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Literature survey on Intelligent Traffic Rules Violation Detector

B N Jeevan[1], Gagan V[2], Gagana Sindhu N[3], Pavan M Pai[4], Mrs. Ramya KR[5]

Student, Dept Of ECE, KSIT, Bengaluru, India[1-4]

Associate Prof, Dept Of ECE, KSIT, Bengaluru, India[5]

Abstract: Intelligent Traffic Rules Violation Detector uses artificial intelligence and deep learning techniques to detect vehicle violating traffic rules. The increasing number of vehicles on the road has led to a rise in traffic congestion and accidents. To address this issue, we propose an Intelligent Traffic Rules Violation Detector (ITRVD) system that uses computer vision and machine learning techniques to detect traffic rule violations in real-time. The system consists of cameras installed at traffic intersections, which capture images of vehicles and pedestrians. These images are then processed using object detection algorithms to identify vehicles, pedestrians, and traffic signals. Machine learning algorithms are used to analyse the behaviour of vehicles and pedestrians and detect traffic rule violations such as running red lights, speeding, and pedestrian non- compliance. The system alerts authorities in real-time, enabling swift action to be taken against violators. Experimental results show that the ITRVD system achieves high accuracy in detecting traffic rule violations, making it a valuable tool for improving road safety and reducing traffic congestion.

Keywords: Intelligent Transportation Systems, Traffic Rule Violation Detection, Computer Vision, Machine Learning, Road Safety.

1. INTRODUCTION

Ensuring road safety and compliance with traffic regulations is a growing challenge in urban and rural environments. With the increasing number of vehicles and riders, law enforcement agencies face difficulties in monitoring compliance with key safety requirements, such as the use of helmets by both riders and pillion passengers, the presence of High-Security Registration Plates (HSRP), and adherence to permissible silencer sound levels. These parameters not only ensure individual safety but also contribute to reducing noise pollution and maintaining order on the roads.

The High-Security Registration Plate (HSRP) system has been mandated in many regions to standardize vehicle identification and curb illegal practices such as plate tampering or unauthorized duplication. Helmet detection is a critical safety measure, as non-compliance contributes significantly to fatal and severe injuries during road accidents. Similarly, monitoring the sound levels emitted by motorcycle silencers helps address the growing concerns about noise pollution and ensures compliance with legal limits. Advancements in computer vision, machine learning, and acoustic analysis provide opportunities to develop automated systems capable of addressing these challenges simultaneously. Such a system can utilize image processing and sound analysis techniques to monitor compliance in real-time, reducing the reliance on manual intervention and improving enforcement efficiency. The integration of these technologies promises a more streamlined and scalable approach to enhancing road safety. This paper presents a comprehensive survey of existing techniques and technologies relevant to the detection of HSRPs, helmet usage by riders and pillion passengers, and silencer sound levels. By analyzing and comparing various approaches, this study aims to identify current challenges, gaps, and opportunities for developing an integrated, efficient, and robust system for traffic regulation enforcement. The rapid growth of urbanization and the increasing number of vehicles on the road have led to a significant rise in traffic congestion and accidents. According to the World Health Organization (WHO), over 1.35 million people die every year as a result of road traffic accidents, making it one of the leading causes of death globally. In addition to the human toll, traffic congestion also has significant economic and environmental impacts, including wasted time, fuel, and increased air pollution. To address these challenges, there is a growing need for intelligent transportation systems that can detect and prevent traffic rule violations in real-time. Traditional methods of traffic enforcement, such as manual surveillance and radar guns, have limitations in terms of accuracy, efficiency, and scalability.

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2. LITERATURE REVIEW

Dr D Esther Rani *et.al* [1] proposed a system that harnesses the power of cutting-edge technologies, such as Automatic License Plate Recognition (ALPR), real-time alerts, and dynamic traffic control mechanisms, to create a robust framework for monitoring and regulating traffic violations. The real-time alert mechanism is a standout feature of this system. By instantly notifying law enforcement agencies and traffic management personnel upon detecting violations, this system facilitates rapid and effective action against offenders. This immediacy not only ensures the swift handling of accidents but also acts as a deterrent, discouraging individuals from breaking traffic rules. Moreover, the system's capability to dynamically adjust traffic signal timings based on realtime vehicle density is a testament to its intelligence and adaptability. Unlike conventional traffic light systems that operate on fixed time intervals, this system optimizes traffic flow by tailoring signal durations according to the actual flow of vehicles. This proactive approach not only reduces congestion during peak hours but also enhances fuel efficiency, curtails emissions, and contributes to environmental conservation.

Mr. K. A. Patil , Ashish Chougule *et.al* [2] designed an algorithm used in this project can detect the traffic violations. The goal of the project is to decrease the work for traffic police officers, control and observe the traffic and measure against violated vehicle owner in a quick and effective way. The proposed model necessitates two things in particular - Vehicle detection process, Graphical User Interface [GUI]. The CCTV camera footage that was recorded from different areas will be sent to the system. Vehicles will be detected from the footage. Whenever the proposed software tests the footage, the violation will be detected. The proposed software supports signal violation by involving the algorithm called R-CNN algorithm.

P.Srinivas Reddy, Ramesh O., *et.al* [3] proposed a paper wherein three automatic traffic violation detection using artificial intelligence and deep learning concepts. This paper uses the YOLOv3 concept for detecting 2- wheeler vehicles without helmet, seat belt detection and red signal jump violation features. Traffic violations can be detected in a day light. But for the night time it becomes a great challenging task for detecting any kind of violations. Not only night time but there are other factors which will affect the detection such as, weather conditions during day and night, camera quality used for surveillance, etc. The other real time issue faced by Karnataka Traffic Police is that they are finding it difficult to identify the vehicle violating the rules in night time because of high beam headlights used by vehicles during night. When light rays from these bright sources reach the front element of the camera lens, which reflects or bounces back different elements, thereby potentially diminishing the quality of an image or video. There is some more future work in this paper as the algorithm used to detect the violation is not optimized. It's a time-consuming process and needs few optimizations in the code.

S. A. Elsagheer Mohamed *et.al* [4] *designed* a vehicle violation detection system based on human computer interaction and vision is a system that records vehicle violations through computer vision and human-computer interaction technology. The system studied in this article utilized computer vision technology to preprocess the extracted images and then uses Kalman filtering to track vehicles. Then, it utilized the intelligent interaction interface of human–computer interaction technology system to detect vehicle violations, record and count vehicle violations, and presented the final recorded results to the administrator. Therefore, the research system in this article can recognize traffic signs, detect vehicle violations, and then provide useful information and warnings to drivers through human–computer interaction. This can effectively improve traffic safety, reduce manual patrol and monitoring costs, and improve the accuracy and efficiency of violation detection. Intelligent vehicle violation detection systems based on human–computer interaction and computer vision may encounter many difficulties in the research. Here are the possible challenges and the corresponding solutions: for computer vision systems, there is a lot of annotated data for model training. If the actual annotation data is limited available, the dataset can be augmented by using techniques such as data augmentation. Also, consider using semi-supervised or unsupervised learning to effectively utilize unannotated data. To make the system easy to use and understand, an efficient and intuitive human–machine interface needs to be designed. This can find the optimal design scheme through user research and design thinking.

J. Jin and Y. Deng *et.al*[5] proposed a system can cover few of the loopholes existing in the present system with features like multiple over speeding detection simultaneously, automatic helmet wear detection, triple riding detection system and violation fine alert system hence providing better, safer and smart replacement to existing system. The system will recognize the vehicle's license plate and convert the photos to grayscale images. The grayscale photos are then converted to binary images, which only include the numbers '0' and '1'. Following the binary graphics, the system will segment the automobile license plate's personality. The character and number will be segmented for each separate figure.
After that, all of the characters and numbers will be converted to binary form in terms of the matrix and recognized by

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the neural network. After that, image cropping and recognition come next.

S. S. Wankhede and P. Bajaj *et.al* [6] used the YOLO v5 model for traffic violation detection and proposed a model for the overall system where all the vehicle owner's information will be kept and a profile will be assigned to them. In those profiles, a point system will be introduced from -5 to +5, for every violation 1 point will be deducted. The research aims to improve traffic regulations in Bangladesh by addressing human carelessness. The YOLOv3 algorithm has an accuracy of 97.67% for vehicle counts and 89.24% for speeds, while YOLOv5 has a higher accuracy of 92.34% for vehicle speed detection. Dense traffic flows reduce detection time. Novel researchers have improved speed and vehicle identification, but their practical usefulness is limited by time constraints and lack of context. YOLOv5 is the best option for traffic rule violation detection in Bangladesh due to its expertise in real-time object identification, accuracy in localizing and categorizing items related to traffic rule enforcement, and efficient design. Its ability to provide quick and high-precision findings is crucial for prompt monitoring and enforcement of traffic laws, enhancing road safety and user wellbeing. Further refinement of the YOLO v6 algorithms could increase precision and lower false positive rates.

B. S. Prabhu, S. Kalambur and D. Sitaram *et.al* [7] proposed a study, in which we can find 3 major frameworks, which are Test-Bed, UPF and KITTI. Using these frameworks can be helpful in detecting lane- based traffic violation problems, speed problems, etc. After much deliberation, it has been determined that cost efficiency is a high priority when making decisions. We will propose a system with a low cost and a high- performing device to collect more precise data. For specific data to be extracted from video footage, it will be ensured that the camera resolution is high enough. Furthermore, a computer with sufficient processing power to process all traffic-related data and run algorithms in a short period of time must be provided. The quality of the images will be good enough to detect vehicles, license plates, and lanes. So, in conclusion, we can say that road accidents cannot be removed from their roots. But the number of fatalities and injuries due to road accidents can be reduced by introducing some new systems using these algorithms and frameworks, so that the terrifying situation may be reduced.

Madhuravani S., Deepthi N. B., Umar S *et.al* proposed AI based system for helmet detection aims to improve the safety of motor-cyclists. It uses computer vision techniques to analyse images and videos captured by cameras installed on the road, and it detects whether or not a person is wearing a helmet. 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. 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.

Mr. M. V. Rajesh *et.al* [9] If a vehicle goes ahead of the predefined traffic line on the road, it is recognized as a traffic violation. The proposed system is faster and works more efficiently than human. As we all know, traffic police is the one who captures the image of individuals violating traffic regulations but the traffic police won't be capable of detecting and capturing more than one violation simultaneously. The algorithm used here was effectively able to identify the kind of violation described here which is violating the traffic signal. The current system provides detection for traffic signal violation. Further, the system will be capable of processing a single data at a time. And also, the program has slower runtime, which can be further enhanced by using a system containing high processing speed. Further research is required for applying the existing algorithm for other high level image processing techniques as it improves the system's runtime by ignoring other unnecessary things. An OpenCV algorithm can be used in place of the existing one to enhance the performance of the system we are using now. Our further aim is to detect the number plate of the vehicle that violates the traffic signal and add more traffic violation conditions to improve the efficiency of the system.

G. Ou. Y. Gao and Y. Liu *et.al* [10] The designed algorithm was effective in detecting the types of violations specified on this project, which were denying traffic signals, parking in no-parking zones, and driving in the wrong direction. The detection convergence for the three types of traffic violations mentioned differs because each has a distinct threshold state. The system detects all three violations, but it detects signal and parking violations better than direction violations. Likewise, the system can only process one data set at a time. Also,the programmed runtime is a little slow, which can be bettered by using a computer with a high-speed processor or GPU. Future research will concentrate on the application of the developed algorithm to other advanced image processing ways. Because of this, the program's runtime may be bettered.

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In conclusion, improving road safety would be greatly aided by a traffic rules detection system that effectively recognizes and complies with a variety of traffic regulations. By informing drivers about traffic conditions, road signs, and other context-sensitive safety regulations, these systems can be made to help drivers. They
may make use of a variety of technology, like as artificial intelligence, cameras, and sensors, to precisely perceive and respond to the ever-changing road environment. By guaranteeing that drivers continually follow traffic regulations, integrating this cutting-edge technology into the vehicle safety framework may help lower the number of fatalities and accidents on the road. Such a system's efficacy would depend on its capacity to precisely and instantly detect and process.

CONCLUSION

The paper focuses on developing an intelligent traffic violation detection system that identifies violations like swerving and blocking pedestrian lanes using genetic algorithms and computer vision. By preprocessing CCTV footage into frames, applying background subtraction, and validating violations, the system ensures accurate detection. It overcomes human limitations, improving monitoring efficiency and enforcement. Future advancements include integrating number plate recognition, optimizing runtime with advanced algorithms like OpenCV, and expanding the system's capabilities to detect more violations, reducing accidents and enhancing traffic safety through effective law enforcement and driver accountability.

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