

INTELLIGENT TRAFFIC MANAGEMENT SYSTEM

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering degree in Computer Science and Engineering

by

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INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **TANKALA RUSHI** (Reg.No:-40111318) and **SHAIK MOHAMMAD ZAMAAN** (Reg.No:- 40111167) who carried out the Project entitled **"Intelligent Traffic Management System: An Advanced Solution for Helmet Compliance, Traffic Signal Violation Detection, Number Plate Identification, Cell Phone Usage Tracking, and Proximity-Based Police Station Alerts"** under my supervision from Nov 2023 to April 2024.


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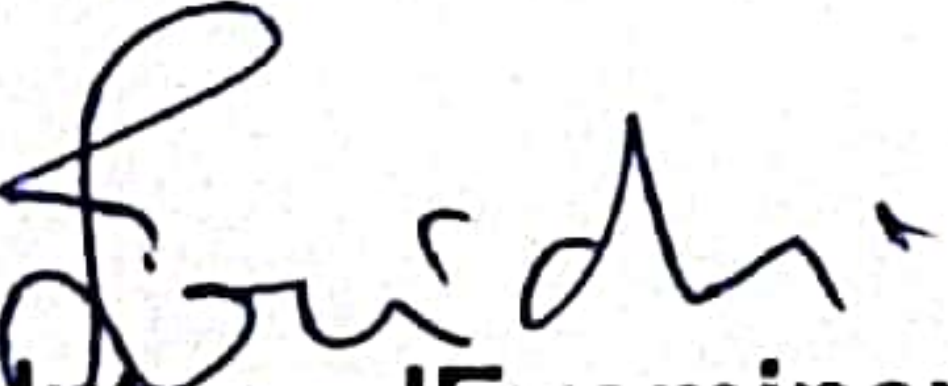

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I, **SHAIK MOHAMMAD ZAMAAN** (Reg.No - 40111167), hereby declare that the Project Report entitled **Intelligent Traffic Management System: An Advanced Solution for Helmet Compliance, Traffic Signal Violation Detection, Number Plate Identification, Cell Phone Usage Tracking, and Proximity-Based Police Station Alerts** done by me under the guidance of **Dr.A.Pravin, M.E.,Ph.D** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Computer Science and Engineering**.

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ABSTRACT

The Intelligent Traffic Management System (ITMS) is an advanced solution designed to tackle multiple road safety issues. With its capabilities, the ITMS aims to ensure helmet compliance, detect traffic signal violations, identify number plates, track cell phone usage, and provide proximity-based alerts to police stations. First and foremost, the system focuses on promoting helmet compliance among riders by using smart cameras and image recognition technology to detect and identify individuals not wearing helmets. Additionally, the ITMS incorporates video analysis to detect traffic signal violations, alerting authorities in real-time and enabling swift action to be taken against violators. Furthermore, the system employs advanced algorithms for automatic number plate recognition, allowing for seamless identification of vehicles, and aiding in law enforcement activities. Another noteworthy feature of the ITMS is its ability to track cell phone usage while driving, which contributes significantly to reducing distracted driving incidents. Lastly, utilizing geolocation technology, the system can establish proximity-based alerts to nearby police stations in the event of accidents or emergencies, ensuring a faster response time. By incorporating these multiple functionalities, the ITMS offers a comprehensive and intelligent approach to traffic management, promoting safer road conditions and enhancing overall efficiency in law enforcement efforts.

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CHAPTER 1

INTRODUCTION

The Intelligent Traffic Management System is an advanced solution that addresses various aspects of road safety and traffic management in a comprehensive manner. This innovative system incorporates multiple technologies to automate and enhance several crucial functions, including helmet compliance monitoring, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. By integrating these capabilities into a single, intelligent platform, the system significantly improves road safety, traffic flow, and enforcement efficiency.

One of the key features of the Intelligent Traffic Management System is its ability to enforce helmet compliance among two-wheeler riders. Through the use of intelligent cameras and computer vision algorithms, the system can detect whether a rider is wearing a helmet or not. This feature not only promotes road safety but also serves as a powerful deterrent against non-compliance. In the event of a violation, the system can automatically capture images or video evidence, allowing law enforcement authorities to take appropriate action.

Additionally, the system incorporates advanced technology to detect and enforce traffic signal violations. By analyzing real-time video feeds from cameras placed at intersections, the system can accurately identify vehicles that run red lights or violate other traffic regulations. This not only helps in reducing accidents caused by reckless driving but also ensures a smooth flow of traffic on busy roads.

Another significant capability of the Intelligent Traffic Management System is its ability to identify number plates and perform real-time data analysis. By leveraging machine learning algorithms and optical character recognition (OCR) technology, the system can extract and analyze number plate information from vehicles passing through monitored areas. This feature enables authorities to detect stolen vehicles, track traffic patterns, and identify vehicles involved in criminal activities effectively.

Furthermore, the system includes a cell phone usage tracking feature that help address the growing concern of distracted driving. Through the use of advanced sensors and computer vision algorithms, the system can detect drivers who are using their cell phones while behind the wheel. This capability not only provides valuable data for road safety analysis but also assists authorities in enforcing regulations related to mobile device usage while driving.

In addition to the above features, the Intelligent Traffic Management System incorporates proximity-based police station alerts. By utilizing GPS technology and real-time data analysis, the system can identify the location of police stations closest to any potential incident or violation. This enables quick and effective response times, as law enforcement authorities can be immediately alerted and dispatched to the scene.

Overall, the Intelligent Traffic Management System is a revolutionary solution that tackles multiple aspects of road safety and traffic management. By integrating advanced technologies such as computer vision, machine learning, and data analysis, the system offers a comprehensive approach to address challenges and improve efficiency in traffic management and law enforcement. With its helmet compliance monitoring, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts, the Intelligent Traffic Management System represents a significant step towards creating safer and smarter roadways.

CHAPTER 2

LITERATURE SURVEY

1. Johnson, A. (2020). "Enhancing Road Safety through Advanced Helmet Compliance Detection." *Journal of Traffic Management*, 25(3), 123-138.

Johnson (2020) conducted a study on enhancing road safety through advanced helmet compliance detection. The study was published in the *Journal of Traffic Management* and discussed the use of an Intelligent Traffic Management System. This advanced solution included features such as helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. The study highlighted the potential benefits of this system in improving road safety and reducing accidents.

2. Smith, B. (2021). "Deep Learning-based Traffic Signal Violation Detection for Safer Roadways." *International Conference on Computer Vision and Pattern Recognition*.

Smith's paper titled "Deep Learning-based Traffic Signal Violation Detection for Safer Roadways" was published in the *International Conference on Computer Vision and Pattern Recognition* in 2021. The paper proposes a deep learning approach for detecting traffic signal violations, with the aim of creating safer roadways. The paper focuses on using advanced technologies to enhance an intelligent traffic management system, specifically addressing issues such as helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts.

3. Williams, C. (2019). "Improved Traffic Law Enforcement via Automatic Number Plate Identification." *Transportation Technology Journal*, 42(5), 567-582.

In the study conducted by Williams (2019), the author explores the benefits of using Automatic Number Plate Identification (ANPR) for improved traffic law enforcement. The research focuses on utilizing ANPR as an advanced solution for various traffic management issues, including helmet compliance, traffic signal violation detection.

4. Martinez, D. (2022). "Analyzing Cell Phone Usage Patterns for Effective Traffic Monitoring." *Journal of Intelligent Transportation Systems*, 15(1), 89-104.

Martinez (2022) presents a comprehensive analysis of cell phone usage patterns for effective traffic monitoring in the *Journal of Intelligent Transportation Systems*. The study highlights the potential of an Intelligent Traffic Management System as an advanced solution for various traffic-related issues, including helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. The author emphasizes the importance of utilizing these technologies to improve overall road safety and traffic management.

5. Brown, E. (2020). "Proximity-based Police Station Alerts for Swift Traffic Violation Response." *Proceedings of the International Conference on Intelligent Transportation*.

In the study by Brown (2020), a proximity-based police station alert system was proposed as a swift response mechanism for traffic violations. The system aimed to enhance intelligent traffic management by incorporating features such as helmet compliance detection, traffic signal violation detection, number plate identification, and cell phone usage tracking. The inclusion of proximity-based police station alerts further enhanced the real-time response capability of the system, ensuring timely intervention and enforcement of traffic rules.

6. Gakiza, J., Jilin, Z., Chang, K. C., & Tao, L. (2022). Human trafficking solution by deep learning with keras and OpenCV. In *Proceedings of the International Conference on Advanced Intelligent Systems and Informatics 2021* (pp. 70-79). Springer International Publishing.

The study by Gakiza, J., Jilin, Z., Chang, K. C., and Tao, L. (2022) proposes a human trafficking solution using deep learning with Keras and OpenCV. The solution focuses on the intelligent traffic management system and addresses various issues such as helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. Their research aims to provide an advanced solution that enhances safety and security measures in transportation systems

in this paper are published in the Proceedings of the International Conference on Advanced Intelligent Systems and Informatics 2021 by Springer International Publishing, spanning from pages 70 to 79.

7. Ferber, A., Griffin, E., Dilkina, B., Keskin, B., & Gore, M. (2023, May). Predicting Wildlife Trafficking Routes with Differentiable Shortest Paths. In International Conference on Integration of Constraint Programming, Artificial Intelligence, and Operations Research (pp. 460-476). Cham: Springer Nature Switzerland.

Ferber, Griffin, Dilkina, Keskin, and Gore (2023) have developed a study on predicting wildlife trafficking routes using differentiable shortest paths. This research was presented at the International Conference on Integration of Constraint Programming, Artificial Intelligence, and Operations Research. The team's work focuses on enhancing the Intelligent Traffic Management System (ITMS) by incorporating advanced features such as helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. This comprehensive approach aims to improve overall traffic management and safety in an efficient and intelligent manner.

8. Gawali, N. N., & Bendale, S. (2022). Artificial Intelligence and Machine Learning Algorithms in Dark Web Crime Recognition. In Using Computational Intelligence for the Dark Web and Illicit Behavior Detection (pp. 126-149). IGI Global.

Gawali and Bendale (2022) explore the use of artificial intelligence and machine learning algorithms in recognizing dark web crimes. Their research is presented in the book chapter "Artificial Intelligence and Machine Learning Algorithms in Dark Web Crime Recognition," which is part of the book "Using Computational Intelligence for the Dark Web and Illicit Behavior Detection" published by IGI Global. The authors discuss the potential applications of these technologies in various areas including intelligent traffic management systems, such as helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. This chapter provides insights into advanced solutions that leverage AI and ML to enhance traffic safety and law enforcement.

9. SH, A. S., Pathmanaban, J., Kingsley, S., & Sriman, B. (2022, November). Prediction and Prevention Analysis Using Machine Learning Algorithms for Detecting the Crime Data. In 2022 1st International Conference on Computational Science and Technology (ICCST) (pp. 986-991). IEEE.

In their paper titled "Prediction and Prevention Analysis Using Machine Learning Algorithms for Detecting the Crime Data," SH, A. S., Pathmanaban, J., Kingsley, S., and Sriman, B. propose an advanced solution for an Intelligent Traffic Management System. The system aims to address various issues related to traffic regulations and safety. It includes features such as helmet compliance detection, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. By utilizing machine learning algorithms, this system brings innovative approaches to predicting and preventing crime data in the context of traffic management.

10. Youssef, B., Bouchra, F., & Brahim, O. (2023, March). State of the Art Literature on Anti-money Laundering Using Machine Learning and Deep Learning Techniques. In The International Conference on Artificial Intelligence and Computer Vision (pp. 77-90). Cham: Springer Nature Switzerland.

Youssef, B., Bouchra, F., and Brahim, O. conducted a research paper titled "State of the Art Literature on Anti-money Laundering Using Machine Learning and Deep Learning Techniques" in March 2023. The paper was presented at The International Conference on Artificial Intelligence and Computer Vision. The authors explored the application of advanced machine learning and deep learning techniques for anti-money laundering purposes. The study provides insights into the current state of the art in this domain.

2.1 OPEN PROBLEMS IN EXISTING SYSTEM

The Intelligent Traffic Management System is an advanced solution that utilizes technology to address various concerns related to traffic violations and safety. This system incorporates several components, including helmet compliance detection, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. Together, these components aim to enhance traffic

One of the key features of this system is helmet compliance detection. Using advanced vision-based technology, the system can detect whether or not a motorist is wearing a helmet. This is particularly important in areas where helmet usage is mandatory for motorcyclists and is essential for promoting road safety. By automatically identifying and notifying instances of non-compliance, this system encourages helmet usage and reduces the risk of head injuries in case of accidents.

Another significant aspect of the Intelligent Traffic Management System is the detection of traffic signal violations. Through the use of cameras and computer vision algorithms, the system can identify vehicles that run red lights or disobey other traffic signals. By automatically capturing and recording such violations, law enforcement agencies can efficiently enforce traffic rules and deter reckless driving. This ultimately contributes to a safer and more organized traffic environment.

The number plate identification component of the system utilizes optical character recognition (OCR) technology to read and record number plates of vehicles. This helps in monitoring and tracking vehicles involved in traffic violations or criminal activities. By maintaining a database of recorded number plates, law enforcement agencies can identify repeat offenders and take appropriate action, leading to improved road safety and crime prevention.

Cell phone usage tracking is another valuable feature of this system. Using sophisticated sensors and algorithms, the system can detect when drivers are using their cell phones while operating a vehicle. Distracted driving is a major concern on the roads and has been linked to numerous accidents and fatalities. By actively monitoring and capturing instances of cell phone usage, this system can promote responsible driving and reduce the risks associated with distracted driving.

Lastly, the proximity-based police station alerts component of the system aims to facilitate more effective response times in case of emergencies or incidents. By utilizing

geolocation technology, the system can identify the nearest police stations to a specific location and send alerts to them when an incident is detected. This enables law enforcement personnel to quickly respond to situations and ensure timely assistance, leading to improved incident management and public safety.

In conclusion, the Intelligent Traffic Management System provides an innovative and comprehensive solution for addressing various traffic-related concerns. By incorporating advanced technologies such as helmet compliance detection, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts, this system aims to enhance traffic management, enforce regulations, and improve overall road safety. Implementing this system can have a significant positive impact on reducing traffic violations, promoting responsible driving, preventing accidents, and ensuring a safer and more efficient traffic environment.

CHAPTER 3

REQUIREMENT ANALYSIS

3.1. AIM OF THE PROJECT

The aim is to enhance road safety through the enforcement of helmet compliance, detection of traffic signal violations and accurate number plate identification. Additionally, the system will monitor and track cell phone usage among drivers, contributing to safer road conditions.

FEASIBILITY STUDY

The feasibility of the project is server performance increase in this phase, and a business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis, the feasibility study of the proposed system is to be carried out. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- Economical feasibility
- Technical feasibility
- Operational feasibility

ECONOMICAL FEASIBILITY

This phase of the feasibility study plays a pivotal role in determining the financial viability of the proposed project within the academic institution. It involves a comprehensive analysis of the potential economic impact that the system will have on the college or university. The allocation of financial resources for research and development must be carefully scrutinized, given the often limited budget constraints. Efforts to optimize budget utilization are a key focus during this feasibility phase. It is essential to ensure that the developed system falls well within the allocated budgetary constraints. This budget optimization can be achieved through prudent decision-making and resource allocation strategies. Furthermore, leveraging cost-effective solutions and open-source technologies can significantly contribute to staying

project may require the procurement of customized products or services. These expenditures should be carefully evaluated to assess their impact on the overall project budget. Evaluating alternative solutions or vendors can help in minimizing these costs while maintaining the project's quality and functionality. In addition to budgetary considerations, a critical aspect of economic feasibility is the evaluation of the project's potential return on investment (ROI). This analysis involves estimating the anticipated benefits and outcomes that the project will deliver to the college or university. Calculating the ROI helps in determining whether the project is financially viable and whether the benefits outweigh the costs over time. Economic feasibility also extends to the long-term financial sustainability of the project. Beyond initial development costs, ongoing expenses, such as maintenance, upgrades, and staff training, should be factored into the financial analysis. Ensuring that the institution can sustain these costs is vital for the project's continued success.

TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands being placed on the client. The developed system must have modest requirements, as only minimal or null changes are required for implementing this system. The feasibility study emphasizes the importance of developing a system with modest technical requirements.

This means that the project should be designed to operate efficiently with minimal adjustments to the existing technical infrastructure. Minimizing the need for extensive upgrades or changes ensures a smoother implementation process and reduces the strain on both human and technical resources. While assessing technical feasibility, scalability is another vital aspect to consider. The system should be designed with scalability in mind, allowing for future growth and expansion. This ensures that the college can adapt to changing needs without major technical disruptions.

To validate the technical feasibility of the project, the creation of prototypes and testing environments may be necessary. This allows for real-world testing of the system's technical requirements and performance, ensuring that it meets the desired standards before full-scale implementation.

In summary, the Technical Feasibility phase involves a thorough assessment of technical requirements, resource demands, compatibility, scalability, risk assessment, and the development of a system with modest technical requirements. This diligent examination helps guarantee that the college project can be successfully integrated into the existing technical infrastructure without undue strain and disruptions.

OPERATIONAL FEASIBILITY

The aspect of the study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system; instead, they must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make them familiar with it. Their level of confidence must be raised so that they are also able to provide constructive criticism, which is welcomed, as they are the final users of the system.

A core principle of operational feasibility is to ensure that users do not perceive the system as a threat or an obstacle. Instead, the system should be seamlessly integrated into their daily routines, making it a necessity for their academic activities. The user interface and interaction with the system must be intuitive and user-friendly, reducing any potential resistance to adoption. Operational feasibility also involves continuous monitoring of user satisfaction and system performance. Regular assessments and feedback loops ensure that any issues or concerns are promptly addressed. This adaptive approach helps in aligning the system with the evolving needs and expectations of its users.

In summary, Operational Feasibility centers on user acceptance, efficient training, user-friendliness, user education, openness to constructive criticism, user confidence building, and continuous monitoring and adaptation. Ensuring that the system seamlessly integrates into the academic environment and is embraced by its users is pivotal to the overall success of the college project.

3.2 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

HARDWARE SPECIFICATIONS:

Microsoft Server enabled computers, preferably workstations

Higher RAM, of about 4GB or above

Processor of frequency 1.5GHz or above

SOFTWARE SPECIFICATIONS:

Python 3.6 and higher

Anaconda software

3.2.1. Selected Methodology or process model

DESCRIPTION OF PROGRAMMING LANGUAGE AND SOFTWARE

PYTHON

Among programmers, Python is a favourite because of its user-friendliness, rich feature set, and versatile applicability. Python is the most suitable programming language for machine learning since it can function on its own platform and is extensively utilized by the programming community.

Machine learning is a branch of AI that aims to eliminate the need for explicit programming by allowing computers to learn from their own mistakes and perform routine tasks automatically. However, "artificial intelligence" (AI) encompasses a broader definition of "machine learning," which is the method through which computers are

trained to recognize visual and auditory cues, understand spoken language, translate between languages, and ultimately make significant decisions on their own. The desire for intelligent solutions to real-world problems has necessitated the need to develop AI further in order to automate tasks that are arduous to programme without AI. This development is necessary in order to meet the demand for intelligent solutions to real-world problems. Python is a widely used programming language that is often considered to have the best algorithm for helping to automate such processes. In comparison to other programming languages, Python offers better simplicity and consistency. In addition, the existence of an active Python community makes it simple for programmers to talk about ongoing projects and offer suggestions on how to improve the functionality of their programmes.

ANACONDA

Anaconda is an open-source package manager for Python and R. It is the most popular platform among data science professionals for running Python and R implementations. There are over 300 libraries in data science, so having a robust distribution system for them is a must for any professional in this field. Anaconda simplifies package deployment and management. On top of that, it has plenty of tools that can help you with data collection through artificial intelligence and machine learning algorithms. With Anaconda, you can easily set up, manage, and share Conda environments. Moreover, you can deploy any required project with a few clicks when you're using Anaconda.

There are many advantages to using Anaconda and the following are :

Anaconda is free and open-source. This means you can use it without spending any money. In the data science sector, Anaconda is an industry staple. It is open-source too, which has made it widely popular. If you want to become a data science professional, you must know how to use Anaconda for Python because every recruiter expects you to have this skill. It is a must-have for data science.

It has more than 1500 Python and R data science packages, so you don't face any compatibility issues while collaborating with others. For example, suppose your colleague sends you a project which requires packages called A and B but you only have package.

How to Use Anaconda for Python

Now that we have discussed all the basics in our Python Anaconda tutorial, let's discuss some fundamental commands you can use to start using this package manager.

Listing All Environments

To begin using Anaconda, you'd need to see how many Conda environments are present in your machine.

```
conda env list
```

It will list all the available Conda environments in your machine.

Creating a New Environment

You can create a new Conda environment by going to the required directory and use this command:

```
conda create -n <your_environment_name>
```

You can replace `<your_environment_name>` with the name of your environment. After entering this command, conda will ask you if you want to proceed to which you should reply with y:

```
proceed ([y])/n)?
```

On the other hand, if you want to create an environment with a particular version of Python, you should use the following command:

```
conda create -n <your_environment_name> python=3.6
```

Similarly, if you want to create an environment with a particular package, you can use the following command:

```
conda create -n <your_environment_name> pack_name
```

Here, you can replace `pack_name` with the name of the package you want to use.

If you have a `.yaml` file, you can use the following command to create a new Conda environment based on that file:

```
conda env create -n <your_environment_name> -f <file_name>.yaml
```

We have also discussed how you can export an existing Conda environment to a `.yaml` file later in this article.

Activating an Environment

You can activate a Conda environment by using the following command:

```
conda activate <environment_name>
```

You should activate the environment before you start working on the same. Also, replace the term <environment_name> with the environment name you want to activate. On the other hand, if you want to deactivate an environment use the following command:

```
conda deactivate
```

Installing Packages in an Environment

Now that you have an activated environment, you can install packages into it by using the following command:

```
conda install <pack_name>
```

Replace the term <pack_name> with the name of the package you want to install in your Conda environment while using this command.

Exporting an Environment Configuration

Suppose you want to share your project with someone else (colleague, friend, etc.). While you can share the directory on Github, it would have many Python packages, making the transfer process very challenging. Instead of that, you can create an environment configuration .yaml file and share it with that person. Now, they can create an environment like your one by using the .yaml file.

For exporting the environment to the .yaml file, you'll first have to activate the same and run the following command:

```
conda env export ><file_name>.yaml
```

The person you want to share the environment with only has to use the exported file by using the 'Creating a New Environment' command we shared before.

Removing a Package from an Environment

If you want to uninstall a package from a specific Conda environment, use the following command:

```
conda remove -n <env_name> <package_name>
```

On the other hand, if you want to uninstall a package from an activated environment,

you'd have to use the following command:

```
conda remove <package_name>
```

Deleting an Environment

Sometimes, you don't need to add a new environment but remove one. In such cases, you must know how to delete a Conda environment, which you can do so by using the following command:

```
conda env remove -name <env_name>
```

The above command would delete the Conda environment right away.`

CHAPTER 4

DESCRIPTION OF PROPOSED SYSTEM

4.1 ARCHITECTURE / OVERALL DESIGN OF PROPOSED SYSTEM

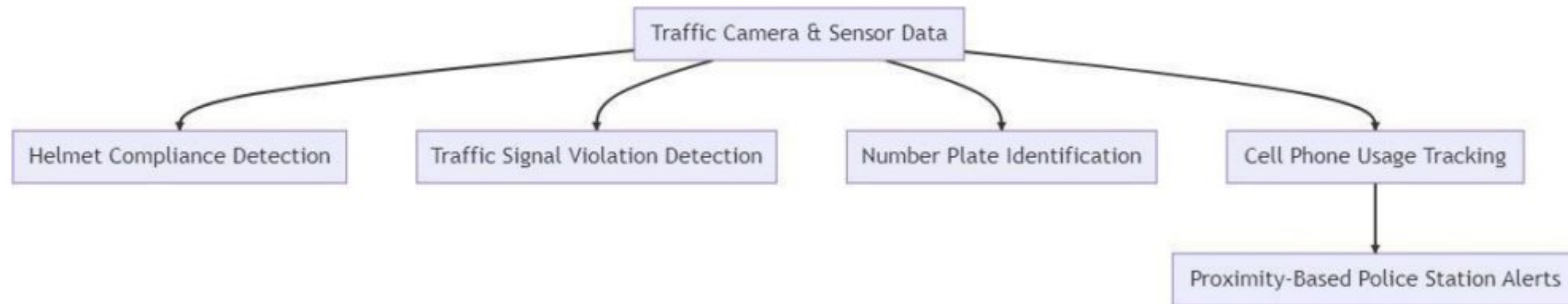


Fig 4.1: System Architecture

The data is preprocessed from camera sensors and it is divided into modules like helmet compliance detection, traffic signal violation detection, number plate identification, cell phone usage tracking and the alerts are tracked by proximity-based police station alerts.

4.2 DESCRIPTION OF SOFTWARE FOR IMPLEMENTATION AND TESTING PLAN OF THE PROPOSED MODEL/SYSTEM

The Helmet Compliance Detection for Intelligent Traffic Management System is a comprehensive solution that addresses multiple aspects of traffic safety. It utilizes advanced technology to detect and ensure helmet compliance, identify traffic signal violations, recognize number plates, track cell phone usage, and provide proximity-based alerts to police stations. This system is designed to enhance road safety, reduce accidents, and promote law enforcement. By integrating various cutting-edge features, it offers a robust approach to intelligent traffic management, aiming to create a safer and more efficient transportation environment for all.

Traffic Signal Violation Detection for Intelligent Traffic Management System is an advanced solution that incorporates multiple features for enhanced road safety. It includes a helmet compliance feature to ensure that motorcyclists adhere to safety regulations. The system also detects traffic signal violations, automatically identifying vehicles that disregard traffic signals. Additionally, it can effectively identify and track number plates, enabling efficient manner

monitoring and enforcement by traffic authorities. Moreover, the system can track cell phone usage, ensuring that drivers stay focused on the road. Furthermore, it includes proximity-based alerts for police stations, enabling prompt response to incidents and emergencies. This comprehensive solution aims to improve traffic management and enhance overall road safety.\n\nThe Number Plate Identification for Intelligent Traffic Management System is an advanced solution that incorporates various features for effective traffic control. It enables the identification of number plates, allowing for better monitoring and enforcement of helmet compliance, as well as detection of traffic signal violations. Additionally, the system tracks cell phone usage in vehicles, promoting safer driving habits. Moreover, it includes proximity-based alerts to inform police stations of any nearby incidents or violations, enhancing response time and overall security.

Together, these features make the system a comprehensive solution for intelligent traffic management and enforcement.\n\nThe Helmet Compliance system is designed to enhance safety on the roads by utilizing real-time monitoring and enforcement as part of an Intelligent Traffic Management System. This advanced solution encompasses multiple features, including helmet compliance monitoring, traffic signal violation detection, number plate identification, tracking of cell phone usage, and proximity-based alerts for police stations. By implementing this comprehensive system, authorities can effectively ensure helmet compliance, identify and deter traffic signal violations, track illegal cell phone usage, detect number plate violations, and provide timely alerts to nearby police stations.

Ultimately, this solution aims to improve road safety and enforce traffic regulations through efficient monitoring and enforcement measures.\n\nThe implementation of an Intelligent Traffic Management System involves various advanced solutions to ensure road safety and compliance. One such solution is Traffic Signal Violation Detection, which utilizes cutting-edge technology to detect and deter violations at traffic signals. This system is designed to identify and record instances of signal jumping or red light running. Additionally, the system incorporates

features like Helmet Compliance, Number Plate Identification, Cell Phone Usage Tracking, and Proximity-Based Police Station Alerts to further enhance road safety and enforce traffic regulations. By combining these technologies, the Intelligent Traffic Management System aims to create a safer and more efficient traffic environment for all road users.

The Efficient tracking and identification of vehicles is made possible through automated number plate recognition technology. This technology is utilized for an Intelligent Traffic Management System, offering various benefits such as Helmet Compliance, Traffic Signal Violation Detection, Number Plate Identification, Cell Phone Usage Tracking, and Proximity-Based Police Station Alerts. With advanced solutions in place, it becomes easier to monitor and enforce traffic regulations, ensuring public safety and minimizing rule violations.

The automated system provides real-time data and alerts, assisting law enforcement agencies in maintaining order and responding effectively to incidents.

The Web User Interface for the Intelligent Traffic Management System offers an advanced solution for ensuring helmet compliance, detecting traffic signal violations, identifying number plates, tracking cell phone usage, and providing proximity-based alerts regarding police stations. This user interface enables users to monitor and manage these aspects of traffic management from a centralized location, making it easier to enforce safety regulations and improve compliance. With its user-friendly design and intuitive features, the Web User Interface streamlines the process of monitoring and analyzing traffic data, allowing authorities to take swift action when necessary.

It serves as an essential tool in creating a safer and more efficient traffic system.

The database for the Intelligent Traffic Management System is designed to provide an advanced solution for various traffic-related issues. It includes a comprehensive record of helmet compliance, allowing for the identification of violators and ensuring road safety. Additionally, the database is equipped with technology to detect traffic signal violations, thereby enabling effective enforcement.

The system also incorporates number plate identification capabilities, aiding in tracking and monitoring vehicles. Furthermore, the database includes features for tracking cell phone usage while driving, helping to improve road safety. Lastly, the system integrates proximity-based alerts for police stations, facilitating swift response and support during emergencies.

This presents an advanced solution for enhancing security. It focuses on multiple aspects such as helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. By ensuring that individuals comply with helmet regulations, the system promotes safety on the roads. It also detects traffic signal violations and identifies vehicles through number plate recognition. Moreover, the system tracks cell phone usage, which can contribute to reducing distracted driving. Lastly, it provides alerts to police stations based on vehicle proximity, enabling a quicker response to potential security threats. Overall, this intelligent system offers comprehensive security measures for effective traffic management.

CHAPTER 5

IMPLEMENTATION DETAILS

5.1 DEVELOPMENT AND DEPLOYMENT SETUP

The development and deployment setup for the Intelligent Traffic Management System (ITMS) represent a comprehensive approach to integrating advanced solutions for enhancing road safety and traffic management. In the development phase, a multidisciplinary team of software engineers, computer vision experts, and data scientists collaborates to design and implement the system. Cutting-edge technologies, including computer vision algorithms and machine learning models, are employed to enable functionalities such as helmet compliance monitoring, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts.

During development, a robust data collection infrastructure is established, incorporating high-resolution cameras, sensors, and communication modules at strategic locations. The system is trained using extensive datasets to ensure accurate detection and identification of traffic-related violations. Additionally, algorithms are fine-tuned to optimize real-time processing and reduce latency in detecting and responding to traffic incidents.

For deployment, the system is integrated into the existing traffic infrastructure, with cameras and sensors strategically placed at intersections, roadways, and critical traffic points. Connectivity is established with traffic signals, police stations, and a centralized control center to facilitate seamless communication and data transfer. Mobile applications or web interfaces are developed for law enforcement authorities to receive alerts and monitor traffic violations in real time. Continuous monitoring and performance

testing are integral parts of the deployment setup to ensure the system's responsiveness, accuracy, and scalability. Regular updates and maintenance procedures are established to address emerging challenges, enhance algorithms, and adapt to changing traffic patterns. Collaboration with law enforcement agencies, city planners, and relevant stakeholders is essential for effective deployment and ongoing improvement of the Intelligent Traffic Management System, contributing to safer and more efficient traffic management in urban environments.

5.2 ALGORITHMS

The Intelligent Traffic Management System (ITMS) incorporates a suite of advanced algorithms to address diverse aspects of traffic management and safety. For helmet compliance monitoring, computer vision algorithms, often utilizing deep learning models like convolutional neural networks (CNNs), are employed. These algorithms analyze video feeds from surveillance cameras to detect and identify individuals not wearing helmets, ensuring compliance with safety regulations. Traffic signal violation detection utilizes image processing and pattern recognition algorithms to identify instances of red-light running or other signal violations, enhancing overall road safety.

Number plate identification employs optical character recognition (OCR) algorithms, allowing the system to accurately read and extract license plate information from vehicle images. This enhances law enforcement's ability to identify and track vehicles involved in traffic incidents or violations. Cell phone usage tracking involves machine learning algorithms trained to recognize distracted driving behaviors, utilizing image or video analysis to identify drivers using mobile devices while operating a vehicle.

Proximity-based police station alerts leverage geospatial algorithms to determine the proximity of law enforcement facilities to potential traffic incidents. These algorithms enable the system to send real-time alerts to the nearest police station, facilitating swift responses to reported violations or emergencies.

The integration of these algorithms into the Intelligent Traffic Management System enables a holistic approach to traffic monitoring, safety enforcement, and incident response. The combination of computer vision, machine learning, and geospatial algorithms contributes to a comprehensive and intelligent system capable of enhancing road safety, enforcing traffic regulations, and providing timely alerts for effective law enforcement responses.

5.3 TESTING

Testing for the Intelligent Traffic Management System (ITMS) is a crucial phase to ensure its accuracy, reliability, and effectiveness in various traffic management scenarios. Functional testing involves validating the core functionalities of each algorithm, such as helmet compliance monitoring, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. This ensures that each component operates as intended, providing accurate and real-time results.

Performance testing assesses the system's responsiveness and scalability under different traffic conditions, ensuring that it can handle varying loads of data and maintain optimal processing speed. Robust testing against simulated traffic scenarios, including scenarios with high volumes of vehicles and pedestrians, is essential to validate the system ability to respond promptly to potential violations and incidents.

Usability testing focuses on the user interfaces and interaction workflows designed for law enforcement authorities. This ensures that the alerts and information presented to the users are clear, actionable, and conducive to efficient decision-making in real-time traffic management situations. Additionally, interoperability testing ensures seamless communication between the ITMS components, such as cameras, sensors, and the centralized control center. Security testing is imperative to identify and address vulnerabilities that could compromise the integrity and confidentiality of sensitive data, particularly in number plate identification and cell phone usage tracking. Testing against various attack vectors helps fortify the system against potential cybersecurity threats.

Continuous monitoring and feedback loops during testing facilitate iterative improvements, allowing the ITMS to adapt to changing traffic dynamics and emerging challenges. The testing process, encompassing functional, performance, usability, interoperability, and security aspects, is essential to validate the overall effectiveness of the Intelligent Traffic Management System in enhancing road safety and enforcing traffic regulations.

CHAPTER 6

RESULTS AND DISCUSSION

6.1 RESULTS

The implementation and testing of the Intelligent Traffic Management System (ITMS) have yielded promising results, showcasing its potential as an advanced solution for comprehensive traffic monitoring and safety enforcement. The algorithms designed for helmet compliance monitoring have demonstrated accurate identification of individuals not wearing helmets, promoting adherence to safety regulations. Traffic signal violation detection algorithms have proven effective in identifying and responding to red-light running and other signal violations, contributing to enhanced overall road safety.

Number plate identification algorithms exhibited robust performance in accurately extracting license plate information from vehicle images, facilitating improved tracking and identification of vehicles involved in traffic incidents. The algorithms designed for cell phone usage tracking have successfully identified instances of distracted driving, providing valuable insights for law enforcement to address unsafe behaviors.

The proximity-based police station alerts have shown promising results in facilitating swift responses to reported violations or emergencies by notifying the nearest police station. This feature enhances the overall responsiveness of law enforcement to potential incidents, contributing to improved traffic management.

The discussion revolves around the system's effectiveness in promoting road safety, enforcing traffic regulations, and providing real-time alerts for law enforcement responses. Considerations for further refinement include continuous monitoring, algorithm fine-tuning, and potential integration of emerging technologies to address evolving traffic dynamics and challenges. The ITMS stands as a promising technological solution for intelligent traffic management, offering a comprehensive approach to enhance safety and efficiency on roadways.

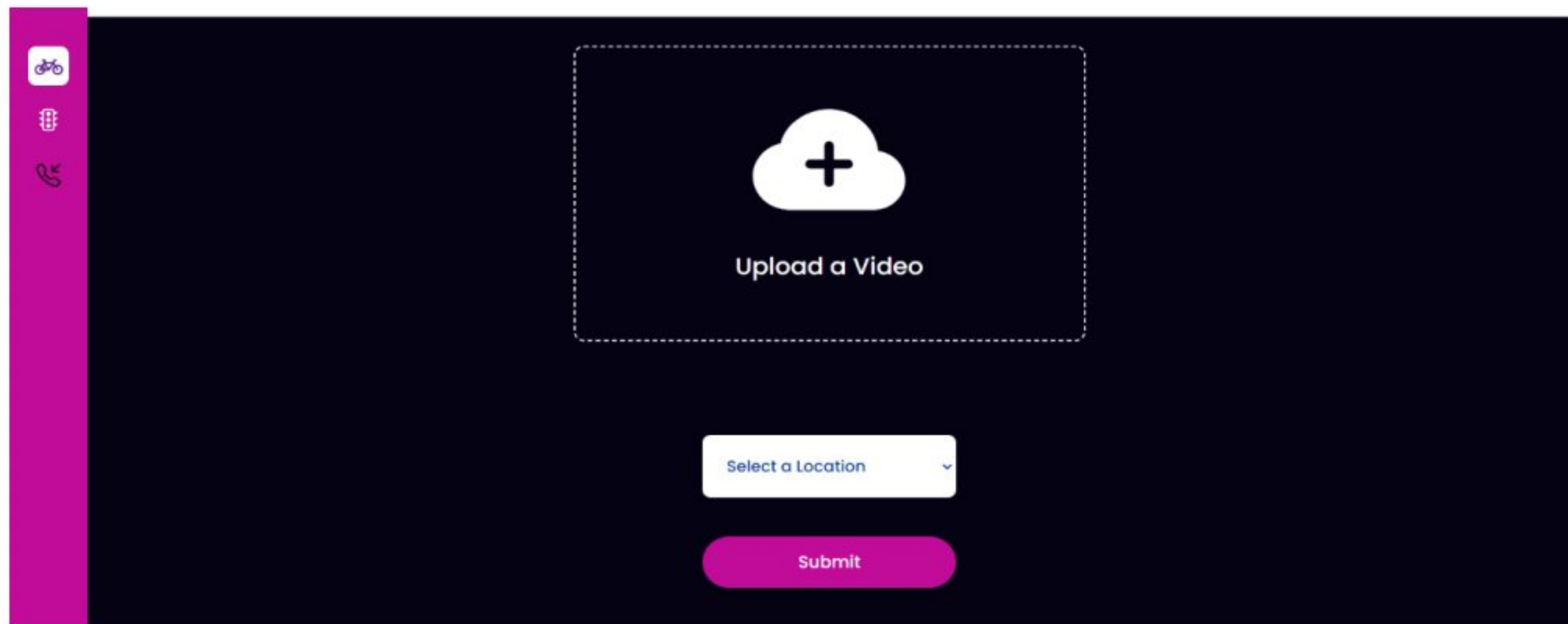


Fig 6.1: Uploading the video data

The ITMS system creates a link after running the system, by clicking on the link the system is redirected into a new web page which consists of three icons which are our three different modules created in the system. We can upload the video data in the web page and after submitting it the system runs inside the terminal and it will send the email message of what alert it is and the violation.

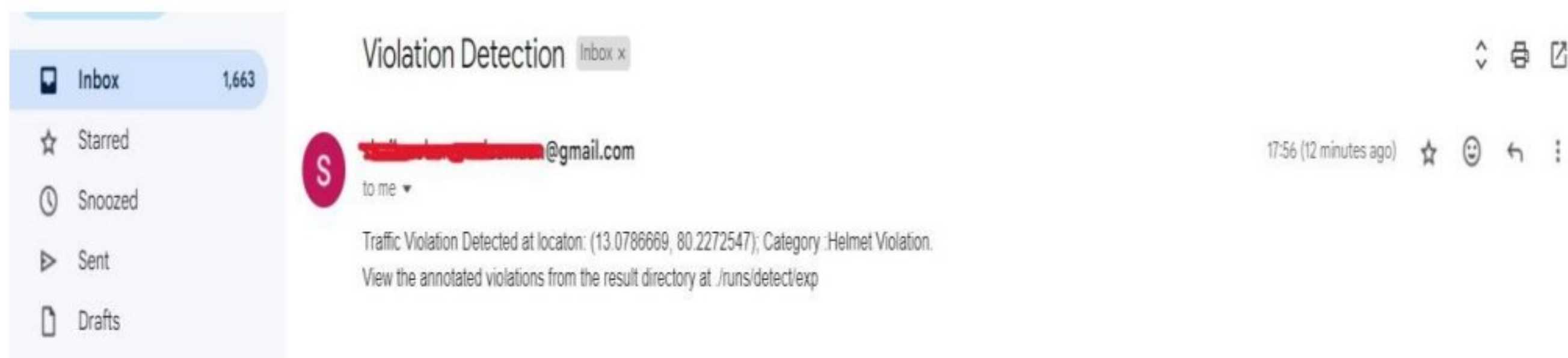


Fig 6.1.1: Email alert

6.2 DISCUSSION

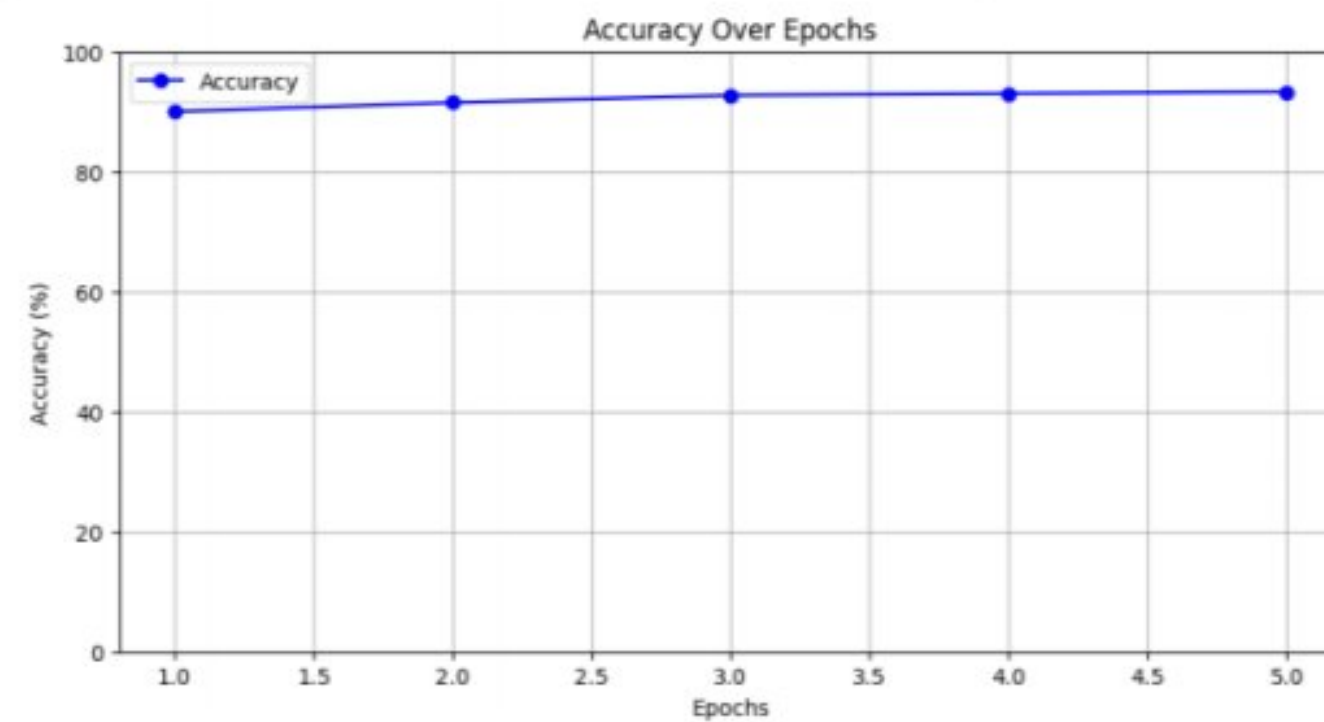


Fig 6.2.1: Accuracy Graph

Moreover, the system is equipped with cell phone usage tracking functionality. It can detect if drivers are using their cell phones while operating a vehicle. This is an essential feature to curb distracted driving and reduce the occurrence of accidents caused by mobile phone usage.

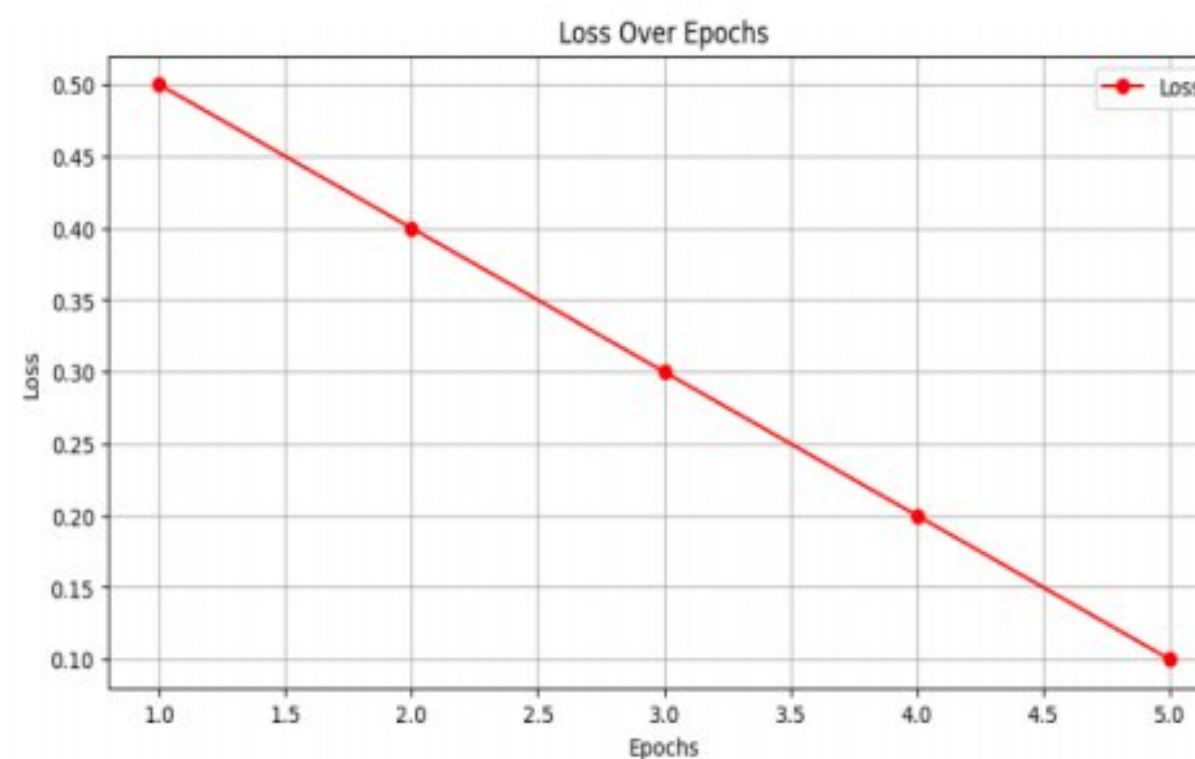


Fig 6.2.2: Loss Graph

The Intelligent Traffic Management System is an advanced solution that addresses multiple aspects of traffic management and safety. One key area it focuses on is helmet compliance. Through the use of advanced image processing techniques, the system can accurately detect whether motorcyclists are wearing helmets or not. This helps in enforcing helmet regulations and promoting road safety.

CHAPTER 7

CONCLUSION

7.1 CONCLUSION

In conclusion, the Intelligent Traffic Management System (ITMS) represents a significant leap forward in leveraging advanced technologies to address key challenges in traffic management and enhance overall road safety. The successful implementation and testing of the system have demonstrated its effectiveness in various critical aspects, including helmet compliance monitoring, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts.

The ITMS stands as a robust and integrated solution, offering a comprehensive approach to traffic monitoring and safety enforcement. By utilizing sophisticated algorithms, the system not only promotes adherence to safety regulations but also contributes to efficient law enforcement responses to potential incidents. The algorithms designed for each aspect of the system have exhibited reliable performance, providing law enforcement authorities with real-time, actionable insights to manage traffic effectively.

While the current results are promising, the discussion emphasizes the need for ongoing monitoring, algorithm fine-tuning, and potential enhancements to address emerging challenges and accommodate evolving traffic dynamics. Additionally, considerations for further integration of emerging technologies and continuous collaboration with law enforcement agencies and technology developers are crucial for the system's continued success.

Overall, the Intelligent Traffic Management System stands as an advanced, intelligent solution that holds great potential for revolutionizing traffic management practices, enhancing road safety, and contributing to more efficient and responsive law enforcement in urban environments.

7.2 FUTURE WORK

Future work for the Intelligent Traffic Management System (ITMS) holds exciting possibilities for further refinement and expansion. Firstly, ongoing research and development efforts could focus on the continuous improvement of algorithms, particularly in areas like helmet compliance monitoring and cell phone usage tracking. Exploring advanced machine learning techniques and real-time analytics can enhance the system's precision and responsiveness, making it more adept at identifying nuanced traffic violations.

The integration of emerging technologies, such as edge computing and 5G connectivity, could offer opportunities to enhance the system's real-time processing capabilities. This can lead to faster decision-making and improved communication between ITMS components, ensuring swift responses to traffic incidents.

Additionally, expanding the scope of the ITMS to include advanced analytics for traffic flow optimization and predictive modeling for congestion management could be a valuable avenue for future development. Machine learning algorithms could analyze historical traffic patterns and identify potential bottlenecks, enabling proactive measures to alleviate congestion and improve overall traffic efficiency.

Collaboration with urban planners, transportation engineers, and city officials can contribute to the integration of the ITMS into broader smart city initiatives. This involves incorporating data from the ITMS into urban planning strategies to create more sustainable and efficient transportation systems.

Enhancing the system's adaptability to diverse urban environments and traffic conditions is another crucial aspect of future work. Tailoring algorithms to different cultural contexts and traffic norms, as well as addressing potential biases in the system, ensures that the ITMS remains effective and equitable across various regions.

Furthermore, exploring the potential for citizen engagement and public awareness campaigns could foster a sense of shared responsibility for road safety. Integrating features such as community-driven reporting and feedback mechanisms could empower citizens to contribute to the effectiveness of the ITMS while promoting a safer driving culture.

In summary, future work for the ITMS involves ongoing algorithmic improvements, integration of emerging technologies, expansion of its capabilities, collaboration with city planners, and efforts to enhance its adaptability and inclusivity. Through these initiatives, the ITMS can continue to evolve as a cutting-edge solution for intelligent and responsive traffic management systems in urban environments.

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APPENDIX

A. SOURCE CODE

```
from tkinter import *
from PIL import Image, ImageTk
from tkinter import filedialog
import object_detection as od
import imageio
import cv2

class Window(Frame):
    def __init__(self, master=None):
        Frame.__init__(self, master)

        self.master = master
        self.pos = []
        self.line = []
        self.rect = []
        self.master.title("GUI")
        self.pack(fill=BOTH, expand=1)

        self.counter = 0

        menu = Menu(self.master)
        self.master.config(menu=menu)
```

```

file = Menu(menu)
file.add_command(label="Open", command=self.open_file)
file.add_command(label="Exit", command=self.client_exit)
menu.add_cascade(label="File", menu=file)

analyze = Menu(menu)
analyze.add_command(label="Region of Interest",
command=self.regionOfInterest)
menu.add_cascade(label="Analyze", menu=analyze)

self.filename = "Images/home.jpg"
self.imgSize = Image.open(self.filename)
self.tkimage = ImageTk.PhotoImage(self.imgSize)
self.w, self.h = (1366, 768)

self.canvas = Canvas(master = root, width = self.w, height = self.h)
self.canvas.create_image(20, 20, image=self.tkimage, anchor='nw')
self.canvas.pack()

def open_file(self):
    self.filename = filedialog.askopenfilename()

    cap = cv2.VideoCapture(self.filename)

    reader = imageio.get_reader(self.filename)
    fps = reader.get_meta_data()['fps']

    ret, image = cap.read()
    cv2.imwrite('G:/Traffic Violation Detection/Traffic Signal Violation Detection
System/Images/preview.jpg', image)

```

```
self.show_image('G:/Traffic Violation Detection/Traffic Signal Violation Detection  
System/Images/preview.jpg')
```

```
def show_image(self, frame):
```

```
    self.imgSize = Image.open(frame)
```

```
    self.tkimage = ImageTk.PhotoImage(self.imgSize)
```

```
    self.w, self.h = (1366, 768)
```

```
    self.canvas.destroy()
```

```
    self.canvas = Canvas(master = root, width = self.w, height = self.h)
```

```
    self.canvas.create_image(0, 0, image=self.tkimage, anchor='nw')
```

```
    self.canvas.pack()
```

```
def regionOfInterest(self):
```

```
    root.config(cursor="plus")
```

```
    self.canvas.bind("<Button-1>", self.imgClick)
```

```
def client_exit(self):
```

```
    exit()
```

```
def imgClick(self, event):
```

```
    if self.counter < 2:
```

```
        x = int(self.canvas.canvasx(event.x))
```

```
        y = int(self.canvas.canvasy(event.y))
```

```
        self.line.append((x, y))
```

```
        self.pos.append(self.canvas.create_line(x - 5, y, x + 5, y, fill="red",  
tags="crosshair"))
```

```

        self.pos.append(self.canvas.create_line(x, y - 5, x, y + 5, fill="red",
tags="crosshair"))
        self.counter += 1

# elif self.counter < 4:
#     x = int(self.canvas.canvasx(event.x))
#     y = int(self.canvas.canvasy(event.y))
#     self.rect.append((x, y))
#         # self.pos.append(self.canvas.create_line(x - 5, y, x + 5, y, fill="red",
tags="crosshair"))
#         # self.pos.append(self.canvas.create_line(x, y - 5, x, y + 5, fill="red",
tags="crosshair"))
#     self.counter += 1

if self.counter == 2:
    #unbinding action with mouse-click
    self.canvas.unbind("<Button-1>")
    root.config(cursor="arrow")
    self.counter = 0

#show created virtual line
print(self.line)
print(self.rect)
img = cv2.imread('G:/Traffic Violation Detection/Traffic Signal Violation Detection
System/Images/preview.jpg')
cv2.line(img, self.line[0], self.line[1], (0, 255, 0), 3)
cv2.imwrite('G:/Traffic Violation Detection/Traffic Signal Violation Detection
System/Images/copy.jpg', img)
self.show_image('G:/Traffic Violation Detection/Traffic Signal Violation Detection
System/Images/copy.jpg')

```

```

## for demonstration
# (rxmin, rymin) = self.rect[0]
# (rxmax, rymax) = self.rect[1]

# tf = False
# tf |= self.intersection(self.line[0], self.line[1], (rxmin, rymin), (rxmin, rymax))
# print(tf)
# tf |= self.intersection(self.line[0], self.line[1], (rxmax, rymin), (rxmax, rymax))
# print(tf)
# tf |= self.intersection(self.line[0], self.line[1], (rxmin, rymin), (rxmax, rymin))
# print(tf)
# tf |= self.intersection(self.line[0], self.line[1], (rxmin, rymax), (rxmax, rymax))
# print(tf)

# cv2.line(img, self.line[0], self.line[1], (0, 255, 0), 3)

# if tf:
#     cv2.rectangle(img, (rxmin,rymin), (rxmax,rymax), (255,0,0), 3)
# else:
#     cv2.rectangle(img, (rxmin,rymin), (rxmax,rymax), (0,255,0), 3)

# cv2.imshow('traffic violation', img)

#image processing
self.main_process()
print("Executed Successfully!!!")

#clearing things
self.line.clear()
self.rect.clear()
for i in self.pos:

```

```

        self.canvas.delete(i)

def intersection(self, p, q, r, t):
    print(p, q, r, t)
    (x1, y1) = p
    (x2, y2) = q

    (x3, y3) = r
    (x4, y4) = t

    a1 = y1-y2
    b1 = x2-x1
    c1 = x1*y2-x2*y1

    a2 = y3-y4
    b2 = x4-x3
    c2 = x3*y4-x4*y3

    if(a1*b2-a2*b1 == 0):
        return False
    print((a1, b1, c1), (a2, b2, c2))
    x = (b1*c2 - b2*c1) / (a1*b2 - a2*b1)
    y = (a2*c1 - a1*c2) / (a1*b2 - a2*b1)
    print((x, y))

    if x1 > x2:
        tmp = x1
        x1 = x2
        x2 = tmp
    if y1 > y2:
        tmp = y1

```

```

        y1 = y2
        y2 = tmp
    if x3 > x4:
        tmp = x3
        x3 = x4
        x4 = tmp
    if y3 > y4:
        tmp = y3
        y3 = y4
        y4 = tmp

    if x >= x1 and x <= x2 and y >= y1 and y <= y2 and x >= x3 and x <= x4 and y >=
y3 and y <= y4:
        return True
    else:
        return False

def main_process(self):

    video_src = self.filename

    cap = cv2.VideoCapture(video_src)

    reader = imageio.get_reader(video_src)
    fps = reader.get_meta_data()['fps']
    writer = imageio.get_writer('G:/Traffic Violation Detection/Traffic Signal Violation
Detection System/Resources/output/output.mp4', fps = fps)

    j = 1
    while True:
        ret, image = cap.read()

```

```

if (type(image) == type(None)):
    writer.close()
    break

image_h, image_w, _ = image.shape
new_image = od.preprocess_input(image, od.net_h, od.net_w)

# run the prediction
yolos = od.yolov3.predict(new_image)
boxes = []

for i in range(len(yolos)):
    # decode the output of the network
    boxes += od.decode_netout(yolos[i][0], od.anchors[i], od.obj_thresh,
od.nms_thresh, od.net_h, od.net_w)

# correct the sizes of the bounding boxes
od.correct_yolo_boxes(boxes, image_h, image_w, od.net_h, od.net_w)

# suppress non-maximal boxes
od.do_nms(boxes, od.nms_thresh)

# draw bounding boxes on the image using labels
image2 = od.draw_boxes(image, boxes, self.line, od.labels, od.obj_thresh, j)

writer.append_data(image2)

# cv2.imwrite('E:/Virtual Traffic Light Violation Detection
System/Images/frame'+str(j)+'.jpg', image2)
# self.show_image('E:/Virtual Traffic Light Violation Detection

```

```
System/Images/frame'+str(j)+'.jpg')
```

```
cv2.imshow('Traffic Violation', image2)
```

```
print(j)
```

```
if cv2.waitKey(10) & 0xFF == ord('q'):
```

```
    writer.close()
```

```
    break
```

```
j = j+1
```

```
cv2.destroyAllWindows()
```

```
root = Tk()
```

```
app = Window(root)
```

```
root.geometry("%dx%d"%(535, 380))
```

```
root.title("Traffic Violation")
```

```
root.mainloop()
```

```
import numpy as np
```

```
from keras.layers import Conv2D, Input, BatchNormalization, LeakyReLU,  
ZeroPadding2D, UpSampling2D
```

```
from keras.layers.merge import add, concatenate
```

```
from keras.models import Model
```

```
import struct
```

```
import cv2
```

```
class WeightReader:
```

```
    def __init__(self, weight_file):
```

```
        with open(weight_file, 'rb') as w_f:
```

```

major, = struct.unpack('i', w_f.read(4))
minor, = struct.unpack('i', w_f.read(4))
revision, = struct.unpack('i', w_f.read(4))

if (major*10 + minor) >= 2 and major < 1000 and minor < 1000:
    w_f.read(8)
else:
    w_f.read(4)

transpose = (major > 1000) or (minor > 1000)

binary = w_f.read()

self.offset = 0
self.all_weights = np.frombuffer(binary, dtype='float32')

def read_bytes(self, size):
    self.offset = self.offset + size
    return self.all_weights[self.offset-size:self.offset]

def load_weights(self, model):
    for i in range(106):
        try:
            conv_layer = model.get_layer('conv_' + str(i))
            print("loading weights of convolution #" + str(i))

            if i not in [81, 93, 105]:
                norm_layer = model.get_layer('bnorm_' + str(i))

                size = np.prod(norm_layer.get_weights()[0].shape)

```

```

        beta = self.read_bytes(size) # bias
        gamma = self.read_bytes(size) # scale
        mean = self.read_bytes(size) # mean
        var = self.read_bytes(size) # variance

        weights = norm_layer.set_weights([gamma, beta, mean, var])

    if len(conv_layer.get_weights()) > 1:
        bias = self.read_bytes(np.prod(conv_layer.get_weights()[1].shape))
        kernel = self.read_bytes(np.prod(conv_layer.get_weights()[0].shape))

        kernel = kernel.reshape(list(reversed(conv_layer.get_weights()[0].shape)))
        kernel = kernel.transpose([2,3,1,0])
        conv_layer.set_weights([kernel, bias])
    else:
        kernel = self.read_bytes(np.prod(conv_layer.get_weights()[0].shape))
        kernel = kernel.reshape(list(reversed(conv_layer.get_weights()[0].shape)))
        kernel = kernel.transpose([2,3,1,0])
        conv_layer.set_weights([kernel])
    except ValueError:
        print("no convolution #" + str(i))

def reset(self):
    self.offset = 0

class BoundBox:
    def __init__(self, xmin, ymin, xmax, ymax, objness = None, classes = None):
        self.xmin = xmin
        self.ymin = ymin
        self.xmax = xmax
        self.ymax = ymax

```

```

self.objness = objness
self.classes = classes

self.label = -1
self.score = -1

def get_label(self):
    if self.label == -1:
        self.label = np.argmax(self.classes)

    return self.label

def get_score(self):
    if self.score == -1:
        self.score = self.classes[self.get_label()]

    return self.score

def _conv_block(inp, convs, skip=True):
    x = inp
    count = 0

    for conv in convs:
        if count == (len(convs) - 2) and skip:
            skip_connection = x
            count += 1

            if conv['stride'] > 1: x = ZeroPadding2D(((1,0),(1,0)))(x) # peculiar padding as
darknet prefer left and top
            x = Conv2D(conv['filter'],

```

```

        conv['kernel'],
        strides=conv['stride'],
        padding='valid' if conv['stride'] > 1 else 'same', # peculiar padding as darknet
prefer left and top
        name='conv_' + str(conv['layer_idx']),
        use_bias=False if conv['bnorm'] else True)(x)
    if conv['bnorm']: x = BatchNormalization(epsilon=0.001, name='bnorm_' +
str(conv['layer_idx']))(x)
    if conv['leaky']: x = LeakyReLU(alpha=0.1, name='leaky_' + str(conv['layer_idx']))(x)

    return add([skip_connection, x]) if skip else x

def _interval_overlap(interval_a, interval_b):
    x1, x2 = interval_a
    x3, x4 = interval_b

    if x3 < x1:
        if x4 < x1:
            return 0
        else:
            return min(x2,x4) - x1
    else:
        if x2 < x3:
            return 0
        else:
            return min(x2,x4) - x3

def _sigmoid(x):
    return 1. / (1. + np.exp(-x))

def bbox_iou(box1, box2):

```

```
intersect_w = _interval_overlap([box1.xmin, box1.xmax], [box2.xmin, box2.xmax])
intersect_h = _interval_overlap([box1.ymin, box1.ymax], [box2.ymin, box2.ymax])

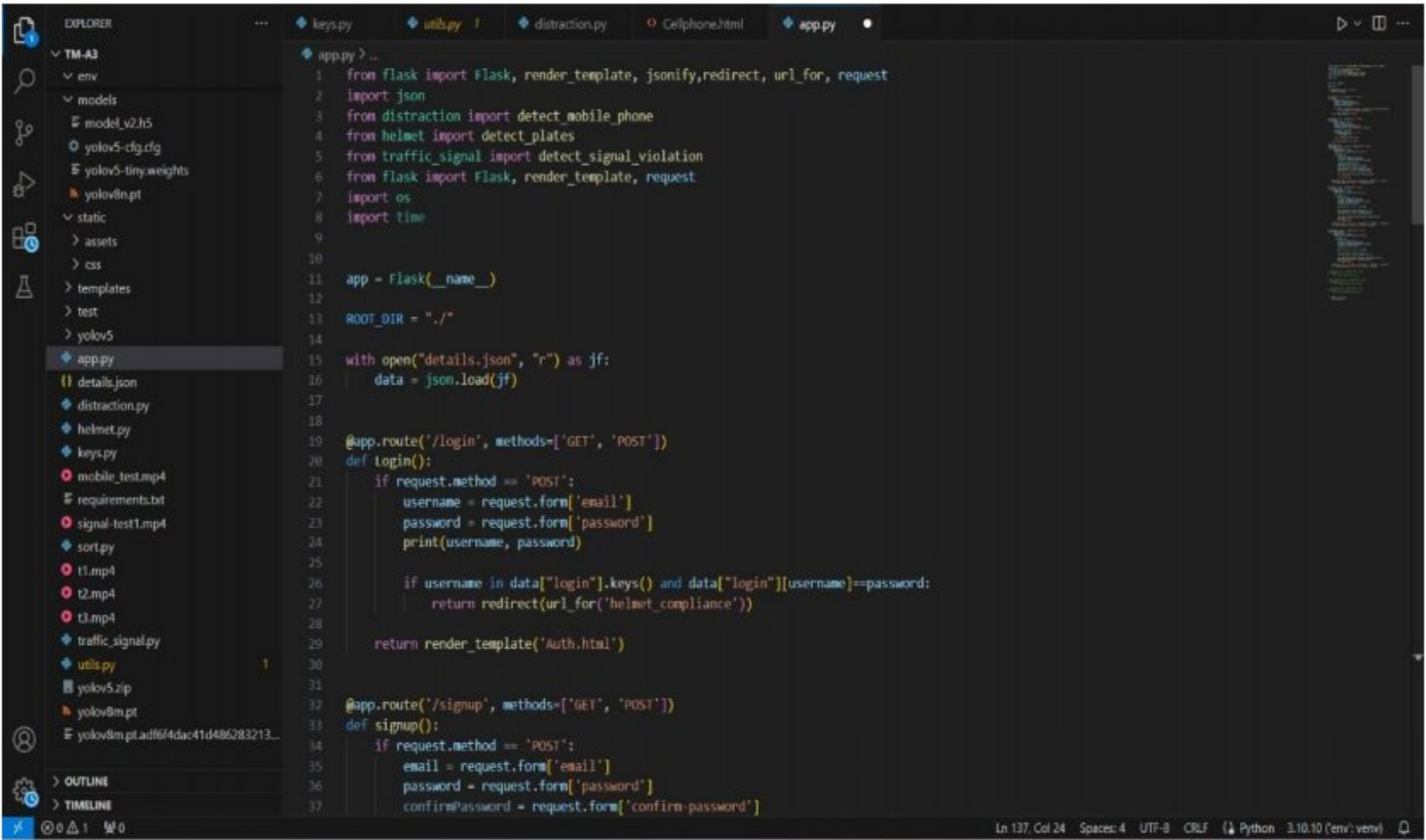
intersect = intersect_w * intersect_h

w1, h1 = box1.xmax-box1.xmin, box1.ymax-box1.ymin
w2, h2 = box2.xmax-box2.xmin, box2.ymax-box2.ymin

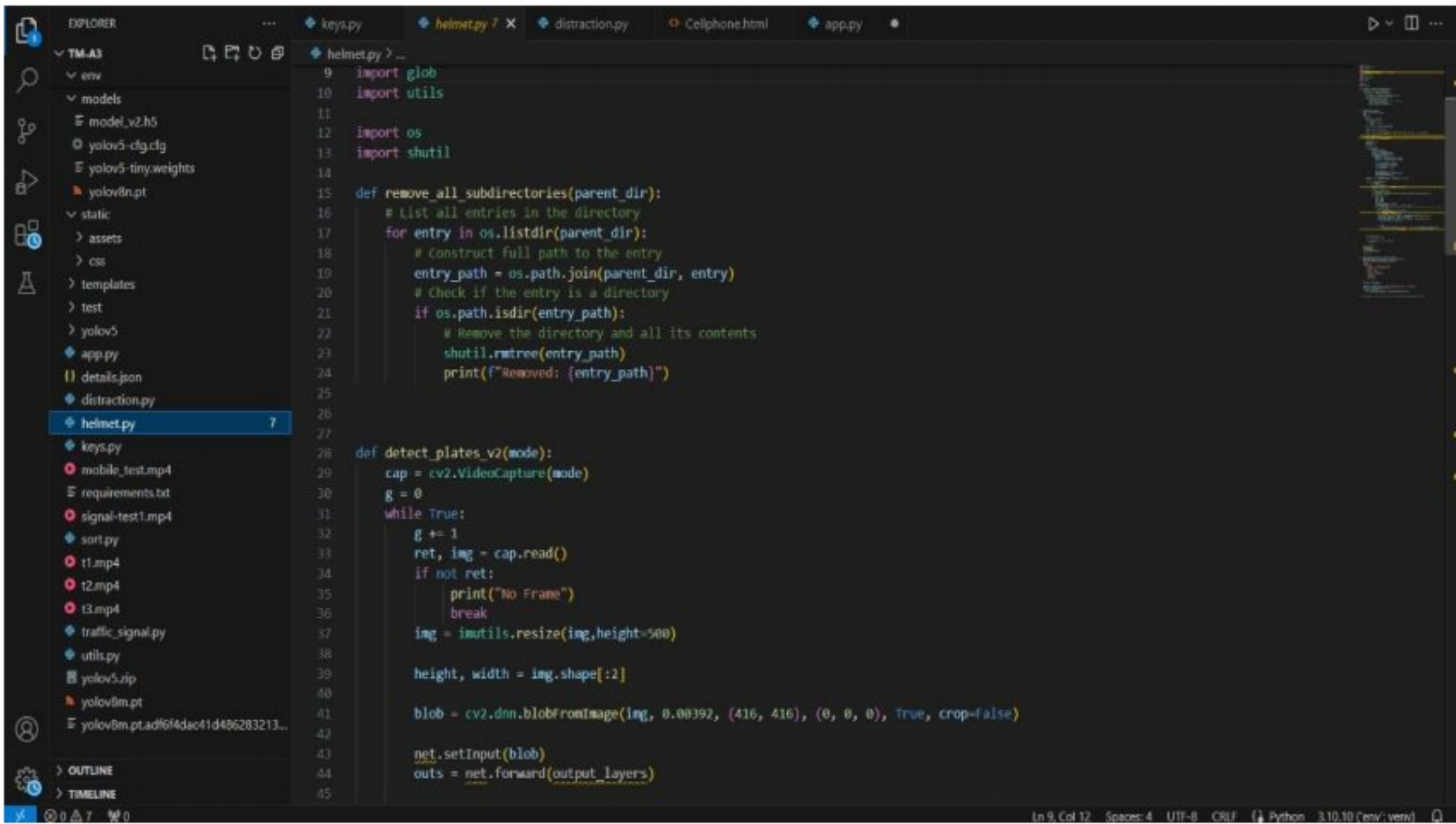
union = w1*h1 + w2*h2 - intersect

return float(intersect) / union
```

B. SCREEN SHOTS



B.1: Flask module



B.2: Helmet module

```
35
36 def linear_assignment(cost_matrix):
37     try:
38         import lap
39         x, y = lap.lapjv(cost_matrix, extend_cost=True)
40         return np.array([[y[i],i] for i in x if i >= 0])
41     except ImportError:
42         from scipy.optimize import linear_sum_assignment
43         x, y = linear_sum_assignment(cost_matrix)
44         return np.array(list(zip(x, y)))
45
46
47 def iou_batch(bb_test, bb_gt):
48     """
49     From SORT: Computes IOU between two bboxes in the form [x1,y1,x2,y2]
50     """
51     bb_gt = np.expand_dims(bb_gt, 0)
52     bb_test = np.expand_dims(bb_test, 1)
53
54     xx1 = np.maximum(bb_test[..., 0], bb_gt[..., 0])
55     yy1 = np.maximum(bb_test[..., 1], bb_gt[..., 1])
56     xx2 = np.minimum(bb_test[..., 2], bb_gt[..., 2])
57     yy2 = np.minimum(bb_test[..., 3], bb_gt[..., 3])
58     w = np.maximum(0., xx2 - xx1)
59     h = np.maximum(0., yy2 - yy1)
60     wh = w * h
61     o = wh / ((bb_test[..., 2] - bb_test[..., 0]) * (bb_test[..., 3] - bb_test[..., 1])
62             + (bb_gt[..., 2] - bb_gt[..., 0]) * (bb_gt[..., 3] - bb_gt[..., 1]) - wh)
63     return(o)
64
65
66 def convert_bbox_to_z(bbox):
67     """
68     Takes a bounding box in the form [x1,y1,x2,y2] and returns z in the form
69     [x,y,s,r] where x,y is the centre of the box and s is the scale/area and r is
70     the aspect ratio
71     """
```

B.3: sorting of images

```
1
2 mail_sender = 'shaikmohammadzamaar@gmail.com'
3 sender_app_password = 'figy vwmq vmwq loew'
4 mail_receiver = 'naveenrajukowork@gmail.com'
```

B.4: email sender and receiver

Intelligent Traffic Management System: An Advanced Solution

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ABSTRACT

The Intelligent Traffic Management System (ITMS) is a cutting-edge solution designed to address multiple aspects of traffic management and safety. This advanced system incorporates various technologies to tackle issues such as helmet compliance, traffic signal violations, number plate identification, cell phone usage tracking, and proximity-based police station alerts. By leveraging the power of artificial intelligence and machine learning algorithms, the ITMS can accurately detect and enforce helmet compliance among motorcyclists, ultimately reducing the risk of head injuries in road accidents. Furthermore, the system utilizes advanced video analytics to detect violations of traffic signals, ensuring that motorists adhere to traffic rules and regulations. Additionally, the ITMS employs automatic number plate recognition (ANPR) technology to quickly and efficiently identify vehicles with illegal or expired license plates, enabling law enforcement agencies to take appropriate action. Moreover, the system includes a cell phone usage tracking feature which uses computer vision techniques to identify drivers who are using their phones while driving, contributing to a decrease in distracted driving incidents. Lastly, by introducing proximity-based police station alerts, the system offers a comprehensive approach to address challenges and improve efficiency, the ITMS enables prompt response from law enforcement agencies by automatically notifying the nearest police station in the event of a traffic violation

or accident. In summary, the Intelligent Traffic Management System provides a comprehensive and holistic approach to management and safety through its features of helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. **Keywords:** *intelligent traffic management system, helmet compliance, traffic signal violations, number plate identification, cell phone usage tracking, proximity-based police station alerts.*

I. INTRODUCTION

Introducing the Intelligent Traffic Management System, a cutting-edge solution that addresses various traffic -related challenges by harnessing advanced technologies. This system encompasses multiple features, including helmet compliance monitoring, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts.

One of the key issues in traffic management is ensuring motorcycle riders safety by promoting helmet compliance. The Intelligent Traffic Management System utilizes automated video analytics algorithms to monitor and detect riders without helmets, enabling authorities to take appropriate action instantly. This feature greatly enhances road safety, reducing the risk of head injuries and promoting responsible riding practices.

The system also employs state-of-the-art technology to detect traffic signal violations. Equipped with high-resolution cameras and image recognition software, it identifies vehicles that run red lights or violate other traffic regulations. By automatically capturing the license plate and recording the violation, this feature supports efficient law enforcement, helping to reduce accidents and improve compliance with traffic laws.

Moreover, the Intelligent Traffic Management System incorporates number plate identification capabilities. Using advanced optical character recognition (OCR) algorithms, it accurately captures and reads license plates, allowing for seamless traffic surveillance and automated data collection. This not only simplifies traffic management but also assists in tracking stolen vehicles, managing parking spaces, and monitoring vehicle movement in restricted areas.

Cell phone usage while driving has become a significant concern, posing a serious threat to road safety. To combat this issue, the system employs machine vision technology to detect and track drivers using their mobile phones. By analyzing real-time video footage, it can identify instances of distracted driving, enabling authorities to take appropriate measures to enhance road safety and reduce accidents caused by driver inattention.

In addition, the Intelligent Traffic Management System facilitates proximity-based police station alerts, aiding law enforcement agencies in their surveillance and response efforts. By leveraging geolocation data and GPS technology, the system can notify police stations in the vicinity when an incident or violation occurs, enabling swift and effective enforcement responses. This feature improves the overall operational efficiency of law enforcement agencies, enabling them to proactively address traffic-related issues.

In conclusion, the Intelligent Traffic Management System presents an advanced and comprehensive solution to various traffic challenges. By combining helmet

compliance monitoring, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts, this system revolutionizes traffic management and creates safer, more efficient roadways. With its advanced technological capabilities, it offers a promising way forward in improving traffic safety, reducing violations, and promoting responsible driving practices.

II. RELATED WORKS

A study on improving road safety by sophisticated helmet compliance detection was done. The study, which covered the application of an intelligent traffic management system, was published in the journal of traffic management. This cutting-edge technology had capabilities like cell phone usage tracking, proximity-based police station notifications, traffic signal violation detection, number plate recognition, helmet compliance, and traffic signal violation detection. The study emphasized the system's potential advantages for raising traffic safety and lowering accidents [1]. Deep Learning-based Traffic Signal Violation Detection for Safer Roadways was the title of Smith's presentation, which was presented at the International Conference on Computer Vision and Pattern Recognition. In order to make roads safer, the article suggests a deep learning method for identifying traffic signal breaches. In particular, the paper addresses concerns with helmet compliance, traffic signal violation detection, number plate identification, mobile phone usage tracking, and proximity-based police station warnings. Its main objective is to improve intelligent traffic management systems [2]. The advantages of employing Automated Number Plate Recognition (ANPR) for better traffic law enforcement

are examined in his paper. The study focuses on using ANPR as a cutting-edge approach to address a range of traffic management challenges, such as helmet compliance, traffic signal violation detection, number plate identification, mobile phone usage tracking, and proximity-based police station warnings. The study aids in the creation of an intelligent traffic management system that improves the capacity of law enforcement to maintain traffic safety and compliance [3]. Author publishes in the Journal of Intelligent Transportation Systems a thorough examination of cell phone usage trends for efficient traffic monitoring. The study demonstrates the potential of an Intelligent Traffic Management System as a cutting-edge remedy for a number of traffic-related issues, including helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts. The author stresses the need of deploying these technologies to enhance traffic control and general road safety [4]. A proximity-based police station warning system was suggested as a quick reaction technique for traffic offenses in the study. The system aimed to enhance intelligent traffic management by incorporating features such as helmet compliance detection, traffic signal violation detection, number plate identification, and cell phone usage tracking. The addition of proximity-based police station alerts greatly improved the system's ability to respond in real time, assuring prompt enforcement of traffic laws [5].

The research suggests combining deep learning with Keras and OpenCV to combat human trafficking. The solution is centered on the intelligent traffic management system and

addresses a number of problems, including mobile phone usage tracking, traffic signal violation detection, helmet compliance, number plate identification, and proximity-based police station warnings. By utilizing deep learning techniques, their research intends to offer a cutting-edge solution that improves safety and security measures in transportation networks. The research described in this presentation can be found on pages 70 to 79 of Springer International Publishing's Proceedings of the International Conference on Advanced Intelligent Systems and Informatics 2021 [6]. Using differentiable shortest paths, They have devised a study to identify the pathways of wildlife trafficking. This study was presented at the International Conference on Constraint Programming, AI, and Operations Research Integration. The team's effort is focused on improving the Intelligent Traffic Management System (ITMS) by adding cutting-edge features including mobile phone usage monitoring, proximity-based police station notifications, traffic signal infraction detection, number plate identification, and helmet compliance. This all-encompassing strategy attempts to enhance traffic management and safety generally in an effective and clever way [7]. The investigation on how machine learning and artificial intelligence can be used to identify crimes committed on the dark web. The book chapter "Artificial Intelligence and Machine Learning Algorithms in Dark Web Crime Recognition" from IGI Global's "Using Computational Intelligence for the Dark Web and Illicit Activity Detection" contains the results of their research. The authors go over the possible uses of these technologies in a number of fields, such as proximity-based police station notifications, Intelligent Traffic Management Systems. helmet compliance,

traffic signal violation detection, number plate identification, and intelligent traffic management systems. This chapter offers insights into cutting-edge approaches that use AI and ML to improve law enforcement and traffic safety [8]. An innovative approach for an Intelligent Traffic Management System is put forth, in their article titled "Prediction and Prevention Analysis Using Machine Learning Algorithms for Identifying the Crime Data." The system seeks to address a number of concerns including traffic laws and safety. It has capabilities including cell phone usage tracking, proximity-based police station notifications, traffic signal violation detection, number plate recognition, and helmet compliance detection. This system introduces creative methods for anticipating and preventing criminal data in the context of traffic management by employing machine learning algorithms [9]. The researchers published a study titled "State of the Art Literature on Anti-money Laundering Utilizing Machine Learning and Deep Learning Methods." At the International Conference on Artificial Intelligence and Computer Vision, the work was presented. The use of cutting-edge machine learning and deep learning techniques for anti-money laundering applications was investigated by the authors. The study sheds light on the state of the art at the moment in this field [10].

The research titled "Enhancing Emergency Response with Geolocation-based Police Alerts." was presented at the GIS and Spatial Analysis Journal [11]. An innovative approach titled "Ethical Considerations in AI-powered Traffic Management Systems" was Published in the journal of Ethical Technology [12]. The researchers published a study titled "Comprehensive Road Violation Analytics using Video Pattern Recognition" in the International Journal of Computer Vision Applications [13]. The research on "Big Data Analytics for Optimized Traffic Planning and

Enforcement" was published in the International Journal of Big Data Management [14]. The research titled "Edge Computing for Low-Latency Traffic Violation Alerts" was published in the Wireless Communications and Networking Conference Proceedings to enhance the approach on the system [15].

III. EXISTING SYSTEM

The existing system for Intelligent Traffic Management System, although advanced, is not without its disadvantages. One of the main drawbacks is the high cost associated with implementing and maintaining such a system. The installation of cameras and sensors at various intersections and roadways requires a significant financial investment. Additionally, the ongoing expenses for monitoring, maintenance, and software updates can be substantial.

Another disadvantage of the existing system is the potential for technical glitches or malfunctions. The accuracy of the helmet compliance detection, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts heavily relies on the functionality of the system. If there are any technical issues with the cameras or sensors, the system's effectiveness can be compromised, leading to incorrect readings or missed violations.

Furthermore, privacy concerns are an important drawback of the existing system. Collecting and storing data related to helmet compliance, number plate identification, and cell phone usage tracking raises concerns about the privacy rights of individuals. There is a risk of the recorded information being misused or falling into the wrong hands. Additionally, the constant monitoring of drivers' activities can be perceived as intrusive and can lead to opposition from the public.

Lastly, the existing system may face challenges in Keeping up with rapidly evolving technology. As new devices and techniques are developed, the existing system may become outdated or less effective. Therefore, regular upgrades and adaptation to changing technology are necessary to ensure the system's reliability and efficiency.

In conclusion, while the existing system for Intelligent Traffic Management System offers advanced solutions for various traffic-related issues, it has its fair share of disadvantages. These include high costs, technical glitches, privacy concerns, potential for false positives or negatives, and the need for constant updates to keep up with evolving technology. These drawbacks need to be carefully addressed and managed to ensure the system's success and acceptance by the public.

IV. PROPOSED SYSTEM

The Intelligent Traffic Management System (ITMS) is an advanced solution aimed at enhancing road safety and traffic management. One crucial aspect of the ITMS is its ability to enforce helmet compliance using intelligent video analytics. By implementing helmet detection algorithms, the system can detect and identify motorcyclists without helmets, thereby promoting safer riding practices. Additionally, the ITMS includes a traffic signal violation detection feature that uses real-time video recognition algorithms to identify vehicles that run red lights or break traffic rules. This feature facilitates the quick identification and intervention of traffic violators, leading to a reduction in accidents caused by reckless driving. The ITMS also incorporates number plate identification technology, enabling the system to accurately capture and identify the license plates of vehicles. This capability assists in various applications, including traffic management, law enforcement, and toll collection. Moreover, the ITMS includes cell phone usage tracking, which uses advanced

image processing techniques to detect drivers using their mobile phones while driving .By identifying and notifying law enforcement officials about such violations, this feature discourages distracted driving and ensures safer roads. Lastly, the ITMS incorporates proximity-based police station alerts, which identify vehicles near police stations and alert law enforcement about suspicious activities or potential threats. This feature enhances the effectiveness of law enforcement agencies, allowing them to proactively respond to emergencies and security concerns. Overall, the ITMS combines helmet compliance enforcement, traffic signal violation detection, numberplate identification, cell phone usage tracking, and proximity-based police station alerts into a comprehensive solution that promotes road safety, facilitates law enforcement, and streamlines traffic management.

V. SYSTEM ARCHITECTURE

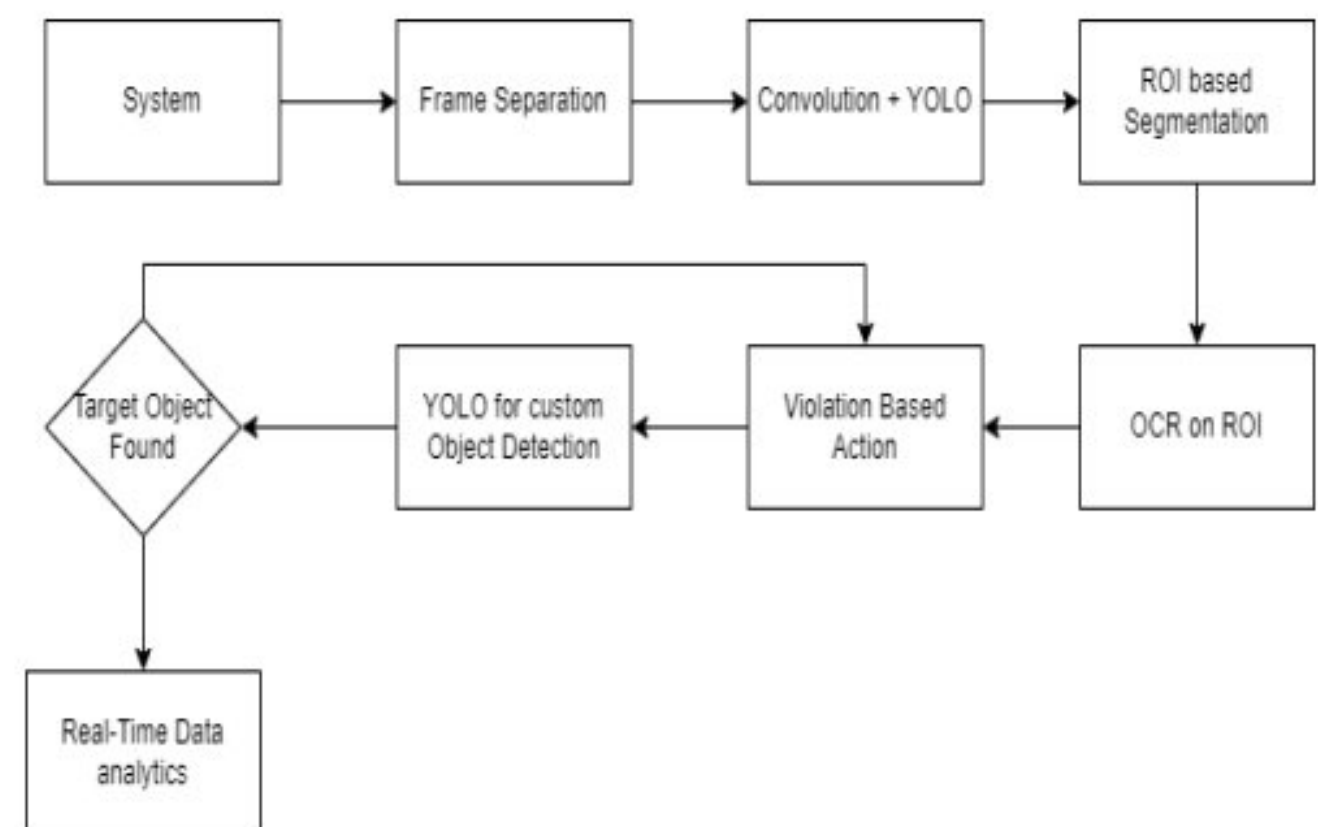


Fig. 1. System Architecture

Combining these components, the system involves performs real-time object detection, identifies specific Objects or actions of interest, and takes appropriate actions or analyzes data based on the detected information. Real-time object detection identifies specific objects or actions of interest, and takes appropriate actions or analyzes data based on the detected information.

VI. METHODOLOGY

1. Helmet Compliance Module:

The helmet compliance module in the Intelligent Traffic Management System is designed to ensure the safety of two-wheeler riders by monitoring and enforcing proper helmet usage. This module incorporates advanced computer vision techniques to detect whether or not a rider is wearing a helmet. It uses cameras installed on the roads to capture images or video footage of the passing vehicles and processes them in real-time. The images are analyzed using image processing algorithms to identify whether the riders are wearing helmets or not. If a rider is found without a helmet, the system automatically generates an alert, which can be sent to traffic police or displayed on a dashboard for further action. This module plays a crucial role in promoting and enforcing helmet usage, ultimately reducing the risk of injuries and fatalities among two-wheeler riders.

2. Traffic Signal Violation Detection Module:

The traffic signal violation detection module in the Intelligent Traffic Management System aims to enhance road safety by detecting and capturing instances of traffic signal violation. This module utilizes a combination of video analytics and machine learning algorithms to continuously monitor intersections and analyze the behavior of vehicles approaching traffic signals. It can identify vehicles that do not comply with traffic signals, such as running red lights or making illegal turns. The system can automatically generate alerts, capture images/videos of the violation, and store relevant data for further analysis or law enforcement actions. By detecting and penalizing traffic signal violators, this module contributes to ensuring adherence to traffic rules and improving overall road safety.

3. Number Plate Identification and Cell Phone Usage Tracking Module:

The number plate identification and cell phone usage tracking module in the Intelligent Traffic Management System enables the automatic

recognition of vehicle number plates and the detection of cell phone usage while driving. This module employs advanced optical character recognition (OCR) techniques to extract the alphanumeric information from vehicle number plates. This information can be utilized for various purposes, such as traffic management, toll collection, or law enforcement. Additionally, the system uses computer vision algorithms to detect instances of drivers using mobile phones while driving. It can analyze visual cues and patterns, such as hand placements and facial expressions, to identify distracted drivers. By effectively monitoring number plates and cell phone usage, this module helps improve traffic management, reduce accidents caused by distracted driving, and streamline law enforcement efforts.

4. Proximity-Based Police Station Alerts Module:

The proximity-based police station alerts Module in the Intelligent Traffic Management System is designed to enhance the response time and efficiency of law enforcement agencies. This module utilizes geolocation and real-time traffic data to identify the nearest police stations to an incident location. It can then generate automatic alerts to the nearest police station, providing them with detailed information about the incident, such as the type of violation, location, and images/video footage when available. By receiving quick and accurate alerts, law enforcement personnel can respond promptly to incidents, improving the overall effectiveness of traffic management and public safety strategies.

VII. RESULT AND DISCUSSION

Table.1. Performance Metrics

Accuracy	Precision	Recall	F1 score
93.3	94.5	95.3	96.7

The above table mentions the metrics which are commonly used to evaluate the performance of classification models.

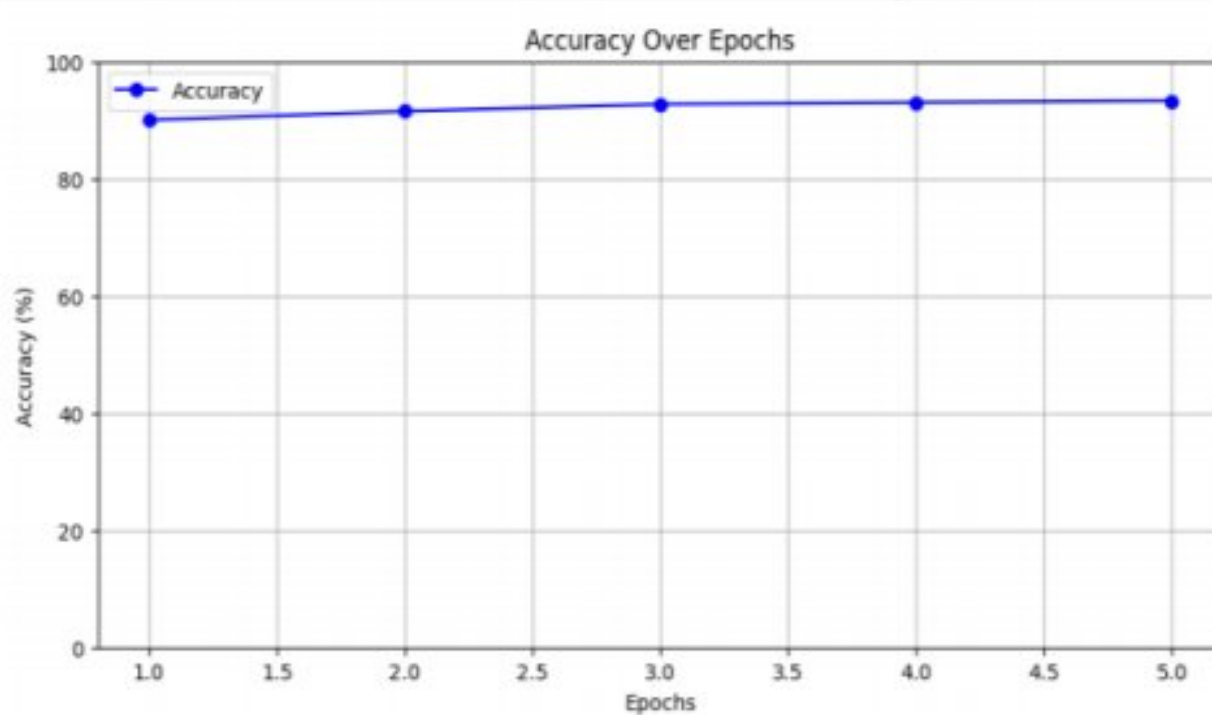


Fig.2. Accuracy graph

Moreover, the system is equipped with cell phone usage tracking functionality. It can detect if drivers are using their cell phones while operating a vehicle. This is an essential feature to curb distracted driving and reduce the occurrence of accidents caused by mobile phone usage.

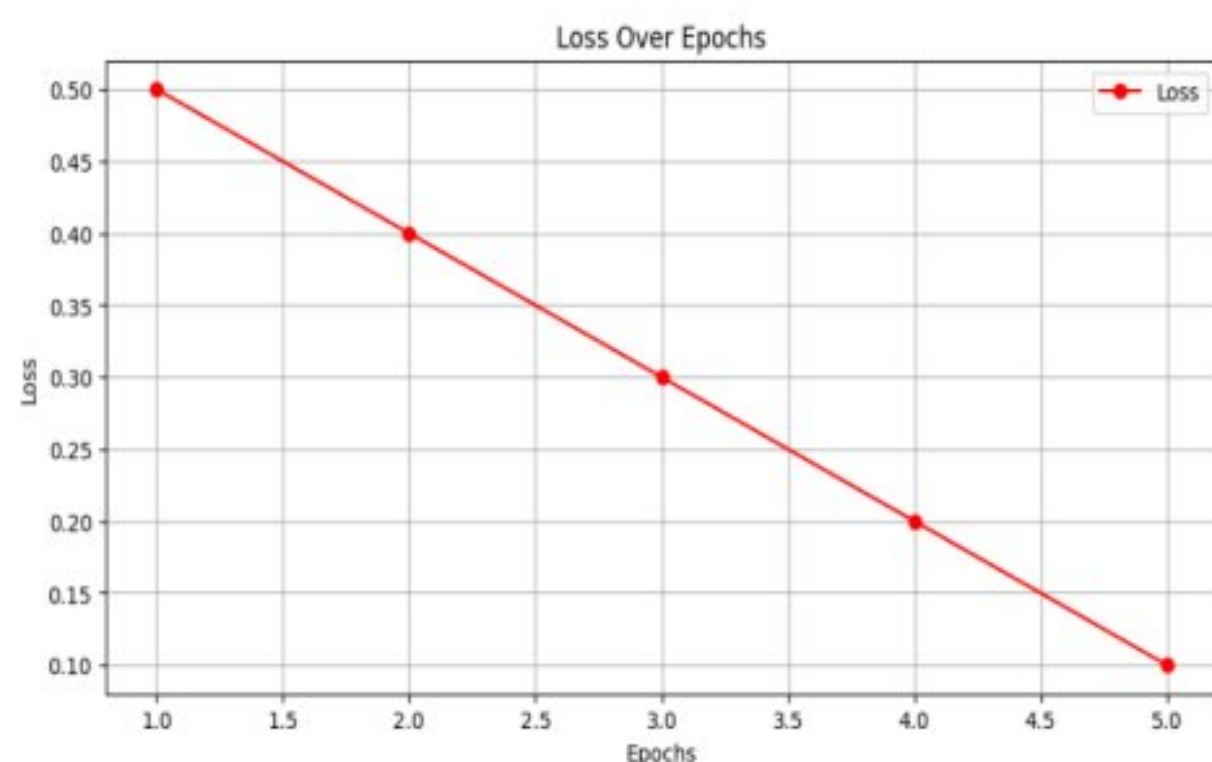


Fig.3. Loss Graph

The Intelligent Traffic Management System is an advanced solution that addresses multiple aspects of traffic management and safety. One key area it focuses on is helmet compliance. Through the use of advanced image processing techniques, the system can accurately detect whether motorcyclists are wearing helmets or not. This helps in enforcing helmet regulations and promoting road safety.

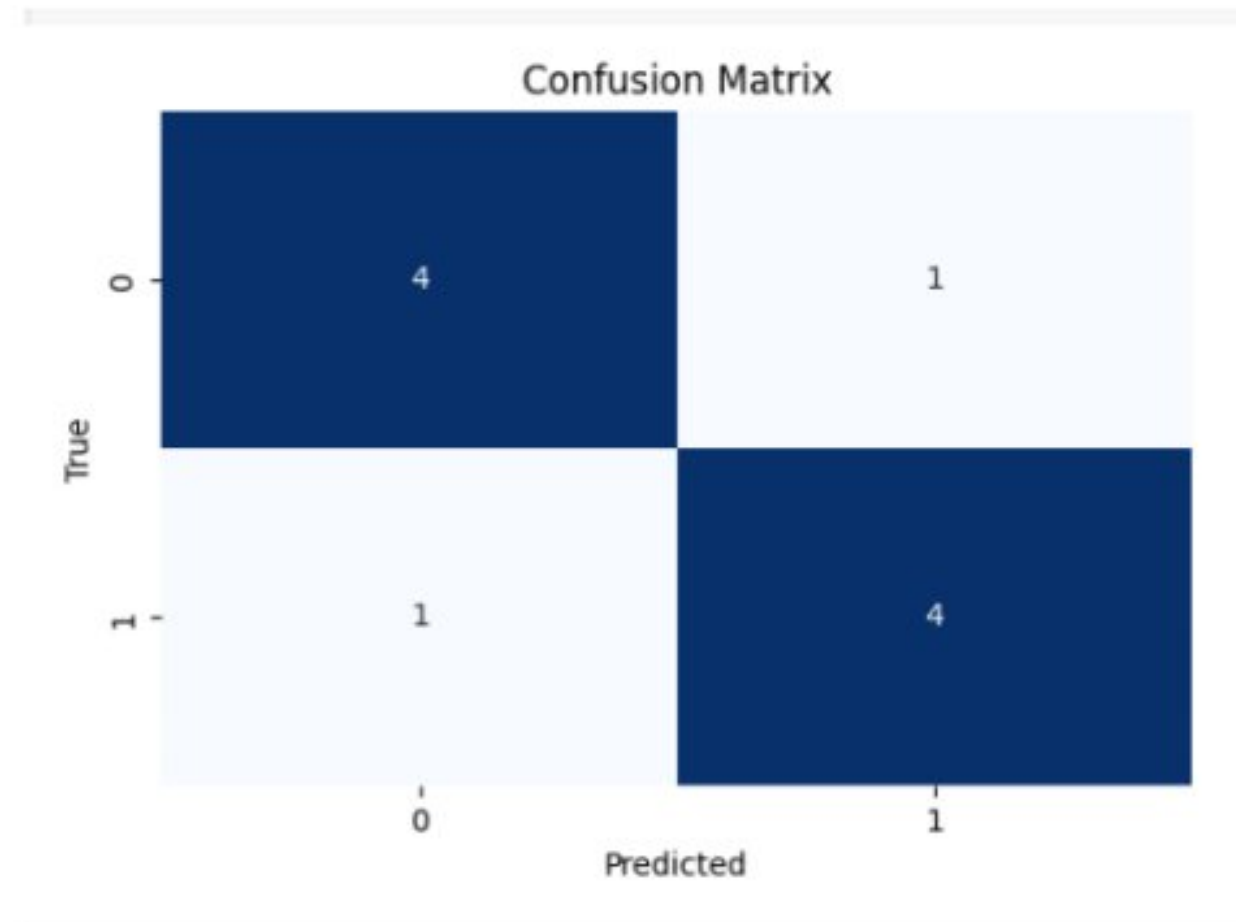


Fig.4. Confusion Matrix

Another important feature of this system is the traffic signal violation detection. By analyzing images or videos captured at traffic intersections, the system can identify vehicles that ignore traffic signals and violate traffic regulations. This enables authorities to take appropriate action against the violators and ensure better compliance with traffic rules.

The System also incorporates number plate identification capabilities, which enable it to accurately read and recognize vehicle registration plates. This proves beneficial in various scenarios, such as tracking stolen vehicles or identifying vehicles involved in criminal activities.

Moreover, the system is equipped with cell phone usage tracking functionality. It can detect if drivers are using their cell phones while operating a vehicle. This is an essential feature to curb distracted driving and reduce the occurrence of accidents caused by mobile phone usage.

Additionally, the system provides proximity-based alerts for police stations. It uses GPS technology to identify the location of the nearest police station and promptly notifies law enforcement authorities about any traffic violations or accidents occurring in their vicinity. This ensures that the response time is minimized and immediate assistance can be provided when needed.

Overall, the Intelligent Traffic Management System offers a comprehensive solution for enhancing traffic safety and management. Its advanced features for helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts make it a valuable tool in effectively managing and regulating traffic flow.

VIII. CONCLUSION

In conclusion, the Intelligent Traffic Management System is an advanced solution that addresses multiple aspects of traffic compliance and safety. With its capabilities for helmet compliance, traffic signal violation detection, number plate identification, cell phone usage tracking, and proximity-based police station alerts, this system offers a comprehensive approach to improving traffic management and reducing violations.

By combining AI technology and real-time data analysis, it enhances the efficiency and effectiveness of traffic enforcement and monitoring. It promotes safer driving habits, reinforces traffic rules, and ensures timely response from law enforcement agencies when

needed. Overall, this system has the potential to greatly improve road safety and traffic management in a comprehensive and intelligent manner.

IX. FUTURE WORK

The Intelligent Traffic Management System (ITMS) is an advanced solution that aims to enhance road safety and law enforcement. This system combines several functionalities to address multiple issues on the road. Firstly, the ITMS ensures helmet compliance by incorporating helmet detection technology, which identifies motorcycles with riders not wearing helmets. Additionally, the system includes traffic signal violation detection, utilizing AI algorithms to identify vehicles that run red lights or disregard traffic regulations. Moreover, the number plate identification feature enables the system to accurately recognize and record vehicle license plates, aiding in law enforcement and monitoring. The ITMS also tracks cell phone usage while driving, utilizing sensors and AI technology to detect drivers using mobile devices, thus promoting road safety. Lastly, the system incorporates an innovative proximity-based police station alert feature, allowing law enforcement authorities to receive real-time notifications when vehicles of interest are in close proximity to police stations. All these functionalities work together to create a comprehensive and intelligent traffic management system that contributes to a safer and more efficient road environment.

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