iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** IV **Month of publication:** April 2024

DOI: https://doi.org/10.22214/ijraset.2024.61188

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue IV Apr 2024- Available at www.ijraset.com

Intelligent Traffic Management System: Detecting Over Speeding, Red-Light Violations, Helmet Violations, and Triple Riding

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Abstract: According to recent reports, traffic violations have mostly resulted in an increase in fatalities and injuries on Indian roads. Because manually identifying traffic violations takes time, an automatic computer vision-based object identification model was required. The fundamental idea behind this research is to identify many transgressions using a single video frame. To perform various activities, the security camera's input video stream is processed and annotated. COCO is the dataset utilized for red-light leaping, while Google pictures are annotated to provide the dataset for over boarding. Tensorboard is used to train the model and visualize its results. The criteria employed include precision, recall, Fmeasure, and Pmeasure. Red light skipping accuracy is 93%, and the over boarding mAP value is 0.5:0.95. This system makes extensive use of the video feed to detect various forms of breaches.

Keywords: YoloV7-X, Pytesseract, computer vision, object-detection, bounding box, Precision, Tensorboard, Recall, F-measure, P-measure, Fully Connected Neural Network (FCNN)

I. INTRODUCTION

These days, there is a lot of intricate traffic on the road. Pollution and traffic jams can occasionally come from this. Because of these negative consequences, as well as the country's rising population and quickly changing environment, traffic violations on Indian roadways have increased. Numerous traffic sensor technologies are being developed to address this issue. Thiagarajar College of Engineering, Madurai 15; Dr. M. Suguna, Assistant Professor, CSE Department; mscse@tce.edu Gokila Harini Krishna. Thiagarajar College of Engineering, Madurai-15 Gokilaharini@student.tce.edu Undergraduate Student Information Technology Department The three most common traffic violations in India are reckless driving, overboarding, and piling into a moving vehicle. Violations of traffic laws on Indian roadways result in a range of accidents and other issues in both rural and urban areas [1]. Although the government has made significant efforts to reduce this, manually screening cars takes time, and errors might occur due to carelessness or outages. As a result, a traffic violation detection system is always necessary to handle this issue. This can detect offenses such as reckless driving, signal jumping, and vehicle counting [2]. The old technique of preventing traffic violations is to assign administrators by hand who inspect the vehicles. This is a time-consuming and labor-intensive technique. Automated Traffic Monitoring System Computer Vision is the next approach used to detect traffic offenses as things get automated [3]. Rather than utilizing regular police to monitor autos, this alternative used cameras. This boosted automation potential and has been the most frequently asked problem statement in computer vision, a discipline with a focus on AI and ML, image processing, and deep learning. This can identify class instances and semantic items in digital images and movies. The majority of the efforts have been made for speeding and running red lights. However, the overboarding came as a surprise. Another noticeable aspect in a large number of events around the country has been pillion riding. According to a recent Times of India report, overboarding is causing deaths and injuries in numerous Indian districts. This necessitates careful attention and paves the way for the development of an object detection algorithm and YOLOv7 [4] overboarding detection systemIn this method, dynamic objects are classified using neural network and object identification models. In addition to skipping red lights and passing the video as an input stream, pillion riding is recognized. This work seeks to detect traffic offenses involving several vehicles and provides a thorough grasp of the concepts and technology involved in constructing traffic violation detection systems based on object detection and image processing. It also covers some of the most current breakthroughs in a variety of industries and throws light on a number of applications, such as the detection of multiple automobile offenses.

II. LITERATURE SURVEY

The study [1][2] uses the object detection method YOLOv3[5] and a neural network, which is used to grade vehicles that stray from traffic laws, to implement object detection for traffic offenses. By monitoring and reprimanding, this technology effectively reduces transgressions. When the captured object is in direct line, red light skipping is noticed. A neural network is utilized to classify the video after it has been recorded and entered into the model [6]. According to Suraj K. Mankani's preferences in the study, the system DSP board Embest Dev Kit 8500D can also be used for object tracking and detection when the MBS algorithm is applied [7]. The video stream from the security camera is sent into Krishna's [3] "Automated Traffic Monitoring System Using Computer Vision" model, which counts the number of cars and those that go over the speed limit. In the study proposed by Mohana [8], MATLAB-implemented methods such as GMM (Gaussian Mixture Model) and SOBS (Selforganizing Background Subtraction) are utilized to evaluate the usefulness and performance of the object detection model. They used measures such as false positive rate, recall, specificity, false negative rate, F-measure, and percentage of erroneous classification (PWC). The publication [9] discusses the use of capsule neural networks in a variety of applications. The Machine Learning model [11] is developed by comparing the findings of cluster analysis, generalized regression neural network (GRNN), backpropagation neural network (BPNN), and wavelet neural network (WNN) in the context of time series data. Feng Yang proposes YoloV7-Deepsort, a YoloV7-based approach [4] for tracking video objects.

III. SYSTEM ANALYSIS

A. Existing System

Using computer vision and YoloV3, the work adds to the present object identification paradigm for traffic offenses [17].The major purpose of this project is to use a single video stream to identify several traffic violations committed by autos. The proposed approach employs OpenCV for real-time computer vision and YoloV7 for object detection.

DISADVANTAGES OF THE EXISTING SYSTEM

1) *Recognition Accuracy:* YoloV7 is a valuable tool for object detection, but it may not be completely accurate in spotting multiple offenses at once, especially when traffic is complicated, in inclement weather, or in poor light.
2) *Processing Speed:* YoloV7 and OpenCV real-time video stream processing may experience performance challenges, particularly when analyzing high-resolution video feeds or using devices with limited CPU power.
3) *Variability in Traffic Violations:* The diversity and complexity of violations that might occur in real-world traffic circumstances may restrict the proposed model's ability to detect various types of infractions. It may have difficulty appropriately distinguishing finer or less frequent transgressions that differ from the norm.
4) *Dependence on Camera Quality:* The positioning and quality of the security cameras that record the video feeds may affect the system's performance. Occlusions, a small field of vision, and low camera quality can all make it more difficult to effectively identify traffic violations.
5) *Generalization to Different Traffic Environments:* The usefulness of the proposed model may vary depending on whether the traffic environment is urban, rural, or highway. Variables such as traffic density, road design, and vehicle types may have an impact on the model's generalizability in different circumstances

B. Proposed System

Using computer vision and YoloV3, the work adds to the present object identification paradigm for traffic offenses [17].The major purpose of this project is to use a single video stream to identify several traffic violations committed by autos. The proposed approach employs OpenCV for real-time computer vision and YoloV7 for object detection.

The traffic infraction detection system includes two submodules:

Identify the red light that is jumping.

Identify pillion passengers who have overboarded a car. YoloV7 is the object detection algorithm currently in use.The general procedure is as follows. OpenCV is used to divide the video feeds from the security camera into multiple frames so that various operations can be performed on them. Following that, the frames are evaluated by placing bounding boxes over the assessment object. The coordinates are referred to as the threshold line; an object violates the signal if its coordinate exceeds the threshold line.

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IV. SYSTEM DESIGN

SYSTEM ARCHITECTURE

Below diagram depicts the whole system architecture.

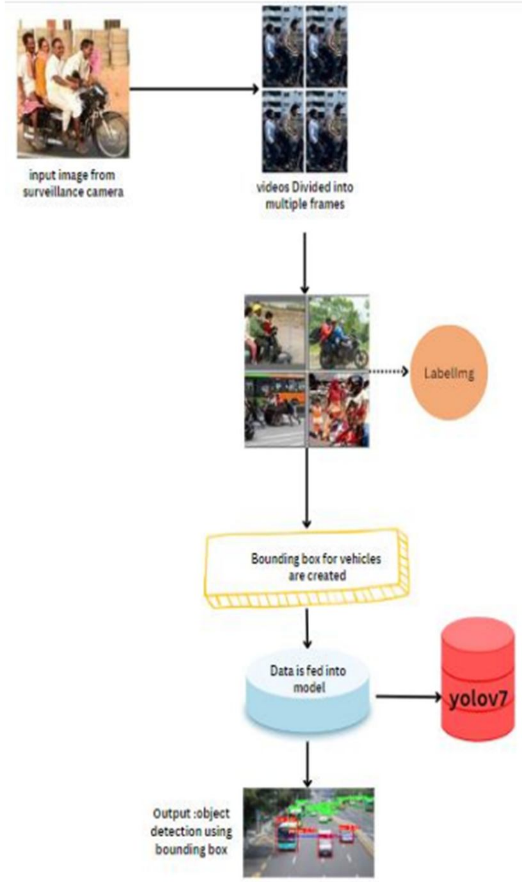

Fig 1. Methodology followed for proposed model

V. SYSTEM IMPLEMENTATION

MODULES

1) *Module 1:* Leaping Red Lights. The COCO dataset aids in the identification of red-light avoidance. The dataset is placed on top of the Yolov7 model, which is a clone of the original. Each car in the lane is identified and a bounding box is drawn around them. To mark the bounding boxes, either bounding box regression or logistic regression are utilized, with the overlap of the bounding boxes representing actual items. The threshold line can be expressed by describing its location or coordinates on the picture video frame. If an object crosses the line, it is indicated as having been violated. The model is also more refined, as it recognizes vehicles both on and above the indicated line, as opposed to earlier methods, which only detect items on the line. The assumptions are: ● The object is static and video streams are processed over a specific time interval. ● Vehicle violations can only be recognized at specific times.
2) *MODULE 2:* Over boarding and pillion riding Vehicle over boarding is detected by training the yoloV7 model with annotated photos. The photographs are tagged with the program Labelling and grouped into three categories: train, test, and validation.70% of the data is categorized as Training, 20% as Testing, and 10% as Validation.

VI. RESULTS AND DISCUSSION

The traffic violation model detects the multiple vehicle infractions that lead to penalties and accidents on Indian roadways. The assumption is that the automobiles are immobile, the video feed is only viewed for a limited duration, and over boarding is only recorded when a red light is recognized.

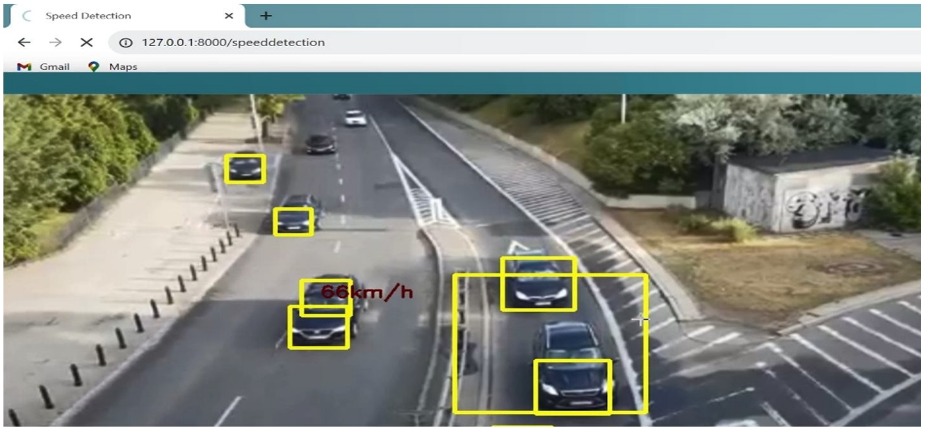

Fig 2. Identifying Speed of Vehicle

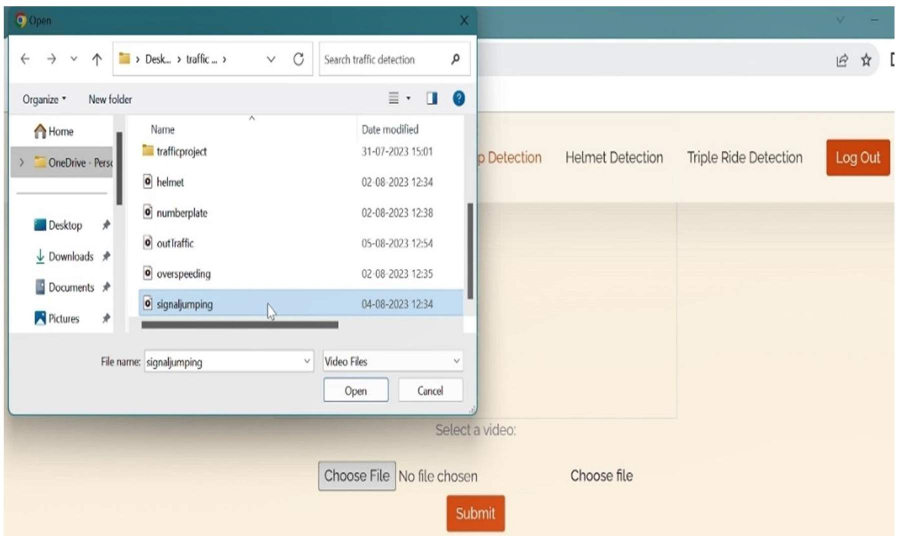

Fig 3. Uploading CC-Footage

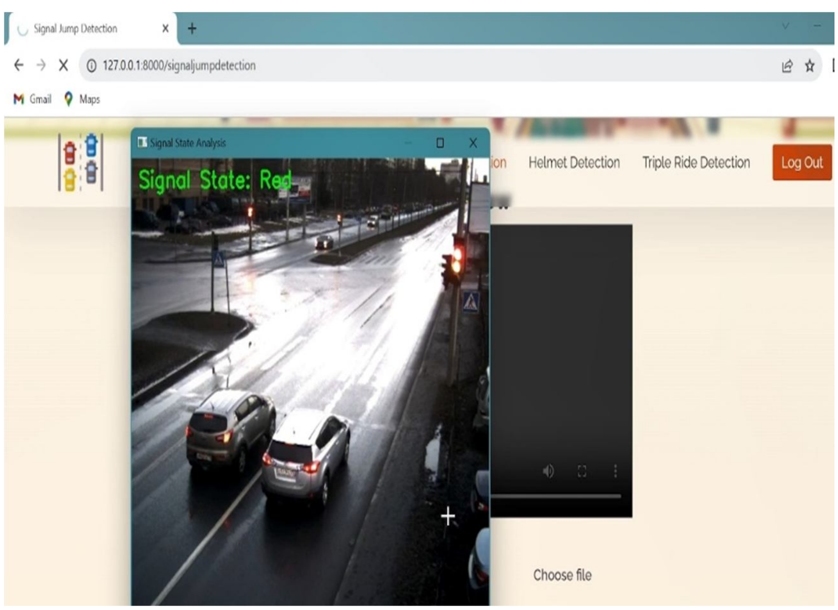

Fig 4. Identifying Signal Jumping

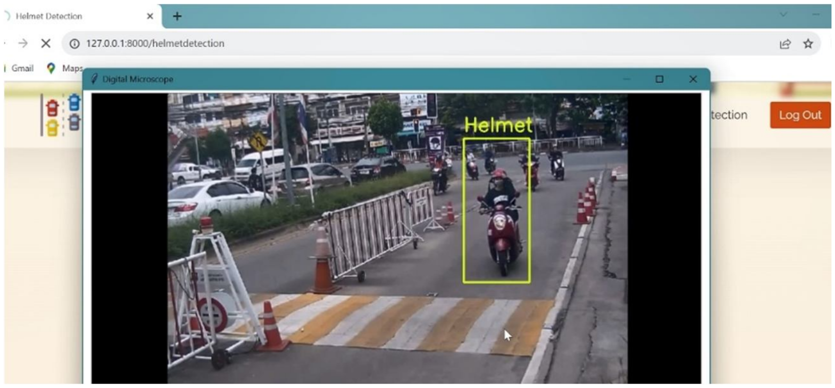

Fig 5. Identifying Helmet Users

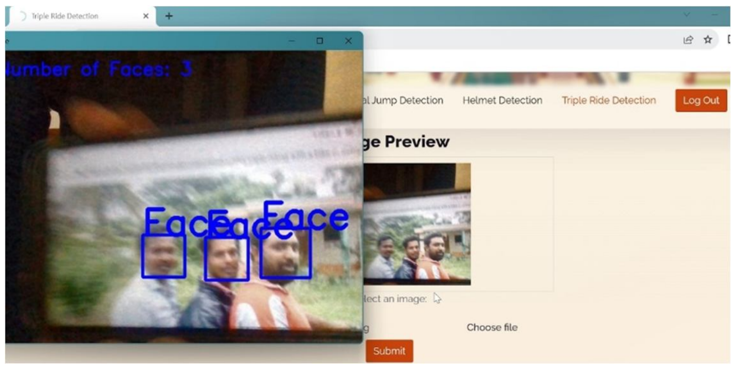

Fig 6. Triple ride detection

VII. CONCLUSION AD FUTURE WORK

The YoloV7 object identification model serves as the foundation for the proposed traffic infraction detection system, which is highly efficient, rapid, and viable. A comparison is made between our effort and real-time activities. The video streams generated the results, which indicated approximately 93% accuracy and a mAP value gain of 0.5:0.95. There is a lot of room for improvement in this project because the same video stream can be used to detect speed and take other precautions to avoid reckless driving. Either the model or the process scope makes full use of the video feed. This may be the most effective strategy to reduce accident rates and government fines.

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