

Key Technologies and Development Status of Internet of Vehicles

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Abstract: Internet of Vehicles is a special application of Internet of Things.In recent years,it has become an important symbol of the Smart City and Intelligent Transport System construction with increasingly attention from all circles at home and abroad.This paper is aimed to make an analysis and summary of the existing Internet of Vehicles technology,and expound the latest results and the product of current major IT companies and Research and Development departments to view research direction further.This paper describes the sensor technology,RFID technology,communication technology and data processing techniqueand explain the problems encountered at present.Finally it illustrates currently representative application example of Internet of Vehiclesand compares the current actual research achievements at home and abroadand analysis and prospects for further explanation.Internet of Vehicles era is coming.

Keywords: Internet of Vehicles,Smart City,Intelligent Transport System.

1 Introduction

Along with the development of modernization, the automobile industry has been rapid development, the automobile has become the most important part of urban transport system. Traffic congestion, traffic safety and environmental pollution have become urgent problems to be solved in traffic construction planning.

IOV (Internet of Vehicles) is a kind of Internet of thingswith the functions of information services, promoting energy-saving emission reduction and ensuring driving safety, it's specific applications in Internet of Things in urban transport network. Through sensors, RFID, GPS and other technology to achieve information acquisition and processing of the vehicle on themselves and the outside world, and real-time exchange information through the Internet technology to achieve full supervision and services of vehicles and roads, that is called IOV (Internet of Vehicles), and eventually it will provide information support to improve the operational efficiency and safety of traffic. IOV will realize the real-time interconnection of human-vehicle-road to ensure the driving convenience, intelligence, efficiency and safety. It will have a wide application prospect in intelligent automobile, ITS (Intelligent Transportation System) and Smart City.

At the World Expo2010, SAIC-GM Pavilion(SAIC General Motor Pavilion)demonstrated the envisioned future of IOV and held a series of "Direct-to-2030"sustainabletransportation forums,"IOV—City Intelligent Traffic Network".

In 2011, Internet of Things“12th five-year plan” introduced, it made clear things that IOV will be first to deploy intelligent transportation, intelligent logistics and other fields.

In 2012, China's Ministry of transportation issued the "2012-2020 China's Intelligent Transport Development Strategy", which requires to basically establish an intelligent transportation system suitable for the development of modern transportation in 2020.

In 2015, China's IOV began to enter a period of rapid development, car manufacturers and major IT companies increasingly attach importance to develop IOV related industries.

The development of IOV provides a new solution for traffic problems, mainly in the driver assistance systems, increase safety, improve traffic efficiency and so on. Although current IOV in technology and standards are still not mature enough, but it has reflected its importance to the automotive and transportation. IOV technology must be development trend of intelligent cars and intelligent transportation, the car will be the next important mobile Internet portal, IOV times is coming.

2 Key technologies of IOV

2.1 RFID technology and intelligent sensing technology

RFID is a non-contact short-range wireless communication technology that can identify and read-write related data through wireless signals. It has many applications in RFID,such as access control system, electronic traceability and anti-counterfeiting system.It is one of the most basic technologies in IOV.

Sensing technology is an important indicator to measure the degree of national information, we can use sensor with a combination of various types to collect relevant information^{[1]-[2]},So that we can more comprehensive understand the

information, and the next step of processing to make more accurate judgments, it's equivalent to the eyes in the whole vehicles networking system.

If the IOV can be simply understood as intelligent vehicles, intelligent transportation equipment and the communication network to connect them, then as the eye sensors in which play the most basic and extremely important role. Within the vehicle, the sensor group real-time collected the vehicle's internal operating state information and reflected to the user through the intelligent vehicle terminal. Nowadays BMW can monitor fuel consumption, mileage, battery voltage, driving trajectory, doors and windows open or close conditions and other vehicle information through a series of sensors, you can also conduct a preliminary vehicle fault detection and analysis. The car terminal or the relevant mobile APP interconnection can make it display, it's convenient and efficient. On the other hand, intelligent vehicles can also collect a large number of demand information for users to judge around the vehicle. Such as precrash system, which will involve the sensor technology, real-time collection distance with car and analyze to determine whether it's danger. Such as Volvo's precrash system and city safety system, which works with city safety system with full brake capability. If the vehicle ahead suddenly brakes, and the driver doesn't take any action about warning system, the vehicle will automatically brake to avoid the occurrence of a collision.

2.2 Communication technology

IOV is a special applications of IOT, communications technology will be the key and difficult points. IOV involves many communication technologies, such as RFID and WIFI, Bluetooth and other 2.4G communication technology, GPRS, 3G and 4G and other mobile communication technology. According to different communication objects, it can be divided into: IVN (in-vehicles network), V2R (Vehicles to Roads), V2V (Vehicle to Vehicle) and V2I (Vehicles to Infrastructure)^{[3][4]}.

Table1. Several kinds of communication

Category	Application	Feature	Technology
IVN	Internal information transmission	real-time, higher reliability	CAN, LIN, MOST, FlexRay
	Short range wireless communication	short distance	Bluetooth
V2I	Vehicle and external communication device	long distance, high speed movement	GSM, GPRS, 3G, GPS
V2R	vehicle and external traffic facilities	short distance and high speed movement	microwave, infrared, DSRC
V2V	transmission between mobile vehicles	security and real time	microwave, infrared, DSRC

In the process of moving, the vehicles need to switch frequently for information collection and transmission. Therefore, the integration of HWNS (Heterogeneous Wireless Networks) is one of the difficult problems to be solved in the current communication technology. Another difficulty is the unity of the vehicle to vehicle communication protocol^{[5][6]}. In July 2010, IEEE officially released IEEE802.11p communication standard, which is expansion of the IEEE802.11 standard communication protocol, mainly used in vehicle electronic wireless communications for V2V and V2I. It has more advanced hand off schemes, mobile operations, enhanced security, identification, and peer-to-peer authentication. Most importantly, communication at the prescribed frequency of the vehicle, it will act as basis for DSRC (Dedicated Short Range Communications) or vehicle communication. However, IEEE802.11p still faces challenges in response to the high mobility of vehicles, time-varying and the diversity of information requirements^{[7][8]}.

2.3 Data processing technology

The advent of the Big Data has made an explosive growth in the amount of information, according to statistics of human production in 2012, all printed materials, the amount of data is 200PB, all the history of mankind said all the data is about 5EB. According to IBM research, 90% of all data obtained for the entire human civilization were generated within the past two years. The vehicle real-time updates and collect all kinds of data by RFID, sensors, wireless communication technology, and taking into account the complexity of the external environment and randomness, and change of data is instantaneous and the switching of network topology in the process of vehicle movement, which the amount of data is very alarming. So big data process and analysis technology put forward a very high demand in order to make reasonable contribution to intelligent transportation system in the future through the big data platform to divert traffic and schedule resource. Such as the current Google Driverless car produces about 1G of data per second, 2PB data per year, the amount of data generated in the future will be unimaginable.

3 Development status of IOV

In recent years, IOV has become a research focuses at home and abroad, the automotive industry will usher a new round of revolution of technology, from the traditional mechanical control cars to electronic and network technology control cars. IOV will achieve a large network of people-vehicle-road interconnection, and then build the future intelligent transportation system, create smart and civilized city.

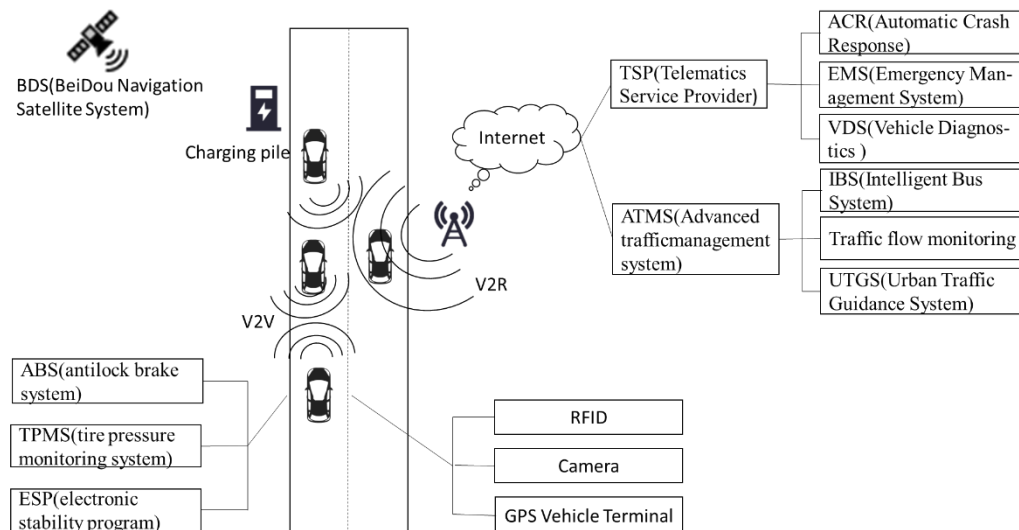


Figure1.Framework of IOV

Domestic and foreign major IT companies and related automotive manufacturers have also invested in IOV research. And IOV research early explorers is OnStar in the domestic. In 1996, GM launched Onstar products in North America, Today, OnStar is one of largest domestic personal customer IOV companies, nowadays it has more than 20 car networking services, such as OnStar 4G LTE, vehicle detection, emergency management system, stolen vehicle location, automatic crash response. OnStar launched the 4G LTE car is the first domestic vehicle wireless network technology, it has efficient transmission speed and stability and powerful network signal to lay the foundation for the further development of IOV.

BAT in IOV layout earlier is Baidu, it combined with the automobile industry early, because Baidu maps. In 2014, Baidu launched CarNet to achieve the interconnection between people-cars-Mobile. In 2015, Baidu evolved from Carlife to CarNet without adjustment, you can perfect fit Linux, QNX and Android. Client Baidu Carlife is not a simple intelligent, but attached to Baidu's ecological——Baidu's voice recognition technology, real-time traffic data, and initial establish their own IOV ecosystem.

ETC (Electronic Toll Collection) is the world's most advanced toll collection system, through the vehicle electronic tags and microwave antenna of ETC driveway to communication and process by internet technology and the settlement banks, so as to achieve the vehicle don't need to park to pay the fee through the toll station^[9]. In recent years it has been promoted at home and abroad, this is a practical application of IOV and nearby in our side, not far away. According to the Ministry of Transportation Highway Science Research Institute statistics, these two years it led to the increase production value of 3 billion RMB, saving investment 18 billion RMB through the construction of the ETC, the development of intelligent transportation economic benefits thus evident.

4 Prospect

Intelligent car and IOV will be the focus of future research and development trends, and the two most important concerns are safety and convenience. The current intelligent driving technology has got great development and application in the new reform cars, thus IOV has put on the agenda and led to research heat. In the future, the information exchange between V2R (Vehicles to Roads), V2P (Vehicle to Person), V2V (vehicle to vehicle) and V2I (Vehicles to Infrastructure) will make considerable progress^[10]. After intelligent transportation system completely establishment, people will bid farewell to the traffic lights, traffic accidents and a series of problems, IOV is approaching, It will become an integral and important part of human life.

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