

Research on Intelligent Monitoring Technology of NC Machine Tool

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Abstract: The existing CNC machine monitoring system has some problems, such as low degree of network, long period of fault diagnosis, high maintenance cost and so on. With the development of mobile Internet technology, its application in industrial field is further deepened. Based on the author's study and practical experience, this paper first analyzed the advantages of intelligent monitoring system for NC machine tools based on GPS, and then put forward how to construct an intelligent monitoring system for NC machine tools based on GPS. Based on the GPS technology, this paper solved the difficulty of remote monitoring and control for NC machine tools with many intelligent devices, and provided some references for the intelligent management of NC machine tools.

1. Introduction

In recent years, the level of science and technology in China has been improved, which makes the application of artificial intelligence technology in various fields more and more extensive, and further promotes the development of intelligent manufacturing. The development of intelligent manufacturing mainly focuses on accurate control of automatic execution, automatic perception of information depth and intelligent automatic decision-making, so that intelligent manufacturing can form a reliable closed-loop operation through the functions of these three directions. Especially in the process of application of GPS technology, precise monitoring can be realized on the basis of the closed-loop system of "perception-analysis-decision-control-feedback", and the development process of intelligent monitoring and control of NC machine tools has been comprehensively promoted.

2. Advantages of Intelligent Monitoring System for NC Machine Tools Based on GPS

At present, most CNC machine tools in our country are equipped with corresponding data acquisition interfaces, but there are some shortcomings such as poor compatibility, poor flexibility, poor cross-platform, monotonous data display and lack of monitoring means. It is not only unfavorable to the maintenance and maintenance of NC machine tools, but also has great influence on the operation of NC machine tools. The application of intelligent monitoring technology in NC machine tools to realize remote monitoring and intelligent monitoring of CNC machine tools will further promote the development of intelligent manufacturing.

CPS oriented CNC machine tool monitoring system is a service-oriented architecture based on the strategy of CPS and combined with the characteristics of NC machine tool monitoring CPS. It can use computer and information according to the actual production requirements of NC machine tool. The correlation technology of CPS in network field realizes the monitoring of the basic state of NC machine tool, tool state, machining process.

On this basis, with the help of 3D visual reproduction of machining process, intelligent data analysis, abnormal warning and other related technologies, automatic tool changing and automatic compensation can be realized in the process of NC machine tool machining, and the control command can be issued if necessary to solve problems in machining process automatically. Therefore, compared with the traditional NC machine tool monitoring system, the intelligent monitoring system oriented to CPS has more real-time and vivid process monitoring, higher

autonomy and more accurate intelligent real-time control.

3. Construction of Intelligent Monitoring System of NC Machine Tool Based on GPS

3.1 System framework.

The intelligent monitoring system of NC machine tools based on GPS mainly includes the perceptual control layer, the network layer and the decision application layer. In the process of setting up, it is necessary to do well the functional design and data interaction of each level, so as to ensure the smooth realization of communication between layers. The details are shown in figure 1.

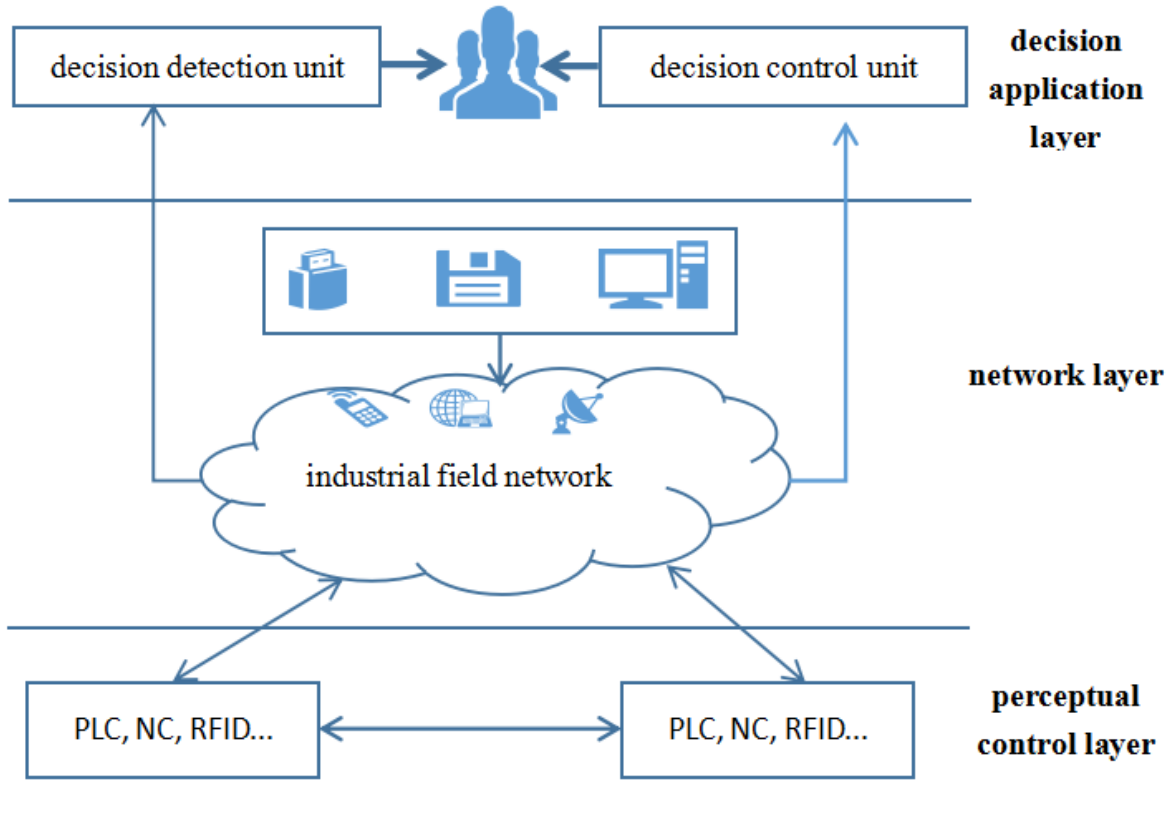


Fig. 1 Architecture of GPS intelligent monitoring system for NC machine tools

3.2 Perception control layer.

The perceptual control layer is the interaction point between CPS and the actual physical process of NC machine tools. In order to realize the effective fusion of information space and physical world, the perceptual control layer should not only have the basic functions of data acquisition and the execution of remote control instructions, but also have data cleaning, feature extraction and other intelligent application functions. Based on the above functions, this paper designed the information physical fusion middleware of NC machine tools as shown in figure 2, which includes controller, visual interface, command processor and application interface, device driver, data acquisition and management, communication service.

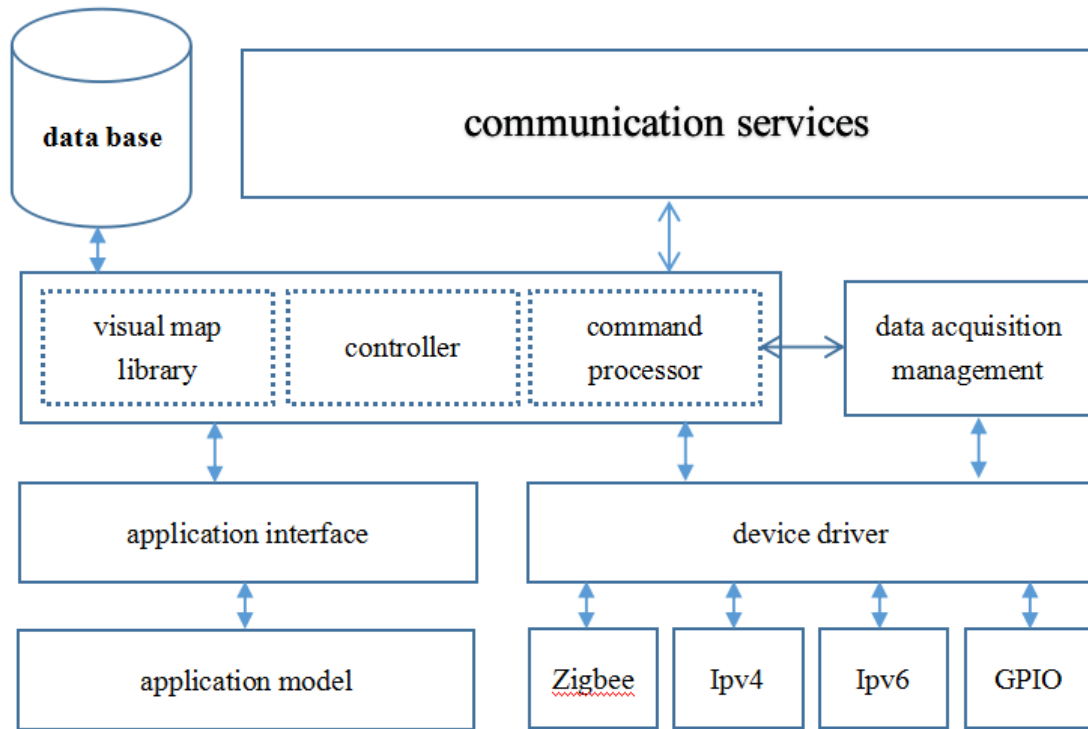


Figure 2 Perception layer structure

The management core part adopts the MVC design pattern. The controller directly manages the data, logic and related rules throughout the module. On the one hand, the real-time data collected is transformed into processing model or view command; On the other hand, the control instructions of the remote decision control unit are received and the process parameters of the machine are adjusted according to the instruction information, thus ensuring the timely management and control of the NC equipment. Visual graphic library provides a rich graphic library for operators. Operators can view real-time status information and remote control commands of CNC machine tools through man-machine interface and interact with CNC equipment. Command handlers provide all the operational commands of the middleware. On the one hand, device drivers are used to collect data on sensors, PLC, NC, RFID and other numerical control devices. On the other hand, it is used to realize the communication with other information physical fusion middleware. In order to realize the interconnection of heterogeneous networks, four kinds of main communication drivers, Zig-Bee, IPV4, IPV6 and GPIO, are designed in the device driver. The data acquisition and management unit is responsible for extracting the engineering data related to the workpiece from the device driver, such as processing parameters, sensor data and so on, and storing the data into the real-time database. The application interface calls the application model according to the user's demand, and provides intelligent application, such as feature extraction, data cleaning and so on. The communication service adopts lightweight, simple object access protocol based on XML. Compared with the traditional CNC equipment directly connected to the network layer, the information physical fusion middleware of NC machine tools can coordinate the networked CNC equipment more efficiently. On the one hand, by associating the related numerical control devices, the middleware can perform data redundancy processing and machine tool basic state evaluation in the LAN, thus reducing the bandwidth consumption of the network layer. On the other hand, the monitoring command of the network layer makes the production line more integrated and intelligent by coordinating and controlling the middleware instead of the discrete numerical control equipment, which provides the support for the small batch flexible production.

3.3 Network layer.

As the core of CPS architecture, the network layer provides real-time data sources and reliable data analysis results for the decision application layer, and provides massive data storage support

for the perceptual control layer. In the whole NC machine tool intelligent monitoring system operation, it plays the role of supporting platform. However, cloud platform has powerful computing power and storage ability by virtue of virtualization technology and network integration of distributed resources. Therefore, cloud platform is used to realize mass storage and intelligent analysis of processing information.

3.4 Decision application layer.

It is oriented to operators, and its main purpose is to realize the remote visual monitoring and intelligent control of NC machine tools. Therefore, the decision application layer mainly includes decision monitoring unit and decision control unit. The decision monitoring unit mainly includes online machining process simulation, 3D visual reproduction, customization report and chart, etc.. Visual reproduction technology can enable operators to monitor the current processing status of all networked machine tools, thus improving the perception and judgment of the operators on the whole process. The custom reports and charts are used to compare with the data estimated by the accounting department and the corresponding real-time data of the ERP system in order to meet the requirements of the customized production management. The decision control unit includes the virtual operating console of the machine tool, and the operator can carry on the auxiliary control operation to the netting machine tool according to the data analysis result provided by the decision monitoring unit. The control instructions are sent to the corresponding NC equipment through the network to realize the remote control of NC machine tools. At the same time, compared with the traditional NC system, the intelligent monitoring system of NC machine tool oriented to CPS also has the function of wireless network communication, which can be transmitted through PC, tablets or smart phone, so, each NC machine tool can become a node in the factory network and promote the process of unmanned production.

4. Conclusion

This paper studied the intelligent monitoring technology of NC machine, and the application of intelligent monitoring technology in monitoring data acquisition, storage, remote control and visual monitoring is discussed. Thus, the shortcomings of the previous monitoring methods have been effectively remedied, and the intelligent development of manufacturing field in China has been promoted.

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