Design and Research of Intelligent Operation and Maintenance System for Wisdom Verification Detection Pipeline

Yuhan He¹, Zhen Jing¹, Yan Yang², Yanling Sun¹, Xiaohui Zhai¹, Yu Xing¹, Baoshan Xing³, Liying Guo³, Qun Gao³, Chunyan Shi³, Lu Zou³ and Jiale Song³

¹State Grid Shandong Electric Power Research Institute, Jinan, China
²State Grid Qinghai Electric Power Research Institute, Xining, China
³Shandong Zhongshi Yitong Co., Ltd., Jinan, China

Abstract. Since the pipeline inspection platform equipment bears the main work of the full performance test of the energy meter and the collection terminal, the quality requirements for the metering automation verification pipeline equipment are getting higher and higher, and the reliability also puts forward higher requirements. Design and develop a power meter and acquisition terminal fully compatible with the smart verification detection pipeline system, through the wireless data transmission and computer network technology to automatically detect the temperature rise in the automated pipeline equipment. The intelligent operation and maintenance system uses computer network technology and modern management ideas to combine organic sensors, technology, wireless data transmission technology, data processing technology, and monitoring of abnormal operation of automated pipeline equipment.

1. Introduction

With the long-term use of the automated verification pipeline, there may be temperature overheating, overvoltage and overcurrent, and abnormal alarms inside the equipment. Due to the airtightness of the equipment cabinet, abnormal problems existing during long-term operation of the equipment cannot be judged and processed in time, which directly affects the safe and stable operation of the entire pipeline. The overheating problem is an evolving process. If not controlled, overheating the degree will be intensified and will have a great impact on the performance of the insulation in the equipment and the life of the equipment. In severe cases, open flames and fire accidents may occur.

In response to this situation, the intelligent operation and maintenance system APP is developed to display the abnormal information of all the stations and the detection units of all the areas or the specified areas in real time. It can be viewed on an Android tablet or on a computer browser. After the detection system has abnormal information, the alarm will be pushed, and the tablet will wake up and play the alarm sound. According to different types of abnormal information, there are three alarm levels: Level 1, Level 2, Level 3, which are distinguished by red, orange, and yellow on the interface, and the alarm sounds of each alarm level are different. When the station alarms for 5 minutes, if it is not processed in time, it will alarm again.
2. Fully compatible smart verification detection system function design

All line bodies and test units in the fully compatible Wisdom Verification Detection System have an abnormality detection function. During the operation, the mechanical device is abnormal or the meter is not positioned properly. In time, the sound and light alarms and stops the operation, and the abnormal information is summarized into the monitoring room. After the abnormality is eliminated, the work continues.

The smart verification detection system has an online monitoring function that can monitor various abnormal conditions of all components in real time, and can automatically diagnose abnormal conditions of key equipment and individual functional units. The alarm information is displayed and uploaded locally in real time.

The smart verification detection system has the power-off breakpoint memory and recovery function. When the system suddenly loses power, the fully-compatible smart verification detection system has the function of remembering the state of the device. After the call is made, the operation can be continued by simple operation; Faulty functional unit, the system automatically disconnects the unit so that it does not affect the operation of the entire fully compatible smart verification detection system.

The smart verification detection system sets the operation timeout failure prompt, and sets the timeout failure prompt in the parts of the drive unit such as the cylinder, the motor, the electromagnetic valve, and the actuators such as the electric measuring instrument, the camera, and the laser engraving machine. If the stop cylinder is not in the lift position, the transfer cylinder is not lifted, the camera does not execute the photographing command, the engraving machine does not execute the engraving command, and the test detection unit test is stagnant.

When the intelligent verification detection system has various abnormal conditions such as timeout failure, abnormal data failure, and special unit failure, the faulty equipment stops running and sound and light alarms are issued. Abnormal information can be automatically uploaded to the dispatching hall, monitoring room, large screen, local operation terminal and mobile operation terminal on the seventh floor of the measurement center for easy query, processing and storage. The system diagnostic function can locate and indicate the specific fault location and the cause of the fault, and intelligently recommend a fault handling solution. The block diagram of the intelligent operation and maintenance system is shown in Figure 1.

![Figure 1. Wisdom verification detection system block diagram.](image)

Intelligent operation and maintenance platform, including real-time status, abnormal information, heat map, maintenance map, historical abnormal record, box table information verification, pallet binding, coded labeling defective product processing, box table binding, palletizing, checklist Status, data analysis, monitoring.

The abnormal monitoring client can be deployed on multiple desktops, and data rotation training is performed on the corresponding PLC respectively. When an abnormal condition of a specific type of attribute is calculated, the WebService service is called to notify the back end.
The WebService service provides an exception notification interface internally. When the exception notification interface is invoked, the exception information is saved to the database, and the exception information is pushed to the intelligent operation and maintenance platform; the state notification interface is provided to the outside, and when the state notification interface is called, the state is The information is pushed to the intelligent operation and maintenance platform for real-time status of the intelligent operation and maintenance platform, such as display box table information verification, pallet binding, coded labeling defective product processing, box table binding, and palletizing.

3. Design of intelligent operation and maintenance platform for detection system
The main goal of the intelligent operation and maintenance system is to monitor the factors affecting the working quality and working efficiency of the equipment, and to prevent the faults of the staff in the equipment when the field equipment suddenly stops running. The real-time status monitoring interface of the intelligent operation and maintenance system is shown in Figure 2.

![Intelligent operation and maintenance platform real-time status monitoring interface.]

Figure 2. Intelligent operation and maintenance platform real-time status monitoring interface.

The real-time status monitoring interface displays the entire pipeline. When an abnormality occurs, the message is prompted at the top right of the page. When there is a new message, it is accumulated here. Each message prompts to be manually closed. Marks the location where the exception message occurs and flashes it. The 2D map can be manually zoomed, click the red box to pop up the prompt box, the prompt box displays the abnormal position and the abnormal description, click “View Details” to enter the abnormal information page shown in Figure 3.
Figure 3. Status monitoring exception information interface.

The abnormal information displays the last 100 historical abnormal records of the abnormal position in the form of a small card, and the latest abnormal information is displayed at the top and left. The small card style is divided into two states: a collapsed state, an expanded state, and a default folded state. The content includes: an abnormal position, an abnormal description, an occurrence time, and a processing state; when the processing state is "unprocessed", the small card can be clicked. The card expands down to display the "Process" button. After the "Process" button is clicked, the "Processing Status" changes to "Processed". At this time, the real-time status interface does not mark this position, and the corresponding abnormal message prompt box disappears automatically.

When a new box passes through the conveyor, the external program will call the status notification interface, and the intelligent operation and maintenance platform displays the box information in real time. The box information includes: box number, box type, table set (table number, table type, relative position): The first few rows of the table, the table status code: 0 is normal, non-zero is abnormal, abnormal description), box status code, box abnormal description. The box table information verification interface and the box table binding interface are shown in FIG. 4 and FIG. 5.

Figure 4. Box table information verification interface.
The new box appears from the left side, and the old box moves to the right. When the status code is not 0, the corresponding part is marked red, and the lower log area prints abnormal information. At this time, the conveyor belt will stop. After the manual operation is abnormal, click the “Schedule” button. The conveyor belt continues to go down. Box type: 01 single-phase table, 02 three-phase table or concentrator or special change, when 01, the box style is 4 rows and 3 columns, when 02, the box style is 2 rows and 2 columns.

The tray binding interface is shown in Figure 6. Pallet type: 01 single-phase table, 02 three-phase table or concentrator or special change. When 01, the tray style is one line and three. When it is 02, the tray style is one line and two.

When there is a new pallet binding passing the conveyor, the external program will call the status notification interface, and the intelligent operation and maintenance platform will display the pallet
binding information in real time, and the information includes: nickname, status code, and abnormal description. The palletizing interface is shown in Figure 7.

![Figure 7. Pallet binding interface diagram.](image)

The new pallet binding appears from the left side, the old pallet binding moves to the right, when the status code is non-zero, the corresponding part is marked red, and the lower log area prints abnormal information. At this time, the conveyor will stop, after the manual operation excludes the abnormality, click the “Schedule” button. The conveyor belt continues to go down.

The check status interface can view the current check progress of each line body, and can view the historical checklist data according to batch, time, test items, test points, and epitopes. The data source is an external checklist library. The data analysis interface collects historical anomaly data and displays it visually. The analysis includes: statistics on the number of occurrences of each abnormality, statistics on the number of abnormal times generated by each device, and statistics on the number of maintenance times of the device. In order to allow staff to reserve spare parts for equipment parts with high faults. The monitoring interface is interfaced with the video service interface, and the video pictures captured by the cloud track camera can be viewed according to the conditions.

4. Conclusion
The automatic inspection pipeline system often performs inspections for a long time and high load, and the internal heat of the equipment is continuously accumulated, which causes the temperature overheating phenomenon to be intensified. The intelligent operation and maintenance system can detect problems in advance and prevent risks. The intelligent operation and maintenance system saves operation and maintenance costs, reduces personnel input, realizes unattended production line, improves failure treatment time by more than 50%, and connects manpower costs by more than 60%. System related videos, information, etc. can be connected to the 7th floor large screen, with dual functions of display and status monitoring. Compared with traditional operation and maintenance methods, the intelligent operation and maintenance system has the characteristics of wide monitoring range and strong timeliness, and can detect and monitor the internal abnormalities of the equipment in real time. The intelligent operation and maintenance system can upload warning information in a variety of ways to ensure that the warning information can be accurately reported.
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