

Research on Subway Operation Safety Platform Model Based on Blockchain and Internet of Things

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Abstract: With the continuous and rapid increase in the scale of subway operation, the security situation faced by the operating units is becoming increasingly severe. Based on the analysis of the characteristics of subway operation and the current situation of information construction, this paper deeply analyzes the main problems of subway operation safety information construction. Aiming at the problems of poor data circulation, difficult supervision, distrust, fear of leakage, poor timeliness, poor quality and insufficient certificates, this paper puts forward the construction requirements of subway operation safety platform. The platform model is designed from three aspects of block chain platform, platform logic architecture and Internet of Things forensics, and the new mode of safe and efficient management of subway operation is explored.

Keywords: Metro operation, Security platform, Model structure, Blockchain, Internet of things.

1. Introduction

With the advancement of urbanization in China, residents' travel has become an important problem to be solved in cities. Therefore, the subway has become the first choice for the development of transportation in large cities due to the advantages of low energy consumption and convenient ride. Because the subway is built underground, ventilation is inconvenient, emergency evacuation is difficult, fire, flood and other serious accidents are difficult to control, so safety accidents are easy to cause serious consequences, such as Zhengzhou 7 · 20 flood caused by 12 days of death and other events. With the rapid and continuous increase of domestic subway lines and mileage in recent years, the security situation faced by operating enterprises is becoming increasingly serious[1–3].

Due to the large number of passenger flow and safety risks in the subway system, there are many safety management units in the subway operation, such as external supervision units, transportation competent units, emergency management units, special equipment management units, fire safety management units, safety management units, environmental management units, health management units, etc. The internal safety management units include the safety committee and safety department of the subway group, the relevant departments of the subway construction company before the initial operation, many departments of the subway operation company related to the operation safety, the general dispatching center, the line operation branch, the vehicle, the pass number, the power supply, the engineering, the monitoring, the logistics and other branches; and many third-party units involving operational security. All units and departments have carried out information system construction according to business needs, such as the information system of external supervision units, the subway operation monitoring system established by the relevant departments or units of the subway company, the subway operation communication system, the subway maintenance system, the subway operation Measurement system, the hidden trouble investigation and management system, the emergency

response system, the subway facilities protection system, etc. [4–6]. These systems have played an important supporting role in ensuring the safety of subway operation. However, due to the lack of overall planning for development and construction, the current business application systems have many problems, such as numerous information islands, difficult interconnection, relatively backward information infrastructure, low level of information sharing, mutual trust, and low comprehensive utilization efficiency of information resources, and insufficient support for the comprehensive improvement of safety risk control.

In order to cope with the characteristics of variability, concealment and suddenness of safety risks, it is urgent to make full use of modern information technology, integrate data and information of various majors and types of work, construct corresponding operation safety platform, improve management level, and realize efficient management of subway operation safety.

2. Subway operation safety information Construction Problems

2.1. Poor Data Circulation and Difficult Quality Assurance

Data sharing is difficult. Units and departments store large amounts of data and are scattered in their respective information systems, making it difficult to unblock. In addition, each system lacks the standard unified data structure and access form, business data is difficult to achieve cross-sectoral circulation sharing. Data quality is difficult to guarantee. Multi-source data sources and complex transmission paths make the real source of shared data blurred. Multi-source transmission makes data specifications not uniform, and data will be damaged and lost in data collection. At the same time, ill-calculation and confusion also bring obstacles to data integrity.

2.2. Data Difficult to Monitor, Insufficient Certificates

Forged tampering leads to weak supervision. In the process

of subway operation, the operators or third-party units have illegal and illegal operations, falsely reporting or concealing the information of key activities, such as tampering with documents or forging evidence afterwards, which is easy to lead to the absence of supervision and insufficient certificates, resulting in difficulties in accountability. In the process of data sharing and exchange, the data sharing and exchange service provider, as the main body of data supervision, lacks a clear data supervision mechanism in the whole process of data collection, audit, governance, transmission and application. The security of data transmission process is not guaranteed, and the behavior of data exchange is difficult to trace, which causes great pressure on the supervision departments.

2.3. Data Is Not Trusted, Data Is Afraid to Leak

Collaborative sharing lacks mutual trust. Under the information sharing principles of ' who is in charge, who provides, who is responsible ' and ' who handles, who uses, who manages, who is responsible ', the current technical authorization is difficult to clearly define the ownership, use rights and management rights in the process of data circulation, and lacks effective mutual trust and sharing mechanism. Data is afraid to leak. Users, as producers of data, lack data ownership and control in essence, and are often collected and sold by third-party platforms without consent. Serious damage to rights and interests is common. This makes some departments data collection is not active, do not trust the user, worry about sharing the data is not safe, resulting in less useful data.

2.4. The Data Is Not Timely and The Human Influence Is Great

Data collection efficiency is low without standards. Many data are collected manually, so that the real-time performance of the data is poor, which directly leads to poor timeliness of processing and feedback, and may cause security risks to be delayed and cause safety accidents. In addition, due to the different judgment of different individuals, manual data collection leads to large data deviation, and even the phenomenon of manual modification of data may occur, resulting in poor data quality, and ultimately lead to distortion of safety assessment, incorrect assessment conclusions, and even cause safety accidents.

3. Demand Analysis of Subway Operation Safety Informatization Construction

At present, the data sharing and exchange of each system only deploys a node and a supporting virtual pre-library in the department, and the data is pushed to the pre-library by various departments. The data resources are highly concentrated, the data supply chain is not rich, and the data sharing process is complex. In addition, data management involves data producers, collectors, managers, users and other subjects, which puts forward higher requirements for cross-sectoral collaboration. However, there are weak trust problems among multiple departments, and the sharing enthusiasm is not high. Data quality is the basis of data mining, and the timeliness of data updating and cross validation of multi-party data are particularly important. Data is transferred in multiple departments, and the transfer process is complex.

The responsibility of data collection, verification, use and even subsequent leakage needs to be clarified to all departments, implement responsibility, and urge all departments to improve data quality and avoid data leakage.

In order to solve the above problems, this paper puts forward the construction needs of subway operation safety platform : on the one hand, the decentralization and collective maintenance of block chain technology effectively solve the cooperation needs between departments and enhance trust relationship ; blockchain encryption algorithm can effectively protect data security and meet security needs ; the consensus and quasi-real-time synchronization mechanism of blockchain can effectively solve the problems of update real-time and cross-validation ; the untampered and traceable technical characteristics of blockchain can solve the traceability problem involving multi-agent processes, and distinguish permissions and responsibilities. On the other hand, the Internet of Things technology is mainly used to solve the real source of data and forensics problems, the timeliness of data acquisition, processing and feedback.

4. Subway Operation Safety Platform Model Based on Blockchain and Internet of Things

4.1. Blockchain Platforms

4.1.1. Introduction to Blockchain Technology

Blockchain technology uses blockchain data structure to verify and store data, uses distributed node consensus algorithm to generate and update data, uses cryptography to ensure the safety of data transmission and access, and uses intelligent contracts composed of automated script codes to program and operate new distributed infrastructure and calculation paradigm of data [7-8].

4.1.2. Construction Ideas of Blockchain Platform

The blockchain platform is the basic platform of the whole data chain. It uniformly carries the block storage, sorting service, network broadcasting, policy access and other powerful support for data application services and business management, and makes full use of the characteristics of the underlying technology of blockchain, such as information traceability, shared accounts, asymmetric encryption, high-performance consensus algorithm, and intelligent contract engine to build the whole data chain platform.

The platform connects the subway operation monitoring system, subway operation communication system, subway maintenance system, subway operation monitoring system, hidden danger investigation and management system, emergency response system, subway facility protection system and other various subway operation safety related systems to the upper chain. According to the requirements of the regulatory unit, the platform can provide interface to connect to the upper chain or transmit relevant data or reports only according to the requirements.

4.1.3. Overall Architecture of Blockchain Platforms

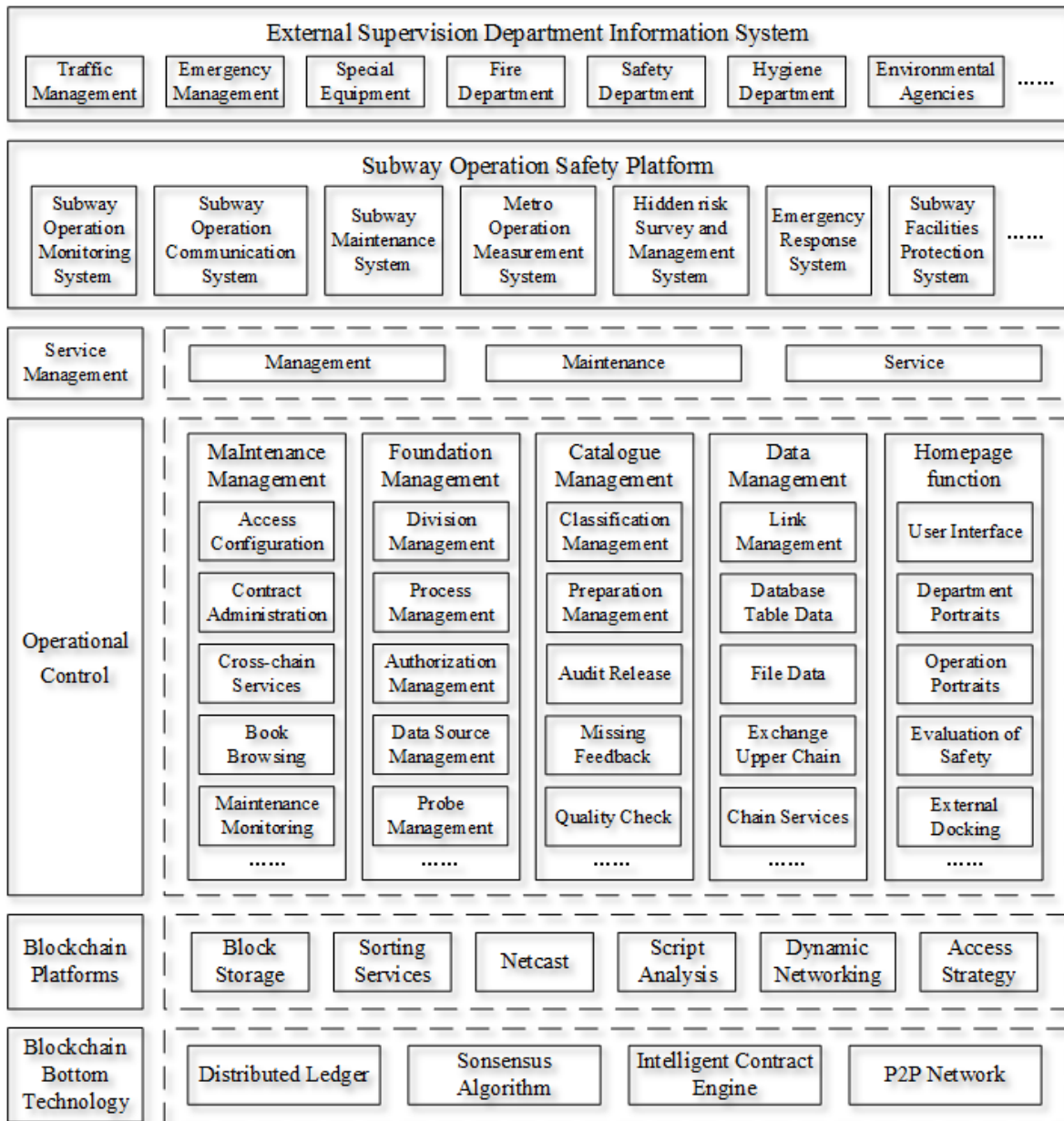


Figure 1. Blockchain Architecture of Subway Operation Safety Platform

4.2. Platform Logic Architecture

Since the platform needs to connect with the business and data needs of the regulatory authorities, and form a security evaluation report on the internal comprehensive security management business, the logical structure of the platform is mainly determined based on different business needs.

Because the safety assessment before the initial operation of the subway is up to the competent department, and there are third-party evaluation institutions, subway construction units, subway operation units, as well as many product suppliers and third-party units, this paper takes the safety assessment before the initial operation of the subway as an example to elaborate the logical structure.

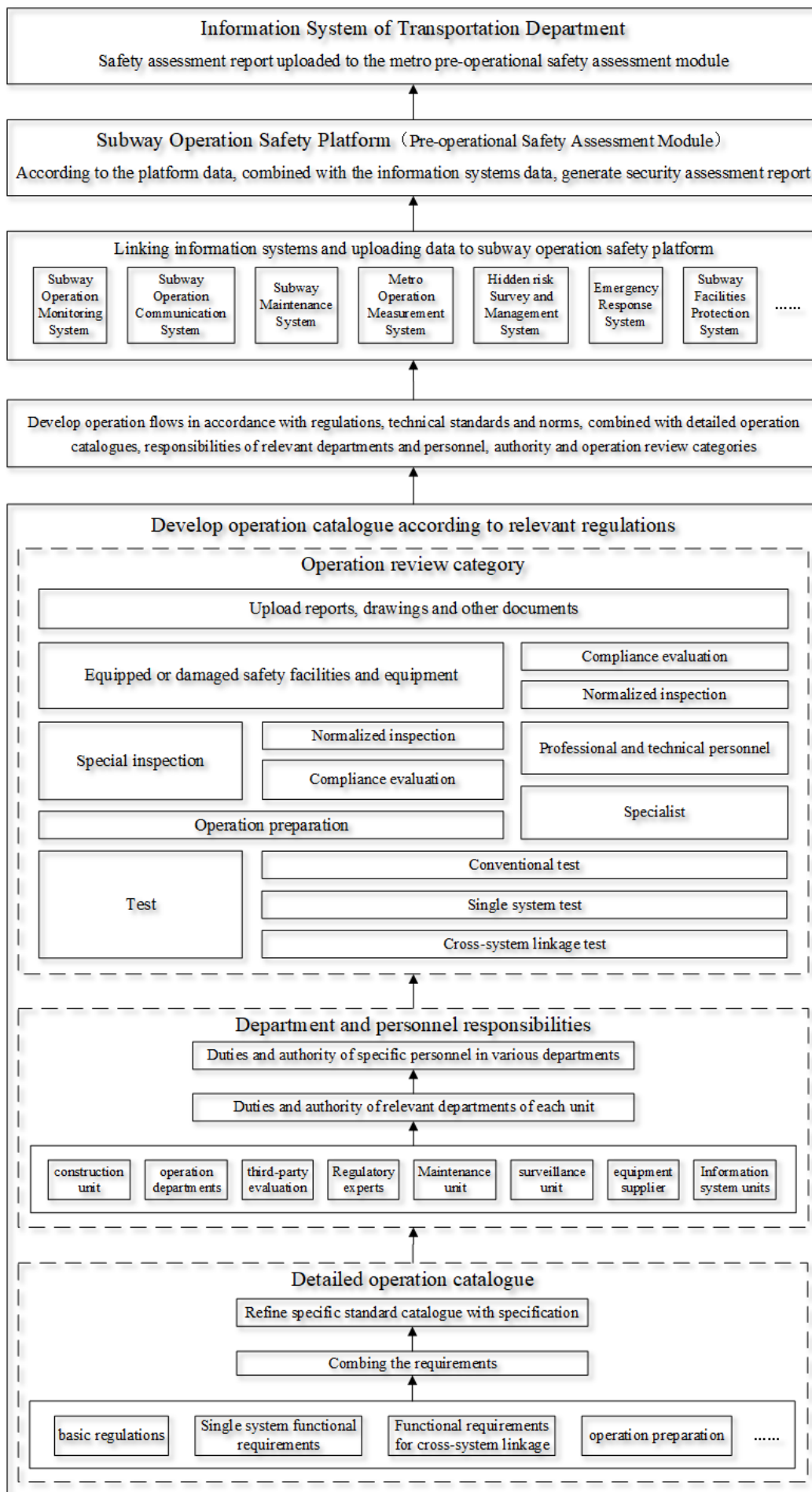


Figure 2. Logic Structure of Subway Operation Safety Platform

4.3. Internet of Things Forensics

4.3.1. Introduction to Internet of Things Technology

The Internet of Things refers to the connection of any object with the network according to the agreed protocol through information sensing equipment. The object exchanges and communicates information through the information media to achieve intelligent identification, positioning, tracking, supervision and other functions. Its core technologies mainly include sensor technology, RFID tags, embedded system technology and intelligent technology [9–11].

4.3.2. Internet of Things Forensics Implementation

Method

Internet of Things forensics is mainly aimed at different types and levels of forensics. Such as files, reports and other upload classes, can be high beat meter through the Internet access blockchain, to ensure that information can not be changed ; its information collection such as subway operation monitoring system, subway facilities protection system can be realized by automatic measurement technology, MEMS wireless tilt sensor, leakage water and crack infinite sensor and other Internet of Things technology. Whether the safety facilities are equipped and damaged can be quickly confirmed by the maintenance personnel combined with RFID sensing technology. Manual inspection configuration of the whole process inspection recorder, real-time recording and upload inspection audio and video and geographical location information, part of the inspection also need to configure panoramic recorder. The test is equipped with multiple check recorders and panoramic recorders according to the scene. The test instrument is connected to the platform to ensure that all test activities and data are recorded and uploaded in real time. Ground protection patrol line inspection can be equipped with UAV and other equipment to realize real-time recording and uploading of inspection activities. The inspection vehicle system can be connected to the platform to record and transmit data and video.

5. Conclusion

(1) Aiming at the problems of poor data circulation, difficult supervision, distrust and fear of leakage in the safety of subway operation, the decentralization and collective maintenance of blockchain technology are used to effectively solve the collaborative needs between departments ; using encryption algorithm to ensure data security ; using consensus and quasi real-time synchronization mechanism to solve update and cross validation problems ; using the untampered and traceable technical characteristics of blockchain, the traceability problem involving multi-agent processes is solved, and the rights and responsibilities are distinguished.

(2) In view of the problems of poor timeliness, poor quality

and insufficient storage of subway operation safety data, the Internet of Things technology is adopted to ensure the authenticity of data and timely data acquisition, processing and feedback.

(3) In order to ensure the safety of subway operation, a subway operation safety platform model based on blockchain and the Internet of Things is designed. The blockchain architecture, logical architecture and the Internet of Things forensics method of the platform are shown in detail, and the new mode of safe and efficient management of subway operation is explored.

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