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Automatic Density Based Traffic Signal Control System Using Deep Reinforcement Learning

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ABSTRACT

A novel proximity and load-aware resource allocation for vehicle-to-vehicle (V2V) communication is proposed. The proposed approach exploits the spatio-temporal traffic patterns, in terms of load and vehicles' physical proximity, to minimize the total network cost which captures the tradeoffs between load (i.e., service delay) and successful transmissions while satisfying vehicles's quality-of-service (QoS) requirements. vehicle-to-vehicle (V2V) communication emerged as a key enabling technology to ensure traffic safety and other mission-critical applications. The proposed approach exploits the spatial-temporal aspects of vehicles in terms of their physical proximity and traffic demands, to minimize the total transmission power while considering queuing latency and reliability. Due to the overhead caused by frequent information exchange between vehicles and the roadside unit (RSU), the centralized problem is decoupled into two interrelated sub-problems. From the global view of the vehicular network, intuitively, the more sensing data are collected and delivered to the platform, the higher the social welfare is. However, excessive traffic load will slump system social welfare when the network stability is broken by serious data congestion.As a result, network stability control is of significant importance to achieve long-term optimal system social welfare.

Keyword: quality-of-service (QoS), roadside unit (RSU), traffic control.

1. INTRODUCTION

Vehicle to vehicle communication:

Vehicle-to-vehicle (V2V) communications comprises a wireless network where automobiles send messages to each other with information about what they're doing. This data would include speed, location, direction of travel, braking, and loss of stability. Vehicle-to-vehicle technology uses dedicated short-range communications (DSRC), a standard set forth by bodies like FCC and ISO. Sometimes it's described as being a WiFi network because one of the possible frequencies is 5.9GHz, which is used by WiFi, but it's more accurate to say "WiFi-like." The range is up to 300 meters or 1000 feet or about 10 seconds at highway speeds (not 3 seconds as some reports say).

V2V would be a mesh network, meaning every node (car, smart traffic signal, etc.) could send, capture and retransmit signals. Five to 10 hops on the network would gather traffic conditions a mile ahead. That's enough time for even the most distracted driver to take his foot off the gas.

On the first cars, V2V warnings might come to the driver as an alert, perhaps a red light that flashes in the instrument panel, or an amber then red alert for escalating problems. It might indicate the direction of the threat. All that is fluid for now since V2V is still a concept with several thousand working prototypes or retrofitted test cars. Most of the prototypes have advanced to stage where the cars brake and sometimes steer around hazards. Why? It's more exciting for a legislator or journalist to see a car that stops or swerves, not one with a flashing lamp.

Fig: vehicle to vehicle communication

Vehicle-to-vehicle communication (V2V communication) is the wireless transmission of data between motor vehicles.

The goal of V2V communication is to prevent accidents by allowing vehicles in transit to send position and speed data to one another over an ad hoc mesh network. Depending upon how the technology is implemented, the vehicle's driver may simply receive a warning should there be a risk of an accident or the vehicle itself may take preemptive actions such as braking to slow down.

2. RELATED WORK

2.1 A Cooperative Approach to Traffic Congestion Detection With Complex Event Processing and VANET

Using many algorithms the research in VANET focuses on simulating vehicular traffic to detect congestion. Many researchers have addressed the issue of distributed detection and propagation of traffic congestion information also some researcher proposed a system that uses vehicle based GPS systems to discover and disseminate traffic congestion information. The cooperative approach to traffic congestion detection with complex event processing and VANET. The work focuses on an event-driven architecture (EDA) as a novel mechanism to get insight into VANET messages to detect different levels of traffic jams; furthermore, it also takes into account environmental data that come from external data sources, such as weather conditions. Distributed traffic information systems have come up as one of the most important approaches for detecting traffic flow problems on a road.

2.2. A traffic congestion detection and information dissemination scheme for urban expressways using vehicular networks

The cooperative vehicle-infrastructure technologies have enabled vehicles to collect and exchange traffic information in real time. Therefore, it is possible to use Vehicular Ad-hoc Networks (VANETs) for detecting traffic congestion on urban expressways. However, because of the special topology of urban expressways (consisting of both major and auxiliary roadways), the existing traffic congestion detection methods using VANETs do not work very well. A congestion detection and notification scheme using VANETs for urban expressways. The scheme adopts a simplified Doppler frequency shift method to estimate and differentiate traffic conditions for major and auxiliary roadways.

2.3 Efficient Data Propagation in Traffic-Monitoring Vehicular Networks

In ref [7] the problem of efficiently collecting and disseminating traffic information in an urban area is investigated. Here they have formulated the traffic data acquisition and explored the solution in mobile sensor network domain. Road congestion and traffic-related pollution have a large negative social and economic impact on several economies worldwide. We believe that investment in the monitoring, distribution, and processing of traffic information should enable better strategic planning and encourage better use of public transport, both of which would help cut pollution and congestion. This paper investigates the problem of efficiently collecting and disseminating traffic information in an urban setting.

2.4 Road Traffic Congestion Detection through Cooperative Vehicle-to-Vehicle Communications

Cooperative vehicular systems are being developed to improve traffic safety and management. Reducing road traffic congestion can be achieved through effective management strategies. a higher potential to improve traffic safety and efficiency through the continuous exchange of information between vehicles (Vehicle-to-Vehicle or V2V communications) and between vehicles and infrastructure nodes (Vehicle-to-Infrastructure or V2I communications). The drawback of this approach is that the selection of the cluster head usually generates additional signaling overhead. The initial investigations have demonstrated the capacity of the proposed mechanism to accurately quantify the traffic congestion level, while efficiently using the cooperative communications channel.

2.5. Secure Vehicular Traffic Re-routing System using SCMS in Connected Cars

The centralized system encounters two vital issues, the central server needs to perform genuine calculation and communication with the vehicles continuously, which can make such architecture infeasible for extensive zones with various vehicles; and driver security is not guaranteed since the drivers need to share their area furthermore the beginning stages and goal of their excursion with the server, which may keep the acknowledgment of such courses of action. The considering is that all the more convincing vehicle re- directing can be proactively given to individual drivers accommodatingly, in light of the communitarian information amassed from shrewd mobile phones or structures presented in vehicles, to encourage the impacts of blockage in the city. The advances of the rising distinguishing and get ready pushes empowers unavoidable change of the Intelligent Transportation System (ITS).

3. PROPOSED SYSTEM

- A system which handles traffic using Artificial Intelligence technique for adapting signal according to the density of traffic thereby automatically increasing or decreasing traffic signal time using Experience Replay mechanism.
- The proposed traffic light control system reduces the waiting time at traffic lights by 33% compared to a conventional traffic light control system using deep reinforcement learning.

- Therefore, there is a need to realize a traffic signal control system (TSCS) that automatically obtains a better control law considering multiple factors using deep reinforcement learning.
- In this environment, each agent denes the switching of its signal phase as an action. Specfically, for state *st* , each agent selects one of the four signal phases.
- Vehicles to dynamically optimize their resource allocation.
- In order improve traffic signal for efficient traffic management, a dynamic phase duration is introduced.
- Longer phase durations are allocated to a traffic signal with more traffic congestion (with High Priority) and have shorter phase durations to a Traffic signal with less Traffic (with Low Priority).

4. SYSTEM ARCHITECTURE

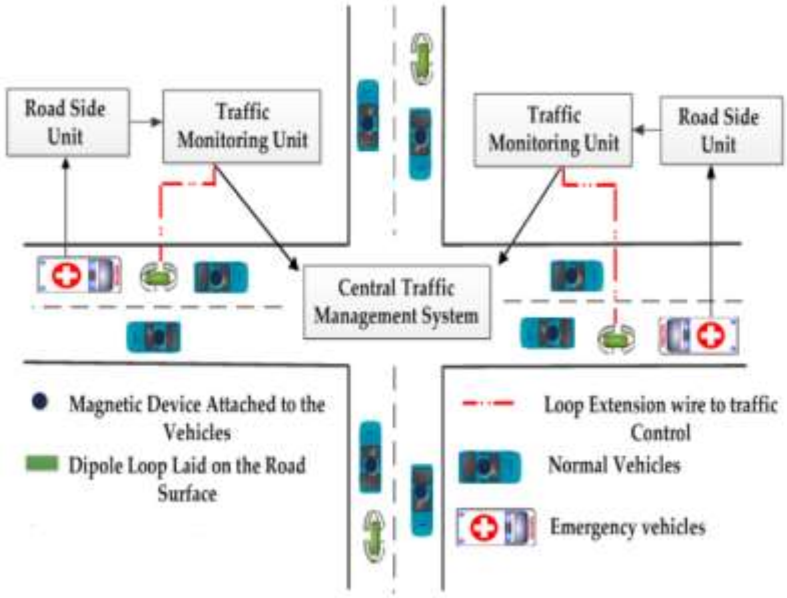
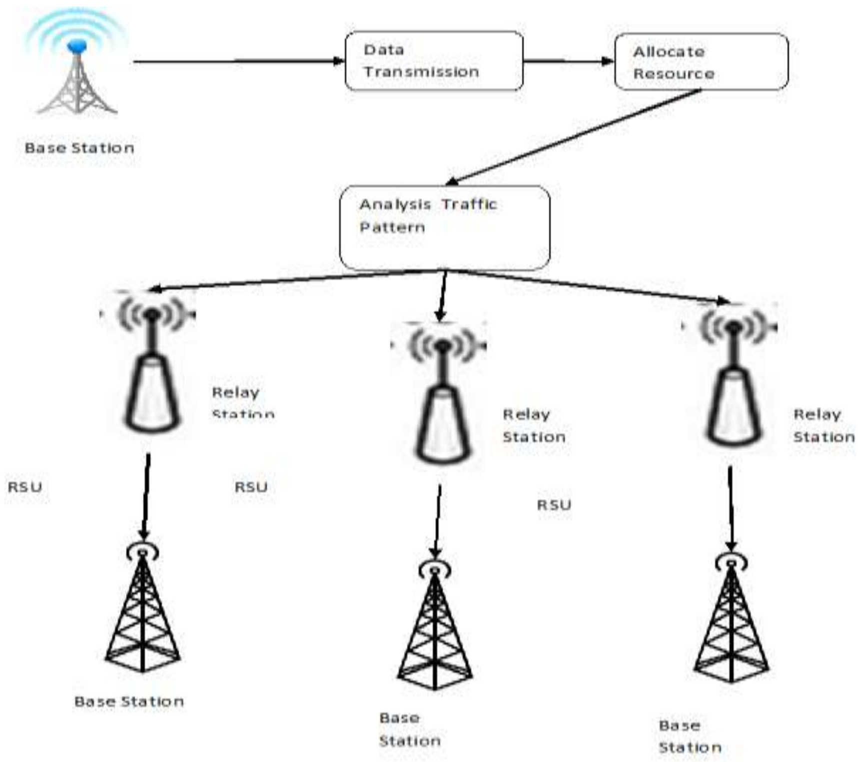


Figure:4.1 System Architecture



5. CONCLUSION & FUTURE ENCHANCEMENT

Social welfare and network stability in a vehicular participatory sensing system. The proposed approach exploits the spatial-temporal aspects of vehicles in terms of their physical proximity and traffic demands, to minimize the total transmission power while considering queuing latency and reliability. Due to the overhead caused by frequent information exchange between vehicles and the roadside unit (RSU), the centralized problem is decoupled into two interrelated sub-problems. First, a novel RSU-assisted virtual clustering mechanism is proposed to group vehicles in zones based on their physical proximity. Given the vehicles' traffic demands and their QoS requirements, resource blocks are assigned to each zone. Second, leveraging techniques from Lyapunov stochastic optimization, a power minimization solution is proposed for each V2V pair within each zone. Our system, on the other hand, is designed to be effective and fast, although not optimal, in deciding which vehicles should be re-routed when signs of congestion occur as well as computing alternative routes for these vehicles. A hybrid architecture that off-loads parts of the computation and decision process in the network and uses V2V communication to better balance the need for privacy, scalability, and low overhead with the main goal of low average travel time.

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