Motor Parameter Measurement and Testing System Based on Labview

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***Abstract*-A motor parameter measurement and testing system based on virtual instruments and C8051F340 microcontroller is developed. This system can sample dynamic signals including each phase voltage, current, speed, torque, and temperature with a high-speed. USB 2.0 is used for transmission, and by application of LabVIEW, system can graphical display performance indicators when motor is running and realize data storage and management. It has certain significance for motor research.**

Keywords-Motor data acquisition, LabVIEW, USB2.0, Human-computer interaction

I. INTRODUCTION

With development of technology, relationship between motor and industrial production become more and more closely, and motor control requirements are increasing gradually [1]. So it is very important to test comprehensive performance parameters of motor. However, motor testing system based on traditional technology platform, which has been a long development period, high cost, low degree of automation, poor lack of portability and some other shortages[2].

At present, NI company introduced a powerful virtual instrument software — LabVIEW for automatic detection and control of complex systems. It can quickly collect data, realize data analysis and processing. It achieved hardware simulation through software [3].

Hence, a new motor detection system is proposed in this work, the whole process is organised as follow: First, we through microcontroller and related hardware to capture and conditioning motor parameters, then establishing friendly human-computer interaction system by USB protocol. At last ,LabVIEW is introduced in data analysing and processing.

II. HARDWARE DESIGN

Detection system is mainly consists of motor, MCU and related circuitry, USB communication interface and a computer with LabVIEW (hardware block diagram is shown in Figure 1). Measured system parameters includes phase voltage, current, speed, torque, and motor temperature signals. Corresponding parameters are detected by various sensors: current by current transformers and temperature by NTC thermistor, which are all analog signals, while speed is digital pulse signal instead. Then these signals will be processed by C8051F340 microcontroller[4][5].

C8051F series microcontrollers are developed by SILICON - LABS Company. These devices are fully integrated missed-signal System-on-a-Chip MCUs. It cosists high-speed pipelined 8051-compatible microcontroller core (up to 48MIPS), universal serial bus (USB) function controller, true 10-bit 200 ksps differential/single-ended ADC, precision internal calibrated 12MHz internal oscillator and 4x clock multiplier, up to 64 Kb of on-chip Flash memory, up to 4352 Bytes of on-chip RAM (256+4Kb), up to 40 Port I/O (5V tolerant). Therefore, designing of hardware interface are simplified and reliability of system is improved.

III. SOFTWARE DESIGN

PC software of system is developed based on LabVIEW 2010. Main features include: Set motor control parameters; Data acquisition and waveform display; Data analysis and management. Main process are as follows: first, computer communicates with microcontroller through USB interface, then processing real time data acquisition and use Access database for storage. Finally, data in database are transfered for analysising and processing[6]. PC program flow chart is shown in Figure 2.

A. USB host and USB device communication process

In order to facilitate USB interface application, system will use USB interface dedicated driver development package (USB—Xpress 3.11 Edition) which provided by SILICON-LABS Company. In PC application software development procedure, dedicated USB_api reference library will be used to efficiently develop USB interface program.

Host API is provided in form of a Windows Dynamic Link Library (DLL). Host interface DLL communicates with USB device via provided device driver and operating system's USB stack [7]. Following is a list of host API functions available:

SI_GetNumDevices—Returns number of devices connected；SI_CheckRXQueue—Returns number of bytes in a device's RX queue；SI_SetTimeouts—Sets read and write block timeouts； SI_Open—Opens a device and returns a handle；SI_Read—Reads a block of data from a device；SI_write—Writes a block of data to a device； SI_Close—Cancels pending IO and closes a device.

B. data ACQUISITION process

Data acquisition is to collate data transmitted from MCU and then deposited into Access database, so the "Database Connectivity Toolkit" provided by NI Company is adopted. MCU will send data of various performance parameters in form of an array. First we must index array in each batch to separate individual data, then get cluster

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binding in turns, finally enter them into "DB Tools Insert Data VI" block. This completes the processing of incoming data, then we apply relevant Database module to store data in Access database table which can be created by yourself [8]. Part of programming is shown in Figure 3.

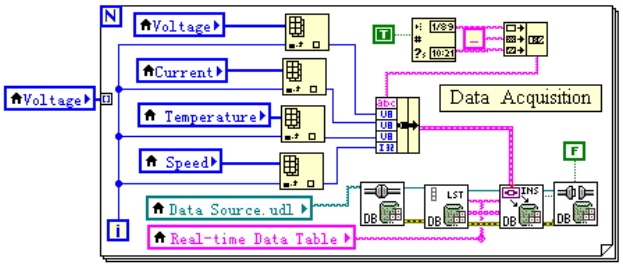

Figure 3. Data Acquisition

C. *data processing process*

1. Reading data. Data has been transformed into two tables in 2.2 (data acquisition process) and stored in database for data analysis. Real-time data table is used for real-time analysis, while historical data table for future calls and analysis [9]. Only need to input data source and table name can display data sheet. Part of programming is shown in Figure 4.

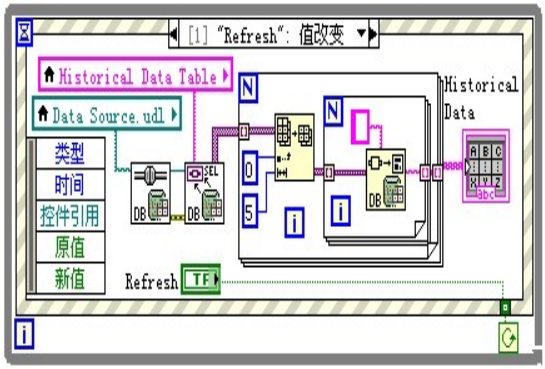

Figure 4. Data read

2. Remove and empty data. The way is to add SQL statements to SQL query port in "DB Tools Execute Query VI" module. Part of programming is shown in Figure 5.

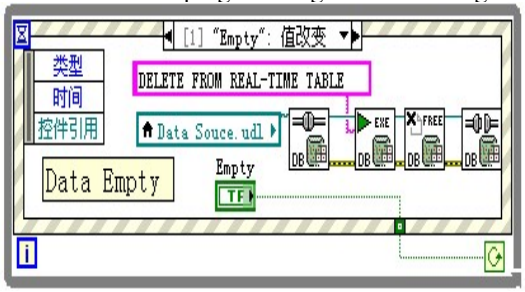

Figure 5. Data empty

3. Database compression. Records deleting does not reduce memory size of database file, even if all data are removed. This is because database in use for some time will occupy too much free space in database caused by data deleting. In order to save disk space, it is necessary to reduce allocation to database file and transaction log files. Part of programming is shown in Figure 6.

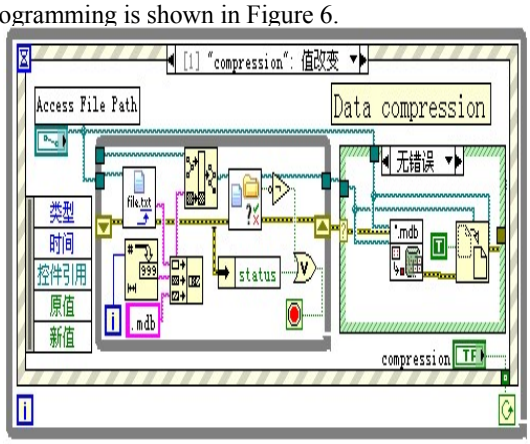

Figure 6. Data compression

D. *Experiment and Data*

Human-machine interface with normal operation of motor is shown in Figure 7. It can be seen from waveform that testing system operating in a stable state, computer and microcontroller have a normal communication. It not only realized waveform display, data storage, historical data query, results analysis and some other basic functions, but also have a friendly interface and easy to be operated.

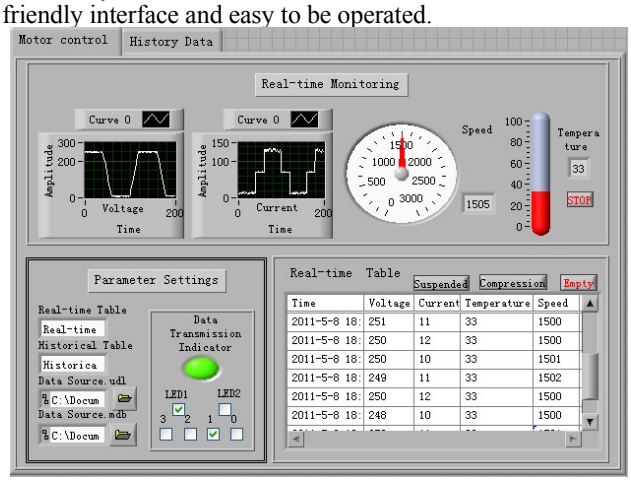

Figure 7. Human-machine interface

IV. CONCLUSION

Testing system through C8051F340 microcontroller and related hardware to collect and recuperate motor parameters, adopting USB protocol to establish a friendly human-machine interaction system with computer, realizes data analysis and processing by LabVIEW. It completes the sampling of dynamic signals including each phase voltage, current, speed, torque, and temperature with a high-speed, graphical display performance indicators. Moreover, data storage and management is achieved. Tested by experiment, the most significant advantages of this system are stable operation, low cost, simple operation, flexibility, short

development cycle and so on. Thus, it is valuable for motor research and has a market potential in the future.

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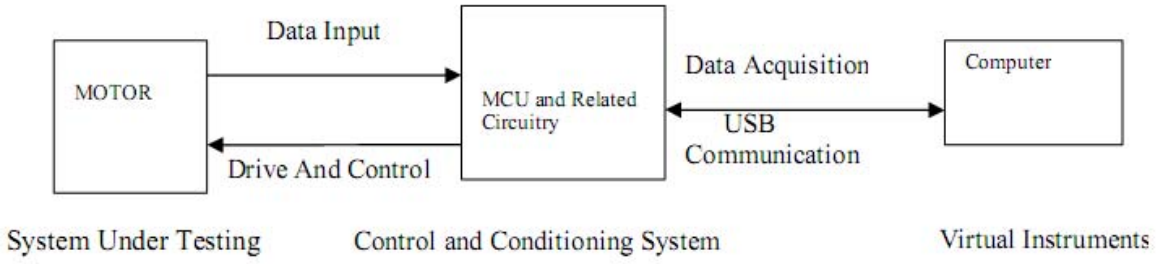

Figure 1. Test system hardware block diagram

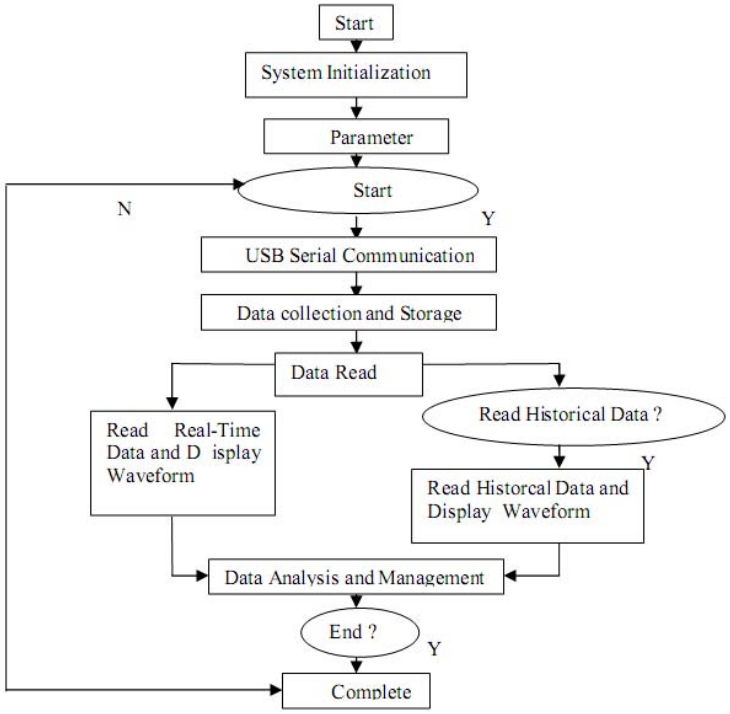

Figure 2. PC program flow chart