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Intelligent Hairdryer

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Abstract

This system by PIC16F1946 as the control core of the whole design。This design can control the hairdryer by three control method:touch switch,gesture recognition module and fingerprint module.If control the hairdryer by touch switch, user can change the state of the hairdryer according to personal preference.It also can be controlled by gesture recognize module.Fingerprint module can record the state of the hairdryer when user use the hairdryer and fingerprint module. User use the fingerprint module again when use the hairdryer next time,hairdryer will run with the state that had been recorded.

Keywords

PIC16F; gesture recognition; fingerprint recognition.

1. Introduction

Our intelligent blower can add more functions to the circuit, such as mobile phone Bluetooth, mobile phone app, fingerprint identification module, temperature sensor (automatically adjust the temperature of the blower according to the surrounding temperature), so as to meet the needs of more different users. In terms of appearance design, it has great market competition potential to change the appearance according to different user needs.

The use of single-chip microcomputer control circuit, through gesture recognition to adjust the wind speed and heat of the blower, makes the use of ordinary switch control of the blower more simple and convenient. General common hair dryer is controlled by a simple circuit of rocker switch or push-pull switch to adjust the wind speed and heat. This design applies gesture recognition to people's common hair dryer. The whole control system is controlled by a single chip microcomputer, which makes the ordinary hair dryer more intelligent and makes the smart home closer to life.

2. System scheme:

2.1. The choice of single chip microcomputer

Scheme 1: pic16f1946 MCU has a few instructions, 54 I / O pins (one of which can only be used as input), and independent programmable level change interrupt pin. PIC MCU has low power consumption and fast running speed, and the program can be compiled by C language.

Scheme 2: STM32 MCU has rich peripherals, more pins and more registers.

Scheme 3: 51 series single chip microcomputer is more traditional, cheaper, simple to use, but does not have self programming function, less self function, and needs more peripheral components.

Only a few instructions are needed for the blower. Compared with the three kinds of single chip microcomputers, pic16f1946 can be easily implemented with high speed and low power consumption, so scheme one is selected.

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2.2. Selection of wind speed and heat regulation scheme

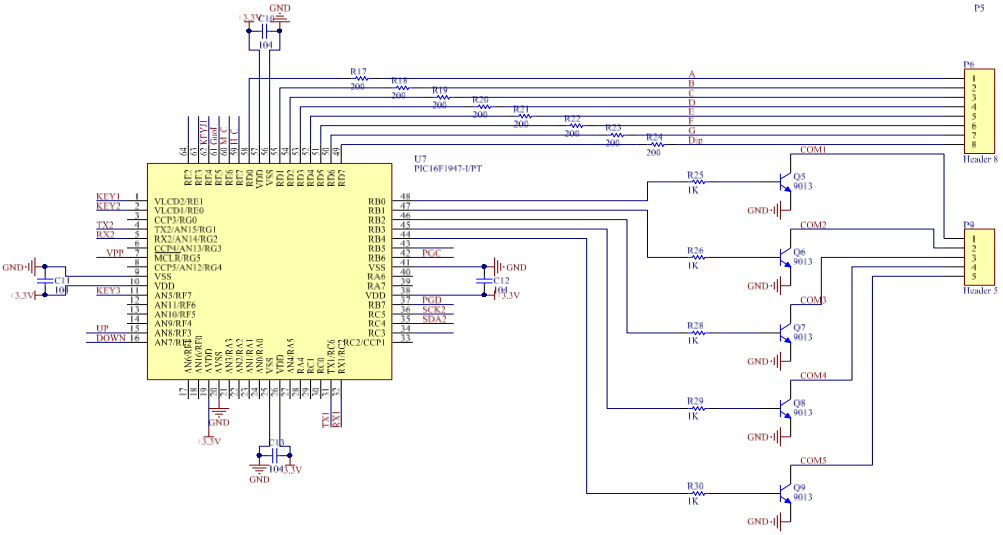
Scheme 1: connect the heating wire and the motor with the speed change switch, directly connect the 220 V power supply, and adjust the speed of the motor through the voltage stabilizing diode.

Scheme 2: the SCR is controlled by the high and low level of MCU output to change the output AC voltage, so as to adjust the wind speed and heat of the blower.

3. System design:

The system is mainly composed of pic16f1946 chip, fingerprint recognition module, gesture recognition module, isolated power supply, motor drive module and heating wire power supply module.

3.1 Control core: 8-bit 64 pin pic16f Series MCU. PIC microcontroller has few instructions, and it is easy to control the blower. PIC microcontroller has low power consumption and fast running speed.



Control core circuit diagram

3.2 The bridge rectifier circuit inputs the 220 V rectifier into the direct current of the motor.

3.3 The power supply module of LED display screen provides 5V DC power from the power supply module of 220V to 5V.

3.4 The photoelectric coupling circuit is used to isolate the MCU chip from the external circuit.

3.5 The type of SCR is tmg20 C60.

3.6 Power isolation module

3.7 Hardware frame diagram:

4. Function and index:

4.1. The display content (LED display) is shown in Figure 1.

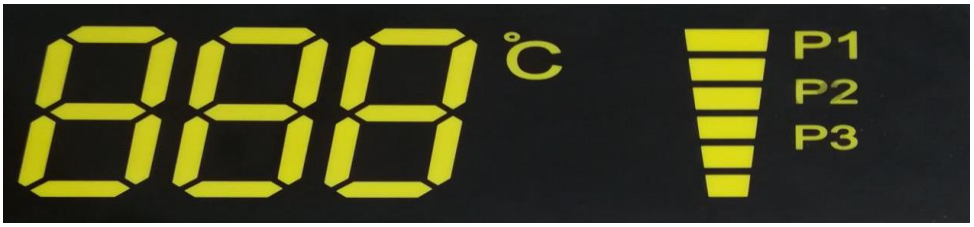


Figure 1. LED display

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4.2. Control and display:

4.2.1 speed control: a total of 6 speed gears are designed, and each gear can adjust the speed of about 1000 rpm. Speed can be adjusted by touch switch and slide bar. The display contents are 6 Display bars. The large left to right indicates that the speed is from low to high. When the speed is at the highest gear, the 6 Display bars are all displayed.

4.2.2 There are 6 temperature ranges in total, and the order is from high to low;200oc/ 180oc/ 160oc/140oc/120oc/100oc from high to low. The air outlet temperature is fed back through NTC induction and adjusted by pressing the key step by step. Five key switches are used to control the speed, heat and operation mode of the blower. The above speed and temperature adjustment is cyclic. When the speed is set at any temperature range, the outlet temperature will be kept within the design value after the speed is adjusted (deviation is allowed). When the machine is turned on, it will run according to the speed and temperature setting of the last shutdown.

4.2.3 gesture control: the rotation speed of left and right stroke control is increased and decreased, and the heating of upper and lower stroke control is increased and decreased. When the palm is close to the palm, the speed and power decrease at the same time, while when the palm is far away, the value increases (the value depends on the voltage). This function can be realized in any speed and power gear.

4.2.4 preset program P1, P2 and P3 to control the alternating change of temperature

P1: at the current speed, it runs in a cycle of 3 seconds hot and 1 second cold;

P2: at the current speed, 25 seconds hot-5 seconds cold cycle operation;

P3: at the current speed, 60 seconds hot-10 seconds cold cycle operation;

It is adjusted by 1 switch one by one, P1-P2, - P3 - normal temperature gear - P1-P2, - P3 cycle change. During the operation of the preset program, the display temperature is displayed according to the actual detected temperature.

4.2.5 the overall control flow chart of intelligent blower is shown in Figure 2.

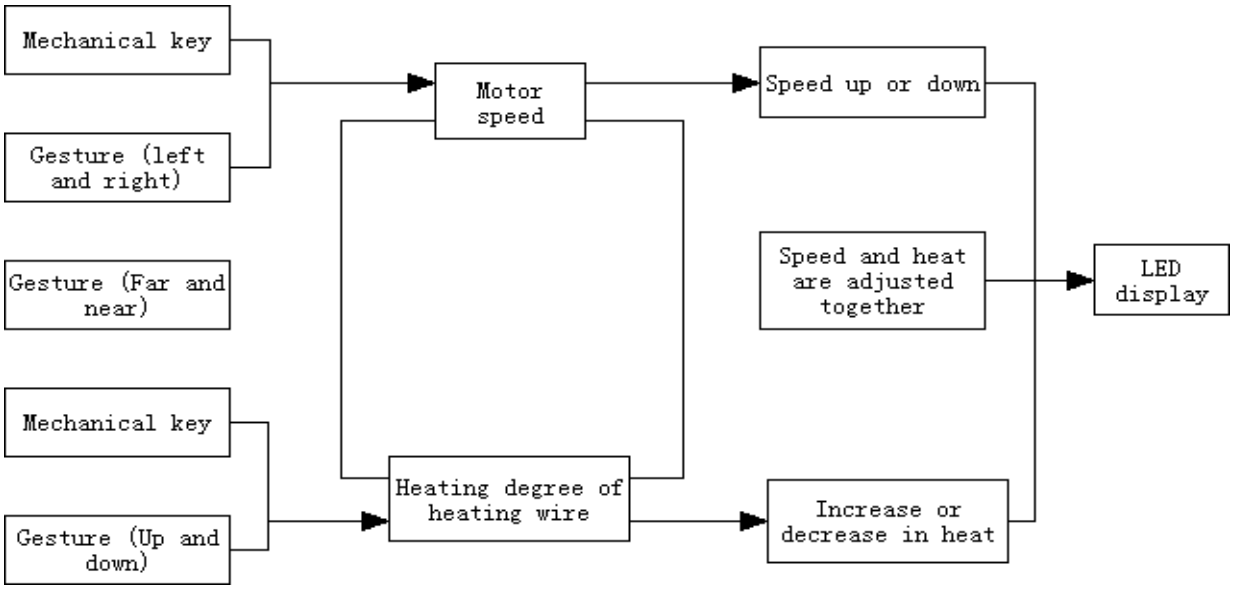

Figure 2. Control and display 1

4.2.6 fingerprint identification:

It is used to record and call up personal preference settings. In any running gear, starting fingerprint input can save the current running setting, and call this setting with the same

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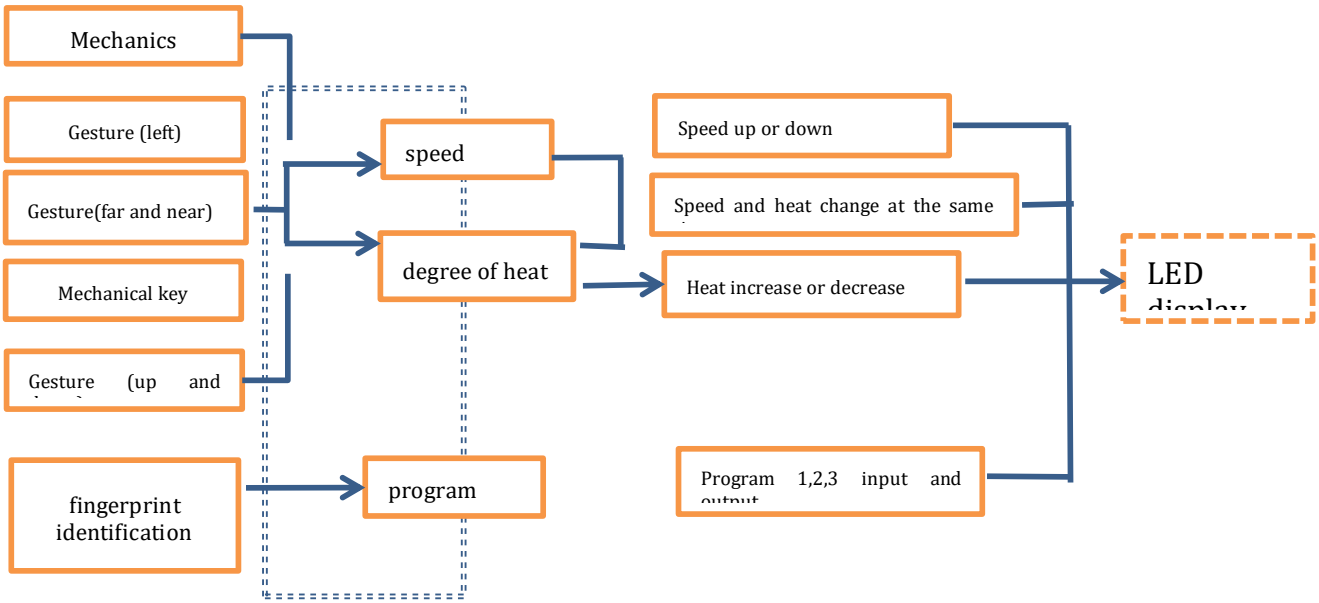
fingerprint. Input and call different settings with different fingerprints. A certain number of preferences can be set. If the input exceeds the set limit, the first recorded settings will be replaced.

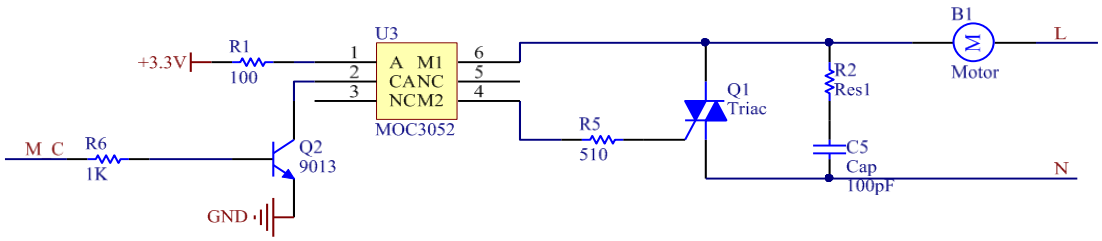


Control and display 1

5. Implementation principle:

5.1. Motor speed change:

The 220 V, 50 Hz alternating current enters the circuit, and the signal of MCU is input to 2 pins of moc3052 through MC terminal and then amplified, and the amplified signal is output to gate pin of tmg220c60 through 4 pins, Single chip microcomputer controls the trigger time. Due to the different trigger time, the output current of SCR is only part of its AC cycle, and the voltage is only part of the full voltage. Therefore, the AC voltage input of the motor can be adjusted, and the AC voltage is input to the motor after being rectified by the bridge rectifier circuit, so as to control the motor speed.



Motor control circuit

5.2. Heating wire temperature change:

When the 220 V AC power is input, the signal is amplified from the HC end to the 2 pins of moc3052, and then output to the gate pin of tmg220c60 through 4 pins, The trigger time is controlled by single chip microcomputer. Due to the different trigger time, the output current of SCR is only part of its AC cycle, and the voltage is only part of the full voltage. Therefore, the voltage input of motor can be adjusted to control the heating degree of heating wire.

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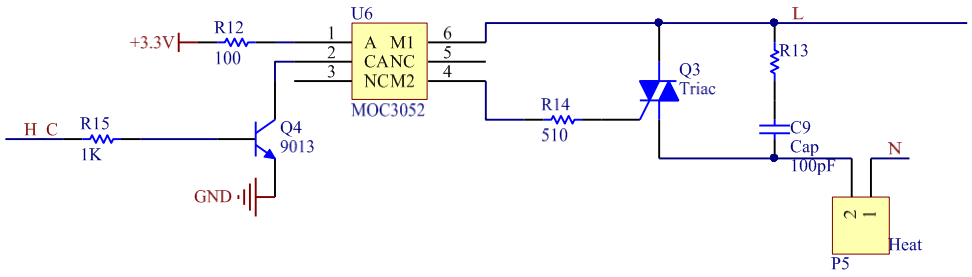

Heating wire control circuit

5.3. Gesture recognition:

The infrared sensor of the gesture recognition module is used to recognize the distance of the gesture. When the module recognizes the gesture, the corresponding I / O (TXD) outputs the corresponding level. The serial port outputs the gesture recognition result in the form of command. The command is transmitted to the MCU chip to control the state of the motor and heating wire.

With the sensor in the upper direction, the gesture recognition module recognizes the direction value

Top: 0x04; bottom: 0x08; left: 0x02; right: 0x01; near: 0x10; far: 0x20.

When the output identification result corresponds to the corresponding output high and low level of I / O control, I / O outputs low level when the power is on by default, I / O2 outputs high level when the power is on (identification result is 0x04), I / O2 outputs low level when the power is down (identification result is 0x08), and others are similar.

Operation principle: when completing an action, such as up or down, the hand must leave the sensor detection area.

5.4. fingerprint identification:

6. Circuit and program design

6.1. System composition:

The system is mainly composed of pic16f1946 chip, gesture recognition module, isolated power supply, motor drive module and heating wire power supply module. This design is based on pic16f single-chip microcomputer. It is controlled by key switch control, gesture recognition control and fingerprint recognition mode control. The key control of this system is only regulated by the weak current control single chip microcomputer, so it is safer than the ordinary hair dryer. Through the key control, the user can adjust the operation state of the blower according to his preference. Through gesture recognition to identify hand movements to control the heat and wind speed, and adjust the speed and temperature of the blower.

6.1.1. Control core: 8-bit 64 pin pic16f Series MCU. As shown in Appendix 4, figure 3.

6.1.2. The single-phase bridge rectifier circuit rectifies the 220 V AC into the motor input DC.

6.1.3. The LED display power module provides 5V DC power from the 220 V to 5V power module.

6.1.4. The photoelectric coupling circuit is used to isolate the MCU chip from the external circuit.

6.1.5. The type of SCR is tmg20c60 three terminal bidirectional SCR.

6.1.6. Power isolation module, as shown in Appendix 4, figure 4.

6.1.7. The hardware frame diagram is shown in Figure 5 of Appendix 4.

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6.2. Motor speed change:

The 220 V, 50 Hz alternating current enters the circuit, the signal of single chip microcomputer is input to 2 pins of moc3052 through MC terminal and then amplified, and the amplified signal is output to gate pin of tmg220c60 through 4 pins, Single chip microcomputer controls the trigger time. Due to the different trigger time, the output current of SCR is only part of its AC cycle, and the voltage is only part of the full voltage. Therefore, the AC voltage input of the motor can be adjusted, and the AC voltage is input to the motor after being rectified by the bridge rectifier circuit, so as to control the motor speed. The motor control circuit is shown in Appendix 4, Figure 6.

6.3. Heating wire temperature change:

When the 220 V AC power is input, the signal is amplified from the HC end to the 2 pins of moc3052, and then output to the gate pin of tmg220c60 through 4 pins, The trigger time is controlled by single chip microcomputer. Due to the different trigger time, the output current of SCR is only part of its AC cycle, and the voltage is only part of the full voltage. Therefore, the voltage input of motor can be adjusted to control the heating degree of heating wire. The control circuit of heating wire is shown in Figure 7 of Appendix 4.

6.4. Gesture recognition:

The gesture recognition module uses the general gesture recognition module developed and produced by leikuaxian science and technology center, and the maximum recognition distance is about 20cm.

The infrared sensor of the gesture recognition module is used to recognize the distance of the gesture. When the module recognizes the gesture, the corresponding I / O (TXD) outputs the corresponding level. The serial port outputs the gesture recognition result in the form of command. The command is transmitted to the MCU chip to control the state of the motor and heating wire.

Taking the sensor as the up direction, the gesture recognition module recognizes the direction value

Top: 0x04; bottom: 0x08; left: 0x02; right: 0x01; near: 0x10; far: 0x20.

When the output identification result corresponds to the corresponding output high and low level of I / O control, I / O outputs low level when the power is on by default, I / O2 outputs high level when the power is on (identification result is 0x04), I / O2 outputs low level when the power is down (identification result is 0x08), and others are similar.

Operation principle: when completing an action, such as up or down, the hand must leave the sensor detection area.

7. Test plan and conclusion

7.1. Test scheme: by adjusting the gears of motor and heating wire, test the actual working conditions of motor and heating wire, and understand the changes of some important parameters of motor and heating wire when changing gears.

7.2. Test process

7.2.1. Power isolation module: input 220 V AC and output 5 V DC

7.2.2. Key control:

After pressing key1 twice, the LED screen will flash, the temperature control gear will be activated, and the temperature gear will be adjusted by pressing key2. Every time key2 is pressed, six temperature gears will change step by step.

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Press key1 for four times continuously, P1P2P3 on LED screen flashes, operation mode shift is activated, press key2 to select P1, P2 and P3; when P1 is on, it will operate at the current speed in 3 seconds hot-1 seconds cold cycle; when P2 is on, it will operate at the current speed in 25 seconds hot-5 seconds cold cycle; when P3 is on, it will operate at the current speed in 60 seconds hot-10 seconds cold cycle.

Each time you press the up key, the wind speed and the wind speed display bar of the LED display screen will increase step by step; each time you press the down key, the wind speed and the wind speed display bar of the LED display screen will decrease step by step.

7.2.3 gesture recognition test:

Control wind speed by left and right wave: when waving left, wind speed decreases, while wind speed rises when waving right. Once every left or right wave, wind speed gear drops or rises step by step.

Up and down wave control temperature: when the upward wave temperature rises, the wind speed decreases when the downward wave, and the temperature level rises or decreases gradually every upward or downward wave.

Keep away from or close to control wind speed and temperature simultaneously: when the hand is close to the sensor, the wind speed and temperature will be reduced to the minimum immediately. When the hand is away from the sensor, the wind speed and temperature will rise to the last state you just executed.

7.2.4 Temperature range: the temperature is divided into six gears: 100, 120, 140, 160, 180 and 200, and the control gear can be selected by pressing the key and gesture recognition. When using the key, select: press the gear adjustment key again when the temperature rises to the maximum gear, then the temperature will change to the lowest gear. When using gesture recognition: when the temperature rises to the maximum, warm up gesture is used again, and the temperature will not change. It is necessary to adjust it by using the gesture of cooling one by one. The temperature range is adjusted step by step, and the cross adjustment is only suitable for the long and near gestures.

7.2.5 Wind speed gear: the wind speed corresponds to the six horizontal bars on the LED display screen one by one. Each time you click the up button, the motor speed will rise by one gear, and the LED display screen will also rise by one horizontal bar. Each time you click the down key, you will drop a gear, and the LED display will also drop a bar. When the lowest bar LED is displayed, the motor speed is the slowest and the wind speed is the smallest. When the highest bar LED is displayed, the motor speed is the fastest and the wind speed is the largest. The adjustment of wind speed gear is step-by-step adjustment. The key recognition and gesture adjustment can only adjust the wind speed gear step by step, and the cross level adjustment is only applicable to the far and near gestures of gesture recognition.

7.2.6 Use digital multimeter to measure the output voltage of two thyristors when the blower is working.

7.3. Test equipment:

Digital multimeter model: my65

7.4. Test data:

Wind speed range	1gear	2gear	3gear	4gear	5gear	6gear
Voltage / V	148.2	158.4	164.5	193.6	215.1	227.9

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Temperature range	100°C	120°C	140°C	160°C	180°C	200°C
Voltage / V	111.6	129.6	147.3	163.8	179.6	193.7

7.5. Result analysis:

This test mainly tests whether the product can work normally and whether the preset functions can be realized. After testing, the key function of the fan can accurately enter the key function control module according to the preset program, which can switch the temperature and P1, P2, P3 state, and control the wind speed of the motor and the temperature of the heating wire. The up and down keys of the wind speed can accurately adjust the wind speed of the fan according to the preset program, and the secondary adjustment can be realized in any state without activating the key function in advance. All the buttons can work normally, realize the step-by-step adjustment of the motor and heating wire, and accurately display on the LED display.

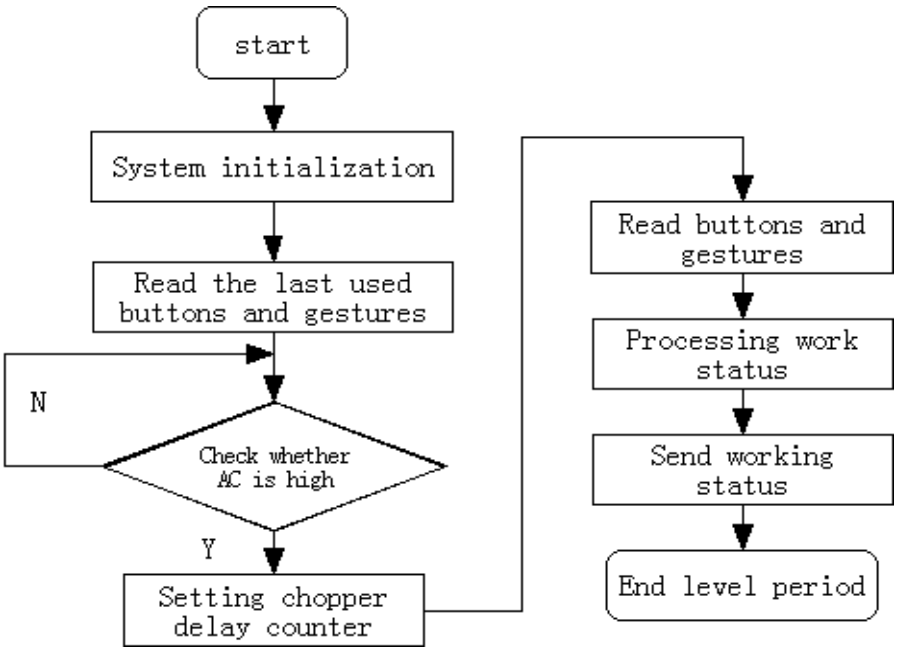
The gesture recognition function can normally control the wind speed of the motor and the temperature of the heating wire according to the preset program. Each gesture can achieve a preset scheme to adjust a gesture. In the state of gesture recognition, the step-by-step adjustment and cross level adjustment of the motor and heating wire are accurately displayed on the LED display.

This product can work normally and realize the preset function, and the corresponding function is accurate. The LED display screen displays normally, which can quickly display the switch between function and gear, so that users can understand the actual working state of the hair dryer in real time. The working voltage and current are relatively stable and fluctuate in the normal range.

7.6. Realization function: realize gesture control of air duct speed and heat; realize key control of air duct speed and heat.

8. Flow chart

8.1. The program flow chart is shown in Figure 3 and Figure 4



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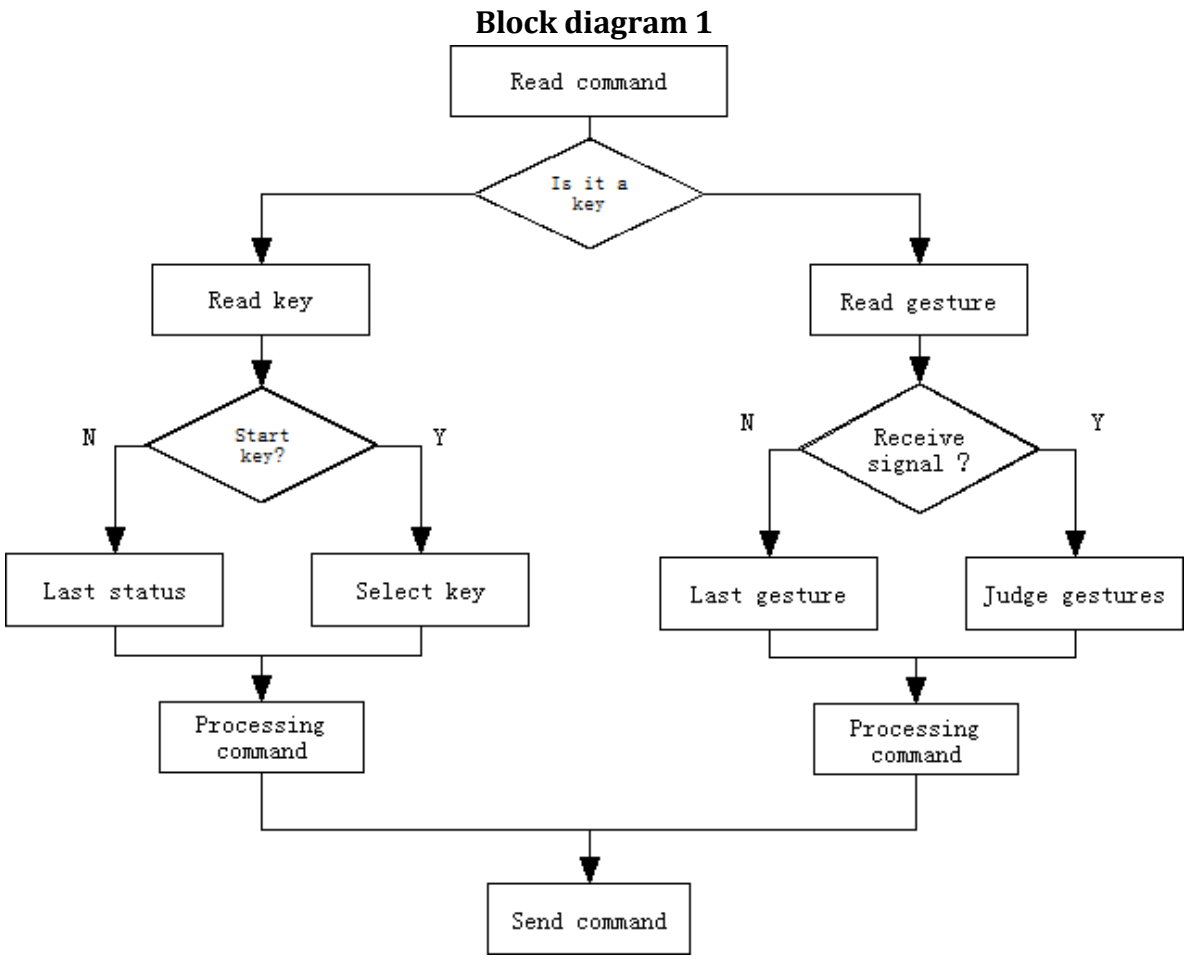

Block diagram 1

8.2. 8.2 The circuit diagram of circuit board module is shown in Figure 3 and Figure4

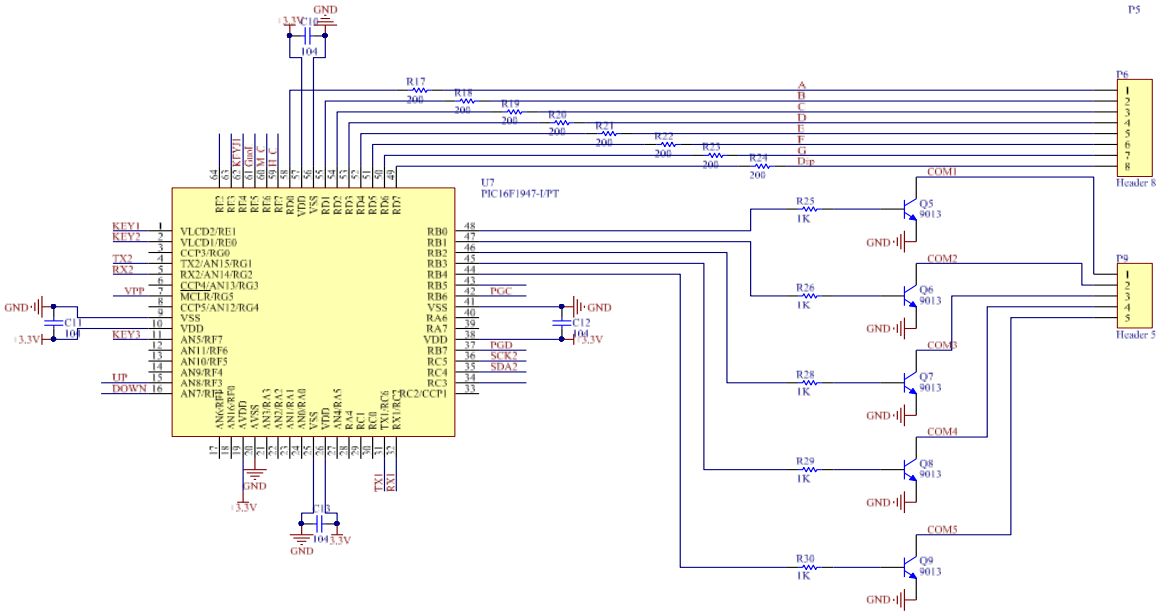

Figure 3. Control core circuit

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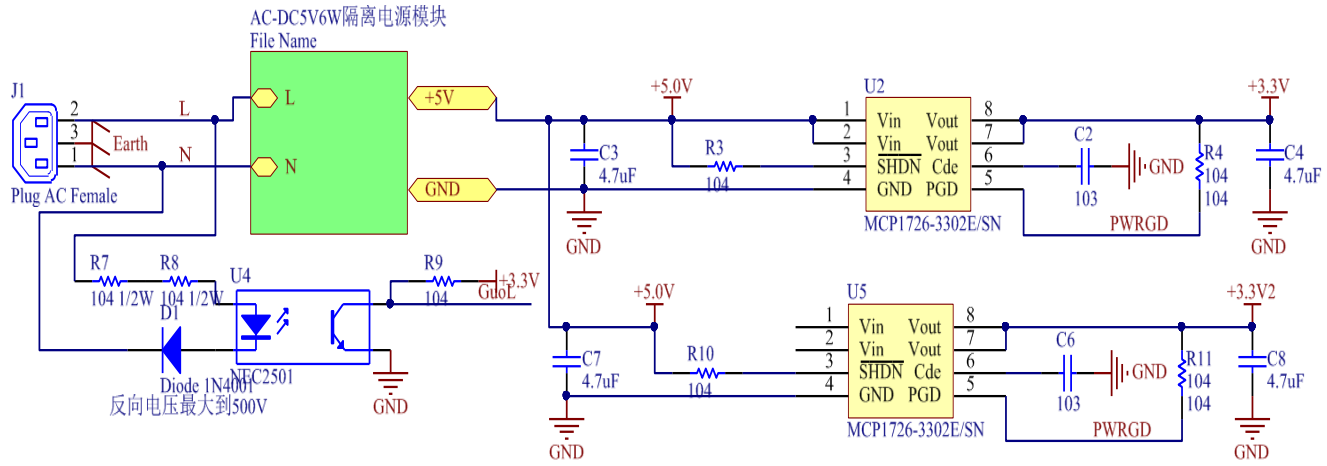

Figure 4. Power isolation module

8.3. The hardware flow chart is shown in Figure 5

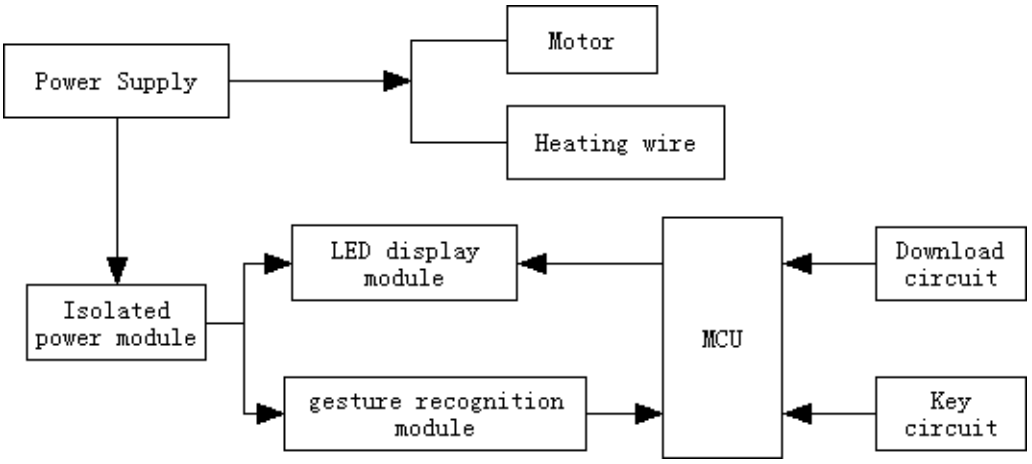

Figure 5. Hardware flow

8.4. The motor control diagram is shown in Figure 5

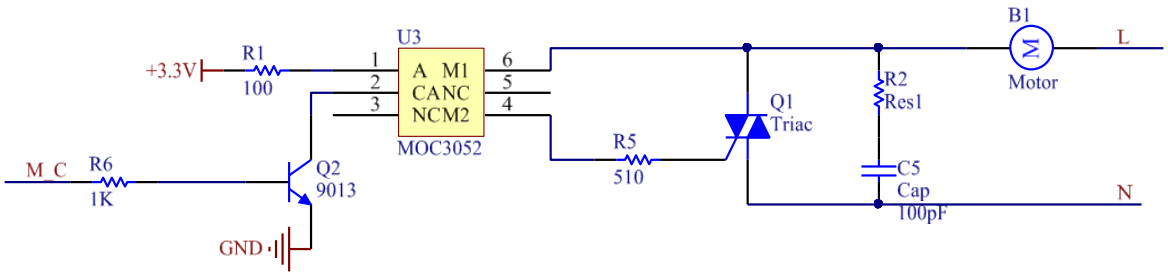

Figure 6. Motor control circuit

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8.5. The control circuit diagram of heating wire is shown in Figure 5

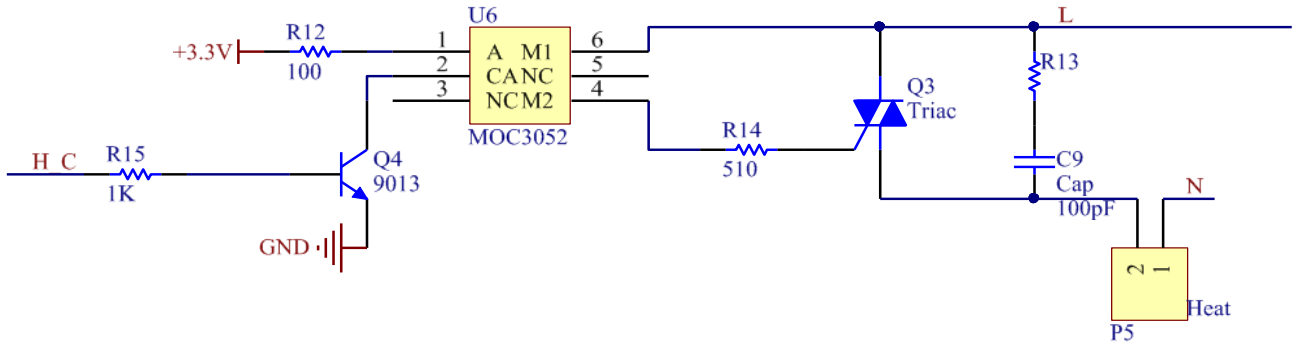

Figure 7. Heating wire control circuit

9. Main program code:

```
void main(void) {
  unsigned char CharData1,CharData2,CharData3;
  unsigned int IntData1,IntData2,IntData3;
  LONGTOCHAR LongToCharData;
  INTTOCHAR  IntToCharData;
  SystemInition();
  UART2_Inition();
  UART1_Inition()
  Count_Start=0x0;
  while(Count_Start<200){
    CLRWDT();
    ReadSwitch();
  }
  while(Check_ACH()==0)  {  CLRWDT();  }
   while(Check_ACL()==1)  {  CLRWDT();  }
  WorkStatus=POWERON; Count_Start=0x0;
  while(1){
    CLRWDT()
    while(Check_ACH()==0)  {  CLRWDT();  }
    TMR1L=0x0;  TMR1H=0x0;  T1CONbits.TMR1ON=1;
    NOP();  NOP();
    Motor_O=0;  Heat_O=0;
    Flag_MotorOn=0; Flag_HeatOn=0;
    IntData1=ReadTime1();
    while(((Flag_MotorOn==0)||(Flag_HeatOn==0))&&(IntData1<7900)){
      CLRWDT();
      if(IntData1>=Motor_Power[MotorS]){
        if(Flag_Motor==1)  {  Motor_O=1;  Flag_MotorOn=1; }
      }
      if(IntData1>=Heat_Power[HeatS]){
        if(Flag_Heat==1)  {  Heat_O=1;  Flag_HeatOn=1;  }
```

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```
      else{
        Flag_HeatOn=1;
      }
    }
    IntData1=ReadTime1();
  }
  DealWork();
  if(MainKey==KEY_BYPASS){
    MainKey=0x0;
    Flag_Heat=0;
  }
  Deal_TX1();
  if(Flag_U1Error==1){
    UART1_Inition();
  }
  IntData1=ReadTime1();
  while(IntData1<7900){
    CLRWDT();
    IntData1=ReadTime1();
  }
  T1CONbits.TMR1ON=0;
  Motor_O=0;  Heat_O=0;
  while(Check_ACL()==0)  {  CLRWDT();  }
  TMR1L=0x0;  TMR1H=0x0;  T1CONbits.TMR1ON=1;
  NOP();  NOP();
  Motor_O=0;  Heat_O=0;
  Flag_MotorOn=0; Flag_HeatOn=0;
  IntData1=ReadTime1();
  while(((Flag_MotorOn==0)||(Flag_HeatOn==0))&&(IntData1<7900)){
    CLRWDT();
    if(IntData1>=Motor_Power[MotorS]){
      if(Flag_Motor==1)  {  Motor_O=1;  Flag_MotorOn=1; }
    }
    if(IntData1>=Heat_Power[HeatS]){
      if(Flag_Heat==1)  {  Heat_O=1;  Flag_HeatOn=1;  }
      else{
        Flag_HeatOn=1;
      }
    }
    IntData1=ReadTime1();//读取Time1
  }//while(((Flag_MotorOn==0)||(Flag_HeatOn==0))&&(IntData1<7500))
  ReadSwitch();
  ReadShouShi();
  DealWork();
```

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```
    if(MainKey==KEY_BYPASS){
      MainKey=0x0;
      Flag_Heat=0;
    }
    Deal_TX1();
    if(Flag_U1Error==1){
      UART1_Inition();
    }
    IntData1=ReadTime1();
    while(IntData1<7900){
      CLRWDT();
      IntData1=ReadTime1();
    }
    T1CONbits.TMR1ON=0;
    Motor_O=0;  Heat_O=0;
    NOP();
  }//while(1)
}
```

10. The advantages of intelligent blower are as follows:

10.1 with LED display screen, the number of air duct stops can be displayed

10.2 there are 6 heat gears and 6 wind speed gears that can be adjusted

10.3 in terms of key control, it is safer than ordinary air duct because it is only triggered by weak current

10.4 in addition to the key control, there is more convenient gesture control, which makes the blower control more simple and convenient

11. Function of intelligent blower

Products with gesture control can share the usage of keys and achieve desired functions from a more intelligent direction. After showering or shampooing, there may be residual water in both hands, which may lead to the user's bad effect experience of insensitive keys. After adding gesture control, the user can send gesture instructions to the receiving position of the gesture module of the hair dryer by memory, so as to reduce the adverse impact of the environment on the use of the hair dryer and improve the use efficiency of the product. In addition to sharing the use of keys, the gesture control of this product also has a cross level adjustment function. When you are too close to the air outlet of this product, this product will have the user protection function, instantly adjust the wind speed and heat of the hair dryer to the minimum, until you leave the dangerous range of the hair dryer, the gesture module will automatically recognize and restore the temperature and wind speed to the minimum The last state you set is to prevent the user from burning the skin when using the hair dryer in the blind area of vision because it is too close to the outlet fan.

12. Concluding remarks

The system and creative concept of this product is not limited to intelligent hair dryer. As a carrier, we can integrate the creative concept into more daily household appliances, such as

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intelligent fan, intelligent air conditioner and so on. We can add voice control module, temperature sensing module and so on according to the actual use of the product. If the products sell well, we can also consider developing mobile phone control app to make your life more efficient and convenient

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