Portable Elevator Integration of Multi-parameter Measurement Instrument Design

Pengfei Wang[1, a]*, Zonghua Li[1, b]

[1]Inner Mongolia autonomous region Special equipment inspection，
Hohhot，010031, China
[a]wangpengfei0210@126.com, [b]nmgtzsbjyydtb@126.com

Keywords: Portable, Multi-parameter, Elevator inspection.

Abstract. This paper introduced a portable elevator integration of multiple parameter measuring instrument, which can measure distance, resistance, voltage, current, rotation speed, linear speed, etc. and be easy to carry with a compact structure at the same time, providing a convenient, efficient, and fast testing instrument to the elevator safety inspection project.

Introduction

The safety of the elevator needless to say, but with the update of the elevator manufacturing technology, the elevator safety inspection standard and the inspection instruments, and with the high-speed increasing number of the elevator, the traditional testing method is time-consuming and need to carry much more test instruments, making the elevator inspection workers take a huge amount of labor and even have to adopt the method of extension of the test cycle. Objectively, it will cause certain security hidden danger. At the request of inspecting elevator rapidly, efficiently and in high quality, developing an elevator inspection instrument being portable and collecting a variety of test functions in it is urgent in the elevator inspection project.

Current research

In elevator installation, maintenance, inspection and other field, the speed detection device for detecting elevator speed, the clamp meter for checking whether the supplied voltage meet the elevator working conditions and doing the elevator balance coefficient test and the range finder for detecting the safe distance of the well head space and pit space are relatively mature researched in domestic and foreign and there are many types corresponding products. The clamp meter is mainly represented by Fluke, Japan SANWA, Japan HIOKI, Germany BEHA brand in foreign and Hong Huayi, Taiwan TES, Shenzhen Victory brand in domestic. The tachometer and other speedometer is mainly represented by Japan SANWA, Japan Kyoritsu KYORITSU, RHEINTACHO music of German, American and Mongolia Monarch brand in foreign and Dalian Laite, LUTRON / Lu Chang, the self-tester, SHIMPO electrical product brand in domestic. The range finder is mainly represented by Switzerland, Leica LEICADISTO, Bosch BOSCH, France Ake Tektronix Agatec in foreign and Puri measure, Hong Kong CEM, Huayi instrument MASTECH in domestic. In order to better adapt to the elevator technology development and promote the elevator operation security, the inspection and testing equipment of elevator associated components have been integrated and improved to a certain extent by domestic and foreign researchers to be portable and multifunction, such as escalators synchronization rate tester, escalators operating parameters tester, elevator or escalator mass analyzer, especially the EVA-625 Elevator comprehensive performance tester sold by the United States GP company, owning the EVA system and having a broadband response, it can

accurately quantify the acceleration and noise measurement data and diagnose the machinery and control elements of elevator and escalator systems, so that the defects and worn components can be identified before a failure occurs in the elevator. But above equipment is bulky, expensive, and not portable.

The design principles and basis

Portable elevator integration of multi-parameter measurement instrument design principle is that under the premise of in seeking compact structure and easy to carry, to integrate all the basic functions of common use tools of elevator safety inspection such as tachometer, speedometer, range finder, clamp meter etc. on a chip together to achieve a form of multi-parameter measurement function and easy to carry.

ARM is a dedicated computer system. It based on computer technology and has strict requirement to function, reliability, cost, size, power consumption, etc. It's software and hardware can be cut and easy to adapt to the application. It generally consists of embedded microprocessors, peripheral hardware devices, embedded operating systems and user applications, etc., used to monitor, manage, control other devices in real time. Same time, it is compact, highly integrated, powerful, rich in resources and cost performance. Having so much advantage, you can easily combine tachometer, speedometer, range finder and other instruments' functional modules into one.

The system Design

The overall structure design of the system. It uses embedded ARM chip as the master and uses "handheld PC with Test Master Box" as the basic architecture. It connects the test master box to sensors and collects each sensor signal to the master system, so it is high real-time and reliable. Collecting and analyzing various parameters by the master box, it communicates with handheld PC, realizing the upper machine instructions and the functions of the check and record test data. The overall structure of the system is shown in Fig. 1.

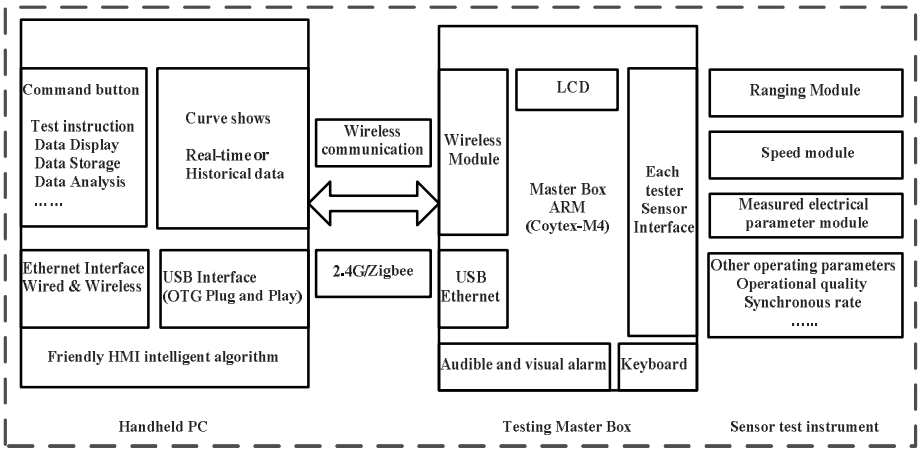

Fig. 1 The overall structure of the system

The master structure design of the system. Combined with both of the ARM development simple, abundant resources and powerful DSP signal processing capabilities, the master chip takes the STM32F4 chips of "Coytex-M4 + DSP" architecture. Owning rich IO interface, it's easy to develop a master circuit. The DSP module mainly responsible for monitoring management and network transmission system task by finishing the data storage, analysis, processing and letting the main processor ARM freed from the heavy calculations. Based on this design concept and developed the embedded data acquisition and processing system. It can not only accurately collect high-frequency

data signal, but also ensure the timeliness and accuracy of the calculation process and make the system is stable and reliable. The module block diagram of the master box function is shown in Fig. 2. The system mainly includes data acquisition and control, data transmission control, master-slave system and its peripheral device design, network transmission, the main processor ARM and DSP interface and other components. Considering the DSP' high speed, can increase data buffer between A / D conversion chip and DSP to match the relative low-speed and high-speed data acquisition devices DSP. So that try to use high-speed asynchronous FIFO to achieve live sensor data signal A / D conversion and signal extraction.

STM32F4xx adopts Harvard structure. It has higher speed of instructions, parallel flow technology, two level storage structure inside and outside, independent adder and multiplier, strong ability of floating point arithmetic than the traditional Von Neumann structure, greatly improving the overall speed. Taking STM32F4xx as a data processing core of the system, to start the AD conversion and read the sensor data, storage and calculate analysis, makes the data processing ability greatly increased.

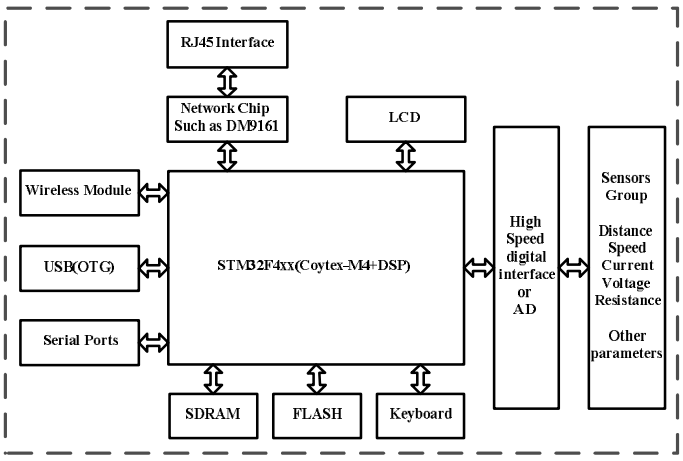

Fig. 2 The module block diagram of the master box function

The system function

Hardware installation. Depending on the test object, install the appropriate test equipment and these sensors are connected by respective interface circuit with the master box.

Testing process

Instructions issued. Upon completion of the hardware installation, instructions can be issued by a variety of ways:

The first, there are keyboard keys of the master box for selecting. You can individually detect the signal and you will have multiple choice.

The second, you can click the function button of the test interface of via handheld PC to issued test instructions. Then the instructions will be sent to the master box via wireless communication.

The third, with the master box and PC, you can make all the data to detect a specific type of elevator by pressing the combination function keys.

Under the instructions have be issued and accepted by the master box successfully, as soon as the master box issue the test command, the feedback Instructions will be show on the master box and PC.

Data collection. After the elevator began testing the conditions of operation, you can press the

start button to collect, receive and save data. When collecting data, if the default acquisition parameters are inappropriate, the sampling frequency, the test numbers and other parameters can also be changed. The same time, the main control system will save the collected data with making collection timing as a reference point. For different test parameters, may require different test time and operating mode, the system will separately and intelligently save them and give intelligent alert.

Data display. The real-time curve can be displayed according to the need during data acquisition and the historical data can be showed in the way of drawing after the test completed. In addition, handheld PC complete the real-time communication with the master box via 2.4G wireless communication.

Test analysis. After completing the testing process, the system can do some intelligent analysis for collected data and compare them with the reference value to make the biased parameters be highlighted or audible alarm if necessary. Through Ethernet or USB OTG, the testing data can be saved to the U disk and other removable storage for more in-depth analysis on a PC.

Summary

By studying the portable elevator integration of multi-parameter measurement instrument, it can be used to solve the disadvantage that the more types of previous elevator testing equipments are not easy to carry, to assemble, to disassemble and inconvenient to inspect in spot and to greatly facilitate the workers of elevator inspection units, construction and installation units and maintenance units for reducing their workload and improve their efficiency, so that the work of the elevator safety inspection and testing can be more rapid, efficient and with high quality.

References

[1] Yongwei Mu, The accident injuries and precaution during the elevator inspection process preventive measures, J. Zhejiang building. 2009, 26 (8): 70-72.

[2] Ming Gu, Shengxiao Guan, Guilin Huang, The research of elevator comprehensive detection system based on ARM11, J. Electronic Technology, 2013,3: 77-81.

[3] Zhe Tian, Embedded system development and application, M. Beijing, Beijing University of Aeronautics and Astronautics Press, 2005, 14～55.