The Construction and Evaluation of the Security Management System of CNG Gas Cylinder with RFID Based on Internet of Things

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Abstract: According to the concept of networking and architecture, Chongqing establish CNG cylinders RFID security management system. Study, the focus on the promotion of the application appeared in a variety of design, management, failure to study the problem, propose solutions for the problems to deal with the network data analysis, on-site field trips and other methods, the safety management system for construction, operation, maintenance, etc. complete summary of Chongqing CNG cylinders RFID security management and evaluation system to provide support for the development of special equipment Soft Science RFID security management system.

1. Introduction

In the 21st century, countries around the world attach great importance to ecological environment protection and low-carbon economy. Natural gas has become an important alternative fuel for automobiles. With the rapid growth of CNG vehicles and CNG filling stations in China, the development of CNG in Chongqing has been at the forefront of the country. By the end of 2018, more than 120,000 CNG vehicles and 200,000 CNG cylinders have been built in Chongqing, and 130 CNG filling stations have been built.

Due to aging of cylinders, inevitable corrosion, natural or man-made damage and other factors, there have been many vicious accidents caused by leakage. Because of the frequent filling of CNG cylinders and the operation of vehicles, it is difficult to supervise the cylinders. If the gas cylinder leaks accident, it will not only waste energy, but also cause disasters such as explosion, fire, environmental pollution and so on, resulting in huge loss of life and property.

To solve this problem, under the leadership of Chongqing Municipal Government, Chongqing Special Procuratorate is responsible for the implementation of electronic label safety management for Chongqing cylinders by means of information technology. The construction, operation and supervision of electronic label safety management system for CNG cylinders in Chongqing have creatively combined the general situation of Internet of Things. The system structure ensures the safe use and supervision management of CNG cylinders, which is of great significance to the safety supervision and management of special equipment and the actual inspection work.

2. Overview of Internet of Things Development

Internet of Things refers to the ubiquitous terminal devices and facilities, including sensors with "intrinsic intelligence", mobile terminals, industrial systems, building control systems, home intelligent facilities, video surveillance systems and other "external capabilities", such as attaching various assets of RFID, personal and vehicle with wireless terminals, etc. Through a variety of wireless and wired long-distance and short-distance communication networks to achieve interconnection, application integration and cloud-based SaaS operation mode, in the Intranet, private network, Internet environment, to provide security, controllable and even personalized real-time online monitoring, location traceability, alarm linkage, dispatching command, and plan management. Management and service functions such as remote control, safety precaution, remote maintenance, online upgrade, statistical report forms, decision support, leadership desktop and so on,

realize the integration of "management, control and management" of "all things" with "high efficiency, energy saving, safety and environmental protection".

IBM first mentioned that human beings will realize the full integration of intelligent infrastructure and physical infrastructure, and the deep integration of IT and all walks of life, so as to manage social and natural systems in a scientific and wise way and form the so-called Internet of Things. The EU launched the EU Action Plan on the Internet of Things in November 2009, which aims to lead the development of the Internet of Things in the world. I

China started early in the development of the Internet of Things. The development of technology and standards has basically kept pace with the international development. It has supported several key technical areas and important application areas. Nearly 100 units in China have carried out the research and application of sensing, and achieved some results. Some regions in China have taken measures to promote the development of the Internet of Things industry. In terms of application and development, the Internet of Things has been initially applied in China's public safety, civil aviation, transportation, environmental monitoring, smart grid, agriculture and other industries on a large scale.

3. The Principle of Internet of Things Supervision Based on RFID

Radio Frequency Identification (RFID) is a very important technology in the Internet of Things. The essence of the Internet of Things is to use radio frequency automatic identification (RFID) technology to realize the automatic identification of goods (commodities) and the interconnection and sharing of information through the computer Internet. Radio Frequency Identification (RFID) is an abbreviation of Radio Frequency Identification (RFID) technology in English. It is an advanced non-contact automatic identification technology that began to rise in the 1990s. In the conception of "Internet of Things", RFID tags store standardized and interoperable information. They are automatically collected to the central information system through wireless data communication network to realize the identification of goods (commodities). Then, information exchange and sharing are realized through open computer network, and "transparent" of goods is realized.

4. Development of CNG Cylinder Electronic Label Safety Management System Based on Internet of Things Technology

The safety management system of CNG cylinder electronic label in Chongqing adopts the current international advanced Internet of Things technology (including RFID technology, microelectronics technology, computer technology, network technology, wireless communication technology and automatic control technology), establishes the identity card of the RF electronic label of the cylinder, and realizes the whole process tracking and monitoring of the cylinder.

Through the establishment of information electronic archives and databases of cylinders, the system installs an electronic tag on each cylinder, giving the cylinder a unique "electronic identity card". It automatically collects data and information of all cylinders in the city from production, installation, registration, issuance, use, inspection to scrap, and centralizes them in storage. The unified data center has realized the informationization and automation safety supervision of unqualified cylinders such as illegal refitting, undocumented, overdue and missed inspection, realized the dynamic closed supervision of the whole process of "one bottle, one file" and "one bottle, one certificate", and established a scientific and reasonable cylinder safety management system.
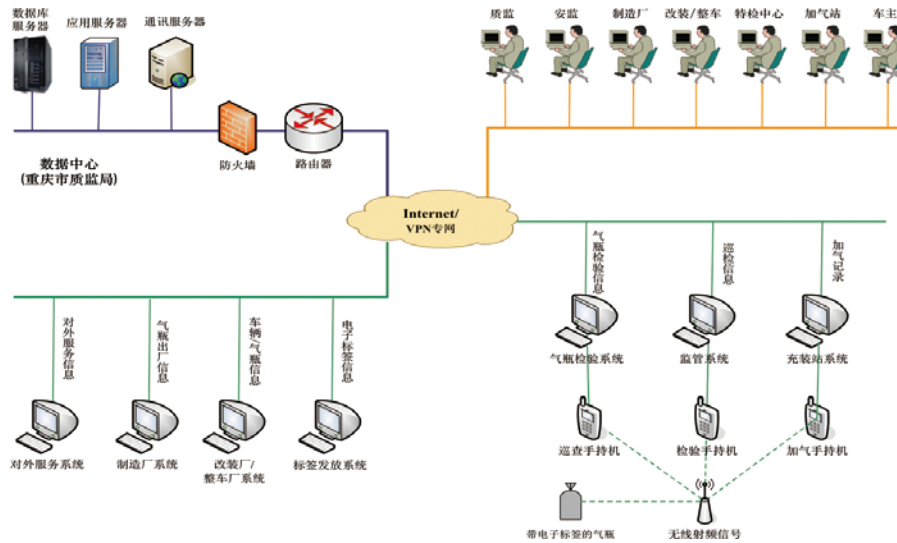
Figure 1. Safety Management System for CNG in Chongqing

It consists of a data center and eight application subsystems. The information center of Chongqing Quality Supervision Bureau has established the unique and unified data center in the whole city. The eight application subsystems are label distribution system, supervision system, manufacturing plant system, vehicle factory system, refitting plant system, filling station system, inspection institution system and external service system.

5. Analysis of CNG Electronic Label Safety Management System in Chongqing

Chongqing Vehicle CNG Cylinder Electronic Label Dynamic Supervision Integrated System not only dynamically supervises CNG cylinders, but also joins in the supervision of personnel and all special equipment of gas station, so as to achieve the purpose of safety supervision.

1) The potential safety hazards can be investigated. Taking Bishan District as an example, six vehicles with forged registration certificates have been detected since the system was put into operation.

2) Find out the regulatory base. Through the operation of the system, we have thoroughly checked the base number and distribution of supervision, and provided first-hand information for the implementation of more effective supervision.

3) Regular inspection has been carried out. Because the system can automatically control the filling through the scanning results of electronic labels, it can effectively prevent the filling of cylinders that exceed the periodic inspection cycle, and solve the long-term problem of "overdue inspection" that troubles the supervisory organs.

4) Filling behavior can be regulated. Electronic recognition and intelligent gas filling of the system effectively eliminate the interference of human factors, and illegal gas filling and "problem filling" are completely stopped.

5) Dynamic supervision can be realized. The system controls the filling gun automatically by intelligent controller, and realizes timely exchange, update and query of cylinder data and filling data through network. It realizes real-time dynamic supervision of CNG cylinder installation, registration, filling, inspection, inspection, duplication and scrap.

Figure 2. Safety Management System of CNG Electronic Label in Chongqing

In the process of acceptance and acceptance of Chongqing CNG cylinder electronic label safety management system, its analysis mode is the actual operation of the network inspection system, and analysis of its data; to spot check the operation of the system, field observation of the operation of the management system.
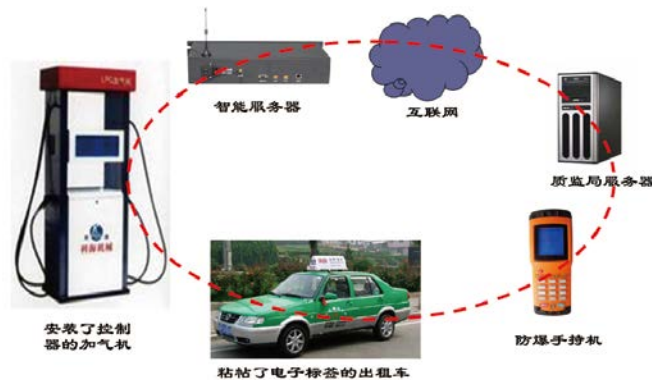

Figure 3. Schematic diagram of on-site inspection of CNG tag safety management system

Through network data analysis and field investigation, it is found that the problems in the operation of CNG tag safety management system in Chongqing are summarized as follows:

1) Due to the backwardness of infrastructure construction, the data upload of the system is delayed. For example, the time for uploading and filling information from some filling stations found during field visits exceeded 6 seconds.

2) Individual operation process has the discretion space of operators, and there are some misoperation. The smooth operation of the supervision system is disturbed by human factors and equipment factors.

3) The combination of cylinder and automobile electronic tag needs to be optimized. Nowadays, electronic tags are used for both automobiles and cylinders, and there is a lack of optimization in the face of more cylinders on buses. At the same time, we hope to achieve the effect of map positioning, so that the car and cylinder can be better integrated and positioned.

4) Combining with the latest cloud computing, the dynamic performance of cylinder filling can be better predicted and monitored.

6. Prospects for the Promotion of Internet of Things Technology in Safety Supervision of Special Equipment

The major accidents of special equipment are almost the accumulation of all kinds of minor and imperceptible hidden dangers and faults for a long time. They are the process from quantitative change to qualitative change. The emergence of the integrated information technology application mode of the Internet of Things makes it possible to realize the safety prediction of special equipment through information technology devices. Using the Internet of Things technology to construct

different equipment and different enterprises' classified supervision mode, the safety responsibility of special equipment users can be effectively implemented in every link, every post and every operation process of production and operation, and the occurrence of major accidents can be prevented to the greatest extent. At the same time, emergency rescue command and rescue after accidents can be realized.

Internet of Things data monitoring platform includes database, front-end equipment status monitoring, alarm control, application control, log module, report system, etc. It has real-time monitoring of equipment operation status, failure status of key parts, pipeline leakage, equipment energy efficiency monitoring (such as boilers), sensor terminal status monitoring, RFID terminal status monitoring. Measurement, critical alarm, operation statistics, periodic report, equipment account, maintenance record, data access control, authority management, sharing interface, etc. Monitoring the status of key parts of special equipment (such as boilers, industrial pressure pipes, movable pressure vessels, lifting equipment, etc.), real-time monitoring the operation of special equipment based on factory parameters and testing standards of special equipment and regulations of Safety Supervision Regulations and Safety Production Law. Special equipment fault warning and accident alarm. Special RFID tags are used to monitor the safety bolts in key parts of large amusement facilities, and integrated sensor RFID tags are used to monitor the status of key power parts (cylinders, bearings, etc.) to realize the monitoring of key parts of special equipment. Using RFID, face recognition and human body sensing technology to build personnel quality monitoring system. Maintenance status of special equipment and personnel quality supervision and control system for elevators, boilers, cranes and other equipment users who often borrow certificates and work without certificates can play a strict management purpose.
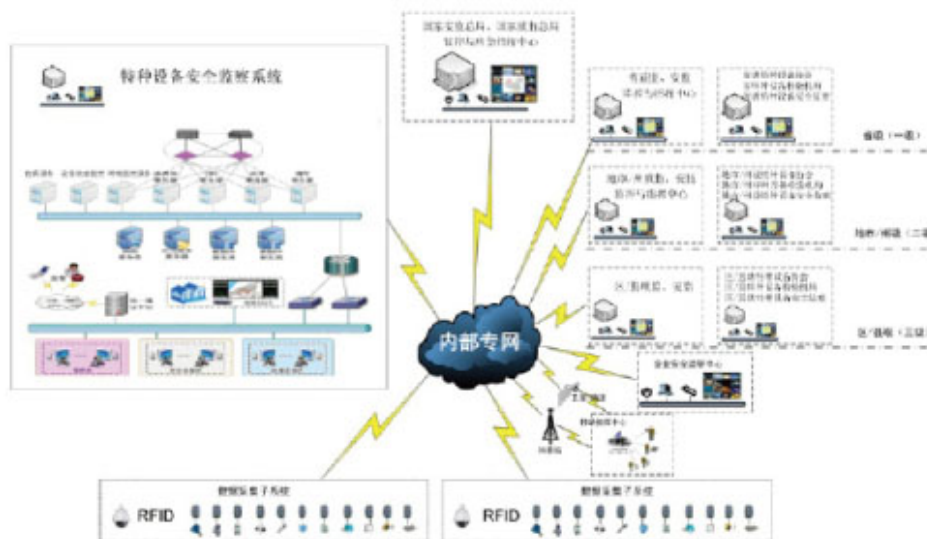

Figure 4. Software System of Special Equipment Safety Monitoring Platform

7. Conclusion

The function of the system basically meets the requirements of "the development and implementation of the application software of Chongqing Cylinder Electronic Label Safety Management System (CNG part)", and carries out dynamic management of nearly 130,000 CNG vehicles in the whole city.

The construction, operation and supervision of the safety management system for CNG cylinder electronic labels in Chongqing have creatively combined the concept and architecture of the Internet of Things, guaranteed the safe use and supervision management of CNG cylinders, and has great significance for the safety supervision and management of special equipment and actual detection work. The smooth operation of Chongqing CNG cylinder electronic label safety management system proves that Internet of Things technology has great potential in the safety supervision of special equipment.

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