A real-time substation's air quality monitoring system based on SCM

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Abstract

The paper designed a real-time substation's air quality monitoring system based on SCM, which takes 51 series STC89C52 to control the core, to use respectively DHT11 digital temperature and humidity sensors, Sharp GP2Y1010AU dust sensors and MQ138 formaldehyde gas sensors to collect humidity, temperature, PM2.5 concentration and formaldehyde gas concentration. Software part, using C language to take the development of the program in KEIL µVISION4 Software Development Platform. So we can pay real-time attention to changes of indoor air quality.

Keywords

Substation; air quality; dust sensors; formaldehyde gas sensors.

1. Overview of substation air quality

Because substation's small work environment, air of substation contained more pathogenic microorganisms, higher temperature, relative humidity, carbon dioxide (CO2), fine particulate matter (PM2.5) and formaldehyde (HCHO) concentration than the general environment, air pollution is terrible[1-2], so easily leading to cross-infection between people, due to prolonged imbalance in temperature and humidity, the concentration of carbon dioxide, PM2.5, excessive formaldehyde gas environment, physical discomfort, which can work in low efficiency. Therefore people began to realize the importance of the substation's air quality.

2. The overall scheme of the design

The design essence of the problem is the design of embedded systems, this involves two part's design of hardware circuit and software program , so while determining the overall program, we must achieve complete independence of both but balanced. So to use the idea of embedded system design(shown in Figure 1-1) to determine the overall program design of the subject[3-4], specific program is shown in Figure 1-2.

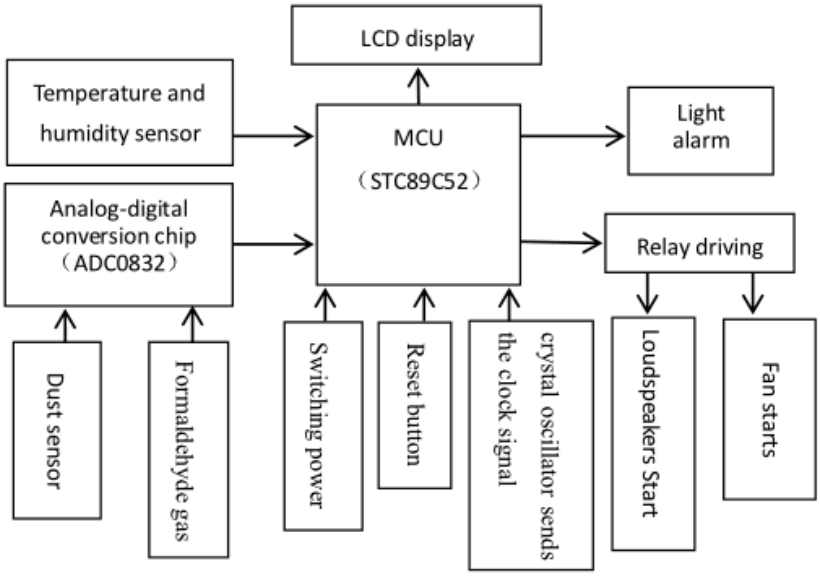

Fig1.The overall scheme

2.1 Formaldehyde gas sensor

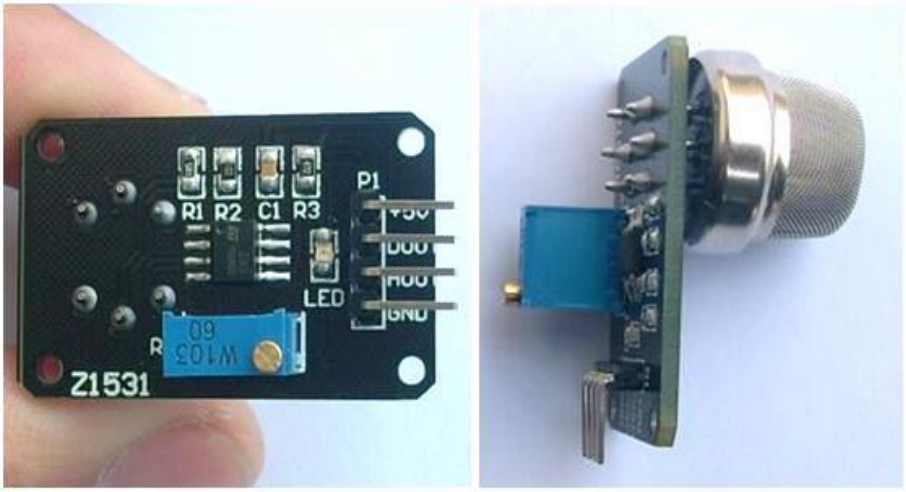

Fig 2.MQ138 formaldehyde gas sensor module

The gas sensor module of MQ series has many advantages: quick response and recovery, high sensitivity and wide detection range, especially that testing a circuit is easy. Suitable for detecting organic gases such as fuel gases and alcohols, aldehydes, aromatic compounds ect. Formaldehyde gas sensors of MQ-138 are formed on a stainless steel chamber by the Sensitive element made up by formaldehyde sensitive layer, a ceramic tube,detection electrode and current heater .the encapsulation of the sensormodule has four pins, including two used to take for analog and digital signals, and the other two for supplying heating current. in order to complexes analog-digital conversion chip of ADC0832, The paper use the analog signal to output.

2.2 PM2.5 dust sensor

Japan's Sharp Corporation's GP2Y1010AU dust sensors with advantages of small size, high sensitivity, high accuracy, good stability, easy installation and maintenance and a long service life, etc. They can be used to detect particles larger than 0.8μm, are widely used in indoor dust, pollen, dust, smoke and other concentration detection, the appearance is shown in FIG3.The biggest feature of the sensor is the built-in flow generator, so that the outside air can be sucked into by themselves up to date environmental data.

Fig3 .GP2Y1010AU0F dust senor

3. The overall design of software programs

For the entire system, the design adopted modular ideas programming, so you can completely combine the software program code together. First, to define necessary header files, MCU I / O port variables,global variables,write the main function; Secondly, to write subroutines of each module, to do the right subroutine call in the main function; finally, inspect procedures' logical errors, and to

check grammar errors by KEIL µVISION4 C51 software, constant compiling debugging, and ultimately achieve the effect of"0 error (s), 0 Warning (s)." The overall design scheme shown in Figure 4.

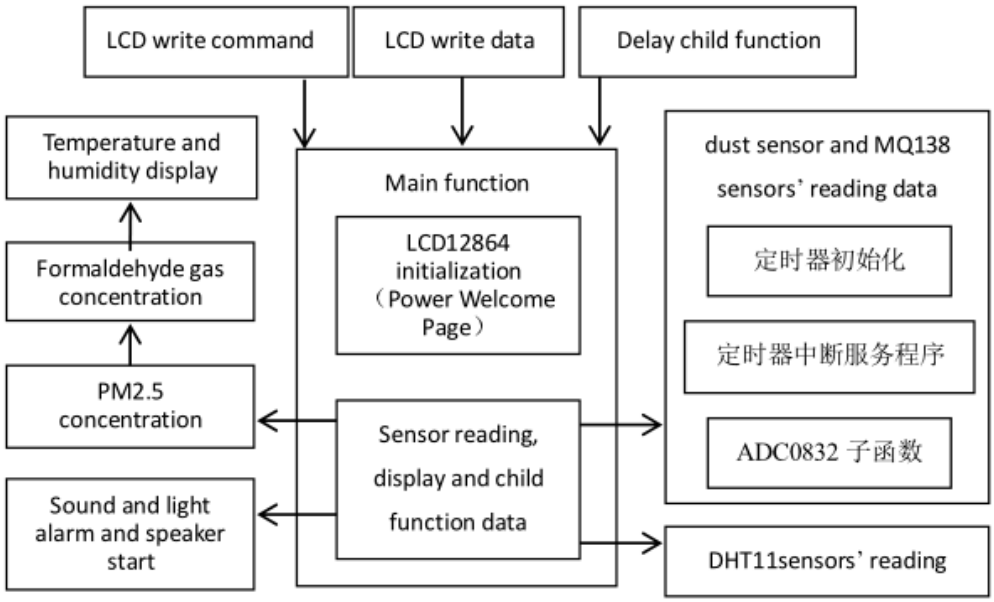

Fig 4.The overall design scheme

4. Conclusion

For hardware design part,choose to purchase the required electrical components and to build the hardware circuit. Among them, the three sensors is particularly important, they are the core components of system functions, the design selected DHT11 digital temperature and humidity sensor,Japan's Sharp Corporation's dust sensor GP2Y1010AU, the reason why formaldehyde gas sensor chose MQ series gas sensor module is that the series sensor module's good commonality and ease of use.

For software design, using C language programming in Keil uVision4 C51 microcontroller software development platform. Modular programming can make the whole software design ideas clear.Among, the sensors' data reading is the most important,it,analog to digit conversion and timer interrupt subroutine must be called reasonably.

The design mainly emphasises on practicality and humanity, in the substation, the medical staff and patients can visually see the indoor air quality through the man-machine interaction face. The design can also be used to develop air purifier or the new kind of air conditioning, they embedded the design can not only control temperature and humidity , but also detect the concentration of PM2.5 and formaldehyde gas concentration in the air, and improve quality of air by controlling the "Fan Module" .

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