Research on Robot Oriented Remote Online Monitoring and Fault Diagnosis System

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Abstract

Robot is a kind of multi degree of freedom automatic mechanical device, which can realize various functions according to its own power and control system. It is one of the basic equipment for building automatic production line, intelligent factory, industry 4.0 and other modern production workshops. It is widely used in welding, painting, assembly, collection and placement, product detection and testing And other applications, its work has the advantages of high efficiency, durability, accuracy and so on. For a complex integrated system such as robot, if we can't identify and adjust these accuracy abnormal sources and faults effectively, the accuracy of the equipment will be seriously damaged, which requires on-line monitoring, diagnosis and maintenance of the machining process based on the manufacturing quality accuracy. The integrated platform of robot online monitoring and remote maintenance is a special measurement and control platform for robot operation status maintenance under the research hotspot of "equipment maintenance system based on remote diagnosis and status monitoring". In the research of robot typical fault on-line monitoring and operation maintenance theory, based on the time-varying stiffness stability prediction theory, the prediction on-line intelligent optimization control strategy is constructed.

Keywords

Robot; Online monitoring; Remote maintenance.

1. Introduction

As a kind of mechatronics system with complex structure, robot is composed of mechanical body, controller, driving system and sensor, which integrates the latest research results of mechanical engineering technology, automation technology, electronic engineering technology, information sensing technology and computer science and technology. It is based on the characteristics of multi-disciplinary integration of robots that the condition monitoring and fault diagnosis of various unavoidable faults in the operation and use of robots are the premise to ensure the efficient work of robots[1].

Germany launched the strategy of "industry 4.0", aiming to realize the interaction between machines and build "intelligent factory" and "intelligent production"[2]. The United States proposed the "roadmap of robot development in the United States" with the strategic goal of overcoming key technologies such as strong adaptability, autonomous navigation, education and training of robots[3]. Japan launched the "new robot strategy of Japan", and proposed to use data termination, networking, cloud computing and other technologies in the next generation of robots[4]. South Korea launched "robot future strategy 2022", aiming to promote local enterprises to enter the international market and seize the market share of international intelligent robots. In some special scientific experiments, robots are placed in the environment of high-intensity nuclear radiation, high-pressure deep sea, outer space, where human beings can not survive. Field operating robots have been unable to meet the needs of this kind of situation. The technical requirements of remote operating robots have been put forward. Therefore, the development of a set of robot remote monitoring and fault diagnosis system has become the development of industrial robots An important part of.

A series of advanced technologies, such as robot remote management, remote monitoring, remote expert diagnosis and so on, have been developed based on the network to realize the information exchange, diagnosis and maintenance of machining state with robot as the monitoring node[5]. The existing robot on-line monitoring and remote maintenance systems (such as abb, Everett, etc.) are based on self diagnosis and on-line monitoring of electrical information such as electromechanical system, PLC, position servo unit, other external devices connected to the actuator, so as to realize the fault identification of the robot. Due to the existence of technical barriers, it is impossible to promote technology on the open control system. In addition, in practical application, there are a lot of factors that affect the machining accuracy of the robot, such as the running state fault of the robot (such as the main board fault, photosensitive module fault, program running disorder, etc.) and the mechanical fault (such as the error is too large, mechanical fault, etc.), only the on-line monitoring, self diagnosis and remote maintenance functions of the mechanical and electrical system are used, so the above fault conditions cannot be refined A definite diagnosis. To build an online monitoring and remote maintenance system based on the network framework for the above fault information, to realize the centralized management and analysis of the operation status data of key equipment, diagnostic experts no longer spend a lot of time on various industrial sites, which will greatly improve the working efficiency of fault diagnosis, in order to fully grasp the operation status of the robot and realize the machine based on the manufacturing quality accuracy It provides a platform for engineering application. Furthermore, in view of the non-linear and complex influence factors of the physical state information such as robot running faults, the theory and method of accurate and rapid identification and intelligent maintenance strategy of various kinds of fault information are studied on this platform to ensure the high-precision and efficient operation of the robot.

Development of robot remote monitoring and maintenance system: Based on the remote diagnosis software interface of dh5936 online monitoring and acquisition system, the software development of remote online monitoring, fault diagnosis and maintenance system based on the typical fault diagnosis function of Visual C + + robot is carried out to realize the remote data acquisition control and data display of robot online monitoring unit. Build a remote maintenance system for robot fault monitoring and management under the network architecture, so that the equipment monitoring personnel in the remote monitoring center can run the client on the PC, control and diagnose the operation status of the equipment, and build an online robot monitoring and maintenance implementation strategy and integrated solution under the Internet architecture. Among them, the architecture of the robot dedicated online monitoring and remote maintenance system based on dh5936 online monitoring system is shown in Figure 1.

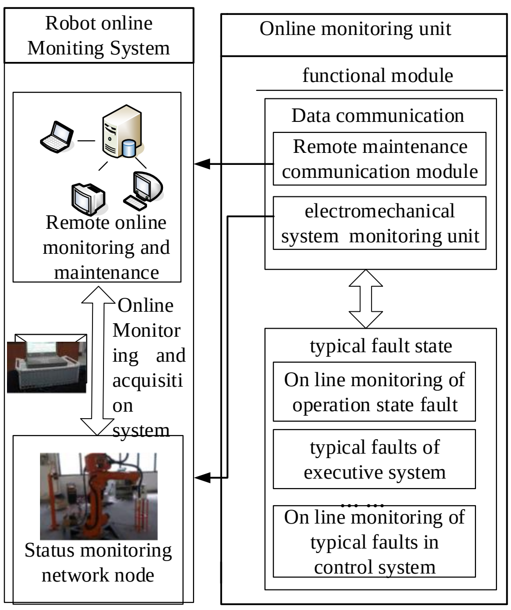

Fig. 1 Schematic diagram of Architecture

2. Architecture development

The architecture of multi robot remote monitoring system is the structure of how to connect individuals for diagnosis in order to achieve the predetermined behavior. It represents the long-term and static relationship mode of knowledge, information, control and other aspects among the elements in the system, and defines the responsibilities that each individual needs to perform in the system from a global perspective, that is, roles. Each robot can get a high-level view about the whole behavior of the system through the system architecture knowledge, which helps to guide the local control to achieve cooperation and enhance the global consistency of the system. Two point one control mode

2.1 Control Mode

The control methods of robot remote control system mainly include direct control, monitoring control and sharing control. Under direct control, the operator directly controls the remote robot with the help of predictive display technology and time-delay force feedback technology. In the way of monitoring and control, it mainly depends on the autonomous ability of the robot, excluding the time delay from the bottom control loop, and the operator can intervene the movement of the robot at any time as a part of the closed loop. According to the complementarity between the direct control and the monitoring control, the shared control method adopts the method of developing the advantages and avoiding the disadvantages, which not only allows the operator to directly operate and play his judgment and decision-making ability, but also ensures the robot has a certain degree of local autonomy.

At present, the robot is not completely autonomous, so the real-time monitoring of the whole system is necessary. There are two main functions of this layer. One is to provide the operator with the motion state information of multiple robots, including the internal and external sensor information, video information, and fault diagnosis information. When the unforeseen situation of the system makes the coordination control layer and the behavior control layer unable to solve, the system monitoring personnel can deal with exceptions, conflicts and deadlocks, for example, it can make the robot stop moving or return to its original position immediately. Second, through human-computer interaction, to establish the task model needed by users, and then to refine and decompose the task to determine each specific robot sub task in the system. This layer is divided into 8 functional modules as shown in Figure 2. The main functions of each module are as follows.

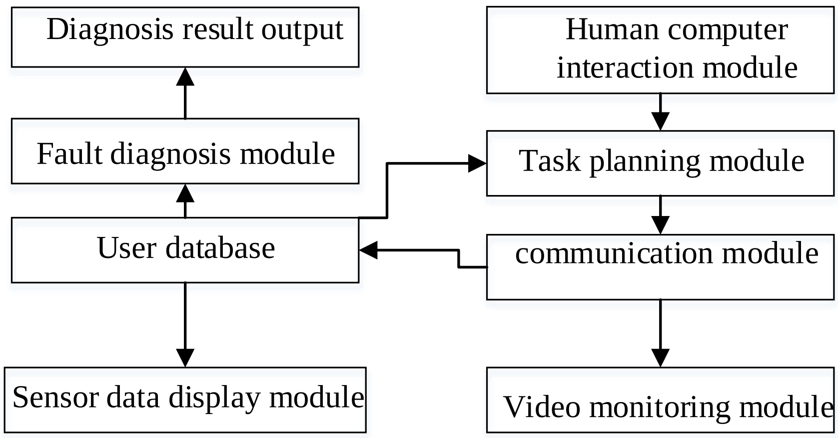

Fig. 2 Monitoring and diagnosis laye

1. Human computer interaction module. Receive the operator's command and indicate the system's conditions, and carry out some of the system's Basic information configuration (e.g. selection of interpolation method for each joint).

2. Task planning module. The system adopts the centralized task allocation method, and the task planning module is used to store.Bidding tasks from users are decomposed by certain ways based on

negotiation strategy and negotiation, The protocol realizes the dynamic assignment of tasks among robots, and sends the decomposed tasks to the communication module in a certain way.

3. Communication module. Information transmission between the monitoring terminal and each robot server is realized, including sub task assignment information, sensor information, video image, etc.

4 a user database. Including system status, user operation command, robot motion record and image record Record, sensor data, fault diagnosis results, etc.

5. Fault diagnosis module. Through a certain algorithm, real-time analysis of the sensor information on the robot can determine whether the robot has a failure. If there is a failure, give the failure type, and put forward suggestions to solve the failure

The fault diagnosis result is sent to the fault display module.

6. Sensor data display. Put the sensor data of the remote robot end in the form of curve or number

Real time display.

7. Video monitoring module. The video information of each robot is decompressed and displayed in the remote monitoring terminal.

8. Fault display and alarm module. Display the diagnosis result of the fault diagnosis module and give it when there is a fault alarm signal and display suggestions for troubleshooting.

3. The development of software platform of robot remote monitoring and fault maintenance system based on Network

3.1 Software Development

On the basis of the hardware platform, VC + + language is used to program the remote monitoring and coordinated control of the two arms. According to the existing personnel and technical conditions, purchase dh5936 online monitoring and acquisition system, network cable interface data acquisition card, 8-Channel signal conditioning module and industrial control main board, and build the hardware module of robot online monitoring system. Focus on the development of acquisition card drive application and online monitoring software function, complete the function of remote maintenance node, and provide the basis for the development of remote online monitoring and maintenance system. Based on the software interface provided by dh5936 online monitoring and acquisition system, the robot remote online monitoring and maintenance system is developed by VC + +, and the remote control function is mainly developed. The software is developed by the network driver provided by the data acquisition card, so as to realize the data acquisition control and corresponding monitoring and maintenance of specific nodes.

3.2 Software Implementation

The software of multi robot remote monitoring and coordination control system can be divided into client operation software and service,There are two parts in the operation software of the server, the operation software of the server includes three degrees of freedom fixed base robot operation software and six degrees of freedom movable base robot operation software. Remote client operation software includes human-computer interaction module, control instruction module, sensor data display module, and video monitoring module. On the one hand, the server operation software is responsible for communication with remote client, on the other hand, it can also carry out local control and video monitoring for individual robot. Through the operation of the software, users can input the motion parameters and instructions of the robot to control the motion of the remote robot. On the other hand, users can monitor the motion of the remote robot through the sensor curve and video screen.

4. Experimental Verification of Robot Remote Online Monitoring and Maintenance System

This paper analyzes the typical fault phenomenon and its causes in the process of robot operation, carries out experimental verification on the constructed system platform, and studies the integrated strategy method of online monitoring, prediction and control for the common fault control fault in operation. The specific implementation process shown in Figure 3 is as follows: the robot equipment collector logs in to the remote fault diagnosis center to set the monitoring task and parameters, communicates with the online monitoring system through the network drive interface of the signal acquisition module, the online monitoring system receives the measurement point and setting task, and carries out the online of key functional components through various sensors preset on the robot Monitoring and signal acquisition, data communication between the collected signal and the remote fault diagnosis center through the network drive interface uploaded by the data, real-time display, analysis and fault diagnosis of the signal by the collector and fault diagnosis expert in the remote fault diagnosis center, generation of fault report from the fault diagnosis conclusion and storage in the server through the remote fault diagnosis center Transmit the report file down with the data communication module of the online monitoring system, read and display the diagnosis report sent down to the online monitoring system, and repair the CNC machine according to the instructions. Through the implementation of the process, the applicability of the online monitoring and fault diagnosis system is verified.

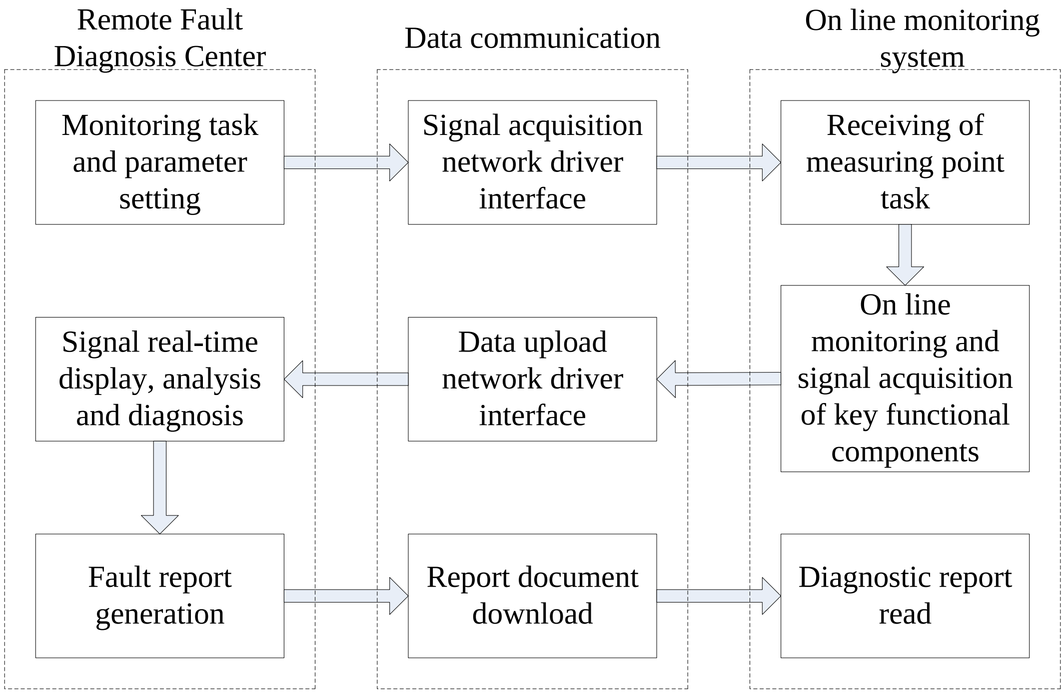

Fig. 3 specific implementation process

5. Conclusion

More and more network communication technology has been applied to people's production and life, and the reliability and stability of communication has been enhanced, which provides the basis for the development of robot remote monitoring and maintenance coordination control system based on network. This paper mainly studies the remote control of robot system in the network environment, the transmission of sensor data and video data, and the experimental verification of two existing robots in the laboratory.

The main work and achievements of this paper include the following:

1. Analyze and design the hierarchical system of multi robot remote monitoring and coordination control system based on Network

The corresponding physical platform is built by using the three degree of freedom manipulator and the six degree of freedom manipulator with movable base.

2. In the multi robot remote monitoring system, the operator is far away from the robot server and communication belt. Due to the wide limitation, the signal transmission delay between them becomes a prominent problem that affects the work of multi robot remote monitoring system. This delay will

reduce the stability and operability of the system. The problem of network delay is deeply analyzed, the research of special compensation algorithm and technology for transmission delay is beneficial to increase the transparency and sufficiency of remote control. Give full play to the operator's perception and judgment ability to improve the overall performance of the system.

Acknowledgements

This paper is supported by The University Program of Tianjin of Technology and Education (KJ1701); Graduate Innovation Fund Project of Research Department of Tianjin Vocational and Technology Normal University (YC19-09);

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