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Analysis of the new transportation and inspection mode of overhead transmission lines based on visual management

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Abstract. In the process of urban construction and development, there are more and more construction projects such as building houses and planting trees, digging ditches, building Bridges and paving roads. The number of large-scale mechanical operations around the transmission lines continues to rise, which not only increases the pressure of channel operation and maintenance, but also hinders the stable operation of the power system. In order to further improve the quality and efficiency of the operation and maintenance of overhead transmission lines, some scholars proposed to continuously promote the operation and inspection business of transmission lines and create a new operation and inspection mode based on the concept of visual management, which can not only change the traditional work mode, but also solve the problems existing in the conventional operation and inspection. On the basis of understanding the problems facing the overhead transmission line inspection work, this paper focuses on the main content of practical work by determining the transportation inspection platform system architecture with visual management concept as the core, and discusses the application effect of the new transportation inspection mode of overhead transmission line with visual management as the core combined with experimental cases.

Keywords： Visual management; Overhead transmission line; New mode of transportation and inspection; Drones; inspection.

1. Introduction

Now, in order to better meet the demand of different areas of electricity, Chinese electric power enterprises are expanding the operation scale of overhead transmission lines while building the ultra-high voltage grid. From the long-term perspective of power system operation, although the new operation and inspection mode can find the safety problems faster, the number and ability of the operation and inspection staff are not up to the standard, the problem of aging personnel structure is common in grass-roots units, and the shortage of personnel is also the main challenge facing the development of power transmission profession. According to the accumulated experience of overhead transmission line construction and management in recent years, the main problems are as follows:[1-3]

On the one hand, the security risks of the external environment are becoming more severe. Overhead transmission lines are the core content of transmission and distribution network operation. Regular inspection and investigation of transmission lines can guarantee the stability of power system on a basic basis. However, because the transmission lines are in the natural environment for a long time and bear a large power load, they will be affected by external factors such as earthquake, landslide and strong wind. Therefore, during the operation of the power system, the staff must fully consider the operation and inspection work of the overhead transmission lines and truly realize the practical significance of regular operation and inspection work. At the same time, with the steady development of social economy, there are more and more bad behaviors such as soil taking, crane planting and illegal construction in the protected areas of overhead transmission lines, and the internal and external contradictions of overhead transmission lines are becoming more and more obvious. At this time, only by constructing a management system with visual management concept as the core and monitoring the working conditions of overhead transmission lines 24/7 can the new mode of operation and inspection be implemented orderly.[4]

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On the other hand, the traditional mode does not meet the requirements of intelligent management. The traditional operation and inspection work mainly consists of manual inspection and power outage maintenance, and the way to obtain information is relatively simple. In the management of equipment channel and working environment, no standardized and perfect management system has been proposed. Especially after entering the era of big data, the traditional model of measuring overhead transmission lines by footsteps has been unable to meet the requirements of on-site visual management. Therefore, in the innovation and development of electric power enterprises, it is proposed to use UAV and other technical equipment to fully integrate the traditional transportation and inspection business, which can not only change the traditional transportation and inspection mode, but also effectively alleviate the increasingly severe development contradictions. Truly meet the needs of lean operation and maintenance management, and comprehensively promote regional and differentiated operation and maintenance management mode.[5-6]

On the basis of understanding the construction and operation status of overhead transmission lines, this paper focuses on the application effect of the new transportation and inspection mode according to the basic concept of visual management, and defines the main content of the new transportation and inspection mode of overhead transmission lines with visual management as the core, in order to provide technical support for the development of electric power enterprises in the new era.

2. Methods

2.1 System Architecture

The integrated visual transmission management system is a system structure with intelligent transmission network architecture as the core. It will integrate big data mining, self-organizing communication network, expert system, Internet of Things and other technologies together, and coordinate with the traditional power network structure to ensure that the overhead transmission line network has environmental assessment, self-perception, intelligent diagnosis and other capabilities. Through rational use of intelligent operation and maintenance system, it can provide staff of relevant departments with functions such as online monitoring of equipment status, early warning of failure and remote line inspection during visual management of overhead transmission line operation and inspection, effectively control the occurrence probability of safety accidents and reduce system costs. The specific structure design is shown in Figure 1 below:[7-9]

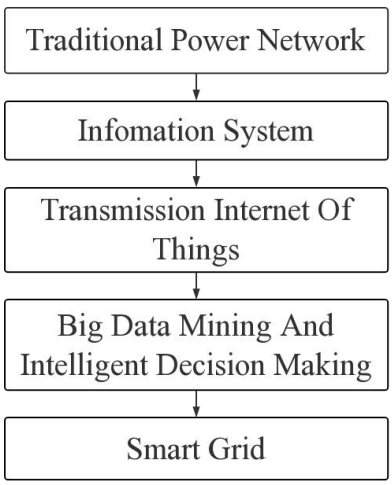

Figure 1 System architecture diagram

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From the analysis of the structure, it can be seen that the platform is divided into four parts: node perception, operation and inspection, sensor network, intelligent prevention and control platform, and mobile operation terminal. Through the rational use of power-saving equipment, transmission line data can be collected and sent to the background server of the control center. The data information collected by sensors can be analyzed and processed, and then representative line status information can be screened out to help department employees complete decision-making management and observe the early warning information pushed by the channel video receiving platform in real time.[110-12]

2.2 New Modes

In the innovation and development of network technology means, emerging technologies represented by artificial intelligence have been widely applied to various fields of economic and social development, which not only speeds up the pace of development of science and technology, but also shows the development advantages of modern economy. After entering the era of big data, in order to realize the industrial innovation goal of hidden dangers of overhead transmission lines, electric power enterprises need to build a sound scientific theoretical system, propose a new mode of operation and inspection, and solve the problems existing in traditional operation and inspection work. According to the analysis of the new operation and inspection mode shown in Figure 2 below, the specific contents are as follows:

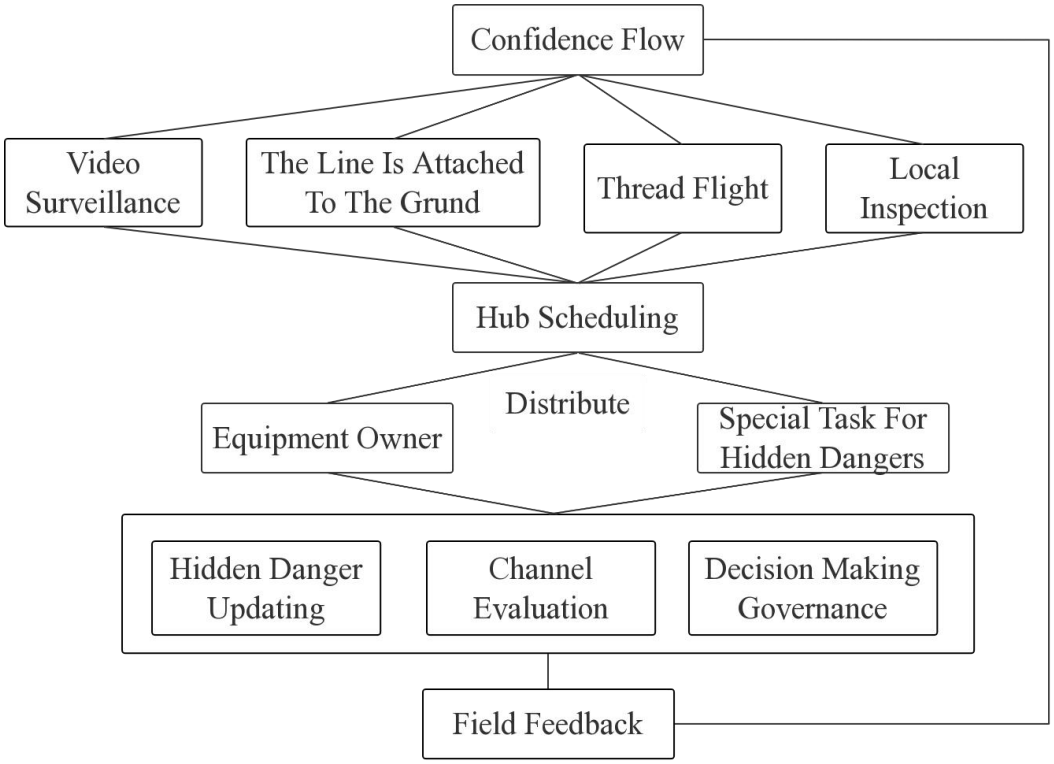

FIG. 2 New mode of operation and inspection

First, video surveillance. In this working mode, video monitoring and patrol is placed in an important position, which can not only transform the traditional transmission line channel inspection mode, but also guide the power system operation to achieve the goal of intelligent management. At the same time, the practical work efficiency will also be raised from the traditional one patrol a day to 15 minutes a beat, the overall efficiency increased by about 50 times. Although a large number of scientific researches and information guidance have been conducted on video surveillance data, and an auxiliary decision-making system consistent with practical work has been formed, which provides a lot of help for the operation of overhead transmission lines, the

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underlying architecture design still faces many problems, and the underlying data of video surveillance also has security risks.[13-15]

Second, line dependency. In the new working mode, the inspection work of the territorial/line protection channel should be placed in the auxiliary position, and the inspection staff should be guided to inspect the transmission lines, and a large number of data should be provided as support. At present, the mobile inspection technology applied by electric power enterprises can basically comprehensively supervise the work of line patrol, but it also has the problem of being too formalized. Therefore, in order to better inspect the quality of inspection work and provide effective basis for channel analysis and management, line protection should upload standardized recruitment every week, which can provide sufficient image data for practical management.

Third, threading. In this working mode, the threading flight of UAV is placed in the core position, and the rational use of UAV during the operation and inspection can not only propose a fast, efficient and low-cost inspection method for the passage, but also scientifically avoid the work risk. On the one hand, the staff should use the UAV to carry out daily flight of fixed lines. According to the reading cycle, the staff should investigate trees, foreign bodies and bird's nests in different areas one by one, complete the verification of the dominant defects, and then conduct a comprehensive net pulling on the fixed hidden areas to effectively evaluate the transmission channels. On the other hand, the staff should carry out autonomous flight in the flight through the line, combine it with ontology inspection, channel and other work, collect channel image information by multiple points, fully release the working pressure of the phenomenon staff, and control the suitability of the UAV to the transport inspection staff.

Fourth, ontology inspection. In this working mode, the ontology inspection of UAV is placed in the first place to ensure that relevant technical equipment meets the working requirements, so as to ensure the safety and stability of transmission channel operation on the basis of this. When the number of overhead transmission lines continues to rise, the running time of equipment and the number of ontology inspection will also increase. The traditional investigation work by means of telescope and climbing pole can no longer meet the needs of practical development. Therefore, the staff should use the machine to carry out periodic inspection and strictly follow the technical route and working index of UAV ontology inspection, so as to truly realize the replacement of the old and the new in transmission and operation inspection. At the same time, it is necessary to give full play to the role of the equipment owner, improve the work level of the equipment owner in analyzing the defects of the equipment ontology, fully release the staff of the department, and ensure the safety and effectiveness of the equipment ontology.

3. Result analysis

In the current overhead transmission line operation and maintenance management, most of them still rely on manual mode, which not only has many limitations, but also affects the efficiency and quality of overhead transmission line network operation. Therefore, in combination with the concept of visual management, this paper creates the monitoring terminal technology as shown in Figure 3 below, so that staff can grasp the security risks contained therein more quickly.

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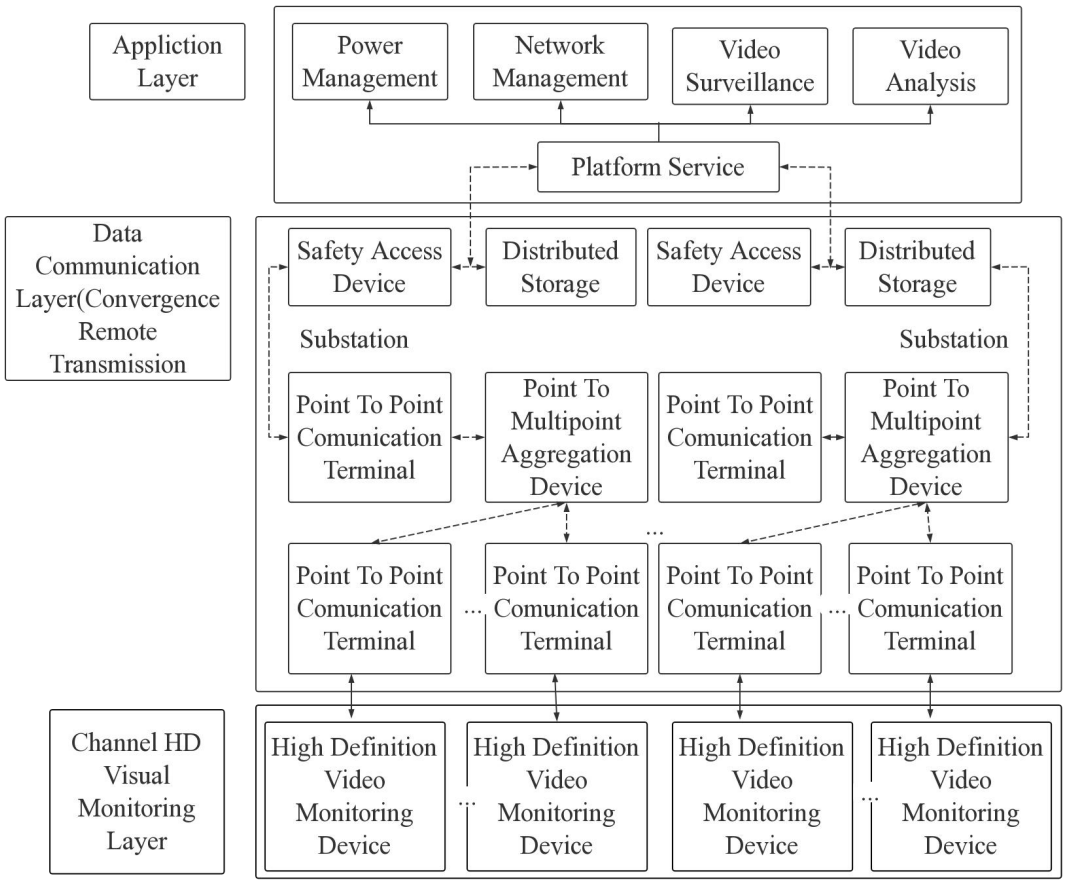
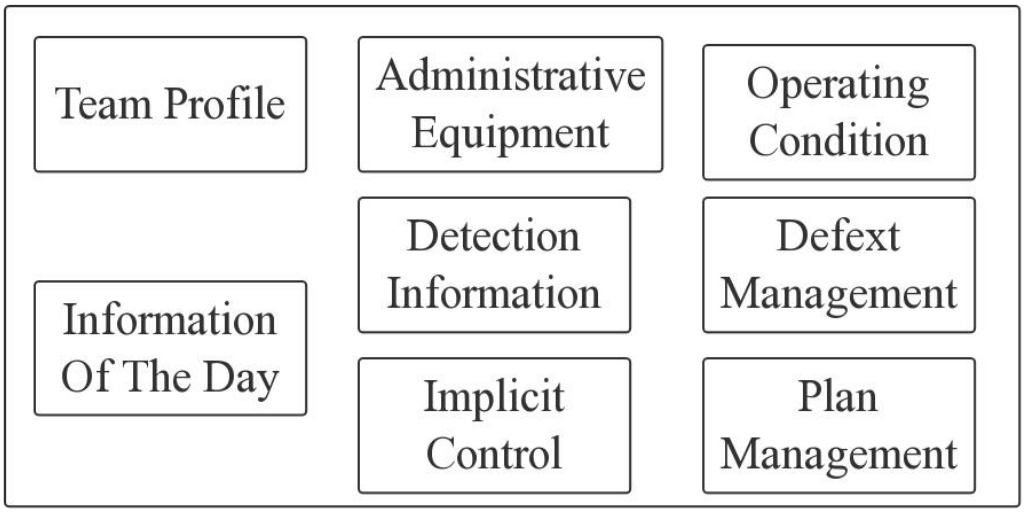


FIG. 3 Monitoring terminal technology

At the same time, the visual management platform can access external data, integrate and apply hazard point data and PMS data, truly realize unified data processing, control repeated ledger operations, sort out and analyze ontology information, hazard source information, defect information, etc. so as to provide an effective basis for the operation and inspection management of overhead transmission lines.



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First of all, in the visual operation and maintenance management of new transmission lines, online monitoring devices can be scientifically installed and image acquisition frequency can be scientifically designed in accordance with practical work requirements, so as to truly realize cross-regional online monitoring.

Secondly, improve the safety protection level of important overhead transmission lines. After determining the fortification level of important overhead transmission lines, ensure that two or more important transmission lines will not trip at the same time due to a certain reason. At the same time, the rational use of differentiated reinforcement measures, according to the cumulative data analysis over the years, scientific division of visual management of human resources, cost control, to ensure that the power enterprise can run stably at a low cost.

Finally, improve the level of safety management of important overhead transmission lines. If the staff can accurately judge the safety risks of the safe operation of the channel and strengthen the supervision of the practical work, then the ability of the overhead transmission line to resist risks can be improved on the basis. The visual management system can better achieve this goal, and the new mode of operation and inspection can help the staff discover more problems. Through rational use of visual monitoring center in operation and inspection management, channel operation and maintenance mode of centralized monitoring and network disposal can be realized to deal with sudden security problems in time.

4. Conclusion

In summary, the rational application of intelligent terminal platform to create lidar scanning system can not only obtain more optical image data, but also integrate and analyze the operation and inspection information of overhead transmission lines under the guidance of big data analysis, three-dimensional visualization and other technologies, so as to build a management and control system with overhead transmission line channel as the core, providing an effective basis for power system management and control of line network. Therefore, while paying attention to the study of overhead transmission lines, it is necessary to combine the visual management concept to build intelligent and digital technology means, so as to improve the robustness of system operation and master more valuable data information.

References

[1] Xiao Su. Construction of a New Mode of Overhead Transmission line Inspection for Urban Development [J]. Science and Technology Vision, 2021, 000(027):183-184.

[2] Shuhui Liu. Research on Lean Management Mode of transmission lines based on intelligent patrol [J]. Communications Power Technology, 2022, 39(14):5.

[3] Dejun Li. Research on the implementation of integrated management of transmission line operation and inspection [J]. Engineering Technology Research, 2021, 3(7):114-115.

[4] Yu Sui, Banpingjuan Ning, Pingjuan Niu, et al. Research review on electric inspection technology of mounted UAV for overhead transmission lines [J]. Power Grid Technology, 2021, 45(9):13.

[5] Xiao Su. Construction of a New mode of overhead Transmission line inspection for Urban Development [J]. Science and Technology Vision, 2021(27):2.

[6] Bing Liu, Chaowu Liu. Research on Transmission line inspection Mode in the new era [J]. Science Popular, 2021, 000(005):P.274-275.

[7] Fantao Zeng. Discussion on Application of UAV in Aerial Transmission line inspection in mountain area [J]. Science and Technology Information, 2021, 019(030):28-30.

ISSN:2790-1688 DOI: 10.56028/aetr.4.1.202.2023
[8] Guoping Wang, Zhengqing Xu, Shaoliang Zhou, et al. Research and development of three-dimensional visualization Control Technology for Substation Operation and Inspection Service [J]. Electrotechnical Engineering, 2021(14):3.

[9] [9] Changjian Zeng, Li Li, Guohua Zheng, et al. Research on the Integration of Transmission Line Transportation and Inspection based on VR Technology [J]. Journal of Shandong Agricultural University: Natural Science Edition, 2021.

[10] Peizhen Xing, Zengchun Zhou. Analysis on the integrated management strategy of transmission line operation and inspection in power system [J]. Science Popular, 2021, 000(012):P.382-383.

[11] Xin Liu, Gang Liu. Research on State Operation and Maintenance Management of overhead transmission lines [J]. Economic and Technical Cooperation Information, 2022(30):3.

[12] Ziyang Liu. Study on Lean Operation and Inspection Management of Transmission Lines [J]. Easy Learning Computer, 2021, 000(007):P.1-1.

[13] Xiaodong Chen. Analysis on construction management and Quality Control of overhead transmission line engineering [J]. Science Popular, 2021, 000(012):P.25-26.

[14] Junfan Yang Ziming. Analysis of the function of Intelligent Platform in Transmission line transportation surface [J]. Computer Products and Distribution, 2022(2):38-40.

[15] Zhijun Lin, Baojun Liu, Junfeng Guan, Yan Zhang. Three-dimensional modeling of overhead transmission lines based on image feature analysis [J]. Electronic Devices, 2022, 45(1):172-177. (in Chinese)