

# Research on Construction and Management Method of Safety Monitoring System in Railway Engineering Laboratory

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**Abstract:** The railway engineering laboratory is the basic place for teachers and students to conduct scientific experiments and experimental teaching. It is not only the main carrier of scientific research, knowledge innovation, and technological invention of railway engineering, the training of students' practical ability and innovation consciousness, but also a window for Central South University's railway engineering professional knowledge innovation technology to serve the society. With the development of the Railway Engineering Laboratory of Central South University, it is of great significance to change the safety monitoring work method of traditional railway engineering laboratories and improve work efficiency with the information technology.

**Keywords:** Railway Engineering; Laboratory Construction; Safety Monitoring; Preventive Measures

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## Introduction

The railway engineering laboratory of Central South University has a long history, especially since the successful application for the establishment of the "railway engineering" undergraduate major in 2015, the number of teachers and students, the space and scale of the railway engineering laboratory, the number and types of instruments and equipment have all produced huge variety<sup>[1-3]</sup>. Since equipped with the advanced experimental equipment such as the "Donghua" test system and the "Riyueming" track inspection instrument, the frequency and number of teachers and students participating in experimental teaching has become higher and higher, and the probability of safety problems has increased<sup>[4]</sup>. Therefore, carrying out research on the construction of the safety monitoring system of the railway engineering laboratory is of vital importance to the overall safety construction of the laboratory<sup>[5]</sup>.

## 1. Significance of the construction of the safety monitoring system of the railway engineering laboratory

### 1.1 The construction of a safety monitoring system can provide a solid guarantee for the prevention of laboratory safety problems.

The railway engineering laboratory of Central South University relies on the National Engineering Laboratory of High-speed Railway Construction Technology and MOE Key Laboratory of Engineering Structures of Heavy Haul Railway<sup>[6]</sup>. As the laboratory has been open for a long time, the frequency of entering and leaving the laboratory is increasing. The possibility of the theft of valuable indoor equipment is also increasing.

Therefore, by the use of high-tech means such as the Internet, cloud computing, and big data, a better solution can be provided for timely detection of problems in the operation of the railway engineering laboratory and prevention of theft. In

particular, high-definition cameras are installed in the interior and corridors of the railway engineering laboratory, connected to the automatic fire alarm system and inspection system, so as to prevent and solve the safety problems of the railway engineering laboratory and provide more adequate protection.

## **1.2 The construction of safety monitoring system makes teachers, students and employees feel safer**

A safe and stable laboratory environment is the fundamental guarantee for reform and development. The railway engineering laboratory is equipped with high-definition camera monitoring system, smoke alarm system, automatic sprinkler system and other high-tech facilities using the Internet as the medium, which can form a multi-integrated railway engineering laboratory safety guarantee system to protect the various experimental processes of teachers and students.

The automatic fire alarm and fire extinguishing system can monitor the occurrence of fire in the railway engineering laboratory in real time. The high-definition video surveillance system can prevent laboratory thefts in advance and investigate them afterwards. At the same time, the collected information can be connected with local public security systems and other state agencies, which can deter criminals and reduce thefts in railway engineering laboratories. When problems occur, teachers and students have a higher sense of security, and the construction of the safety monitoring system has greatly improved the satisfaction of teachers and students with the safety work of the railway engineering laboratory.

## **2. Basic construction ideas for the safety monitoring system of railway engineering laboratories**

### **2.1 Main working ideas**

To realize the effective integration of high-definition video monitoring system, fire safety monitoring system and face recognition intelligent access control system, the original relatively independent system is integrated into an integrated railway engineering laboratory safety monitoring system. The integration of high-definition video monitoring system and fire safety monitoring system, the mastery of fire scene information can provide laboratory managers with a strong basis for scientific decision-making. In view of this, the safety monitoring network system of the railway engineering laboratory should be composed of three parts: a video monitoring system, a transmission network system, and a monitoring center. In the case of limited network bandwidth, we can adjust the network transmission code stream to better connect to the Internet.

### **2.2 The specific implementation steps of the program construction**

During the construction of the safety monitoring system of the railway engineering laboratory, the following steps are mainly taken:

(1) Delineate the key safety precautions of the railway engineering laboratory, formulate a basic laboratory safety monitoring design plan, and divide the laboratory safety monitoring level according to the distribution of large and medium-sized railway engineering laboratories and valuable equipment.

(2) According to the long-term record of the content of the railway engineering laboratory equipment, the general rules and specific implementation plans of laboratory safety monitoring can be drawn to provide on-site basis for the layout of safety monitoring equipment.

(3) Build a safety monitoring network for railway engineering laboratories, secure laboratory video monitoring and access control systems, and cover large and medium-sized experiments with high risks or valuable instruments in railway engineering, and establish video monitoring systems and transmission network systems, and the personnel management plan deployment of the monitoring center.

### **3. Specific implementation methods of safety monitoring system in railway engineering laboratory**

#### **3.1 Building a high-definition video surveillance system**

For cases and situations that cannot be discovered in time, the number of suspects, physical characteristics, and circumstances of the incident can be locked with video playback, as effective evidence to prosecute the suspect, and reported to the public security department for arrest. The full coverage and real-time monitoring of high-definition cameras in the laboratory and surrounding areas can have a powerful deterrent effect on criminals. Some criminals with criminal minds may develop fear and thus give up criminal attempts. For example, in the railway engineering laboratory, some sensors are very expensive. On the basis of strict storage, the use of high-definition video surveillance can effectively achieve the standardization of use and prevent the loss or damage of the sensor.

#### **3.2 Building an automatic fire safety monitoring system**

With the upload of information, the laboratory fire safety department can solve the problems found immediately, avoiding the phenomenon that the fire protection facilities are not in place and some points are missed. When a fire occurs, the smoke alarm system will immediately detect the smoke, steam and dust generated due to combustion and other reasons, and send out an alarm signal to accurately predict the point of the fire. When the temperature of the automatic sprinkler system in the laboratory and corridor rises to a certain level, the installed closed sprinkler will automatically blast or melt off to realize automatic sprinkler fire. The patrol, smoke alarm and automatic sprinkler form a "three-in-one" laboratory fire safety system, which is an important part of the laboratory safety monitoring system in colleges and universities.

#### **3.3 Construction of face recognition and intelligent access control system**

The laboratories of most domestic universities have officially used the face recognition application system of China's independent intellectual property rights. In China, many shopping malls have begun to use facial recognition, and some college canteens can also use facial recognition to pay. Some universities have begun to try the installation and application of facial recognition systems in laboratories, especially graduate laboratories, professional subject laboratories, etc., where the users are relatively fixed and the collection of facial information is relatively easy.

### **4. The beneficial effects of the construction of the safety monitoring system on the railway engineering laboratory**

The construction of the safety monitoring system of the railway engineering laboratory mainly includes video monitoring and access control systems. With the construction of Central South University's integrated digital laboratory, the railway engineering laboratory constructed laboratory video surveillance and access control systems, and covers the operation of large and medium-sized experiments that are more dangerous or have expensive instruments in railway engineering. The monitoring system includes video surveillance and image storage, TV wall and LED display, access control system, voice intercom and information management platform, support 24 hours a day uninterrupted recording, hard disk data storage capacity of not less than 30 days, and can pass The network remote access monitors the safety status of the laboratory in real time, which is convenient for query, evidence collection, hidden danger investigation and accident analysis.

### **5. Conclusion**

With the deepening of laboratory informatization, the application of computer network and information technology in laboratory management is becoming more and more perfect. Combining with the current safety management of railway

engineering laboratories, the advantages of information technology in the management of railway engineering laboratories are used, which can better solve the safety problems in the experimental teaching and research work of railway engineering.

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## References

- [1] Peng Huli, Li Zhen, Cai Benxiao, et al. Design of a Laboratory Safety Monitoring System of Power and Door Lock[J]. *Experimental Technology and Management*, 2019, 38(04):246-249.
- [2] Zhang Qifeng. Construction of University Laboratory Technology Prevention System under the Background of “Internet Plus”[J]. *Experimental Technology and Management*, 2019, 38(06):125-127,197.
- [3] Zhiping Zeng, Bin Yan, Josph Eleojo Victor, Zhihui Zhu, Weidong Wang, Ping Lou, Wei Li. Research on Experimental Teaching Reform of Railway Engineering under the Training of International Students[J]. *Journal of Educational Theory and Management*, 2021, 5(1), 25-32.
- [4] Jiang Zhoushu, Lin Haidan, Qi Wentao. Innovation and practice on laboratory safety management[J]. *Experimental Technology and Management*, 2016, 33(011):1-5.
- [5] Qi Wentao, Jing Yangping, Sun Shuqiang, et al. Construction of Informatization Management System for Laboratory Safety in Universities[J]. *Experimental Technology and Management*, 2015, 34(02): 294-296.
- [6] Zeng Zhiping, Zhu Zhihui, Wang Weidong, et al. Research on Establishment of Innovative Experimental Teaching System and Teaching Methods of Railway Engineering—Taking the Vibration Mechanics Test of the Floating Slab Damping Track as an Example[J]. *Creative Education Studies*, 2021, 9(1): 65-71.