SPEED SENSE USING YOLO

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Abstract - The Speed Sense project focuses on real-time monitoring and enforcement of speed limits using computer vision techniques, specifically designed for constrained environments like colleges or offices. It detects and tracks vehicles in a video stream, calculates their speeds, and identifies those exceeding predefined speed thresholds. When a vehicle surpasses the speed limit, the system captures a screenshot, records the footage with speed data, and stores this information for further review. Additionally, the project incorporates number plate detection to send automated emails to vehicle owners regarding overspeeding incidents. By automating speed enforcement and providing visual evidence of violations, Speed Sense aims to enhance road safety, reduce accidents, and promote adherence to traffic regulations within the campus.

1. INTRODUCTION:

In today's modern world, where transportation plays a pivotal role in societal functioning, ensuring road safety remains a critical concern. With the exponential growth in vehicular traffic, speeding violations have become increasingly prevalent, posing a significant threat to public safety and necessitating innovative solutions. The "Speed Sense" project emerges as a response to this pressing need, aiming to develop an automated system for real-time monitoring and enforcement of speed limits, particularly in constrained environments such as colleges or offices.

The project utilizes cutting-edge technologies such as computer vision and machine learning to detect and track vehicles in a video stream, accurately calculate their speeds, and identify those exceeding predefined speed thresholds. By leveraging advanced algorithms and image processing techniques, the system provides precise speed measurements and promptly flags speeding violations.

One of the key features of the "Speed Sense" project is its ability to capture screenshots of vehicles exceeding the specified speed limit, providing visual evidence of speeding violations. Additionally, the project records the footage of the video along with the corresponding speed information, enabling authorities to analyze and take appropriate action against violators. To enhance functionality within a campus setting, the system also incorporates number plate detection, automatically sending emails to the respective vehicle owners when overspeeding is detected.

The significance of the project lies in its potential to enhance road safety and reduce the incidence of accidents caused by speeding. By automating speed monitoring and enforcement, the system helps deter drivers from violating speed limits and relieves the burden on law enforcement agencies by streamlining the process of identifying and penalizing offenders.

Furthermore, the project aligns with broader initiatives aimed at promoting sustainable transportation and improving overall traffic management. By fostering compliance with speed limits, it contributes to creating safer roadways and fostering a culture of responsible driving among motorists.

In light of the aforementioned considerations, the "Speed Sense" project holds immense promise in addressing the persistent challenge of speeding violations within campus environments. Its innovative approach, coupled with its potential to significantly enhance road safety, makes it a valuable asset in the ongoing efforts to create safer and more efficient transportation systems.

2. LITERATURE SURVEY

In paper [1], "Rapid Object Detection using a Boosted Cascade of Simple Features" (2001) - Paul Viola and Michael Jones, it isn't specifically about speed detection but introduces the Viola-Jones object detection framework, which has been foundational in the field of computer vision.

In paper [2], "YOLOv3: An Incremental Improvement" (2018) - Joseph Redmon et al. YOLO (You Only Look Once) is a popular framework for object detection that has been adapted for various real-time applications, including vehicle detection in traffic.

In [3], "Simple Online and Realtime Tracking with a Deep Association Metric" (2017) - Wojke, Nicolai, et al. This paper discusses improvements in object tracking, which is essential for applications such as speed detection where objects (vehicles) need to be consistently identified across multiple frames.

In [4], "Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks" (2015) - Ren, Shaoqing, et al. This work introduces advancements in region-based CNNs which are pivotal for accurate and fast object detection, applicable in traffic surveillance systems.

In [5], Moving object detection based on high-speed video sequence images, moving object detection is one of the key technologies in the field of target extraction, pattern recognition and motion measurement. The problem of moving object detection based on high-speed video sequence images is investigated in this paper. First, the high-speed video tracking system is introduced. Second, an improved hybrid detection method combined background subtraction with frame difference is proposed, and the moving object is post-processed by using the threshold area de-noising and morphology filter. Finally, the experiment results show that the proposed method detects the moving object from the high-speed video sequence images precisely and effectively.

In [6], "Over-Speed and License Plate Detection of Vehicles" - Shivraj Dhonde; Jayesh Mirani; Sunit Patwardhan; K. M. Bhurchandi, it deals with the swift expansion of the global economy, cities in various nations may face day to day problems like road congestion, frequent accidents, deterioration of the traffic conditions, or other urban traffic concerns. Vehicle detection technology based on video can collect a wealth of information from video frame sequences, such as vehicle speed, vehicle type, and vehicle number plate, at a cheap cost and with great efficiency. These electronic technologies are not only useful in people's daily lives, but they also provide management with safe and efficient services.

In [7], “Vehicle Speed Detection Using Corner Detection” - K.V. Kiran Kumar; Pallavi Chandrakant; Santosh Kumar; K.J. Kushal, vehicle speed detection is used to estimate the velocity of the moving vehicle using image and video processing techniques. Without any camera calibrations video is captured and analyzed for speed in real time. By employing frame subtraction and masking techniques, moving vehicles are segmented out. Speed is calculated using the time taken between frames and corner detected object traversed in that frames. Finally frame masking is used to differentiate between one or more vehicles. With an average error of +/-2 km/h speed detection was achieved for different video sequences.

In [8], “Vehicle speed detection from camera stream using image processing methods” - Jozef Gerát; Dominik Sopiak; Miloš Oravec; Jarmila Pavlovicová(2017), it deals with the topic of detection of vehicle speed based on information from video record. In theoretical part we describe the most important methods, namely Gaussian mixture models, DBSCAN, Kalman filter, Optical flow. The implementation part is comprised of the architectural design and the description of modes of communication of individual segments. The conclusion comprises the tests of obtained video records using different vehicles, different natures of driving and the vehicle position at the time of recording.

In [9], “A Computer Vision based Vehicle Counting and Speed Detection System” - Faiyaz Ahmad; Mohd Zeeshan Ansari; Shuja Hamid; Mohammed Saad, the number of vehicles on the roads are increasing with every passing year. Appropriate measures are required to gain some information about the traffic density for traffic management. Moreover, higher the number of vehicles on roads, higher are the chances of rash driving and over-speeding. This paper addresses the issue by proposing a vision-based approach to estimate vehicle speed and set up an overall vehicle counter as well a counter of vehicles belonging to different classes. This paper provides practical significance for traffic management on roads. The implementation requires three steps: video acquisition, object detection and multiple object tracking. After video acquisition, the task of vehicle detection is done using YOLOv5 which also classifies the vehicle. To track multiple vehicles in every passing frame of the video, we have used the StrongSORT algorithm which is an improvement of DeepSORT algorithm. The research experiment provided an accuracy of 85.27% for vehicle detection. The accuracy for speed of the vehicles was 87.9% with marginal room for errors from their ground truth values. Moreover, the model performs well in terms of counting the number of vehicles.

3. PROPOSED METHODOLOGY:

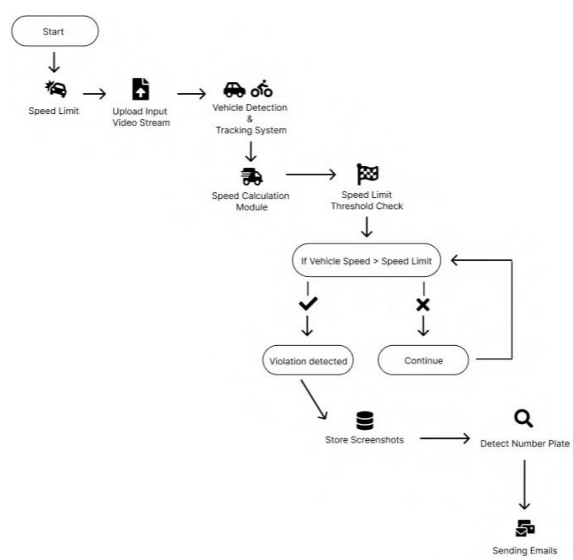


Fig 3.1 Flow Diagram

3.1 Input data Stream:

This module represents the initial step where the system receives a continuous video stream from cameras placed along roadways or at specific checkpoints.

3.2 Vehicle Detection and Tracking Module:

This module utilizes computer vision techniques to detect and track vehicles within the video stream in real-time. It involves algorithms for object detection and tracking to identify vehicles and monitor their movements.

3.3 Speed Calculation Module:

Once vehicles are detected and tracked, this module calculates their speeds based on their movement patterns and distances covered over time. It involves algorithms to compute vehicle speeds accurately.

3.4 Speed Limit Threshold Check:

This module compares the calculated speeds of vehicles against predefined speed limits for the respective road segments or areas. It determines whether a vehicle is exceeding the speed limit threshold.

3.5 Violation Detected:

If a vehicle is detected exceeding the speed limit threshold, this module triggers actions to capture evidence of the violation. It includes capturing a screenshot of the violating vehicle and storing relevant metadata such as timestamp, location, and speed information.

3.6 Footage Recording:

This module records the entire video footage along with corresponding speed information for future reference and analysis. It ensures that all recorded data is stored for further scrutiny or action.

3.7 Number Plate Detection and Emails:

This module detects the number plates of vehicles that exceed the speed limit using plate recognizer API. It extracts number plates and automatically sends an email notification to the respective vehicle owners, informing them of the speeding violation and providing relevant details.

4.IMPLEMENTATION:

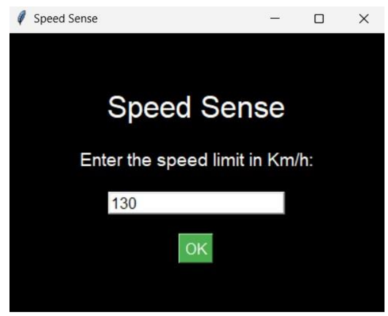


Fig 4.1 Entering speed limit

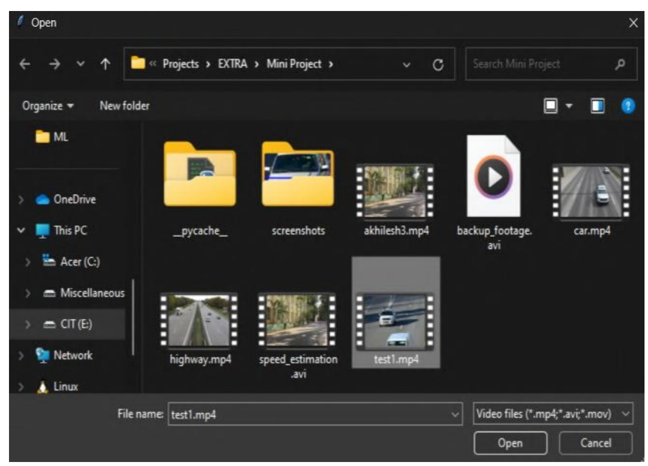


Fig 4.2 Uploading video file

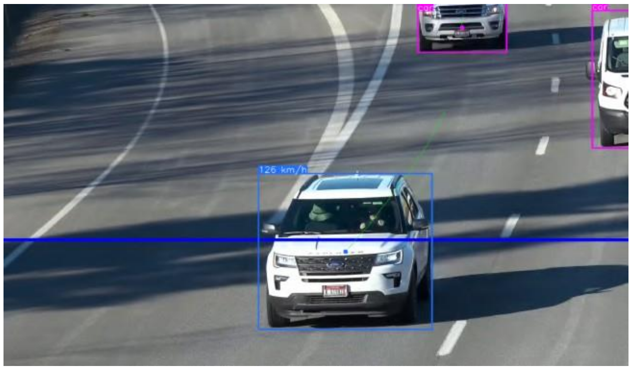


Fig 4.3 Object Detection

Fig 4.4 End of video processing

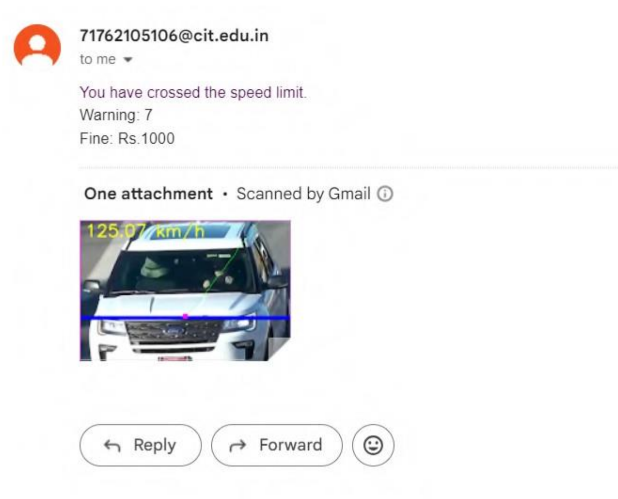
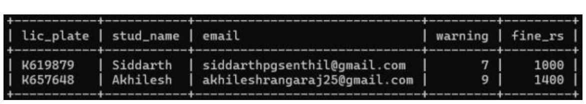


Fig 4.5 Email notification



lic_plate	stud_name	email	warning	fine_rs
K619879	Siddarth	siddarthpgsenthil@gmail.com	7	1000
K657648	Akhilesh	akhileshrangaraj25@gmail.com	9	1400

Fig 4.6 Sample database

5. CONCLUSION

In summary, the "Speed Sense" project has effectively accomplished its objective of identifying vehicle speeds and recording instances of vehicles exceeding a designated threshold within campus environments. By leveraging YOLO object detection for real-time tracking and speed estimation, the system accurately identifies speeding vehicles. The ability to save captured instances for further analysis enhances its utility for traffic monitoring and law enforcement purposes.

The integration of number plate recognition APIs enables the extraction of vehicle details, facilitating better enforcement and record-keeping. Additionally, in forthcoming endeavors, we intend to refine the system by enlarging the captured screenshots to enhance clarity and precision. Implementing real-time alerts for overspeeding vehicles will enable prompt intervention, further enhancing road safety measures. These developments will make our system more robust and effective in monitoring and regulating traffic flow within constrained environments such as colleges or offices.

6. REFERENCES

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[3]. Simple Online and Realtime Tracking with a Deep Association Metric

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