

Research on Elevator Safety Detection Management based on Big Data

Pengcheng Liu[1], Jing Xiong[1], Wanli Yu[2], Hui Cheng[3], Xiaoqing Wang[3,*]

[1]Hangzhou Special Equipment Testing and Research Institute

[2]Wenzhou Special Equipment Inspection & Sciences Research Institute

[3]Zhejiang Academy of Special Equipment Science

*wxq18329138075@163.com

Abstract. In the rapid development of social economy, people's quality of life is getting higher and higher, elevator as one of the essential means of transportation in daily life, how to ensure the safety and stability of elevator equipment operation, has become the main issue of research and discussion. Since the sensors in the elevator can collect a large amount of data information, which can provide effective basis for the study of the operating state of the elevator equipment, scientific researchers propose to use big data technology to optimize the elevator safety detection and management, build a sound management system and monitoring methods, and solve the elevator safety failures and abnormal situations as soon as possible. In this paper, on the basis of understanding the research status of elevator safety detection management, according to the theory of big data technology, put forward the elevator safety detection management system with big data as the core, and combined with practical cases for verification and analysis. The final results show that the application of big data technology in elevator safety detection management is very important.

Keywords: Big data; An elevator; Safety detection; Platform architecture; Data transmission.

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1. Introduction

Because the elevator operation is generated under the power drive, it will run in accordance with the pre-set rigid trajectory law, its purpose is to facilitate the transportation of people or things on higher floors. In the running state of the elevator, common safety accidents include falling from high altitude, slide and other adverse phenomena, which will not only cause serious damage to the elevator equipment, but also increase the economic burden of the enterprise, and seriously threaten the life safety of passengers. According to the practical investigation and research, most of the elevator safety accidents are caused by human factors, and mainly occur during the elevator installation and maintenance. An integrated study of elevator safety accident cases shows that, in the daily working state of the elevator, the relevant departments should regularly check and maintain the internal safety risks of the equipment, maintain and overhaul in strict accordance with the regulations, and deal with the safety faults as soon as possible to avoid unnecessary damage to personal safety and life and property caused by hidden dangers, so as to give full play to the application value of elevator equipment. To provide convenient conditions for residents' life and daily work.[1-3]

The elevator controller is the key element of the overall system operation, the staff should strictly check the application performance of the elevator brake, only in this way can ensure the elevator, has stability and safety in the working state. From the overall design point of view, the compression spring inside the brake plays an important role in ensuring that the friction plate has a cushioning effect and the brake disc is compacted, so as to ensure the normal operation of the elevator system. In order to further improve the safety of elevator operation, the friction plate between the brake disc and the brake should be separated to ensure that both are in a static state at the same time, and there will be no flowing current operation, then the elevator motor will stop working immediately.[4-6]

In the current development of urban construction, all parts of our country have increased the regulation of elevator management, and started to implement the installation declaration and regular inspection system from the 1980s. Nowadays, the elevator is a special equipment widely recognized by the public. It needs to handle the registration certificate, hire professional maintenance units and declare regular inspection every year. However, from the perspective of overall development, although elevators in various regions have been strictly controlled in accordance with the law, there are still many problems in operation. For example, due to the non-standard use and lack of maintenance funds, the current elevator complaint probability is higher and higher, and because their appeals are not satisfied, many parties turn to the media for help, which not only has negative social effects, but also brings great pressure to elevator safety supervision. At present, the technology and application measures of elevator safety testing in our country are not perfect, it is difficult to guarantee the safety and stability of elevator equipment operation based on. Therefore, on the basis of understanding the theory of big data technology, this paper mainly studies the elevator safety detection management application system and practical performance, in order to provide an effective basis for the operation management of elevator equipment in the new era.

2. Method

2.1 Platform Architecture

The use of big data technology involves the elevator safety monitoring platform, which is mainly used to process and analyze a large number of real-time status data. Therefore, it is necessary to ensure that the platform architecture supports concurrent access, has extremely high application performance, and can simultaneously meet the needs of large-scale and massive data processing. From the perspective of practical application, apart from the basic characteristics of big data, the debate big data also has the characteristics of data retention, heterogeneity and different sources. According to the investigation and research of the relevant departments, the domestic production of elevator machine manufacturers more than 400, the annual output of the elevator in 2016 reached 770,000 sets, the development has reached millions of sets. Due to the large number of elevator manufacturers and elevator equipment used, the data structure and main sources of elevator big data are relatively complex. Therefore, when designing the monitoring platform architecture, it is necessary to consider the structural characteristics of data information and choose the appropriate processing method first.[7-9]

The arrangement platform design is mainly used to provide integrated monitoring services for large-scale elevators. Attention should be paid to improving the emergency treatment level and supervision efficiency of elevator accidents, effectively preventing the occurrence of safety accidents, and improving the level of elevator safety management. At the same time, the application characteristics of elevator big data should be fully considered, and the application performance of the application platform in data storage, data access, data analysis and other aspects should be clarified. According to the hierarchical structure, the platform architecture design is shown in Figure 1 below:

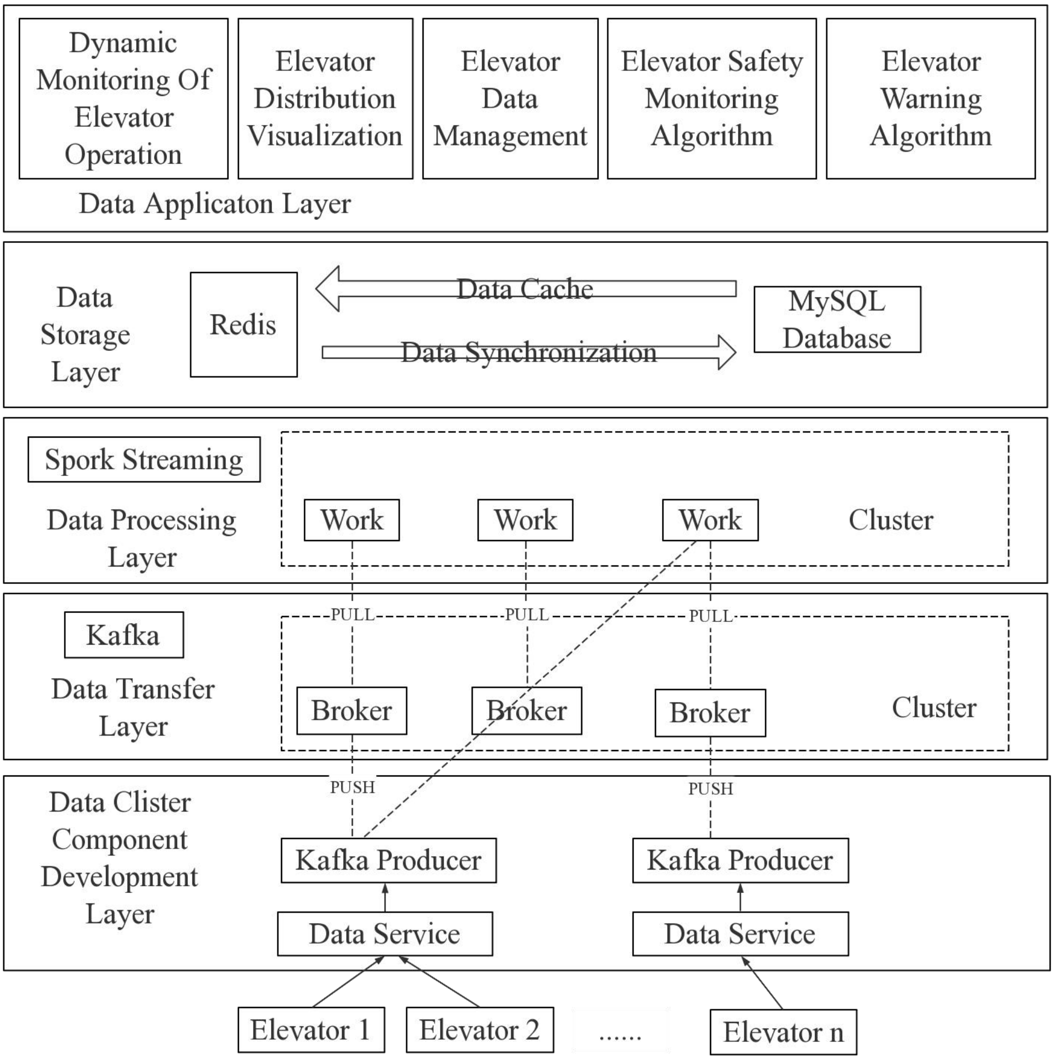

Figure 1 Platform architecture diagram

First, the data integration distribution layer. Generally, elevator data includes production data, maintenance data, operation data and other contents, and these data information has diversified characteristics. After collecting relevant data, the platform architecture shall pass it directly to the database through unified processing and data transformation, and provide unified data services externally. Since elevators are widely used in cities, in order to facilitate management and application, regional management should be divided according to the geographical location of elevators and manufacturers, and then data should be distributed according to management blocks. Data distribution will replace elevator equipment and provide data sources as data producers in the whole platform.

Second, the data transfer layer. This hierarchical design is primarily responsible for passing production data to data consumers and building Bridges for efficient transmission between the two. This level design belongs to the middle price of platform architecture, which can provide efficient data transmission mechanism for the whole distributed platform, and has unique functions such as asynchronous transmission and traffic peak elimination.[10-13]

Third, the data processing layer. In a distributed working environment, analysis tasks will be assigned to all nodes in the cluster to achieve the expected goals through system operations, and each node will be assigned to different processing tasks according to its own performance. From the perspective of practical operation, this level will provide rich and perfect data analysis functions, mainly judge whether the elevator failure, analyze whether the elevator equipment potential risks.

Fourth, the data storage layer. The component of this level is the database, which has the unique functions of efficient data reading and writing, high-speed data caching, data persistence, etc. The basic information and processing result data of each elevator can be managed and stored in a unified way. This hierarchical design includes relational databases, non-relational databases and data incremental subscription consumption components that provide data synchronization, as shown in Figure 2 below:

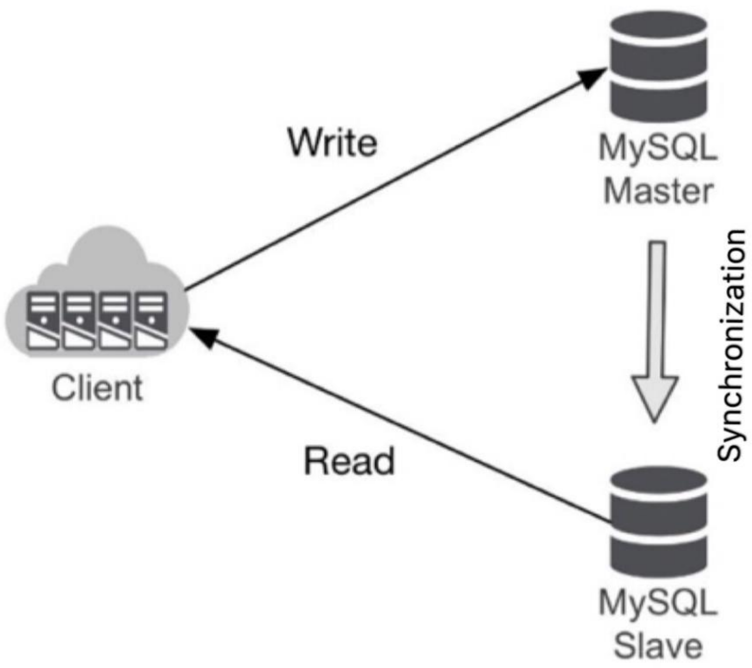

Figure 2 Structure diagram of the data layer

According to the above figure, the Master database is mainly responsible for writing, updating, and deleting basic operations, while the Stave database provides reading operations and uses the strategy of read and write separation to improve the application performance of the database.

Fifth, the data application layer. This level design needs to provide the core functions of the platform, such as elevator distribution visualization, elevator operation dynamic monitoring, elevator data management, fault detection algorithm, anomaly warning algorithm management, etc. For example, the elevator data management can add, delete, modify all the elevator basic information, fault information and detection information content.

2.2 Data integration and Distribution

As the data information during the operation of elevator equipment has diversified characteristics, the function of data integration is to process the information uniformly and provide unified data service externally. Combined with the overall structure design and analysis of heterogeneous data integration shown in Figure 3 below, it can be seen that adapters are used to convert different data information into a unified format and encapsulate it as atomic data service, which is the minimum data unit that can be accessed. At the same time, all data services are stored in the system and transformed into composite data services based on service composition technology. In fact, there are multiple atomic data services, which can fully show a certain side characteristics, and finally form a global data service.[14-15]

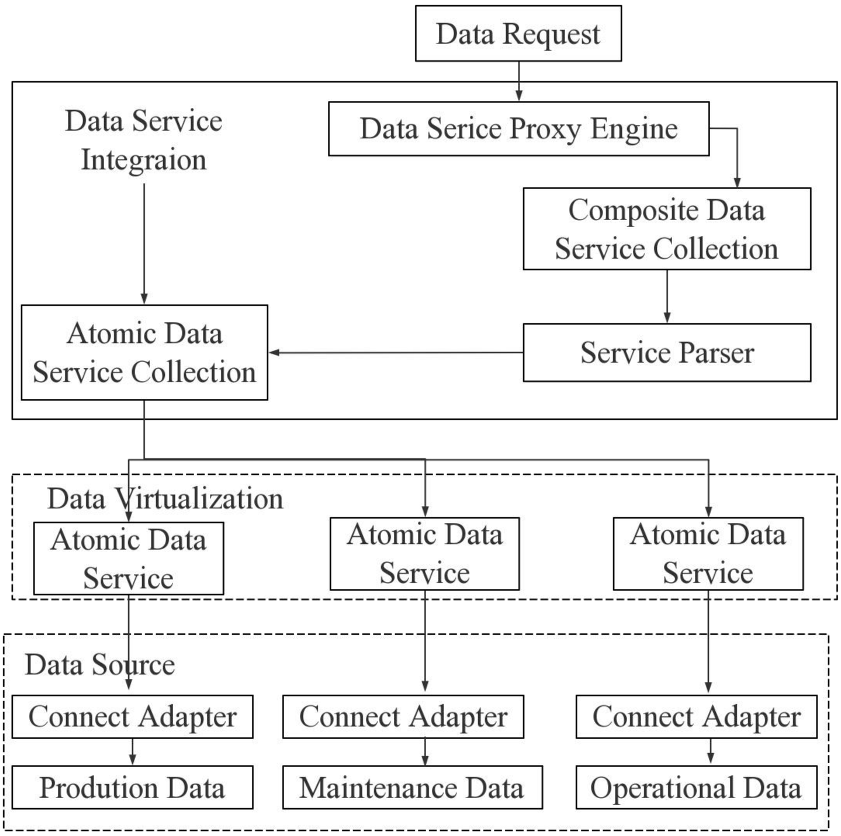

FIG. 3 Overall structure diagram of heterogeneous data integration

3. Result analysis

After collecting large-scale real-time elevator data, it is necessary to detect the safety failure during the elevator operation in time by monitoring the operating status of the elevator. As the elevator belongs to the electromechanical integration of special transportation equipment, including the control system, mechanical system, safety protection system of these three parts, so in the design of safety detection management experiment, we should fully consider the data information of different areas, and describe the elevator state transfer finite state machine (FSM) model after proposing the corresponding detection method.

Every moment of the elevator's life can be described using a certain state, with state transitions occurring at specific events. In this paper, FSM is used to model and analyze the elevator running state and state transition process. This content mainly includes three core combinations, first refers to the state set, second refers to the input set, and finally refers to the state transition rule set. The corresponding finite state machine is constructed according to the running state of the elevator. The specific state transfer is shown in Figure 4 below:

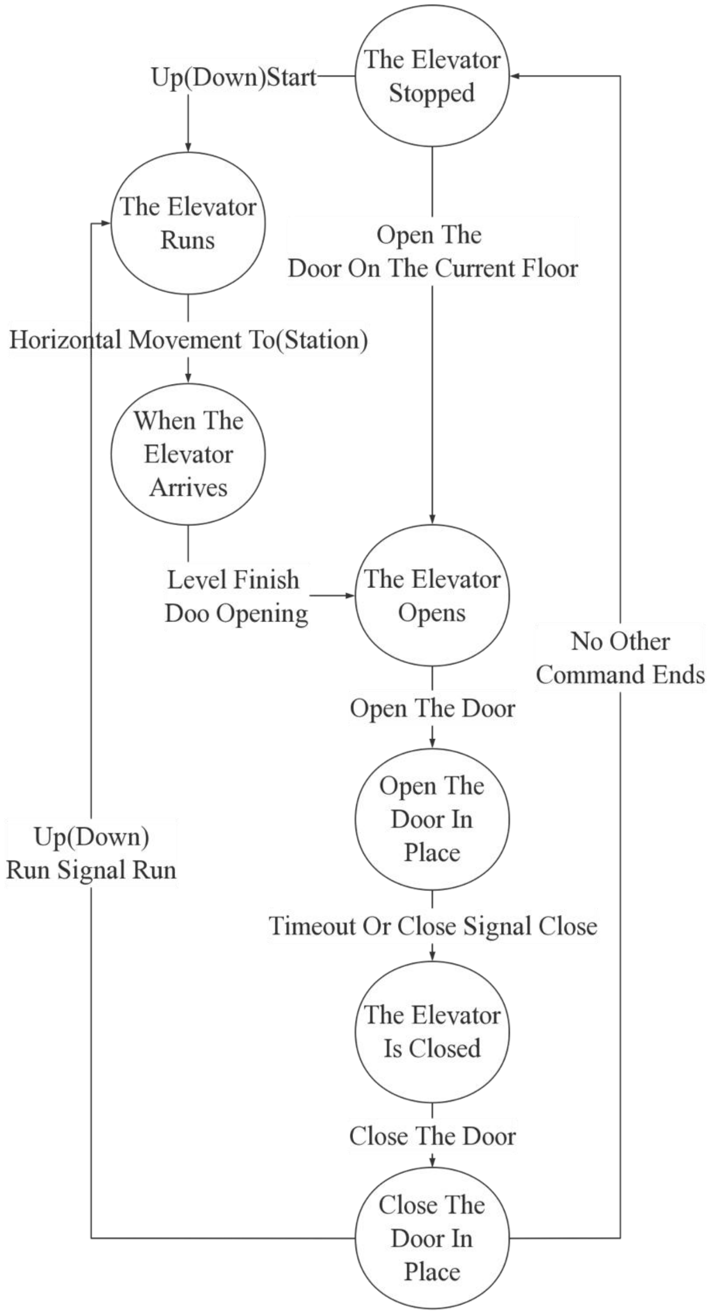

Figure 4 Structure of FSM state transition

In the figure above, the nodes represent the state of elevator operation, the double-circle nodes represent the termination state, the directed arc represents the state transition process, and the text on the arc represents the events and actions that triggered the state transition.

In the research experiment of this paper, the elevator fault detection algorithm with stream data as the core is used for verification and analysis, as shown in Table 1 below:

Table 1 Fault detection algorithm

Input: elevator real-time flow data, sliding window size t
Output: elevator fault type
Step 1：Receiving elevator flow data according to the size of the sliding window D，That is, the microdata block is divided every t time.
Step 2： Data preprocessing, filtering useless state parameters, extracting elevator representation id field, and composing data.<key， value>tuple
Step 3：use GroupByKey Operation, clustering according to the key, and merging the

data with the same id into the same group. <key，List(value）>tuple
Stel 4：Take out the first piece of data in the group, match the state in the fsm state transition diagram according to the parameter value of the state data, and mark it as the initial state s1.
Step 5：will List（Value）Take out the data one by one, match it with each state in the state transition diagram, And mark its state one by one. Si（i＝2,3,4,...n）
Step 6:Set the copy tmp of the initial state si.
For s＝S2 To Sn
Count ＝ 0//Record the number of skipped states, and judge whether to time out according to the set threshold max.
if s＝＝temp then
if s＝＝Open the door in place then
if count <max
count+＝1
continue
else then
continue
else then
if tmp＝＝Elevator stop state then
if s！＝Elevator operation state | | s！＝Elevator opening state then Elevator abnormality
else then
if Up (down) signal ！＝1 then //The up (down) signal is 1, and someone is calling the elevator.
if s＝Elevator operation state then Abnormal operation of elevator
else if s＝Elevator opening state then The elevator opens abnormally.
if tmp＝＝Elevator operation state then
if s！＝Elevator arrival state then
Elevator leveling anomaly
if Open door signal＝＝1 then Open the door when the elevator is running//The door opening signal is 1, and the elevator is opening.
if tmp＝＝Elevator arrival state then
if s！＝Elevator opening state then Abnormal door opening，The door system cannot be opened normally.
if tmp＝＝Elevator opening state then
if s！＝Open the door in place. then open the door abnormally, and the opening time is too long.
if count>＝max then Abnormal opening of the door, too long opening time.
if tmp＝＝The elevator opens in position, then
if s！＝The elevator is closed. then the elevator is closed abnormally
if tmp＝＝The elevator closes, then
if s！＝The elevator is closed in place, then
The elevator is closed abnormally, so it cannot be closed in place.
if Light curtain signal = 1 then //The light curtain signal is 1, and someone is passing through the light curtain door.
Elevator card holder

if tmp＝＝The elevator is closed in place, then
if Up (down) signal＝ ＝1 then
if s！ ＝When the elevator is running, then the elevator cannot start.
count＝0
tmp＝s
end
Step 7：Return to step4 to process the next set of data.

The final experimental results prove that once abnormal or illogical state transition process occurs, the algorithm studied in this paper can detect it directly and quickly, and can eliminate the wrong data labor caused by delayed data transmission, further improving the effectiveness and scientificity of data detection. At the same time, when verifying the performance of the research platform and application algorithm in this paper, it is found that with the increasing number of elevators, the processing time of data information will be higher and higher. It should be noted that the experiment in this paper simulated the extreme case that each elevator would send data to the platform every second. However, in the real working state, the elevator equipment would not send data to the platform when it stopped hibernating. Therefore, the experimental configuration in the real environment is sufficient to withstand the monitoring tasks of a large number of elevator equipment.

Conclusion

To sum up, in the gradual increase of the number of urban elevators, how to ensure the safety of elevators has become the core issue of research and discussion. As the elevator equipment itself contains a large number of sensors, which will collect and record the running state of a large number of elevator equipment, and the corresponding data information has strong application value, so the research scholars put forward the use of big data technology to effectively deal with it and integrate it with the elevator safety detection and management. Through data analysis, the application can be mined to improve the level of elevator safety detection and management. Based on this, the safety quality of elevator operation is guaranteed.

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