Home Automation Using 8051 Microcontroller

A MINI PROJECT REPORT

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IN

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CHAPTER 1

INTRODUCTION:

This mini project inlcludes the automation in home using 8051 microcontroller, which is basically controlling home appliances using 8051 microcontroller.

There are several appliances used in home for daily life needs, which can be controlled by various microcontrollers. But not all microcontroller is favourable for every applications.

Depending on the application we can decide which type of microcontroller to be chosen. We know basically the microcontrollers are very small size hardware devices which can control other devices or things based on apllication and program. Microcontroller includes both microprocessor and internal memory storages, interrupts and timers inbuilt in it.

Altough there are plenty of advanced microcontrollers are available in today's market, we are using 8051 microcontroller as it is as our one of core subjects in the current semester. Also to understand about the advance microcontrollers we should learn the basics.

As the era of today being as to control everything automatically with specific conditions, (here everything inlcudes almost all electronic devices used in daily life) even though things can be controlled using remote we want it to be controlled aoutomatically without wasting our time to take the remote in hand and operate.

Air conditioner is almost available in every house today, we can cnotrol air conditioner using the remote comes with it. But for a automated home that is not sufficient. It should be controlled automatically without giving the input through remote/operate manually again and again.

It possible to control air conditioner aoutomatically with the help of microcontroller and temperature sensor. Based on the temperature reading occurred in tempearutre sensor the microcontroller can control the air conditioner with specific program/coding programmed in it.

CHAPTER 2

Aim:

The main objective of this mini project is to control air conditioner by 8051 micrcontroller with the help of LM35 temperature sensor based on the thresold temperature.

Here thresold tempearture means the temparature beyond which the air conditioner to be turned on and below which it should get turned off.

For example if the room temperature is more than 25 degree centigrade the air conditioner should get turned on automacially.

For more temperature read by LM35 temperature sensor the temperature of air conditioner should be less. As temperature read by LM35 decreases the temperature of air conditioner increases and slowly when temperature read by LM35 is lesser than 25 degree centigrade the air conditioner gets turned off automatically.

CHAPTER 3

COMPONENTS REQUIRED

1. Air conditioner
2. 8051 Microcontroller-AT89C52
3. LM35 Temperature sensor
4. Relay
5. Battery
6. LCD Display
7. ADC converter
8. Phototransistor Optocoupler
9. TIP122 Transistor
10. 1N4004 Diode
11. Resistor
12. Capacitor
13. Crystal Oscillator
14. Switch
15. Breadboard
16. Connecting Wires

3.1 Air conditioner

Air conditioner is a cooling electronic device used in homes as daily life used accessories. It is used to coolen the room temperature. It has main 4 parts in it as follows:

1. Evaporator
2. Condensor
3. Expansion Valve
4. Compressor

When the air conditioner is turned on by giving electrical power supply the evaporator takes the hot air of inside the room and then gets the liquid refrigerant then the hot refrigerant is passed through compressor to reduce the pressure then it is passed through condensor and it is cooled in this stage and then again with help of expansion valve it is circulated to evaporator and the hot air is passed outside the room and the air inside the room is cooled with repition of this cycle.

There are mainly 5 types of air conditioners available in market:

1. Window air conditioners
2. Air source heat pumps
3. Central air conditioners
4. Ductless air conditioners
5. Portable air conditioners

Fig-1: Air Conditioners

3.2 8051 Microcontroller

We know basically the microcontrollers are very small size hardware devices which can control other devices or things based on apllication and program. Microcontroller includes both microprocessor and internal memory storages, interrupts and timers inbuilt in it.

There are several appliances used in home for daily life needs, which can be controlled by various microcontrollers. But not all microcontroller is favourable for every applications.

8051 Microcontoller has

1. 4KB ROM
2. 128Bytes RAM
3. 2*16bits Timers
4. 32 Input/Output Pins
5. 1 Serial Port
6. 6 Interrupt sources

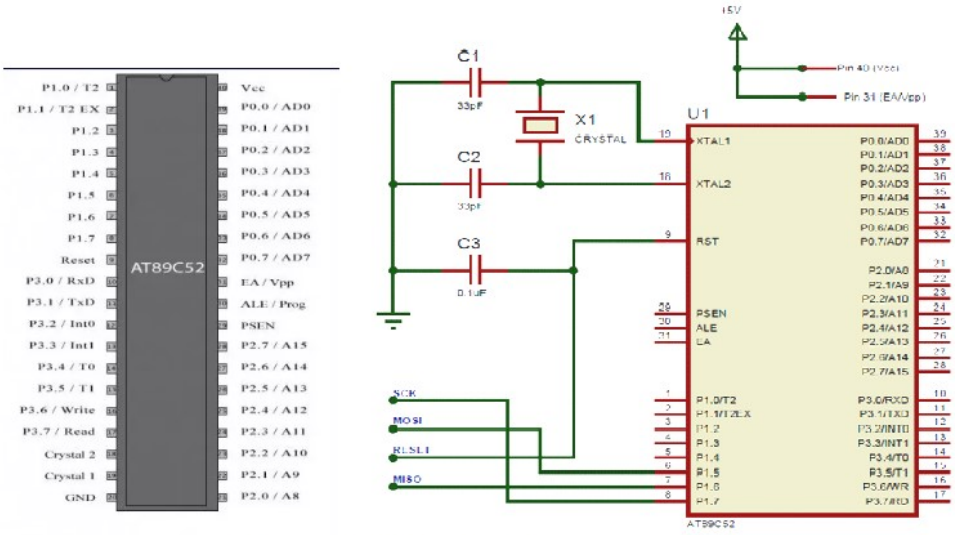

Fig-2: AT89C52 Microcontroller

3.3 LM35 Temperature Sensor

LM35 is a analog temperature sensor which senses the temperature and varies the output voltage of it. The output voltage of LM35 temperature sensor depends on the temperature around it. The output voltage of LM35 temperature sensor is directly propotional to the temperature.

It measures the temperature by providing the output volatge in degree centigrade or celsius (not in volts).

For 1degree celsius the equivalent output voltage is 10mV. For example- 250mv indicates 25 degree celsius.

The temperature ranging of LM35 temerature sensor is from -55 degree celsius to 150 degree celsius.

The temperature output of LM35 temperature sensor is more accurate than thermistor.

In this project depending on the variation of temperature obtained by LM35 temperature sensor the microcontroller instruct the air conditioner to turn on/turn off and also to be opearted in which temperature of air conditioner.

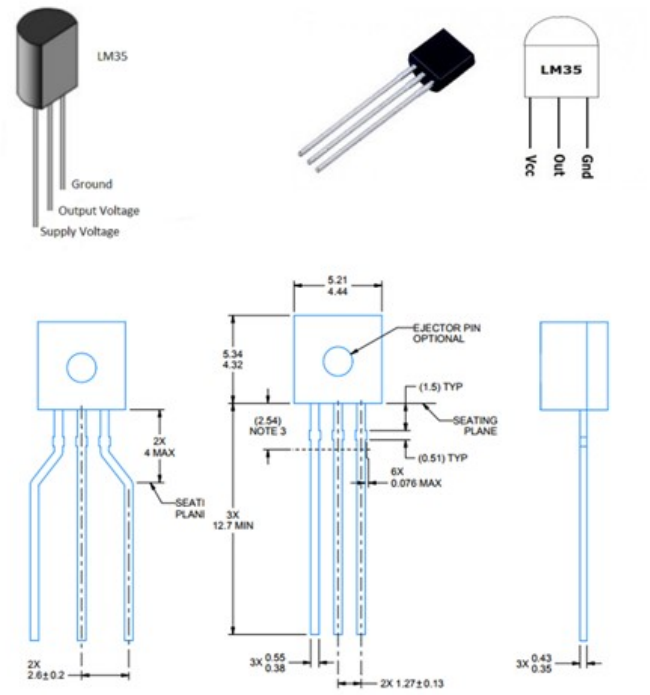

Fig-3:LM35 Temperature Sensor

3.4 Relay

Relay is electromagnetic switch. It is used for high voltage operation. Depending on the current flowing through it relay gets turned ON or OFF.

In this project relay is used to operate the air conditioner. In other words the air conditioner is turned ON or OFF using the relay.

In simulation of this project DC fan is used instead of air conditioner for sample, so the relay is not used for simulation in software.

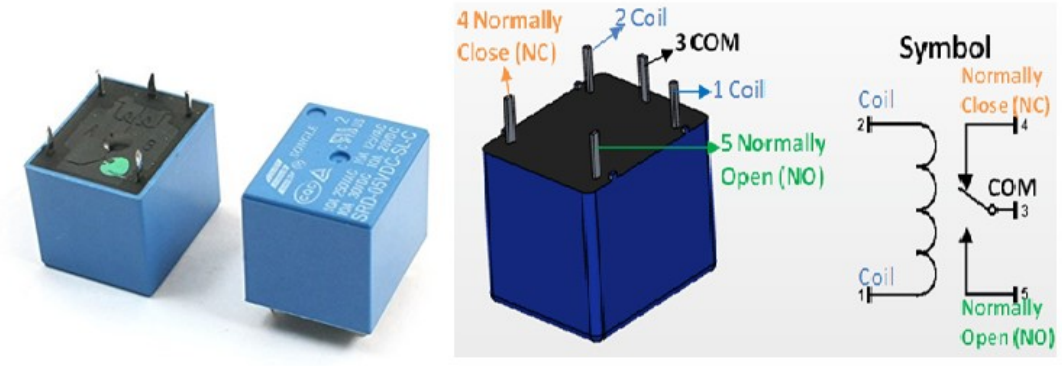

Fig-4: Relay

3.5 Phototransistor Optocoupler

Optocoupler is used to switch or change the current in the output circuit. It includes a Ifrared (IR) LED and a phototransistor in it.

Depending on the input infrared light by LED the current in output circuit is switched or changed by phototransistor.

Here the infrared light intenisty of LED is propotional to electrical signal.

In this project the above metioned principle is used to change the temperature in air conditioner depending on the different temperature obtained by LM35 temperature sensor.

Phototransistor optocoupler in relay. But as for simulation relay is not used, the optocoupler is directly used with the help of TIP122 transistor to operate the DC fan in different speed.

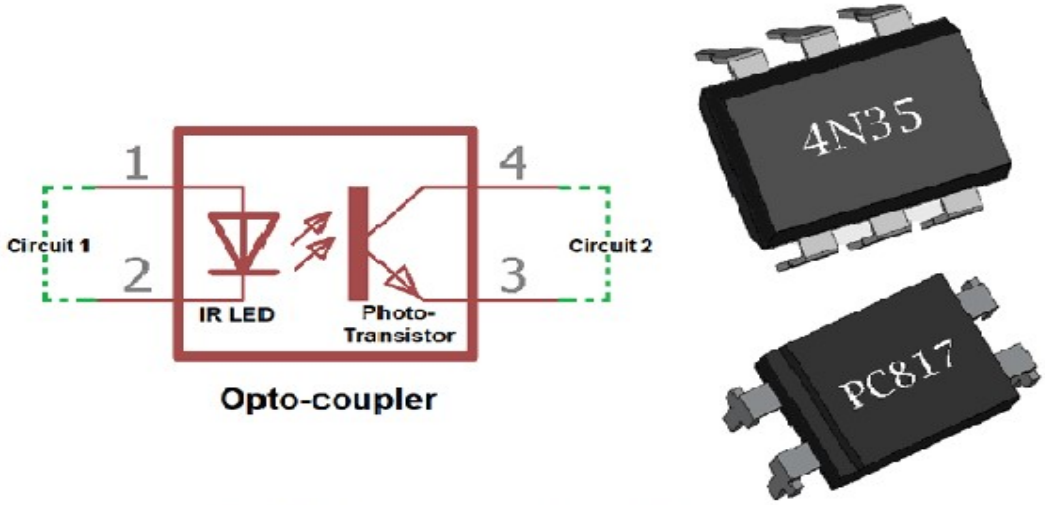

Fig-5: Phototransistor Optocoupler

3.6 ADC converter

ADC or analog to digtal converter is a signal converting device used for converting analog signals to digital signals. ADC or analog to digital converter can convert analog voltage signals to equivalent digital signals represented by 0s and 1s.

It is interfaced extrernally with 8051 microcontroller in case the microcontroller is not having a in built ADC or analog to digital converter. It can take input voltages for -5Volts to +10 volts.

In this project the 8051 microcontroller we are using is AT89C52 which is not having inbuilt ADC or analog to digital converter. Hence it is interfaced externally to AT89C52 microcontroller.

In this project ADC or analog to digital converter is used for converting analog output voltage signal by LM35 temperature sensor to digital signals as input for AT89C52 microcontroller.

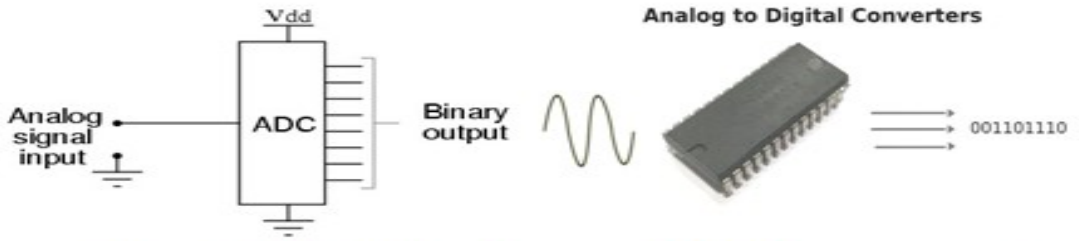

Fig-6: ADC (Analog to digital converter)

3.7 Crystal Oscillator

Crystal oscillator is a type of electronic oscillator. Crystal oscillator is used for generating electric signals with precise frequency.

For some of the 8051 microcontrollers crystal oscillator is inbuilt whereas for some of the 8051 microcontroller it has to be externally interfaced.

In this project the crystal oscillator used to generate electrical signal for 8051 microcontroller that is AT89C52 with frequency of 1 MHz. The crystal oscillator is interfaced externally to AT89C52 microcontoller with two capacitors of 1nF each.

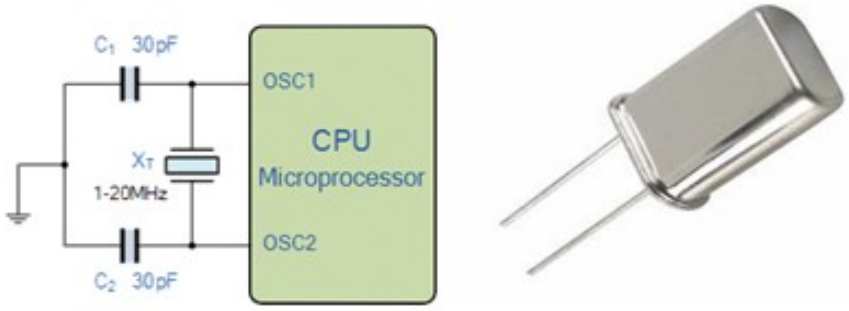

Fig-7: Crystal Oscillator

3.8 LCD

LCD or Liquid Crystal Display is a type of elctronic display used to project or show the image or text output we want. It has liquid crystals in it which are combined with polarizers. This type of display doesn't emit the light in direct manner. In LCD a backlight is used to project the visible image or text.

In this project LCD is interfaced extrernally to AT89C52 microcontroller and it is used to project or show the room temperature read by LM35 temperature sensor. Also it is used to show the condition of air conditioner (ON or OFF).

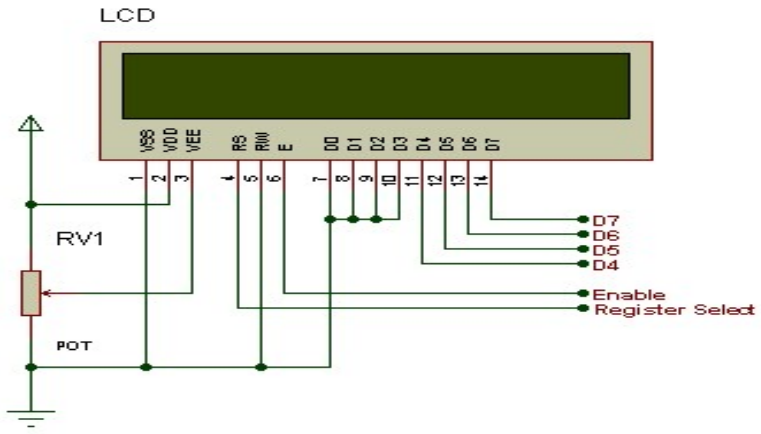

Fig-8: LCD

3.9 TIP 122

TIP 122 is an NPN transistor. It is a darlington transistor. The collector current rating is about 5Amperes which better compared to normal NPN transisitor (one advantage).

TIP122 tarnsistor has a gain of about 1000. Across its collector emitter side it can withstand about 100Volts. Which makes it application for heavy loads.

In this project it TIP122 is used for air conditioner. The input of TIP122 transisitor is provided by phototransistor optocoupler and the output is connected to air conditioner with relay set.

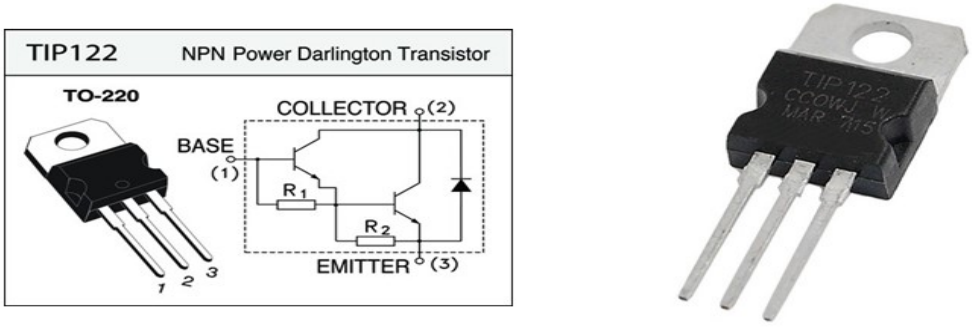

Fig-9: TIP122 Transistor

3.10 1N4004 Diode

Diode is a semicondcutor device with 2 terminals (anode and cathode). I allows the current to flow only in one direction. Thus it is called unilateral elctronic device.

There are several types of diode available in market but for this project we are using 1N4004 which is a rectifier diode as the maximum current carrying capacity of 1N4004 is 1Amperes with the withstanding peak capacity of 30Amperes.

In this project the rectifier diode 1N4004 is connected in parallel with the load (for main project air conditioner and for simulation DC fan). It used to make the current flow only in one direction to prevent any type of back current problem in case occures unfortunately.

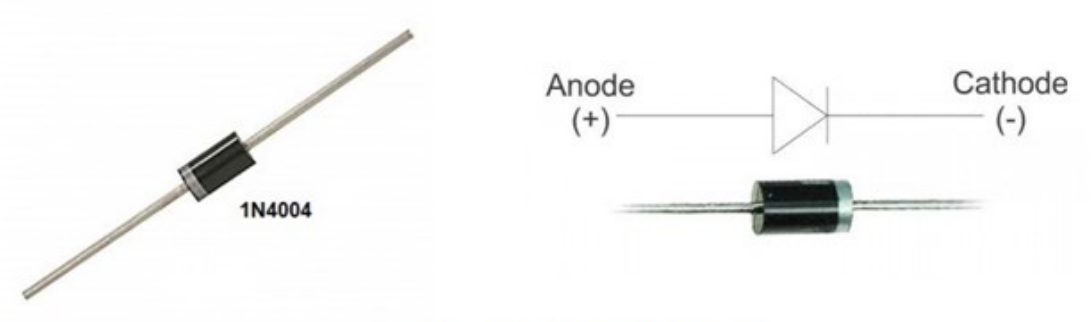

Fig-10: 1N4004 Diode

3.11 Resistor

A resistor is a passive two terminal component which opposes the flow of current. It's opposing property is called as resistance.The unit is ohm for resistance. The current I in amperes flowing through a resistor of resistance R is given by

$$I = \frac{V}{R}$$

The power consumption in watts by a resistor is given by

$$P = I^2 \times R = I \times V = V^2 / R$$

Resistance is also given by

$$R = \rho \times \frac{l}{A}$$

Resistance in other words can be defined as the very opposing nature of a conductor to oppose the current flow. It is proportional to the voltage difference in two points of a conductor and inversely proportional to the current flowing in the conductor. It is obtained by ohms law.

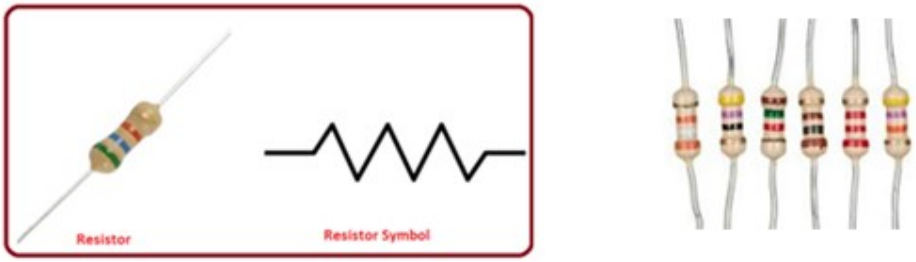

Fig-11: Resistor

3.12 Capacitor

A capacitor is an electrical component storing electrical energy. The property possessed by it is known as capacitance. In this project we have used 0.1 micro farad and 1 nano farad and 150 pico farad capacitors.

Capacitor is linear and bilateral device. Capacitor follows Ohm's law, so it is a linear device. Current in capacitor can flow through both the sides or directions of a capacitor, hence for it is a bilateral device.

Capacitor has two terminals and current can flow through any of these terminals. The measure of the capacitor is capacitance and the unit is 'Farad'.

In the market there are several capacitors available with variety of types (ceramic and electrolyte etc.) and of different capacitance values.

Here in this project we have used both ceramic and electrolyte capacitors. Three 1 nano farad capacitors among which two is coonected with crystal oscillator in order to provide sustained frequency and another is used for reset of AT89C52 microcontroller.

0.1 micro farad and 150 pico farad capacitors are used with load and ADC converter respectively in order to provide stability by providing smooth current fluctuation.

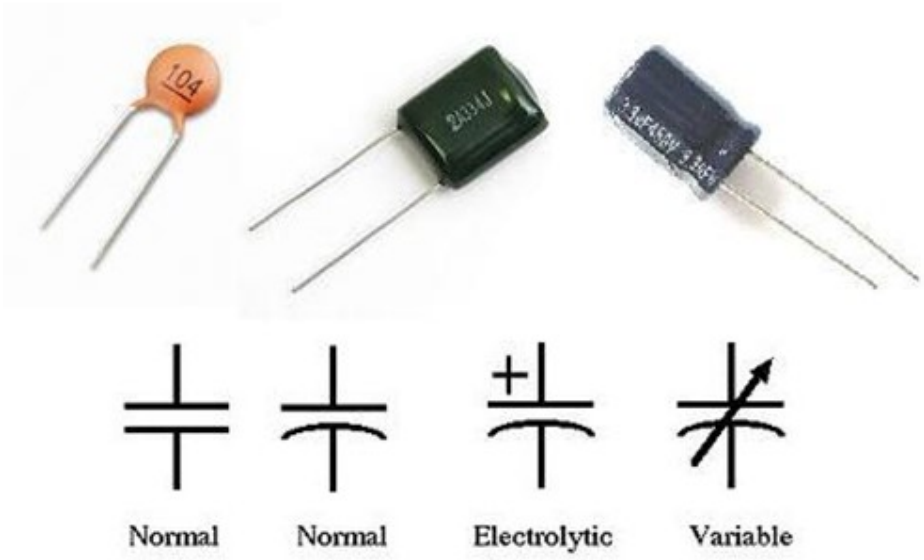

Fig-12: Capacitor

3.13 Battery

Battery is a device which is having many electrochemical cells in it in series or in any fashion in order to store desired quantity of electrical energy.

The electrical energy which is stored in battery can afterwards be used for supplying power to any other device or circuit depending upon the neccessity or requirements or the demand.

The batteries can be AC type or DC type with different values. Here in our project we are using a DC battery of 9 Volts with the help of resistor which we are making as 5V. It can supply the power of 12Watts.

Here the battery is used as a power supply device and with the help of a battery clip it is provided or connected to the system.

Here in this project the power supply is used for many things as follows:

1. To operate AT89C52 microcontroller
2. To operate LCD
3. To operate ADC
4. To operate phototransistor otpcoupler
5. To operate LM35 temperature sensor

Fig-13: Battery

3.14 Switch

A switch is an electrical component which can make a circuit open or closed. The power switch operates normal 'On/Off' operation by means of changing the position of the switch.

There are several types of switches available in the market. Here in this project push button is used in order to reset the AT89C52 microcontroller. Also power switch is used here in order to turn ON or OFF the DC supply to the system.

Fig-14: Switch

3.15 Breadboard

It is a device for testing the circuit designs. There is no need of soldering in it as done in case of pcb's.

Breadboard is an electrical equipment which serves as a base for many circuit designs instead of using PCBs and other complex equipments.

Breadboard is used for testing many circuit designs before they can be implemented for PCBs.

The breadbord consists of several holes in it with electric conductor metal plate below.

The components required for a particular circuit design is attached through the holes of the breadboard.

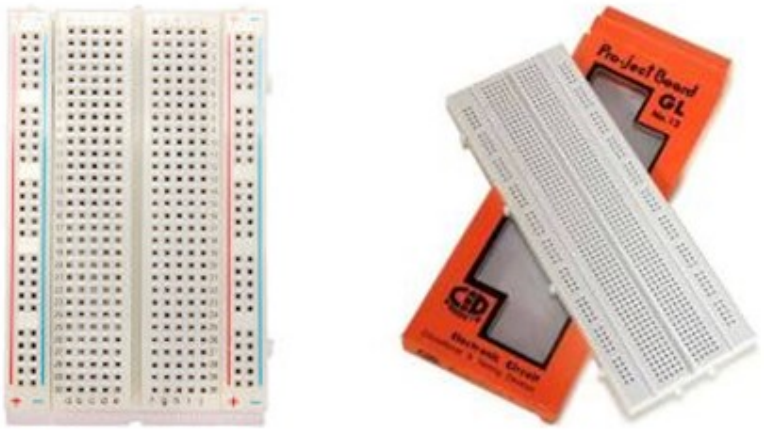

Fig-15: Breadboard

3.16 Connecting Wires

These are used to connect various components in the circuit building .In our project we have used male to male jumper wires as connecting wires.

The wires are basically are the metal rods which allows the current flow through it. Wires are of various types depending upon the applications such as:

1. Single Strand Wires
2. Multi Strand Wires
3. Jumper Wires

Here we have used some single strand and some jumper wires. Jumper wires are basically connectors. It can be male-male, male-female, female-female connectors.

Fig-16: Connecting Wires

CHAPTER 3

Block Diagram

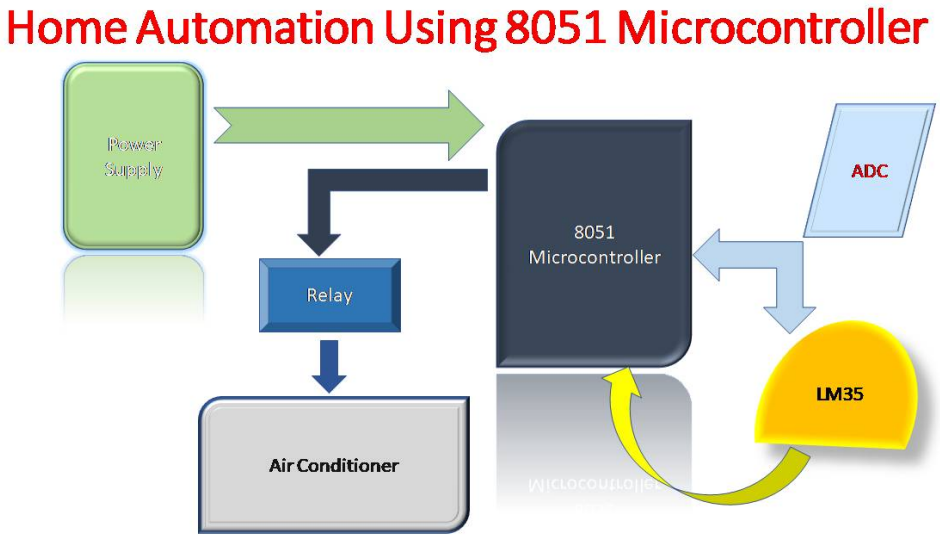

Fig-17: Block Diagram

CHAPTER 4

4.1 Circuit diagram

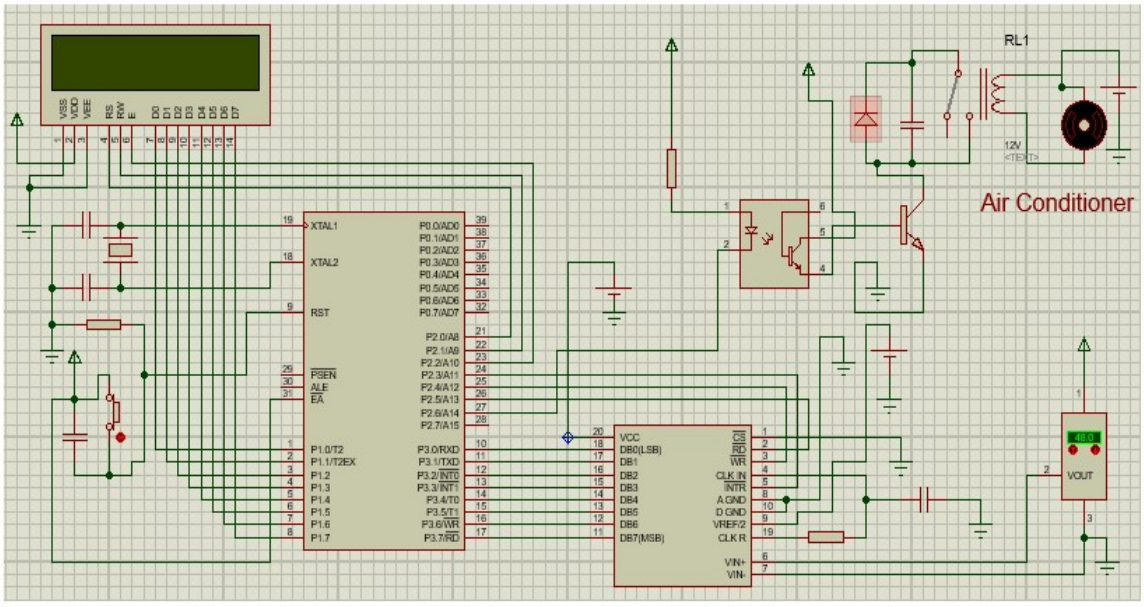

Fig-17: Circuit Diagram

4.2 Circuit description

The power supply is connected to AT89C52 microcontroller, LCD, ADC, phototransistor otpcoupler, LM35 temperature sensor.

The power supply is given to LM35 temperature sensor to 1st terminal. For the temperature reading the output voltage terminal (2nd terminal) of LM35 temperature sensor is connected to 6th Pin of ADC or Analog to digital converter (VIN+ Pin). The 3rd terminal of LM35 temperature sensor is grounded.

Following chart describes the connection of pins between ADC Analog to digital converter and AT89C52 microcontroller:

ADC or Analog to digital converter	AT89C52 microcontroller
Pin 18 or DB0 (LSB)	Pin 10 or Port 3.0
Pin 17 or DB1	Pin 11 or Port 3.1
Pin 16 or DB2	Pin 12 or Port 3.2
Pin 15 or DB3	Pin 13 or Port 3.3
Pin 14 or DB4	Pin 14 or Port 3.4
Pin 13 or DB5	Pin 15 or Port 3.5
Pin 12 or DB6	Pin 16 or Port 3.6
Pin 11 or DB7 (MSB)	Pin 17 or Port 3.7
Pin 5 or INTR’	Pin 24 or Port 2.3
Pin 3 or WR’	Pin 25 or Port 2.4
Pin 2 or RD’	Pin 26 or Port 2.5

Also in ADC, Pin 20 or VCC is used for power supply and Pin 7 or VIN- is connected to ground. Other Pins of ADC are used for proper circuitry with the help of resitor and capacitor.

Following chart describes the connection of pins between LCD or Liquid Crystal Display and AT89C52 microcontroller:

AT89C52 microcontroller	LCD or Liquid Crystal Display
Pin 1 or Port 1.0	Pin 7 or D0
Pin 2 or Port 1.1	Pin 8 or D1
Pin 3 or Port 1.2	Pin 9 or D2
Pin 4 or Port 1.3	Pin 10 or D3
Pin 5 or Port 1.4	Pin 11 or D4
Pin 6 or Port 1.5	Pin 12 or D5
Pin 7 or Port 1.6	Pin 13 or D6

Pin 8 or Port 1.7	Pin 14 or D7
Pin 21 or Port 2.0	Pin 4 or RS
Pin 22 or Port 2.1	Pin 5 or RW
Pin 23 or Port 2.2	Pin 6 or E

The 9th Pin or RST and 31st Pin or EA' are connected to power supply by means of switch with the help of resistor and capacitor in order to function the reset operation and enable access operation for AT89C52 microcontroller respectively.

Pin 19 (XTAL1) and Pin 18 (XTAL2) are connected to crystal oscillator which is further connected to two 1nF electrolyte capacitor in order to provide precise and sustain frequency of 1MHz.

In LCD or Liquid crystal display the pin 1 (VSS) and pin 3 (VEE) are connected to ground and pin 2 (VDD) is connected to power supply.

Coming to phototransistor optocoupler 1st and 5th terminal are connected to power supply with resistor of 330ohm. The input terminal or 2nd terminal of phototransistor optocoupler is connected to Pin 27 or port 2.6 of AT89C52 microcontroller.

The output terminal or 4th terminal of phototransistor optocoupler is connected to the base of TIP122 transistor. The emitter of TIP122 transistor is grounded and the collector is connected to the load (for main project-air conditioner, for simulation-DC Fan).

The input for the load (for main project-air conditioner, for simulation-DC Fan) is main power supply also for the concept of the project which is to control it automatically the another input is taken from collector terminal of TIP122 transistor with diode and capacitor (connected in parallel) for circuit stability.

Also for main project the load (air conditioner) is connceted with relay for due to AC supply and higher voltage compared to other devices of the system which works on DC supply. But for simulation the load is DC fan, so relay is not rquired.

CHAPTER 5

Working Procedure

All the working procedure is given below in steps with necessary mathematical calculation.

Step-1:

All the power supplies to the system is given by turning on the main power switch. Let us consider initially the room temperature is high, more than 25 degree celsius (assume 40 degree celsius).

Step-2:

The room temperature is sensed and read by LM35 temperature sensor and it is converted to equivalent amount of analog voltage signal output.

For 1 degree celsius tempearture equivalent output volatge is 10mV. For 40 degree celsius it is = $40*10*10^{-3}$ Volts=400mV=0.4Volts.

Step-3:

The 0.4V analog volatge signal is feeded as input for ADC or analog to digital converter. The following formula is used for getting the digital output of ADC:

Using the above formula N=8 here, V_{ref}=5V, $V_{in(analog)}$=0.4V

So, ADC reading=(2^8*0.4)/5=20.48 (in decimal)

ADC reading in binary = 00010100 [considering only integer part that is 20 in decimal]

Step-4:

The digital output of ADC is fed into AT89C52 microcontroller as input of temperature reading. With the help of the program (coding) the temperature reading is displayed on LCD (i.e Tempearture 40 degree celsius).

Step-5:

As the temperature is higher than 25 degree celsius (now 40 degree celsius) the air conditioner should be turned on with less temperature of air conditioner. The state of air conditioner is diplayed on LCD (i.e A.C ON) below temperature reading.

Step-6:

As the room temperature decreases the temperature of air conditioner increases gradually and when the room temperature is below 25 degree celsius it is turned off aoutomatically by the command of AT89C52 microcontroller.

CHAPTER 6

6.1 Simulation Diagram

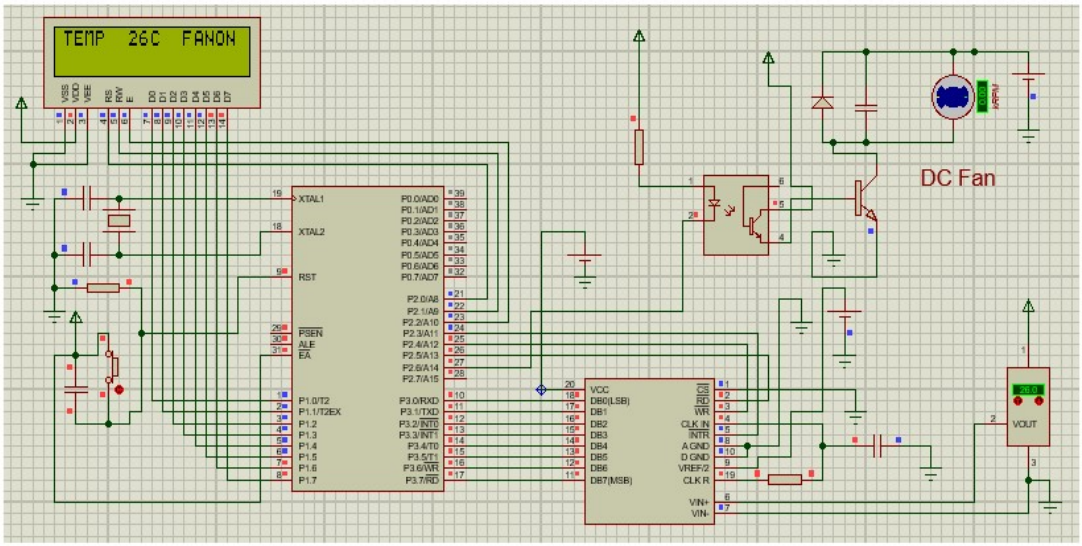

Fig-18: Simulation Circuit

For simulation the only change done is here intead of air conditioner, DC fan is used as load. The working procedure is same as main project as previously discussed.

Here with the rise in room temperature fan speed incresaes and with decrease in room temperature the fan speed decreases gradually and below 25 degree celsius the fan is turned off.

6.2 Program

```
#include<reg51.h>
#define MYDATA P3
#define ldata P1
#define FL3i 35
#define FL2ii 35
#define FL2i 30
#define FL1ii 30
#define FL1i 25
#define NLii 25
#define NLi 20
#define HL1i 20
#define HL1ii 10
#define HL2i 10
#define HL2ii 00


sbit rd=P2^5;
sbit wr=P2^4;
sbit INTR=P2^3;
sbit rs=P2^0;
sbit rw=P2^1;
sbit en=P2^2;
sbit MTR=P2^6;
sbit busy=P1^7;


void lcdInit(){
lcdCmd(0x38);
lcdCmd(0x0c);
lcdCmd(0x01);
lcdCmd(0x80);
return;
}

void lcdData(char value){
ldata=value;
rs=1;
rw=0;
en=1;
en=0;
return;
}

void display(char d1,char d2){
      lcdData(d2);
      msDelay(30);
      msDelay(30);
      lcdData(d1);
      msDelay(30);
      msDelay(' ');
      msDelay(30);
      lcdData('C');
}
```

```
void msDelay(unsigned int value){
unsigned int x,y;
for(x=0;x<value;x++)
            for(y=0;y<1275;y++);
      }

      void lcdReady(){
      busy=1;
      rs=0;
      rw=1;
      while(busy==1)
      {
      en=0;
      en=1;
      }
      return;
      }

      void lcdCmd(unsigned char value){
      lcdReady();
      ldata=value;
      rs=0;
      rw=0;
      en=1;
      en=0;
      return;
```

```
      void convert(char value){
            char y,d1,d2,d3;
      y=value/10;
      d1=value%10;
      d2=y%10;
      d3=y/10;
      d1=d1|0x30;
      d2=d2|0x30;
      d3=d3|0x30;
      display(d1,d2); }

void update(char value){
      char y,d1,d2,d3;
      y=value/10;
      d1=value%10;
      d2=y%10;
      d3=y/10;
      d1=d1|0x30;
      d2=d2|0x30;
      d3=d3|0x30;
      lcdData(d2);
      msDelay(30);
```

```
 while(value>=FL2i  &
  value<FL2ii){

lcdCmd(0xc0);
for(i=0;i<12;i++){
      msDelay(30);

 }
bkl2:
MTR=0;
      msDelay(75);
      MTR=1;
      msDelay(25);
      value=adcRead();
if(value>=FL2i && value<FL2ii){
      lcdCmd(0x86);
      update(value);
      goto bkl2;
 }
else
break;
}
```

```
while(value>=FL3i){

      lcdCmd(0xc0);
      for(i=0;i<12;i++){
            msDelay(30);

       }
      bkl3:
      MTR=0;
      value=adcRead();
      if(value>=FL3i){
            lcdCmd(0x86);
            update(value);
            goto bkl3;
       }
      else
      break;
      }


       }
 }
}
```

```
                  void main(){ /*Main function starts.Execution
begins from here.*/
                   P0=0xff;   /*Setting all pins of P0 to ls to
make it as output port in negative logic*/
                   MYDATA=0xff; /*Setting all pins of P3 to ls to
make it as input port in positive logic*/
                   INTR=1;/*Active low signal therefore initialised
as high.*/
                   rd=1;/*Active low signal therefore initialised
as high.*/
                   wr=1;/*Active low signal therefore initialised
as high.*/
                   MTR=1;/*Active low is required to drive
optocoupler,so initialised as high.*/

                   msDelay(50);

                   lcdInit();/*Initialises LCD with appropriate
Display Setting*/
                   motorcontrol();/*Calls motorcontrol()
subroutine*/
                   } /*main function closed*/
```

CHAPTER 7

7.1 RESULT

The whole system works properly and the following output is obtained:

- Temperature reading detected
- 8051 running properly with the program
- Air Conditioner is turning off/on automatically

Hence the home automation is done using 8051 microcontroller where using LM35 and AT89C52 the air conditioner is operating automatically according to room temperature.

7.2 Application

The whole system except can be used for controlling

1. Air conditioners
2. Fans
3. Motors
4. Coolers
5. Heaters etc.

Chapter 8

Conclusion

- Normally Air Conditioners are expensive. So, adding this small circuit which costs around Rs. 1000/- will not increase the cost to higher extent.
- But for other home appliances which are less expensive the circuit price may matter or may not also.

Chapter 9

References

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