University of Ottawa
ELG 5142 Term Project Proposal
"Intelligent Traffic Management System"
Group 4

Selected Article

Mandal, P., Chatterjee, P., & Debnath, A. (2019). An intelligent highway traffic management system for smart city. In Intelligent Computing: Proceedings of the 2019 Computing Conference, Volume 1 (pp. 1-10). Springer International Publishing.

I. Introduction

In the realm of Smart Cities, where intelligent control systems aim to enhance the quality of living, one critical aspect stands out: Intelligent Traffic Management System [1]. With rapid urbanization and increasing traffic congestion, an efficient real-time traffic management system becomes crucial for ensuring safety and comfort for travellers. Traditional infrastructure alone cannot handle the growing volume of vehicles, leading to gridlocks and accidents. But, by incorporating smarter technologies, such as real-time traffic analysis and information dissemination, the overall traffic management system can alleviate congestion and provide timely assistance to those in need [2]. Our proposal highlights "An Intelligent Highway Traffic Management System for Smart City" which aims to improve safety, security, and time management for travellers.

II. Literature Review

This paper discusses the proposed work to reduce congestion in a lane during accidents by providing relevant information to vehicles behind the accident area. This approach is specifically designed for the 2-lane highway. The authors discuss some works on smart traffic management systems:

- Javaid et al. proposed a hybrid approach to optimize traffic flow on roads [3]. Their system takes traffic density as input from cameras/sensors and manages traffic signals using a combination of centralized and decentralized approaches. However, the use of a centralized server to store the captured images and data introduces a risk of single-point failure.
- Junping et al. introduced an intelligent transportation system that can accumulate a large volume of data from various sources using video sensors [4]. However, the requirement for a significant amount of memory to store the videos is a major drawback of this system.
- Wiering et al. proposed a learning algorithm-based adaptive control system to manage traffic lights [5]. Their system uses a cumulative voting system to determine the expected gain for setting the traffic light green signal by all the vehicles waiting at an intersection. This approach allows drivers to take the lowest estimated waiting path, which can reduce waiting times at intersections. However, this approach may not be effective at isolated intersections and could become inefficient if all drivers opt for the same route, leading to overcrowding on the optimal route. Overall, this study highlights the potential benefits and limitations of using learning algorithms to manage traffic flow.

III. Objectives of the project

The objective of the paper is to propose a distributed approach for real-time traffic analysis on highways when accidents occur and to use this analysis to make smart decisions to reduce congestion on the lane.

IV. Proposed Methodology

Our approach is to provide a real-time traffic management system on highways that makes smart decisions when an accident occurs based on a warning message. In our proper system, we have first a highway with two opposite lanes; each lane has a unique identifier called a Lane Identifier (Lid) assigned by the transportation management authority; and second, we have Road Side Units (RSU) located between the two lanes; each one has unidirectional antennae. Each antenna transmits the needed traffic information to avoid accidents. Third, we have vehicle equipment that contains a digital camera to capture the road in front of the vehicle. The On-Board Unit (OBU) is responsible for decision-making after analysing the images captured from the camera if there's an accident in the vehicle's lane. GPS Receiver to determine the vehicle's current location, LED Display to show notification messages to the drivers, and Wireless Transceiver that enables the exchange of messages between vehicles. With the aid of these system components, when an accident occurs, the source vehicle generates a warning message whose structure includes: Source Vehicle Position (SPos), Lane ID (LId), and Hop Limit (HLim), which prevents infinite message broadcasting. Upon receiving a warning message, vehicles compare lane identifiers (LId) to determine relevance. If the message matches their lane, they assess their position relative to the source vehicle's position to decide the action. If the vehicle is ahead, the message is discarded. If the source vehicle is behind, the distance to the accident spot is calculated. If below a threshold, a STOP signal is displayed; otherwise, the vehicle searches for bypass lane positions broadcasted by RSUs, taking the bypass road if available and broadcasting the warning message to nearby vehicles and RSUs within the hop limit (HLim).

V. Simulation Setup

The proposed algorithms will be simulated using NS-3 to analyze and validate the network of the smart city traffic management system design in Linux using twelve nodes, six of which are dynamic vehicles and the other six are static Road Side Units (RSUs) with AdhocWifiMac. We use a packet size of 1000 bytes, a vehicle transmission range of 250 m, an RSU transmission range of 330 m, and PhyMode type OFDM (DataRate-6 Mbps, BW-10 MHz) with a simulation time of 60 s.

VI. Expected Outcomes

- Enhanced Safety: By detecting and promptly responding to accidents and hazards, minimizing risks and ensuring the safety of road users.
- Real-time Information Provision: By providing real-time information about traffic conditions, travel times, and alternative routes, empowering them to make informed decisions and choose efficient travel options

VII. References

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