Vehicular Traffic Re-Routing For Avoiding Traffic Congestion in VANET

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ABSTRACT
The number of vehicles allow to use a particular lane is not fixed in the existing system. When there is an active mobile network and suddenly an accident occur, the upcoming vehicles gets slow down due to the congestion. In the existing system, only the detection of congestion is analyzed but not a solution is given. The proposed system includes Dijkstra’s algorithm is used for detecting the shortest paths for re-routing, during the time of congestion. The congestion avoidance algorithm helps in preventing the state of congestion in the mobile network. With the help of these two algorithms in proposed systems, the congestion is avoided considerably. Hence the performance of the mobile network in improved tremendously.

INTRODUCTION

In the recent years, vehicular networking has gained a lot of popularity & academic research community is seen to be the most valuable concept for improving efficiency & safety for future transportation. Among last decades, traffic density among the world has been increasing rapidly (Schrenk and Lomax, 2009).

The main idea in VANET is ITS (Intelligent transport system) (Sussman, 205). It is a system of hardware, software & operator that allow better monitoring & control of traffic mainly to optimize the traffic flow. It presents a wide variety of technologies to reduce congestion by monitoring the traffic flows through sensor (or) cameras & re-routing the vehicles through variable message boards VMS.

Communication between the vehicles & road is done through Road side Equipment (RSE) (Strom, et al., 2010). It represents the connected vehicle roadside devices that are used to send & receive message from nearby vehicles using Dedicated Short Range Communication (DSRC). It contains a processor, data storage, & communication capabilities that support secure communication among the vehicles & road side communication.

Event-driven architecture EDA (Luckham, 2002) is mainly used for communication between the procedure & consumer with minimum delay or no delay. It monitors the changes in state & responds in real time.

Complex event processing (David, et al., 1998) is a new technology which is used for extracting information from distributed message-based system. In distributed message based system the objects (or) vehicles are communicating with one another by means of sending messages or by remote invocation method.

This paper states that congestion control algorithm is used to avoid the congestion when accident occurs. In this system, vehicles can be viewed as both mobile sensors and actuators. When congestion occurred in a particular area, re-routing can be performed. The traffic guidance system operates in 4 phases (1) data collection & representation (2) traffic congestion prediction (3) vehicle selection for re-routing (4) alternative route assignment for each such vehicle & pushing the guidance to the vehicles.

Related work:

VANET have widely been used to develop distributed ITS. Intervehicular dissemination protocol called Received Message-Dependent Protocol (RMDP) which is used for acquiring local traffic information without centralized servers. Each vehicle disseminates/ broadcasts its own traffic information from other vehicles. If the number of reception error becomes larger and the broadcast storm problem might occur.

Recently many algorithms like weight of-evidence based classification algorithm (Sayyid, et al., 2009) are proposed. It contains only partial or incomplete information and it provides an efficient method of traffic congestion detection only when limited data is available. The main drawback is that it is very complex.
Floating car data (Llorca, 2010) is a technology which collects the traffic information from a set of individual vehicles. The vehicles are equipped with GPS and GSM communication systems. It also gathers information about global location, speed & direction.

Each vehicle is equipped with global positioning system (GPS) (Antonios Skordylis and Niki Trigoni, 2011) to detect local traffic & report periodically to the Access Point. The main goal of traffic monitoring system that minimizes bandwidth utilization. It contains (1) data acquisition (2) data delivery.

**Existing and Proposed:**

In previous work, a novel mechanism is proposed to detecting distributed traffic congestions for distributed TISs through a CEP-based EDA. This system takes advantage of enhanced maps (Emaps) (Bétaille and Toledo-Moreo, 2010) which allow vehicles to work under certain circumstances. The EDA performs a CEP processing for incoming beacon signals. The EDA can process information from external source. It can detect different level of traffic congestion through communication protocol. In the previous work EDA will detect the congestion it does not prevent the congestion.

In this system, vehicles can be viewed as both mobile sensors and actuators. The EDA is attached with each vehicle to collect the information about the environment and passing the information to other vehicles (Arbabi and Weigle, 2009). When the sign of congestion occurred in road segment, it provides the re-routing operation (Dunkel, et al., 2011). The traffic guidance system operated in 4 phase. (1) Data collection and representation; (2) traffic congestion prediction; (3) vehicle selection for re-routing; and (4) alternative route assignment for each such vehicle.

![EDA Component](image)

**Fig. 1:** EDA Component.

**Network Model:**

A network is simulated, with minimum of 50 nodes moving in a defined area. Each node moves randomly, in a range $[0, v_{max}]$. We create a road segment using ns2. In that road segment we create the number of nodes. Each node acts as a vehicle.

**Operation Mode:**

EDA takes beacon as input and it monitor the traffic flow condition in motorway lanes. It contains two different operation modes.

- **Lane mode:** In this mode, EDA will detect congestion by taking the account of lane information to detect the traffic jams.
- **Raw mode:** In this mode, it will detect the traffic congestion without taking into the account of lane information. It informs only about the area of road that is congested without specifying the affected lanes.

**Lane mode and raw mode traffic congestion in single lane:**

The congestion in lane mode is detected using EFA, STA, TCA, TAA, ESA, AA, and EFM.

In this mode, the EDA takes into account the lane information of the beacons to detect traffic jams at the lane level. Thus, the different alarms and warnings comprise information about which are the congested lanes.
The event filter agent (EFA) it is mainly used for discarding events. A new stream of valid location events is created.

The slow traffic agent (STA) it monitors the traffic conditions along the motorway. It creates a slow vehicle group event that contains the number of vehicles driving at very low speed.

The traffic congestion agent (TCA) it detects a high density of slow traffic and generates a traffic congestion event.

The traffic alarm agent (TAA) takes the stream of traffic congestion as input and categorizes them into different levels of congestion.

The external source agent (ESA) mainly deals with the information from external source such as weather conditions etc…

The adaptation agent (AA) used for deciding the operation mode such as lane (or) raw mode.

Lane mode traffic congestion in multilane -Traffic guidance:
Our traffic guidance system is composed of: (1) a centralized traffic monitoring and re-routing service (which can physically be distributed across several servers), and (2) a vehicle software stack for periodic traffic data reporting (position, speed, direction) and showing alternative routes to drivers (Skordylis and Trigoni, 2011). Vehicles run this software either on a smart phone or an embedded vehicular system. Vehicles are equipped with GPS receivers and can communicate with the service over the Internet when needed. When starting a trip, each vehicle informs the service of its current position and destination; the service sends back a route computed according to its strategy.

It is assumed that the service knows the road network as well as the capacity and legal speed limits on all roads. Logically, the traffic guidance system operates in four phases executed periodically: (1) data collection and representation; (2) traffic congestion prediction; (3) vehicle selection for re-routing; and (4) alternative route assignment for each such vehicle and pushing the guidance to the vehicles.

Representation and estimation of traffic data:
Road network is represented in form of nodes, where nodes correspond to intersections, edges to road segments, and weights to estimated travel times. When new traffic data is available the nodes are updated periodically. The travelling time can be estimated for each vehicle based on the road segment. GPS is used for monitoring the traffic information and reconstructing the traffic state information.

Fig. 2: Detection of congestion.

Lane mode traffic congestion in single-lane–rerouting:
When the congestion is occurred rerouting will be performed based on the time, speed and signal position. A Congestion Control algorithm is proposed for event-driven safety messages in different congestion scenario.

When congestion occurs in the road segment, the service looks for nearby vehicles to re-route. Specifically, we select vehicles from incoming segments (i.e., segments which bring traffic into the congested one). To decide how far from congestion to look for candidates for re-routing; the service uses a parameter L (level). This parameter denotes the furthest distance (in number of segments) a candidate vehicle can be away from the congested segment.

The selected vehicles need to be ranked and assigned to alternative paths according to their rank for all strategies, except DSP. In this way, the performance of the strategies improves. The impact a congested road
segment has on a vehicle’s travel time is different depending on the remaining distance to the vehicle’s destination. Intuitively, the drivers that are close to their arrival point may have a different perception of the congestion than the drivers that are far away from their destination. Our system uses an urgency function to rank the vehicles that are selected for re-routing. Hence, the vehicles with higher urgency are re-routed first and get relatively better routes. We present the global re-routing process on which our traffic guidance system is based on.

Performance evaluation:
With regard to the evaluation of the EDA, the following two different measurements have been used: 1) the detection rate (DR) and 2) the mean time to detection (MTTD). We compare the existing and proposed system based on the parameters as mention in above.

Fig. 3: Alternate routes are provided during slow membership.

Conclusion:
The proposed system employees both Dijkstra’s algorithm, for finding the shortest alternative path and congestion avoidance algorithm for the congestion free transport. As a future work, the number of vehicles permitted to travel in a particular lane can be limited such that the congestion can be controlled effectively.

REFERENCES


