e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

ENABLING ROAD SAFETY THROUGH INTEGRATED HELMET DETECTION AND LICENSE PLATE RECOGNITION WITH REAL-TIME EMAIL NOTIFICATIONS

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DOI : https://www.doi.org/10.56726/IRJMETS45467

ABSTRACT

Road safety is a pressing concern, and this study proposes an integrated system that combines Helmet Detection with Automatic License Plate Recognition (ALPR) and an Email Notification System to address critical safety issues. The YOLOv8 model serves as the foundation for real-time object detection, trained on a meticulously collected dataset of 3500 images, accurately labeled using RoboFlow.

Keywords: Helmet Detection, Automatic License Plate Recognition (ALPR), Email Notification System, YOLOv8 Model.

I. INTRODUCTION

Road safety is a critical issue worldwide, with millions losing lives or suffering injuries annually from accidents. Motorcyclists are especially vulnerable, with head injuries being a major cause of death and disability. Despite the benefits of wearing helmets, enforcing laws and ensuring compliance is challenging for authorities, particularly in crowded areas.

In recent years, computer vision technologies have emerged as a promising solution. By using advanced algorithms and machine learning, systems can detect motorcyclists without helmets and notify authorities in real-time when violations occur. Furthermore, license plate recognition systems can identify vehicles involved in accidents or violations.

This paper presents a Helmet Detection with License Plate Recognition and Email Notification system using Python, YOLOv8, and OpenCV. The system accurately detects helmets and license plates in real-time, notifies authorities via email, and enables efficient law enforcement. The primary objective is promoting road safety by enforcing helmet laws and detecting violators. A dataset of 3500 images was collected, labeled, and used to train a YOLOv8 model for object detection. The model detects helmets and license plates in various conditions robustly and accurately. The system automatically emails authorities when violations are detected, enabling real-time monitoring and law enforcement. The system has three main components: helmet detection using YOLOv8, license plate recognition using Plate Recognizer API, and email notification to authorities containing violation details.

II. METHODOLOGY

Helmet Detection using YOLOv8

A YOLOv8 model was trained on the collected dataset of 3500 labeled helmet/no helmet images. The model detects helmets reliably in various conditions. When no helmet is detected on a rider, the image is cropped and saved for license plate recognition.

License Plate Recognition

License plates in the saved images are recognized using Plate Recognizer API. This cloud-based API uses deep learning and computer vision techniques to accurately recognize license plates in real-time. The API supports various countries' license plates.

Email Notification

When a license plate is recognized, it is matched to a CSV file containing registered users' details. If a match is found, an email notification is sent to concerned authorities using SMTP protocol. The email contains violation details like image, location, and vehicle/owner information.

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III. MODELING AND ANALYSIS

Model and Material which are used is presented in this section. Table and model should be in prescribed format.

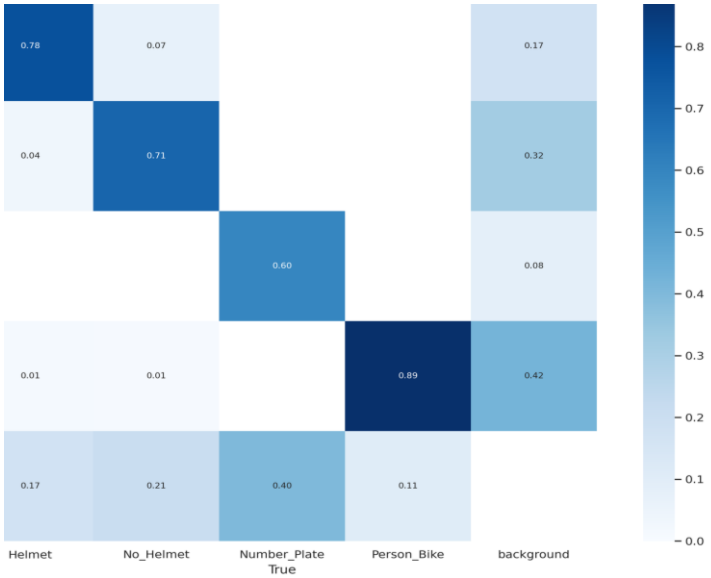

Figure 1: Confusion Matrix

The above is the heat map of a confusion matrix. By above heat map, we can observe that:

- 78 times out of 100, the system predicted helmet correctly.
- 71 times out of 100, the system predicted the persons without helmet correctly.
- 60 times out of 100, the system predicted the number plate correctly.
- 89 times out of 100, the system predicted person with bike correctly.

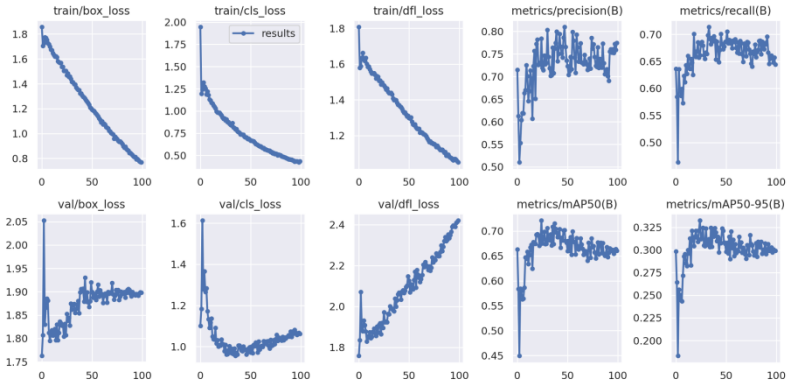

Figure 2: Results

YoloV8 uses multiple loss functions to optimize the prediction of bounding box coordinates and class probabilities for objects in an image. The algorithm's performance is evaluated using metrics such as mAP50, mAP50-95, precision, and recall, which provide a comprehensive picture of its ability to accurately detect objects and classify them correctly. We look at the results.png, which comprises training and validation loss for bounding box, objectness, and classification. It also has the metrics: precision, recall, mAP@0.5, and mAP@0.5:0.95 for training.

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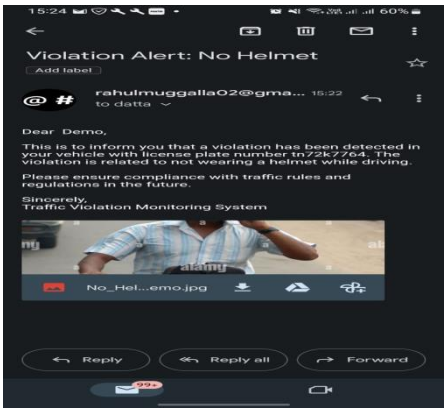
IV. RESULTS AND DISCUSSION




```
No License Plate Found in Image / License Plate can't be recognized
No user data found for license plate: None
No user data found for license plate: ka06b17779
User Details for License Plate :  kl666798
  License Plate     Name        Email
0      kl666798  Testing  abc@xyz.com
Email sent to abc@xyz.com
User Details for License Plate :  tn72k7764
  License Plate   Name           Email
1     tn72k7764   Demo   demo@gmail.com
Email sent to  demo@gmail.com
License Plate already identified earlier : tn72k7764
Skipping License Plate : tn72k7764.....
```

V. CONCLUSION

This paper presented an AI-based solution using YOLOv8, license plate recognition, and email notification to improve road safety by enforcing helmet laws. The system demonstrated high accuracy in detecting helmet violations and recognizing license plates automatically in real-time. It has the potential to significantly enhance road safety and prevent head injuries and fatalities by detecting violators and alerting authorities promptly. The system can be further enhanced by incorporating additional capabilities like facial recognition. This project represents a valuable contribution to applying AI for impactful real-world applications.

VI. REFERENCES

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