Real-time state monitoring and fault diagnosis system for motor based on LabVIEW

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ABSTRACT : Motor is the most widely used production equipment in industrial field. In order to realize the real-time state monitoring and multi-fault pre-diagnosis of three-phase motor, this paper presents a design of three-phase motor condition monitoring and fault diagnosis system based on LabVIEW.

The multi-dimensional vibration acceleration, rotational speed, temperature and current and voltage signals of the motor are collected with NI cDAQ acquisition equipment in real time and high speed. At the same time, the model of motor health state and fault state is established. The order analysis algorithm is used to process the original data at an advanced level, and the diagnosis and classification of different fault types are realized. The system is equipped with multi - channel acquisition , display , analysis and storage . Combined with the current cloud transmission technology, we will backup the data to the cloud to be used by other terminals.

INTRODUCTION

In today's manufacturing industries, mechanical and electromechanical systems are driven by electric motors on the premises . Any small fault occurred in a motor will led to complete motor failure if not addressed in time.

The key requirements of the status monitoring and fault diagnosis system are listed as follows:

1. Measure the real-time parameters of the motor, including triaxial acceleration, rotational speed, temperature, working current and voltage, at 1KSPS to 25 KSPS sampling rate per channel.
2. Process the raw data. After filtering and amplifying, the data can be transformed into actual physical quantities.
3. Display the actual parameters and status of the motor on the monitoring interface of the Industrial Personal Computer(IPC).
4. Analyze the critical status of each parameter and the specific fault source of motor by multiple analysis algorithm.
5. Archive all of data in the MySQL database on local and Ali cloud servers at intervals of 10ms.

SYSTEM IMPLEMENTATION

A. Hardware Structure

- **NI cDAQ 9188**:8-slot Ethernet chassis
- **NI 9211**:a 4-channel, ±80 MV C series temperature input board
- **NI 9205**:a 16-bit,32-channel C series voltage input card
- **NI 9232**:a 3-channel, 102.4 KSPS, sound and vibration input board

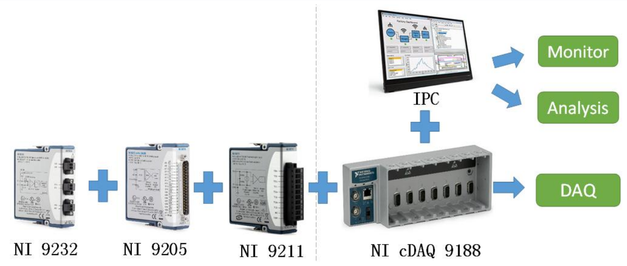

Fig.2. Hardware structure

B. Software Structure

The software is mainly based on LabVIEW, and its environments are listed as follows:

- **LabVIEW 2015**
- **MySQL 5.7.20**
- **Alibaba cloud server（Centos 7.3)**

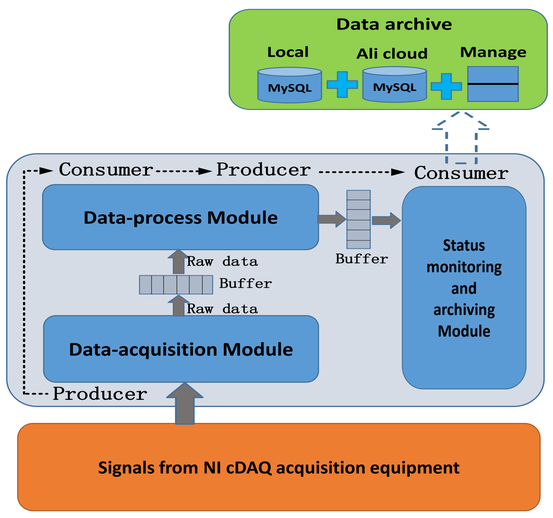

Fig.3. Software structure

Data flow is based on a two-tier producer and consumer framework, the software system is divided into three modules:

- **data acquisition module**
- **data processing module**
- **status monitoring and storage module**

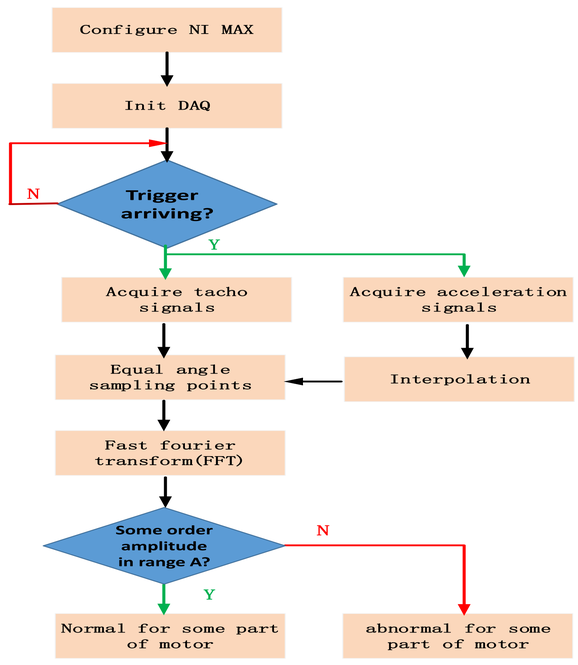

Fig.4. Work flow of order analysis algorithm

The data processing module mainly includes the following steps:

a) Filter by Butterworth low-pass filter
b) Amplify the filtered data
c) Obtain the resampling time point
d) Interpolate the data to the resampling time point
e) Fast Fourier Transform(FFT)
f) Analyse the amplitude of order

SUMMARY

- After two months of testing, the system basically meets the requirements of the system design.
- The function of real-time data acquisition and data processing and analysis runs stably.
- Next work, we will continue to perfect system functions and add multiple analysis algorithms.

Acknowledgements

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SYSTEM STRUCTURE

According to the above requirements, the status monitoring and fault diagnosis system includes the following functions:

- **Real-time Data Acquisition**
- **Data Processing and Analysis**
- **Status Monitoring and Archiving**

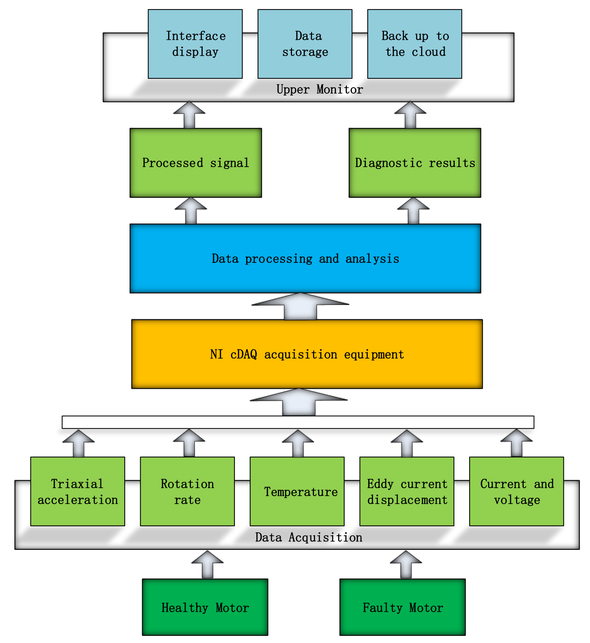

Fig.1. System architecture

RESULTS

A. Real-time data monitoring results

Fig.5. The monitoring interface of the system

- ✓ Test in March 2018
- ✓ Run steadily for two months
- ✓ Meet the requirements of system design

B. Fault diagnosis results

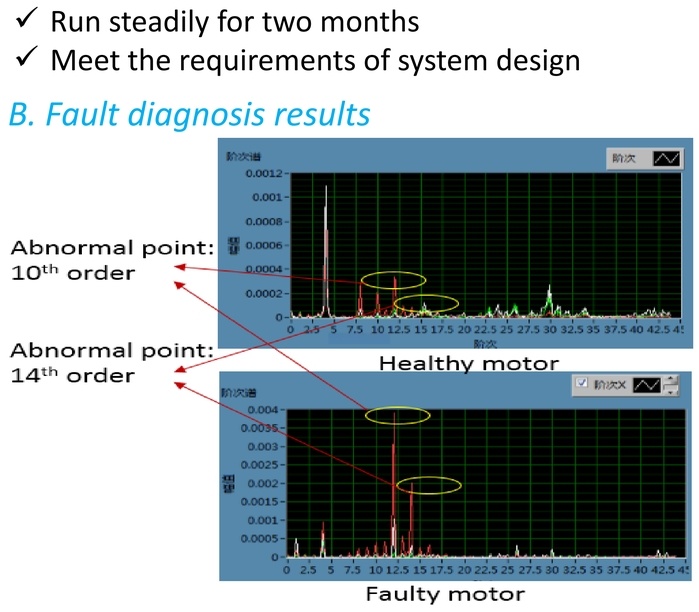

Fig.6. Order spectrum contrast graph

- There's a difference at the 10th and 14th orders
- This reflects a fault feature of the motor