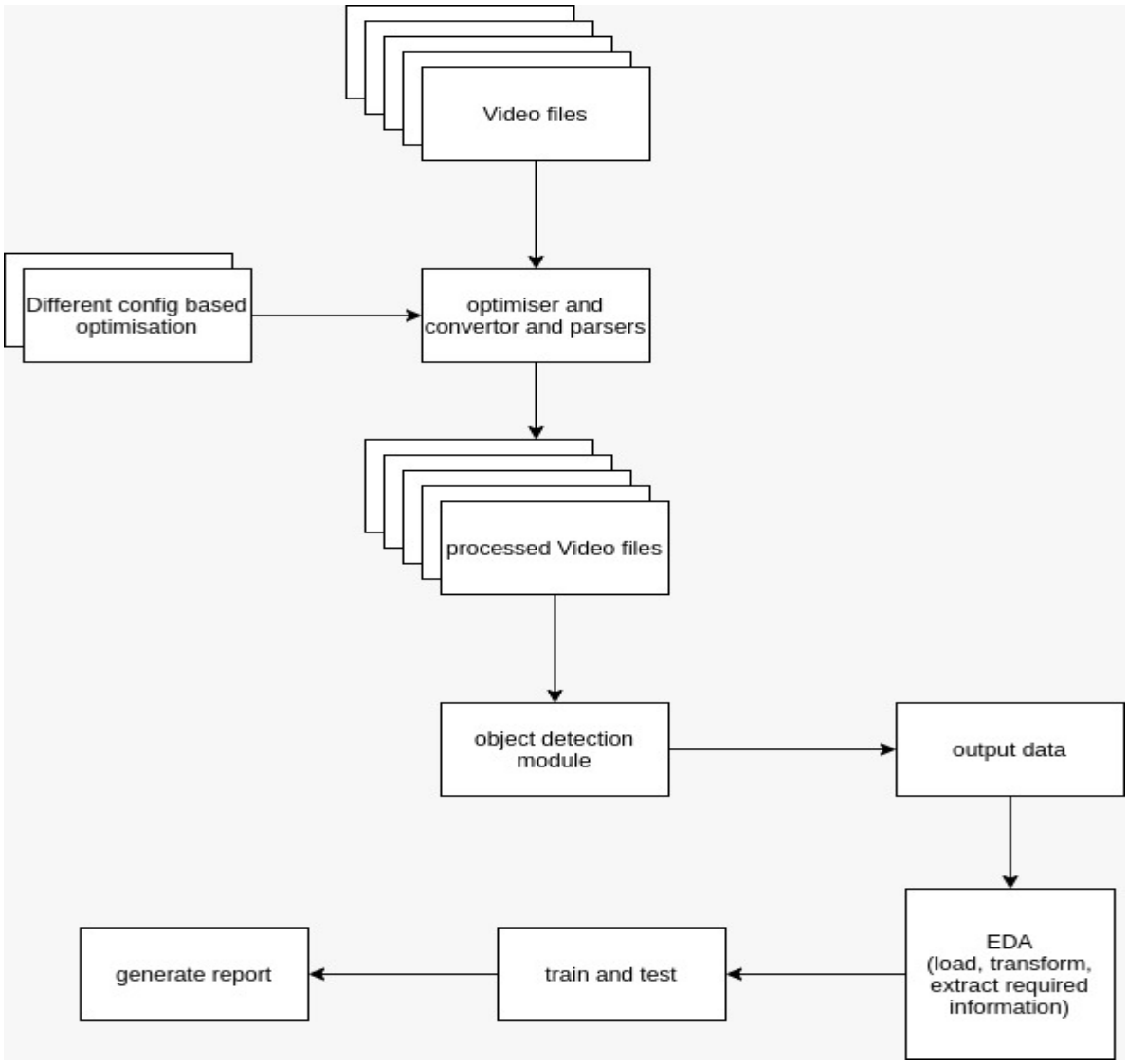
SELF DRIVING CARS

Self-driving is the future most promising technology to be used, but the working behind can be very complex as it combines a variety of techniques to perceive their surroundings, including radar, laser light, GPS, odometer, and computer vision. Advanced control systems interpret sensory info to allow navigation methods to work, as well as obstacles and it. This is a big step towards Driverless cars as it happens at very fast speed.

SECURITY

Object Detection plays a vital role in the field of Security; it takes part in major fields such as face ID of Apple or the retina scan used in all the sci-fi movies. Government also widely use this application to access the security feed and match it with their existing database to find any criminals or to detecting objects like car number involved in criminal activities. The applications are limitless.

Program Flow



OBJECT DETECTION WORKFLOW AND FEATURE EXTRACTION:-

Every Object Detection Algorithm works on the same principle and it's just the working that differs from others. They focus on extracting features from the images that are given as the input at hands and then it uses these features to determine the class of the image.

3.5 Project Application in Real-Life

The project can be implemented in various fields, we thought of implementing it in local marts. The objective was simple:

We talk to the owners, and they let us use their computers to run our program on their CCTV footage. After we did that, making an excel sheet of the same and doing some basic visualizations to help the owners figure out the foot of people based on the time of the day. This will help them manipulate the prices accordingly and gain more profits while providing the customers something in return as well.

Example: They can give a discount that is limited to that very specific time period, they make a profit during the times they weren't and the customers get the products at a cheaper rate than usual. It's a win-win situation for both.

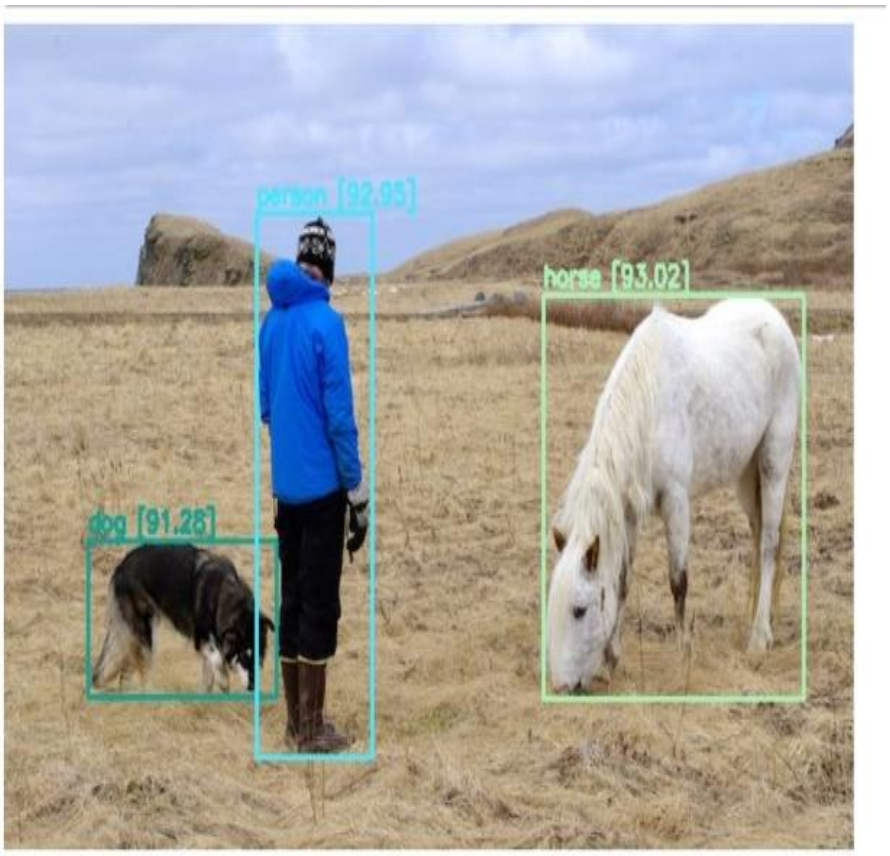
The application can be applied for various other fields as well, say for example security systems for shops and in public places. The system can be trained to identify threats and inform the nearest authority as an alert + record the event as proof.

4. EXPERIMENTAL RESULTS

Evaluating object detection models is not straightforward because each image can have many objects and each object can belong to different classes. This means that we need to measure if the model found all the objects and also a way to verify if the found objects belong to the correct class.

This means that an object detection model needs to accomplish two things:

- Find all the objects in an image
- Check if the found objects belong to the correct class



A object detection model produces the output in three components:

- The **bounding boxes** — x1, y1, width, height if using the COCO file format
- The **class** of the bounding box
- The **probability score** for that prediction— how certain the model is that the class is actually the predicted class

We need to take a closer look at the **probability score** component. Mostly because modern neural networks are poorly calibrated

Now imagine you need to compare the performance of two different object detection models. Since we know that the probability scores are poorly calibrated, there is a good chance that a bounding box with a probability score of say 80% having the same location coordinates as a bounding box with a probability score of 50% on the other model.

5.CONCLUSION AND FUTURE WORK

Object Detection tasks come with challenges we don't see in multiclass classification tasks. With object detection, you need to find the objects and predict the correct class. Also, each image usually have a variable number of annotated objects.

Deep learning based object detection has been a research hotspot in recent years. This project starts on generic object detection pipelines which provide base architectures for other related tasks. With the help of this the three other common tasks, namely object detection, face detection and pedestrian detection, can be accomplished. Authors accomplished this by combing two things: Object detection with deep learning and OpenCV and Efficient, threaded video streams with OpenCV. The camera sensor noise and lightening condition can change the result as it can create problem in recognizing the object. The end result is a deep learning- based object detector that can process around 6-8 FPS.

By using this thesis and based on experimental results we are able to detect obeject more precisely and identify the objects individually with exact location of an obeject in the picture in x,y axis.This paper also provide experimental results on different methods for object detection and identification and compares each method for their efficiencies.

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