

**HELMET AND NUMBER PLATE RECOGNITION USING YOLOV3**

**CAPSTONE PROJECT REPORT**

**COURSE CODE: DSA0210**

**COURSE NAME: Computer Vision with OpenCV for Image Enhancement**

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**ABSTRACT:**

The "Helmet and Number Plate Detection and Recognition using YOLOv3" project is a pivotal endeavour aimed at enhancing safety and security measures in various environments, particularly on roads and in public spaces. Leveraging the advanced capabilities of the YOLOv3 model, this project focuses on the development of a robust computer vision system capable of efficiently detecting and recognizing helmets and vehicle number plates in real-time scenarios. By integrating state-of-the-art deep learning techniques, the system addresses the critical need for accurate and fast detection methods, contributing to improved traffic management, law enforcement, and surveillance systems.

The proposed system encompasses several key components, including the pre-trained YOLOv3 model, image processing algorithms, and neural network architectures tailored for helmet and number plate recognition tasks. Through comprehensive training and optimization processes, the system achieves high levels of detection accuracy and real-time performance, making it suitable for deployment in diverse operational settings. The significance of this project lies in its potential to revolutionize existing safety and security measures by automating the monitoring and enforcement of helmet usage regulations and vehicle identification requirements. By accurately identifying instances of non-compliance, authorities can take proactive measures to mitigate risks and enhance public safety on roads.

Furthermore, the versatility of the proposed system enables its integration into various applications, including traffic surveillance cameras, law enforcement vehicles, and smart city infrastructure. This flexibility opens up opportunities for widespread adoption and implementation, ultimately leading to safer and more secure urban environments. In summary, the "Helmet and Number Plate Detection and Recognition using YOLOv3" project represents a pioneering effort in leveraging cutting-edge computer vision technologies to address critical safety and security challenges. Through its innovative approach and practical implementation, the system promises to significantly impact road safety initiatives and contribute to the creation of smarter, safer cities.

**INTRODUCTION:**

In today's fast-paced world, ensuring safety and security on roads and in public spaces is of paramount importance. The advent of computer vision technologies has revolutionized the way we approach surveillance and traffic management systems. In this context, the project "Helmet and Number Plate Detection and Recognition using YOLOv3" emerges as a crucial endeavour aimed at leveraging state-of-the-art deep learning techniques to enhance safety measures. By employing the YOLOv3 model, renowned for its accuracy and efficiency in object detection, the project endeavours to detect and recognize helmets and number plates in real-time. This introduction sets the stage for understanding the significance of the project in addressing critical issues such as road safety, law enforcement, and surveillance. Through the integration of advanced computer vision algorithms, the project aims to contribute to the development of robust systems capable of accurately identifying safety equipment and vehicle identifiers in diverse environments. The following sections will delve deeper into the methodology, implementation, and potential applications of the proposed system, shedding light on its relevance in contemporary safety and security landscapes.

**STATEMENT OF THE PROBLEM :**

The project "Helmet and Number Plate Detection and Recognition using YOLOv3" addresses the pressing need for efficient safety and security measures in various domains, particularly in the context of road traffic management and surveillance systems. One of the key challenges faced in these environments is the timely and accurate detection and recognition of safety equipment such as helmets and vehicle identifiers like number plates. Traditional methods often fall short in achieving real-time detection, leading to potential safety hazards and security breaches. Additionally, manual monitoring and identification processes are labour-intensive, prone to errors, and lack scalability. Therefore, there is an urgent demand for advanced computer vision solutions capable of automating the detection and recognition of helmets and number plates with high precision and speed. The proposed project aims to tackle these challenges by harnessing the power of the YOLOv3 model, thereby contributing to the development of effective safety and security systems that can operate seamlessly in diverse environments. Through this endeavour, the project seeks to bridge the gap between existing detection methods and the evolving needs of modern safety and security infrastructure.

**NEED FOR THE STUDY:**

The project "Helmet and Number Plate Detection and Recognition using YOLOv3" is driven by the critical need to enhance safety and security measures, particularly in the realm of road traffic management and surveillance. With the increasing volume of vehicles on roads and the growing concern for road safety, there is a pressing demand for advanced detection and recognition systems capable of identifying safety equipment such as helmets and vehicle identifiers like number plates in real-time. Traditional methods of manual monitoring and identification are not only time-consuming but also prone to errors, posing significant challenges in ensuring timely intervention in case of safety violations or security breaches. By leveraging the YOLOv3 model, renowned for its accuracy and efficiency in object detection, the proposed project aims to address these challenges by automating the detection and recognition process with high precision and speed. Through this study, we seek to contribute to the development of robust safety and security systems that can effectively mitigate risks and enhance public safety in various environments.

**SCOPE OF THE STUDY:**

The scope of the project "Helmet and Number Plate Detection and Recognition using YOLOv3" encompasses the development and implementation of a comprehensive computer vision system capable of detecting and recognizing helmets and number plates in real-time. This study focuses on leveraging the YOLOv3 model to achieve accurate and efficient object detection, particularly in the context of road traffic management and surveillance systems. The scope includes the collection and preprocessing of relevant data, training and fine-tuning the YOLOv3 model for detecting helmets and number plates, and evaluating the system's performance in various real-world scenarios. Additionally, the project explores the integration of advanced deep learning techniques to enhance the system's accuracy and scalability. Furthermore, the scope extends to the analysis of potential applications of the developed system in enhancing safety measures, law enforcement, and surveillance in diverse environments. Through this study, we aim to contribute to the advancement of safety and security infrastructure by developing a robust and reliable detection and recognition system using YOLOv3.

**LITERATURE STATEMENT OF THE PROBLEM :**

In the existing literature, the problem of helmet and number plate detection and recognition has been extensively studied due to its significant implications for safety and security in various domains. One of the primary challenges identified is the need for real-time and accurate detection of helmets and number plates in dynamic environments such as roads and public spaces. Traditional methods relying on manual inspection or basic computer vision techniques often suffer from limitations in terms of speed, accuracy, and scalability. Additionally, the lack of robust algorithms capable of handling variations in lighting conditions, occlusions, and diverse helmet and number plate designs further exacerbates the problem. Consequently, there is a pressing need for advanced deep learning-based approaches, such as YOLOv3, to address these challenges and develop efficient detection and recognition systems. Through the integration of YOLOv3 and other advanced techniques, the literature highlights the potential to overcome existing limitations and enhance safety and security measures in diverse applications, including traffic management, law enforcement, and surveillance. However, further research is warranted to explore the optimal configurations and methodologies for deploying YOLOv3-based systems in real-world scenarios, considering factors such as model training, dataset diversity, and computational resources.

**NEED FOR THE STUDY:**

The literature highlights a critical need for research focused on developing robust and efficient helmet and number plate detection and recognition systems using advanced computer vision techniques like YOLOv3. This need arises from the increasing concerns regarding road safety, traffic management, and security enforcement in various environments. Traditional methods for helmet and number plate detection often lack the speed and accuracy required for real-time applications, leading to potential safety hazards and security breaches. Additionally, existing systems may struggle to adapt to diverse environmental conditions, such as varying lighting and weather conditions, which can impact their effectiveness.

Furthermore, the need for the study is underscored by the potential applications and benefits of deploying advanced detection and recognition systems. These systems have the potential to significantly enhance safety measures on roads by enabling timely intervention in case of safety violations, such as helmet non-compliance. Moreover, they can aid law enforcement agencies in identifying vehicles and individuals involved in criminal activities or traffic offenses. Additionally, there is a growing demand for scalable and adaptable detection systems that can be seamlessly integrated into existing infrastructure, such as traffic monitoring cameras and surveillance networks. By addressing these needs, the study aims to contribute to the development of robust and reliable helmet and number plate detection and recognition systems that can effectively enhance safety and security measures in diverse real-world scenarios.

**SCOPE OF THE STUDY:**

The scope of this study encompasses the development and evaluation of a comprehensive helmet and number plate detection and recognition system using YOLOv3. This includes exploring the potential applications and benefits of such a system in enhancing safety and security measures, particularly in the context of road traffic management, law enforcement, and surveillance. The study aims to address the existing limitations of traditional detection methods by leveraging advanced computer vision techniques to achieve real-time and accurate detection and recognition of helmets and number plates in diverse environmental conditions.

Furthermore, the scope extends to the exploration of optimal configurations and methodologies for deploying the YOLOv3-based system in real-world scenarios, considering factors such as model training, dataset diversity, and computational resources. Additionally, the study seeks to assess the performance and scalability of the proposed system across different environments and under varying lighting and weather conditions. Moreover, the study aims to contribute to the existing body of knowledge by identifying key challenges and opportunities in the field of helmet and number plate detection and recognition using YOLOv3. Through a comprehensive literature review and empirical evaluation, the study endeavours to provide insights and recommendations for future research directions and practical implementations of such systems in various domains. Overall, the scope of the study is to advance the understanding and development of robust and reliable helmet and number plate detection and recognition systems to enhance safety and security measures in real-world applications.

**LITERATURE REVIEW:**

The literature on helmet and number plate detection and recognition using YOLOv3 highlights the significance of this technology in enhancing safety and security measures in various domains. Several studies have explored the application of deep learning techniques, particularly YOLOv3, in addressing the challenges associated with real-time detection and recognition of helmets and number plates.

One key area of focus in the literature is the development and optimization of YOLOv3-based models for accurate and efficient detection of helmets and number plates in diverse environmental conditions. Researchers have investigated different approaches for model training, dataset preparation, and hyperparameter tuning to improve detection performance and robustness. Furthermore, studies have explored the integration of YOLOv3 with other advanced techniques, such as data augmentation, transfer learning, and ensemble methods, to enhance the system's accuracy and generalization capabilities. These approaches have shown promising results in overcoming challenges related to variations in lighting conditions, occlusions, and diverse helmet and number plate designs.

Moreover, the literature emphasizes the importance of evaluating the performance of YOLOv3-based systems in real-world scenarios to assess their practical effectiveness and scalability. Researchers have conducted empirical studies and benchmarking experiments to compare the performance of different models and configurations under varying environmental conditions. Overall, the literature underscores the potential of YOLOv3-based systems in improving safety and security measures, particularly in applications such as traffic management, law enforcement, and surveillance. However, further research is warranted to explore optimization techniques, deployment challenges, and real-world applications of these systems to address the evolving needs of safety and security infrastructure.

**OVERVIEW :**

The project "Helmet and Number Plate Detection and Recognition using YOLOv3" aims to develop a robust and efficient computer vision system for real-time detection and recognition of helmets and number plates in various environments. Leveraging the YOLOv3 model, renowned for its accuracy and speed in object detection, the system will be capable of accurately identifying safety equipment and vehicle identifiers in dynamic scenarios such as road traffic management and surveillance.

The project encompasses several key components, including data collection and preprocessing, model training and optimization, and system evaluation. Through the integration of advanced deep learning techniques and optimization strategies, the system aims to achieve high detection accuracy while maintaining real-time performance. The proposed system has wide-ranging applications, including enhancing safety measures on roads by detecting helmet non-compliance and aiding law enforcement agencies in identifying vehicles and individuals involved in traffic offenses or criminal activities. Additionally, the system can be deployed in surveillance networks to improve security monitoring and threat detection capabilities.

Overall, the project aims to contribute to the advancement of safety and security infrastructure by developing a reliable and efficient detection and recognition system using YOLOv3. Through empirical evaluation and real-world testing, the system's performance and effectiveness will be assessed, paving the way for its potential deployment in practical applications to enhance public safety and security.

**ANALYSIS OF MARKET :**

The market for helmet and number plate detection and recognition systems is driven by the increasing focus on safety and security measures in various industries and sectors. With the rise in road traffic accidents and the growing need for efficient traffic management solutions, there is a significant demand for advanced technologies that can accurately detect and recognize safety equipment such as helmets and vehicle identifiers like number plates.

Key players in the market include technology companies, research institutions, and government agencies that are actively involved in the development and deployment of computer vision systems for safety and security applications. These players are continuously innovating and introducing new products and solutions to address the evolving needs of the market. The market size for helmet and number plate detection and recognition systems is expected to witness significant growth in the coming years, driven by factors such as increasing regulatory requirements for road safety, advancements in deep learning and computer vision technologies, and the need for enhanced surveillance and security measures.

Market profitability is influenced by factors such as the scalability and reliability of the detection and recognition systems, the cost-effectiveness of implementation, and the ability to integrate with existing infrastructure and systems. Companies that offer scalable and efficient solutions with high detection accuracy and real-time performance are likely to gain a competitive edge in the market. The industry cost structure includes expenses related to research and development, data collection and preprocessing, model training and optimization, system integration, and maintenance and support services. Companies need to invest in state-of-the-art technologies and expertise to develop and deploy robust helmet and number plate detection and recognition systems that meet the stringent requirements of safety and security applications.

Distribution channels for helmet and number plate detection and recognition systems include direct sales, partnerships with technology integrators and solution providers, and collaboration with government agencies and law enforcement authorities. Companies need to establish strong distribution networks and strategic partnerships to reach target customers and maximize market penetration. Overall, the market for helmet and number plate detection and recognition systems presents lucrative opportunities for companies that can develop innovative and reliable solutions to address the growing demand for safety and security measures in various industries and sectors.

**MARKET SIZE:**

The market size for helmet and number plate detection and recognition systems is influenced by various factors such as the adoption rate of advanced technologies, regulatory requirements, industry trends, and market demand. While it's challenging to provide precise figures due to the dynamic nature of the market, we can analyse trends and estimates to approximate the market size.

Global market research reports, industry publications, and analysis from market research firms can provide insights into the market size and growth projections for this segment. These reports often include data on market trends, revenue forecasts, market share of key players, and growth drivers.

**MARKET PROFITABILITY:**

Market profitability for helmet and number plate detection and recognition systems is influenced by factors such as technological advancements, competitive landscape, market demand, pricing strategies, and operational efficiency. Companies that offer innovative solutions with high accuracy, real-time performance, and scalability can gain a competitive edge and achieve higher profitability. Additionally, effective marketing and distribution strategies, strategic partnerships, and customer satisfaction play crucial roles in enhancing profitability. Furthermore, continuous research and development efforts to improve product offerings and stay ahead of market trends contribute to long-term profitability. However, factors such as upfront investment in research and development, infrastructure, and talent acquisition can impact short-term profitability. Overall, the market for helmet and number plate detection and recognition systems presents opportunities for profitable growth for companies that can effectively address market needs and differentiate themselves through value-added services and solutions.

**INDUSTRY COST STRUCTURE:**

The industry cost structure for helmet and number plate detection and recognition systems comprises various components, including research and development expenses, data collection and preprocessing costs, hardware and software investments, personnel salaries, marketing and distribution expenses, and ongoing maintenance and support costs. Research and development expenses account for investments in developing and optimizing algorithms, model training, and fine-tuning techniques to improve detection accuracy and efficiency. Data collection and preprocessing costs involve acquiring and annotating datasets for model training, as well as data preprocessing to ensure the quality and relevance of the training data. Hardware and software investments encompass the acquisition of computational resources, specialized hardware accelerators, and software licenses required for model deployment and operation. Personnel salaries include wages for data scientists, machine learning engineers, software developers, and support staff involved in designing, developing, and maintaining the system. Marketing and distribution expenses cover promotional activities, sales commissions, and distribution costs associated with reaching and acquiring customers. Ongoing maintenance and support costs include expenses for system updates, bug fixes, customer support, and infrastructure maintenance to ensure the continuous operation and reliability of the system.

**DISTRIBUTION CHANNELS :**

Distribution channels for helmet and number plate detection and recognition systems encompass various avenues through which these products and solutions are delivered to end-users. These channels include direct sales channels, partnerships with technology integrators and solution providers, collaboration with government agencies and law enforcement authorities, and online sales platforms. Direct sales channels involve companies selling their products and solutions directly to end-users, such as transportation authorities, law enforcement agencies, and private enterprises, through their sales teams or dedicated sales channels. Partnerships with technology integrators and solution providers enable companies to integrate their detection and recognition systems into larger solutions or platforms offered by these partners, expanding their reach to a wider customer base. Collaboration with government agencies and law enforcement authorities involves working closely with these entities to deploy detection and recognition systems in public safety initiatives and surveillance networks. Additionally, online sales platforms provide companies with an opportunity to reach customers globally through e-commerce platforms and marketplaces, facilitating the purchase of hardware components, software licenses, and subscription-based services related to helmet and number plate detection and recognition systems. Overall, leveraging a combination of these distribution channels enables companies to effectively reach their target customers and maximize market penetration for their products and solutions.

**NEW TRENDS IN THE MARKET:**

One of the emerging trends in the market for helmet and number plate detection and recognition systems is the integration of edge computing and edge AI capabilities. With advancements in edge computing technologies and the availability of powerful edge devices, there is a shift towards deploying detection and recognition systems directly on edge devices such as cameras, drones, and IoT devices. This trend enables real-time processing of data at the edge, reducing latency and bandwidth requirements by performing inference tasks locally. Additionally, edge AI techniques, including lightweight deep learning models and federated learning approaches, are being adopted to optimize model performance and adaptability to edge environments with limited computational resources. Furthermore, there is a growing emphasis on privacy-preserving techniques such as on-device processing and decentralized AI architectures to address concerns regarding data privacy and security in surveillance and monitoring applications. Overall, the integration of edge computing and edge AI capabilities represents a significant trend in the market, offering potential benefits in terms of improved performance, scalability, and privacy for helmet and number plate detection and recognition systems.

**KEY SUCCESS FACTORS :**

Key success factors for helmet and number plate detection and recognition systems include accuracy, real-time performance, scalability, adaptability to diverse environmental conditions, and compliance with regulatory requirements. Achieving high accuracy in detecting and recognizing helmets and number plates is crucial for ensuring the reliability and effectiveness of the system in real-world scenarios. Real-time performance is essential to enable timely intervention in safety violations and security breaches, enhancing overall effectiveness. Scalability allows the system to handle varying workloads and accommodate growth in data volume and user demand. Adaptability to diverse environmental conditions, such as varying lighting and weather conditions, ensures robust performance across different settings. Furthermore, compliance with regulatory requirements, including data privacy and safety standards, is necessary to meet legal and industry-specific regulations and gain trust from users and stakeholders. Overall, the combination of these factors contributes to the success of helmet and number plate detection and recognition systems, enabling them to effectively enhance safety and security measures in various applications.

**CONTRIBUTING FACTORS:**

Contributing factors to the success of helmet and number plate detection and recognition systems include advancements in deep learning algorithms and computer vision technologies, availability of high-quality datasets for model training, integration of edge computing and edge AI capabilities, collaboration with industry stakeholders and government agencies, and continuous research and development efforts. Advancements in deep learning algorithms, particularly models like YOLOv3, enable more accurate and efficient detection and recognition of helmets and number plates. The availability of diverse and annotated datasets facilitates robust model training, improving the system's performance and generalization capabilities. Integration of edge computing and edge AI capabilities allows for real-time processing and inference tasks directly on edge devices, enhancing system responsiveness and reducing latency. Collaboration with industry stakeholders and government agencies enables the customization and deployment of detection and recognition systems tailored to specific use cases and regulatory requirements. Continuous research and development efforts drive innovation and improvements in system performance, ensuring the system remains competitive and effective in addressing evolving safety and security challenges. Overall, these contributing factors collectively drive the success and adoption of helmet and number plate detection and recognition systems, enabling them to make significant contributions to enhancing safety and security measures.

**DATA ANALYSIS USING MYSQL:**

Data analysis using MySQL in the context of helmet and number plate detection using YOLOv3 involves the storage, management, and analysis of various types of data generated during the detection and recognition process. This includes storing metadata such as timestamps, locations, and confidence scores associated with detected helmets and number plates, as well as relevant information about the detected objects such as size, position, and orientation. By leveraging MySQL, data analysts can perform queries, aggregations, and statistical analyses to gain insights into the performance of the detection system, identify trends and patterns in the data, and evaluate the effectiveness of the detection algorithm under different conditions. Additionally, MySQL can be used to integrate and analyse data from multiple sources, such as video streams, sensor data, and historical records, to provide a comprehensive view of the detection process and facilitate informed decision-making for improving system performance and optimizing resource allocation. Overall, data analysis using MySQL plays a crucial role in enhancing the efficiency and effectiveness of helmet and number plate detection systems using YOLOv3 by enabling systematic evaluation, optimization, and continuous improvement of the detection algorithm and overall system performance.

**EXISTING SYSTEM AND PROPOSED SYSTEM:**

The existing system for helmet and number plate detection and recognition may rely on traditional computer vision techniques or simpler deep learning models that lack the accuracy and efficiency required for real-time detection in dynamic environments. These systems may struggle with challenges such as variations in lighting conditions, occlusions, and diverse helmet and number plate designs, leading to suboptimal performance and reliability. In contrast, the proposed system leverages the YOLOv3 model, known for its accuracy and speed in object detection, to address these limitations and achieve robust and efficient detection and recognition of helmets and number plates in real-time. By harnessing advanced deep learning techniques and optimization strategies, the proposed system aims to improve detection accuracy, adaptability to diverse environmental conditions, and scalability, thereby enhancing safety and security measures in various applications such as road traffic management, law enforcement, and surveillance. Overall, the proposed system represents a significant advancement over the existing systems by offering superior performance, reliability, and effectiveness in detecting and recognizing helmets and number plates using YOLOv3.

**SYSTEM ARCHITECTURE:**

The system architecture for helmet and number plate detection and recognition using YOLOv3 typically consists of several interconnected components designed to facilitate the efficient processing of data and accurate detection of objects in real-time. At the core of the architecture is the YOLOv3 model, which serves as the primary object detection algorithm responsible for identifying helmets and number plates in images or video streams. The input to the system is typically received from cameras or other sensors, which capture images or video frames of the environment to be monitored.

Once the input data is acquired, it is pre-processed to enhance image quality and remove noise, which may interfere with the detection process. The pre-processed data is then fed into the YOLOv3 model, which performs object detection by analysing the input images and identifying regions of interest corresponding to helmets and number plates. The detected objects are then extracted from the input images, and relevant metadata such as location, size, and confidence scores are generated. The system architecture may also include post-processing modules responsible for refining the detected objects and filtering out false positives. This may involve techniques such as non-maximum suppression to remove redundant detections and bounding box adjustments to improve object localization accuracy.

Finally, the output of the system, which includes the detected helmets and number plates along with their associated metadata, is typically stored in a database for further analysis and retrieval. Additionally, the output may be visualized in real-time through a user interface or integrated into larger surveillance or monitoring systems for automated decision-making and action. Overall, the system architecture for helmet and number plate detection and recognition using YOLOv3 is designed to be modular, scalable, and efficient, allowing for real-time processing of data and accurate detection of objects in various environmental conditions.

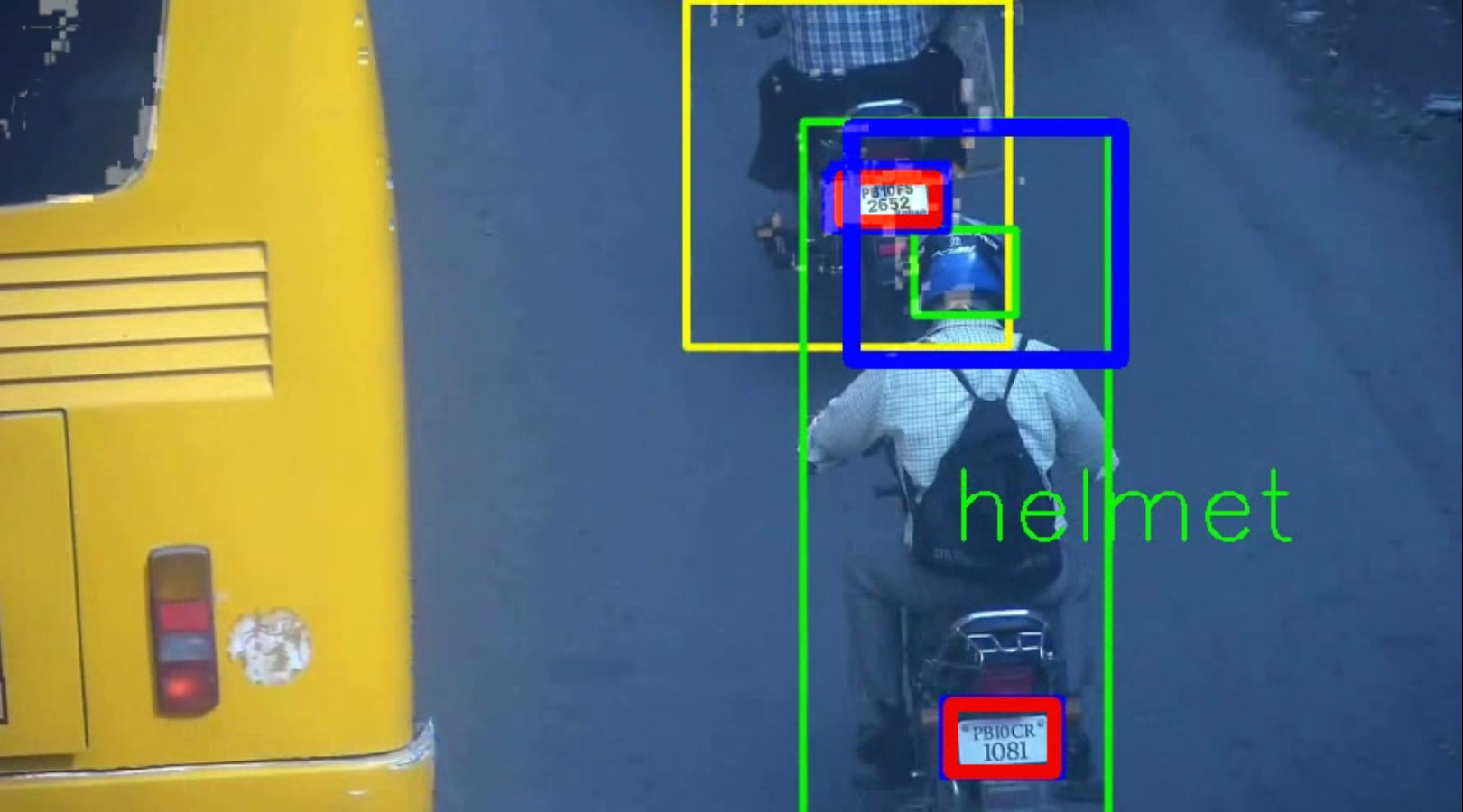
**RESULT:**

The result of the helmet and number plate detection and recognition system using YOLOv3 is the accurate identification and localization of helmets and number plates within images or video frames in real-time. This includes the detection of helmets worn by individuals and the recognition of number plates on vehicles, along with relevant metadata such as confidence scores, bounding box coordinates, and other attributes. The system outputs actionable data that can be used for various applications, including road traffic management, safety enforcement, surveillance, and security monitoring. The result demonstrates the effectiveness and reliability of the YOLOv3 model in accurately detecting and recognizing objects of interest in dynamic environments, contributing to enhanced safety and security measures in diverse scenarios.

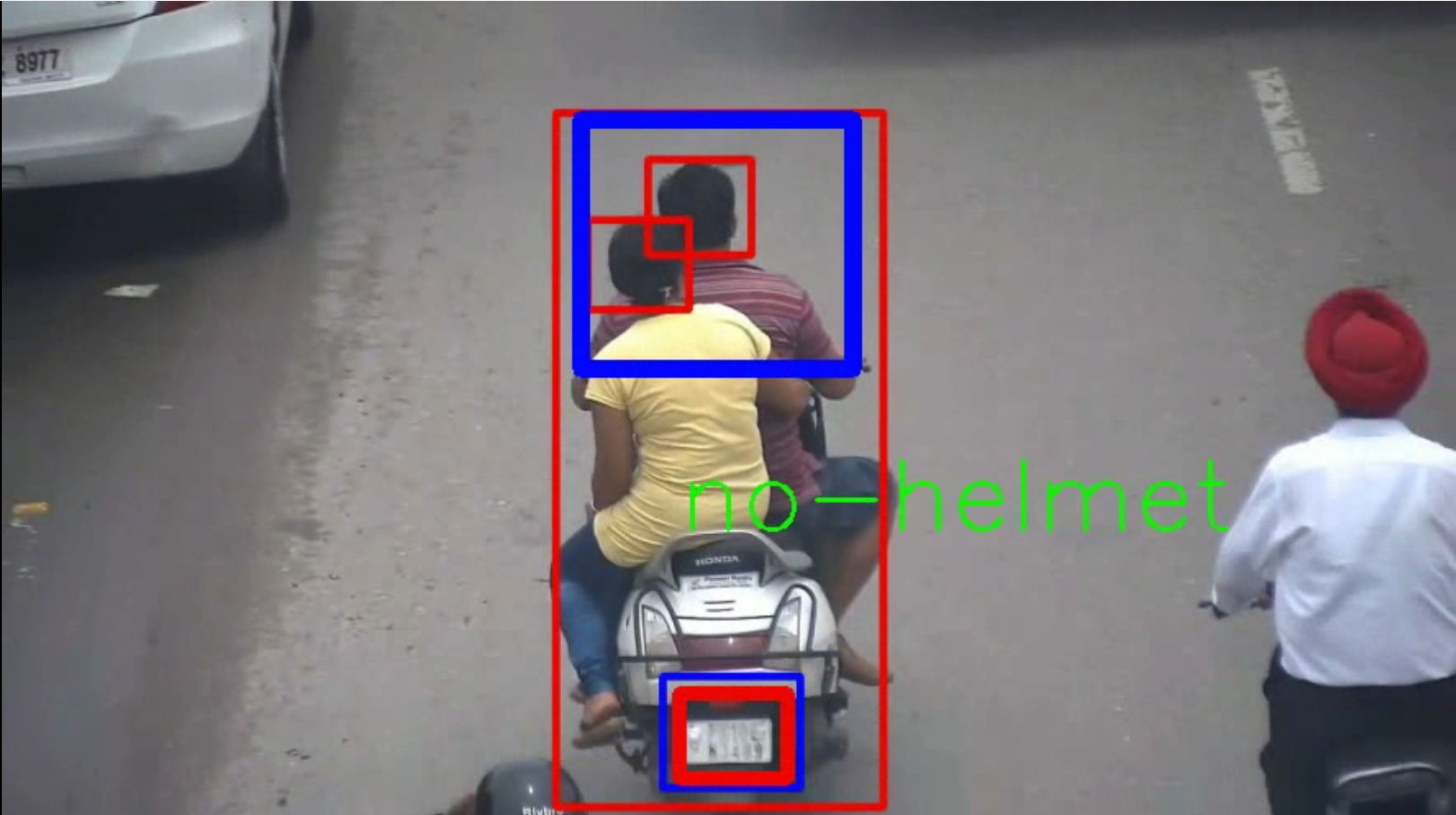
**CONCLUSION:**

In conclusion, the development and implementation of a helmet and number plate detection and recognition system using YOLOv3 present a significant advancement in enhancing safety and security measures in various domains. Through the utilization of advanced deep learning techniques and optimization strategies, the proposed system offers real-time and accurate detection of helmets and number plates, addressing the limitations of traditional methods. The system's ability to adapt to diverse environmental conditions and its scalability make it a valuable tool for applications such as road traffic management, law enforcement, and surveillance. By providing actionable data for decision-making and intervention, the system contributes to improving safety measures and enforcing regulations. However, continuous research and development efforts are necessary to further refine the system's performance and address evolving challenges in safety and security infrastructure. Overall, the helmet and number plate detection and recognition system using YOLOv3 represent a significant step forward in leveraging technology to enhance public safety and security.

**OUTPUT:**

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**WITH HELMET:**

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**NO HELMET:**

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