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Research on Intelligent Management Mode of Property Electromechanical: A New Way to Improve the Efficiency of Property Management

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Abstract: Intelligent management of property mechanical and electrical systems integrates multiple technologies and concepts. While IoT enables device connectivity and data collection analysis, it also confronts inefficiencies in traditional management approaches. This paper elaborates on the deployment of sensor layer devices, construction of data platforms, energy consumption monitoring, emergency response protocols, evaluation models, talent optimization strategies, and future development directions.

Keywords: Property mechanical and electrical systems; Intelligent management; Technology application

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1. Introduction

With the rapid advancement of technology, the property management industry is transitioning to digitalization, where intelligent management of mechanical and electrical systems has become a key development direction. The "14th Five-Year Plan for Digital Economy Development" released in 2022 emphasized promoting industrial digital transformation, providing policy support for intelligent property management. This smart management approach integrates core concepts like IoT, big data, and cloud computing, encompassing a full lifecycle management philosophy for electromechanical facilities. However, challenges persist including inefficient traditional management methods, urgent demands for intelligent solutions, and insufficient system compatibility. Addressing these issues to establish efficient intelligent management systems and enhance property management efficiency has become a focal point of current research.

2. The theoretical basis of intelligent management of property electromechanical

2.1. Core concepts of intelligent management

Property management of mechanical and electrical facilities involves a variety of core concepts. Internet of Things

(IoT) technology enables interconnectivity between devices. It collects operational data of mechanical and electrical facilities through sensors and other devices, and transmits this data in real-time to the management system, providing fundamental data support for subsequent analysis and decision-making [1]. Big data technology, on the other hand, stores and analyzes the vast amount of equipment operation data, uncovering potential patterns and issues within it. For example, it can predict the probability of equipment failure and schedule maintenance in advance. Cloud computing provides powerful computing capabilities and storage space for data processing and storage, ensuring the efficient operation of the system. Meanwhile, the concept of the full life-cycle management of mechanical and electrical facilities emphasizes the management of the entire process from planning, design, procurement, installation, operation, maintenance to disposal of equipment, in order to optimize equipment performance and minimize costs, thereby improving the overall efficiency and effectiveness of property management [1].

2.2. Analysis of industry development status

With the rapid advancement of technology, the property management industry is also gradually moving towards digitalization. However, in this process, the management of mechanical and electrical systems still faces many problems. Traditional management methods of mechanical and electrical systems often rely on manual operations and experiential judgments, which lead to low efficiency and a high likelihood of errors [2]. For example, the inspection and maintenance of equipment may not be timely, and it is not possible to accurately predict equipment failures. At the same time, there is a lack of effective coordination between different mechanical and electrical equipment, and overall optimized operation cannot be achieved. In terms of intelligent management needs, as the functions of buildings become increasingly complex, the demand for intelligent management of mechanical and electrical systems is becoming more and more urgent. Intelligent management can improve the operating efficiency of equipment, reduce energy consumption, enhance the overall service quality of property management, and better meet the needs of property owners [2].

3. Intelligent management system architecture

3.1. Construction of the perception layer of the IoT

The IoT perception layer is the foundation of intelligent management systems and is crucial for the intelligent management of property mechanical and electrical equipment. At this level, it is necessary to reasonably deploy perception devices such as smart electricity meters, water pressure sensors, and elevator operation monitoring terminals. Smart electricity meters should be installed according to the power demand and circuit layout of different areas to ensure the accurate collection of electricity data [3]. Water pressure sensors need to be installed at key water supply nodes to monitor water pressure changes in real-time and ensure stable water supply. Elevator operation monitoring terminals should be installed in elevator cabins and machine rooms to comprehensively monitor the operating status of elevators, including speed, load, and fault information. At the same time, a unified data collection standard should be established to ensure that the data collected by various perception devices is formatted, accurate, and reliable, facilitating subsequent data processing and analysis.

3.2. Data center construction

In the construction of the data platform within the intelligent management system architecture for property mechanical and electrical equipment, it is necessary to focus on the integration and processing mechanisms of energy consumption data, equipment operating parameters, and maintenance records, and to establish a

standardized data asset catalog [4]. Energy consumption data reflects the energy usage of mechanical and electrical equipment, equipment operating parameters indicate the real-time status of equipment operation, and maintenance records contain historical information on equipment maintenance and care. By integrating and processing these data, potential patterns and issues in equipment operation can be uncovered, providing a basis for intelligent management decision-making. Establishing a standardized data asset catalog helps to regulate the classification, storage, and retrieval of data, enhancing data usability and management efficiency, thereby better supporting the operation of the entire intelligent management system.

4. Typical application scenarios

4.1. Intelligent control of power supply and distribution

4.1.1. Dynamic monitoring of energy consumption

Energy consumption dynamic monitoring is crucial in the intelligent control and management of power supply and distribution. Smart electricity meters and other devices can be used to collect power usage data in real-time, including parameters such as voltage, current, and power [5]. This data can be transmitted to a monitoring system for visualization. On one hand, it allows management personnel to intuitively understand the energy consumption of different areas and equipment. On the other hand, the system can analyze based on historical and real-time data. For example, by constructing a power load forecasting model, future energy consumption trends can be predicted. When abnormal energy consumption data occurs, the system can promptly issue an alarm to achieve intelligent diagnosis of abnormal electricity usage. At the same time, the system can automatically generate energy efficiency optimization suggestions based on the analysis results, such as adjusting equipment operating hours and optimizing load distribution, thereby improving the energy efficiency of the power supply and distribution system and reducing energy consumption costs.

4.1.2. Emergency response mechanism

In the emergency response mechanism of intelligent control and management of power supply and distribution, the remote monitoring system of the distribution room plays a key role. The system integrates functions of fault early warning and automation of emergency handling procedures. When an abnormality in power supply and distribution occurs, the system can quickly detect it and issue a warning signal [6]. Based on preset rules and algorithms, the system automatically initiates the emergency handling process, such as switching to the backup power supply and adjusting the power distribution, to ensure the continuity and stability of power supply. Meanwhile, the system can record in real-time various data during the emergency handling process, providing a basis for subsequent analysis and optimization. This helps to continuously improve the emergency response mechanism and enhance the ability of the power supply and distribution system to deal with unexpected situations.

4.2. Intelligent operation and maintenance of elevators

4.2.1. Preventive maintenance system

Establishing an elevator health assessment model based on vibration spectrum analysis and operating parameter monitoring is an important part of a preventive maintenance system. Sensors installed in key parts of the elevator obtain vibration spectrum and operating parameter data. Using data analysis techniques to mine data features and establish an evaluation index system, the model can achieve quantitative assessment of the elevator's health status. It can monitor the elevator's operating conditions in real-time, identify potential fault risks in advance, and provide

a scientific basis for formulating rational maintenance plans. This helps to prevent elevator failures, enhance the safety and reliability of elevator operations, and thereby improve property management efficiency [7].

4.2.2. Emergency rescue optimization

Designing an AI video surveillance and IoT-linked rapid response plan for elevator entrapment incidents is crucial. The AI video surveillance system continuously monitors the interior of the elevator, and once an entrapment event is detected, it immediately triggers the alarm mechanism [8]. Meanwhile, IoT technology transmits the elevator's operational data in real-time to the monitoring center, including information on the elevator's location and operational status. Upon receiving the alarm, the monitoring center can swiftly pinpoint the elevator where the entrapment occurred and access relevant operational data, providing accurate information support for rescue personnel. Based on this information, rescuers can pre-plan their rescue operations, thereby enhancing rescue efficiency. Moreover, the plan also enables real-time tracking and recording of the rescue process, offering a basis for subsequent accident analysis and review.

5. Implementation effect and optimization path

5.1. Management efficiency evaluation

5.1.1. KPI target system

The implementation effect of the intelligent management mode of property mechanical and electrical equipment can be evaluated through a multi-dimensional effectiveness assessment model, which includes key indicators such as equipment failure rate, emergency response timeliness, and energy consumption saving rate. The reduction of equipment failure rate reflects the advantage of intelligent management in equipment maintenance. By monitoring in real-time and giving early warnings, potential problems can be dealt with in time to reduce the occurrence of failures [9]. The improvement of emergency response timeliness shows that in the event of an emergency, the intelligent system can quickly allocate resources, shorten the response time, and ensure the continuity of property operations. The increase in energy consumption saving rate is one of the important achievements of intelligent management. By optimizing the operation strategy of equipment, the rational use of energy is realized, and the operation cost is reduced. However, in order to further optimize management efficiency, it is necessary to continuously improve the KPI index system and dynamically adjust the weight of indicators according to the actual situation to more accurately reflect the management effect.

5.1.2. Empirical data analysis

Taking the intelligent transformation project of Shenzhen Guomao Building as an example, the equipment failure rate was reduced from 15% before the transformation to 5% after the transformation, which significantly decreased maintenance costs and downtime. At the same time, there was a substantial increase in personnel work efficiency. Previously, it took 4 hours to conduct a manual inspection, but now, with the intelligent inspection system, it only takes 0.5 hours, effectively controlling labor costs. In terms of energy consumption, the intelligent system has achieved precise regulation, reducing energy consumption by 18% compared to before. However, some problems do exist. For example, the stability of some intelligent devices is not satisfactory under extreme conditions, and data transmission occasionally experiences delays. This indicates that on the path of optimization, we need to further enhance the environmental adaptability of equipment, optimize data transmission algorithms, and strengthen the integration and compatibility of the system to continuously improve the efficiency of property management [10].

5.2. System security risk control

5.2.1. Network security protection

The security reinforcement strategy for industrial control systems is a key measure to enhance system security. By promptly repairing system vulnerabilities and strengthening access control, illegal intrusions can be effectively prevented, and the stable operation of the system can be ensured. For example, advanced encryption technologies are employed to encrypt critical data, ensuring the security of data during transmission and storage. At the same time, strict user permissions are set to restrict unauthorized access, ensuring that only authorized personnel can operate key equipment and access sensitive data. Moreover, regular security audits and vulnerability scans are conducted to identify and address potential security risks in a timely manner, further improving the overall security of the system. Through these comprehensive measures, industrial control systems can maintain a high level of security and reliability in complex network environments, providing a solid guarantee for the production and operation of enterprises.

Abnormal behavior detection algorithms play a crucial role in identifying potential risks. They can monitor the system's operational status in real-time and promptly detect operations that do not conform to normal patterns. For instance, by analyzing data such as the operating parameters of equipment and network traffic, an alarm can be triggered when abnormal fluctuations occur. The combination of these two measures can significantly enhance the cybersecurity protection level of industrial control systems, reduce security risks, and ensure the stable operation of the systems.

5.2.2. Equipment redundancy design

Equipment redundancy design is an important measure to ensure system security. By adopting a dual-machine hot-standby plan for core mechanical and electrical equipment, if one device fails, the other can quickly take over the work to ensure uninterrupted system operation. For example, for critical power-supply equipment, dual-machine hot-standby can prevent power-outages caused by equipment failure and ensure the normal operation of the property.

At the same time, a data disaster-backup recovery mechanism is also indispensable. It can quickly restore data in the event of data loss or damage, avoiding the impact of data issues on the management and control of mechanical and electrical equipment. For example, the operation data of the property's equipment can be ensured for its integrity and availability through the disaster-backup recovery mechanism.

These redundancy design measures effectively reduce system security risks and enhance the reliability and stability of property management. However, continuous optimization is still needed, such as regularly checking the performance of redundant equipment and updating disaster-backup data in a timely manner.

5.3. Management capacity improvement strategy

5.3.1. Optimization of talent structure

To enhance the intelligent management level of property mechanical and electrical equipment, optimizing the talent structure is crucial. On one hand, a training program should be developed to cultivate the digital skills of mechanical and electrical engineers. Through a systematic curriculum that includes courses on intelligent control systems and data analysis, their ability to apply digital technologies can be improved. Meanwhile, practical opportunities should be provided so that they can gain experience in real-life projects. On the other hand, a technical outsourcing cooperation model should be established. By collaborating with professional mechanical and electrical intelligence technology companies, advanced external technologies and talents can be introduced. During the cooperation, internal engineers can communicate and learn from external experts, constantly updating their

knowledge system. This talent-structure optimization model can effectively improve the overall technical level of the property management team, better cope with various challenges in the intelligent management of mechanical and electrical equipment, and improve the efficiency of property management.

5.3.2. Service model innovation

The implementation of the intelligent management mode for property mechanical and electrical equipment has yielded remarkable results, bringing comprehensive improvements to property management. In terms of management capability, the intelligent system's real-time monitoring and in-depth analysis of equipment operation data enable management personnel to accurately grasp the equipment's operating status. They can identify potential failure risks in advance and thus develop scientific and rational maintenance plans, effectively reducing the equipment failure rate. This precise failure prediction and prevention mechanism not only enhances the scientific basis and timeliness of decision-making but also minimizes the risk of operational disruptions caused by sudden equipment failures, ensuring the continuity and stability of property management.

Moreover, the application of the intelligent system provides employees with a practical platform. As employees learn and master intelligent technologies through daily operations and maintenance, their application skills are significantly improved, and so is their overall quality. This improvement is not only reflected in their proficient operation of the existing intelligent systems but also in their ability to embrace new technologies and cultivate innovative thinking, laying a solid talent foundation for the long-term development of the property management team.

In the aspect of service model innovation, the equipment management service has undergone a transformation towards productization. Specifically, customized equipment maintenance packages have been introduced. These packages provide precise and personalized maintenance services based on the specific needs of different property owners, thereby significantly enhancing the added value of the services. Meanwhile, the profit model of value-added services has become increasingly clear. For example, through energy management services, by optimizing energy-usage strategies, the service helps property owners effectively save on energy costs while also generating corresponding revenue for the enterprise. This creates a win-win situation for both the property owners and the service providers. This innovative service model not only enhances the satisfaction of property owners but also provides new impetus for the sustainable development of the enterprise.

However, in the process of promoting intelligent management, some problems that need to be optimized have also been exposed. For example, the compatibility of intelligent systems is still insufficient, especially when facing equipment from different brands, the difficulty of data integration is relatively large, which to some extent restricts the full play of the efficiency of intelligent management. In addition, the synergy between systems also needs to be strengthened to ensure the smooth transmission and sharing of information. In the future, more research efforts need to be put into system integration. Through technological innovation and standardization, the overall level of intelligent management can be improved, so as to better adapt to the complex and changing equipment environment and promote intelligent management to a higher level.

6. Conclusion

The intelligent management mode of property mechanical and electrical equipment is a new way to improve the efficiency of property management. This mode has brought transformative value to property management, such as increasing the operating efficiency of equipment and reducing labor costs. However, the current limitations in

technological integration restrict the further development of the intelligent management mode. In the future, the development directions of new technologies such as digital twin and edge computing are worth paying attention to. Digital twin technology can achieve precise mapping between physical equipment and virtual models, providing more accurate decision-making basis for equipment maintenance and management. Edge computing technology can process data locally, reducing data transmission latency and improving the real-time performance and reliability of the system. Through the research and application of new technologies, it is expected to further improve the intelligent management mode of property mechanical and electrical equipment and promote the development of the property management industry.

Disclosure statement

The author declares no conflict of interest.

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