Design of the Temperature and humidity sensor and vibration sensor Interface Circuit for the Intelligent Managerial System of Blasting Equipment Library

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Abstract. This paper mainly analyses the necessity to manage the explosive in the coal mine blasting equipment library. It makes intelligent management possible by using digital monitoring technology, communication technology and software technology and sensor technology for reference. High performance microcontroller was used for interface circuit design of temperature, humidity and vibration sensor, the results shown that normal operation. This study may represent a novel candidate resource for intelligent management of equipment library.

Introduction

In order to ensure the safety in the production of coal mine, the storage of powder and its access management must be strict and intelligent. With the rapid development of digital control technology, we can make intelligent management possible by using Temperature and humidity sensor and vibration sensor interface circuit.

Component of Coal Mining Blasting Equipment Library System

The intelligent management system is made up of three parts: the lower machine, the control device and PC. The system is shown as Fig.1.

Control System of the Lower Machine

The storage and access of the explosives and detonators in the reservoir area are managed by the lower machine (computer entrance guard system). The control system of lower machine is mainly composed of single chip microcomputer STC12C5A60S, temperature and humidity sensor, vibration sensor, the fingerprint machine, electromagnetic lock control and communication module [1]. The lower machine uses single chip to control the system [2]. The system is shown as Fig.2.

Interface circuit of temperature, humidity and vibration sensor

Temperature and humidity sensor is an equipment or a device which can convert the amount of temperature and humidity into electrical signal of easy to measure. Temperature and humidity sensor on the market in general is measuring the temperature and relative humidity.

Temperature and humidity of system were detected by capacitive digital temperature and humidity sensor AM2301 which has character of mature technology, stablity and reliability. In fact , there have a NTC temperature sensor , a capacitive humidity sensor and an 8-bit microcontroller in digital temperature and humidity sensor AM2301 [3]. Similar to the temperature sensor DS18B20, single wire transfer was used between single-chip microcomputer with the AM2301 interface, occupy less port, communication distance can be up to 20 meters and its data transmission formats:

40 bit data = 16 + 16 bit humidity data bit temperature data + 8 bit checksum[4].

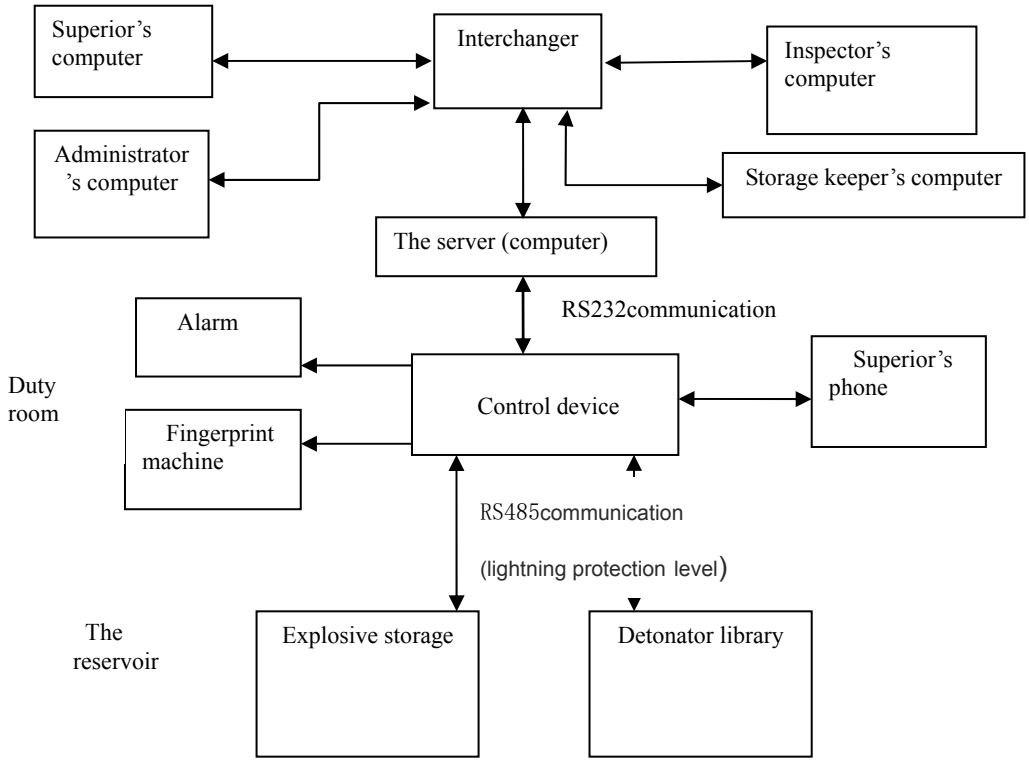

Fig.1. Managerial system of the coal mining blasting equipment library

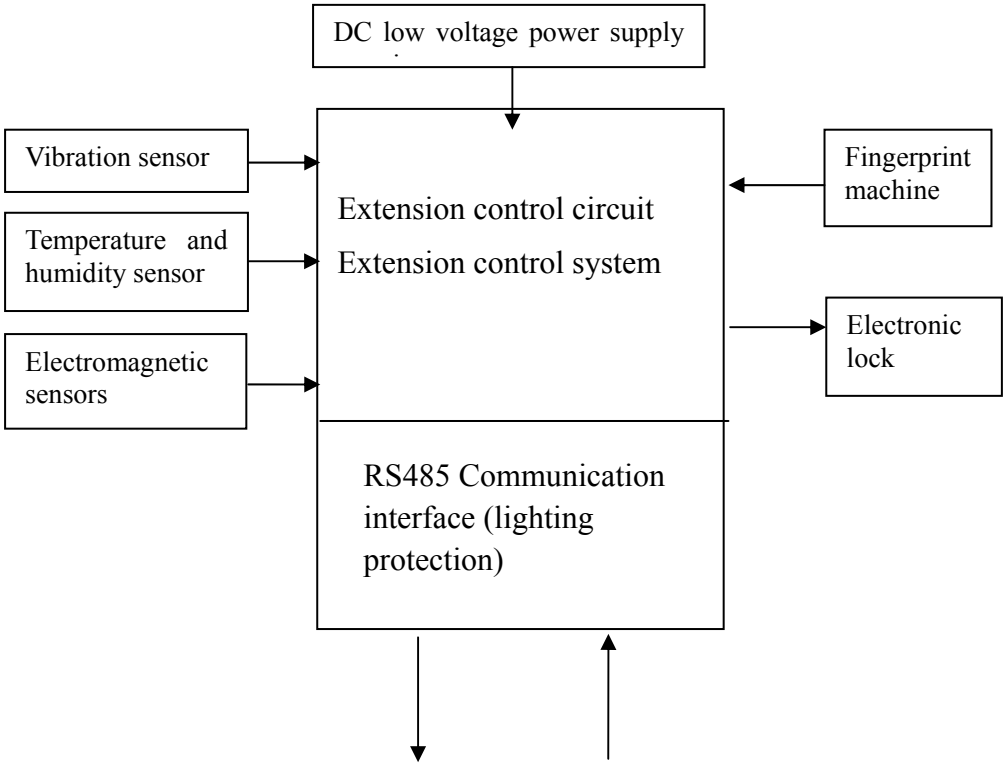

Fig.2. Control system of lower machine for coal mining blasting equipment library

Vibration sensor system is consist of buzzer and contact spring, vibration signal was tested by spring heavy hammer structure with piezoelectric ceramic chip, and through LM358 op-amp amplifier and output control signals, which has the advantages of low cost, high sensitivity, stable and reliable work and vibration testing wide adjustable. It was widely applied in anti-theft system of

automobile and motorcycle. Vibration sensor was used in 80% vehicle alarm now. Sensors can also be with single chip microcomputer, wireless transmitting module, cable warning systems, application is very extensive.

Vibration sensor rated working voltage of 12V DC, minimum working voltage must be greater than 5 V, the output is detected a vibration output 1 second drop-down signals[5]. Sensor's red lines connect the + 12 V, black lines connect GND, blue line is the signal output end of the sensor, detected a vibration output 1 second drop-down signals, the port can be direct and single chip microcomputer interface, no vibration at high level. Vibration detection sensitivity of the sensor is continuous adjustable , sensitivity increased at clockwise and lower sensitivity at counterclockwise.

Coal mine blasting equipment library temperature and humidity sensor, vibration sensor interface circuit (Figure 3)

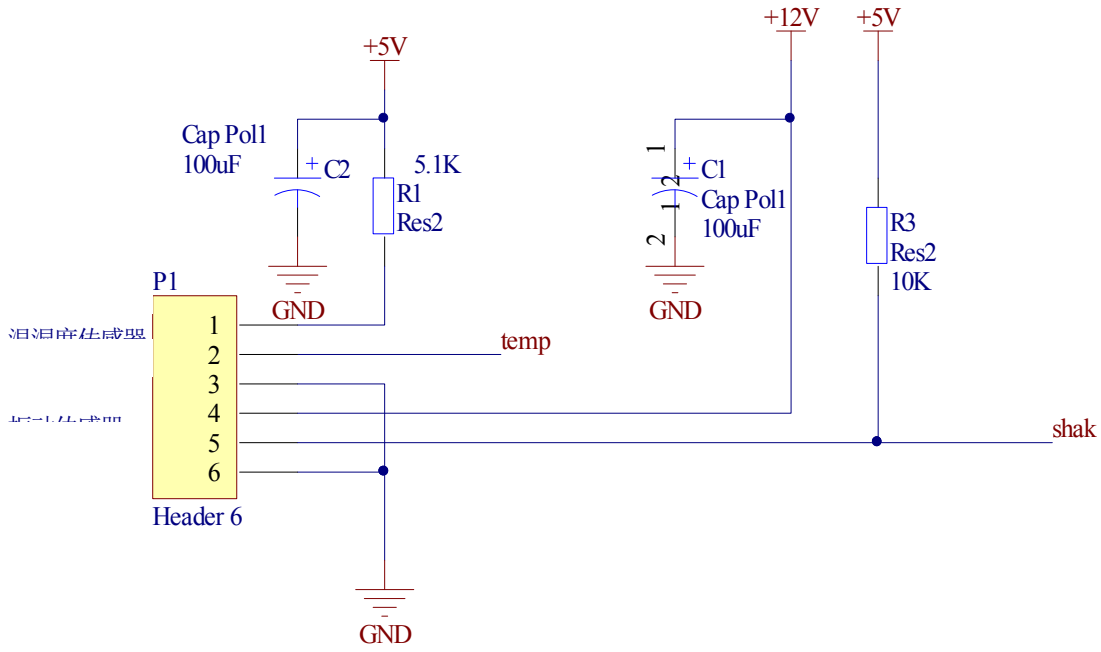

Fig.3. Temperature and humidity sensor and vibration sensor interface circuit

Test results

The program for Temperature and humidity sensor.

```
/*********************************************\
|* function：  Update the system temperature and humidity data function  *|
\*********************************************/
void Update_TempHumi_Am2301(void)
   {
       unsigned char xdata Sensor Check;//Checksum
        if(Sensor_AnswerFlag == 1)
        { Sensor_Check = Sensor_Data[0]+Sensor_Data[1]+Sensor_Data[2]+Sensor_Data[3];
                          if(Sensor_Check ==Sensor_Data[4])//Check success
           {              //Update the humidity
              Humi_data= Sensor_Data[0]*256+Sensor_Data[1];
              Current_humidity[5]= '0'+Humi_data%10;
             Current_humidity[4]= '.';
             Current_humidity[3]= '0'+Humi_data/10%10;
             Current_humidity[2]= '0'+Humi_data/100%10;
             Current_humidity[1]= '0'+Humi_data/1000%10;
             Current_humidity[0]= '0'+Humi_data/10000%10;
              // Plus or minus temperature judgment
```

```
                    if(Sensor_Data[2]&0x80)
                {
                    Sensor_Data[2]&=0x7F;
                   Current_temperature[0]=0x2D;
                 }
                 else
                 { Current_ temperature[0]=0x2B;
                   }
                //Update the temperature
                Temp_data= Sensor_Data[2]*256+Sensor_Data[3];
                  Current_temperature[5]= '0'+Temp_data%10;
                Current_temperature[4]= '.';
                Current_temperature[3]= '0'+Temp_data/10%10;
                Current_temperature[2]= '0'+Temp_data/100%10;
                Current_temperature[1]= '0'+Temp_data/1000%10;
                 }
            else//Check failure    To read the data
            {
                //String = S_Data;//"Data: ";
                 //UART_PutStringAnd_Data(String,Sensor_Data);
                //UARTSend(' ');
                //UARTSend(' ');
                //String = S_CRCF;//"Check: Wrong";
                 //UART_PutString(String);
            }
          }
          else// Sensor is not connected
          {
              //String = S_NotS; //"Sensor Not Connected";
              //UART_PutString(String);
          }
      }
/*****************************************\
|* function：Read sensor sends a single byte *|
\*****************************************/
unsigned char Read_SensorData_Am2301(void)
   {
      unsigned char i,buffer,tmp;
      unsigned int cnt;
      buffer = 0;
      for(i=0;i<8;i++)
      {
          cnt=0;
          while(!Sensor_SDA) // To test whether low level last end
          {
             if(++cnt >= 3600)// To prevent the crash
               {
                  break;
               }
          }
          // delay Min=26us Max50us Skip the "0" the high level of data
          Delay_N10us_Am2301(40);     // delay 30us
```

```
        // Judge sensors send data
        tmp =0;
        if(Sensor_SDA)
        {
           tmp = 1;
        }
        cnt =0;
        while(Sensor_SDA)         // Waiting for the high level end
        {
             if(++cnt >= 2400)//  Prevent freezes
             {
                break;
             }
        }
        buffer <<=1;
        buffer |= tmp;
    }
    return buffer;
}
```

The test index is normal After the test.

Conclusion

Through reasonable design and a lot of experiments of the temperature and humidity sensor and vibration sensor interface circuit, the experiment parameters of coal mining blasting equipment library can reach the expected indicators, avoid safety accidents caused by explosives from the source. This system achieves the intelligent management for the storage and access for explosives and detonators, which can avoid the safety accidents from the greatest degree of caused by such sources.

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