Dynamic Traffic Control System

ECE 576 – Engineering of Computer Based Systems
Course Project

Project Description

Designing a dynamic traffic control system intended to increase the efficiency of the flow of traffic through busy city streets while automatically adapting to traffic patterns and changing conditions, including weather, accidents, etc. While existing traffic control systems include some limited dynamic controls, such as ground induction loops and traffic cameras for monitoring the number of cars at a stop light, speed sensors embedded in the road, and synchronized light timing, such systems are often static in general. Throughout this semester, you will be designing and implementing a dynamic traffic control system that is scalable, distributed, and provides increased traffic flow and reduced wait times for drivers.

Groups: You are required to work with ***ONE*** partner for the course project. Once you have chosen a partner you will be required to work with that partner for the duration of the semester. Please choose your partner carefully.

Multi-group Efforts: Multi-group efforts will be permitted on a case by case basis for the second and third phase of the project. Such efforts must focus on developing two distinct but interrelated components that will interact with each other to provide an overall system design more complex than the individual groups could accomplish on their own. Fell free to discuss ideas with other groups and the instructor throughout the first phase and in the planning stages of the second phase.

Phase 1: Initial System Design/Specification *(25%)*

(Due March 14)

Design and implement a simple dynamic traffic control system for a single four-way intersection. Design, implementation, and integration of your traffic control system within a graphical traffic simulation environment. The following provides an overview of the components and requirements you must consider in designing your traffic control system. You must provide a detailed specification, implementation, and system evaluation report along with all code and documentation for you code.

- The traffic control system and simulation environment should be implemented as two distinct components. The traffic control system should be modeled as a state-based implementation, with each state clearly defined.
- The intersection model should consist of two lanes of through traffic and one protected left-turn lane in each direction. Each lane has ground loop inductors for detecting the presence of vehicles at the intersection, two car lengths back from the intersection, and seven car lengths back from the intersection. Your traffic control system should use the information from the ground loop inductors to adjust light timing.
- Designs metrics for the traffic control system include, but are not limited to, average vehicle throughput per green light, average wait time, and average car speed.
- Your simulation environment should incorporate multiple simulation situations, such as heavy traffic during peak commuting times, light traffic at night, moderate traffic on the weekends, etc. Do not hardcode simulation situations, but rather allow for an efficient mechanism for specifying the traffic behavior.
- Your simulation environment should consist of a graphical interface depicting the intersection and traffic. The graphical interface does not needs to be extremely detailed, but should have a clear indication of the intersection lanes, current light configuration, cars waiting at the intersection, etc. While you do not need to model the exact movement and speed of cars, you are welcome to do so if time permits. You may use any programming language to implement your traffic control system and simulation environment. Suggested programming languages include C/C++ with OpenGL or Java.

Phase 2: Project Proposal *(25%)*

(Due March 28)
Write a proposal/specification detailing your proposed scalable, distributed dynamic traffic control system implementation. The following provides an overview of the components and requirements for this project phase. However, due to the individuality of each project not all requirements will apply to each project. You must provide a detailed specification of your proposed project and clearly indicate all components that will be developed during the third phase of your project.

- The traffic control system and simulation environment should consider multiple intersections and streets.
- *Scalability*: A scalable traffic control system should allow the same system design to be integrated at any intersection throughout a city and provide seamless interoperability.
- *Distributed:* A distributed traffic control system should communicate traffic information between intersections to allow for the system to dynamically adjust to changing traffic speed, congestion, etc.
- *Dynamic:* A dynamic traffic control system should be able to dynamically change the light timing to increase traffic flow as the traffic characteristics change and accommodate dynamic events, such as emergency vehicles, accidents, or provide real-time traffic re-routing.
- *Research:* All groups ***MUST*** provide one relevant paper related to dynamic traffic control that applies to their proposed project.
- *Approval:* All groups ***MUST*** meet with the instructor during the week of March 20-24 to discuss the scope and appropriateness of the proposed project.

Phase 3: Project Implementation *(50%)*
(Due May 2)

Design and implement the proposed project and provide a detailed specification, implementation, and system evaluation report along with any code and documentation for you code. The final project report is due on May 2, but each group ***MUST*** demonstrate their final project implementation during the week of April 24-28.