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Traffic Accident Classification and Automatic Notification Using GPS

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ABSTRACT

Road traffic accidents leads to the causes of deaths and injuries of various levels. New communication technologies included into modern vehicles present an opportunity for improved assistance to people injured in traffic accidents, it reduce the response time of emergency services, and it will increase the information about the incident. The proposed methodology is a novel intelligent system which is able to automatically detect road accidents, notify them through vehicular networks, and estimate their severity. This system considers the most relevant variables that can characterize the severity of the accidents (variables such as the vehicle speed, the type of vehicles involved, the impact speed, and the status of the airbag). It requires each vehicle to be endowed with an On-Board Unit responsible for detecting and reporting accident situations to an external Control unit that estimates its severity, allocating the necessary resources for its assistance. The advantage of the use of vehicular networks to collect precise information about road accidents that is then used to estimate the severity of the collision. Severity estimation is classified into minor, major and severe accidents based on the information about the accidents. Corrective measures will be taken from the database containing all the accidents information. Existing system does not focused on reducing the accidents, this was overcome by GPS tracking device used in the proposed system.

Keywords: Vehicular networks, On-Board Unit, Control Unit, Data Mining

INTRODUCTION

During the last ten years, the entire vehicles around the world has experienced the remarkable growth, increasing traffic density and causing more and more traffic accidents. This outline represents a severe problem in most countries, as an example, 2,714 people died on Spanish road in 2009, which means one death for 1,949 inhabitants. The accidents results shows that many of the deaths occurred during the time between the accident and the arrival of medical assistance. In a traffic accident, completing the assistance of the seriously injured persons during the hour immediately following the incident is crucial to minimize the negative effects on the health of the occupants. Therefore, a fast and secure rescue operation after a traffic accident occurs significantly increasing the probability of the injured and reduces the injury severity.

For a noticeable reduction in assistance time, two major steps must be taken: (i) fast and accurate accident reporting to an appropriate Public Safety Answering Point (PSAP), and (ii) fast and efficient evacuation of occupants trapped inside a vehicle. In recent years, there have been many advances in the development of technologies for communication between vehicles (V2V), also known as (VANETs or *Vehicular Ad hoc Networks*). These technologies are based on short-range communication systems, or *Dedicated Short-Range Communication* (DSRC), offering support for cooperative security applications between vehicles. In fact, it is expected that the 802.11p working group will soon approve the IEEE 802.11p standard, offering a viable solution for inter-vehicular security applications. Moreover, many efforts and research from academia and industry have prompted the development of technologies to support vehicle-infrastructure interaction (V2I), which has particular relevance for road safety applications, mobility, and monitoring.

The effectiveness of the assistance to passengers involved in a traffic accident could be significantly improved if emergency services had available relevant information on the conditions under which the

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accident happened before moving to the area of the accident. This extra information, provided by sensors inside the vehicle, would be used to estimate the severity of the injuries to the occupants. Also, having more information would allow determining the optimal set of human and material resources to send to an accident situation, with the consequent cost reduction and increased assistance quality. This proposal does not focus on reducing the number of accidents, but on improving post collision care with a fast and efficient management of the available emergency resources, which increases the chances of recovery and survival for those injured in traffic accidents.

RELATED WORKS

Neha[2] proposed, A congestion control system, which uses sensors installed on the road side units to monitor the data and the cars also having the capacity to collect data from the road infrastructure, will report the data to wireless traffic lights. Cars equipped with the navigators have the capability to receive feedback from the wireless traffic lights and other cars in other traffic zones in a city and dynamically adjust their routing paths to control congestion. Congestion occurs when the road infrastructure does not cope with the increase demand of the infrastructure. Car congestion generally may occur because of accidents and various unfavorable weather conditions. Traffic delays and congestion are the major source of the inefficiency, fuel consumption, wastage of time and pollutants. So, efficient measures must be taken for the detection and avoidance of the congestion. Car congestion generally occurs during the rush hours of the day. A. Nivetha, R. Priya, V. Radhika and Dr. S.Mary Praveena[5] A monitoring system is designed in where it receives sensory data via wireless sensor network and further processes the data to indicate the current driving aptitude of the driver. Analyzing information related to fatigue using two distinct methods eye movement monitoring and biosignal processing. It is critical that several sensors are integrated and synchronized for a more realistic evaluation of the driver behavior. The sensors applied include a video sensor to capture the driver image and a bio signal sensor to gather the driver photoplethys mograph signal. A warning alarm is sounded if driver fatigue is believed to reach a defined threshold. The manifold testing of the system demonstrates the practical use of multiple features, particularly with discrete methods, and their fusion enables a more authentic and ample fatigue detection.

The growth of sensor technology and network based information technology has expanded the reach of wire-less sensor networks into numerous areas such as health care, remote control, wildlife habitat monitoring, military explosive detection, intelligent home monitoring and environment observation and forecasting system. On the other hand, the recent increase in traffic accidents is possibly four distinctive driving patterns through analysis by a Hidden Markov Model (HMM) studied the reliability of steering behavior to detect caused by driver distraction and low attention during driving. Intelligent transport systems are promoted by integrating the sensor technology in to the transport to measure the driver alertness level.

Richi Nayak, Daniel Emerson, Justin Weligamage, Noppadol Piyatrapoomi[6] proposed, to conform the industry-standard processes, the CRISP-DM (CRoss-Industry Standard Process for Data Mining) framework was used to guide the study through development of its data exploration, data preparation, model deployment and model assessment and evaluation. The DM goal was to improve the prior model that predicted the crash status of road segment from road attributes. The improvement strategy was to prepare and assess a series of new crash-proneness datasets by moving the binary crash threshold higher into the crash count range (e.g. 0-2 crashes vs. more than 2 crashes and so on). Assessment was accomplished through predictive model accuracy measures and examination of classes of cluster model and the crash count ranges within the classes.

Understanding business problems, data and pre-processing In the CRISP_DM stage of understanding business problems, the study was engaged in the discovery activities guided by the goal of seeking to contribute to knowledge that would make roads safer, specifically in the management of road surface friction. The specific DM goal was to produce a more accurate model than that of our prior stage of modeling. This model had contributed substantially to the understanding data phase, by demonstrating that the road crash data could produce predictive road crash models able to distinguish between road segments with and without crashes based on road & traffic attributes.

Attributes such as skid resistance and texture depth were found to have strong relationship with roads having crashes, and wet & dry roads were found to have differing distributions of crash with respect to skid resistance and traffic rates. We challenged the assumption of the linear relationship between road segment crash count and traffic rates. F. Martinez, C.-K. Toh, J.-C. Cano, C. Calafate, and P.

Manzoni[9] proposed, Adaptive techniques for VANETs usually consider features related to the vehicles in the scenario, such as their density, speed, and position, to adapt the performance of the dissemination process. These approaches are not useful when trying to warn the highest number of vehicles about dangerous situations in realistic vehicular environments.

The Profile-driven Adaptive Warning Dissemination Scheme (PAWDS) designed to improve the warning message dissemination process. PAWDS system that dynamically modifies some of the key parameters of the propagation process and it cannot detect the vehicles which are in the dangerous position. Proposed system identifies the vehicles which are in the dangerous position and to send warning messages immediately. Generally, crash detection systems (CDS) can be divided into pre-crash and post-crash systems. A pre-crash system is a passive automobile safety system designed to reduce the damage caused by a collision. Most CDS use radar, and sometimes laser sensors or cameras to detect an imminent crash. Depending on the system, they may warn the driver, pre-charge the brakes, retract the seat belts (removing excess slack) and automatically apply partial or full braking to minimize the crash.

EXISTING WORK

This approach collects information when an accident occurs, which is obtained by sensors installed on the vehicles. The data collected from the sensors are structured in a packet, and are forwarded to a remote Control Unit through a combination of V2V and V2I wireless communication. In the existing system, only the accidents are indicated to the emergency services. The descriptions about the accidents are not informed such as how many person's are injured, and the type of the accident. The road accident scheme was mainly used to reduce the number of accidents and to inform the respective authority about the accident through messages. The transmission of messages should be fast. To send them speed different message transmission schemes can be employed. The locations of the accidents are informed to the emergency services via the control unit.

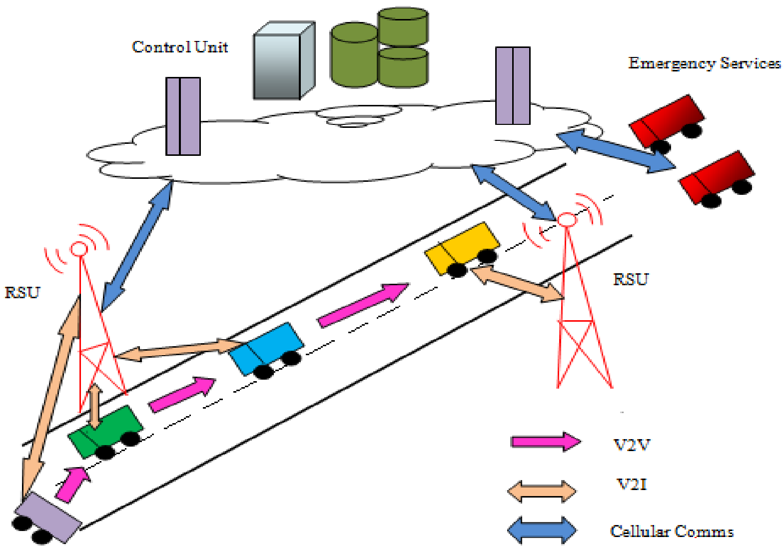

Fig1. *Architecture*

The architecture provides:

- direct communication between the vehicles involved in the accident,
- automatically send the important information about the accident to the Control Unit, and
- Accident notification and the information about the accidents are send to the emergency services.

The proposed estimation based on data mining classification algorithms, using the historical data about previous accidents. Advantage of the use of vehicular networks to collect precise information about road accidents that is then used to estimate the severity of the collision. This system does not focus on directly reducing the number of accidents, but improve the collision assistance. The road accident scheme was mainly used to reduce the number of accidents and to inform the respective authority about the accident through messages. The transmission of messages should be fast.

To send them speed different message transmission schemes can be employed. The location of the accidents are informed to the emergency services via the control unit. The Naive Bayes algorithm was used to track the exact position of the vehicle. GSM technique was used to send and receive SMS from/to the user about the location of the vehicle. The vehicular communication need to take place in order to exchan ge information between two or more vehicles. The existing system does not focus on reducing the number of accidents and it only concentrates on improving post-collision assistance. It requires manual decisions for deciding the action to be taken. So, it results in incomplete or inaccurate data.

Road Network

A road network can be considered as a graph with positive weights. The road junctions are represented by nodes and each edge of the graph is associated with a road segment between two junctions. The weight of an edge may represents the length of the associated road segment, the time taken to traverse the segment or the cost of traversing the segment. Using directed edges it is also possible to model one-way streets. These graphs are special in the sense that some edges are more important than others for long distance travel. All of these algorithms work in two phases. In the first phase, the graph is preprocessed without knowing the source or target node. The second phase is the query phase. In this phase, source and target node are known.

Vehicle Object

They are required to detect accidents and provide information about its causes. Fetching the data from in-vehicle sensors is possible nowadays using the On-Board Diagnostics (OBD) standard interface, which serves as the entry point to the vehicle's internal bus. This encompasses the majority of the vehicles of the current automotive park, since the percentage of well-suited vehicles will keep growing as very old vehicles are replaced by new ones.

Data Acquisition Unit (DAU). This device is responsible for periodically collecting data from the vehicle (airbag triggers, speed, fuel levels, etc.), converting them to a common format, and providing the collected data set to the OBU Processing Unit.

OBU Processing Unit. The main objective of the OBU lies in obtaining the available information from sensors coming inside the vehicle to determine when there has been a dangerous situation that must be reported to the nearest answering point, as well as to other nearby vehicles that may face this situation.It is in charge of processing the data coming from sensors, determining whether an accident occurred, and notifying dangerous situations to nearby vehicles, or directly to the Control Unit. The information from the DAU is gathered, interpreted and used to determine the vehicle's cur- rent status. This unit must also have access to a positioning device (such as a GPS receiver), and to different wireless interfaces, thereby enabling communication between the vehicle and the remote control center.

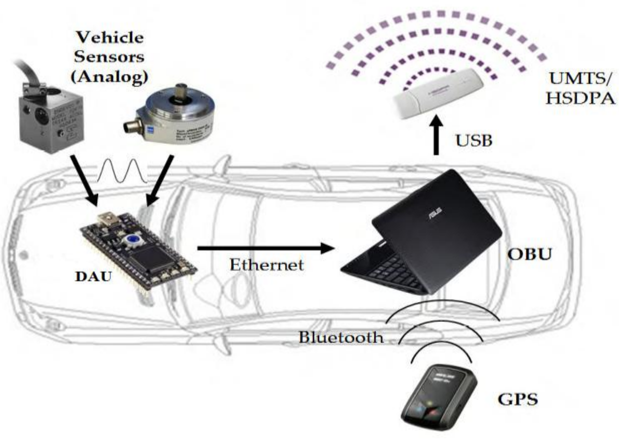

Fig2. *On board unit*

Control Unit

The Control Unit (CU) is associated to the response center in charge of receiving notifications of accidents from the OBUs installed in vehicles. The Control Unit is responsible for dealing with warning messages, obtaining information from them, and notifying the emergency services about the conditions under which the accident occurred. After receiving the message, the CU must store the crash data in a database to record that the accident information has been successfully delivered. The CU should have an available database providing information on different manufacturers and models of existing vehicles. The critical areas of the vehicle to be avoided during rescue procedures (e.g., fuel tanks) are not marked in most vehicles and could cause a hazard to the emergency teams. Thus, when the emergency services receive an accident alarm, they can obtain the information regarding the damaged vehicle (manuals, information on hazardous areas, etc.) before rescuers arrive to the area where it happened.

Reception/interpretation. The first step for the CU is to receive a warning message from a collided vehicle, and so there must be a module waiting for the arrival of messages and retrieving the values from the different fields.

Accident severity estimation. When a new accident notification is received, this module will determine how serious the collision was, and the severity of the passengers' injuries.

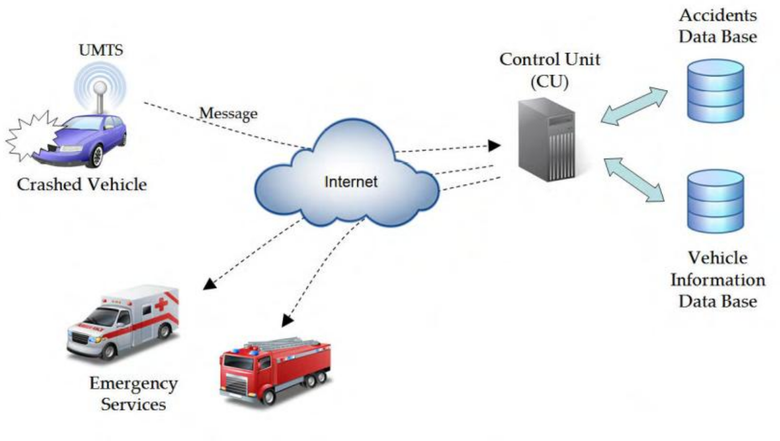

Fig3. *Control unit*

Resource assignment. After deciding the severity of the accident, an additional module is used to define resource sets adapted to the specific situation.

Database update. The data collected from the notified accident are stored into the existing database of previous accidents, increasing the knowledge about the accident domain.

Server. The Control Unit incorporates a Web Server to allow easy visualization of the historical information recorded and the current accident situations requiring assistance. A web interface was chosen in order to increase user friendliness and Interoperability.

Emergency Services Notification

When the information has been correctly managed, the notification module sends messages to the emergency services including all the information collected, the estimated severity, the recommended set of resources, as well as additional information about the vehicles involved in the collision (for preliminary planning of the rescue operation). The information about vehicles consists of standard rescue sheets, which highlight the important or dangerous parts of a specific vehicle that should be taken into account during a rescue operation: batteries, fuel tanks, etc.,

PROPOSED WORK

The existing system mainly focused only on sending the accident information to the emergency services. It does not focused on reducing the accidents. To overcome the drawback, proposed system uses GPS to decrease the number of accidents happen. GPS is a device used to track the location of the vehicles and the Road side units. GPS tracked the road side units and the message about the road side units to the upcoming vehicles. Because of previously getting information about the road side units, the driver can understand and the number of accidents will be reduced.

Existing system send only the limited number of information about the accident to the emergency services. But proposed system adds the severity about the accident to the emergency services. This will used to give emergency first to severe accidents than major and minor accidents. Because compare to major and severe accidents, the number of persons injured and damage of vehicles will be more in severe than in major and minor accidents. Here, all the vehicles will be endowed with vibration sensor. If the sensor shows the value above 5 then there will be accident occurred otherwise there will be a little bit of crash between the vehicles.

There will be a chance of getting accidents in the same location. This will happen due to curve on the road or some other faults. To overcome this, the accident information are stored in the database. This database contains all the information of the accident such as Accident type, Location, Severity of accident. Database will be checked weekly once, and if accident was happened in the same location often then there will some problem in that location. So that, the corrective measures will be done on that particular place.

Severity Estimation

The information about the accident are analyzed and their severity are measured. The severity of the accident are divided into three ways such as minor, major and severe. Vibration Sensor are placed at the front of the vehicle. This vibration sensor have various levels. If only the level of the vibration sensor was 5, then it was considered that accident was occurred otherwise there will be a slight damage between the vehicles.

Severe accident will be occur only when the vibration sensor have the levels of above 9. In the severe accident, there was more damage on the vehicles and the persons inside the vehicle was more injured. Immediate emergency services was need for severe accidents. Major accident will be considered on the levels between 7 to 8. Here, there will be a moderate damage on vehicles and persons inside the vehicles. Minor accident takes the value of 5 to 7. Here there is little damage on the vehicles and the persons are not injured high.

Tracking of RSU

GPS is a device used to track the location of any vehicle. In addition it also help to avoid accident by means of GPS tracking device. Road side units are tracked by the GPS. Each vehicle will get the information about the road side units within 1 km. Because of getting information about road side units previously, accident will be avoided. Existing system does not focussed on reducing the accident but because of GPS we can reduce the number of accidents.

Corrective Measures

The received accident information from control unit are stored in the database. By evaluating the database, the information about the type and location of accident are extracted. The extracted details are analyzed. If the accidents occur at particular location often then the corrective measures will be taken. The databases are analyzed weekly and the report are generated. The remedial measures such as placing sign boards, providing speed breakers are developed in the particular zone.

CONCLUSION

The new communication technologies integrated into the automotive sector offer an opportunity for better assistance to people injured in traffic accidents, reducing the response time of emergency services, and increasing the information they have about the incident just before starting the rescue process. To this end, the system designed and implemented a prototype for automatic accident notification and assistance based on V2V and V2I communications. However, the effectiveness of this technology can be improved with the support of intelligent systems which can automate the decision making process associated with an accident. A preliminary assessment of the severity of an accident is needed to adapt resources accordingly. This estimation can be done by using historical data from previous accidents using a Knowledge Discovery in Databases process.

It will able to classify the accidents depending on the types of impacts, and increase the accuracy of the system, especially for front crashes where the vehicle is usually the striking one. To this end, developed a prototype that shows how inter-vehicle communications can make accessible the information about the different vehicles involved in an accident and also accidents are avoided by using GPS. GPS tracked all the road side units and the information will be displayed to the vehicles.

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