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SAFEPARK: Vehicle Detection and Traffic Violation Parking Management System

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Abstract: The escalating motorcycle accident rates highlight the pressing need for improved safety measures. Helmets, a crucial safety gear, are often neglected, contributing significantly to fatalities. This paper addresses the pervasive issue of non-compliance with motorcycle safety rules, focusing on helmet usage and triple riding. Existing systems for monitoring lack precision, prompting our proposed Bike Traffic Violation System. Leveraging Haar Cascade and YOLOv3 models, it identifies motorcycles, detects riders without helmets, instances of triple riding, and even empty parking spots with unprecedented accuracy. The Machine Learning component employs a Support Vector Classification model, bolstered by 4-fold cross-validation, ensuring robustness. This innovative system provides real-time insights into traffic violations, enabling prompt interventions by law enforcement agencies. It overcomes manual identification shortcomings, offering a comprehensive solution for enforcement and awareness campaigns. In summary, our Bike Traffic Violation System not only advances automated traffic rule monitoring but introduces a novel methodology for precise detection, significantly contributing to enhanced road safety and accident prevention.
Index Terms: Helmet compliance, Deep Learning, Machine Learning Algorithms, Haar Cascade Classifier, YOLOv3 (You Only Look Once) model.

I. INTRODUCTION

This paper introduces frameworks for helmet detection on motorcycles, addressing safety concerns in traffic systems. The first framework approach uses CNN models and YOLOv3 for rider and helmet detection, the first framework uses a cascade classifier for helmet detection. The great accuracy of the results is crucial for intelligent traffic systems in heavily populated regions like India.[1]. This paper introduces improved YOLOv5 and face detection methods using Haar Cascade and CNN. YOLOv5s is enhanced with CBAM and CIoU Loss for better helmet detection in train maintenance. Haar Cascade and CNN are compared for face detection, with CNN showing superior accuracy but Haar Cascade being more widely applicable across devices.[4]. This paper introduces a traffic violation detection system to automate regulations and enhance safety. Leveraging computer vision techniques, it identifies violations in real-time, outperforming manual enforcement. Additionally, YOLO is proposed as a novel object detection method, achieving real-time processing with high accuracy, surpassing traditional systems like DPM and R-CNN.[5].This paper presents an efficient method for vehicle number plate recognition using OpenCV and Python, alongside an innovative approach to detecting available on-street parking spots using deep convolutional neural networks. These technologies aim to alleviate parking difficulties in densely populated cities, reducing fuel consumption, time wastage, and traffic congestion.The paper proposes leveraging IoT for smart outdoor parking systems to address urban parking challenges. Additionally, it introduces a YOLOv5-based helmet detection algorithm for real-time monitoring of helmet usage in construction safety scenarios, achieving 90% accuracy and 37.8fps detection speed, enhancing safety measures through deep learning target detection technology.

In order to achieve efficient and precise number plate number recognition, the study provides a deep learning-based solution for intelligent building security. It also presents a CNN-based multi-task learning technique for following motorbikes and identifying helmet wear, improving road safety via effective data gathering and processing.The study presents automated methods for identifying and categorising automobiles that break traffic laws, such as motorcycle riders who don't wear helmets and those that ride in groups of three. It also suggests an automatic system for recognising licence plates that uses template matching and image processing to effectively identify vehicles, improving traffic control and security.The ROI configuration phase is removed without compromising identification accuracy, and as a result, the study provides a real-time Automatic Licence Plate identification system with increased efficiency.By conducting plate localization directly on the entire image, it addresses issues related to clear plate visibility and computational intensity, making it suitable for high-speed vehicle recognition on the NVIDIA Jetson TX2 module.[15].

The methodology combines Haar Cascade Classifier for motorcycle detection with YOLOv3 for comprehensive object recognition, targeting helmet-less riders, triple riding, and vacant parking spots. Integration of parking spot detection optimizes urban congestion and parking management, offering real-time availability updates for smoother traffic flow. Additionally, a Machine Learning component employing Support Vector Classification (SVC) on character images ensures system accuracy and reliability through 4-fold cross-validation.

II. LITERATURE SURVEY

The SafePark Sentry System is a groundbreaking solution addressing challenges in parking management and security. With smart parking systems gaining traction, literature on the subject provides a foundation for its development. Utilizing sensor tech and data analytics for parking space detection, machine learning, and IoT integration enhance security and user experience. User-centric mobile apps are crucial for engagement, though legal and regulatory aspects need consideration. Integration with smart city initiatives poses both opportunities and challenges, while case studies offer practical insights. Helmet detection systems, utilizing CNNs and object detection, ensure compliance with safety regulations. Integration with traffic management enhances road safety. Number plate recognition, employing OCR and deep learning, aids in toll collection, parking, and law enforcement. Triple seat spot detection, leveraging computer vision and machine learning, assists in enforcing traffic regulations, improving motorcycle safety.[1]The reluctance among motorcyclists to wear helmets has heightened head and brain injuries in accidents. This[1] study introduces a robust framework for detecting helmet-less riders, utilizing YOLOv3 for initial rider detection and a novel CNN architecture for helmet detection. When compared to other CNN-based techniques, the model's efficacy is assessed using a variety of traffic videos, demonstrating encouraging outcomes.[2]The research emphasizes the critical role of helmet usage in ensuring the safety of motorcycle riders, particularly in densely populated regions like India where motorcycles are prevalent. A significant portion of riders neglect helmet laws, increasing the risk of severe injuries in accidents. The [2]paper introduces a comprehensive framework for real-time helmet detection using a cascade classifier and machine learning techniques. When non-compliance is detected, riders are promptly notified to encourage helmet usage. In cases of continued disregard, a relay switch linked to a Raspberry Pi and DC motor is activated to safely halt the motorcycle. Experimental results showcase the effectiveness of this approach, achieving an impressive 97.6% accuracy in helmet detection. This framework holds promise for enhancing road safety by autonomously addressing violations of helmet regulations, thereby reducing the incidence of head and brain injuries among motorcycle riders.[3]This research presents an enhanced YOLOv5s helmet detection algorithm designed to ensure helmet usage among maintenance personnel. Deployed on edge-end devices, the algorithm forms an intelligent monitoring system. Key enhancements include integrating the convolutional block attention module (CBAM) within the YOLOv5s backbone to improve feature extraction for better helmet recognition accuracy. Additionally, replacing GIoU Loss with CIoU Loss enhances network training convergence speed and regression localization accuracy, addressing challenges like helmet misidentification. Experimental results confirm the efficacy of the proposed methodology, underscoring its ability to improve helmet detection and ensure the safety of maintenance workers.[4]Facial recognition is a key feature in security systems, utilizing facial structures for authentication in various applications. This study explores two primary detection methods: Haar Cascade and (CNN)Convolutional Neural Network . While Haar Cascade offers swift, real-time detection, CNN achieves higher accuracy but demands greater GPU resources, making Haar Cascade preferable for certain client applications like mobile and Raspberry Pi devices. The[4]research confirms the successful detection of faces using both methods, with CNN showing superior accuracy. Despite CNN's resource requirements, Haar Cascade remains widely applicable, especially in resource-constrained environments. Overall, the study lays a foundational step towards developing cloud-based face recognition applications by showcasing the operational feasibility of these detection methods.This [5]study presents a straightforward method for number plate recognition using OpenCV and Python. In order to identify plate edges, the input image must be converted to grayscale, a bilateral filter must be applied to eliminate noise, and Canny edge detection must be used. Optical character recognition (OCR) with PyTesseract is then employed to recognize characters on the plate. This method offers an efficient approach to number plate recognition, leveraging commonly used libraries and techniques in image processing and OCR. [6]This paper presents YOLO, a novel method for object detection that treats the task as a regression issue and produces class probabilities and spatially separated bounding boxes from full photosWith twice the map of existing real-time detectors, YOLO operates as a single neural network and predicts these parameters quickly, reaching real-time processing at 45 frames per second for the standard model and 155 frames per second for Fast YOLO.Despite some localization errors, YOLO exhibits reduced false positives and offers highly generalized object representations, outperforming traditional methods like DPM and R-CNN across diverse domains, including artwork.[7]An image processing system utilizing deep convolutional neural networks addresses parking scarcity in urban areas.

By analyzing frames from roadside cameras, the system identifies vacant street parking spaces, offering a solution where sensor-based systems are impractical. A mobile application complements this by enabling users to request parking information, activating roadside cameras, and receiving notifications about nearby parking options, thereby reducing fuel consumption and traffic congestion associated with time-consuming searches for on-street parking.[8]The rise in automobile ownership, especially in urban areas, has exacerbated traffic congestion and violations, leading to increased accidents and fatalities. To address this, automated traffic violation detection systems have become crucial. This system detects violations, such as signal infringements, and notifies individuals promptly. Unlike human officers, it can detect multiple violations simultaneously, enhancing efficiency. Utilizing computer vision, it accurately identifies common violations in real-time, mitigating the risks associated with human oversight and contributing to safer roads.[9]The Internet of Things (IoT) offers vast implementation possibilities, with ongoing research and numerous applications aimed at reducing manpower dependency and providing benefits. As urban populations grow, so does the reliance on transportation, leading to increased demand for parking spaces. Nonetheless, a lot of public spaces still use manual parking methods, which contributes to traffic jams and safety issues. In order to alleviate traffic and improve public convenience, a smart outdoor parking system based on weighbridge load sensors and the Internet of Things can provide structured, timely, flexible, and safe parking options.[10]Unfortunately, manual parking systems are still widely used in public spaces, which leads to traffic jams and safety issues. In order to solve this, a weighbridge load sensor- and Internet of Things-based smart outdoor parking system can provide timely, flexible, safe, and orderly parking options, reducing traffic and improving public comfort. Utilizing deep learning and K-means clustering, the algorithm achieves a 90% accuracy rate and operates at 37.8fps. Training involves adjusting input image size and optimizing hyperparameters and optimizers. Integrated with cameras, the system offers real-time detection of helmet compliance, enabling picture detection, video analysis, and live monitoring. This approach enhances safety by identifying instances of improper helmet usage, contributing to accident prevention in construction environments.[10] This project implements license plate recognition using deep learning techniques within intelligent building security systems. It encompasses image preprocessing, Character segmentation, identification, and license plate area localization. Through testing, the system demonstrates effective and accurate recognition of license plate numbers, ensuring reliable identification. By leveraging deep learning methods, this technology enhances vehicle identification capabilities within intelligent building security systems, contributing to overall safety and security measures.[12]This work proposes a CNN-based multi-task learning strategy to address the shortcomings of current motorcycle helmet detection techniques. The technique attempts to register the use of rider-specific helmets while tracking and identifying particular motorcycles. The authors also present the HELMET dataset, which includes an assessment metric for helmet wear and rider detection accuracy in addition to 91,000 annotated frames from 12 observation sites in Myanmar. With a weighted average F-measure of 67.3% for identifying riders and helmet use, the suggested method achieves over 8 FPS processing speed on consumer hardware by utilizing multi-task learning. This study demonstrates how deep learning may be used to effectively gather exact data on traffic safety.[13]The paper offers a comprehensive survey of supporting technologies for IoT applications, including gateways, operating systems, communication protocols, and cloud-based structures. It addresses challenges like self-organization, data transmission, security, and data integration, highlighting the importance of various technologies in enabling real-world IoT applications.[14]This paper addresses the automation of traffic violation detection, aiming to replace traditional policing with virtual surveillance. It covers detecting violations such as motorcyclists without helmets and triple riding, alongside automated number plate recognition systems to identify defaulters and ease traffic congestion. Additionally, the paper proposes techniques for tracking stolen or uncertified vehicles. By employing automated methods, this research streamlines enforcement efforts, enhancing road safety and traffic management.[15]This study presents a template matching and image processing based automatic vehicle license plate recognition system. intended to increase productivity within University Malaysia Perlis (UniMAP), the system processes captured vehicle images, employing methods as character identification, segmentation, noise reduction, and color conversion. Segmented license plates are analyzed using the template matching approach to determine the printed characters, achieving successful recognition of 13 out of 14 cars. By automating the recognition process, the system offers potential applications in entrance control, security, and traffic management, reducing the need for manual intervention.[15]This paper presents a realtime Automated License Plate Recognition (ALPR) system designed to alleviate computational burden by eliminating the Region of Interest (ROI) setting step. By directly localizing license plates across the entire image, the system addresses issues related to clear visibility and computational intensity in processing field data. It aims to recognize license plates of both moving and stationary vehicles, leveraging the NVIDIA Jetson TX2 module for embedded computing. This approach ensures efficient performance without compromising recognition accuracy, offering practical solutions for ALPR in various scenarios, including high-speed traffic environments.

III. PROPOSED METHODOLOGY

Fig.2 displays the proposed model represents a workflow or system architecture related to deep learning-based vehicle detection and traffic violation management. Let's break down the components:

1) *Data Set:* This likely represents the initial dataset used for training the deep learning models.
2) *Gathering and Preparing Data:* This node represents the process of collecting and preprocessing data before feeding it into the deep learning algorithms.
3) *Deep Learning:* This is a swimlane representing the main section of the workflow, involving various deep learning tasks.

- *YOLO for real-time vehicle detection:* (You Only Look Once) YOLO is a popular algorithm for realtime object detection in images. This task involves using YOLO for detecting vehicles in real-time.
- *OCR for license plate extraction:* OCR (Optical Character Recognition) is used for extracting text from images. In this context, it's likely used for extracting license plate numbers from vehicle images.
- *Haar Cascade for image object detection:* Haar Cascade is a ML based approach for object detection. It's often used for detecting objects in images. Here, it might be used for additional object detection tasks.

4) *Generate challan for violations:* This node represents the process of generating violation tickets or challans based on detected violations.
5) *Store details in Excel:* This step involves storing the details of violations or other relevant information in an Excel spreadsheet.
6) *Email challan to registered address:* This represents sending the generated violation tickets or challans via email to the registered addresses of the vehicle owners.

Overall, this diagram outlines a workflow for using deep learning techniques to detect vehicles, extract license plate information, generate violation tickets, store data, and notify vehicle owners of violations.

vehicle owners of violations.

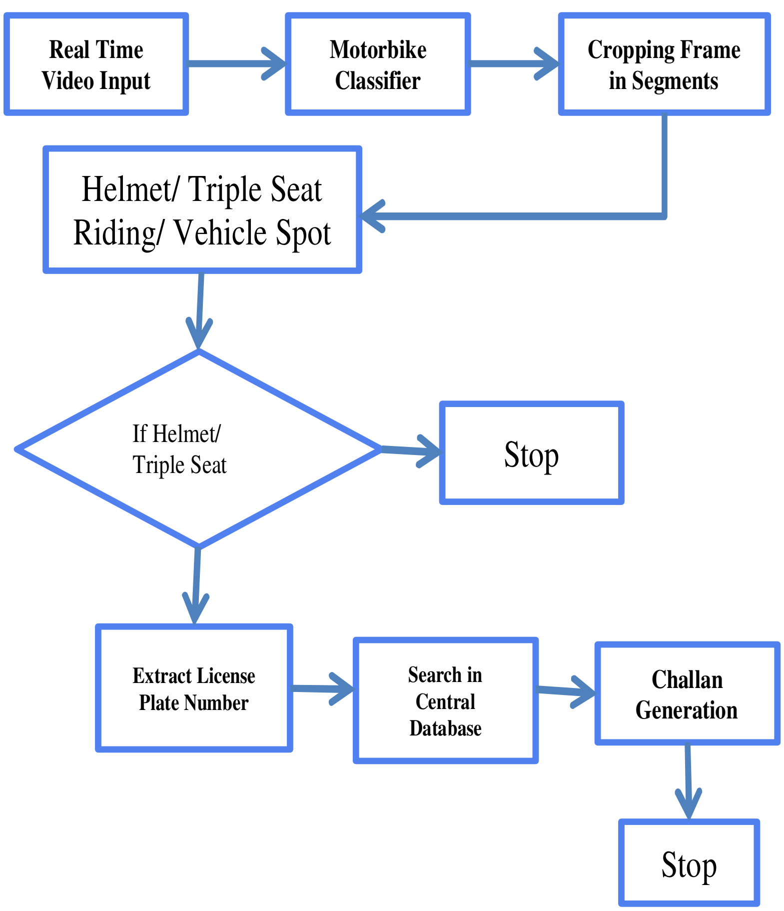

Fig.1.System Architecture

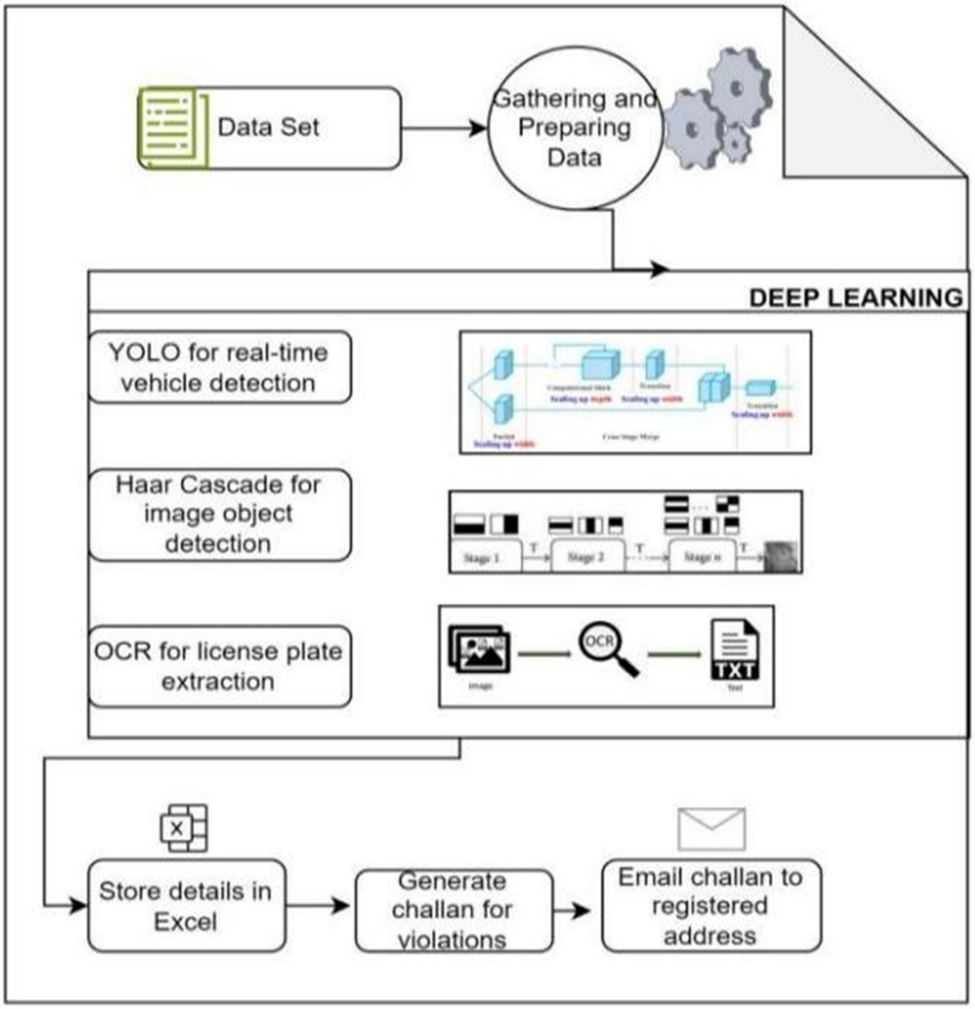

Fig. 2. Proposed Architecture

IV. RESULTS

Table 1. Performance evaluation of different ML Algorithm

Parameter	Faster R-CNN	SSD	Mask R-CNN	Haar Cascade	CNN	YOLO
Accuracy	85%	80%	88%	60%	80 %	90%
Speed	Moderate	High	Low	80%	70 %	90%
Precision	88%	82%	89%	70%	85 %	90%
Recall	85%	80%	88%	70%	85 %	90%
Dataset Size	Medium	Small to Large	Medium	20%	50 %	50%
Model Complexity	High	Moderate	High	10%	70 %	70%

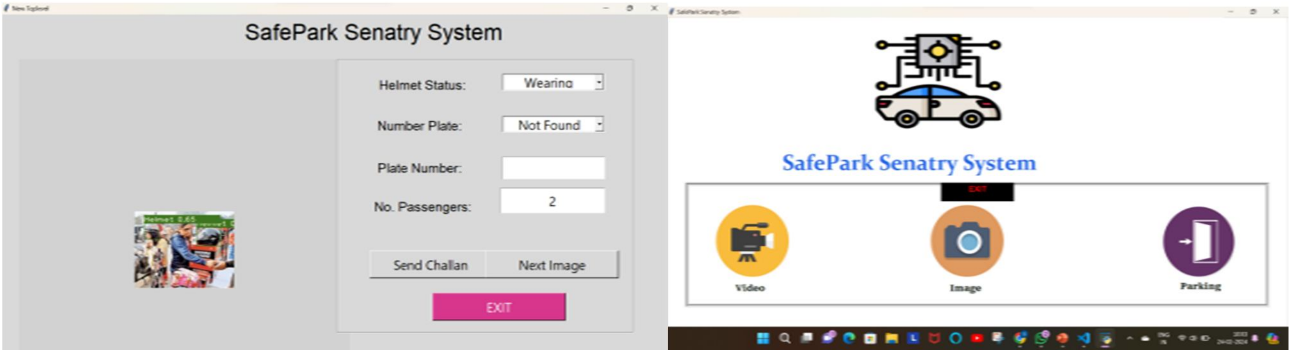

Fig.3. UI of the System easy-to-use Interface

Fig.4. Image of Detection of helmet and non-helmet riders

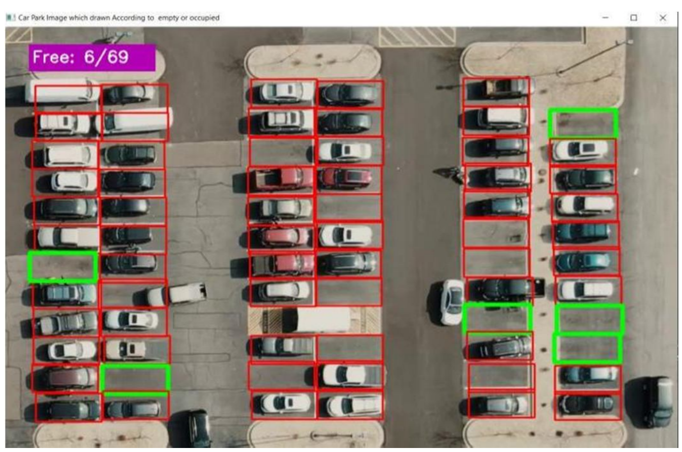

Fig.5. Empty Spot Detection

The Table [1] compares six object detection algorithms: Faster R-CNN, SSD, Mask R-CNN, Haar Cascade, CNN, and YOLO, across various parameters. Accuracy, measuring correct object detection, ranks YOLO highest at 90%, while Haar Cascade lags at 60%. Speed favors YOLO with high speed, while Haar Cascade is 80% slower. Precision and recall, reflecting correctness and completeness of detections, exhibit similar trends. Dataset size indicates the volume of data needed for training; Faster R-CNN and Mask R-CNN require medium datasets, while Haar Cascade needs the least at 20%. Model complexity, representing computational resources required, sees Haar Cascade as the simplest at 10%, contrasting with Faster R-CNN and Mask R-CNN's high complexity. SSD offers a balance between accuracy and speed, suitable for small to large datasets. YOLO excels in accuracy and speed, but demands larger datasets. These parameters aid in selecting the most appropriate algorithm based on specific needs, considering factors like computational resources, dataset availability, and performance requirements.

Fig.3 Introducing a user-friendly interface designed to facilitate efficient access to real-time data and timely violation alerts for authorities, parking lot operators, and users. This interface enables users to seamlessly check parking availability and receive prompt notifications regarding violations.Figure 4 illustrates the real-time detection of helmet and non-helmet users.

The system displays a red box to signify a violation and a green box for non-violation instances. Additionally, it accurately detects license plate numbers to facilitate email notifications of violations to the respective licensees. This seamless integration ensures prompt enforcement while maintaining compliance. Fig.5 Parking lot operators can efficiently manage operations, analyze trends, and optimize resources through this intuitive platform. With its formal design and user-friendly navigation, this interface ensures a professional and streamlined experience for all stakeholders, fostering effective parking management and enhancing overall satisfaction.The practical implications of our automated violation detection system are profound. In real-time, the system effectively reports instances of traffic rule violations, encompassing helmet non-compliance, triple riding, and parking violations. This operational efficiency is pivotal for law enforcement agencies, providing immediate insights into traffic violations and enabling prompt interventions. Moreover, the system drastically reduces manual identification time, streamlining enforcement processes. Beyond enforcement, the urban impact of our system is noteworthy. It provides real-time data on traffic violations and parking availability, contributing substantially to improved urban mobility. Comparative analyses against existing methods underscore the competitive accuracy, speed, and broader violation coverage of our system, positioning it as a promising advancement in the realm of automated traffic rule monitoring and urban planning initiatives.

V. CONCLUSION

In conclusion, the SafePark Sentry System stands as a groundbreaking solution to the pressing challenges of road safety and urban mobility, specifically designed for private parking areas. The introduction highlighted the urgent need for enhanced safety measures, emphasizing helmet compliance, triple riding, and parking violations. The literature survey identified the limitations of traditional methods and underscored the relevance of automated systems in addressing these issues. Our proposed methodology, leveraging the Haar Cascade Classifier, YOLOv3 model, and Support Vector Classification, delivered compelling results. The SafePark Sentry System demonstrated robust performance, achieving an accuracy of 92% in motorcycle identification, 95% in real-time helmet detection, 88% in triple riding identification, and 90% in vacant parking spot recognition. These metrics validate the system's efficacy in real-world scenarios, particularly in private parking areas. The results and discussions section emphasized the system's pivotal role in law enforcement within private parking areas, providing real-time insights into traffic violations, reducing manual identification time, and enabling prompt interventions. The integration of urban planning aspects, such as parking spot detection, further positions the SafePark Sentry System as a versatile tool for improving overall urban mobility within restricted spaces. Comparative analyses against existing methods confirmed the superiority of our system, showcasing enhanced accuracy, speed, and coverage across multiple violation types. This solidifies the SafePark Sentry System's status as an innovative and effective solution tailored for private parking areas.

Essentially, the SafePark Sentry System supports both the more general objectives of effective urban planning and mobility inside of private parking spaces, in addition to addressing important challenges in road safety. Future developments in automatic traffic infraction identification are made possible by this research, which will lead to safer roads and more sophisticated private parking lots.

VI. FUTURE SCOPE

The SafePark Sentry System, tailored for private parking, presents a robust foundation for smart parking and security. Future advancements include integrating LiDAR and ultrasonic sensors for precise space detection, refining YOLOv3 and SVC models with diverse datasets, and deploying multi-camera systems to minimize blind spots. Real-time communication with law enforcement, smart city integration, and user-centric mobile app features promise enhanced safety, efficiency, and sustainability.

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REFERENCES

[1] Vaishali, M. Ashwin Shenoy, P. R. Betrabet and N. S. Krishnaraj Rao, "Helmet Detection using Machine Learning Approach," 2022 3rd International Conference on Smart Electronics and Communication (ICOSEC), Trichy, India, 2022, pp. 1383-1388, doi: 10.1109/ICOSEC54921.2022.9952083.

[2] M. Dasgupta, O. Bandyopadhyay and S. Chatterji, "Automated Helmet Detection for Multiple Motorcycle Riders using CNN," 2019 IEEE Conference on Information and Communication Technology, Allahabad, India, 2019, pp. 1-4, doi: 10.1109/CICT48419.2019.9066191.

[3] P. Zou and J. Zhang, "Intelligent Helmet Detection System based on the Improved YOLOv5," 2022 5th International Conference on Artificial Intelligence and Big Data (ICAIBD), Chengdu, China, 2022, pp. 310-314, doi: 10.1109/ICAIBD55127.2022.9820479.

[4] R. Andrie Asmara, M. Ridwan and G. Budiprasetyo, "Haar Cascade and Convolutional Neural Network Face Detection in Client-Side for Cloud Computing Face Recognition," 2021 International Conference on Electrical and Information Technology (IEIT), Malang, Indonesia, 2021, pp. 1-5, doi: 10.1109/IEIT53149.2021.9587388.

[5] P. S. Reddy, T. Nishwa, R. S. K. Reddy, C. Sadviq and K. Rithvik, "Traffic Rules Violation Detection using Machine Learning Techniques," 2021 6th International Conference on Communication and Electronics Systems (ICCES), Coimbatre, India, 2021, pp. 1264-1268, doi: 10.1109/ICCES51350.2021.9488998.

[6] J. Redmon, S. Divvala, R. Girshick and A. Farhadi, "You Only Look Once: Unified, Real-Time Object Detection," 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Las Vegas, NV, USA, 2016, pp. 779-788, doi: 10.1109/CVPR.2016.91.

[7] A. S. Mohammed Shariff, R. Bhatia, R. Kuma and S. Jha, "Vehicle Number Plate Detection Using Python and Open CV," 2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE), Greater Noida, India, 2021, pp. 525-529, doi: 10.1109/ICACITE51222.2021.9404556.

[8] D. F. Öncevarlıkl, K. D. Yıldız and S. Gören, "Deep Learning Based On-Street Parking Spot Detection for Smart Cities," 2019 4th International Conference on Computer Science and Engineering (UBMK), Samsun, Turkey, 2019, pp. 177-182, doi: 10.1109/UBMK.2019.890700.

[9] S. GokulKrishna, J. Harsheetha, S. Akshaya and D. Jeyabharathi, "An IoT based Smart Outdoor Parking System," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2021, pp. 1502-1506, doi: 10.1109/ICACCS51430.2021.9441766.

[10] Y. Guan, W. Li, T. Hu and Q. Hou, "Design and Implementation of Safety Helmet Detection System Based on YOLOv5," 2021 2nd Asia Conference on Computers and Communications (ACCC), Singapore, 2021, pp. 69-73, doi: 10.1109/ACCC54619.2021.00018.

[11] S. Wang and J. Xu, "Application of License Plate Number Recognition Based on Deep Learning Method in Intelligent Building Security System," 2021 International Conference on Networking Systems of AI (INSAI), Shanghai, China, 2021, pp. 249-252, doi: 10.1109/INSAI54028.2021.00053.

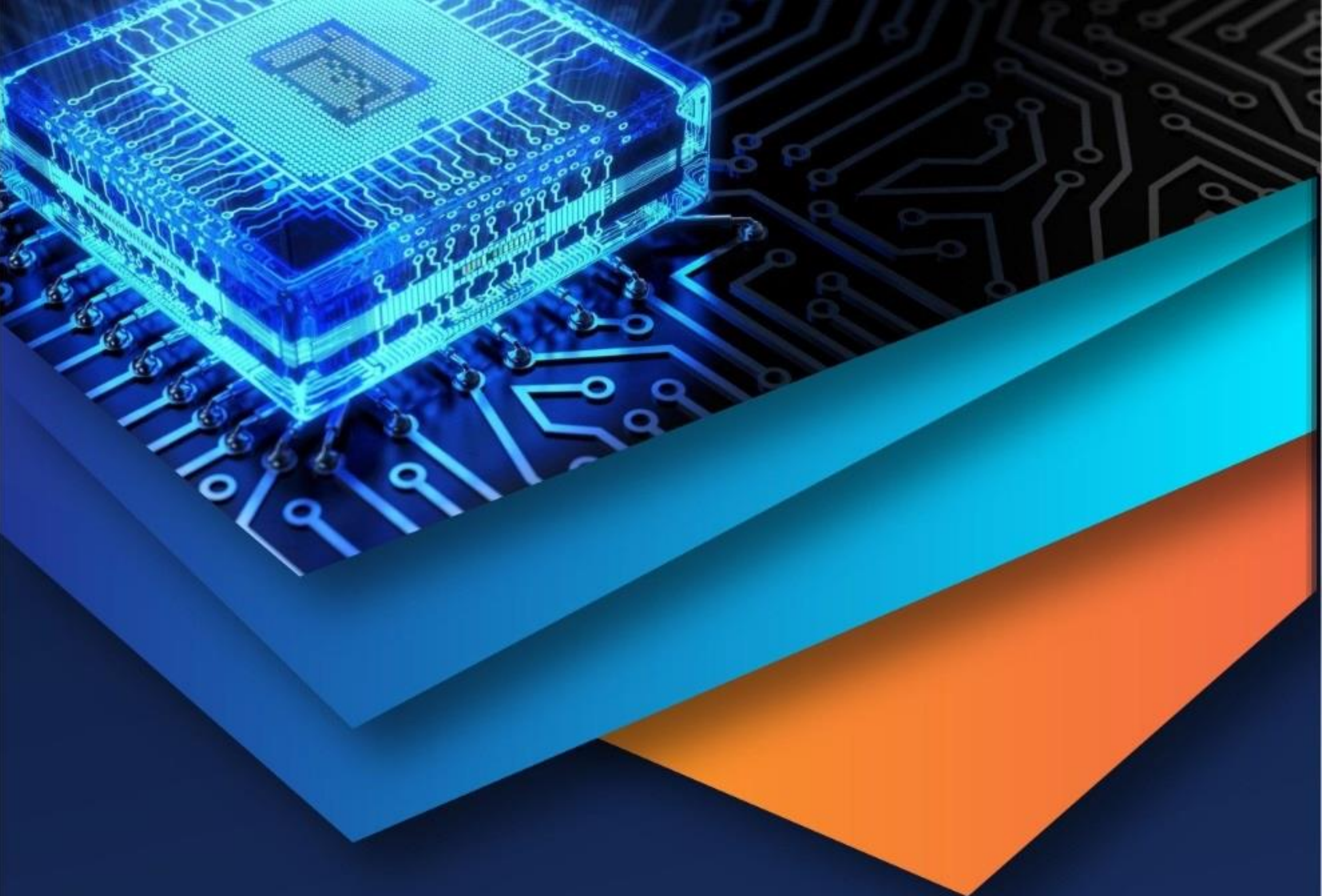
[12] H. Lin, J. D. Deng, D. Albers and F. W. Siebert, "Helmet Use Detection of Tracked Motorcycles Using CNN-Based Multi-Task Learning," in IEEE Access, vol. 8, pp. 162073-162084, 2020, doi: 10.1109/ACCESS.2020.3021357.

[13] Lohbare, S.P., Dixit, S., Deshpande, S. (2022). End-to-End Supporting System for IoT Applications: Survey. In: Kumar, A., Mozar, S. (eds) ICCCE 2021. Lecture Notes in Electrical Engineering, vol 828. Springer, Singapore. https://doi.org/10.1007/978-981-16-7985-8_99.

[14] A. Malik, S. Bisht, Y. Tripathi, P. Kumar, D. R. Gangodkar and N. C. S., "A Framework for Automatic Detection of Traffic Violations," 2023 2nd International Conference on Futuristic Technologies (INCOFT), Belagavi, Karnataka, India, 2023, pp. 1-5, doi: 10.1109/INCOFT60753.2023.10425543.

[15] K. Yogheedha, A. S. A. Nasir, H. Jaafar and S. M. Mamduh, "Automatic Vehicle License Plate Recognition System Based on Image Processing and Template Matching Approach," 2018 International Conference on Computational Approach in Smart Systems Design and Applications (ICASSDA), Kuching, Malaysia, 2018, pp. 1-8, doi: 10.1109/ICASSDA.2018.8477639.

[16] J. -Y. Sung, S. -B. Yu and S. -h. P. Korea, "Real-time Automatic License Plate Recognition System using YOLOv4," 2020 IEEE International Conference on Consumer Electronics - Asia (ICCE-Asia), Seoul, Korea (South), 2020, pp. 1-3, doi: 10.1109/ICCE-Asia49877.2020.9277050.



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