Internet of Thing Based Vehicular Network System and Application

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Abstract. As the current emerging and fiery industry, the Internet of Things has received much attention in all aspects of production and life. Transportation has developed a series of application technologies based on the Internet of Things, the most popular of which is the Internet of Vehicles. The standardization of pure electric vehicles provides a stable foundation for the realization of the Internet of Vehicles. Furthermore, it will further add necessary information collection and transmission modules such as sensors and communication units to realize the interconnection of vehicles, vehicles and vehicles, vehicles and infrastructure, and further form a wider coverage of the Internet of Vehicles. Under the control of the control center, real-time transmission and analysis of information is realized, which lays a foundation for the application of autonomous driving.

Introduction

The Internet of Things (IoT) is a network that extends and expands on the Internet. Its core is wireless sensors and intelligent network systems [1]. The IoT uses sensors to form a network between objects, between people and objects, to identify and exchange data through radio frequency identification (RFID), and to transmit the obtained information to the wireless local area network through human-machine dialogue [2]. The way to process these data, intelligent identification, location, tracking, monitoring and management.

The IoT connects all kinds of things in people's lives to the Internet, forming a larger network. Through this network, you can get information about all kinds of things, and realize the rapid extraction and processing of information. The rational use of this information will bring unprecedented convenience to our production and life. The Internet of Vehicles (IoV) connects the vehicle with the infrastructure of the vehicle, the vehicle and the roadside to realize real-time information exchange [6]. It is the specific application of the Internet of Things in the transportation network and plays an important role in production and life.

The so-called IoV refers to the wireless communication through the electronic devices mounted on the vehicle, so that the static and dynamic information of all vehicles can be extracted and effectively utilized on the information network platform [3]. Based on this, people effectively supervise vehicles with different functional requirements and provide comprehensive services. The Internet of Vehicles dynamically collects, distributes, and processes data through the vehicle network, and uses wireless communication to share information, enabling information exchange between the vehicle and the existing, enabling the vehicle to connect with the city network.

IoV technology is an in-vehicle intelligent communication service that combines global satellite positioning systems and wireless communication technologies. The system is an information interaction network composed of vehicle position, driving speed and driving route [5]. It collects information such as vehicles, roads and traffic environment through electronic devices such as RFID, camera, sensor, GPS and image processing, and according to certain communication [4]. Agreements and standards for information exchange between people-net-environment-infrastructure. The cloud center uses computer technology to analyze and process the acquired information to realize intelligent monitoring, scheduling and management of people, vehicles and roads. At the same time, the driver can contact the center at any time through wireless signals to obtain traffic information and real-time navigation services, safe driving and vehicle fault diagnosis services, entertainment and communication services.

IoT based Pure Electric Vehicles

The IoV technology is designed to solve traffic problems, including preventing traffic collisions, planning travel modes and reducing environmental pollution. As an emerging industry, electric vehicles also have industrial advantages such as environmental protection and energy conservation, and meet the requirements of green, low-carbon and sustainable development. Electric vehicles have advantages over other types of vehicles, so electric vehicles can be used as an effective vehicle for the IoV.

A pure electric vehicle refers to a vehicle that is only powered by electricity, and uses a single battery as a source of energy storage. Compared with traditional fuel energy vehicles, pure electric vehicles have unique advantages in terms of economic performance and environmental performance. At present, the biggest technical bottleneck of pure electric vehicles lies in the power battery technology, which has problems such as high cost and short driving range of one charge.

Incorporating pure electric vehicles into the IoT system, on the one hand, the reasonable invocation of the vehicle's internal energy can be realized to improve the endurance; on the other hand, the traffic system data center can update the charging station information and provide early warning during the driving of the pure electric vehicle. At the same time, the integration of pure electric vehicles into the IoT system will also help the energy interaction between the vehicle and the grid, improve energy efficiency, and stabilize the peak-to-valley difference of the grid.

The application of the IoT in pure electric vehicles mainly includes the following aspects:

Application of IoT in vehicle. The IoT is used in electric vehicles. It is an interactive network of various sensors, positioning systems and other electronic devices installed on the vehicle. It uses IoT technology to realize the control functions and information communication functions of different control systems. The sensor network system can test all relevant parameters in the electric vehicle such as temperature, battery remaining capacity and position, and control the vehicle operating conditions according to the instructions of the traffic control center.

Since the interior of the vehicle is a relatively static environment, the information transmission inside the vehicle directly adopts short-distance wired or wireless communication, and has the characteristics of strong real-time performance, high reliability, and short communication distance. In addition, the application of the IoT in electric vehicles has increased the reliability and safety of the system, making the pure electric vehicle have a more flexible structure, lower production costs, more convenient system components and self-diagnosis of the in-vehicle electronic equipment ability.

Application of IoT between vehicles. The IoT is used in electric vehicles, that is, the communication network between the vehicle and the vehicle is built by the vehicle-mounted terminal, and the traffic flow is coordinated to control the traffic safety [7]. Construct communication frameworks such as Device to Device (D2D), Vehicle Cloud Computing (VCC), Vehicle Fog computing (VFC), Vehicle edge Computing (VEC), complete the interconnection between vehicles, and use sensors to grasp the running status of electric vehicles in real time and predict the future running track of electric vehicles. For example, through the Internet of Things to grasp the dynamics of electric bus operation, reduce waiting time, assist in pre-departure planning; coordinate the distribution of taxis through the IoT, enhance supervision functions, and rationally dispatch. This plays an important role in improving urban transportation, promoting the integration of traffic information, and improving traffic flow.

The data transmission between vehicles is two-way transmission, and the communication technologies used mainly include microwave, infrared technology, and dedicated short-range communication. These technologies have high requirements for security and real-time. The vehicle terminal can collect the vehicle running state information such as the speed, position and direction of the surrounding vehicles in real time, so that the vehicle and vehicle form an interactive communication platform through wireless communication technology, realizing real-time exchange of information such as pictures, short messages, videos and audio.

Application of IoT between vehicle and infrastructure. The IoT is used outside the electric vehicle, that is, the vehicle interacts with various external facilities. Vehicles, portable computers,

smart phones and other handheld devices, in-vehicle electronic devices, traffic cameras, traffic lights and other surrounding road equipment and traffic control centers form a complex network, complete traffic management, vehicle management passenger transportation and logistics scheduling, etc., for digital TV, remote services provided by technical service providers such as data broadcasting. At the same time, by interacting with the infrastructure, various information can help electric vehicles understand the traffic conditions ahead of the road, avoid crowded roads, and achieve the shortest time navigation. These functions can effectively ensure the safety of electric vehicles.

The communication between the vehicle and the infrastructure especially emphasizes the intelligent coordination and cooperation between various components, establishes interconnection and interconnection between the public access network and the remote traffic control center, and realizes data interaction, data storage and data processing between the vehicle and the traffic control center. The main communication technologies include microwave communication, infrared communication, 4G, GPS, satellite communication and so on.

IoV architecture and communication

The IoV uses vehicles as carriers to form a special mobile wireless sensor network. This type of network is divided into two types: vehicle area network (VAN) and vehicular Ad Hoc network (VANET). The VAN [10] is a local area network built in the vehicle, and is used for information exchange and sharing between the vehicle sensor module, the positioning module, and the communication module. The VANET [11] is a mobile self-organizing network dedicated to traffic environment. The vehicle is virtualized into a mobile network node, interacts with the roadside unit (RSU), and collects environmental information about the road and the surrounding area of the vehicle. Including vehicle-to-vehicle (V2V) communication and vehicle-to-road infrastructure (V2I) communication. The V2V mode allows the vehicle to sense the running status of other vehicles in its vicinity in real time, providing security services for traffic management and intelligent driving. The V2I mode is used for communication between the in-vehicle device and the RSU. The real-time traffic information collected by the in-vehicle device is collected into the traffic control center through the RSU, and the traffic operation status is monitored and managed in real time to realize real-time positioning of the vehicle. Tracking, fee management and traffic information release services.

The key technology of the IoV is how to realize the information exchange and interaction between the vehicle and the road, between the vehicle and the vehicle, and the main role played in it is the wireless communication technology. This requires research into which of the many existing wireless technologies is compatible with real-time interaction and is compatible with both traditional and future vehicle networking applications.

Compared with the traditional mobile Internet and the IoT, the IoV has its own unique characteristics and advantages. Firstly, the network structure of the vehicle networking presents a dynamic topology. The high-speed moving vehicle nodes make the topology of the vehicle network change rapidly, and the access mode changes dynamically due to environmental changes. Secondly, electric vehicles have sufficient energy and storage space because the communication nodes are vehicles with sufficient storage space and data processing capabilities, as well as uninterrupted battery life. Third, the movement of the vehicle follows the already established road. As long as the speed and road map of the vehicle are acquired, the running state of the vehicle can be predicted within a certain period of time. Finally, the application scenarios of the IoV are diversified, providing services such as vehicle safety, road maintenance, traffic monitoring, life entertainment, and mobile Internet access.

International Transport System and Autonomous driving

Intelligent Transportation System (ITS)refers to the effective integration of advanced computer processing technology, information technology, data communication transmission technology,

autonomous control technology, artificial intelligence and electronic technology into the transportation management system to establish a wide range. A punctual, accurate and efficient transportation management system that functions internally and comprehensively. The application of intelligent transportation in special vehicles such as buses, taxis, freight vehicles and money-carrying vehicles has been relatively mature. Intelligent transportation can improve road use efficiency and effectively manage traffic congestion.

Driverless vehicles are an important part of the future ITS. The application is based on the vehicle's standard infinite vehicle networking equipment to transmit vehicle status information to the central information system. According to the regulation of the central information system, the behavior of the vehicle is controlled. The transportation system can operate efficiently, stably and continuously under the conditions of participation.

In the process of driving a driverless vehicle, standard wireless vehicle-connected equipment transmits information such as vehicle operating status, vehicle position and destination to the central information system, while road facilities such as traffic lights transmit the detected vehicle information to the central information system. The central information system analyzes and processes the current operating environment, driving route, and vehicle status of the vehicle to determine the operational safety of the vehicle. The central information system calculates road traffic such as traffic flow through the vehicle network calculation cloud based on the received information, and feeds back to the vehicle through the roadside unit. The unmanned vehicle designs and plans the optimal route of the vehicle according to the information to alleviate the traffic jam. When a traffic accident occurs, the driverless vehicle can automatically upload important data such as the accident location and the casualty situation to the central information system through the Internet of Vehicles, so that the traffic police and ambulance personnel can provide support and rescue work.

Through ITS and driverless technology, real-time road conditions and dynamic path planning, road environment awareness, and V2V sensing can be realized. With the ITS as the platform, it can provide road traffic information such as surrounding traffic flow and sudden accidents for vehicles in the network in real time, and provide optimal route navigation for the driver according to real-time traffic information, thereby effectively guiding the driving path of the vehicle and avoiding Congestion of the road saves time for the driver. Road environment perception means that the vehicle has the ability to sense the surrounding road environment through sensors and camera technology. When the current side encounters obstacles or unexpected situations, it can automatically adjust the speed in time to avoid accidents. V2V perception means that "inductive" communication can also be achieved between the vehicle and the vehicle. In the intelligent transportation system, each vehicle is a node with a unique label, which can transmit the driving and status information of the vehicle through wireless and sensing technology, and collect information from the RSU and transmit it to the information center.

Based on the above technology, it is possible to build a foundation for autonomous driving. Autopilot is an application that combines real-time road conditions with dynamic path planning, road environment awareness, and V2V sensing. The vehicle can travel according to the planned route and automatically sense the road and traffic lights ahead, keeping the vehicle in the right lane for straight, turning and parking. It can also react automatically when there is an emergency. This application not only improves traffic flow, reduces travel time, liberates drivers, reduces traffic accidents, but also saves fuel consumption。

Conclusion

This paper first introduces the transportation system under the background of the IoT, and uses pure electric vehicles as a breakthrough to realize the IoV. It introduces the importance and necessity of developing standardized electric vehicles. With the help of various sensors and communication devices, the vehicle networking architecture can be realized and the automatic driving can be further realized with the aid of the intelligent transportation system.

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