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Identification of Traffic Police Requirements Based On Traffic Concentration Along With Traffic Police Detection

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ABSTRACT
Traffic Detection System plays a vital function in the smart city platform in the current environment. The automated traffic management system's fundamental component is automatic moving vehicle detection from video sequences. In a millisecond, humans can detect and recognize things in complex surroundings. However, in order to transfer that mental process to a machine, we must first master the skill of object detection using computer vision techniques. This article addresses traffic concerns by determining the need for traffic cops depending on traffic density. YOLO v5 and computer vision are used to detect traffic cops. The findings of the investigation suggest that the proposed system can give useful data for traffic surveillance.

I. INTRODUCTION

Amajorproblemisseenineverydaylifeaspeoplearealwaysinahurrytoreachtheiroffices,schools etc. The population, as well as the number ofvehicles on the road, is increasing day by day. Imaginebeing late to the office one fine morning only to reach ata junction where the signal has malfunctioned. All thevehicles you see are congested in the middle of the roadwith no way for any vehicle to get out. That's when werealise the importance of traffic police. But unfortunatelymanytimestheyaren'tpresentthere.
Hence we came up with a solution of developingasoftwaretoavoidmajortrafficjamsandvehiclecongestions at rush hours using image recognition anddeeplearningalgorithms.
Thissoftwareaimstoprovidesolutionstoeveryday traffic problems by a simple way of alertingtraffic policemen of increasing vehicles at a particularsignal in a given span of time. Busy roads of India withreckless drivers and untimely signal malfunctions createshavoc due to which accidents and delays are prone tohappen. Our software will immediately notify the trafficinchargeofthatparticulararearegardingthesignalsmalfunction or increase in vehicle activity by installing abasiccameraandmajorroadjunctions. This will helprun traffic police activities smoothly and make peoplefollowtrafficlawsobediently.

Related Works:

Over8Literaturesurveypaperswereviewedand researched. It was found out that most of them usedYOLOv5anddeeplearningalgorithmstodetectvehiclesusingadatasetofimages.Allpaperswerepublishedafterorin2020.

A model is trained in [1] which uses alargenumber of preprocessing techniques that gives a higheraccuracy rate. Post-processing is also used to eliminatethenoiseregionsandproduceamoresmoothshapeboundary.

Thesystem in [2] is a simple real-time videoanalyzer. It has the potential to check whether peoplewearmasksornotandthushelpsustodefeatthewidespreadCOVID-19virus.

Modelstrainedin[3]have a higher accuracyrateindetectingthespeedandvehiclesaswell.It outperformsotherstate-of-the-artdetectionmethods.Thismodeliscompactandtakesuplessstoragespace.

Amulti-sensormulti-levelenhancedconvolutionalnetworkarchitecture is proposed in [4].Combining this technique withLiDAR captured imagesnot only ensures. Reliable and accurate vehicle detectionbutalsodetectsvehiclesindifferentlightingconditions.

[5]presentsanadvancedDLframeworkformotorway traffic flow prediction, by chaining togetherdataprofilingandoutlieridentification,spatialandtemporalfeaturegeneration,andvariousDLmodeldevelopment.

Themodelproposedin[6]wasabletodetectnotonlyterrestrial-capturedvehicleimagesbutalsoimagescapturedfromaUAVthathaspoorquality.

A model which helps in detecting modules of asatellite using video clips as a dataset was proposed in[7].

The strongest advantage of YOLO as comparedtosimilarmethodsisthespeedof45framespersecondisproposedin[8].OthersimilaralgorithmssuchasR-CNNandDPMhaveamuchlowerFPS.

II. DATASET AND FEATURES

Thedatasetcomprises200imagesthatwerecollected through net scraping from various resources.Various data augmentation and preprocessing techniqueswere used on the dataset. Data augmentation is a set oftechniquesforproducingadditionaldatapointsfromcurrent data in order to artificially increase the amount ofdata available. The examination and editing of digitisedimages, particularly in order to increase their quality, isknownasimagepre-processing.

The image preprocessing techniques used in thispaperare:

1. Auto-orientation
2. Resize-416x416

The following are the dataaugmentationapproachesemployedinthispaper:

1. Shear:+-25degreesHorizontal,+-25Degreesvertical
2. HorizontalFlip
3. Grayscale
4. Brightness:Between-25%to+25%
5. Blur:Upto2px
6. Noise:Upto3%ofpixels

By using this our dataset was expanded to 600images.Thedatasetconsistsofpolicemanimagesclicked from different angles for the better training of themodel.ThedatasetimageswereannotatedusingtheLabelImgtool.

III. METHODOLOGY AND ALGORITHMS

Thefollowingmethodscanbeusedtoprocess images:

1. Imagesegmentation
2. Detectionofobjects.

Object detection is the technique utilised in thispaper.Objectdetectionisacomputervisionapproachfordetecting entities in images or videos. Object detectionalgorithmsoftenusemachinelearningordeeplearningto generate meaningful results. We can recognize andidentify objects of interest in photos or video in a matterofsecondswhenwelook at them. Object detection'spurposeistouseacomputertoimitatethisintelligence.

Image segmentation is a technique for breakingdownadigitalimageintosubgroupscalledImagesegments.Thisreducestheimage'scomplexity,makingiteasiertohandleoranalyse.Segmentationmeansassigninglabelstopixels.

In this paper, we have used two object detectionalgorithmsnamely

I. YOLOv5

II. Detectron2

I. YOLOv5

TheobjectdetectionalgorithmYOLO("YouOnly Look Once"), divides images into a grid system.Eachgridcellisinchargeof detecting items withinitself.Becauseofitsspeedandaccuracy,YOLOisoneofthemostwell-knownobjectdetectionalgorithms.

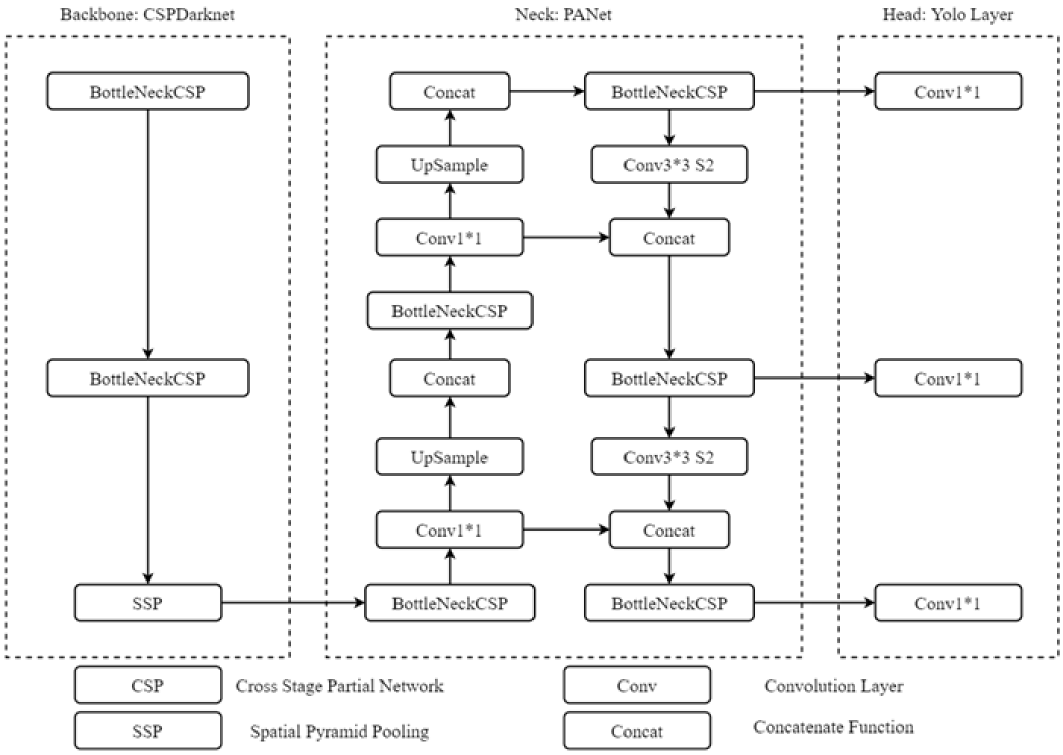


Fig 1.1 YOLOv5 Architecture

Glenn Jocher introduced YOLOv5 utilising the PytorchframeworkshortlyafterthereleaseofYOLOv4.
On GitHub, you can find the open-source code. The IoUscoreindicateshownearthepredictedboxisto
the actual box. It has a range of 0.0 to 1.0, with 1.0 beingthe best result. The box is characterised as Positive sinceit surrounds an object when the IoU is larger than thethreshold.
'mAP'isaprominentassessmentmetricincomputervision(i.e.localizationandclassification).Localizationestablishes whereaninstanceis(e.g.,boundingboxcoordinates),whilecategorizationdescribeswhatitis(e.g.adogorcat).
The mean Average Precision, or mAP score, iscalculatedbyaveragingthe AP over all classes and/orthetotalIoUthresholds,dependingonthedetectionchallengesavailable.
The mean Average Precision, or mAP score, iscalculatedbyaveragingtheAPoverallclassesand/or thetotalIoUthresholds,dependingonthedetectingproblems.
Yolov5'snetworkarchitectureisdividedintothreesections:

(1) CSPDarknetisthebackbone,
(2) PANetistheneck,
(3) YoloLayeristhehead.

ThedataisfirstsuppliedintoCSPDarknet,whichextractsfeatures,andthenintoPANet,whichfuses them. Finally, Yolo Layer gives you the results ofyourdetection(class,score,location,size).
Yolov5'sBenefitsandDrawbacks:
It'saboutathirdofthesizeofYOLOv4(27vs244MegaBytes). It's around 180 percent faster thanYOLOv4.Ontheidenticalassignment,it'saboutasaccurateasYOLOv4(withaslightdifferenceof0.003mAP). The fundamental issue is that, unlike prior YOLOversions,thereisnoofficialpaperforYOLOv5.

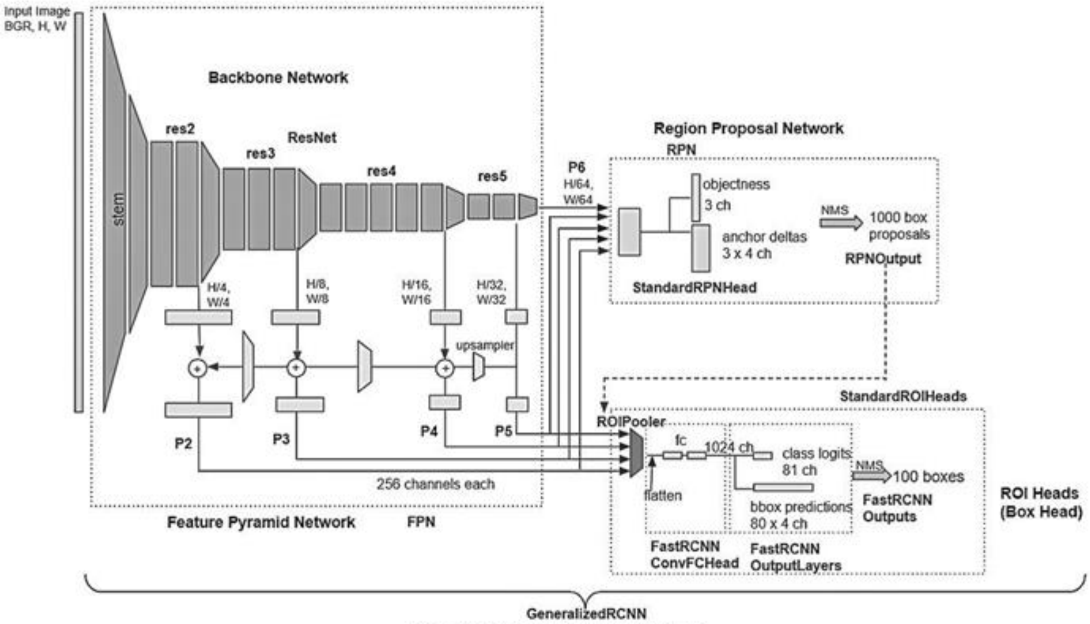


Fig 1.2 Detectron2 Architecture

II. Detectron2

Detectron2 is a complete rebuild of Detectron,which was first released in 2018. Caffe2, a deep learningframework funded by Facebook, was used to create theprecursor. Caffe2 and Detectron are no longer supported.Caffe2 is now included in PyTorch, and its successor,Detectron2,isbuiltentirelyinPyTorch.

Detectron2 aims to promote machine learning byproviding quick training and tackling the challenges thatbusinesses experience when transitioning from researchtoproduction.Ifweneedtoquicklytrainanobjectdetectionmodelwithaspecificdataset,Detectron2comes to the rescue. The COCO dataset is used to trainallofthemodelsinDetectron2.Onthepre-trainedmodel,we only need to fine-tune our custom dataset.The Detectron2 has a variety of Object Detection modelstochoosefrom.InstanceDetectionisoneofthese.

The classification and localization of an objectwith a bounding box around it are referred to as instancedetection. The Faster RCNN model from Detectron2'smodel zoo will be used to determine the language of textfromphotosinthisarticle.Objectdetectioncanbeconductedonanycustomdatasetusing Detectron2.

IV. RESULTS

To evaluate custom YOLOv5 detector performance,wehavetakenthehelpofTensorBoard’sScalarDashboard. The model has been trained on 400 epochsfortheYOLOv5method.

The metric mAP (mean Average Precision) is widelyused to evaluate the accuracy of object detectors such asthe Faster R-CNN, SSD, and many others. Precision is ameasurethatassessestheaccuracyofyourpredictions.In other words, the percentage of your predictions thatare correct is high. Recall assesses your ability to find allofthepositives.Thealgorithm'sabilitytodetectanobject'scentreandhoweffectivelytheprojectedbounding box encompasses an object that is measured inboxloss.

The probability of finding an object in a proposedzone of interest is measured by objectness. The imagewindow is likely to contain an object if the objectivity ishigh.Theclassificationlossindicateshowwellthealgorithmcanpredictanobject'sexactclass.

The model’s precision and mean average precisionimproved significantly before levelling out after roughly100epochs.ThehighestpossiblemAPscorewas0.791.

Around50epochs,boxlossstartstodeclineabruptly.Lossesinclassificationstayconstant.

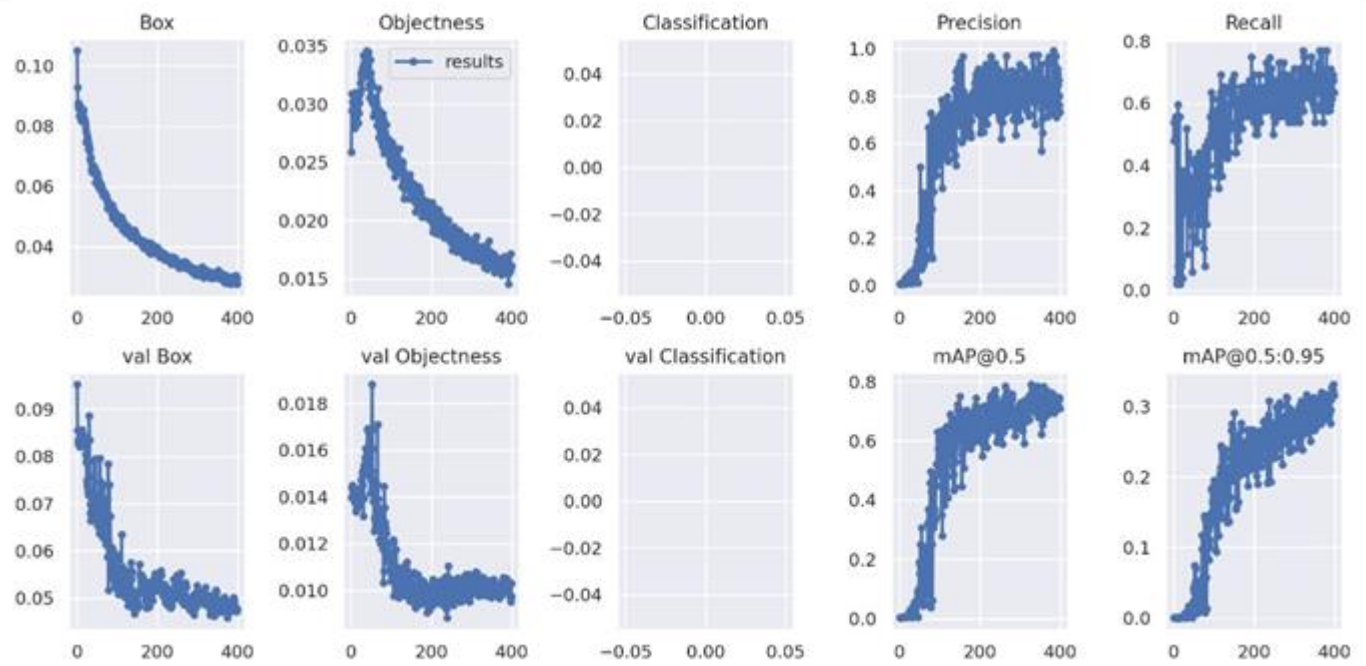


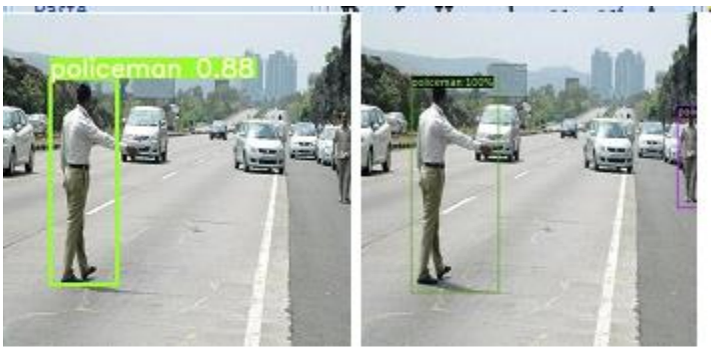
Fig 2.1 YOLOv5 Results

After50epochs,objectlosseslikewiseexhibitasignificantreduction.

Detectron2:

WhendeterminingmAP, the Intersection over Union(IoU) score is used. It's a value between 0 and 1 whichindicateshowmuchtheexpectedandgroundtruthbounding boxes overlap. An IoU score of 0 indicates thattheboxesdonot overlap. An IoU score of 1 indicatesthat the boxes' union is equal to their overlap, indicatingthattheyareperfectlyoverlapping.Thismodelwastrained on 1500 epochs with the Detectron2 algorithm.This model has a precision score of 0.505 and a recallscoreof0.491ontheIoUscale.

Also,wenoticedthatinthetwomodelsthatwe have trained, the Detectron2 is not able to distinguishbetweenapedestrianwearingwhiteclothesandatrafficpoliceman. In some cases, there were false positivesdetected by Detectron2. But in the case of the YOLOv5algorithm, it was able to distinguish between thepedestrianandthepoliceman.Differenceasfollows:



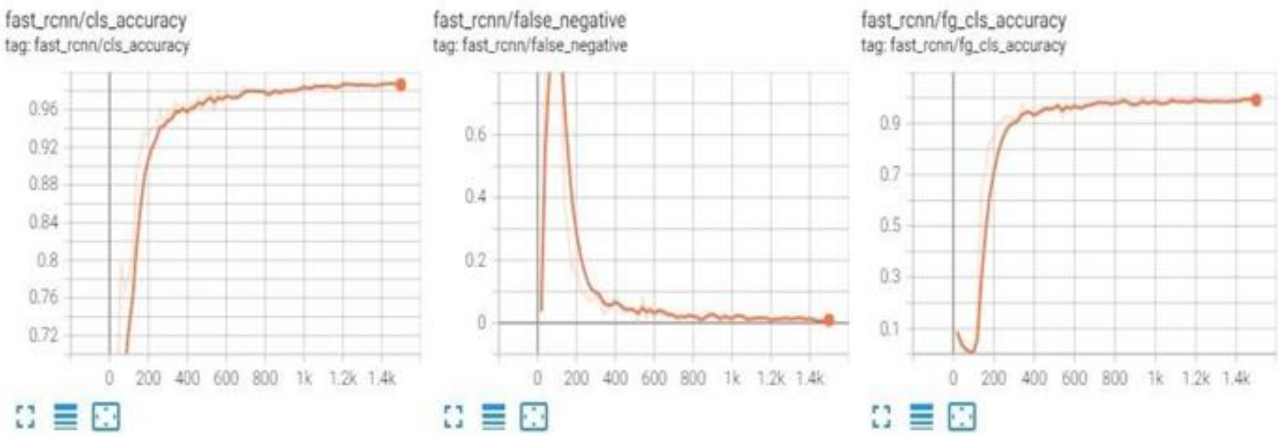


Fig 2.2 Detectron2 Results

V. CONCLUSION AND FUTUREWORK

In this paper we introduced Object Detection forIndian Traffic Policeman Detection. The YoloV5 andDetectron2 Algorithms are used in this study. The modelwas detecting a policeman from features like his WhiteshirtandKhakicolourpants.Themodelwassuccessfullyableto distinguish a police officer and anormal pedestrian wearing a white shirt. As PolicemanDetectionhasn’tbeenimplementedyet,wecannotcomparetheseresults with any other research papers.Based on the work presented in the study, The IoU scorefor the Detectron2 algorithm is 0.505 and the mAP scorefor the YOLOv5 algorithm is 0.791. The lack of datasetswas a limitation; however, by expanding the dataset, thestudycouldbeimproved.Inthefuture,ifneweralgorithms are discovered to yield better results, they canbeusedtoimprovePolicemandetection.

Afutureupgradetotheprojectwillbeasmart signal. The signal will allow vehicles to pass on the basisoftrafficinthecurrentpath.Forexample,ifajunction of four roads is present in a heavily populated area, thesignals on the junction will use our algorithms to detectthe number of vehicles passing through each of the fourroads. The road having the highest number of vehicleswill be given the first priority and will be allowed to passwithanopeningof 30 seconds. The road with fewervehiclesthanthefirstwill be given less priority andhencewillbeopenforalessperiodoftimedependingon the number of vehicles. In this way, the wait time, aswellasthetrafficflow,willbecoordinatedwithease.

Fromthe given two images we can infer thatdetectron2 is not able to distinguish a normal pedestrianwearing a white shirt from a traffic policeman, which isnot the case for the YOLOv5 model. Also, in the case ofthe Detectron2 model, there were more false positivescompared to the YOLOv5 model. The time taken for theYOLOv5modelwasmuchlesscomparedtotheDetectron2 model. Based on the work presented in thestudy, it is plausible to conclude that the YOLOv5 modeloutperformstheDetectron2modelinaspectsofcomputationtimeandaccuracy.

VI. REFERENCES

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