TWO-WHEELER TRAFFIC RULE VIOLATION DETECTION

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ABSTRACT

Ensuring road safety is paramount in modern society, and the increasing prevalence of two-wheelers on roadways demands a robust approach to enforce traffic rules effectively. This project addresses the pressing need for improved road safety by focusing on the detection and identification of traffic rule violations committed by two-wheeler riders.

PROBLEM STATEMENT

Current traffic management systems often struggle to address specific rule violations related to two-wheelers, creating road safety challenges. This project aims to enhance enforcement by implementing a Two Wheeler Traffic Rule Violation Detection system, utilizing computer vision and AI for precise identification of infractions such as helmet non-compliance and unauthorized lane usage. The goal is to automate and improve the accuracy of enforcing traffic rules for two-wheelers, promoting enhanced road safety and compliance.

INTRODUCTION

In our ever-evolving urban landscapes, road safety stands as a cornerstone for fostering secure and efficient transportation systems. The surge in two-wheeler usage demands innovative approaches to ensure adherence to traffic regulations, ultimately minimizing accidents and safeguarding lives. This project takes a significant stride towards bolstering road safety by concentrating on the detection and identification of traffic rule violations committed by two-wheeler riders.

INTRODUCTION

The overarching objective of this project is to develop a sophisticated system capable of accurately detecting violations such as wrong lane usage, absence of helmets, and instances of triple riding. However, beyond mere detection, the system's focus extends to evidence capture, recognizing the paramount importance of documenting and recording violations for effective enforcement and subsequent legal proceedings.

INTRODUCTION

In a departure from traditional approaches, this system not only identifies violations but also goes a step further by capturing comprehensive evidence. Beyond merely flagging instances of non-compliance, it records visual evidence, including images of the violated motorcycle, faces of the riders, and their license plates. This holistic approach not only facilitates immediate enforcement actions but also provides a valuable repository of evidence for future reference, analysis, and legal proceedings.

RELATED WORKS

The paper addresses the issue of traffic rule violations in developing countries, stemming from population growth and an increasing number of vehicles. Existing automated technologies face challenges in handling nonuniform illumination and diverse license plate formats. To overcome these obstacles, the authors propose a system integrating traffic signal detection and speed estimation. This comprehensive approach aims to identify and manage violations effectively. The incorporation of traffic signal detection enhances the system's capability to pinpoint violations at intersections, while speed estimation provides insights into over-speeding incidents. The system's output, including information on violations and speed data, is stored in a database for authorities to take necessary actions. By combining these parameters and leveraging a centralized database, the proposed system offers a promising solution to enhance traffic management and road safety in the face of increasing challenges in developing countries. [1]

RELATED WORKS

The paper proposes a novel helmet identification methodology is introduced, leveraging a dual-pronged approach to enhance detection rates. The first method employs a Haar-like feature-based face detection technique, aimed at effectively distinguishing individuals donning complete helmets from those without. Complementing this, the second method integrates the circle Hough transform, offering a sophisticated means of discerning between individuals not wearing helmets and those sporting half-helmets. By synergizing these two methodologies, the paper aims to significantly improve the overall accuracy and efficiency of helmet detection systems, showcasing a promising stride in the realm of computer vision and safety technologies. [2]

RELATED WORKS

The authors deployed adaptive background removal techniques on video frames to discern dynamic entities, with a primary focus on bikers. Leveraging the power of Convolutional Neural Networks (CNNs), the investigators sought to precisely differentiate motorcyclists from the identified moving objects, honing in particularly on individuals lacking proper helmet adherence. This innovative methodology showcased the integration of cutting-edge computer vision and deep learning technologies to enhance the accuracy and efficiency of helmet detection within a dynamic video environment. The study's findings illuminate a promising stride in the realm of object identification, shedding light on the potential applications of advanced neural network architectures in addressing crucial safety concerns related to helmet usage among motorcyclists. [3]

METHODOLOGY

Data Acquisition: Three datasets were used, including 3283 photographs of faces, 961 images of two-wheelers, helmets, and license plates, and 193 images of the front and back of two-wheelers.

Model Training: Roboflow cloud was used to train three models, one for each dataset.

Model Implementation: Roboflow API is used to access trained models.

METHODOLOGY

Violation Detection: By raising the appropriate flags for violations such as driving in the incorrect lane, failing to wear a helmet, and triple riding, Roboflow Model APIs begin violation detection.

License Plate Extraction: OCR will identify a licende plate if a violation is detected. The plate picture and number are saved when the Space API retrieves the plate number.

METHODOLOGY

Process Flow

- **Initialize each Roboflow Model with API:** This involves setting up and connecting to the Roboflow Models using their API. Initialization includes providing API keys, configuring parameters, and establishing communication with the Roboflow services.
- **Initialize Video Processing:** Set up the video processing pipeline, which includes loading the video, configuring video processing parameters, and preparing the system to handle each frame of the video.

METHODOLOGY

Process Flow

- **Scan Every 180th frame:** Every 180th frame of the video is processed, optimize computational resources while still capturing important information at regular intervals.
- **Detects all two-wheelers/motorcycles in a frame:** Utilize a motorcycle detection model to identify and locate instances of motorcycles within the selected frames.
- **For each detected motorcycle, it extracts its bounding box:** Extract the bounding box coordinates for each identified motorcycle in the frame. This information defines the rectangular region that encloses the motorcycle, facilitating further analysis and processing.

METHODOLOGY

Process Flow

- **Determines if the motorcycle is front-facing or rear-facing:** Determine the orientation of each detected motorcycle using another model, distinguishing between front-facing and rear-facing orientations.
- **Flags a "Wrong Lane Violation" if the motorcycle is rear-facing:** If a rear-facing motorcycle is identified, record a violation indicating a "Wrong Lane Violation." This step ensures that the system recognizes instances where motorcycles are traveling in the wrong direction.

METHODOLOGY

Process Flow

- **Detects faces and helmets within the cropped image:** Employ facial and helmet detection models to identify and locate faces and helmets within the cropped image of each motorcycle. This involves running separate detection algorithms for faces and helmets.
- **Counts the number of faces:** Count the number of faces detected within the cropped image. This count represents the individuals associated with each motorcycle.

METHODOLOGY

Process Flow

- **Reduces the face count if the detected face and helmet areas overlap by more than 60%:** Examines the overlap between detected face and helmet areas. If the overlap exceeds a specified threshold (60%), consider it a redundant detection, and reduce the face count accordingly. This step helps improve accuracy by avoiding double-counting in cases where faces and helmets overlap significantly.
- **No Helmet Violation:** After detecting faces and helmets, checks if there's absence of helmet. This involves counting the number of helmets detected within the cropped image of each motorcycle.

METHODOLOGY

Process Flow

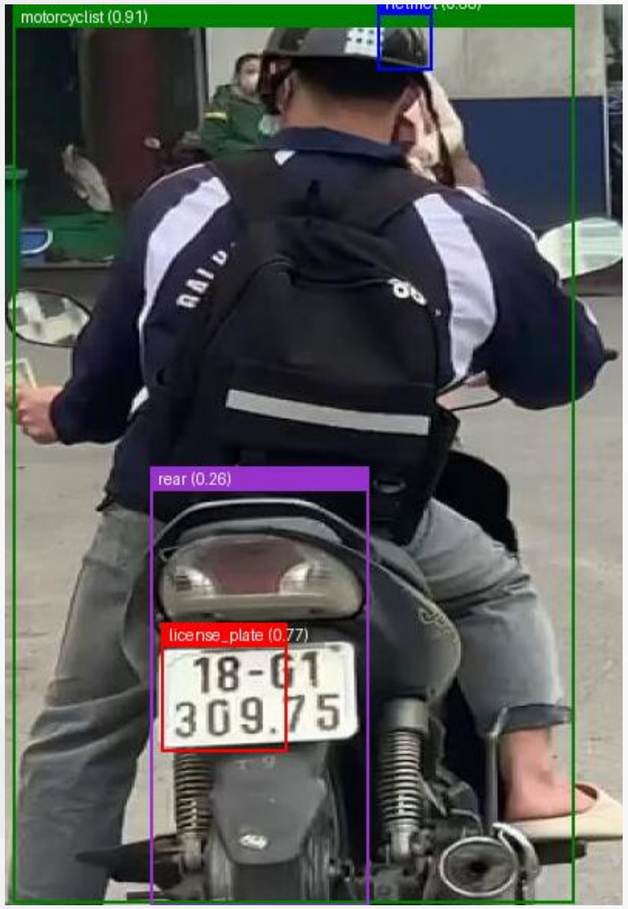
- **Flags a "No Helmet Violation" if no helmets are detected or if the number of faces is greater than 1:** Check the results of helmet detection. If no helmets are detected or if the number of faces exceeds 1 (indicating more than one individual without a helmet), flag a "No Helmet Violation" for the respective motorcycle frame.
- **Sums up the final counts of helmets and faces:** Aggregate the counts of detected helmets and faces across all processed frames. This step provides a consolidated view of the number of helmets and faces identified throughout the video.

METHODOLOGY

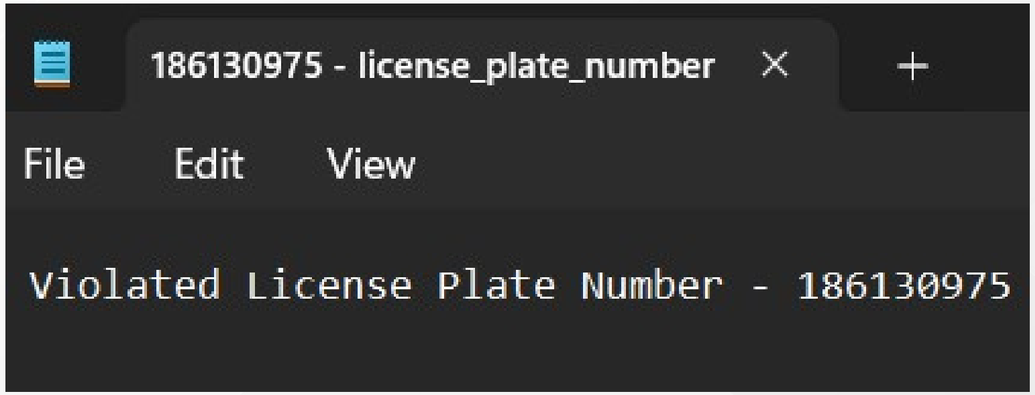
Process Flow

- **Flags a "Triple Riding Violation" if the sum is greater than 2:** Evaluate the sum of helmets and faces. If the combined count exceeds 2, flag a "Triple Riding Violation." This helps identify instances where the number of riders exceeds the safe capacity of the motorcycle.
- **License Plate Detection:** If any violation is identified, capture the license plate image using a model and associated text using OCR.Space API for documentation and further action.
- **Store violation evidence:** Store the relevant images of the violated motorcycle, including the cropped image showing the violation, the license plate image, and the extracted license plate text.

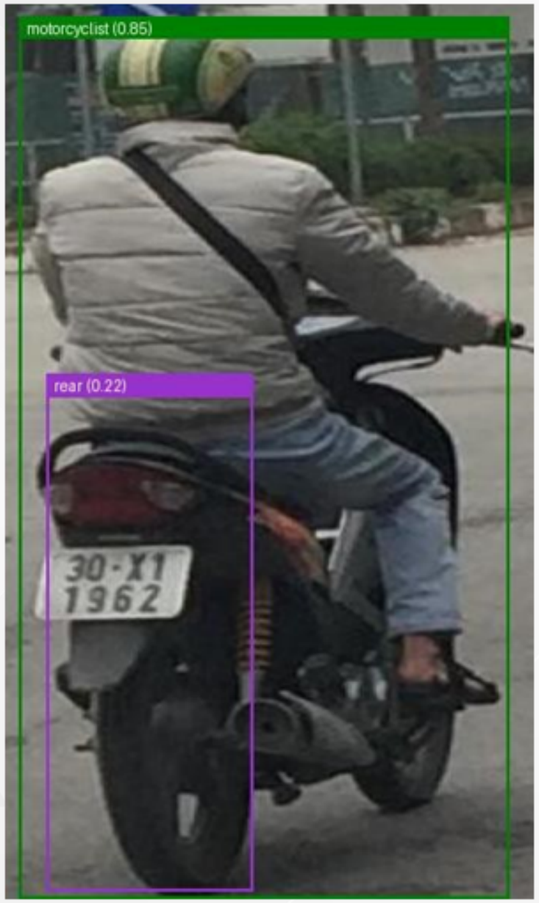
RESULT


motorcyclist (0.91)
rear (0.26)
license_plate (0.77)
18-G1
309.75

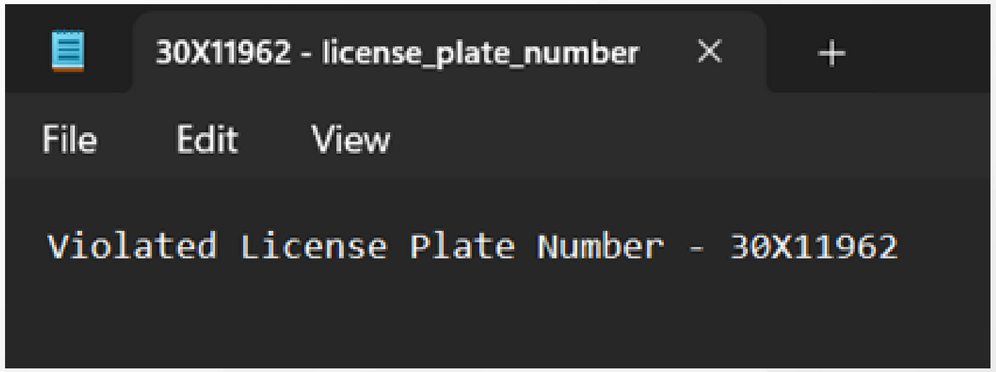

18-G1
309.75


186130975 - license_plate_number
File
Edit
View
Violated License Plate Number - 186130975

RESULT


motorcyclist (0.85)
rear (0.22)
30-X1
1962


30-X1
1962


30X11962 - license_plate_number
File
Edit
View
Violated License Plate Number - 30X11962

CONCLUSION

The Two Wheeler Traffic Rule Violation Detection project showcases a comprehensive approach to monitor and identify violations related to two-wheelers, employing multiple specialized computer vision models for detecting elements like two-wheelers, helmets, license plates, faces, and front/rear sides of two-wheelers. Using Roboflow models, the system efficiently analyzes video frames, providing detailed information on detected violations. Beyond detection, the project incorporates additional checks, such as lane usage, triple riding, and accurate license plate recognition, utilizing OCR for extraction and validation. The output includes visual evidence and text files with violated license plate numbers, contributing to improved road safety and compliance. The project's modular design, integration of external APIs and libraries, and emphasis on versatility highlight its potential for adaptation and expansion in real-world traffic monitoring systems.

REFERENCES

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