Development of an Electrical and Software Solution for the Automated Enforcement of Bus-Only Lanes and Bus-Only Crossings

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Project Description

Background & Problem:
The City of Calgary utilizes bus-only lanes and bus-only crossings as a means of prioritizing transit. Unauthorized vehicles often use these lanes and crossings, leading to an increase in transit time. Currently, there is no automated enforcement system for bus-only lanes. Bus-only crossings are enforced with an automatic gate and/or bus trap system. However, gates require frequent maintenance and bus traps can disrupt transit service.

Project Objective:
The objective of this project is to leverage cameras and other technologies to design a low-maintenance low-cost automated enforcement system for bus-only lanes and bus-only crossings. The enforcement system for bus-only lanes should utilize the front-facing onboard cameras that are currently installed in Calgary Transit’s fleet of buses. For bus-only crossings, the enforcement system will require new cameras.

Project Deliverables:
1. A hardware proof-of-concept that captures footage and other inputs from the bus-only lanes and crossings, then transmits to a server.
2. A software tool that identifies non-authorized vehicles and pedestrians, enabling relevant authorities to keep track of violations and issue tickets.
3. A review of existing technology and literature.

Design Concept

The team tested the proof-of-concept for the two applications at multiple field locations to verify the veracity and reliability of the design.
- The proof-of-concept recorded footage with the appropriate triggers.
- The footage was successfully transmitted to the server.
- The image processing model at the server-side was able to detect violations.

Discussion
- The positioning of the proof-of-concept proved to be important. Each location is different and requires a unique setup.
- Environmental conditions (snowfall, night-time, etc.) can severely impair the effectiveness of the enforcement system. Real-world applications must take these factors into consideration.
- The effective range of the lane application was limited by the camera specifications. For future implementations, it is recommended to use a camera with greater zoom and resolution.
- Training the image processing model was time- and resource-intensive. The greater the desired accuracy, the more data needs to be fed into the model.

Conclusion
The team was able to design a low-maintenance low-cost automated enforcement system for bus-only lanes and bus-only crossings. However, there are numerous challenges that need to be overcome for future real-world implementations if the enforcement is to be effective. These challenges include striking a balancing between cost and high hardware Specifications, accommodating environmental conditions, and extensively training the image processing model to handle all plausible scenarios.

Implementation

Bus-Only Lane Application

Bus-Only Crossing Application

Results

Testing
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