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# Intelligent Traffic Light Scheduling Technique Using Calendar-Based History Information

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## Abstract

One of the most serious problems that are due to the vast increase in the number of vehicles, is the traffic congestion. The severe traffic congestion in modern large cities puts huge pressure on the decision makers to invest in planning and deploying solutions to this problem. Using a proper traffic management methodology could alleviate the traffic congestion problem and contribute to the reduction in traffic jams. Several algorithms for traffic management were presented in the literature. In this paper, we propose a new novel history-based traffic management algorithm that relies on the previous all-year traffic information to predict the traffic flow on congested streets of a crowded city. Thus, we refer to this proposed technique as a calendar-based traffic congestion management system. The main idea is to use the recorded traffic history information to compute the green/red times for each direction on a congested intersection with a traffic light controller. A robust heuristic is proposed to use the history information in predicting the future traffic load on each street leading to an intersection controlled by a traffic light. The proposed algorithm is implemented and tested using MATLAB and the well-known traffic simulator, SUMO. Simulation results show that the proposed algorithm optimizes the traffic flow up to 18% more than a standard traffic system. We also apply the proposed algorithm using a multi-intersection model composed of a mesh of 4x4 intersections, and compare the results with other traffic time management approaches, such as the History-Based Self-Organizing Traffic Lights, HB-SOTL. The proposed algorithm outperforms HB-SOTL by about 18%.

*Keywords:* Intelligent Traffic System, Traffic Management, Traffic Control, History Information, Traffic Simulator, SUMO.

## 1. Introduction

Traffic congestion in urban cities continues to cause huge waste in both drivers and people time, huge increase in the emission of bad gases that contribute to environmental destruction, huge waste of gallons of excess fuel consumption from vehicles that raise the annual fuel bills of countries, large increase in the rate of bad driving behaviors (road rage) on streets, large increase in the number of road accidents, and vast increase of health problems and in death rate [1].

Therefore, traffic congestion is indeed a critical problem and a major concern to transportation specialists and decision makers in almost all countries to invest in planning and deploying solutions to this problem. To mitigate the traffic congestion problem, municipalities tend to construct wide roads with multiple lanes, and build tunnels and bridges at intersections. These solutions are costly, time-consuming to implement and sometimes impossible to construct. As such, other possible solutions attempt to target road intersections, where most traffic jams occur, by using smart traffic controllers implementing adaptive traffic time management. Such solutions were presented in many articles to provide efficient mitigation to the traffic congestion problem (e.g., [2] and [3]). However, they do not utilize previous all-year traffic information to predict the traffic flow on congested road intersections. We believe that if such information is available

and utilized, it will provide further reduction in traffic jams. Thus, in this paper, we propose a new novel history-based traffic management algorithm that relies on the previous all-year traffic information to predict the traffic flow on congested road intersections of a crowded city. We refer to this proposed algorithm as a calendar-based traffic congestion management system. The main idea is to use the recorded traffic history information to compute the green/red times for each direction on a congested intersection with a traffic light controller. A robust heuristic is proposed to use the history information in predicting the future traffic load on each road leading to an intersection controlled by a traffic light. The proposed system is validated through simulation using MATLAB and the well-known traffic simulator "Simulation of Urban MObility", SUMO [4].

The rest of paper is organized as follows. Section 2 provides an overview of existing techniques for smart traffic light controllers at road intersections in addition to the main contributions of this paper. Section 3 describes the proposed calendar-based traffic congestion management system. In Section 4, the experimental results are discussed and compared with one of the state-of-the-art published reports, the History-Based Self-Organizing Traffic Lights (HB-SOTL). Lastly, Section 5 concludes the paper with final comments and future directions.

## 2. Related Work

There are many techniques proposed in the literature to deal with the traffic congestion problem. Most of the techniques

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