Design and Implementation of Traffic Incident Acquisition and Reporting Device Based on LTE Communication

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Abstract. With the development of Internet of Things (IOT) technology, V2X vehicle-road collaboration platform is rapidly applied to intelligent traffic control and road condition service. However, the existing platforms have the problems of inaccurate collection and release of traffic incidents, which can not solve the situation of a large number of secondary accidents and traffic congestion. To meet this demand, a road traffic incident collection and reporting device based on LTE communication is designed. As a roadside intelligent device of LTE-V2X vehicle infrastructure cooperative platform, it realizes the real-time and fast collection and reporting of traffic incidents, and sends them out in real time through V2X internet of vehicle service platform to help drivers adjust their driving routes and avoid congestion points. To help the traffic management department locate the incident quickly and deal with it effectively, so as to eliminate the negative impact of the incident on traffic operation in the shortest time, and further improve the road operation safety and smoothness index and operation efficiency.

1. Introduction
With the development of Internet of Things technology, the interconnection of people, machines and things becomes possible at any time and anywhere. Similarly, in the field of road traffic, with the establishment of LTE-V2X vehicle infrastructure cooperative platform, more and more roadside equipment and driving vehicles are interconnected and interoperable, breaking the barriers of the original road data interaction. Among them, as a roadside smart device, traffic incident acquisition and reporting device has been widely used in LTE-V2X internet of vehicle service platform.

2. The requirements of traffic incident acquisition and reporting
In road traffic operation, a large number of secondary accidents and traffic congestion caused by traffic accidents such as traffic construction, accidents, vehicle failures and other traffic incidents every year have a great impact on the safety and smooth travel of the people.

At present, the reporting of traffic incident information is mainly realized by manual telephone. The information reported by artificial telephone needs to be input regularly, and the reporter often can not accurately describe the type and location of events, which increases the time period of information reporting. After a traffic accident, users will place portable traffic safety facilities (such as traffic cones, warning triangles, etc.) in the warning position to play a warning role. However, this method relies on human eyes to find portable traffic safety facilities, warning distance is easily limited by visual
distance, and drivers in remote areas can not take deceleration, avoidance, bypass measures before seeing portable traffic safety facilities, resulting in limited warning effectiveness, high potential traffic safety hazards and low road traffic rate.

In this context, timely reporting of incident information to traffic management departments and pushing it to road vehicles can bring great social benefits. Therefore, it is urgent to develop a road traffic incident acquisition and reporting device based on LTE communication, which can collect and report traffic operation status and traffic incident information in real time and quickly, and send road traffic incident information to vehicle terminal through V2X internet of vehicle service platform, so as to help drivers adjust driving routes, avoid congestion points, reduce travel time and help traffic management departments quickly. In order to eliminate the negative impact of the incident on the traffic operation in the shortest time, locate the incident and deal with it effectively, so as to improve the road operation safety and smoothness index and operation efficiency.

3. Design of traffic incident acquisition and reporting device

In order to solve the above problems, the traffic incident acquisition and reporting device architecture is built, as shown in Figure 1. The device uses low power ARM Cortex M4 STM32F411 as the core microprocessor to constitute the embedded hardware architecture, NB-IOT/4G communication as the data reporting mode, and uses wide voltage multi-mode power supply to form a low power consumption, portable roadside smart device.

![Figure 1. The architecture of traffic incident acquisition and reporting device](image)

The traffic incident acquisition and reporting device consists of cone barrel (or bracket), control circuit board in the box above the cone barrel and solar panel. As shown in Fig. 2, the specific design is as follows:

At the top of the bracket, a box body is set, a solar panel for power supply is set on the box body, and a control circuit board is set in the box body. The control circuit board integrates embedded micro-control system, NB-IOT/4G wireless transmission communication module, high-precision GPS/Beidou positioning module and high-efficiency power management module. The box body can be flexibly installed on the cone, tripod and other carriers.

The control circuit board includes a measurement processing unit and a communication management unit. Among them, the measurement and processing unit includes the input keys, status indicators and warning indicators for traffic events. The key switches, status indicators and warning indicators are connected with the main control chip through the driving circuit. The main control chip can drive the output of status indicators and warning indicators, read the input traffic events, and transmit them through the communication management unit. Read traffic events including construction, first aid, accidents and other traffic incident information, water, ice and other road status
information, as well as lane, direction and other event location information, and can process the traffic incident information through the communication management board for the required transmission.

The communication management unit includes a communication chip for data interactive transmission, a GPS/Beidou module for positioning and a power management module for power supply management. The power terminal of the power management module is connected with the rechargeable battery in the box body, and a universal charging interface is adopted, which can be charged by a car cigarette lighter or charging treasure. The power management module is equipped with battery over-discharge protection, that is, when the supply voltage of the battery is less than the voltage threshold, the power management module will turn off the output of the battery.

Figure 2. Composition diagram of traffic incident acquisition and reporting device

In the figure, 1-box bracket, 2-battery box, 3-rechargeable battery, 4-box, 5-communication management unit, 6-Measurement Processing Unit, 7-Solar Panel

4. Application of traffic incident acquisition and reporting device

4.1 Traffic Police Single Operational Equipment
The device can be used as a single combat equipment for traffic police to release road accident information, status information and control information. When the traffic accident, traffic control or road abnormal conditions such as water, ice, etc. are encountered, the traffic police can activate the device and arrange it in the event location. The device will automatically upload event information and position information including lane, direction and other parameters. Receiving and distribution center system pushes event information through LTE-V2X Internet of vehicle service platform to intelligent connected vehicle which is 5 kilometers away from the accident site. As shown in Figure 3, it prompts the passing vehicles to actively slow down through the accident section, and actively bypass the control section and the section with accumulated water and ice.

4.2 Regional warning equipment for road construction
The device can be used as a warning device in the construction area for publishing construction occupied roads and closed roads. Because of the wide range of points involved in road construction, such measures as road occupation and temporary road closure are common. The municipal road maintenance department applies the device to the construction work section, opens it immediately when occupying and temporarily closing the road, and pushes the prompt information to the intelligent network vehicle which is 5 kilometers away from the construction section in real time. As shown in
Fig. 3, it prompts the passing vehicle to slow down actively or bypass the construction section, which can better prevent road traffic accidents caused by the construction. By placing the devices at the beginning and end of construction, we can intuitively grasp the length of the construction area and when the construction unit works and closes, thus realizing the remote monitoring of the construction site.

5. Conclusion
Traffic incident acquisition and reporting device is a roadside intelligent equipment of LTE-V2X Internet of Vehicle Service Platform. It is easy to use and maintain, and can be charged by solar energy, cigarette lighter, charging treasure and other charging methods. It has the ability to run smoothly and safely without external power supply and in bad weather conditions such as rain, snow, fog, lightning. The device exposes predefined dial codes on the box body, and can express abundant event information quickly through simple switching operation and report immediately. The device is compact and efficient in structure, flexible in installation and use, convenient in deployment and maintenance, and has a wide range of application scenarios. It can meet the needs of all kinds of traffic participants, including vehicle drivers, traffic managers and vehicle life service providers, for rapid perception and timely handling of events. At the same time, the application of traffic incident acquisition and reporting device provides standard traffic incident data service for intelligent connected vehicles, and creates favorable conditions for the comprehensive promotion of V2X vehicle infrastructure cooperative technology.

Acknowledgement
This research was supported by National Key R&D Program of China (Project No.: 2018YFB1601000).

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