

**School of Computer Science**

**Masters in Applied Computing (M.A.C)**

**COMP8157**

**Advanced Database Topics**

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**Project Proposal**

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# Introduction:

Traffic congestion and violations are major challenges faced by cities across the world. To tackle these issues, we present a smart traffic system that leverages computer vision technology to effectively monitor and regulate traffic. The smart traffic system aims to improve road safety and reduce the number of road accidents by detecting traffic violations using computer vision. The system is designed to detect violations such as jumping a red light and record the plate number of the vehicles involved. The recorded information will be used to send an e-ticket to the violator. With its efficient and secure operation, our smart traffic system aims to reduce congestion, improve road safety, and make the process of enforcing traffic rules more streamlined and hassle-free. By using our smart traffic system, cities can expect to see a significant reduction in traffic violations and a noticeable improvement in traffic flow, helping to alleviate the financial and social costs of traffic congestion.

# Problem statement:

As per Ontario Ministry of Road Transportation, there have been a significant reduction in road accidents in recent years. However, despite of global pandemic, 72,917 road accident occurred in Canada in 2020 which caused death of 1745 victims. Among which 33.2% of drivers were not wearing seatbelt, 25.3% were driving over the speed limit and 17.6% were impaired at the time of incident. Furthermore, distracted driving such as use of mobile phones or dashboard screen also caused death of 45 people in Ontario itself.

Running red lights, speeding, and illegal parking have become major issues that cause traffic jams and accidents on the road. An automated system is required to correctly identify and implement these infractions. The aim is to create a system that is capable of:

* Determine the type of crime (e.g., running red light, speeding)
* Find the offending car by scanning licence plate
* Give proof of the infraction and fine accordingly (such a photo or video of the incident)

# Motivation for solution:

The road traffic regulations play pivotal role in our day-to-day life. It is necessary to make sure everyone who is driving or walking on the roads are safe. With the ongoing trend of buying cars of their own, there is a huge increase in private car owners. This results in traffic rules violations. Canada has huge road network of around 900,000km long, which needs to be monitored on daily basis for safety and to avoid unwanted incidents. These incidents can be anything like drunk driving, speeding, reckless driving, driving without a licence etc. According to data, “there are around 160,000 car accidents each year in Canada” (tests.ca, 2021). This is a huge number of accidents which needs to be prevented. As per the Canadian government,” there have been total 101,572 injuries in road accidents in 2020. Out of this 7868 were serious injuries and 1591 were fatal injuries” (Canada, 2021). These are some of the shockingly high number only due to traffic rules violations, this can be prevented by simple use of technology.

Additionally, increasing use of technology and fast paced life is diminishing value of human lives in some ways. These human lives need to be preserved and cared for by avoiding accidents or punishing the people who are causing it. The current traffic violation system is only recognising the violations of the traffic signals. However, this is not enough to provide road safety. The new traffic system named “Smart Traffic System” deals with various types of traffic violations like running red light, speeding, not wearing seat belt, reckless driving and many more. These traffic violations will be recognised by the traffic cameras, the “Smart Traffic System” implanted in cameras will scan the car’s licence plate and generate e-ticket. This helps the traffic police with the workload and less margin for error due to human factor. The e-ticket will also make it easy to pay the fines online instead of visiting the facility and waiting for hours in the queue.

# Methodology:

We have conducted research and tried finding existing solutions, and we have found that researchers such as Shinde et. al (2019) have used YOLO for traffic flow management and other computer vision techniques for traffic management. S. Nayak et. al (2019) also stated in their research that they have used computer vision techniques in MATLAB to assist in reducing traffic congestions and violations. After careful consideration, we have chosen a tech stack and methodology for our project which may change as the project progresses. The advanced traffic management system will employ computer vision algorithms and deep learning to identify traffic infractions. The cameras situated at crossroads will take pictures which will then be inputted into the system for evaluation. The system will utilize image processing methods to recognize the existence of a car at the intersection and determine whether it ran a red light. The license plate number of the vehicle will be extracted and documented. The collected information will be utilized to create an electronic ticket and send it to the offending party. The database will already have the license and owner information, which will make it possible to send electronic tickets to the offending party.

## Methodology for the project development:

For this project we will be using SCRUM which is an Agile software development methodology. We will make some minor changes to the SCRUM methodology to incorporate the availability of the team.

### SCRUM:

1. Define product backlog: A product back log will be created to ensure that the requirements are captured early on and the inception to planning phase of the project development is completed.
2. Plan sprints: Sprints will be 2 weeks long. Each sprint will have its own sprint backlog and each team member will be assigned a ticket from the sprint backlog.
3. Hold weekly meetings: The team will have a weekly meeting to make sure that the project is going as planned, and the team can have more than one meeting in a week, if required. The team will discuss the progress of their tasks in this meeting and will highlight any issues.
4. Review and retro: At the end of each sprint, a retrospective meeting will be held to explore any problems faced in the previous sprint and to plan the new sprint.
5. Repeat the process: Repeat the process of planning, developing, and reviewing for each sprint until all the items in the product backlog have been completed.

## Milestones for the project deliverables:

### Milestone 1 (February 28th):

1. Develop the computer vision algorithms: Collect dataset or prepare a new dataset for training the computer vision model.
2. Develop the computer vision algorithms: Choose appropriate computer vision algorithms to detect traffic violations. Create model for extracting license plate from images.
3. Implement the system components: Start implementing the system components, including the camera, computer vision algorithms, and data storage/database and retrieval system.
4. Test the system: Test the system components to ensure they work as expected.
5. Evaluate the performance: Evaluate the performance of the computer vision algorithms and make any necessary improvements.

### Milestone 2 (March 28th):

1. Integrate the system components: Integrate the camera, computer vision algorithms, and data storage and retrieval system into a single system.
2. Test the integrated system: Test the integrated system to ensure it functions as intended.
3. Deploy the system: Deploy the system in a real-world environment and monitor its performance.
4. Evaluate and refine the system: Evaluate the performance of the system and refine it based on the results.
5. Prepare documentation: Prepare comprehensive documentation on the system, including its design, implementation, and performance.

# Technology:

* Computer Vision: OpenCV, TensorFlow
* License Plate Recognition: ALPR API (Automatic License Plate Recognition)
* Stop sign and Speed detection of road: Google Roads API
* Object Detection: YOLOv3, Faster R-CNN
* E-ticketing System: Node.js, Laravel
* Database: Firebase

# References:

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3. PyTorch, "PyTorch - An Open Source Machine Learning Library," [Online]. Available: https://pytorch.org/. [Accessed: 31-Jan-2023].
4. Node.js, "Node.js - A JavaScript runtime built on Chrome's V8 JavaScript engine," [Online]. Available: https://nodejs.org/. [Accessed: 31-Jan-2023].
5. Laravel, "Laravel - The PHP Framework For Web Artisans," [Online]. Available: https://laravel.com/. [Accessed: 31-Jan-2023].
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7. P. Shinde, S. Yadav, S. Rudrake, and P. Kumbhar, "Smart Traffic Control System using YOLO," in [International Research Journal of Engineering and Technology (IRJET)], [Dec 2019].
8. S. Nayak, K. Patel, E. Vasani, K. Katakiya, "Machine Vision Based Intelligent Traffic Management Tool," in [IJRAR International Journal of Research and Analytical Reviews], [2019].

# Important links:

1. <https://smartlifestyle.atlassian.net/jira/software/projects/AD/boards/4>
2. <https://github.com/hamzaBaig1998/COMP-8157-ADT>