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Torque Sensor Data Acquisition System of Motor Test Bench Based on LabVIEW

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Abstract：Based on the existing hardware, a Torque sensor data acquisition system of motor test bench based on LabVIEW has been developed in this paper. This software uses a torque sensor for data acquisition and completes data receiving, processing and storing through the serial communication. Together with a torque sensor, a data acquisition system is thus developed.[1] It can collect and store the power, speed and torque information of the measured motor in real time, and then uses the data to analyze the operation characteristics of the permanent magnet synchronous motor to guide the motor optimization experiment.

Key words：LabVIEW software, serial communication, torque sensors, data acquisition

I. INTRODUCTION

In modern instrumentation systems, computers and instruments are tightly bound.[2] LabVIEW uses the visual technique of "to see is to get" to create a human computer interface. It provides a large number of objects in control instrument panel, such as the headers, knobs, charts etc..[3]

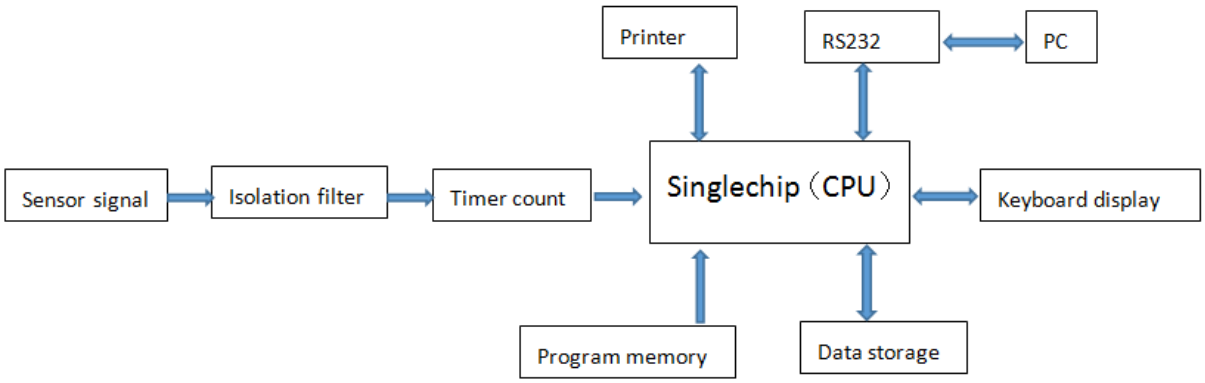
In this paper, with a LabVIEW programming software on your computer as a platform, the acquired data can easily be stored, analyzed and processed. LabVIEW is a virtual instrument software development platform based on graphical compiler language. Compared with the traditional programming language, the interface is more friendly and intuitive, and the data processing is more convenient and diversified.[4]This paper studies the signal of the torque sensor of the motor test bench, which is transmitted to the PC end of the LabVIEW platform through the RS-232 serial port for data processing, display and storing in real time. [5]

1 Hardware platform for data acquisition

A D-type torque sensor with 30 N·m torque range and 6000 rpm speed rang in a company, a computer. Torque sensor technology parameters are as follows:

Torque Accuracy : 0.1~0.5% F·S
Repeatability:0.1~0.5% F·S
Overload:150% F·S
Hysteresis:0.1~0.5% F·S
Linear:0.1~0.5% F·S
Insulation resistance:≥200MΩ
Operating temperature:-20~60℃
Relative humidity:≤90%RH

Instrument measuring microcontroller (CPU) of a data processing center, block diagram as follows:



II. SOFTWARE DESIGN OF DATA ACQUISITION SYSTEM

With NI's LabVIEW as a programming platform, the system mainly aims at realizing the following functions:[6]

（1）Receiving data transmitted by torque sensors, and analyzing and calculating based on the agreement.

（2）Displaying in real time the acquired instantaneous parameters in LabVIEW front panel.

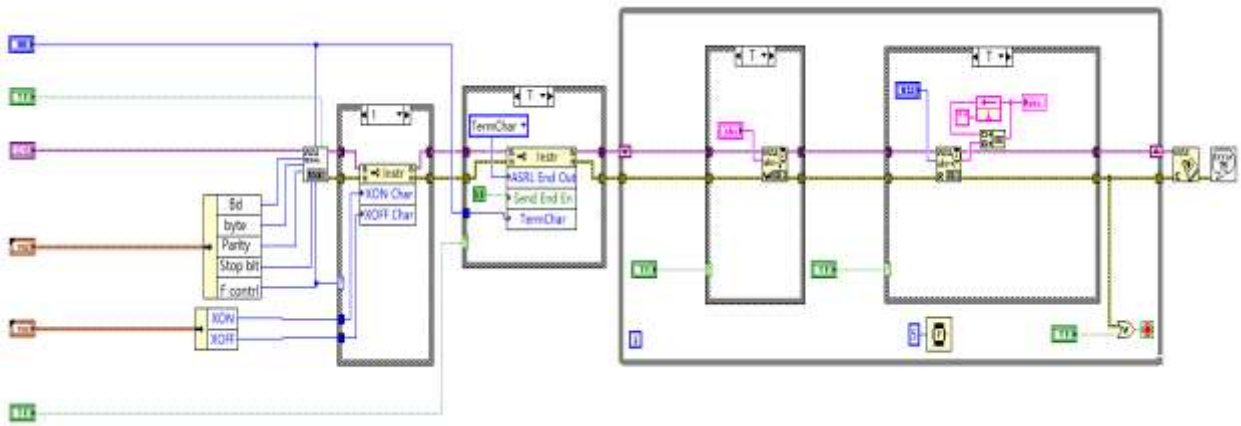
（3）Storing the parsed data.

After being transmitted to the computer by the torque sensor, the data needs to be received, parsed and stored afterwards, which is realized by the virtual instrument LabVIEW software programming. [7]

2.1 Serial connection module of the torque sensor and computer

A common program LabVIEW serial data connection is adopted with 2400Bd baud rate, 8 data bits, no parity bit, written in hexadecimal command 20H and 15 bytes each reading.

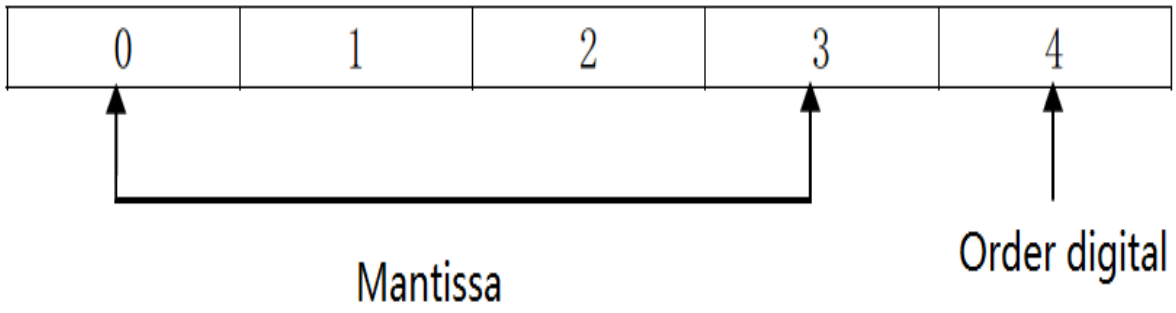
Program flow chart is as follows:



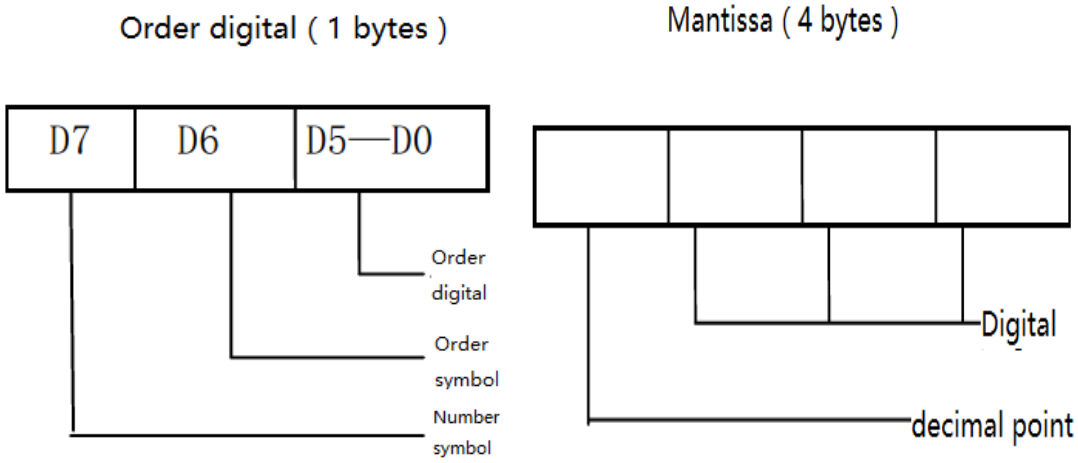
2.2 Parsing communication protocol to desired values

After receiving the commands sent by PC, the torque sensor will transmit, via BCD code, 15 bytes composed signals which include a speed signal, a torque signal and a power signal.

Each signal is sent as the following format shows:



Definition of floating point numbers using scientific notation, decimal point after the first BCD code, the composition structure of 5 bytes, the first four bytes mantissa, after a byte-order code, order code MSB number symbol , for the second high-order character ("0" represents a positive number, "1" represents a negative number), for the six low-order code value in the range of 0-63H

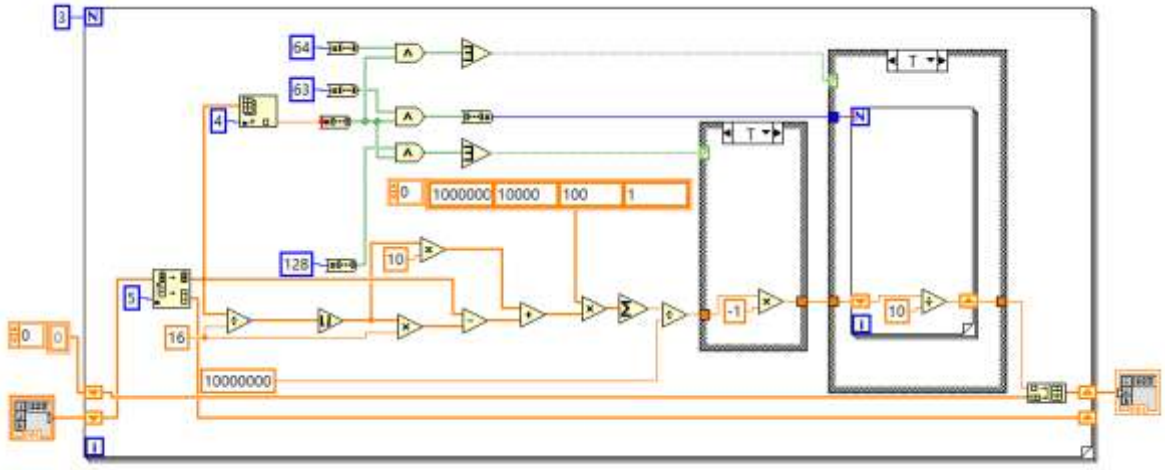


Example 1:

1234.5678=1.2345678*10^3

Received byte order12H 34H 56H 78H 03H

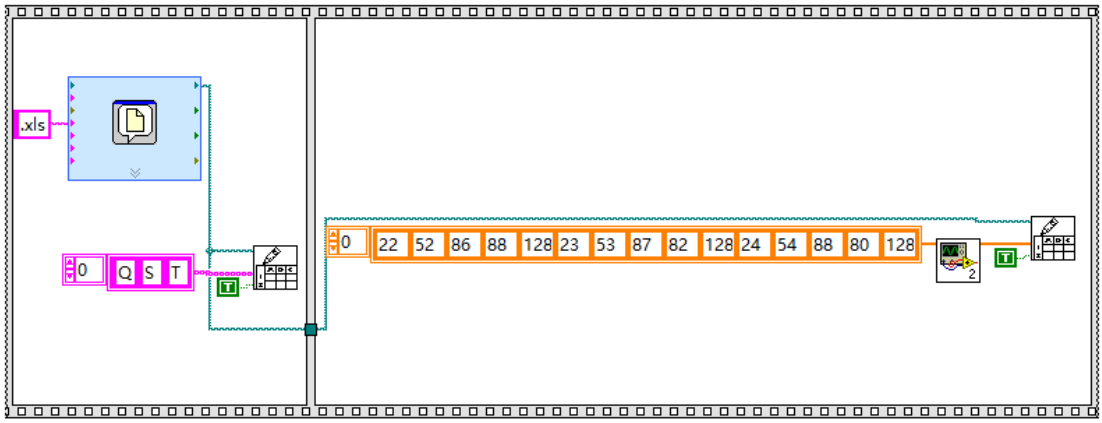
Program flow chart is as follows:



2.3 Storing the acquired values in real-time with the spreadsheet module excl table

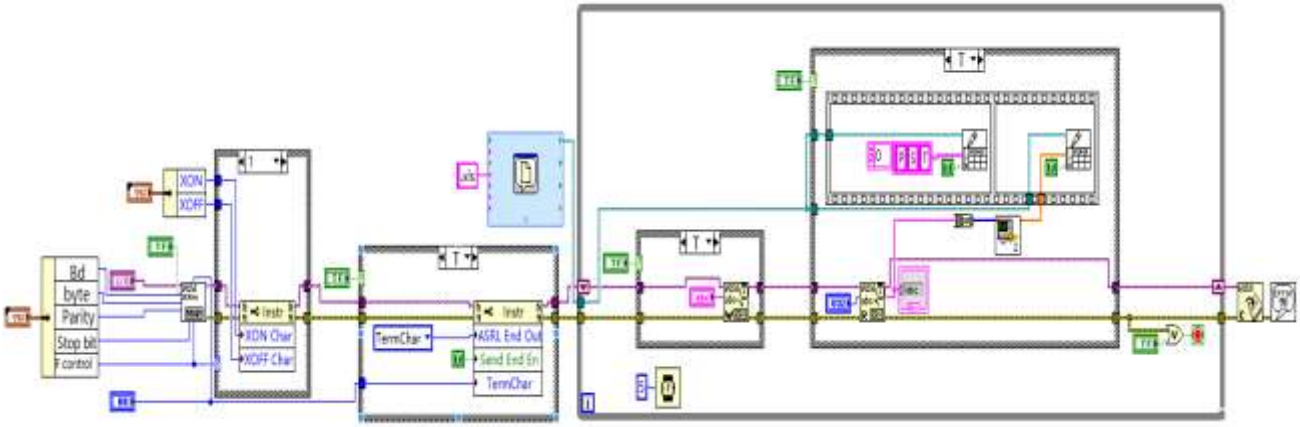
The three parsed values of power, speed and torque will be stored in the excl table named by the user with three value in each row in this module.

Program flow chart is as below:



2.4 The final LabVIEW program after integrating all modules together

Program flow chart is as follows:



III. SYSTEM DEBUGGING VERIFICATION

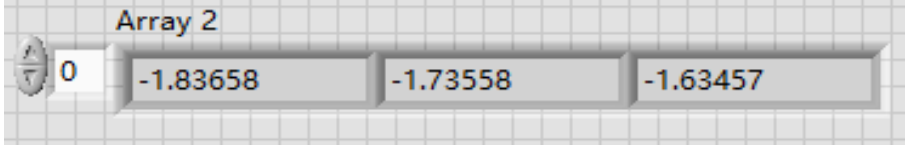
Running Lab VIEW program. The desired excel spreadsheet file is got in the continuous running of the program without any interruption or errors happening. The generated data goes in line with the original expected software structure with three signal values each row.

The data sent by the torque sensor is directly received through the serial port, which is processed by manual operation, and the result is within the allowable range of the experimental error.

Its verification process is as follows:

Serial port to receive the raw data:

Data processed by the software:



Original decimal data： 24 54 88 80 128 23 53 87 82 128 22 52 86 88 128

Raw hexadecimal data： 18H36H58H50H 17H35H57H52H 16H34H56H58H

Hand count data： -1.8365850 -1.7355752 -1.6345658

Data collection procedures：-1.83658 -1.73558 -1.63457

A positive value indicates the positive direction of the rotational torque sensor, a negative value indicates the torque sensor in the opposite direction of rotation.

The final data presentation is as follows:

I32 f_x

	A	B	C	D	E	F
1	P	S	T			
2	-1.83658	-1.73558	-1.63457			
3	-0.83658	-0.73558	-0.63457			
4	0.16342	0.26442	0.36543			
5	1.16342	1.26442	1.36543			
6	2.16342	2.26442	2.36543			
7	3.16342	3.26442	3.36543			
8	4.16342	4.26442	4.36543			
9	5.16342	5.26442	5.36543			
10	6.16342	6.26442	6.36543			
11	7.16342	7.26442	7.36543			
12	8.16342	8.26442	8.36543			
13	9.16342	9.26442	9.36543			
14	10.16342	10.26442	10.36543			
15	11.16342	11.26442	11.36543			
16	12.16342	12.26442	12.36543			
17	13.16342	13.26442	13.36543			
18	14.16342	14.26442	14.36543			
19	15.16342	15.26442	15.36543			
20	16.16342	16.26442	16.36543			
21	17.16342	17.26442	17.36543			
22	18.16342	18.26442	18.36543			
23	19.16342	19.26442	19.36543			

IV. CONCLUSION

It is the common desire of many engineers and technicians that the advanced instrument software LabVIEW could be well combined with common data collection,[8]whichis realized in this paper. With a result of no messing and bloating, the programs are written in strict accordance with the development process of software engineering theory throughout the whole process of the software development.[9]

Through the system debugging verification, the values processed by the software have been accurate to five decimal places, which indicates the accuracy and validity of the collected data has been verified.

Torque sensor data acquisition system can acquire and save the run-time parameters during the motor testing process, which contributes to the examining of the results of motor testing experiments, and the testing parameters can be optimized through the processing.

This paper has a relative strong practical reference for the study of data acquisition and processing of the torque sensor of the motor test bench.

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