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# ANALYZING THE NECESSITY OF ADAPTIVE TRAFFIC CONTROL SYSTEMS (ATCS) IN SRI LANKA

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**ABSTRACT** -Traffic congestion emerges as a significant concern, further amplified by the increasing population and urbanization rates. The rise in vehicular and pedestrian traffic contributes significantly to traffic congestion, exacerbating issues related to mobility, sustainability, and environmental health. Implementing effective traffic management strategies is critical for mitigating these challenges. The objective of this study is to enhance the performance of existing Traffic Control Systems and to analyze the coordination of junctions using micro stimulation software. Using this microsimulation software, it is possible to analyze traffic video footage from the junction under study and extract important traffic flow data for analysis. Despite the availability of numerous studies, a significant gap remains in effectively using simulation models to address congestion issues in Sri Lanka. This study seeks to close this gap by investigating the most effective use of microsimulation software for traffic management in Sri Lanka.

**Keywords:** traffic congestion, microsimulation software, traffic control system

## 1. INTRODUCTION

Traffic congestion in cities, particularly during peak hours, has become a major concern worldwide, with the impact increased by rising population and urbanization rates(Juan Lu et al., 2020).The increase in vehicular and pedestrian traffic not only exacerbates mobility issues, but also threatens sustainability and environmental health (Fattah et al., 2022).In Sri Lanka, the rapid proliferation of vehicles, combined with rapid urbanization, has increased these issues, resulting in severe traffic congestion in city centers. One of the main issues contributing to this congestion is the incapacity of existing traffic control systems to manage peak-hour traffic effectively. These systems often rely on conventional traffic lights, which become saturated when the volume of vehicles exceeds their capacity. This saturation problem is further compounded by the lack of real-time adaptability in these systems, which are frequently preprogrammed rather than dynamically responsive.As a result, police officers are increasingly relied upon to manually control traffic flow at congested intersections. While this approach may alleviate some of the immediate congestion, it also introduces new challenges. High traffic delays, increased fuel consumption, health risks to officers, and inefficient use of labor resources are among the significant impacts associated with this method. As a result, police officers are increasingly expected to manually control traffic flow at congested intersections. While this strategy might reduce some of the immediate congestion, it also creates new challenges. This method has significant consequences, including high traffic delays, increased fuel consumption, health risks to officers, and inefficient use of labor resources. (Greenwood et al., 2007) (Marois et al., 2019).This study aims to close existing gaps in traffic management by focusing on signalized intersections. It seeks to assess delays at these intersections over four legs using appropriate methodologies. The gathered data will then be used to develop a novel adaptive traffic control system that can adjust in real time based on traffic conditions. The study's objectives include identifying key parameters such as variations in signalized intersection cycle times and vehicle behavior. It also aims to understand the dynamics of traffic management by law enforcement officers during peak hours. To achieve these objectives, a decision framework will be developed to effectively replicate and integrate this information. Validation of these objectives will be conducted using microsimulation techniques, ensuring the reliability and accuracy of the proposed model. Finally, the research aims to make a significant contribution to the development of more efficient and adaptive traffic management strategies. These strategies hold the potential to alleviate the adverse impacts of congestion on mobility, sustainability, and environmental well-being in urban areas of Sri Lanka.

## 2. MATERIALS AND METHODS

The initial step in this methodology is to calculate the stopped-time delay, which involves conducting two surveys: a pilot survey and a main survey. **This research is ongoing, and thus far, only the pilot survey has been completed**. The purpose of this study was to determine the time it takes to travel from one point to another along specific routes within this intersection. The primary goals of this study were to evaluate the quality of traffic movement along these routes, identify potential congestion points, determine the causes and extent of delays, and compare pre- and post-implementation results.The study focused on analyzing stopped-time delay, which is the time a vehicle spends stationary in a queue while waiting to cross an intersection. This delay begins when the vehicle comes to a complete stop and ends when it accelerates again. The average stopped-time delay was calculated using the mean delay experienced by all vehicles within a given time frame (Saito & Forbush, 2011).

### 2.1. Pilot Study -Vehicle Registration Number Plate Survey

The main reason to conduct a pilot study before the main study was to identify the most accurate and efficient data collection method and verify the suitability of the chosen controllable parameter for further research.A number plate survey involves strategically positioning observers along the route who are trained to document vital data such as number plates, vehicle types, axles, and passing times (Anagnostopoulos et al., 2008).A Vehicle Registration Number Plate Survey was conducted at the Galkanda Junction, Negombo to address some of the questions raised. The pilot survey consisted of a single 30-minute recording session held in the afternoon around 5 p.m. The Galkanda junction is a four-legged intersection. During the pilot survey, vehicles were monitored at four stations, each covering one direction of traffic flow. This method facilitated the matching of vehicle sightings and allowed for the evaluation of data accuracy. During the number plate survey, 500 vehicle sightings were recorded, which included approximately 6 different vehicles.The main challenge in recording vehicle details, including number plates, was not the speed of the vehicles, but their frequency. When multiple vehicles passed in groups, it was difficult to keep up with the recording task, potentially obscuring one or more of the vehicles.

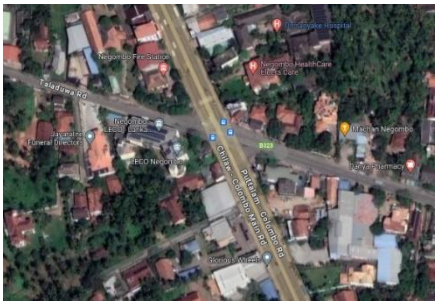


**Figure 1-Galkanda Junction, Negombo**

### 2.2. Main Study: CCTV Footage Analysis

The main study will analyze and simulate traffic flow patterns using CCTV footage to gather comprehensive travel time data. Potential signalized four-legged intersections with existing CCTV capabilities will be identified, and permissions will be obtained to access footage. Recording schedules will be set up to capture traffic behavior at various times of day, with footage from all legs of the intersection retrieved for analysis. Software will be used to extract key traffic parameters, with a focus on stop-time delays and congestion points. The data will then be imported into the micro simulation software to model current traffic conditions and evaluate the efficacy of adaptive traffic management systems. The results will be compared to the baseline data to evaluate adaptive traffic control measures and recommend strategies tailored to specific intersection challenges.

## 3. RESULTS AND DISCUSSION

### 3.1. Pilot Survey Results

The results of this pilot survey indicate that there is a high frequency of closely spaced vehicles (1-minute gaps), which could benefit from adaptive traffic control systems to manage and optimize traffic flow, reduce stop-time delays, and alleviate congestion. The main survey, which includes CCTV footage analysis, will help to validate these findings and aid in the development and implementation of effective traffic management strategies.The histogram analysis shows that vehicle flow was highest early in the observation period, peaking around the 20-30 second mark with approximately 35 vehicles. This suggests a significant increase in traffic at first, followed by a gradual decrease in vehicle counts with noticeable fluctuations. The distribution's slight right-skewness and variability across intervals highlight the dynamic nature of traffic flow, which has generally decreased over time. The expected outcomes of this research is to provide critical insights into traffic behavior and congestion dynamics at any intersection and propose an adaptive traffic control system as a pivotal solution to congestion issues. The study uses a detailed analysis of stopped-time delays to uncover patterns in vehicle behavior, identifying the specific leg of the intersection with the highest delay incidence. Furthermore, it intends to investigate the root causes of these delays, with a focus on the movements that contribute the most significantly to congestion.

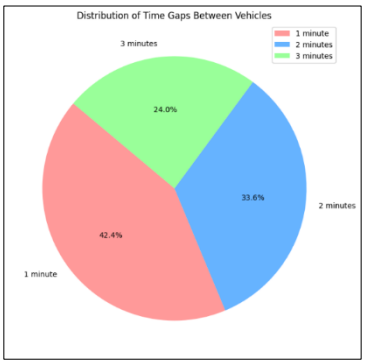


**Figure 2-Distribution of Time Gaps between**

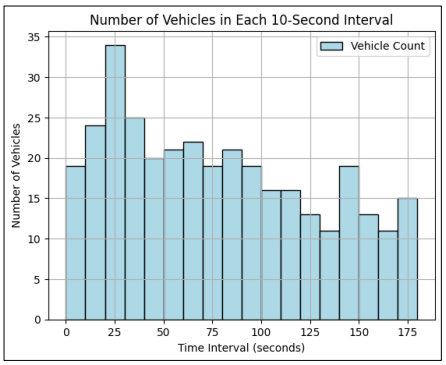


**Figure 4-Number of Vehicles in each 10 second interval**

The development of an adaptive traffic control system tailored to intersection challenges is a critical component of the expected results. This innovative system uses advanced microsimulation software to dynamically respond to real-time traffic conditions, providing a proactive approach to congestion management. By incorporating sophisticated delay recognition capabilities, the proposed system has the potential to intelligently regulate traffic flow, addressing bottlenecks and increasing intersection efficiency.

## 4. CONCLUSION

In conclusion, this study addresses the pressing issue of traffic congestion in Sri Lanka by conducting diverse research and developing innovative solutions. Using microsimulation software and travel time surveys, it identifies key congestion points and proposes an adaptive traffic control system tailored to intersection challenges. The findings provide important insights into traffic behavior and congestion dynamics, paving the way for more effective and sustainable traffic management strategies. Finally, this research contributes to improving urban mobility, sustainability, and environmental well-being by providing an overview for mitigating the negative effects of congestion on both societal and economic levels.

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