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Design of multi-function sensor detection system in coal mine based on ARM

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Abstract. The traditional coal mine sensor in the specific measurement points, the number and type of channel will be greater than or less than the number of monitoring points, resulting in a waste of resources or cannot meet the application requirements, in order to enable the sensor to adapt to the needs of different occasions and reduce the cost, a kind of multi-functional intelligent sensor multiple sensors and ARM11 the S3C6410 processor is used to design and realize the dust, gas, temperature and humidity sensor functions together, and has storage, display, voice, pictures, data query, alarm and other new functions.

1 Introduction

In the safe production of coal mine, as monitoring the dust, gas, hydrology, drilling field and so on, we need to monitor the dust concentration, gas concentration, temperature, humidity, pressure, water quality and other physical quantities. The traditional detection system by separating components, the sensor detects the signal processed directly by the module performance, single function, each module is independent, but also to the specific measurement points, the number and type of channel will be greater than or less than the number of monitoring points, waste of resources or cannot meet the application demand. In order to enable the sensor to adapt to the needs of different occasions and reduce the cost, we need to design a kind of multifunctional sensor. The use of ARM microprocessor can realize software temperature compensation, DAC channel selection and data transfer to the host computer and other traditional sensor cannot be achieved, but also has storage, display, print, voice, data query, pictures, alarm and other new functions. It is of great significance to promote coal mine safety monitoring and ensure the health of the staff.

2 hardware system design

The whole hardware structure of the system includes the analog sensor interface, digital sensor interface, signal conditioning circuit, multi range A/D channel, RS485 interface and ARM11 S3C6410 as the core processor is composed of a central processing unit. the hardware structure of the system is shown in figure 1.

The switch quantity and digital quantity sensor can be connected with ARM directly or through isolation module. The analog output of analog sensor is programmed to amplify the circuit, then it is processed by A/D converter, and then converted to digital signal, and then transferred to the ARM processor. Through the logic control of the multiplexer switch, the microprocessor selects the corresponding sensors of each channel to realize the signal acquisition of different sensors at the same time. The sensor signal is transmitted to the host computer through USB serial port. The key and LCD driver circuit is used to realize the manual operation, data acquisition and status display.

In the hardware design, we select the OK6410 evaluation board of the new ARM11 processor of

Samsung Corp S3C6410. OK6410 evaluation board integrates many high-end interfaces, such as camera, USB, SD card, LCD screen, wireless network and temperature sensor. Feiling camera is on the plate, the camera interface in signal processing, but also increased the I^2C signal to the relevant parameters of the camera configuration. The board adopts high precision temperature sensor DS18B20, the evaluation board can be connected to the WiFi module, which can realize the function of the Internet, the interface can also be used to expand the SD. The TV output interface of evaluation board adopts 2 pin of Standard Specification, which can support the TFT 10inch LCD screen. Audio output and microphone input function is achieved by using AC97 I^2S bus and external WM9714 audio chip.

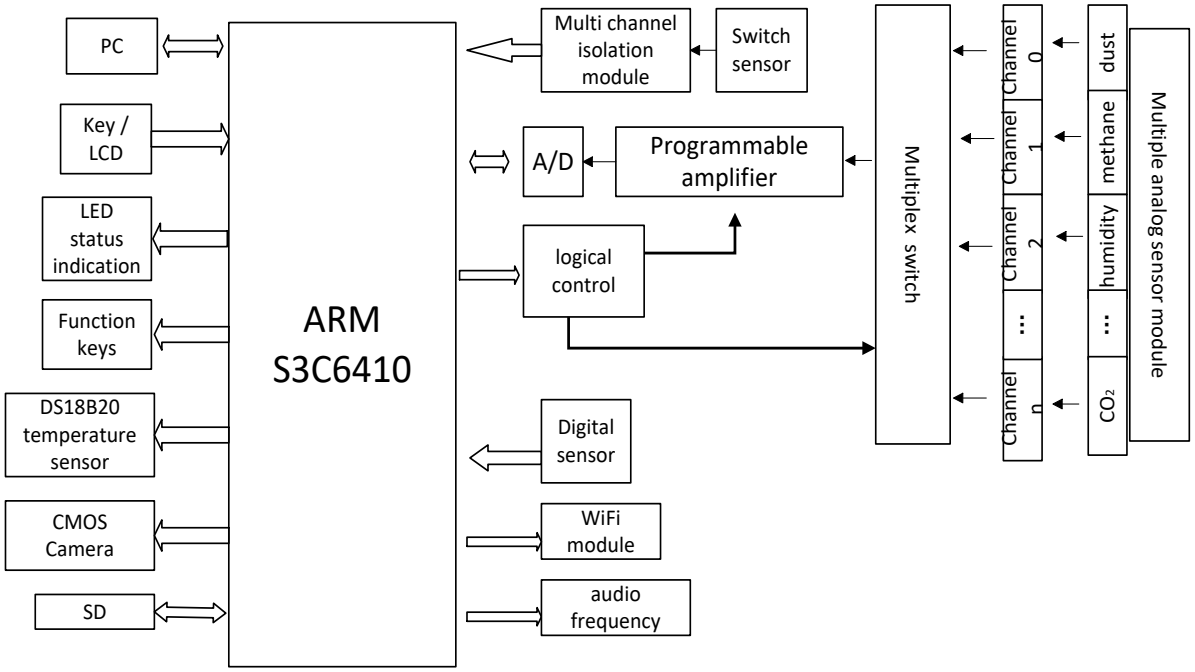

Figure 1 system hardware structure

3 system software design

The multifunctional intelligent sensor is designed by the method of modularization and structure. The main program module mainly completes the functions of self-checking, initialization, channel selection and the function of each module. According to the design of multi-function intelligent sensor detection system hardware, the design of the software part is divided into the lower computer software and PC software, Lower computer software program completes the initialization of the register, but also includes the programmable amplifying function of the keyboard, LCD program and analog to digital converter driver and differential signal. In the process of digital to analog conversion, also do the data operations of the average filtering and threshold filtering. In the data processing of the host computer, the program is realized by LabVIEW programming language. The interface of LABSQL and ACCESS data base is used to make each subroutine module to realize the function of receiving, storing, accessing and displaying the data. The software flow chart of the mine multifunctional intelligent sensor is shown in figure 2.

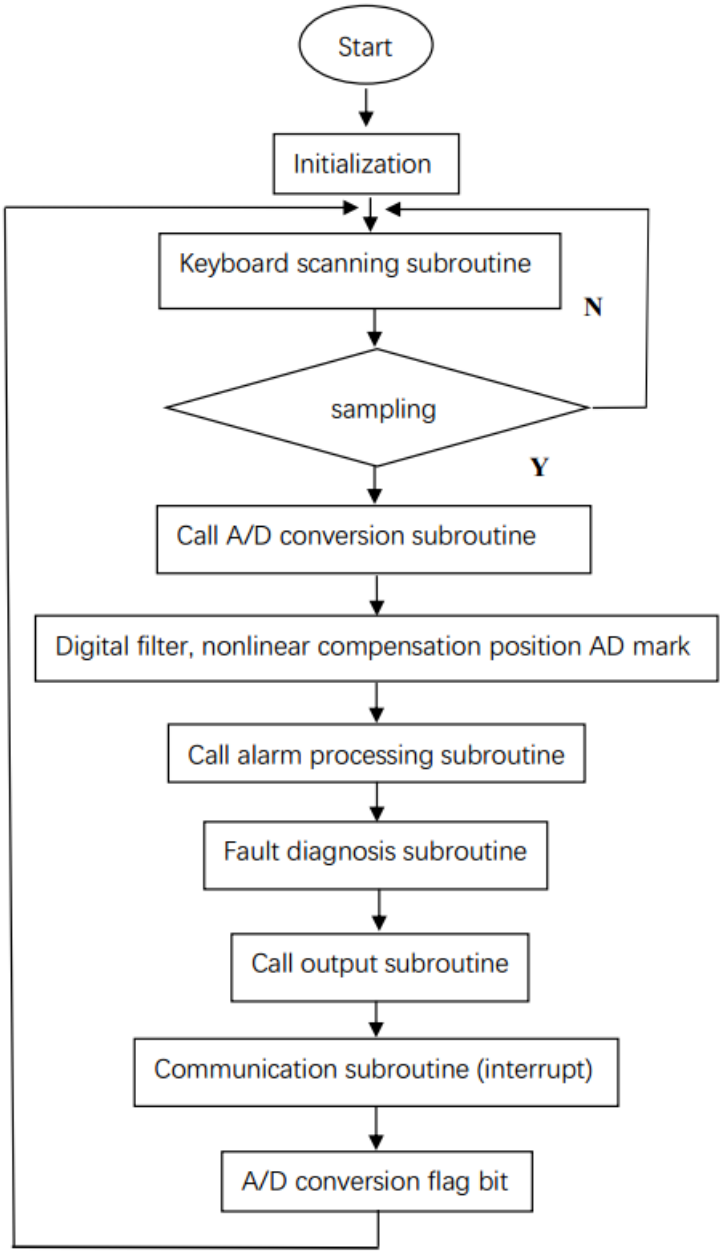

Figure2 software flow chart of mine multifunctional intelligent sensor

4 Systematic debugging

The measurement of gas sensor is chose to debug demo, mainly on the display and alarm parts presentation; input resistance value through the A/D input, display the corresponding concentration value, as shown in Table 1; the calculation error range is within an allowable error range, or adjust the sensor parameters. When the concentration exceeds the preset value, buzzer alarm.

Table 1: Comparison of methane concentration and measured value

	1	2	3	4	5	6	7
Input voltage value (V)	0	0.4125	0.66	0.825	1.2375	1.485	3.3
Actual value (%)	0	0.50000	0.8	1	1.5	1.8	4
Measured value (%)	0	0.49000	0.81302	1.00510	1.50000	1.81504	4

5 Conclusions

Multi-function intelligent sensor is a new research direction in the current development of sensor technology. At present, many scholars are actively engaged in the research work in this field. The multifunctional intelligent sensor in this paper which is based on the ARM system, can immediately detect the concentration of dust and gas, temperature and humidity, to change the single function of the traditional detection for measurement of multiple physical quantities, and has the storage, display, print, voice, data, pictures, alarm and other new query the function of intelligent mine, to meet the current requirements for instruments, is of great significance to the coal mine safety inspection.

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