High-speed Transmission of Information about Car Accident with Inter-Vehicles Communication

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Abstract

This system, by sharing the data of the vehicle behavior by using the inter-vehicle communication between the surrounding vehicles, perform pre-guess or accident disaster scale guess at the time of the accident vehicle, and the transfer to the surrounding vehicles of their information. By transmitting information at a high speed at the time of the accident to the surrounding vehicles, and it is an object prevent things a second following a disaster.

In previous report, we experiment mainly meet the operation minimum requirement. This report, we experiment until the system has minimum practical use.

Keywords: Inter-vehicle communication, Accident, Sensor

1. Introduction

Although the number of incidents of a traffic accident in Japan is decreasing in recent years, it is known that more than a dozen accident by simple calculation in each prefecture in a day, so we are not necessarily unrelated to traffic accident. ⁽¹⁾

Moreover, it is known by statistics that the total number of vehicles and density of vehicles increases and in recent years. So, it is considered the damage scale increase when accident occurred. When the accident occurred, the accident information transmits to police by the people near by accident site, and then, the information transmits to JARTIC (Japan Road Traffic Information Center), in the end, It is reflected to the Car Navigation System in the conventional. If this is the case, the big overhead occurs in pipeline. The people who do not report to the police affect that.

Now that the traffic accident occurred, it is most important thing to take measures to the secondary disaster.

Also the accident information is a very necessary for the vehicles driving around. Inter-vehicle communication can realize the system that can transmit the information about accident statuses to following vehicles rapidly. In this system, It forecast the accident from every information (force interrupt, rate of acceleration, etc...). Its data are shared thorough network between surrounding vehicles. When one vehicle has damaged, surrounding vehicles keep the data about that accident.

After an accident occurred, it forecast the scale of the accident and transmits the information to following vehicles.

In some, by taking the correct distance between vehicles, we can prevent a certain level of accidents. However, we cannot grasp the after the accident happened.

2. System

2.1 Overview

In this system, it is assumed that the surrounding vehicles mount same one. This system is mainly composed of Sensor Unit, Processing Unit, and Monitor Unit. In this system, it is assumed that the surrounding vehicles mount same one.

This system is mainly composed of Sensor Unit, Processing Unit, and Monitor Unit. The sensor unit detects the behavior of vehicle. It acquires the data (3-Axis Acceleration sensor, GPS module, etc...) from each sensing devices. The processing unit handles the data from sensor unit and detects the dangerous behavior or accident. The monitor unit provides information to driver.

The processing unit fetches data from sensors to computer and process the data each pattern. According to patterns, sensor's data transmit to surrounding vehicles with RF modules.

2.2 Accident Detection Procedure

In this system, it detects the accident in two steps.

First step, detect the accident with sensing devices. As mentioned above, this system detects the dangerous behavior with sensing devices. In this step, it processes the values from sensors (3-Axis Acceleration sensor, Shock sensor). These sensors are used for discrimination of accident in a short interval. If its result shows the accident is clear, the system will start the transmission process immediately. In contrast, GPS module is used in same purpose in a long interval. If accident is not very clear, this system grasps the positions or behaviors of surrounding vehicles by location information from module and discriminate the accident.

Second step, forecast the accident scale with behaviors of surrounding vehicles. After a conclusion the accident, this system estimates the accident scale from suspicious behaviors (extinction of tracking, stop at a suspicious location) of vehicles.

For example, if stream of vehicles stopped at a one intersection that has no traffic lights, the system can conclude that the accident has occurred and the street has closed to traffic at that point.

2.3 Basic Process

The action in this system is mainly divided into three patterns. First, the action pattern in normal operation. The normal operation here specifically indicates current traffic status that is a remote possibility. In this pattern, the judgement of step 1 in section 2.2 and transfer the data. Although the data (not including accident information) for following vehicles are basically unnecessary, it is anticipated that the data used for statistics of traffic in future. Second, the action pattern in dangerous behavior. Dangerous behavior indicates the vehicles action that may cause accidents.

If vehicles such these behavior approach, it anticipates that each vehicle damaged and share the data to surrounding vehicles for keeping accident status. Third, the action pattern in accident occurred. This action operates after a judgement of step 2 in section 2.2. This operation means it begins to affect caused by the accident. The accident vehicle (or surrounding vehicles) broadcast the information of accident with RF module and hop the data to following vehicle after another.

2.4 Transmit the Information of Accident

The information of accident transmits to surrounding

vehicles with hopping function on this system. Hopping technology can transfer data at a distance by repeating the flow of transferring the data to the neighboring communication node. By using it, implement a high-speed and long distance communication.

2.5 Data Division

When the system has detected the dangerous behavior by sensing devices, the data will transmit immediately. Because it is assumed that the system is damaged by accident. This function is implemented on network imitating RAID (Redundant Arrays of Inexpensive Disks) System.

This function will be operating while the vehicles that drive dangerous exist around. Because of when the vehicle is broken, system cannot share the data.

3. Experiment

The experiments were conducted to realize this system.

3.1 Measure the Time from Connection to Disconnection

To realize the high-speed transmission between vehicles, it is most needed to shorten the process time a series of processes from connection until the system would have finished to send the data. Therefore, it would be required to measure how much time it takes, the experiment was conducted.

XBee ZigBee module is used as communication

Table 1. The transfer time and consistency of data with XBee(38400[bps]).

Amount of data [B]	10	1K	10K
Expected value [ms]	2.1	213	2130
Experiment value [ms]	5.5	609	6021
Consistency	match	match	match

(a) Client Side

(b) Server Side

Fig. 1. Collision Detection on Android Monitor

module. Although Wi-Fi modules were considered as a communication module in this experiment, it takes more time to establish communication because of the protocol of Wi-Fi has many negotiations on the specification. Prepare two Xbee modules and approach slowly from distant position to receivable position. At the moment of catch the signal (catch the RSSI), transmit the data immediately. We have examined the transfer time and integrity of the data each for 10B, 1KB and 10KB. 10B transmitting is assumed the case of emergency. 1KB transmitting is assumed the case of transmission data of the accident information per vehicle. 10KB transmitting is assumed the case of transmission data of the accident information surrounding vehicles.

This experimental results is shown in Table 1. Incidentally, this experiment has done in actual cars environment. Compared with previous experiment, the measured time is extended. The last time, the environment that there are no obstacles spaces, but such a thing, it is different real environment.

Fig. 2. Experiment (3.2) data procedure flow

3.2 Collision Detection with GPS sensor

Last time we used dual acceleration sensor to detect danger. However, as described above, stopping at the intersection cannot be detected with only the acceleration

sensor. Therefore, check whether the detection accuracy increases by using GPS. Using the GPS function mounted on Android smartphone, share location information of two nearby vehicles. Then share the speed using the position information and the distance between the two units. The smartphone can be also used as a display, so use it as a monitor for in this experiment. Attach the USB-OTG cable to the Android device and transfer the data to processing unit (micro controller) with USB-UART converter.

We used RX-62G manufactured by Renesas Electronics as a microcontroller.

It is equipped CAN (Controller Area Network) function⁽³⁾⁽⁴⁾. CAN function frequently is used in communication between the vehicle equipment. For that reason, to use the microcontroller is convenient. This system will transfer the data from microcontroller to Android device if it exceeds a certain threshold. This experimental results is shown in Fig. 2.

This time, we used the Google Maps API⁽²⁾. This API provides the Map view on Android devices⁽⁵⁾. By using it, this system monitor the server and client location, and vehicle distance each other. When this distance is short extremely, transfer the saved data to the other device. We have enacted the standard of the dangerous level.

Level 0 : The vehicles is status stop and distance is enough long each other.

Level 1: The vehicles is status operate and distance is enough Long each other.

Level 2: The other vehicle is stopped where there is no traffic-light.

Level 3: The vehicles is status operate and distance is very short.

Level 4: By using GPS, rapid deceleration is detected.

In accordance with the above, the system judge the data flow. On Level 0, each vehicle records the own location and speed on own system. On Level 1, each vehicle share own data. On Level2, each vehicle share each data to near the Vehicle. On Level3, each vehicles system monitor the dangerous notification. On Level4, each vehicles system monitor the dangerous notification and hop the data and transfer the own data^{(6) (7)}.

This system will start to hop the data at the timing when an accident is detected at Level 4 or higher and stop to transmit the data after some elapsed.

4. Conclusions

From the experiments, it was confirmed that the speed can be determined to some extent by using the position information. By comparing this data with the data of 3 axis acceleration sensors, accuracy is improved. It is necessary to consider how much data of each vehicle is retained and which algorithm to share. In next report, we will report about experiment including every algorithm.

As in said above, we have the subject that define the standard level of dangerous. By enacting the level of dangerous, the system can decrease more number of accidents.

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