**The Open University of Sri Lanka**

**Faculty of Engineering Technology**

**Bachelor of Software Engineering Honors**

**Department of Electrical and Computer Engineering**

**EEX5362 – Performance Modelling**

**Academic Year 2024/2025**

**Deliverable 1**

**Name: ZNM.Begum**

**S id: s92060365**

**Reg No: 121420365**

**Smart Traffic Light Control System**

**1. High-Level Problem Description**

Urban traffic congestion has become a major issue in modern cities due to increasing vehicle density and inefficient traffic signal management. Traditional traffic light systems operate using fixed timers, regardless of the actual traffic flow at intersections. This leads to unnecessary waiting times, wasted fuel, and increased air pollution.

To address these inefficiencies, a Smart Traffic Light Control System is proposed. The system leverages sensors, IoT devices, and intelligent control algorithms to dynamically adjust traffic signal timings based on real-time traffic conditions.

System Overview

The Smart Traffic Light Control System continuously monitors vehicle flow and adjusts light durations to optimize traffic movement. It collects real-time data from multiple intersections, processes it using decision-making algorithms, and updates the light cycles accordingly**.**

**Key Components:**

* Sensors: Installed at intersections to detect the number of vehicles, their speed, and queue length.
* Controller: Processes sensor data and makes dynamic signal timing decisions.
* Network Communication: Connects all traffic controllers for coordinated multi-intersection management.
* Dashboard Interface: Displays system metrics and real-time traffic status for monitoring by administrators.

**Key Benefits:**

* Reduces average waiting time for vehicles.
* Improves overall traffic flow and throughput.
* Decreases fuel consumption and vehicular emissions.
* Enhances scalability for growing urban areas.

**2. Performance Objectives**

**The performance of the Smart Traffic Light Control System will be evaluated based on measurable characteristics that define system efficiency and responsiveness.**

|  |  |  |
| --- | --- | --- |
| Performance Objective | Performance Metric | Description |
| Minimize Average Waiting Time | Average waiting time per vehicle (seconds) | Reduce queue time by adapting signal durations dynamically. |
| Maximize Throughput | Number of vehicles passed per minute | Ensure more vehicles move through intersections efficiently. |
| Optimize Resource Utilization | CPU and network usage | Maintain real-time performance with minimal system resource load. |
| Reduce Fuel Consumption | Estimated fuel usage per vehicle | Lower idle times to save fuel and reduce emissions. |
| Enhance Scalability | Response time under increased intersections | Ensure system performance remains stable as the number of intersections grows. |

**3. Dataset Description**

The dataset includes vehicle counts, queue lengths, signal states, and waiting times, all measured at different times of the day and across multiple lanes (North, South, East, and West).

**Dataset Overview**

|  |  |
| --- | --- |
| Attribute / Field | Description |
| Intersection\_ID | Unique identifier for the traffic intersection (e.g., A1, A2). |
| Date | The date when data was recorded. |
| Time | The specific time slot (e.g., 07:00, 08:00). |
| Lane | Direction of the lane (North, South, East, or West). |
| Vehicle\_Count | Number of vehicles detected in the lane during the time interval. |
| Avg\_Waiting\_Time (sec) | Average waiting time for vehicles during the red signal. |
| Signal\_State | Current signal light state (Red, Yellow, Green). |
| Queue\_Length (vehicles) | Number of vehicles queued during red light. |
| Avg\_Speed (km/h) | Average vehicle speed measured in the lane. |

**Data Usage**

This dataset will be used to:

* Analyze the relationship between vehicle count, waiting time, and signal state.
* Identify peak-hour traffic patterns and bottlenecks.
* Evaluate how adaptive traffic light control can reduce waiting time and queue lengths.
* Simulate throughput and fuel consumption improvements.

**4. Expected Outcomes**

Using this dataset, the Smart Traffic Light Control System is expected to demonstrate:

* A measurable reduction in average vehicle waiting time compared to fixed-time control.
* Increased throughput during both peak and off-peak hours.
* Improved scalability and responsiveness across intersections.
* A potential reduction in fuel consumption and emissions due to less idle time.

**5. Summary**

This project focuses on the design and performance evaluation of a Smart Traffic Light Control System aimed at optimizing urban traffic management.  
By using data-driven decision-making and a realistic dataset, the system can reduce vehicle delays, improve throughput, and enhance overall traffic efficiency.  
Performance will be measured based on waiting time, throughput, and scalability under varying traffic loads.