Research on Remote Monitoring Based on Cloud for Electric Air Compressor of Rail Vehicle

Qingxuan Li1,a,*, Xuan Zhang2,b, Shangyi Xie3,c, Shixi Zhang4,d, Lihao Zhang5,e

1 Zhejiang Ruili air compressor equipment Co., Ltd Wenzhou 325200, China
2 Zhejiang Ruili air compressor equipment Co., Ltd Wenzhou 325200, China
3 Zhejiang Ruili air compressor equipment Co., Ltd Wenzhou 325200, China
4 Zhejiang Ruili air compressor equipment Co., Ltd Wenzhou 325200, China
5 Zhejiang Ruili air compressor equipment Co., Ltd Wenzhou 325200, China

Abstract: At present, there is no remote monitoring system for air compressors used in rail vehicles. Every time the vehicle is put into the warehouse, the inspector needs to check the appearance of the vehicle. So this kind of inspection method can only find out whether the surface is abnormal, Can not find out whether there is a problem inside the air compressor. In view of the above situation, the remote monitoring device is specially designed for air compressors used in rail transit industry to collect the dew point, temperature and air pressure of the output port of air compressors in real time, and send them to mobile phones and computers through cloud remote transmission, so as to detect whether there are abnormalities in air compressors in advance through data analysis, which is convenient for timely maintenance, reduce the risk of vehicle operation, and no personnel inspection when warehousing.

1. Introduction
Air compressor is widely used in all walks of life, operation and maintenance of service requirements are increasingly high, foreign products and new technology, so in the fierce market share of the first opportunity [1-2], is now the actual application of rail air compressor power supply, control start and stop, and no monitoring of the air compressor, in order to improve the reliability of product operation, we must add some remote monitoring system. At present, the domestic research on the monitoring method [3-5] of the air compressor is still in the initial stage, and on-site personnel are still required to check, fill in the inspection information and hand over the information. Generally, rail transit vehicles are put into storage at midnight, and inspectors are required to be on standby at midnight, so that the operation efficiency and reliability are low, and even the safety of inspectors is affected. It may also fail due to improper operation and other reasons, and the maintenance can not keep up with it, resulting in huge losses for a long time.

If the air compressor fails in operation and cannot be detected in advance, it will directly affect the braking safety. For example, the failure of the dryer causes a lot of moisture in the compressed sir, which causes the pipeline to freeze in winter.
At present, the technology at home and abroad is advancing by leaps and bounds, especially in the field of electronics and information technology, which provides the possibility for the air compressor to achieve remote monitoring. This Research is carries on the monitoring in the mobile network foundation, the sensor signal sends to the collection processing unit data through the DTU to transform into the wireless information, through GPRS and GDMA \ EVdo public mobile network wireless data transmission to the application layer monitoringcenter \[^{6-8}\], through information processing. Operators and manufacturers can log on to app software to view the corresponding information.

2. Structural logic:

2.1 System Architecture Building

The system is mainly composed of five layers: sensors (pressure, dew point, temperature), signal processing unit, signal transmitting unit, cloud server (signal receiving and processing), display (mobile phone, computer, etc.) Are installed on the rail vehicle air compressor.

Various sensors rapidly collect data in real time and feed the data back to the signal processing unit; the transmitting unit transmits the data to a cloud server by using a GPRS and CDMA/EVdo mobile communication network; and the cloud server is provided with a SCAda application server \[^9\] and an output storage library. For stored data curve records and real-time data curve viewing, manufacturers and operators can connect app to the Internet through mobile phones/computers. Through the data curve can understand the status of the air compressor on site, timely detection of problems, timely solution of problems, through data changes can also know whether normal maintenance is needed. The specific architecture is shown in the schematic diagram in Figure 1 below:

![Schematic Diagram](image)

Figure 1 Schematic

2.2 Design and Implementation of the System

The whole system is composed of five layers: sensor (pressure, dew point, temperature), signal processing unit, signal transmitting unit, cloud server (signal receiving and processing), terminal display (mobile phone, computer, etc.). The sensor is the source of the whole monitoring system and mainly realizes the real-time acquisition of compressed air information at the output end of the air compressor; the signal processing mainly receives the information of the sensor and processes and sends the information to the transmitting unit; the transmitting unit mainly receives the information of the processor and transmits the information; and the cloud server stores, analyzes, processes and sends the information. The software uses SQL Server 2008 R2 as the background database. The network layer of the system supports GPRS networking.
2.3 Data acquisition
Acquisition of sensor signals. According to the characteristics of the output signal, air compressor and the unit used by the sensor can be divided into the following types: ① Analog sensor. Converting the non-electric signals measured in the field into analog electric signals \[^{[10-11]}\]. The signal collected by it needs a/D conversion to realize the successful collection of the state parameters. ② The current sensing signal of the high-voltage motor is directly obtained from the remote signal transmission of the high-voltage control cabinet. ③ Switch sensor. When the measured signal reaches a certain set value, the sensor correspondingly outputs a passive dry contact signal.

2.4 network transmission
The transmission layer of the network transmission system is composed of the wireless network, which transmits the data of the bottom on-site air compressor to the cloud server reliably and safely, mainly in the form of GPRS and CDMA/EVdo networking \[^{[12]}\].

3. Research and development process:
Based on SQL Server 2008 R2 database, the system can realize the storage of large-capacity real-time and historical data, set query time, result query, data can be transferred when abnormal occurs, display data points, and switch test points. As shown in the function window shown in Figure 2 below:

Using C# language development, modular design, ease of system debugging, to maintain the flexibility and stability of the system.

As shown in the temperature monitoring picture as shown in Figure 3, the air pressure monitoring picture as shown in Figure 4 and the dew point monitoring picture in Figure 5, the curve and each data point changing from time to time are reflected.
Figure 3 Temperature monitoring screen

Figure 4 Air pressure monitoring screen
4. Conclusion:
Through the system sensor, signal processing unit, signal transmission unit, cloud server, terminal display and database design. So that the remote monitoring can always grasp the operation status of the air compressor is abnormal in advance, repair in advance, and reduce the risk of vehicle operation. When the vehicle is put into storage, there is no need for personnel to check the air compressor on site, so as to reduce energy consumption.

References:
[1] Liu Huibin, LI Xuehua. Integrated monitoring system design of hybrid air compressors [J]. Procedia Engineering, 2011 (15): 938-943.
[2] APREA C, MASTRULLO R, RENNO C. Fuzzy control of the compressor speed in a refrigeration plant [J]. International Journal of Refrigeration, 2004, 27(6).
[3] Cui Yang, Zhou Zekui, Shi Lilian. Remote monitoring system of multi-group air compressor unit based on PLC [J]. Compressor Technology, 2004 (1): 22-24.
[4] Rao Xin, Fang Jianan. Application of BP neural network in remote monitoring system of air compressor [J]. Industrial Control Computer, 2012, 25 (10).
[5] Yu Qin, Weng Zheng, Xin Su-cheng. Remote monitoring system of air compressor based on field bus and PLC [J]. Microcomputer Information, 2008, 24 (7): 1-3.
[6] Yellow-Green Grid. Application of GP R S DTU and Configuration Software in Remote Monitoring System of Oil Field [J]. Instrument and Meter Users, 2007, 14 (3): 59-60
[7] Liu Zhixiong, Yu Zhen, Chen Yanping. Communication Design of GPRS DTU Data Center [J]. Industrial Control Computer, 2007 (12): 23-24.

[8] Wang Yaoting, Guo Wencheng. Embedded Software Design of DTU Based on GPRS [J]. Instrument User, 2013 (5).

[9] Gao Dexin, Yang Qing, Liu Jun, et al. Communication between SCADA system and PLC using OPC interface [J]. Journal of Qingdao University of Science and Technology: Natural Science Edition, 2006, 27 (1): 66-69.

[10] Yuan Qing. Study on New Gas Sensors [D]. Hangzhou: Zhejiang University, 2008.

[11] Application of Aspen Software in Large Polyethylene Plant [J]. Synthetic Resins and Plastics, 2004, 21 (3): 43-47.

[12] Sun Y. Application and research of wifi and GPRS network in telemedicine [D]. Nanjing: Nanjing University of Posts and Telecommunications, 2013.