

# *Research of Regional Innovation in Public Services*

## *--- the Development and Application of Elevator Network Security Monitoring Service Platform*

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**Abstract**—In order to solve the problem of elevator monitoring and improve the safety level, Elevator Network platform of security monitoring services is proposed in this paper. It monitors the real-time operation status of the elevator. The effective traceability and regulatory supervision of elevator manufacturing and maintenance are achieved. Based on the big data analysis of elevator full life, the isolated information of related departments are linked, and failure risk is warned without delay. The system improves the performance and efficiency of supervision and maintenance departments. Meanwhile, it reduces the failure rate and increases the safety level of operation. The monitoring service platform promotes a rapid development of elevator industry.

**Keywords**—regional innovation; public service; elevator network; elevator remote monitoring; big data analysis; internet services

### I. INTRODUCTION

With the rapid development of urban construction, cities have a dramatic increase in the number of elevators. According to industry statistics, to the first half of 2015, the elevator number in China have exceeded 4 million. From the overall perspective, China has a wide range of elevator brands; "aging" have become increasingly prominent; maintenance providers have different levels [1, 2]. The appropriate regulatory power in government department has a very slow growth, and the regulatory technology is relatively low. In recent years, major elevator accidents have occurred, which resulted in the loss of people's lives and property [3, 4]. The effective factors of elevator safety is shown in Fig. 1. Meanwhile, the community had a serious crisis of confidence to the elevator operation. Therefore, modern information technology is adopted to realize, the elevator remote monitoring, remote management, remote transmission and remote services, which has become significantly important [5-7].

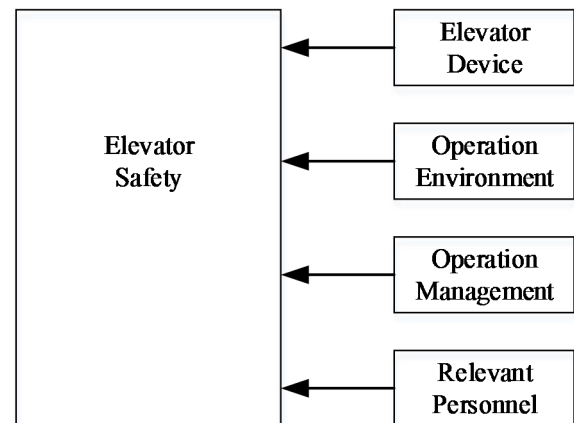


Fig. 1. The Effective Factors of Elevator Safety

To actively cope with the grim situation of elevator safety supervision, according to the latest national and local requirements, Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) Information Center launched an Elevator security monitoring service platform research and application project in early 2015. The project serves the people's livelihood as the fundamental starting point. In accordance with the general requirements of urban elevator public safety, elevator emergency rescue system, real-time running status monitoring system, daily maintenance and intelligent monitoring system are focused and researched based on Internet of Things (IOT), cloud computing, big data mining analysis and other emerging technologies. National elevator safety monitoring cloud platform is built to achieve interoperability and information sharing for national and local data center of elevator safety supervision. The system forms an intelligent comprehensive regulatory system through large data analyzing elevator regulatory information. Urban elevator running real-time monitoring, intelligent monitoring on routine maintenance, remote failure alarm, the big data

analysis of the entire life for elevator warning is realized [8-10].

## II. ELEVATOR NETWORK SYSTEM

The project adopts the "1 + N" construction mode. The cross-regional remote supervision elevator safety cloud computing service center is constructed in Beijing, which achieves direct connection between the main data center and the local cities by the “elevator network”. The real-time operation status of the elevator, the elevator failure information, audio and video information, maintenance information and monitoring inspection information are sampled by CNSS, infrared, optoelectronic, Hall, contacting and other types of sensors installed in the elevator.

Elevator remote monitoring and security cloud service center is to regulatory authorities, manufacturers, maintenance providers and users, which achieves traceability, anti-counterfeit, warning, emergency response and supervision. Maintenance, construction and operation are executed by a third party. Its user includes governments, businesses (manufacturing, installation alteration, use, and maintenance), employees, the public and third organizations. National platform will establish a national data center and a national regulatory services platform. The data is validated and integrated to form credit database, license database, analysis database, status database, tracing database and authentication database. According to the “Special Equipment Safety Regulations” requirements and the public requirement, publish, inquiries, tracing, analysis and other functions are achieved. Data center willfully converges related regulatory information, including elevator manufacturers, maintenance units, inspection and monitoring providers. By various information sources interact, regulation is covered quickly and accurately to the operation and safety-critical sections, such as maintenance, inspection, alteration and repair. By big data analysis techniques, the big data system of completed data link in all life cycle including manufacturing, installation, alteration, repair, inspection and supervision for an elevator. Based on big data analysis applications, the platform supplies accurate decision reference for the government supervision department, manufacturing enterprise, and maintenance unit. So that it could improve the safety management level in all the elevator industry and provide the effectiveness which is unavailable in the traditional isolated information system. The system is shown in Fig. 2.

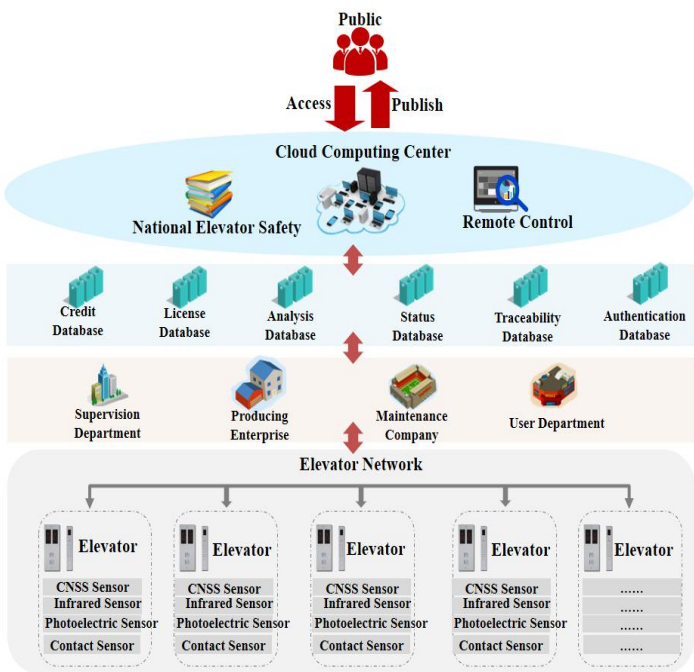


Fig. 2. Elevator Network Security Monitoring Service Platform

The system has 6-layer structure, including user layer, analysis layer, memory layer, application layer, transmission layer and perceiving layer, which is depicted in Fig. 3. In the perceiving layer, the elevator is the monitoring terminal. The monitoring terminal function module is shown in Fig. 4. It is composed by central computing and control unit, sample unit, power unit, display unit and transmission unit. Memory layer is shown in Fig.5 and Fig.6.

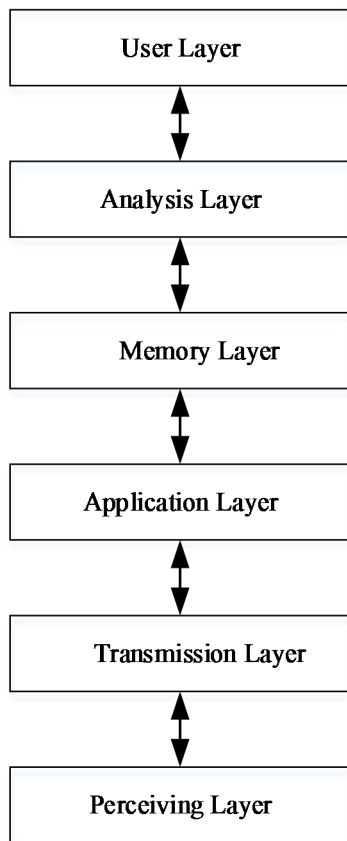


Fig. 3. Six Layers Construction of the Platform

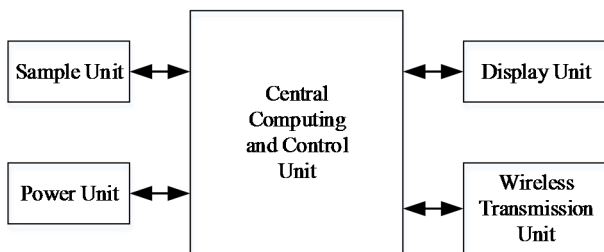


Fig. 4. Monitoring Terminal Function Module

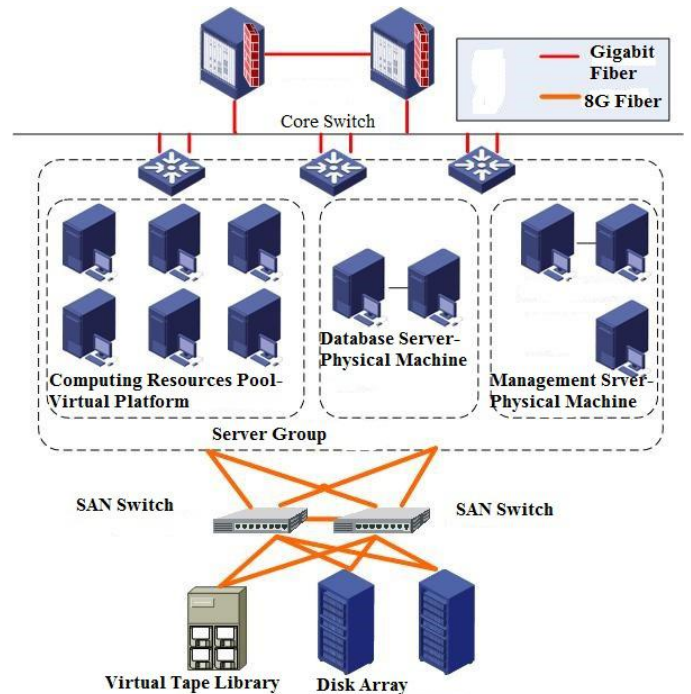


Fig. 5. Server and Storage Backup System

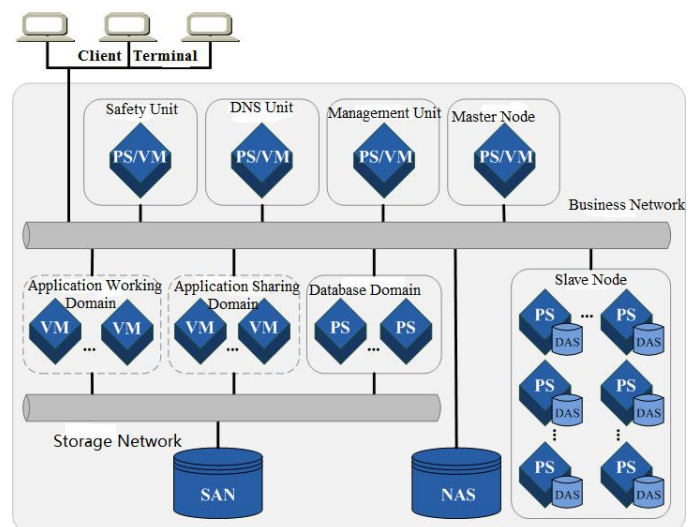


Fig. 6. Hybrid Dynamic Data Center

Elevator emergency response center analyzes and evaluates all kinds of information. Then the center designs the coping strategies and program. So that long-term effective and remote information management for the elevator is achieved. The "three layers of emergency rescue system" is established. When an emergency occurs, emergency response center could locate the point quickly by electronic map, and trace the site real-time video. Meanwhile, it deploys emergency resources and commands rescuers remotely to achieve rapid response to entrapment accidents.

Meanwhile, the regional public websites are built, which could publish the national and local government's and industry's relevant laws and regulations. The published information also includes basic information about

manufacturing companies, maintenance department and government supervision departments. The fault maintenance information violated enterprises and punished personnel information are also published. The public could access the relevant information about elevator manufacturing, maintenance, fault and warning. The system takes full advantage of big data in cloud platform, and communicates all kinds of elevator information with the public and the elevator owners. The masses supervision and reporting mechanisms is improved. In this case, the hidden faults risk could be detected timely and submitted to the maintenance department. The accident and failure are reduced. The IOT standard system of elevator safety monitoring is shown in Table 1.

Table 1. IOT Standard System of Elevator Safety Monitoring

No.	Standard Name	Standard Content
1	Entire Platform Structure	The platform structure and information sharing are specified.
2	Data and Style of basic Elevator Information	The classification of basic elevator information, data format, basic data requirement and data directory are specified.
3	Coding Rule of Sample Device	The coding rules of sensors are specified.
4	Data Sample Specification	The data transmission protocol is specified.
5	Requirement of Transmission Network	The technology conditions and requirements are specified.
6	Storage Requirement of Monitoring Data	The storage format and quality of the data are specified.
7	Storage and Quality Requirement of Image Information	The format, quality and storage time of image are specified.
8	Technology Requirement of Sample Device	The production criteria of front-end sample equipment are specified.
9	Installation and Acceptance Specification of Sample Device	The installation specification and acceptance standard of sensing device are specified.
10	Technology Requirement of Mobile Terminal	The technology requirement of IOT based on mobile terminal are specified.
11	Technology Requirement of Platform	The function and technology requirement of each platform layer are specified.

12	System Information Safety Specification	The information safety of system data and network are specified.
13	System maintenance Requirement	The requirement of platform maintenance and operation are specified.
14	Traceability Specification of Elevator Parts	The traceability range and process of elevator parts are specified.
15	Record Specification of Elevator Maintenance and Management	The record content, format and requirement of elevator maintenance are specified.

### III. EFFECT ANALYSIS

Elevator network safety monitoring service platform development and application improves the operation safety of the elevator and the people's life quality. It plays an active role in promoting the social development.

#### A. Decrease emergency response time

The elevator network platform security monitoring service processes the special equipment safety supervision by information and automatic technology. It greatly reduces the repetitive work and improve the efficiency of supervision. In addition, through the application of IOT technology, the key process is traced, which is gradually opened to the public by wireless technology and intelligent terminal technology. So that citizens become the special safety supervisors. With the mass's power, the special equipment safety supervision ability is improved.

In the past, there is no effective real-time monitoring means. When people are trapped in the elevator, rescue information is transmitted through many layers. The safety supervision department, the maintenance unit, the property management company cannot understand the situation timely, which delays the valuable rescuing time. The public give low evaluation to the poor effectiveness. A comprehensive monitoring service cloud platform of urban elevator is established based on IOT technology. The elevator safety supervision department, maintenance unit, property companies could be informed about the accident information in real-time and rescue the people in the accident rapidly. Meanwhile, the emergency response center can observed people trapped inside the elevator directly and stabilize people's emotion.

#### B. Further strengthen the main responsibility of enterprises

The elevator safety depends mainly on the production quality. It also relies on routine maintenance. In the long time, elevator maintenance replies the producing company, which sets up maintenance center for its own production for the routine maintenance and fault diagnosis. Because of the intense competition in the elevator industry, many producing

and maintenance companies chase immediate profit at the expense of safety. The routine maintenance does not meet the specified requirement. The elevator malfunction or accident cannot be promptly and effectively addressed. And the supervision agency cannot get the relevant information in time. The problems are only found in usual inspection. The working efficiency is in the bottom. With the city Elevator Safety Integrated monitoring service cloud platform based on networking technology, the elevator failure information, and emergency response can be grasped in the real-time. The elevator safety operation status is informed regularly based on the daily call records and, the fault reason analysis, which solves the information asymmetry from the mechanism. It is a fundamental solution for the enterprise regulation, supervision and examination, which increases the pressure on enterprises using the market's invisible hand. So that the enterprises, especially the first responsibility consciousness maintenance units improve their work.

#### *C. Improve the urban public service and management level effectively*

A comprehensive monitoring service cloud platform is established based on IOT technology. Each elevator becomes a real-time monitoring terminal by monitoring facilities installed in the elevator, such as video, audio, and fault information collection sensors. The elevator network realized the centralized monitoring to the distributed elevator status. It inspects the operation data dynamically and grasps the operation status in the network in real-time. When the abnormal data is detected, the warning is delivered to the responsibility department and persons automatically. Maintenance staff inspect the elevator and eliminate safety hazards, which avoids the elevator faults. In the event of failure, the signal is automatically transmitted to the processing center. The user name, machine ID's, fault status and other information are displayed, which is helpful for the addressing of emergency. Through the remote monitoring of safety situation, the elevator safety operation is guaranteed. The urban public service and management level are improved.

#### IV. CONCLUSION

This paper proposes a new elevator network security monitoring solution, which adopts internet technology, cloud calculation and big data analysis. The system samples real-time data about operation status, fault information, audio and

video. Then the data is transmitted to the maintenance unit and national elevator network security platform, which is computed and analyzed. It reduces the elevator failure rate and increases the safety level.

#### **Acknowledgment**

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#### **References**

- [1] Liu Jia, "The Development of the Elevator Technology", Science & Technology Information, vol. 03, pp.90, 2013. (In Chinese)
- [2] Luan Wei, "Research of the Elevator Testing Technology Development", Science and Technology Innovation Herald, vol. 31, pp.115, 2010. (In Chinese)
- [3] Zhao Liming, Yan Chenyang, "Bayesian Elevator Fault Classifications Network Based on Stigmergy Strategy", Proceedings of the 2012 IEEE International Conference on Computer Science and Automation Engineering, pp. 382-386, 2012.
- [4] Chenguang Zhao, Hongyu Xu, Liang Jia, "Research of Elevator Fault Diagnosis Based on Decision Tree and Rough set", 2012 International Conference on Computer Science and Information Proceeding, pp. 1318-1322, 2012.
- [5] Tundong Liu, Xiaosheng Liao, Jianping Zeng, "Design of Intelligent Elevator Remote Monitoring System Based on Ethernet", the 5<sup>th</sup> International Conference on Computer Science & Education, pp. 1120-1123, August 2010.
- [6] Jiwen Chen, Hongjuan Yang, Wenli Fan, "Research of elevator remote monitoring system based on zigbee technology", Advanced Materials Research, vol. 1222-6, pp. 1049-1050, 2014.
- [7] Chen Zexi, Ye Xuan, "Design of Interconnection Gateway in Elevator Remote Monitoring System", 2014 Sixth International Conference on Measuring Technology and Mechatronics Automation, pp. 247-250, 2014.
- [8] Zhang Demin, Li Lian, "Design of the Monitoring and Control System for Elevator Internet Based on CANBus", Automation and Instrument, vol. 27(8), pp. 38-41, Aug. 2012. (In Chinese)
- [9] Xu Yongmei, Liu Songguo, Fan Jinchang, "Elevator monitoring and alarm system based on Internet interaction", Journal of Mechanical & Electrical Engineering, vol.30 (9), pp. 1137-1141, Sep. 2013. (In Chinese)
- [10] Shuilin Tu, Zhengyang Wu, Bin Qian, "Research of the elevator monitoring system based on the internet of things", Applied Mechanics and Materials, vol. 423, pp. 2380-2385, Sept. 2013.