The Research on Data Acquisition and Analysis Platform for Lathe Machine based on Stream Computing

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Abstract. Manufacturing industry is the main body of national economy, the foundation of building a country, the tool of rejuvenating a country and the foundation of a strong country. Lathe machine is the basis of manufacturing industry, which determines the level of intelligent manufacturing industry. This paper uses the real-time processing characteristics of stream computing to build a data acquisition and analysis platform for lathe machine. This platform monitors the efficiency of the equipment in real time, improve the utilization rate of the equipment, and improve the processing efficiency. The platform collects data in real time, analyses the data, and tracks the efficiency and process of the process, which is of great significance to optimize the process and improve production management.

1. Introduction

A new round of global industrial revolution is taking place, and the era of intelligent manufacturing or industry 4.0 is coming. The integrated development of new generation information and communication technology and manufacturing industry is the main theme of this round of technological revolution and industrial reform. The industry 4.0 promoted by Germany and other western developed countries, and it has brought severe challenges and major opportunities to the status of "world factory" for China. In 2015, "Made in China 2025" is firstly proposed in the government work report made by Chinese Primer Li Keqiang at the National People's Congress and the Chinese People's Political Consultative Conference [1]. In the same year, the guidance for actively promoting Internet plus action plan issued by the State Council of China puts forward promoting Internet plus application, especially in manufacturing industry, and enhances the level of digital network intelligent for manufacturing industry, and develops a new mode of collaborative manufacturing based on Internet. In 2016, the guiding opinion on deepening the integrated development of manufacturing industry and the Internet was issued. It proposed to promote the integration of manufacturing industry and the Internet, form the superposition effect, aggregation effect and multiplication effect, accelerate the transformation of new and old development momentum and production system, and realize the transformation from a big industrial country to a strong industrial country [2].

The acquisition and analysis for lathe machine is one of the factors which restrict the normal function. With the continuous development of technology, especially the emergence of the Internet of things, remote diagnosis of machine tools is becoming a reality. NB-IoT is a narrow-band technology, which is a low-power wide area network technology standard and has been widely used in industrial Internet [3].
Based on the development of the new generation of Internet of things technology, such as NB-IoT, data acquisition becomes more convenient and fast, which greatly promotes the development of machine tool data diagnosis technology. The existing storage space for acquired lathe data is small, the security is low, the data processing speed is slow, and the wireless operation distance is short. It is unable to achieve a large number of machine tool remote fault diagnosis. Based on the new generation of Internet of things technology and flow computing technology, this paper proposes a data acquisition and analysis platform for machine tools.

2. System Architecture
All kinds of sensors acquire the status information of lathe machine in real time. The sensors transmit the information to the edge computing node through the data communication interface (RS-232, Ethernet, NB-IoT). The edge computing node sends the pre-processing data to the cloud. The cloud analyzes the data and feeds back the results to the edge computing server, which optimizes the process and improves its production management, and the management personnel can view the running status and statistical data of the equipment in real time through the internal computer.

3. Data acquisition and analysis

3.1 Data acquisition
Data acquisition is mainly divided into two categories. One is the acquisition of lathe machine. Generally, the lathe machine will provide an interface through which data acquisition can be realized [4-5]. There

Figure 1. The system architecture
are intelligent and non-intelligent lathe machine. Even if they are intelligent, their interfaces are not the same. Second development is carried out for the equipment, interface and distribution of different manufacturers to realize data collection. The other is to add sensors to the machine equipment or equipment control cabinet to collect the environment, equipment, personnel and other information. The collected data is in the form of key value, which is obtained by different types of industrial sensors, such as photoelectric, thermal, gas, force, magnetic, acoustic and humidity sensors. The characteristic is that the volume of each record is low, but the frequency is very high.

Asynchronous serial communication interface is widely used in lathe machine to transmit data. The common interface standard is network interface or RS-232 communication interface. The equipment manufacturer will provide the corresponding external interface protocol, through which the real-time data of the equipment can be read directly from the equipment. These real-time data include program execution status, machine coordinates, a variety of internal variable values and switch control values.

For machining equipment with control system but protocol is not open or without control system, additional signal sensors (including video, sound, position, pressure and other sensors) are required to collect relevant state parameters of equipment operation through sampling instrument. At the same time, in order to track the real-time energy consumption of equipment processing, the current / voltage sensor is still needed for the machine without energy consumption sensor inside. Through wired, wireless, NB-IoT, Bluetooth and other ways to transmit data to edge computing nodes.

3.2 Data Storage
Data is stored in Hadoop cluster. Through the architecture of cluster storage system, an efficient and reasonable data organization system is realized to achieve the high reliability and data availability of the storage system [6]. The heterogeneous cluster storage system based on Hadoop uses the sensing algorithm of heterogeneous nodes to form a multi-layer storage area for the nodes in the cluster. By improving the distribution strategy of map reduce computing bottom layer, it can guide the task to focus on the nodes with excellent performance and optimize the energy marketing of Hadoop cluster.

3.3 Data analysis
Relying on the spark streaming platform, the architecture of the industrial management information platform is constructed. The efficiency and stability of the platform's industrial data mining are improved through learning algorithms such as fuzzy inference system parameter optimization and fuzzy rule mining. The operation monitoring and analysis platform of machine tool equipment forecasts common complex non-linear processes, and improves prediction algorithm and improves production efficiency. The system provides a unified API interface for the third-party software development and paves the way for the future function expansion.

4. The microservice for data visualization
The functions of operation, monitoring and display are provided by a series of micro services. Microservice is a kind of architecture style, which uses a group of atomic services as an independent application system. Each service runs in an independent process, and lightweight HTTP communication mechanism is used between services [7]. Spring cloud is based on spring boot, and it simplifies the development of distributed micro service infrastructure [8]. This paper constructs a series of data visualization services based on micro services.
The micro services of this platform include equipment operation efficiency, equipment status history, statistical analysis, operation dash-board, performance dash-board, etc. The operation efficiency of the equipment is to calculate the duration of different states and the operating conditions of the equipment through the signals of various states during the actual operation of the equipment. The overall equipment effectiveness (OEE) is calculated through the product quality information input by the user. OEE is the key indicator of the total productive maintenance (TPM) which can clearly understand the efficiency of the equipment and find out the production bottleneck. The equipment operation status history analysis automatically outputs long-term and short-term equipment status statistics data of various dimensions such as different time periods, different management units, different personnel responsibilities, etc., which is convenient for managers to grasp the equipment status in time, improve equipment management and maintenance methods, and improve equipment utilization. The statistical analysis and optimization is based on the monitoring of key parameters of the equipment, the statistical analysis and comparison with key process parameters, and the analysis results of processing parameters and parameter changes in different periods of the same equipment for the analysis and optimization of the process department. The equipment operation dash-board includes the operation status, including the startup, shutdown, no-load and full load status of the equipment. Display the energy consumption information such as the electric quantity (voltage, current, power) of the equipment. The equipment performance includes the start-up time, effective processing time and operation efficiency of the lathe machine.

5. Conclusion
Lathe machine have been widely used in the manufacturing process, but there are still a lot of manufacturing elements without information interface, and relevant manufacturing instructions and parameters cannot be issued and fed back quickly. The traditional manual release and feedback mode is prone to errors, high labor intensity and low efficiency. Based on this, the platform applies the IOT technology to build the IOT network for the interconnection of machine elements and realize the intellectualization of lathe machine. The platform supports a variety of non-intervention ways to obtain the status of the device without affecting the normal operation of the device. Improve production organization, and improve equipment utilization and production efficiency.

Acknowledgments
This study was supported by QingLan outstanding young teacher project of Jiangsu Province (grant number 201705), 333 talent project of Jiangsu Province (grant number 2018III1886), the shipping big data collaborative innovation center of Jiangsu Maritime Institute and the innovation technology funding of Jiangsu Maritime Institute.

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