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Intervehicular Communication Using Mobile Adhoc Network

M.S.S.Sriram
M.Tech Student,
Srinivasa Institute of Engineering and Technology.

Dr. B. N. Jagadesh
Guide,
Srinivasa Institute of Engineering and Technology.

ABSTRACT:

Recently, considerable research has been focused on applying ad hoc wireless networking technology to on-the-move vehicles. In this paper, we focus on distributed detection of dangerous vehicles on roads and highways. We propose the dangerous-vehicle-detection protocol (DVDP) to detect drivers who violate the permitted speed limit.

In DVDP, each vehicle collects surrounding vehicles' identifications (IDs) and propagates warning information (including its position, speed, time, and collected IDs). This information is then forwarded hop-by-hop using ad hoc communications.

A vehicle that receives this information will start to observe its surrounding vehicles. If surrounding vehicles are identified in the received warning information, it will estimate the speed of such vehicles. If the estimated speed exceeds the permitted speed, such vehicles are then marked as "suspected vehicles," and the updated warning information is further propagated. By repeating this process, the suspected vehicle (where other vehicles observe the speed violation) will ultimately be marked as a "dangerous vehicle.

" This judgment is then further propagated to warn others and to inform the traffic police. We evaluated the performance of DVDP using a simulator that performs both macroscopic and microscopic traffic simulation, taking into account realistic lane and speed models, mobility, position, and location errors.

Simulation results revealed that DVDP's detection probability is greater than 80% when vehicle density is above 40 vehicles/min. When vehicle density is low, deployment of relay points can help to further improve detection probability. In addition, by utilizing vehicles in opposite lanes, detection probability can be further improved.

INTRODUCTION:

Now days, researchers are looking at applying ad hoc mobile communications and networking technology to vehicular networks. Some researchers have mentioned the use of multihop wireless communication to propagate accident and traffic jam information to warn other drivers. In the European Union Seventh Framework Program SAFESPOT project and the Japanese Advanced Road Transportation Sys-terms (ARTS) project, future intelligent transportation system technologies based on vehicle-to-vehicle and vehicle-to-roadside (V2I) communications are actively being studied. In fact, V2V is considered useful

for localized emergency and respond cases, while V2I is viewed as the long-haul pipe for noncritical information push and pull. In the ARTS project, there are several research projects on cooperatively detecting vehicles from approaching ramps, invisible corners, intersections, Vehicles in the wrong lane, vehicles traveling at extremely dangerous speeds, and vehicles wrongly stopping or running on a motorway shoulder. In this paper, we focus on the use of ad hoc communications to detect dangerous vehicles on roads and highways. Reckless and careless driving can endanger the lives of other drivers and passengers on roads and highways.

Increasingly, many accidents can be avoided if such dangerous drivers are detected early and other drivers are warned. In most roads nowadays, cameras and speed detectors are used to monitor and identify drivers who had exceeded the permitted speed limit on roads and highways. This is the primitive approach, and there are limitations. If the drivers slow down before the speed detectors, they will not be detected, even though they had exceeded the permitted speed earlier. Additionally, bad weather can distort the quality of image captured by cameras.

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Currently, there are various interpretations and definitions of dangerous drivers. Reckless drivers are those who are negligent. Fatigue drivers are those who are overpowered by physical and mental stress. They fell asleep while driving, creating a dangerous situation on roads and highways, resulting in accidents and collisions. Aggressive drivers are those who drive and overtake others dangerously, often speeding, and do not give warning or signals to others. They create catastrophic accidents, often involving fatal injuries and loss of lives. In this paper, we focus our research on the detection of drivers who violate the speed limits on roads and highways.

We propose the dangerous-vehicle-detection protocol (DVDP) to detect drivers who violate the permitted speed limit. In this paper, we assume that a kind of next-generation license plate number system is used, where each vehicle disseminates its own vehicle identification (ID) in a regular interval. In DVDP, each vehicle collects surrounding vehicles' IDs and propagates warning information including their position, speed, time, and collected IDs. When a vehicle receives warning information, the vehicle calculates the distance between the current position and the position where warning information was generated.

If the distance is shorter than a certain amount, the vehicle will forward the warning information to preceding vehicles as soon as possible. Otherwise, the vehicle that receives the warning information starts to observe its surrounding vehicles. When it finds vehicles whose IDs are included in its received warning information, it estimates the speed of those vehicles. If the estimated speed exceeds the permitted speed limit, those vehicles are considered as "suspected vehicles," and the updated warning information is then further propagated to vehicles ahead. By repeating this process, the suspected vehicle where multiple other vehicles witnessed the speed violation will ultimately be marked as a "dangerous vehicle."

Related Work:

There are several research works about efficient data ex-change among vehicles. In the field of traffic engineering, many macroscopic traffic simulators had been developed such as Traffic View,

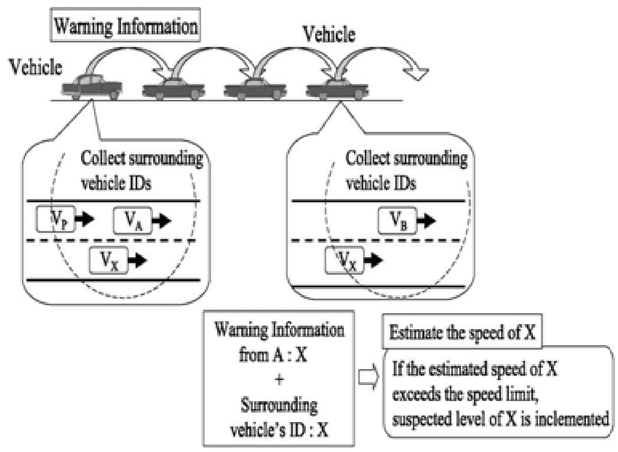

Fig. 1. Overview of the proposed dangerous-vehicle-detection mechanism.

NETSTREAM and GrooveNet Macroscopic traffic simulators reproduce large-scale traffic flows. These simulators are designed to evaluate traffic measures, forecast traffic volume, or make plans for future traffic infrastructures. Recently, a few microscopic traffic simulators had been developed for accurate modeling of vehicular mobility. Currently, such micro-scope traffic simulators are specialized to reproduce relatively small areas of traffic flows. In, a preliminary version of a microscopic model for reproducing more detailed vehicles' behavior in wide areas was proposed.

A common characteristic of the existing systems is that a deterministic radio propagation model was utilized for design and evaluation. Therefore the results will significantly vary when assuming a probabilistic radio model as suggested from empirical studies carried out. None of the existing solutions considered the wireless medium conditions depicted the existence of background traffic. IVC is potentially vulnerable to security threats, such as injection of false data, corruption of data, jamming and denial of service attacks. These threats can lead to severe consequences if they interfere with safety applications or target military operations.

A wide range of approaches may be necessary to address various security concerns, ranging from encryption that permits bad data to be detected. A number of these technical challenges are receiving attention from the Network on Wheels project, whose solutions are being considered by the Car-to-Car Communication Consortium for road traffic safety applications.

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DANGEROUS VEHICLE DETECTION PROTOCOL:

Current methods of deploying speed detectors at fixed points are inadequate for detecting certain kinds of dangerous vehicles. For example, if a dangerous vehicle exceeding the permitted speed limit knows the locations of those speed detectors, it might slow down before the speed detectors, thereby avoiding detection. In this paper, we propose DVDP to detect dangerous vehicle autonomously. Its operation is discussed in the following sections.

Here, we assume a kind of next-generation license plate system. We assume that each vehicle broadcasts its vehicle ID periodically, and that the vehicle ID's radio is 40 m. It is also assumed that those vehicles have wireless communication facilities so that they can transmit and receive data. For intervehicular communications, we use the IEEE802.11 independent basic service set (IBSS). Our protocol is an application layer protocol running over user datagram protocol/ Internet protocol (UDP/IP) and IEEE802.11.

Here, we assume that the wireless communication range is 200 m and that each vehicle knows its precise position and time from its global positioning system (GPS) receiver. Different radios are used for transmitting data and vehicle IDs. In DVDP, each vehicle collects vehicles' IDs from surrounding vehicles and forwards them to preceding vehicles as warning information. Note that DVDP can work well even if dangerous vehicles do not execute DVDP although we assume that all vehicles including dangerous vehicles broadcast their vehicle ID's periodically.

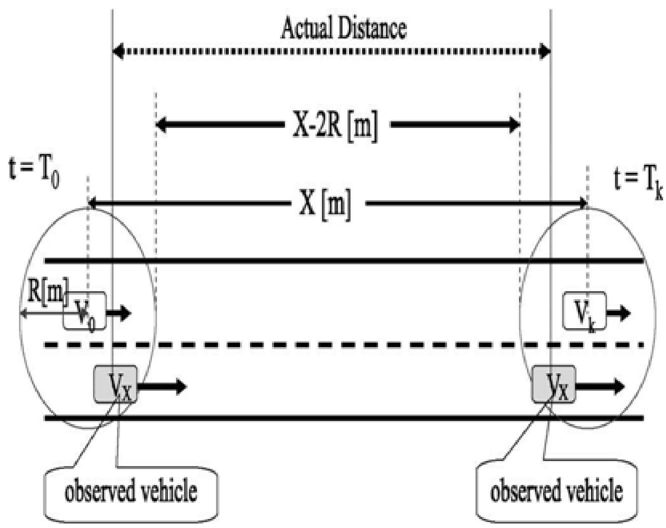
ADVANTAGES OF PROPOSED SYSTEM:

In the evaluation of intervehicular communication, it is desirable that realistic vehicular traffic flows are considered. If intervehicular communication is used for estimating the duration of a traffic jam, one can assume that vehicles in the jam form a line with similar distances, i.e., they have uniform arrangement. If intervehicular communication is used for avoiding collisions at intersections, one can assume that a message informing the approach of a vehicle can reach vehicles on its crossing road by at most a few hops. In such cases, performance of intervehicular communication for real traffic might be similar to simulation results based on artificial macroscopic traffic flow models. However, to identify moving traces of dangerous vehicles and estimate when and how dangerous vehicles exceed the permitted speed using intervehicular communication, one must carefully reproduce real traffic flows on highways for considerable time periods.

In addition, a bottleneck capacity test is defined as one of the verification processes standardized by the traffic engineering society in Japan. Here, the bottleneck capacity means how many vehicles can pass in a specified time period through a bottleneck of a specified road. Since the above function spreads distance between all vehicles, the bottleneck capacity will become smaller. Moreover, for slow vehicles to achieve a specified speed, the length to its preceding vehicle should be longer.

IMPLEMENTATION OF DVDP:

In DVDP, each vehicle executes the following two processes in parallel: 1) forwarding process and 2) observing process. The forwarding process relays the warning information sent from rear vehicles to preceding vehicles. It also relays the warning information of oncoming vehicles so that they can be used for vehicles running in opposing lanes.



The observing process, however, monitors propagations of vehicle IDs from surrounding vehicles and estimates the speed of surrounding vehicles using the warning information obtained in the forwarding process.

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The forwarding process has a forwarding list for keeping the warning information to be forwarded. Likewise, the observing process has an observing list for keeping vehicle IDs to be monitored.

CONCLUSION:

This thesis proposes DVDP - an inter-vehicular communication protocol for distributed detection of dangerous vehicles. DVDP (Dangerous Vehicle Detection Protocol) uses ad hoc mobile communications to propagate warning information to preceding vehicles so that dangerous vehicles can be monitored and identified over time and space.A realistic simulator is implemented that performs both macroscopic and microscopic simulation.

Appropriate speed and lane models are also taken into account, along with considerations for time and position errors. We evaluated the performance of DVDP by examining detection probability over various parameters, such as vehicle density, mobility models, speed of dangerous vehicles, forwarding speed, relay points, and vehicles in opposite lanes. Simulation results revealed that detection probability for realistic vehicular mobility is less than that of macroscopic case. Increasing forwarding speed reduces detection probability. We observed that the deployment of relay points increases detection probability.

Also, the higher the average speed of dangerous vehicles, the higher the detection probability. Exploiting vehicles in the opposite lanes to relay warning information can further improve detection probability. From our results, it is clear that distributed detection of dangerous vehicles is possible using ad hoc sensing, communications, and relay points.Finally, the detection method shown does not exclude relaying information about identified vehicles to some centralized databases (such as police) via V2V and V2I communications. Also, such information can be stored first in a car “black-box” and subsequently off-loaded to a centralized database when connectivity and opportunity permits.

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