Deep Learning Aided Traffic Violation Detection Using Video Footage

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Declaration

"The work described in this thesis was carried out by me and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree"

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Abstract

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ABSTRACT

This dissertation investigates the application of deep learning techniques to detect traffic violations using video footage, with a focus on vehicle dash camera data. The study targets violations such as illegal lane crossing, helmet non-compliance, illegal parking, and turns without signal lights. Leveraging models like LVLane and YOLO, the research addresses the inefficiencies of manual analysis, aiming to enhance law enforcement efficiency and road safety. Preliminary findings indicate challenges in dynamic video analysis and lane type detection, with ongoing efforts to fine-tune models for Sri Lankan road conditions.

1 Introduction

Traffic violations, driven by reckless driving and inadequate enforcement, pose significant risks to road safety. Manual analysis of violation footage is inefficient, necessitating automated, AI-powered solutions. This research explores deep learning techniques to detect violations from video footage, aiming to improve law enforcement efficiency, reduce accidents, and enhance road discipline.

2 Literature Review

Prior studies provide a foundation for traffic violation detection using computer vision and deep learning.

2.1 Traffic Violation Detection Systems

Existing research highlights varied approaches to violation detection.

2.1.1 Computer Vision-Based Methods

Adikari and Karunarathne (2019, 2020) explored fixed CCTV-based systems and mathematical modeling, but these lack focus on dynamic video and deep learning, limiting applicability to our needs.

2.1.2 Deep Learning Approaches

Mohammed (2023) proposed a smart detection system, yet poor documentation and lack of dynamic video analysis reduce its relevance.

2.2 Lane Detection Techniques

Lane detection is critical for identifying illegal lane changes.

2.2.1 Spatial CNN and Variants

Pan et al. (2018) introduced Spatial CNN, a foundational method, though it lacks lane type support. Qin et al. (2020) advanced this with Ultra-Fast Lane Detection, offering speed but no categorization.

2.2.2 LVLane

Rahman and Morris (2020) developed LVLane, supporting lane type detection with robust documentation, making it suitable for this study despite being relatively new.

3 Materials and Methods

This section details the methodology for developing the detection system.

3.1 Research Design

The study adopts a quantitative approach, focusing on vehicle dash camera footage due to its prevalence in capturing violations.

3.1.1 Model Selection

Criteria include adaptability to dynamic conditions and lane type detection.

I LVLane Selected for lane detection due to its rich toolset and support for lane types, fine-tuned for Sri Lankan roads.

II YOLO Pre-trained YOLO models are planned for helmet and parking violation detection, enhanced via transfer learning.

3.2 Data Collection

3.2.1 Data Sources

Data primarily comprises dash camera footage, supplemented by police department collaboration and controlled simulations where feasible.

3.3 Data Analysis

3.3.1 Deep Learning Techniques

Tools like PyTorch, SciPy, and VGG assist in model training and lane annotation.

4 Results

Initial progress shows that traditional methods like Hough Transformation fail in challenging conditions (e.g., curved roads). Deep learning models, particularly LVLane, demonstrate promise, though fine-tuning for local conditions is ongoing.

5 Discussion

Findings align with literature emphasizing the need for dynamic video analysis. Challenges include data annotation and model generalization to diverse road environments.

6 Conclusions

Deep learning offers a viable solution for traffic violation detection, with potential to scale enforcement efforts. Future work will refine models and expand violation coverage.

References

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Appendices

Appendix A: Methodology Details

Detailed configurations for LVLane and YOLO models will be included upon completion of fine-tuning.