Short description: This project is for keeping temperature of a Greenhouse within a specified range. If the temperature is less than the lower limit, lights will be made ON (to increase the temp) and if it is more than the higher limit, fans will be made ON (to cool the house). The opposite will happen in the opposite cases. When the temp will be within the limit, all lights and fans will be put OFF to save power.

Introduction:

Control system for greenhouse is designed to protect the plants from more cool and hot weather and additional control system is included to save power by making fans and lights automatically turn on and off with the help of this control system. In this project, the intelligent control system is developed using ATmega32 microcontroller (AVR) and temperature sensor. Green house system has a very important use nowadays in the agricultural field. Some plants need the specific temperature to grow and grow flowers or fruits. This system can change and control temperature for different crops as need.

The air temperature can be the main environmental component that is responsible for proper growth of crops like tomato. The maximum growth of tomato occurs at the day and night temperature of approximately 25 C. The maximum fruit production occurs with night temperature of 18 C and day temperature of 20C. Naturally the air temperature changes as per the season. The lower temperature (below 18 C) can result in cat facing and higher temperature (above 25 C) results in cracking of tomatoes.

It is possible to control the temperature of greenhouse in the range 180C to 250C by using the microcontroller with suitable temperature sensor. The signal produced by the sensor is analog in nature, which is converted into digital form by Analog to Digital Converter (ADC). This signal is then processed by the microcontroller. The objective of this work was to design optimized technique by developing an electronic model to control temperature of a greenhouse in the range 180C to 250C which is suitable for proper growth of tomatoes. An electronic model is developed by using AVR microcontroller ATmega32 & temperature sensor with some circuit components to control the temperature of greenhouse tomatoes.

Design of the Project in Proteus:

This project uses

- Atmega32a as microcontroller AVR
- LM35 as Temperature sensor
- L293D as control driver unit
- 2 pin Pushbuttons to take input form users
- 16x2 LCD as display (LM016L)
- 1k ohm registers
- 12v DC fan
- 12v DC light

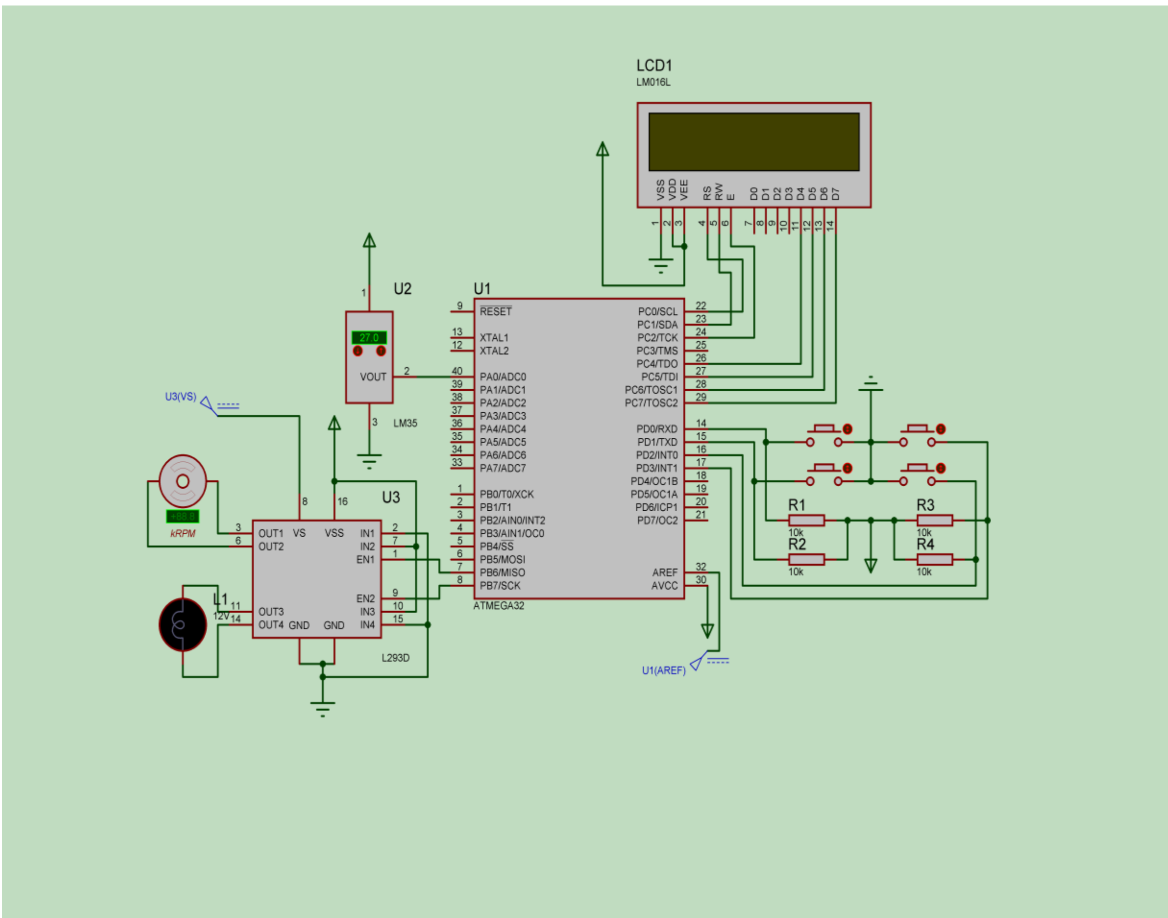
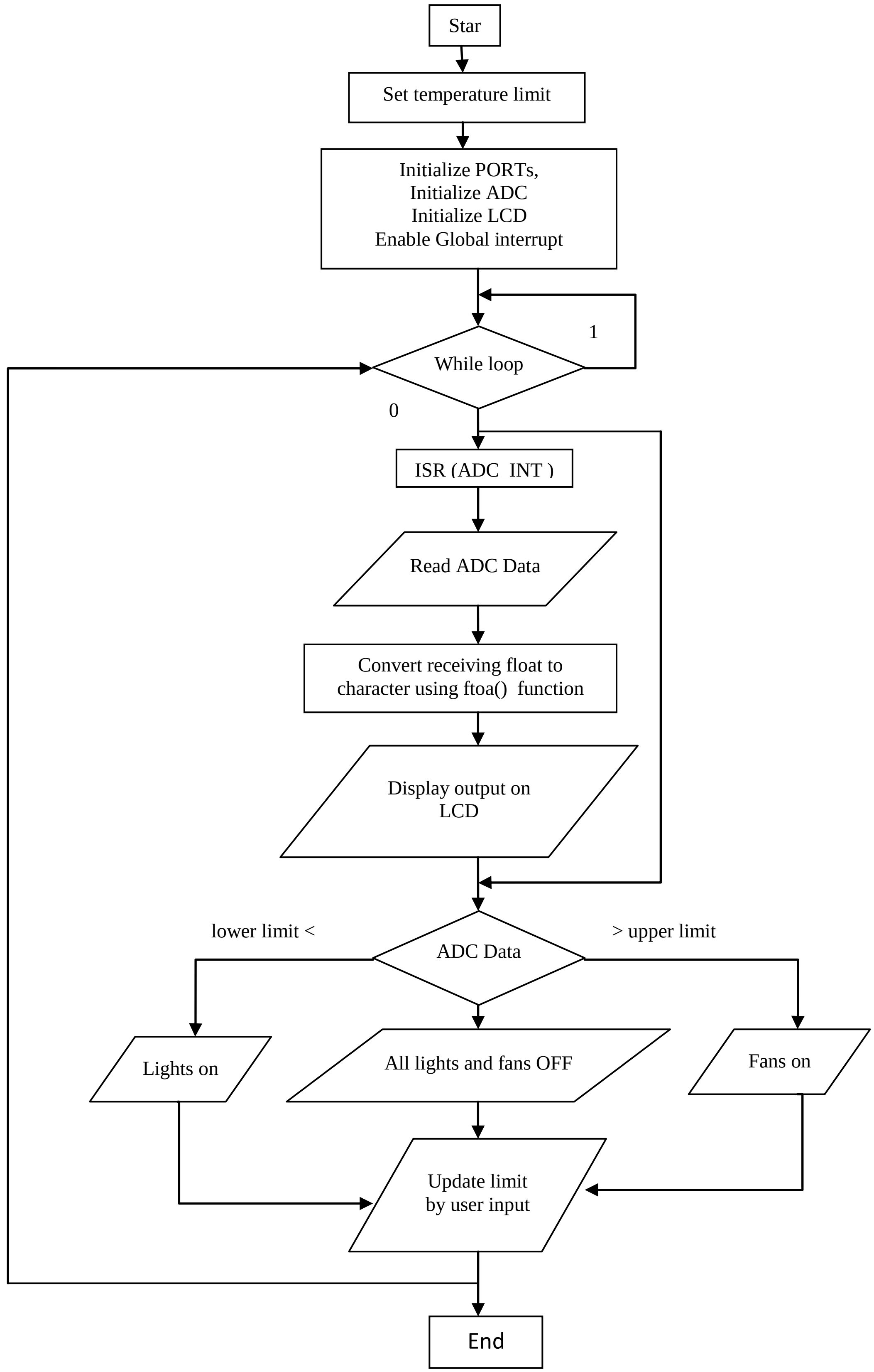


Figure 1: Design of the system in Proteus

Flow chart of the program developed:



Program code:

```
#include <mega32.h>
#include <delay.h>
#include <stdlib.h>
#include <alcd.h>
#define push1 PIND.0
#define push2 PIND.1
#define push3 PIND.2
#define push4 PIND.3

float adc_data;
char up[5], low[5];
float up_limit=25, low_limit=18;

void disp_limit()
{
      delay_ms(110);
      ftoa(low_limit,0,low);
      ftoa(up_limit,0,up);
      lcd_gotoxy(0,1);
      lcd_puts("Limits: ");
      lcd_puts(low);
      lcd_puts(" - ");
      lcd_puts(up);

}
interrupt [ADC_INT] void adc_isr(void)
{

    char disp[16];
    // Read the AD conversion result
    adc_data=ADCW/4; //1.5/10.24;
    ftoa(adc_data,2,disp);
    lcd_gotoxy(0,0);
    lcd_puts("Temp: ");
    lcd_puts(disp);
    lcd_puts(" C");

}

void main(void)
{
        ADMUX=0b11000000;
ADCSRA=(1<<ADEN) | (0<<ADSC) | (0<<ADATE) | (0<<ADIF) | (1<<ADIE) | (1<<ADPS2) |
(1<<ADPS1) | (1<<ADPS0);
```

```
lcd_init(16);
lcd_clear();
#asm("sei")
DDRB=0xFF;
DDRD=0x00;
PORTB=0x00;

while (1)
      {
      //delay_us(10);
      ADCSRA |= (1<<ADSC);
      delay_ms(10);

      if(adc_data<low_limit)   PORTB =0x80;
      else if(adc_data>up_limit)   PORTB = 0x40;
        else PORTB = 0x00;

      //limit
      disp_limit();
      if(push1==0&&up_limit>low_limit) {
        low_limit+=1;
        disp_limit();
        }
      if(push2==0) {
       low_limit-=1;
       disp_limit();
        }
      if(push3==0&&up_limit>low_limit) {
        up_limit-=1;
        disp_limit();
        }
      if(push4==0) {
       up_limit+=1;
       disp_limit();
        }

      }
}
```

Output of the project in Proteus:

- Light on & fan off:

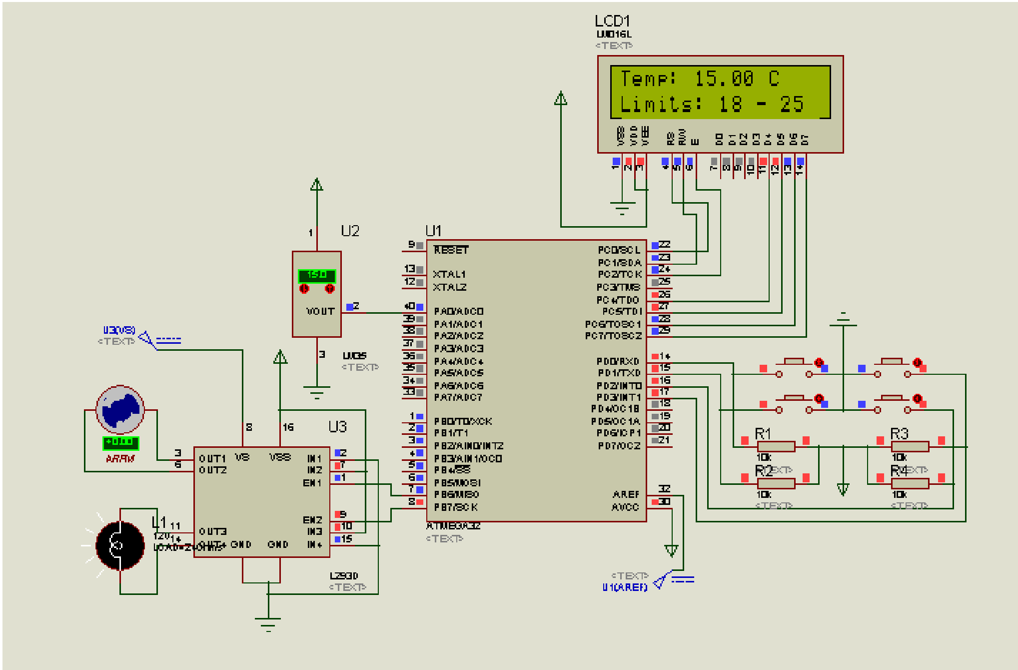


Figure 2: When temp is low light stays on

- Fan on & light off:

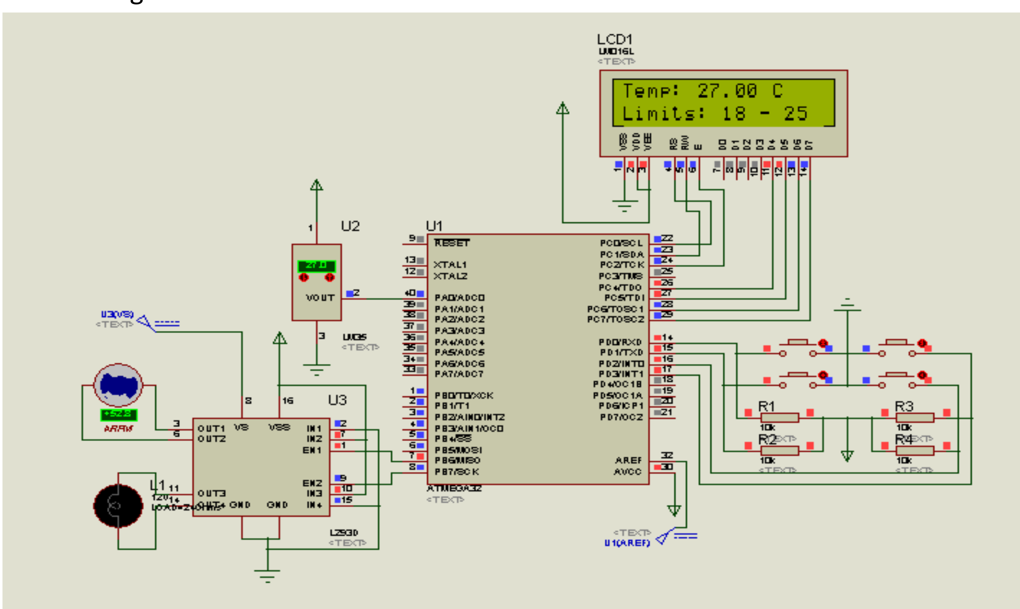


Figure 3: When temp is higher then limit fan goes on

- Both fan and light off:

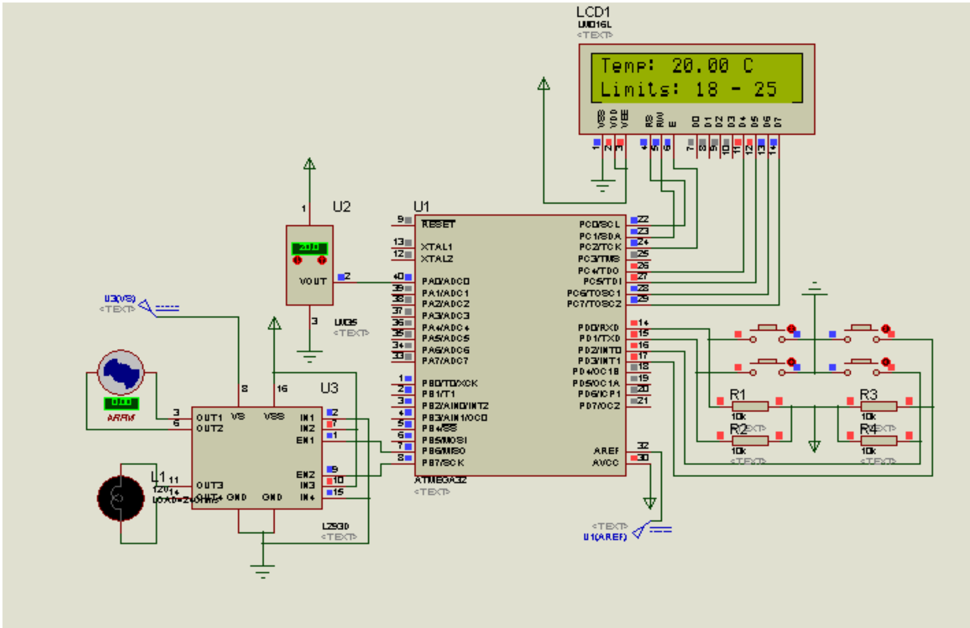


Figure 4: when temp is in limit both fan and light is off (saving power)

Limitation of the project:

Though this project meets it's required factors, it's ignores some other environmental factors like humidity, moisture. As those factors are as important as temperature, they can very much change the overall environment of greenhouse and effect the growths of crops in greenhouse. Besides, the lights and fans placement is not discussed in this project. Placing the lights and fans can help us save a lot of energy.

Approximate Production cost:

Table 1: BOM of control system for green house

Name	Quantity	References	Value	Price per unit (Tk)
Resistors	4	R1-R4	1K	
IC	3	U1	ATMEGA32	180.00
		U2	LM35	45.00
		U3	L293D	35.00
Miscellaneous	2	Fan, L1	12V	
		LCD1	LM016L	130.00
			Total	**390.00**

*Approximate production cost also includes cabling cost and additional tool cost, which is exclusive from the above total.

Scope of Future works:

This system has a wide variety of scope for future work. Those are..

- Wireless communication can be introduce to the system and minimize cabling cost
- This system can also include other environmental factors such as light, humidity and moisture.
- System can be optimized by adding an ideal temperature chart of different crops and let the user chose from those options.
- Data form the sensor can be collect and analyze for further application; such as giving user the advice to plant specific crops to reduce power consumption and get best results.

Conclusion:

In this work, a design and simulation of greenhouse temperature monitoring and control system has been proposed. This system is able to collect the information of temperature inside the greenhouse. And have the ability to keep the temperature in a user define limit by using simple fans and lights. The analog signals a temperature sensor is converted into digital values utilizing the capability of ATMEGA32 via its analog to digital converter for the end devices. Because the overall design allows the fans and lights to be off at the selected temperature and only one either fan or light can be on, required power of system has been reduced, also the system is simple and easy to use.