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THE REAL TIME DETECTION OF TRAFFIC PARTICIPANTS USING YOLOV7 ALGORITHM

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Abstract: The detection and classification of traffic participants, such as vehicles, pedestrians, and traffic objects are essential for ensuring efficient and safe traffic. With the improvement in image recognition and image classification, detection has never been much more efficient and accurate. This paper proposes a real-time object detection system that uses the YOLOv7 algorithm to detect and track traffic participants. Yolov7 is much faster and more accurate than its predecessor making it useful for real-time search results. It is able to handle complex datasets and some conditions such as scale changes and lightning changes. There is no need for high-end devices to run the experiment. The training of any dataset is significantly much faster and shows good accuracy compared to its predecessors. In order to enhance the detection of traffic participants, the system uses a multi-scale feature pyramid network. It also uses a bounding box regression algorithm to improve the accuracy of objects. One upgrade of the YOLOv7 is the ability to detect distant objects which was an issue for the older versions. The weight that is used for this experiment is the YOLOv7 w6-pt. This version can detect traffic participants in harsh lighting conditions and is incomparable to the older models.
Key word: Object detection, Yolov7, Image classification,Traffic participants.

1. Introduction

1.1 Background

Identification of traffic participants is necessary for road safety and preventing accidents the city has many problems such as traffic congestion violence such as hit and run and other problems that need to be controlled from time to time however with the help of the yolo algorithm such situations can be solved and helped the yolo algorithm can monitor traffic participants and classify objects around them [1]. Real-time detection has changed over the years and it's an advancement for object detection self-driving cars have come a long way thanks to this type of algorithm and their surroundings are faster and more accurate [2].

The detection method that is used in this experiment is very accurate and precise traffic participants such as vehicles pedestrians and other objects can be easily detected and their whereabouts in some cases the algorithm may face some detection problems due to the objects unfamiliar size and angle.

The version of the yolo algorithm that is used in this research is the yolov7. It is much faster and more accurate than its predecessor making it useful for real-time search results. This version is able to handle complex conditions such as scale changes and lightning changes [3].

Some of the application that uses object detection are autonomous vehicles which rely heavily mostly on sensors to observe the surrounding environment and take full control of the vehicle without needing human intervention, multiple objects tracking in different situations and multiple object, counting medical image, analysis and so on [2].
In this study, we are going to test the capabilities of the intelligent object detection algorithm by collecting data from urban traffics. The main objective involved in object detection includes object detection and object classification in some cases it may show different results such as in surveillance cameras vehicle cameras and detection during low lights [4]. Some results may not be desirable as they may fail to achieve accuracy mostly in very distant traffic participants and groups of objects that are tightly packed. However, in the overall test the yolov7 achieve greater results and it is more advanced in image recognition based on deep learning grown remarkably.
In order to check this, we used two different YOLov7 weights to observe the classification of an object. The two weights are YOLOv7 W6 and YOLOv7 E6. These two weights are of different sizes and has noticeable difference in speed, accuracy and precision. Both of these weights are able to detect traffic participants harsh lightning conditions, populated area and in real-time too.

1.2 Research Objective

The primary goal of this research is to develop a traffic participants monitoring system using yolo v7 algorithm to improve the precision and classification of objects such as vehicles pedestrians and other traffic objects. The proposed system will be implemented and optimized to detect any traffic participants precisely in real-time. The proficiency of the system will be evaluated using datasets collected from Pune city to check its detection accuracy and also the speed of recognition in analysis to other models. This research will explore the use of a bounding box regression algorithm to improve the recognition precision of different types of datasets whether it is big or small. The ultimate goal is to develop real-time traffic participant detection which can be integrated into vehicles or traffic cameras, thus helping prevent any causalities from accidents and improving public safety. To conclude, this research may contribute to the enhancement of the current real-time object detection system using the yolo v7 algorithm that gives accuracy speed and other safety features.

1.3 Organization of Paper

In the 1st section, it gives a brief introduction about the YOLO algorithm. The 2nd section explains about the related work that is YOLO nano. The 3rd section is about the proposed system and how the algorithm works. The 4th section shows the results and experiment setup of the project. The final 5th section is about the conclusion and further works of the project.

2. Related work

YOLO nano is a compact object identification similar to regular yolo algorithm designed for low-powered devices. YOLO nano has reduced the number of variables in the network that maintains a very good speed and precision unlike the previous algorithm which is bulky complex and has a hard time running on energy-efficient devices [5]
In order to balance both swiftness and precision the yolo nano is designed with simple architecture. It has fewer convolutional layers and also fewer filters YOLO nano employs

depth-separated convolution that results in separate depth-wise and pointwise operations to reduce computational costs in order to minimize computational cost the yolo nano uses anchor-based object detection which predicts an anchor box for every grid cell in the feature map making it very efficient and precise more advanced

Several studies have shown the result of yolo nano on benchmark datasets such as coco and pascal VOC, showing results that are competitive as compared to the other object detection yolo algorithms while also running significantly much faster for illustration the yolo nano achieves a mean average precision of 214 and has a model size of 40 mb and requires around 47b for inference [5]

In conclusion, the yolo nano provides a reliable efficient solution with very good precision and fast response time for object detection on low-power devices without any issues giving the user a wide range of applications for their needs the algorithms use of anchor-based detection and object classification helps maintain good precision while also reducing computational costs.

The yolo nano has good potential for applications in surveillance electronic devices like cell phones vehicles and other resource-constrained devices.

3. Proposed System

The proposed system for real-time detection of traffic participants using the YOLO v7 algorithm consists of the following components:

Dataset Acquisition

For this experiment the datasets have been collected from Pune city.This dataset contains all the traffic participants such as cars bikes pedestrians and animals and they were collected from busy traffic.The training dataset has several images that are from different angles.The most challenging part of these images is that some traffic participants are of different light exposure, different angle which may be hard to detect and also object that may not be familiar to the algorithm.The images were from a side view and moving objects images were taken both day and night to check the detection accuracy [6].

Pre-processing

All the dataset collected do not have the same features and needs to be resized according to the algorithm's requirements.The image quality may be an issue in some cases due to various reasons such as the camera quality or dataset collected during low light which can be problematic for traffic participants detection [6].Some of the datasets may be in landscape or in portrait mode this needs to be in order and resize accordingly so that the detection may be desirable

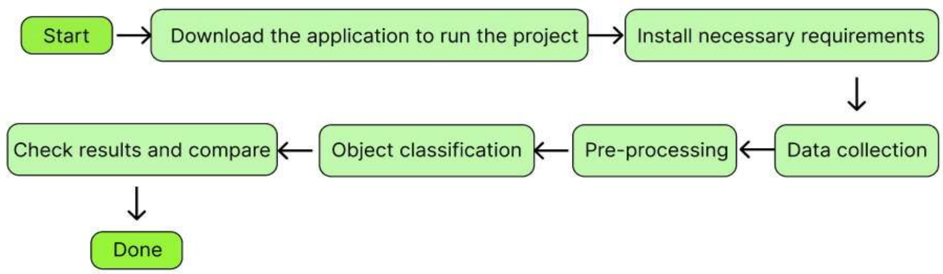
Model selection

After the selection and collection of all the datasets required and pre-processing them, comes the most important part which is the model selection.We have to discard models such as CNN,R-CNN, and fast R-CNN because they are nothing compared to yolo models and the difference between all of them is significantly big compared.YOLO has a better detection acceleration and precision than its competitors and there have been many upgrades of the original model.The performance of YOLO cannot be compromised and object identification is much smoother [6].The YOLOv7 is the successor of yolov5 and yolov6.The first version was released back in the year 2016 and there has been a major upgrade since out of all the yolo versions we chose the yolov7 due to its speed and accuracy.There is a small difference in speed and minor performance between different types of yolov7 weights.For this experiment the weights which will be used are yolov7-w6-pt size 134 mb and yolov7-e6e-pt size 290 mb the previous yolo versions seem outdated compared to yolov7 and slow [9].

System Workflow:

In the figure 1, the model includes the following phases: : (i) Data collection, (ii) Installation of libraries, (iii) Pre-processing and data cleansing, (iv) Choosing the right weight for object detection, and

(v) Object Classification.



4. Results and Discussion

Experimental setup

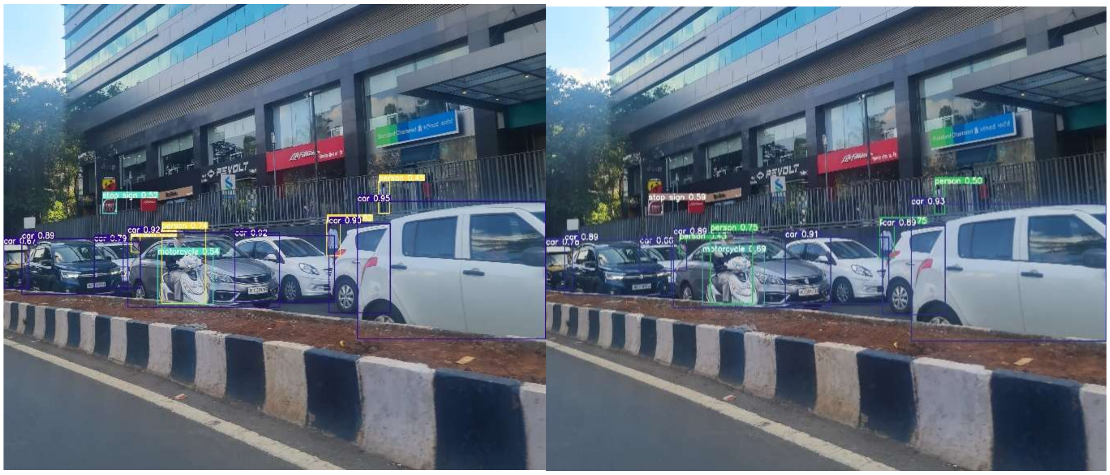
The first step within the experimental setup is to put PyCharm and YOLOv7 on the pc. Yolov7 is an object detection algorithm that can detect objects in real-time. Once you've got installed PyCharm and YOLOv7, the subsequent step is to gather datasets containing photographs of visitor's contributors. It is vital to have a wide variety of pictures that cowl special lighting fixtures conditions, angles, and climate conditions to train the YOLOv7 set of rules appropriately. You may collect datasets from numerous assets, which include on-line repositories, or by using capturing photos the usage of a digicam. After collecting the datasets, the next step is to label the pictures. Labeling the image involves annotating the images with bounding boxes around the site visitors' individuals. you could use various labelling equipment, including Labeling or VoTT to label the pics. As soon as the datasets are classified, the following step is to split them into education and validation sets. The schooling set is used to teach the YOLOv7 version, while the validation set is used to assess the model's overall performance at some stage in training. After splitting the datasets, the following step is to teach the YOLOv7 version using PyCharm. This involves configuring the model's hyperparameters inclusive of gaining knowledge of charge, batch size, and the quantity of epochs to optimize the version's overall performance. subsequently, once the YOLOv7 model is skilled, you could use it to hit upon visitors' members in actual time. You could set up the model on a device together with a digicam or a drone to come across visitors' members in real-time applications together with self-reliant cars or site visitors monitoring systems. YOLOv7 is an ultra-modern algorithm that could technique snapshots in real-time, making it

a really perfect preference for such programs.
In the table.2 shows some of the lists of YOLOv7 models and their test sizes. The test can be tried with any models but each one of them has different fps and speed. The YOLOv7-W6-pt and YOLOv7-E6E-ptareused for this experimentand check their inference time.

Model	Test Size	batch 1 fps	batch 32 average time
YOLOv7-W6	1280	84 fps	7.6 ms
YOLOv7-E6	1280	56 fps	12.3 ms
YOLOv7-D6	1280	44 fps	15.0 ms
YOLOv7-E6E	1280	36 fps	18.7 ms

All the images given below Fig 2. are performed using both YOLOv7-W6 and E6E and as you
can see they are showing slightly different result. The two similar results are of different weights. Both the weights are able to detect nearby objects very well and very precise. These are taken from Pune City, Maharashtra. The YOLOv7 weights shows different layers, parameters and gradients. After the detection,the YOLOv7 E6E have 4 person, 11 cars and 1 motorcycle. Whereas, the YOLOv7 W6 have 3 person, 9 cars and 2 motorcycles for the figures given below.
At some point, the YOLOv7 E6E is able to detect the traffic participants better compared to YOLO w6.

(a) YOLO E6E **(b)** YOLO W6



(c)YOLO E6E **(d)**YOLO W6

In the table. 3 below, shows the differences between the two weights.

Weight	Layer	Parameter	Gradient
YOLOv7 W6	343	70394300	653820
YOLOv7 E6E	792	151687420	817020

In some most of the YOLO models, it is hard to detect objects that are in dark environment but it is not really the case in YOLO v7 model as you can see the figures below. This object detection algorithm is much stronger and more accurate than its predecessors and incomparable one can say [9]. The YOLOv7 algorithm did a good job in detecting even in hardly lightning conditions and some reasonable distant traffic participants [7] [8]. The current YOLOv7 model have improved a lot and there is a big difference between the current model and all the older models.

(a) (b)

Fig 4. Shows the test result of YOLOv7 W6 at night of bikes that are parked in orderly

manner.

But in certain areas, objects that are tightly packed together like a colony of ants or very distant objects may be difficult to detect.In some instance, we may need to detect objects that are hard to detect with our human eye or multiple objects in one spot but the algorithm may not be able to detect them and even if it was possible, it will only be able to detect and classify some participants [7].

The detection of traffic participants is very crucial in today's commute systems. It is necessary for traffic monitoring autonomous driving such as tesla and to avoid traumatic events. The design proposal for real-time detection of traffic participants using the yolo v7 algorithm is a complete solution that uses a deep neural network-based object detection method to detect traffic participants in real time.

In the graph below you can see how the yolov7 performs when it is compared with other detection algorithms. The yolov7 outworks every algorithm by a mile and it is on its own level in terms of speed and precision [9].

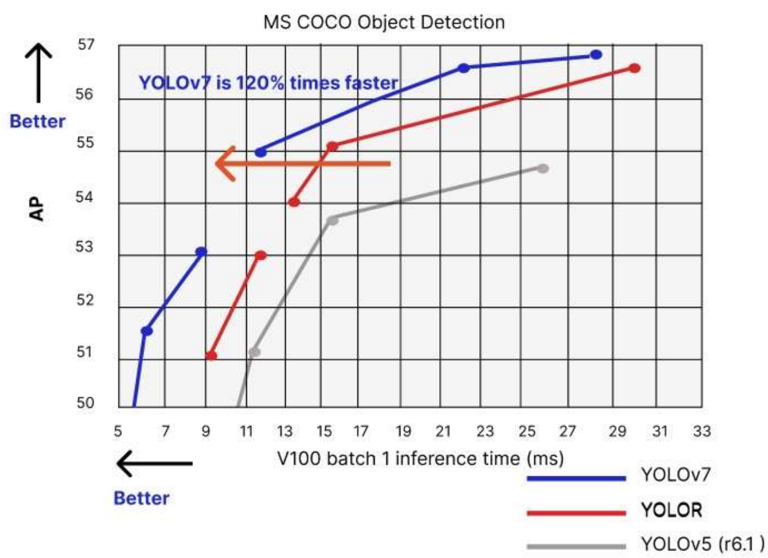


Table.1 given below shows the detailed comparison of frames per second fps of yolov7 with similar models and alongside the coco map is also shown. As seen below, the yolo v7 has a comparatively high fps as compared to other models. Due to its complexity and high performance it can only run only computers and not on cellular devices.

Model	Parameters (Million)	FPS	AP Test in %
YOLO7-Tiny	6.2	286	38.7
YOLOv7	36.9	161	51.4
YOLOv7- W6	70.04	84	54.9
YOLOv7- E6	97.2	56	56.0
YOLOv7- D6	154.7	44	56.6
YOLOv7- E6E	151.7	36	56.8

5. Limitations of this study

Some of the limitations of YOLO may be due to different lighting conditions as the algorithm finds it hard to detect in low light and may not show in the result. This has been one of the drawbacks even in previous models too. Another drawback is that in most cases, YOLO is unable to detect individually small objects that are tightly packed together or a group of similar objects. The results may also be different due to the different sizes, shapes, or angles of the traffic participants. These limitations should be carefully observed when interpreting research results and drawing conclusions about YOLOv7's performance in detecting traffic participants.

6. Conclusion and Future Scope

To sum up, this research suggested a real-time object detection system using the YOLO v7 algorithm. The weight used is yolov7-w6-pt to detect and classify traffic participants such as vehicles, people, and other objects in this research a total of six datasets have been collected to run the algorithm.The proposed system shows enhanced precision and processing quickness compared to previous versions of the yolo algorithm.Furthermore, the system uses a multi-scale feature pyramid network and also a bounding box regression algorithm to increase the identification accuracy of traffic participants.The discovery of this research shows that the proposed real-time traffic participants identification system has the possibility to be integrated into smart roads self-driving cars and smart railways.This could be of great help and may reduce accidents.

The future scope of this research is vast and there is room for a lot of advancement.The integration of this proposed system with the traffic control system can be of great help to traffic surroundings and the data obtained from the system, resulting in reduced heavy traffic and accidents.Another improvement can be done on better recognition of traffic participants actions but this enhancement may require more advanced machine learning techniques.

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