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Empowering Traffic Safety: Helmet Detection and Number Plate Capture with YOLOv5

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***Abstract*—The rider's failure to wear a helmet is one of themajor factors in head injuries sustained in bike accidents. Bikesarethemostpopularformoftransportationsincetheyareinex pensive and require little maintenance. The government hasmandatedthatdriversoftwo-wheeledvehicleswearhelmetswhen operating their vehicles, in accordance with section 129 ofthe motorbike vehicle legislation. Many people who break trafficlawsneverthelessdisregardthem.Bikersatroadintersection saremanually inspected by traffic police in the majority of developingnations. Even yet, this approach is ineffective because it doesn'twork on roads where speeding is most likely to cause accidents.Toprotectbikers,itisnowrequiredtodetectlicenceplates fromvehicleswithouthelmets.Thisstudydescribesthereal-time licence plate detection for riders without helmets utilisingthe real-time object detector YOLOV5 (You Only Look Once).Usingthealgorithm,thesystemlocatestheridersinthelivevi deo. The algorithm is used to determine whether or not themotorist is wearing a helmet. Optical recognition system is thenusedtoextractthecharactersfromthenumberplateandidentif ytheriderasnotwearingahelmet.Toremindpeopletoweara helmet the next time they ride a two-wheeler, the identifiednumberplateswillbeemailedtotheiremailaddresses.**

IndexTerms*—*Detection,YOLOV5,Optical Character Recogni-tion

I. INTRODUCTION

Due to their affordability, two-wheelers are currently themostcommonformoftransportation.Carelessridinghasincr eased the likelihood of bike accidents as There were moreriders than before. The negligence of bikers who do not wearhelmets is a serious problem, and it frequently results in therider suffering a brain injury. As a solution to this issue, mostcountries havelaws regulating helmetusefor two-wheelerusers.Althoughthegovernmentofsomenationshasinsta lleda specialised sensor to verify the wearer of a helmet, it wouldnot be financially sound to purchase sensors for each bike.Thetrafficpolicewillhavelessworktodoasnon-helmetedbikers'licenceplatesareautomaticallydetected.This willalsorequirefewerpersonnel.Asaresult,therewillbefewerrid erswhodonotwearhelmets.

II. DATASET

Since our Helmet Detection and Number Plate CapturingdatasetaretakenbyaCCTVfootageinrealtimewhichc aptures the persons number plate for not wearing helmet.mostofthedatasetusedhereisthedaylighttrafficinurban areas and highways. These datasets are used for furtherdetection process and extract the text by applying the OpticalCharacterRecognitionalgorithm

III. MOTIVATION

Numerous scholars have addressed the issue of automobilenumber plate recognition in recent years. One of the mostimportantphasesinautomaticnumberplaterecognitionisn umberplatedetectionsinceinaccuratenumberplatedetectionim pairs the accuracy of the segmentation and identificationstages. Similar to this, other researchers have also suggested amethod that starts with the identification of bikers and thendetermineswhetherornottherideriswearingahelmet.To extract moving objects for moving object recognition andcategorise them by using their features and the local binarypattern,theauthorsinhaveproposedabackgroundsubtrac tionmethod.

YOLO is the name of the newest state-of-the-art real-timeobject detecting technology. By spatially isolating boundingboxesandapplyingasingleconvolutionalneuralnetwo rktoassignprobabilitiestoeachofthedetectedimages,itispossibl etotreattheobjectidentificationproblemasaregression problem rather than a classification task (CNN).The popularity of YOLO is attributed to its speed, detectionaccuracy, strong generalisation, and open-source nature. TherearefiveYOLOvariantsavailablerightnow(v1,v2v3,v4an d v5). Better functionality, including four connection layers,four convolution layers, and five CSP layers, was added toYOLOV5. It can hasten feature information transmission andfeature fusion. Compared to YOLOV3, YOLOV5 has higheraccuracy. Many YOLOv5 models were trained using the MSCOCOdataset.

IV. EXISTINGSYSTEM

Existing system is based on detection of helmet which firststartswithmovingobjectsegmentationusingdescriptors.Th endetection of helmet tracing the Region of interest which is thehead region then classifies between helmet and non-helmet.ItusesthecircleHoughtransformtodistinguishbetweena helmetandanon-helmet,whichalsocausesamisidentificationofaheadasahelmet becausebothhavearoundshape.costsa lot of computation. Geometric features are not enough todetect the presence of a helmet; many times, the head can bemistakenforthehelmet.

V. LITERATUREREVIEW

InPaper[1]theauthorisaddressingthepressingissueof road traffic accidents, which have emerged as a significantpublichealthconcernthatnecessitatesamultifaceted approachforresolution.IncountrieslikeIndia,thealarmingincre aseinfatalitiesandinjuriesresultingfromroadaccidentshasbeco meacauseforgreatconcern.Thefrequencyofroadaccidents leading to death or permanent disability has risen,underscoring the urgent need for preventive measures

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to beprioritized by relevant organizations involved in public health.However, the current methods employed to implement lawsandpoliciesaimedatcurbingtrafficaccidentsoftenlackefficiencyandcommitment.

In paper [2] the author discusses the prevalence of two-wheelersasacommonmodeoftransportationtoday.However,the inherent risk associated with riding a two-wheeler withoutproper protection is significant. To address this, wearing a hel-metwhileridingabikeishighlyrecommendedasapreventivemeasure.Infact,governmentshaveevenmadeitillegaltoridea bike without a helmet, and have used manual methods toenforce this regulation. To automate the process of identifyinghelmetusagewithoutrelyingonmanualintervention, theauthor proposes a system that utilizes video monitoring of thestreet to automatically determine if a bike rider is wearing ahelmet. This system employs machine learning techniques toaccurately identify different types of helmets with minimalprocessing,makingitefficientandeffectiveinpromotinghelmetusagecompliance.

In paper [3] the author discusses the importance of licenseplate location in automated transportation systems for vehicledetection. In this work, a reliable and real-time method forlicense plate location is presented. The license plate regioncontainsrichedgeandtextureinformation,whichisuti-lized in the proposed approach. Initially, image enhancementtechniquesalongwiththeSobeloperatorareemployedtoextracttheverticaledgesfromthecarimage.Subsequently, arobustalgorithmisappliedtoeliminatebackgroundandnoise edges, retaining only the relevant features. Finally, arectangle window is used to search for the license plate regionintheresidualedgeimage,allowingforseparationofthelicense plate from the original car image. The effectivenessand reliability of the proposed method are validated throughexperimental findings, demonstrating its potential for accuratelicenseplatelocationinautomatedtransportationsystems.

In paper [4] the author discusses the concerning trend ofincreasingmotorbikeaccidentsinmanycountriesovertheyears. The growing popularity of motorbikes can be attributedtovarioussocialandeconomicfactors.However,despitethecrucialroleofhelmetsastheprimarysafetygearformotorcyclists, many riders neglect to wear them. This paperpresents and demonstrates an automated approach for classifying motorbikes on public highways, along with a system forautomatically identifying riders who are not wearing helmets.The system utilizes camera photos of the traffic to implementtheproposedapproach.

In Paper [5] the author discusses the application of helmetdetectioninimageprocessingandpresentsanewmethodfor helmet detection in their research. The proposed methodcombines two techniques to increase the likelihood of detect-ing helmets. The first technique involves utilizing a haar-likefeatureforfacedetectiontodifferentiatebetweenwearingandnotwearingahelmet.Thesecondtechniqueinvolvesusing a circle Hough transform to further distinguish betweenhelmeted and unhelmeted individuals. In the initial section ofthe method, a fast algorithm for helmet detection in coloredimages is suggested. The novel algorithm used in the proposedmethod has shown high detection rates and low false positivesin image experiments, indicating its effectiveness in detectinghelmetsaccurately.

In paper [6] the author discusses the method proposed intheir research for automatic recognition of helmet-less bikeriders in real-time surveillance videos. The suggested methodinvolves multiple steps, starting with backdrop removal andobject segmentation to identify bike riders in the surveillancevideo. A binary classifier and visual cues are then used todetermine whether the bike rider is wearing a helmet or not.Additionally,aconsolidationmethodforreportingviolationsisprovided to enhance the validity of the proposed method. Theperformance of three commonly used feature representationsforclassification,namelyhistogramoforientedgradients,scale-invariant feature transform, and local binary patterns, isalso compared in order to evaluate the effectiveness of theapproachpresented.

Inpaper[7]theauthordiscussesthechallengesinde-tectingtrafficruleoffendersforensuringsafetymeasures,such as occlusion, illumination, poor quality of surveillancevideo, and fluctuating weather conditions. In this article, asystemforautomaticallyidentifyingmotorbikeriderswhoarenotwearingprotectivehelmetsonsecurityfootageisdescribed. The proposed method involves the extraction ofmoving objects from video frames using adaptive backgroundsubtraction.Motorcycleridersarethenselectedfromthemoving objects using convolutional neural networks (CNN).Additionally, CNN is used on the upper one-fourth part of theriders to further detect those who are operating their vehicleswithoutahelmet.

In paper [8] the author discusses how motorcycles havebeenapopularformoftransportation,butthenumberofmotorbikeaccidentshasincreasedrecently.Notwearingasafetyhelmetisoneofthemaincausesoffatalitiesintheseaccidents. Currently, traffic cops manually monitor motorcyclists at intersections or watch CCTV footage to identify thosewithout helmets and fine them, but it requires a lot of effortand action from people. This study proposes an automatedmethod for identifying motorcycle riders without helmets andobtainingtheirlicenseplatesfromCCTVdata.Theheadsection of a classified motorcyclist is analyzed to determine iftheyarewearingahelmetornot.

In paper [9] the author discusses how the rapid growth ofvehiclesandtransportationsystemshasmadeitimpossibleforhumanstofullymanageandmonitorthemmanually.Asaresult,automaticrecognitionoflicenseplatenumbershasbecomeincreasinglyimportantinvariousapplicationssuch as traffic monitoring, tracking stolen vehicles, managingparking tolls, enforcing red-light violations, and border andcustoms checkpoints. However, the diversity of license plateformats, variations in scales, rotations, and non-uniform illumination conditions during image acquisition pose significantchallenges. This

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work proposes an Automated Number PlateRecognition System that utilizes edge detection techniques,histogram manipulation, and morphological operations to segment characters and localizelicense plates. Character classification and recognition are achieved using artificial neuralnetworks.

Inpaper[10]theauthordiscussestheconceptofAutomaticLicense Plate Recognition (ALPR), which involves extractinglicense plate data from images or a series of photographs.ALPR has various applications, including electronic paymentsystemsfortollsandparkingfees,aswellasmotorwayand arterial monitoring systems for traffic surveillance. ALPRtypicallyusescolor,black-and-white,orinfraredcamerasto capture images of licenseplates. The success of ALPRdepends heavily on the quality of the captured photos. As apractical application, ALPR must be able to process licenseplates quickly and effectively in various settings, including in-doorandoutdoorenvironments,duringdaytimeandnighttime.Moreover, ALPR must be able to handle license plates fromdifferentcountries,provinces,orstates,makingitnecessary tobegeneralizedandadaptabletodiverseplateformats.

VI. Proposed Methodology

In our suggested system, we propose a real-time and accu-rate automatic deep learning method for motorcyclist helmetrecognition,whichcomprisesoftwoparts.Thefirststepinvolves detecting motorcycles in the surveillance video usingYOLOv5-MD, an improved version of the YOLOv5 methodspecificallydesignedformotorcycledetection.Thevideofromthesurveillanceisprocessedusingthe YOLOv5algorithm to identify motorcycle regions. The second stage, known ashelmetdetection,takesthemotorcycleregionsidentifiedinthe previous step as input and uses an upgraded version of theYOLOv5 algorithm called YOLOv5-HD to determine whetherthe motorcycle riders are wearing helmets or not. The networkistrainedseparatelyforeachstageasthetasksofvehicleand helmet detection are quite distinct from each other. ThepurposeofYOLOv5-HDistoenhancethedetectionofhelmetson the motorcycle riders, thereby improving the accuracy oftheoverallsystem.Thistwo-stageapproachallowsforefficientandprecisedetectionofhelmet usagebymotorcyclistsinreal-time,makingitavaluabletoolforautomatichelmetrecognitionin surveillancefootage.

YOLO is the typical object detection technique. That is known for its fast inference speed. It uses a regression-based approach to directly generate the bounding box coordinates and class probabilities in a single pass through the network, which makes it faster compared to two-stage approaches like Faster R-CNN. YOLOv5, in particular, has introduced improvements to the backbone network and adjusted parameterstocreatefourdifferentvariantsofthemodel:YOLOv5s,YOLOv5m, YOLOv5l, and YOLOv5x. These variants differin terms of model size, complexity, and accuracy, allowing fora trade-off between speed and accuracy based on the specificapplication requirements.The regression-based approach usedin YOLOv5 allows for efficient and real-time object detection, making it well-suited for various applications such asmotorbike helmet recognition in surveillance footage, as youmentionedinyourpreviousstatement.

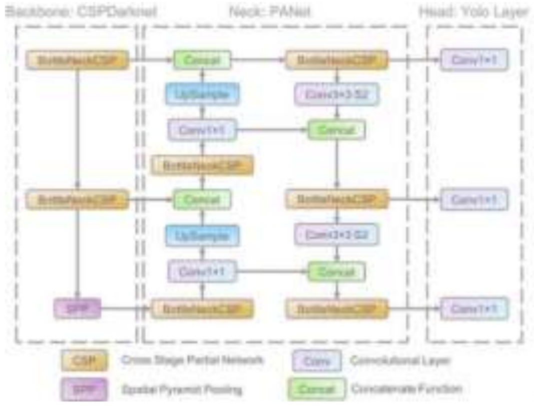

Fig.1.Yolov5 Architecture

TheYOLOv5modelconsistsofthreemaincomponents:the backbone, the feature enhancement module, and the head asshowninFigure1.Eachcomponenthasaspecificfunctionin the overall architecture. The backbone variant of YOLOv5isresponsibleforextractingfeaturesfromtheinputimage.The feature enhancement module in YOLOv5 is designed toenhancethefeaturesextractedbythebackbone.Itusesvarioustechniquessuchasskipconnections,PANet(PathAggregationNetwork),andCSPNet(CrossStagePartialNetwork)toenhancethefeaturerepresentationandimprovetheaccuracyof object detection. The head part of YOLOv5 is responsiblefor generating the final predictions, including the boundingboxcoordinatesandclassprobabilities.

VII. Results

The objective of this paper is to achieve continuous helmet detection and Number Plate Capture through a video feed as

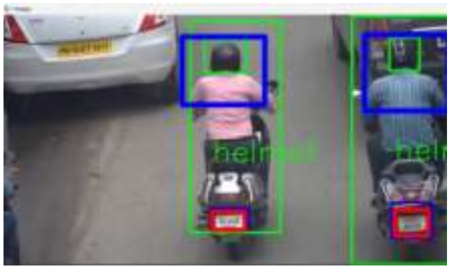

Fig. 2.The above image shows the helmet and the number plate are detectedandalsoshowtheriderhasputontheHelmet

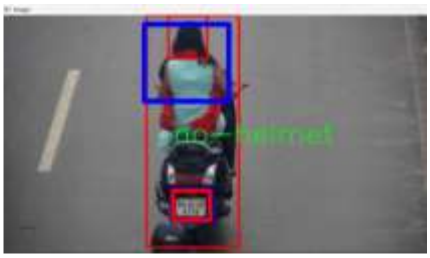

Fig. 3.The above image shows the helmet and the number plate are detected and also shows the person is not wearing the Helmet

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showninFigure2and3.Avideocamerawillbepositionedonthero adtoprovideinputtothesystem.Theframesfromthe video will undergo background subtraction to eliminatepedestrians and other entities, retaining only moving objects.These moving objects will then be classified and labeled usinga trained model, with the COCO model used for commodityobjects and a specialized dataset developed using Tensorflowforpersonsridingbikeswithhelmets.Webscraping wasutilizedtocollectdiverseimagesofhelmetsfortraining.Initially,apersonridingabikewillbedetectedandaboundingbox will be defined around them, restricting the search area.Thesystemwillthencheckforthepresenceofahelmetwithin thatbox,andifdetected,theboxwillbedropped.The remaining boxes will be processed by the number platecheckingsubsystem,whichwillutilizeOCRtocapturethetexton the license plate. A new entry will be created, documentingthetimeandlocationoftheoffense,asnapshotofthe bounding box as proof, and the license plate number.

VIII. Conclusion

When the rider fails to wear a helmet it becomes risk because by chance if the rider face anyaccidentitmayleadtodeath.a headgear. Many motorbike riders continue to disregard thenumerous laws regulating helmet use by two-wheeler drivers.The systems in place are highly inefficient.In this study, wehave suggested a real-time, quick, and efficient framework forYOLO-based non-helmeted motorcycle detection from CCTVfootage. After identifying the motorcyclists who are ridingwithout a helmet, optical character recognition to detect thecharactersinthelicenceplatesandsavetheminacloudsothat theviolatorscanbe heldaccountable.Motorcycles arethetargetclassforthefirststage,thesecondstageforhelmets,non-helmetsandthethirdstageisforlicenceplates.

VIII. FutureEnhancements

The proposed method outperforms the current one becausethe algorithm uses a YOLOv5 model. While many have donetwolayersofCNNtocompletethetasks,oursuggestedapproach just requires one CNN to achieve the study's goal.Thesuggestedmethodworksbetterthananumberoftheestablished techniques for detecting license plates. techniquesinclude boundary- and color-based strategies. The input Picture should have apparent bounds and is sensitive to undesiredbordersintheboundary-basedtechniques.

The proposed method and approaches addressed in relatedworkdifferfromeachotherinthatwetookadifferentstrategy.Forautomaticlicenceplatelocalization,wedevelopeda single convolutional neural network and employed YOLOv5algorithms to complete the task. The authors of and employedboundary-based techniques that are conscious of undesirableedges and depend on high-quality images for algorithm generalization. Since the suggested method does not need to relyon the information from the license plates and many imagequalities were added to the training, it is superior to the color-basedapproach.Thisaidsingeneralizingfrompreviouslyunobserveddata.

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