INF 4178 - Software Engineering I

Practical Work

May 2025

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1. Project Definition

Project Title:
Mathematical Modeling and Simulation of a Sensor-Based Traffic Light Control System

2. Problem Description

Traffic congestion and long waiting times at signalized intersections are persistent challenges in urban mobility systems. These issues not only affect vehicle flow but also impact pedestrian convenience and safety. To enhance intersection efficiency, modern traffic light systems often incorporate inductive loop sensors embedded in the pavement and video detection systems. These sensors can detect and count vehicles in each lane, determine the number of pedestrian wishing to cross the road at each of the four lanes, providing real-time data on traffic conditions.

This project focuses on modeling a traffic light control system at a four-approach junction equipped with inductive loop sensors for vehicular detection and video detection systems for detecting waiting pedestrians. The goal is to develop a mathematical model that dynamically adjusts green light durations based on traffic density and pedestrian presence, aiming to reduce overall vehicle congestion and minimize waiting time for both vehicles and pedestrians.

Students are encouraged to use any suitable mathematical modeling approach—such as queuing theory, discrete event simulation, fuzzy logic, Petri nets, Markov decision

processes, optimization techniques or any other approach—to represent and analyze the system. The model should simulate various traffic scenarios and evaluate the system's performance with respect to vehicle and pedestrian overall waiting time.

3. Scope of the Project

- Model a single four-way intersection with predefined traffic phases.
- Assume two types of sensor are used, inductive loop sensors and video detection systems.
- Implement and simulate the system using any technique of your choice.
- Project should be realized per group of 1-4 students