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The intelligent weather station system based on Arduino

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KEYWORD: Arduino Uno; Temperature and humidity sensor; Air pressure altitude sensor; LCD12864；APC220

ABSTRACT: Weather information is relevant to people's life, but also directly affects the development of all walks of life. So, how to quickly effective monitoring meteorological information is an important research aspect of contemporary society in the development of science and technology. This design was based on the Arduino open source hardware platform as the core digital processor. It used temperature & humidity sensor and atmospheric pressure sensor to collect environmental temperature and humidity and air pressure elevation information, and can get the current date and time by the clock module. This system can not only display the detection environment information on the LCD module, and can through the wireless module upload this information to PC. The whole system has the characteristic, of low cost, lower power consumption and higher collection speed. It not only can be used to detect stable family environment, can also be used in complex environment, such as industrial and agricultural information monitoring.

1 GENERAL INSTRUCTIONS

In recent years, with the development of industry, the environment conditions worsened day by day, human’s demand for understanding surrounding environment information is more and more urgent.[1] With the rapid development of science and technology level, the computer level and monitoring detection capability is increasing day by day, all kinds of monitoring method is also changing, the intelligent weather station which uses Arduino as main control chip has the characteristics of low cost and strong practicability, gradually by the attention of people.

This paper designed a set of intelligent weather station system based on Arduino UNO. this system was not only available to monitor data of environment temperature and humidity and air pressure elevation , and could be able to use wireless module to transmit the environmental information to the PC surveillance terminal, realize the real-time monitoring.

2 THE OVERALL SYSTEM DESIGN

Intelligent weather station system designed in this paper only measure the environment information of temperature, humidity and air pressure altitude, system structure is shown in figure 1. Its core processor is open source software and hardware platform of the Arduino Uno, and uses temperature and humidity sensor, atmospheric pressure sensor to collect environmental information and gets the current date and time by clock module. After that, the system displays the collected meteorological information and date on the LCD, and then sends through the wireless module in a timely manner to the upper computer.

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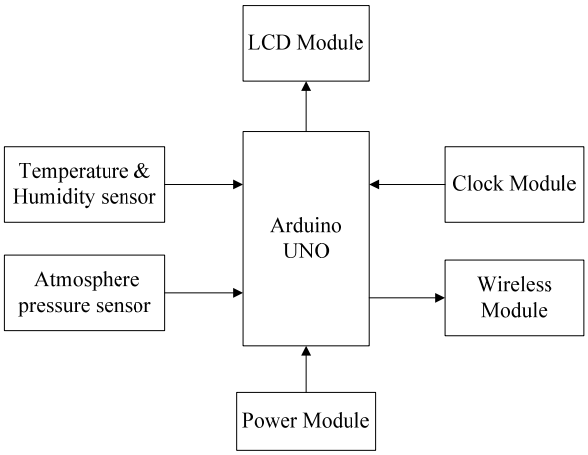
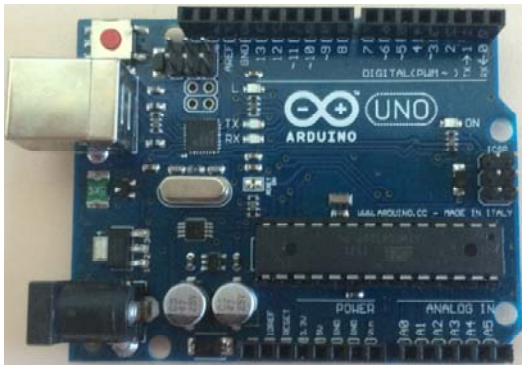


Figure 1. The diagram of hardware connection

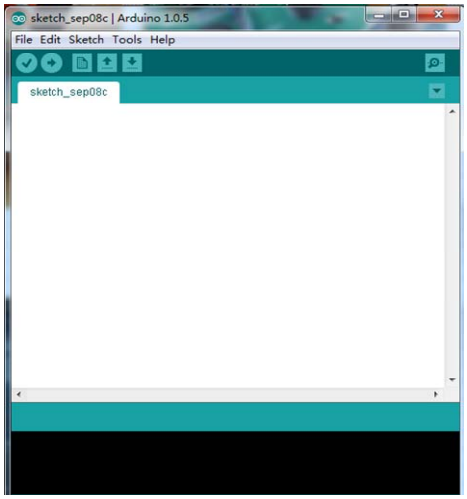
3 INTRODUCTION OF THE SYSTEM HARDWARE

3.1 *Arduino Uno*

Arduino is a family of microcontrollers (tiny computers) and a software creation environment that makes it easy for you to create programs (called sketches) that can interact with the physical world. [2] Arduino Uno is currently the most widely used Arduino controller, with all the Arduino function.[3]On the board, there are 14 digital pins (numbered 0 to 13) and 6 analog pins(numbered A0 to A5) as shown in figure 2(a). Pins 0 and 1 (marked RX and TX) are used for the USB serial connection and should be avoided for other uses. If you need more digital pins on a standard board, you can use the analog pins as digital pins.



(a) Arduino Uno



(b) Arduino IDE

Figure 2. Arduino Uno and Arduino IDE

3.2 *The digital temperature and humidity sensor*

After comprehensive consideration, the digital temperature and humidity sensor DHT22 is chosen as the temperature and the humidity module, as shown in figure 3. It is a temperature and humidity combination sensor which has calibrated digital signal output, takes up the digital I/O of Arduino Uno. The connection between DHT22 and Arduino Uno is shown in the figure below.

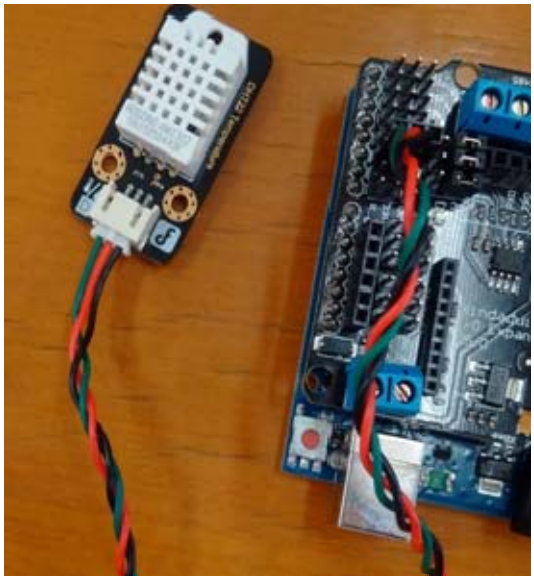


Figure 3 DHT22 connection diagram with the Arduino

3.3 *The atmospheric pressure sensor*

The atmospheric pressure sensor BMP085 is chosen as the Air pressure and elevation detection module. The acquisition signal of BMP085 is analog signal, so it takes up the analog pin of controller. Its power supply voltage is 3.3 V, so we need to pay attention to the power supply voltage when using this chip, cannot use 5 V power supply, otherwise it will burn out.
Figure 4 is the diagram of BMP085 pin. In this design, we did not use the pin of EOC and XCLR, just need to connect the pin of SDA and SCL with the A4 and A5 of Arduino, VCC connected to 3.3 V power supply pin, as shown in figure 5.

Figure 4. The pins of BMP085

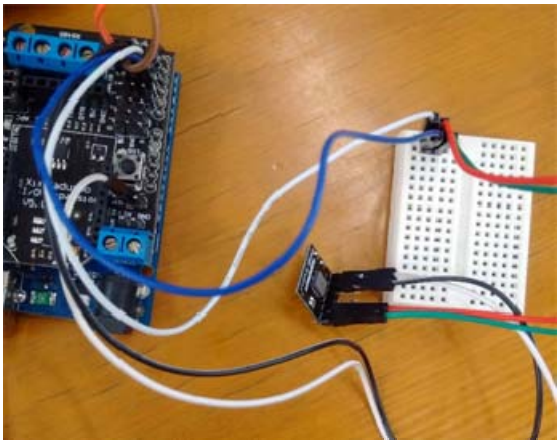


Figure 5. The connection between BMP085 and Arduino

3.4 *The clock module*

DS3231 chip is the clock module in this design. The chip can be continuous electricity because it is built-in battery, so we can ensure the continuity of time. Because of this module is analog signal, so in order to guarantee the consistency of the data acquisition and timing functions , it is consistent with the pin connection of pressure sensor. The wiring diagram is shown in figure 6.

Before starting to use, you need to write a adjust program which will set the initial time of the DS3231 clock module to ensure the chip time is consistent with the current time. For example, we can set the initial time to "on May 9, 2016, 12 o 'clock 0 seconds to 1 minute, Monday", the program implementation is:

```
Char weekday[][4]={“Sun”,”Mon”,”Tue”,”Wed”,
”Thu”,”Fri”,”Sat”};
DateTime dt(2016,5,9,12,1,0,1);
```

After the adjust program is downloaded in the Arduino Uno chip, the controller works well and the time is totally correct, as shown in figure 7, which shows that the clock module initial settings successfully, it can normal work.

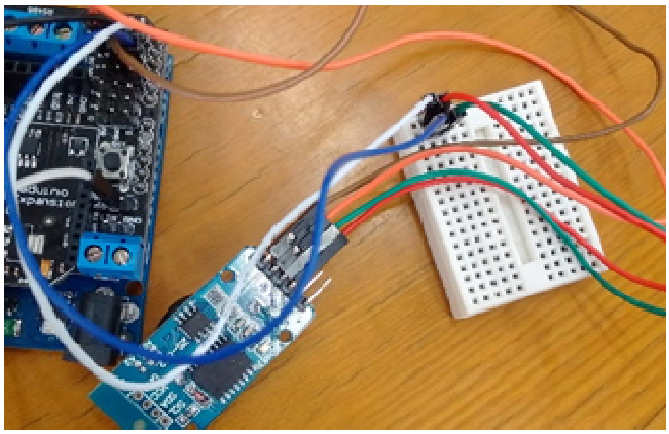


Figure 6 The connection between DS3231 and Arduino

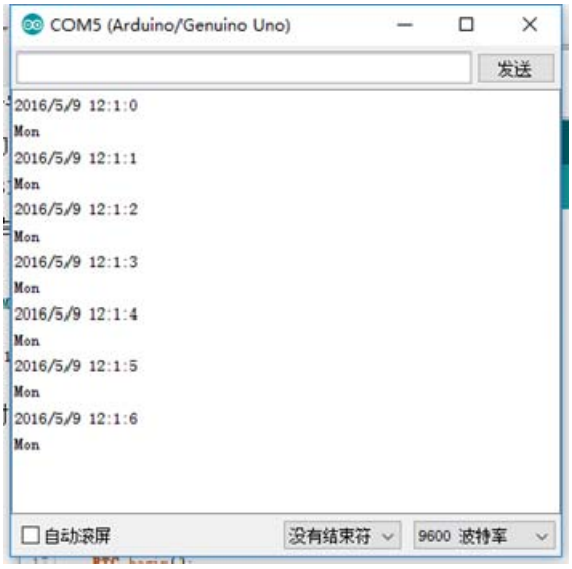


Figure 7. The result display in the serial port

3.5 *The wireless module*

In the design, we used the APC220 as the wireless module. The module is characterized by small volume, wide voltage operation, can be transparent transmission of any size data, and the module of transmission distance is farther. In this system, wireless module can be directly linked with the Arduino Uno extension plate , as shown in figure 8.

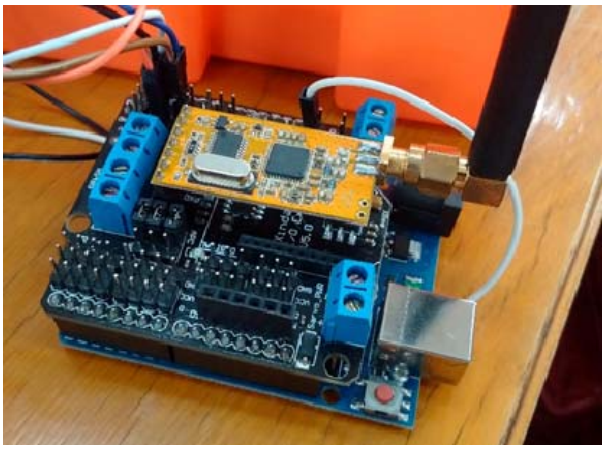


Figure 8. The connection between Arduino Uno and APC220

3.6 *The display module*

The SPI LCD12864 is selected as the display module. The module is based on a 12864 LCD display module, it can display 8192 Chinese characters (16 x16 dot matrix), 128 characters (8 x16 dot matrix) and graphical display (128 x64 dot matrix), and be able to become a strong display system with the Arduino controller.[4]

In this design, RS, RW, EN of the LCD12864 respectively connect with the Arduino digital pin 2, 7, 10, the hardware connection diagram as shown in figure 9.

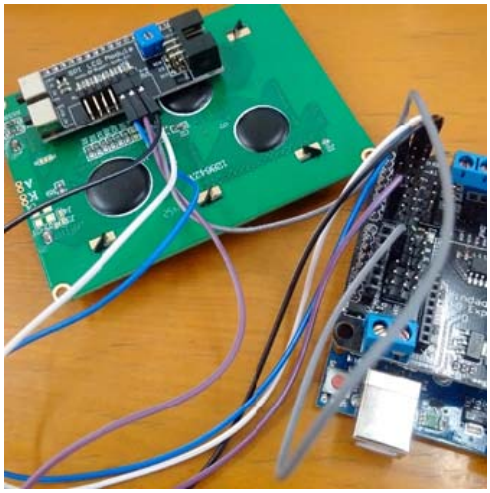
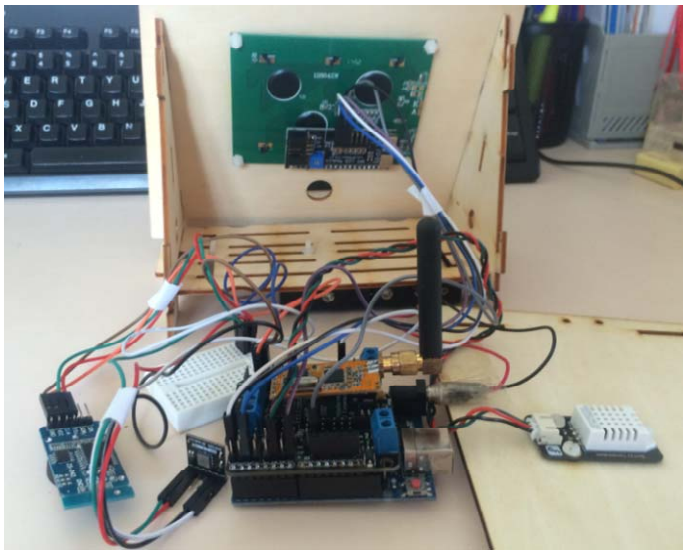


Figure 9. The connection between LCD12864 and Arduino

3.7 *The hardware connection of the system*

After the above module specifically for installation debugging, built a complete system hardware physical diagram as shown in figure 10 (b). Added 3 mm thickness of basswood plate laser cutting on the outside of the whole hardware system, which is used to support and protect the system module, reduce the sunlight radiation effects on measurement results. The appearance of System is shown in figure 10(a).

(a) System appearance figure



(b) The diagram of connection of main hardware

Figure 10. The figure of the actual hardware

4 THE OVERALL SYSTEM FLOW CHART

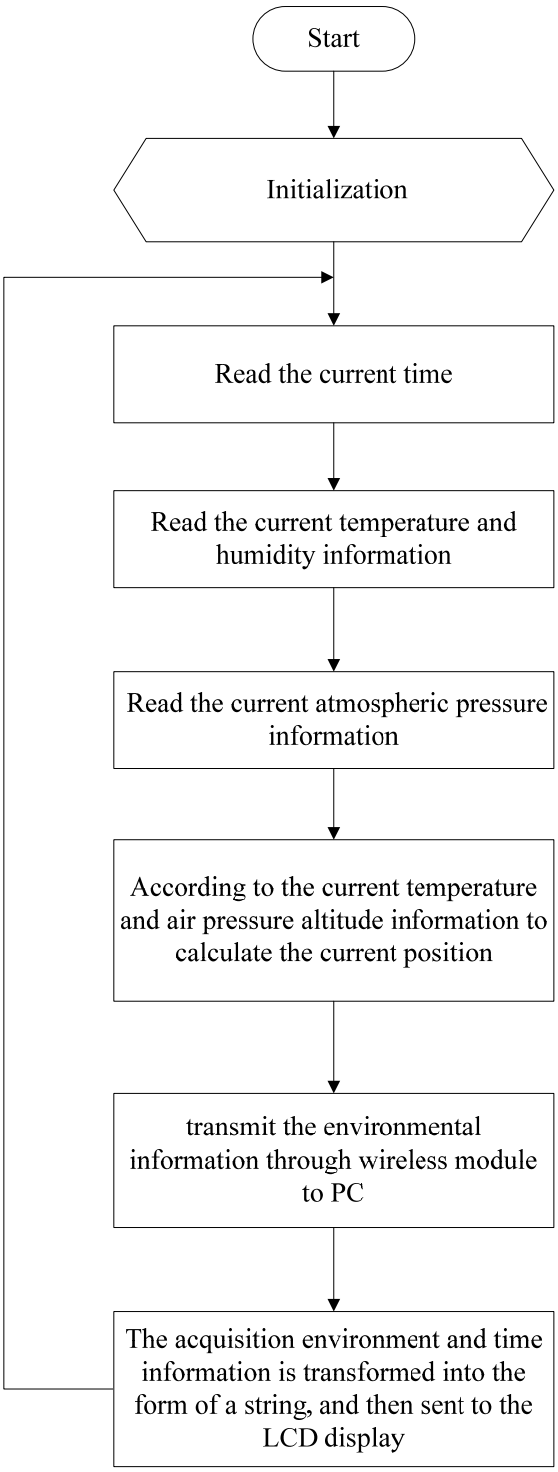


Figure 11. The overall system flow chart

Figure 11 is the software flowchart of the intelligent weather station system. In the initialization part, It need to set up the input/output mode of the Arduino Uno port which are occupied by every modules and set the baud rate of serial port used wireless transmission.

5 THE EXPERIMENTAL RESULTS

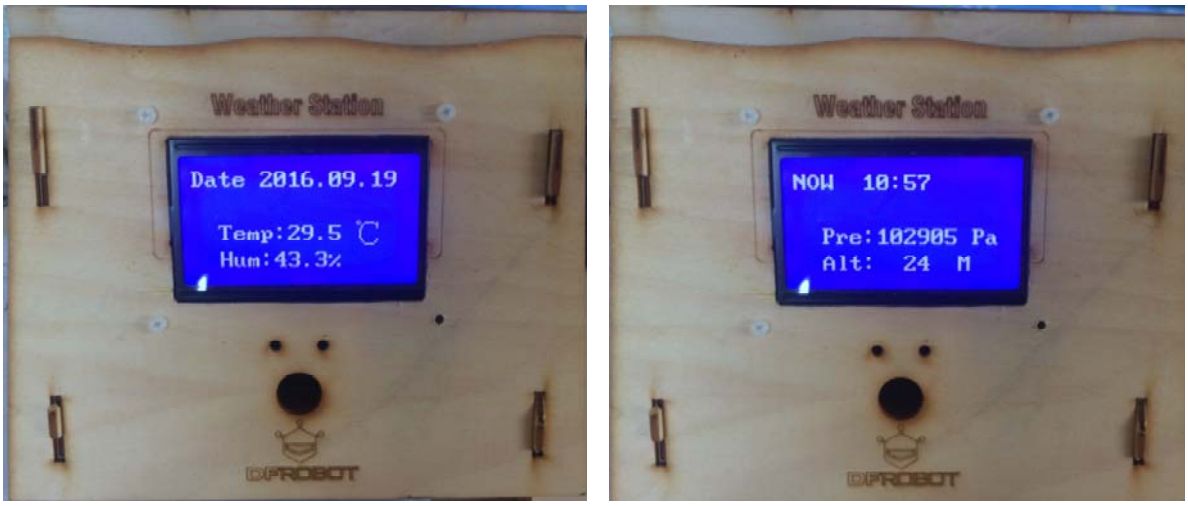


Figure 12. The monitoring results showed in the LCD

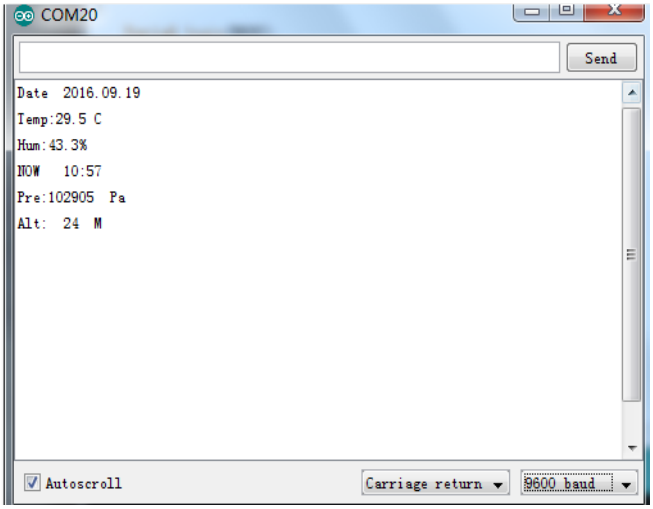


Figure 13. The monitoring results showed in upper computer

After the hardware and software debugging, the system can normally acquisition environment temperature and humidity, air pressure altitude and time information, can display on the LCD12864, and can upload the information to PC through wireless module, as shown in figure 12and figure 13.

6 CONCLUSIONS

A simple set of environmental information monitoring system had been designed based on Arduino Uno. It contains the temperature and humidity sensor, atmospheric pressure sensor, the wireless transmission module and clock module. This paper has introduced the design scheme and consisting modules of the hardware and software detailed, Realization of the debugging and testing of software. The system not only can real-time monitoring of environmental information, and can use the wireless module to transmit environment information to PC. This design has advantages of low cost, low energy consumption and high speed. It not only can be used to detect such as stable family environment, can also be used in complex environment, such as industrial and agricultural information monitoring. This system is characterized of high reliability and expansibility. It can

choose appropriate dust sensors or ultraviolet sensors to monitor the environment dust concentration and uv intensity.

7 ACKNOWLEDGEMENT

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8 REFERENCE

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