The model relates to an substation inspection robot carrying a Unmanned Aerial Vehicle

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Abstract: A kind of substation inspection robot carrying unmanned aerial vehicle (UAV) was studied to solve the problems of complex indoor environment of substation, high intensity of manual inspection and low efficiency of traditional inspection method. Using robot mobile platform connected to the robot controller of ontology, the robot controller of ontology through wireless router and background monitoring system for information transmission and according to the background monitoring system control command control robot mobile platform preset in the transformer substation inspection lines and parking. Walking on the robot mobile platform is equipped with the UAV. Wireless information transmission between the UAV and the robot body controller, take-off and landing controlled by the robot body controller and the camera component on the UAV takes pictures of the equipment and instruments of the substation so as to complete the substation inspection work safely and reliably.

1. Introduction
The application research in the field of electric power mainly involves substation equipment inspection, nuclear power plant operation, high voltage line inspection, cable pipeline inspection, boiler pressure inspection and other robots. Substation is a place where voltage and current are transformed. In order to ensure the safe use of the substation, it is necessary to carry out regular inspection of the substation. Manual inspection is the traditional operation mode of substation inspection. Sometimes, inspection personnel are easy to cause missing and wrong inspection due to factors such as fatigue and boredom. According to the statistics of China Electric Power Research Institute, the annual direct economic loss caused by missed and wrong inspection exceeds 2.6 billion yuan. So it is difficult for manual inspection to ensure the safety and reliability of the power system [3].

The Shandong Electric Power Group began "high voltage live work robot" research in 1999 with the Electric Power Research Institute and other scientific research organizations. China's electric power industry has made more outstanding achievements in the application of intelligent robots, but also accumulated more rich experience. The advantages of intelligent substation inspection robot are mainly reflected in the strong adaptability to the environment, the automation and intelligence of inspection. The high accuracy of inspection which makes its importance in the specific inspection work increasingly prominent. In recent years, China has increased the application of robots in unattended substations for inspection and the research on this kind of robots. It is also one of the most important topics in the research of smart substations. [4-5]

In the 1990s, Japan developed a rail inspection robot applied in 500K V substation and designed its mobile flat inspection robot. The substation inspection robot equipped with UAV includes robot
mobile platform, UAV, robot body controller, wireless router and background monitoring system [6-7]. Robot mobile platform is connected to the robot controller of ontology. The information transmission of robot controller through wireless router and background monitoring system. The platform is preset in the substation. The robot movement is controlled according to the background monitoring system. The patrol line and parking walking robot mobile platform are equipped with UAV [8-9]. Wireless information is transmitted between UAV and robot body controller, take-off and landing are controlled by robot body controller, and the equipment and instruments of substation are photographed by camera components on UAV [10].

With the development of science and technology, using inspection robots to complete inspection tasks can improve the reliability of substation operation which has become a development trend. However, there are the following problems when using the inspection robot to complete the inspection task: 1. When the inspection robot walks to the shooting position and stops, the inclination will be generated due to inertia and other factors so that the shooting target is beyond the shooting range of the camera component. 2. There is a maximum upward angle between the camera component of the inspection robot and the inspection robot. If the inspection robot is close to the equipment in the substation, the camera component is limited by the maximum upward angle. In addition, the camera component will deviate from the shooting range as long as it turns a small angle if the inspection robot is far away from the equipment in the substation.

2. Composition and structure
The utility model relates to a substation inspection robot equipped with a UAV. The substation inspection robot equipped with a UAV includes a robot mobile platform, a UAV, a robot body controller, a wireless router and a background monitoring system. Described the robot mobile platform connected to the robot controller of ontology, the robot controller of ontology through wireless router and background monitoring system for information transmission and control the robot mobile platform control instruction. According to the background monitoring system in substation default inspection lines and parking, the robot mobile platform is equipped with the UAV; The UAV and the robot body controller wireless information transmission and by the robot body controller control take-off and landing through the UAV on the camera component of the equipment and instruments of the substation.

![Figure 1. 1.Robotic Mobility Platforms; 2.UAV(unmanned aerial vehicle); 3.PTZ Camera; 4. VideoComponents; 5.Power supply and data transmission cable; 6.Cable winch; 7.Infrared Camera; 8.Visible light photography; 9.UAV propeller protective cover; 10.Robot body controller; 11.airborne laser finder; 12.Ultrasonic radar; 13.Driving wheel.](image-url)
3. Advantages of substation inspection robot equipped with UAV

(1) The design is not affected by the walking angle of the inspection robot, and the equipment of the substation can be clearly photographed when it is near or far from the equipment of the substation; (2) the main controller and UAV cable information transmission, and power supply, data transmission cable winding on the cable winch, can ensure UAV with the main controller at the same time, the validity and reliability of information transmission between power supply and data transmission cables can also be effective for UAV flight to limit maximum distance, Ensure the safe and reliable completion of substation inspection; (3) The UAV is also equipped with the UAV propeller protective cover, to further avoid the collision between the unmanned person and the equipment in the substation, resulting in unmanned damage; (4) The robot mobile platform is provided with a laser rangefinder and ultrasonic radar connected with the robot body controller, so that the robot mobile platform can effectively avoid obstacles when walking on the specified inspection line in the substation.

4. Application of substation intelligent inspection robot in operation and maintenance

Application of defect tracking. The tracking function of the inspection robot is very powerful. the intelligent robot can track and monitor the defects when the low-voltage alarm occurs in the substation equipment. In addition, the robot can send the inspection results to the equipment observation point in real time to ensure that the operation and maintenance personnel master the data of the measuring device. In this way, operation and maintenance staff can efficiently manage devices. As for the function of intelligent inspection robot, it can effectively check faults, collect data with high integrity. At the same time, it can be used in data monitoring and analysis, reducing the workload of personnel and comprehensively maintain the safety and intelligence of substation operation.

Outdoor environment cleaning applications. There are many obstacles in the maintenance operation of the intelligent inspection robot. In order to deal with this problem comprehensively, the ultrasonic identification system of the robot must be optimized and modified to ensure that the robot avoids obstacles. The robot can effectively receive ultrasonic signals during the process of moving and realize the effect of sending back. If there are obstacles in the path, the robot can send search commands to the control center. The intelligent inspection robot is applied to the substation which mainly has the visualization function-visible light control function. The high resolution camera can receive the operation status and operation data, and monitor the running status of the host. Pay attention to check the equipment, read the pressure count, effectively detect the running state of the equipment. At the same time, calculate the current leakage and working time, and effectively carry out maintenance and maintenance work.

Infrared temperature measurement function. In the application of this function, attention should be paid to the maintenance of substation operation. The setting of application time interval and the monitoring and collection of data. For example, the substation is divided into four operation areas and different operation areas have corresponding working days. During the visible light task, the visible light spectrum is maintained by shutter split position switch, oil level indicator, detector and thermometer. Four testing points are arranged on the switching device, mainly including wiring, main body, transformer equipment, three-phase and neutral box. Scientific infrared temperature
measurement for different equipment, set up multiple detection points at the same time, a full range of infrared detection, maintain the infrared spectrum and visible spectrum. Compared with manual data collection and summary, the intelligent inspection robot does not need human intervention and has less manual logic. After inspection, the robot can automatically upload reports, analyze and maintain equipment faults, and comprehensively improve the operation effect and service quality.

5. Conclusion
The design of substation inspection robot intelligence needs multiple aspects which aim at the problems in the operation targeted design. The design make robot work performance improved under the condition of the guarantee economy demands. Therefore, robot can achieve the stability of power system operation, security needs, contribute to the development of Chinese electric power industry.

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