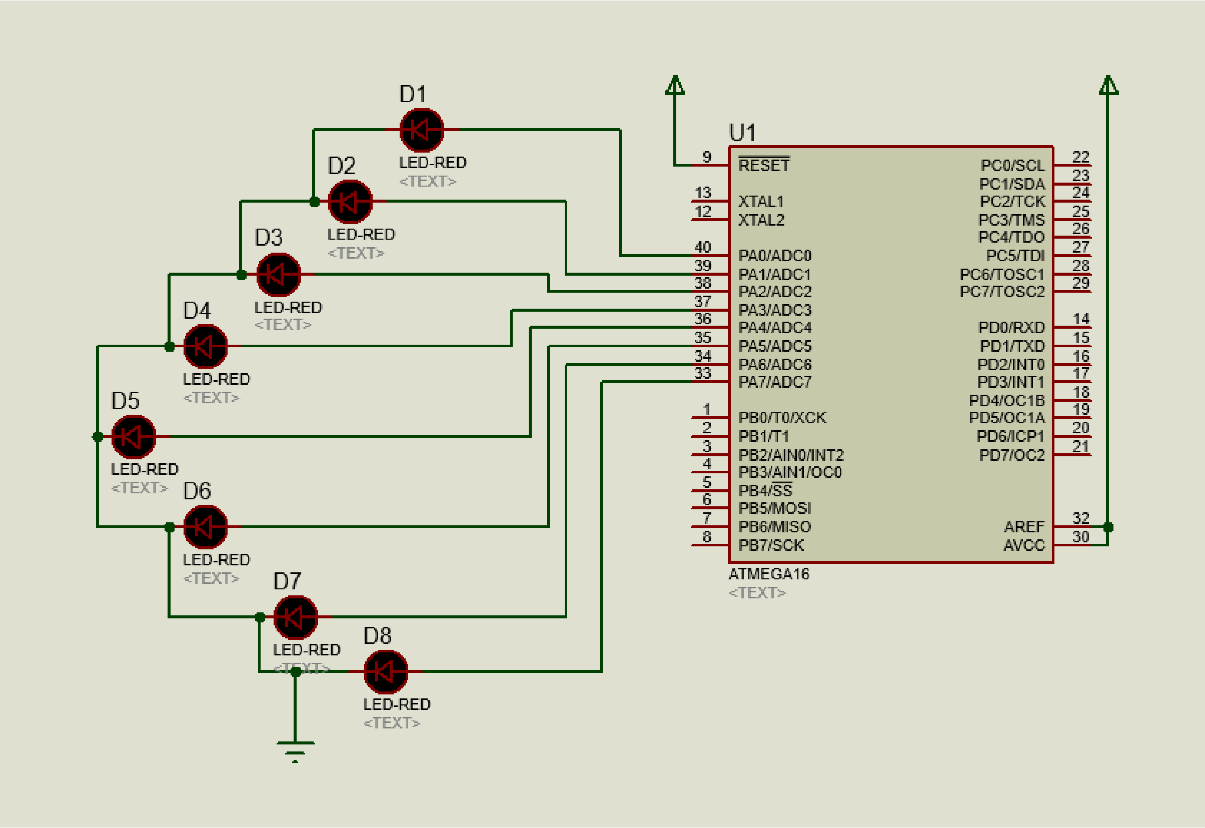
INTRODUCTION TO AVR PROGRAMMING WITH PROTEUS

P1: INTERFACING LED WITH ATMEGA16

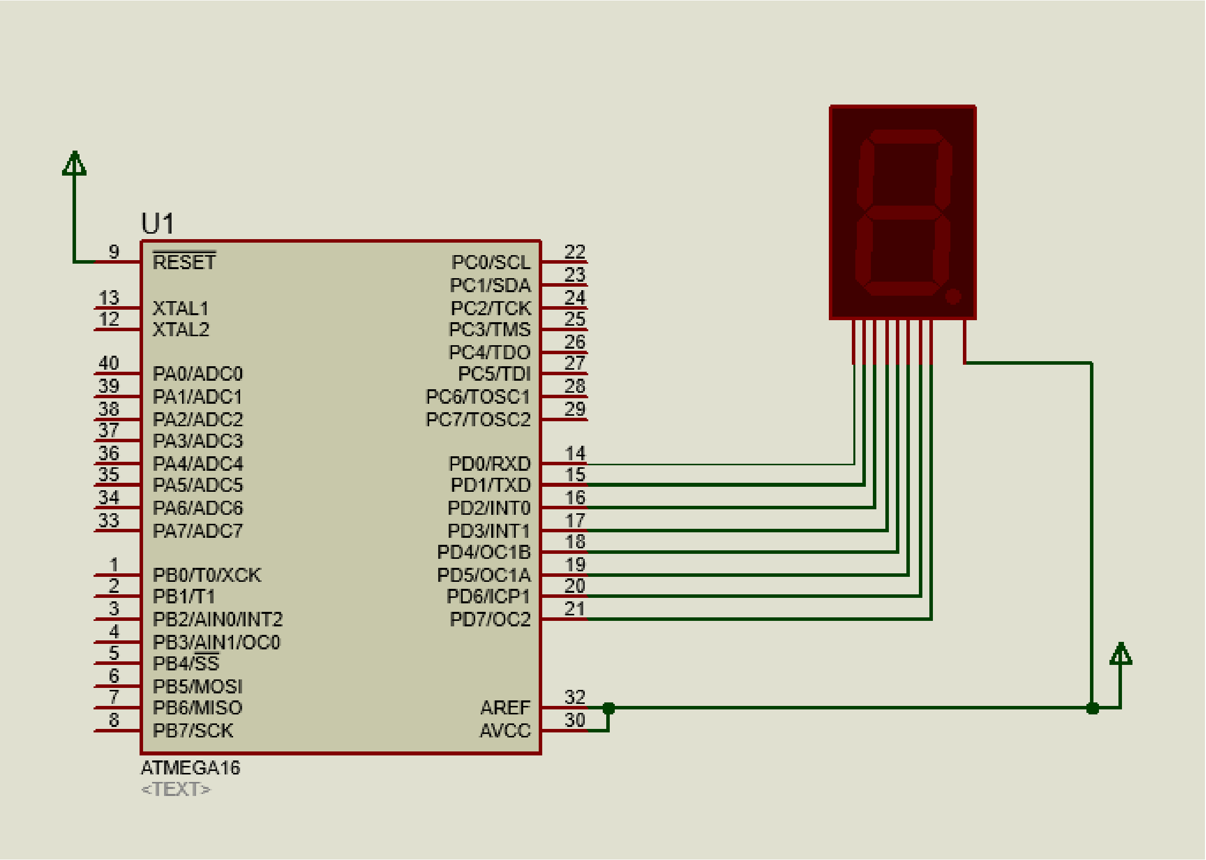


Code in Microchip Studio:

```
/*
 * P1_LedBlink.c
 *
 * Created: 12-03-2021 10:37:34
 * Author: Jervis
 */
#define F_CPU 1000000UL
#include <avr/io.h>
#include <util/delay.h>

int main(void)
{
        DDRA = 0b00000000;
        // Write your code here
        while (1)
        {
                PORTA = 0b11110000;
                _delay_ms(1000);
```

```
                    PORTA = 0b00001111;
                    _delay_ms(1000);
          }
}
```

P2: INTERFACING SINGLE SEVEN SEGMENT WITH ATMEGA16

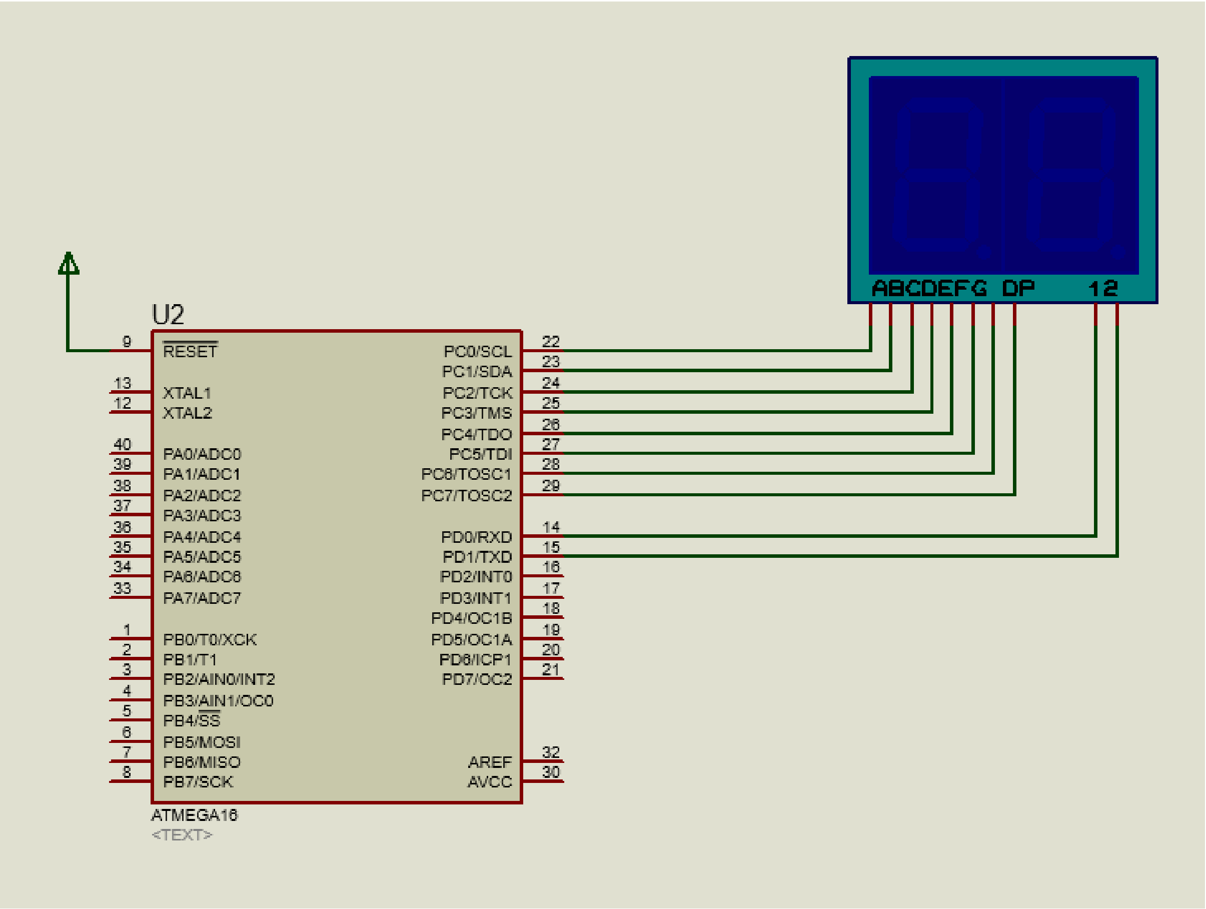


Code in Microchip Studio:

```
/*
 * P2_Single_Seven_Segment.c
 *
 * Created: 12-03-2021 11:00:09
 * Author : Jervis
 */
#define F_CPU 1000000UL
#include <avr/io.h>
#include <util/delay.h>
#define Direction_led DDRD
#define Port_led PORTD
```

```
int main(void)
{
        Direction_led |= 0xff;
        Port_led |= 0xff;
        int n[10]={0xC0,0xF9,0xA4,0xB0,0x99,0x92,0x82,0xF8,0x80,0x90};
        unsigned int i;
   /* Replace with your application code */
   while (1)
   {
                for(i=0; i<10; i++ ){
                        Port_led = n[i];
                        _delay_ms(1000);
                }
   }
}
```

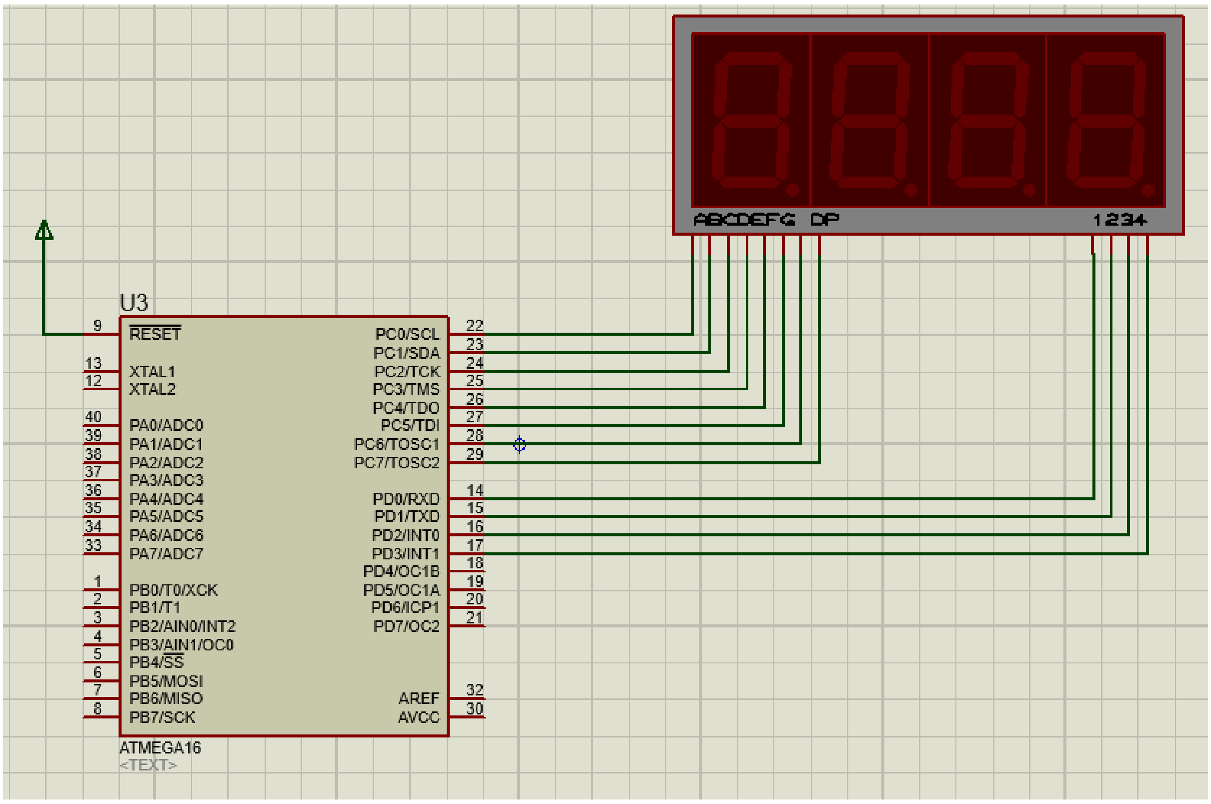
P3: INTERFACING DOUBLE SEVEN SEGMENT WITH ATMEGA16



Code in Microchip Studio:

```
/*
 * P3_Double_Seven_Segment.c
 *
 * Created: 12-03-2021 11:21:05
 * Author : Jervis
 */

#define F_CPU 1000000UL
#include <avr/io.h>
#include <util/delay.h>
#define Direction_led DDRD
#define Direction_led2 DDRC
#define Port_led PORTD
#define Port_led2 PORTC

int main(void)
{
        Direction_led = Direction_led2 = 0xff;
        int n[10]={0xC0,0xF9,0xA4,0xB0,0x99,0x92,0x82,0xF8,0x80,0x90};
        unsigned int i,j,p;

   while (1)
   {
                for(j=0; j<=5;j++){
                        for(i=0; i<=9; i++ ){
                                for(p=1; p<=48; p++){
                                        Port_led = 0x01;
                                        Port_led2 = n[j];
                                        _delay_ms(5);
                                        Port_led = 0x02;
                                        Port_led2 = n[i];
                                        _delay_ms(5);
                                }
                        }
                }
   }
}
```

P4: INTERFACING FOUR SEVEN SEGMENT WITH ATMEGA16

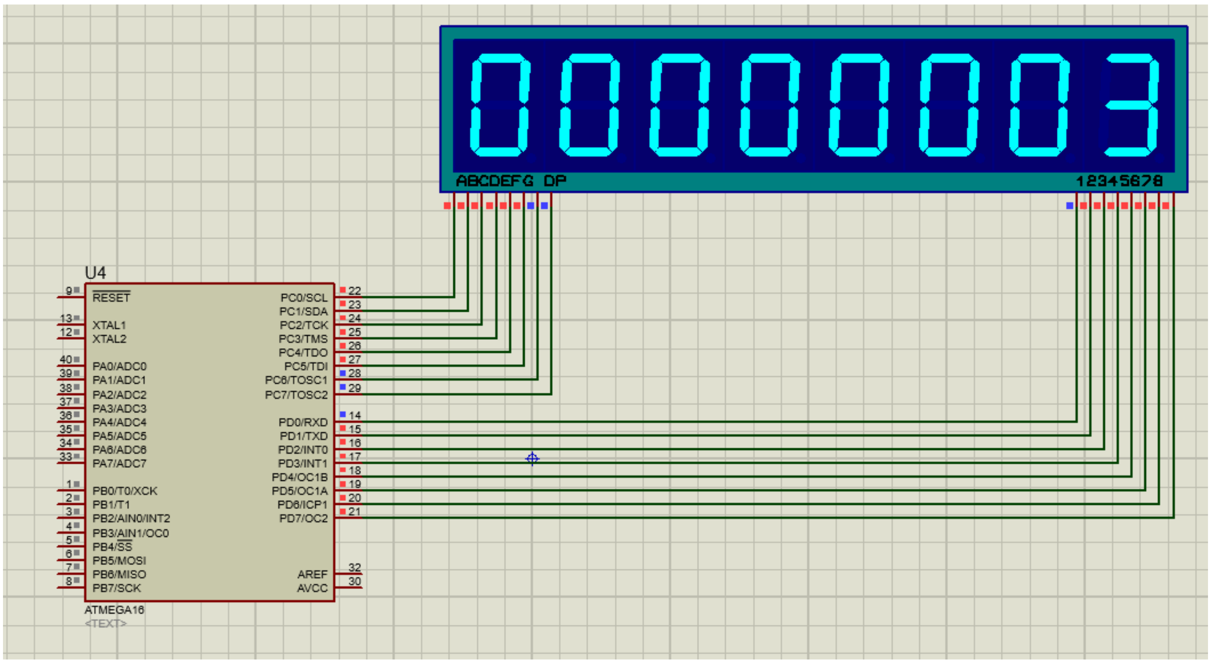


Code in Microchip Studio:

```
#include <avr/io.h>
#include <util/delay.h>

int main(void)
{
        DDRC = DDRD = 0xff;

        int a[10] = {0x3f,0x06,0x5b,0x4f,0x66,0x6d,0x7d,0x07,0x7f,0x6f};

        while(1)
        {
                for (int l =0; l<=9;l++)
                {
                        for (int k = 0;k<=9;k++)
                        {
                                for (int j =0; j<=9;j++)
                                {
                                        for (int i =0; i<=9;i++)
                                        {

                                                for (int p =1; p<=25;p++)
                                                {
```

```
                            PORTD = 0b00001110;
                            PORTC = a[l]; _delay_ms(10);

                            PORTD = 0b00001101;
                            PORTC = a[k]; _delay_ms(10);

                            PORTD = 0b00001011;
                            PORTC = a[j]; _delay_ms(10);

                            PORTD = 0b00000111;
                            PORTC = a[i]; _delay_ms(10);

                        }
                    }
                }
            }
        }
    }
}
```

P5: INTERFACING FOUR SEVEN SEGMENT WITH ATMEGA16

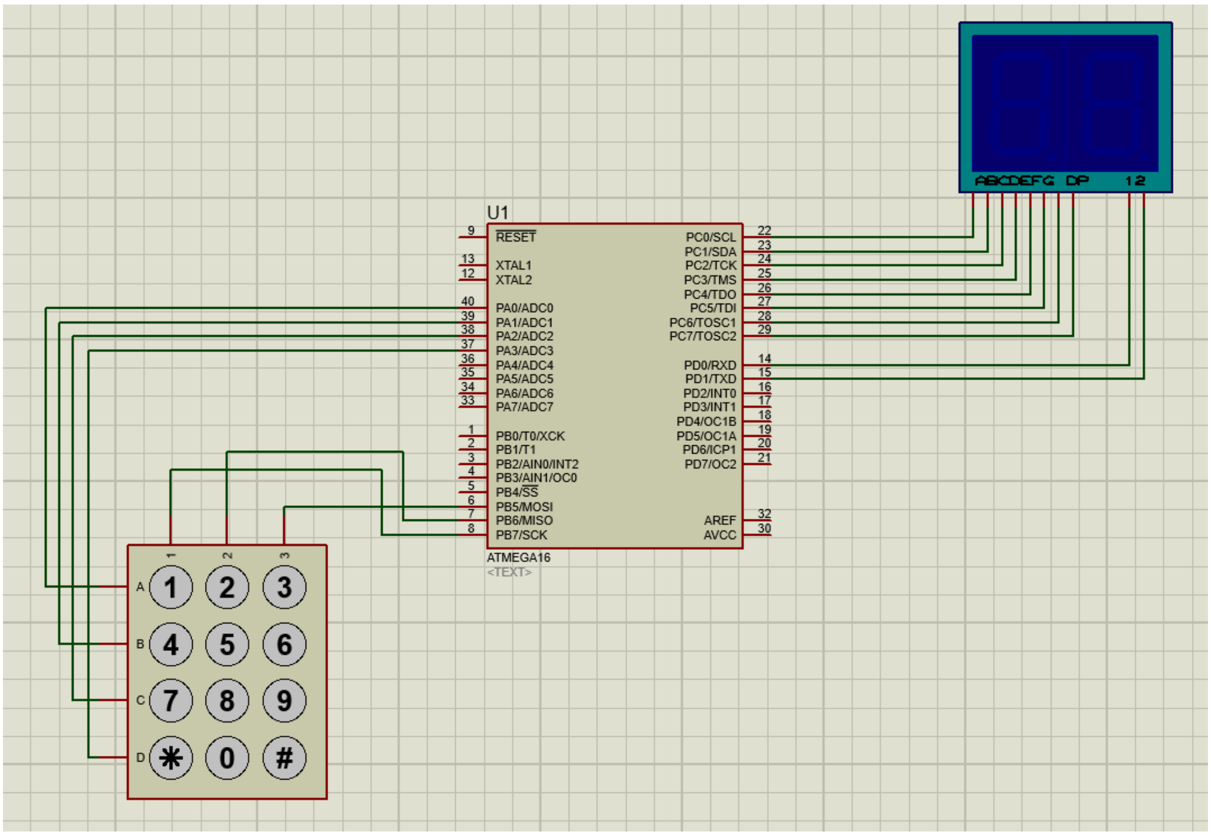


Code in Microchip Studio:

```
/*
 * P5_Eight_Seven_Segment.c
 *
 * Created: 13-03-2021 14:19:37
 * Author : Jervis
 */
#define F_CPU 1000000UL
#include <avr/io.h>
#include <util/delay.h>
#define DC DDRC
#define DD DDRD
#define PC PORTC
#define PD PORTD

int main(void)
{
        DC = DD = 0xff;

   int a[10] = {0x3f,0x06,0x5b,0x4f,0x66,0x6d,0x7d,0x07,0x7f,0x6f};
        unsigned int i,j,k,l,m,n,o,p,r;
   while (1)
   {
                for (i=0;i<10;i++)
                {
                        for (j=0;j<10;j++)
                        {
                                for (k=0;k<10;k++)
                                {
                                        for (l=0;l<10;l++)
                                        {
                                                for (m=0;m<10;m++)
                                                {
                                                        for (n=0;n<10;n++)
                                                        {
                                                                for (o=0;o<10;o++)
                                                                {
                                                                        for (p=0;p<10;p++)
                                                                        {
                                                        for (r=1;r<=48;r++)
                                                                {
                                PORTD = 0b11111110;
                                PORTC = a[i]; _delay_ms(2);
                                PORTD = 0b11111101;
                                PORTC = a[j]; _delay_ms(2);

                                PORTD = 0b11111011;
                                PORTC = a[k]; _delay_ms(2);

                                PORTD = 0b11110111;
                                PORTC = a[l]; _delay_ms(2);

                                PORTD = 0b11101111;
                                PORTC = a[m]; _delay_ms(2);

                                PORTD = 0b11011111;
                                PORTC = a[n]; _delay_ms(2);
```

```
                                         PORTD = 0b10111111;
                                         PORTC = a[o]; _delay_ms(2);

                                         PORTD = 0b01111111;
                                         PORTC = a[p]; _delay_ms(2);
                                                                                  }
                                                                          }
                                                                  }
                                                         }
                                                 }
                                         }
                                 }
                         }
                 }
   }
}
```

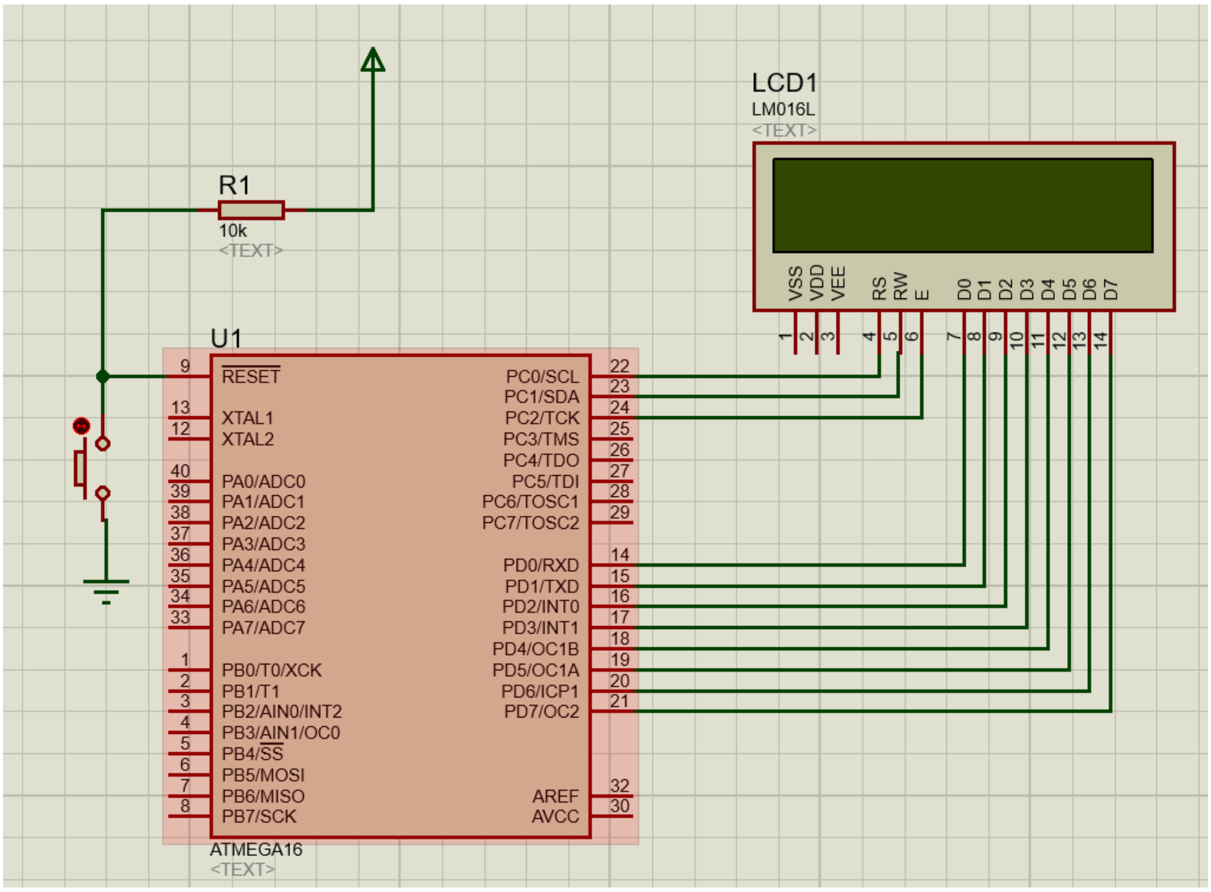
P6: INTERFACING OF KEYPAD AND TWO SEVEN SEGMENT WITH ATMEGA16



```
/*
 * P6_Keypad_Two_Seven_Segment.c
 *
 * Created: 13-03-2021 14:19:37
 * Author : Jervis
 */
#define F_CPU 1000000UL
#include <avr/io.h>
#include <util/delay.h>
#define DC DDRC
#define DD DDRD
#define PC PORTC
#define PD PORTD
int key()
{
        while (1) {
                PORTB = 0b01111111; _delay_ms(20);

                if (PINA == 0xfe) { while (PINA == 0xfe); return  1;}

                if (PINA == 0xfd) { while (PINA == 0xfd); return  4;}

                if (PINA == 0xfb) { while (PINA == 0xfb); return  7;}

                if (PINA == 0xf7) { while (PINA == 0xf7); return 10;}

                PORTB = 0b10111111; _delay_ms(20);

                if (PINA == 0xfe) { while (PINA == 0xfe); return  2;}

                if (PINA== 0xfd) { while (PINA == 0xfd); return  5;}

                if (PINA == 0xfb) { while (PINA == 0xfb); return  8;}

                if (PINA == 0xf7) { while (PINA == 0xf7); return 11;}

                PORTB = 0b11011111; _delay_ms(30);

                if (PINA == 0xfe) { while (PINA == 0xfe); return  3;}

                if (PINA == 0xfd) { while (PINA == 0xfd); return  6;}

                if (PINA == 0xfb) { while (PINA == 0xfb); return  9;}

                if (PINA == 0xf7) { while (PINA == 0xf7); return 12;}
        } }


int main(void)
{
        DC = DD =DDRB = 0xff;
        DDRA = 0xf0; PORTA = 0xff;
   int a[10] = {0x3f,0x06,0x5b,0x4f,0x66,0x6d,0x7d,0x07,0x7f,0x6f};
   while (1)
```

```
    {
                    int num = key();
                    if (num<10)
                    {
                            PD = 0b11111110;
                            PC = a[num];_delay_ms(10);
                    }
    }
}
```

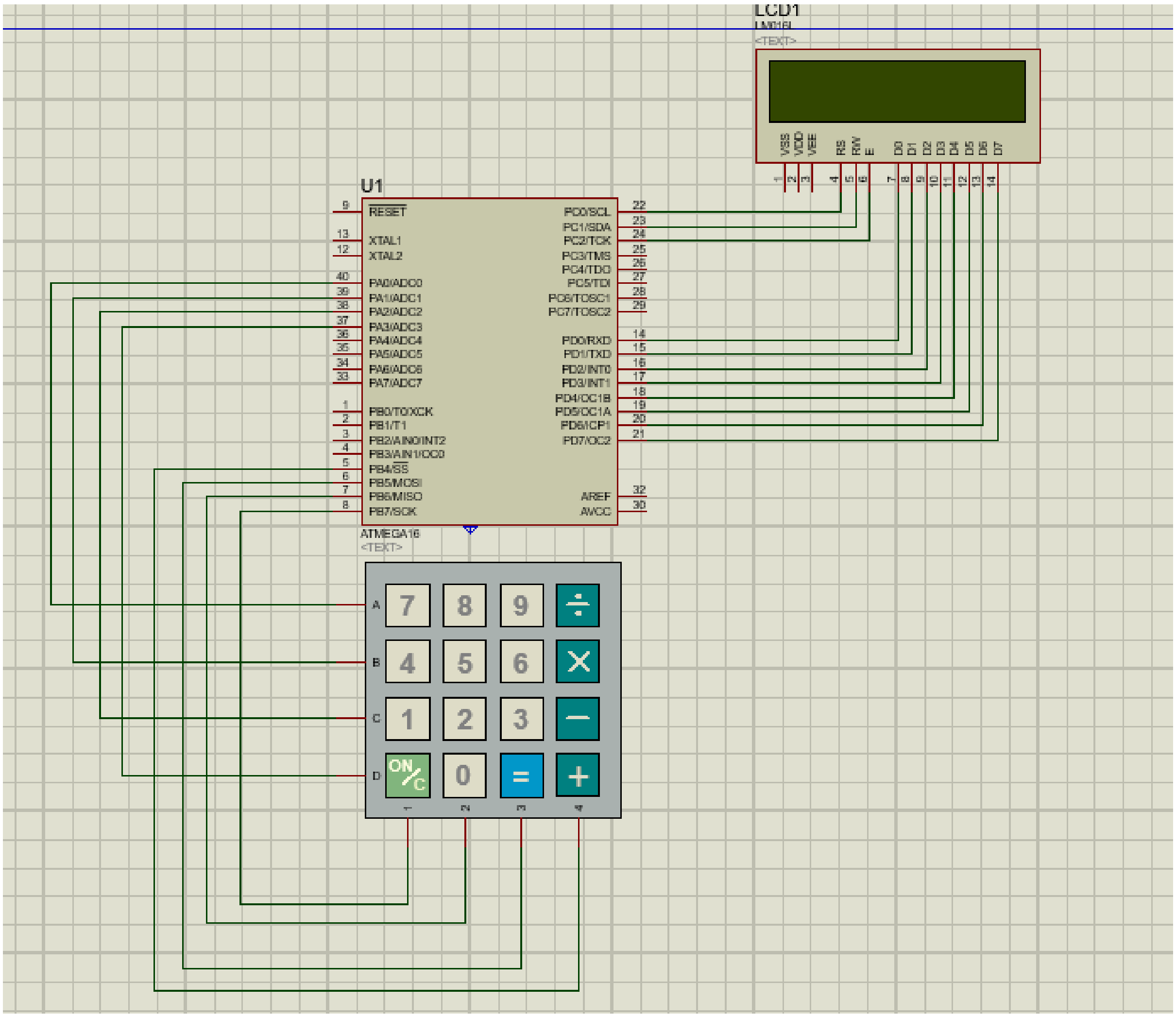
P7: INTERFACING OF LCD 16*2 (4bitMode) WITH ATMEGA16



```
/*
 * P7_LCD_4bit.c
 *
 * Created: 14-03-2021 10:01:19
 * Author : Jervis
 */
#define F_CPU 1000000UL
#include <avr/io.h>
#include <string.h>
#include <util/delay.h>

lcd_init()
```

```
{
        lcd_cmd(0x02);
        lcd_cmd(0x38);
        lcd_cmd(0x0c);
}
lcd_cmd(int x)
{
        PORTD = x;
        PORTC = 0x04;
        _delay_ms(2);
        PORTC = 0x00;
}
lcd_data(int y)
{
        PORTD = y;
        PORTC = 0x05;
        _delay_ms(2);
        PORTC = 0x01;
}
string_data(char *str){
        int i = 0;
        for(i=0; i<=strlen(str) ; i++){
                lcd_data(str[i]);
                _delay_ms(8);
                lcd_cmd(0x06);
        }
}
char arr[11] = "0123456789";
number_data(int number){
        int i;
         if(number>0)
         {
                 i=number%10;
                 number=number/10;

                 number_data(number);
                 lcd_data(arr[i]);
                 lcd_cmd(0x06);
                 _delay_ms(10);
         }
}
int main()
{
        DDRC = DDRD = 0xff;
        lcd_init();
        lcd_cmd(0x80);
        string_data("joy");
        _delay_ms(1000);
        lcd_cmd(0xC0);
        number_data(9999);
_delay_ms(8);
}
```

P8: INTERFACING OF CALCULATOR KEYPAD AND LCD 16*2 (4bitMode) WITH ATMEGA16

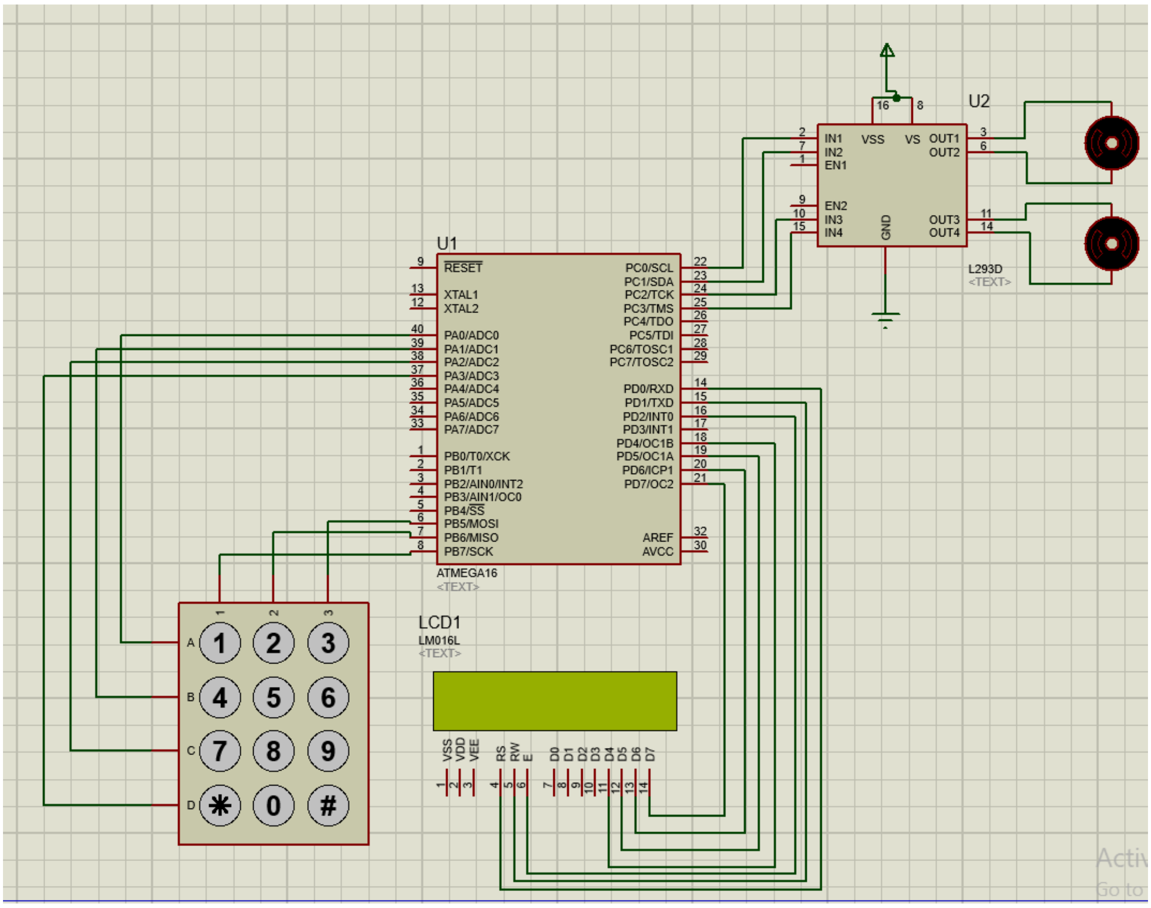


```
/*
 * P8_KeyPad_LCD_4bitMode.c
 *
 * Created: 14-03-2021 22:47:25
 * Author : Jervis
 */

#define F_CPU 1000000UL
#include <avr/io.h>
#include <string.h>
#include <util/delay.h>

lcd_init()
{
        lcd_cmd(0x02);
        lcd_cmd(0x38);
        lcd_cmd(0x0c);
}

lcd_cmd(int x)
{
        PORTD = x;
        PORTC = 0x04;
        _delay_ms(2);
        PORTC = 0x00;
}

lcd_data(int y)
{
        PORTD = y;
        PORTC = 0x05;
        _delay_ms(2);
        PORTC = 0x01;
}

string_data(char *str){
        int i = 0;
        for(i=0; i<=strlen(str) ; i++){
                lcd_data(str[i]);
                _delay_ms(8);
                lcd_cmd(0x06);
        }
}



number_data(int number){
        char arr[11] = "0123456789";
        int i;
         if(number>0)
         {
                 i=number%10;
                 number=number/10;

                 number_data(number);
                 lcd_data(arr[i]);
                 lcd_cmd(0x06);
                 _delay_ms(10);
         }
}

int key()
{
        /*
                101: ON/C;  104: +; 105: -; 106: *; 107: /
                103: =;
        */

        while (1) {
                PORTB = 0b01111111; _delay_ms(20);
        if (PINA == 0xfe) { while (PINA == 0xfe); return  7;}

        if (PINA == 0xfd) { while (PINA == 0xfd); return  4;}

        if (PINA == 0xfb) { while (PINA == 0xfb); return  1;}

        if (PINA == 0xf7) { while (PINA == 0xf7); return 101;}

        PORTB = 0b10111111; _delay_ms(20);

        if (PINA == 0xfe) { while (PINA == 0xfe); return  8;}

        if (PINA== 0xfd) { while (PINA == 0xfd); return  5;}

        if (PINA == 0xfb) { while (PINA == 0xfb); return  2;}

        if (PINA == 0xf7) { while (PINA == 0xf7); return 0;}

        PORTB = 0b11011111; _delay_ms(30);

        if (PINA == 0xfe) { while (PINA == 0xfe); return 9;}

        if (PINA == 0xfd) { while (PINA == 0xfd); return  6;}

        if (PINA == 0xfb) { while (PINA == 0xfb); return  3;}

        if (PINA == 0xf7) { while (PINA == 0xf7); return 103;}

        PORTB = 0b11101111; _delay_ms(30);

        if (PINA == 0xfe) { while (PINA == 0xfe); return  104;}

        if (PINA == 0xfd) { while (PINA == 0xfd); return  105;}

        if (PINA == 0xfb) { while (PINA == 0xfb); return  106;}

        if (PINA == 0xf7) { while (PINA == 0xf7); return 107;}
    }
}


int main()
{
    DDRC = DDRD = DDRB = 0xff;
    DDRA = 0xf0; PORTA = 0xff;

    lcd_init();
    lcd_cmd(0x80);
    string_data("Welcome ......");

    _delay_ms(100);
    lcd_cmd(0x01);
    lcd_cmd(0x80);
```

```
string_data("Enter:");
int result;
int negative_res;
int operand1,operand2;
char operators="";
    while (1)
    {
        int num = key();
        if ((num>0 && num <10)|| (num>103 && num <108))
        {


                _delay_ms(100);

                if (num>0 && num<10)
                {
                    if (operators=="")
                    {
                        operand1= num;
                        number_data(operand1);
                        lcd_cmd(0x06);
                    }
                    else if (operators!="")
                {
                    operand2= num;
                    number_data(operand2);
                    lcd_cmd(0x06);
                }

            }else if (num==104)
            {
                operators = "/";
                lcd_data('/');
                lcd_cmd(0x06);

            }else if (num==105){
                operators = "*";
                lcd_data('*');
                lcd_cmd(0x06);

                }else if (num==106){
                    operators = "-";
                    lcd_data('-');
                    lcd_cmd(0x06);


                }else if (num == 107)
                {
                    operators = "+";
                    lcd_data('+');
                    lcd_cmd(0x06);

                }
        }
```

```
            else if (num == 101){ lcd_cmd(0x01);
                _delay_ms(100);
                result=0;
                negative_res=0;
                operand1=0;
                operand2 = 0;
                operators="";
                lcd_cmd(0x80);
                string_data("Enter:");}
            else if(num==103){
                lcd_cmd(0xC0);
                if (operators == "+")
                {
                    result = operand1 + operand2;
                }else if (operators == "-")
                {
                    if (operand2>operand1)
                    {
                        result = operand2 - operand1;
                        negative_res=1;
                        }else{
                        result = operand1- operand2;
                        negative_res = 0;
                    }

                }else if (operators=="*")
                {
                    result = operand1 * operand2;
                }else if (operators=="/")
                {
                    result = operand1 / operand2;
                }
                if(negative_res ==1){
                    lcd_data('-');
                    lcd_cmd(0x06);
                    number_data(result);
                }else{
                    number_data(result);
                }
            }
        }
_delay_ms(8);
}
```

P9: INTERFACING OF KEYPAD, LCD 16*2 (4bitMode) AND MOTOR WITH ATMEGA16



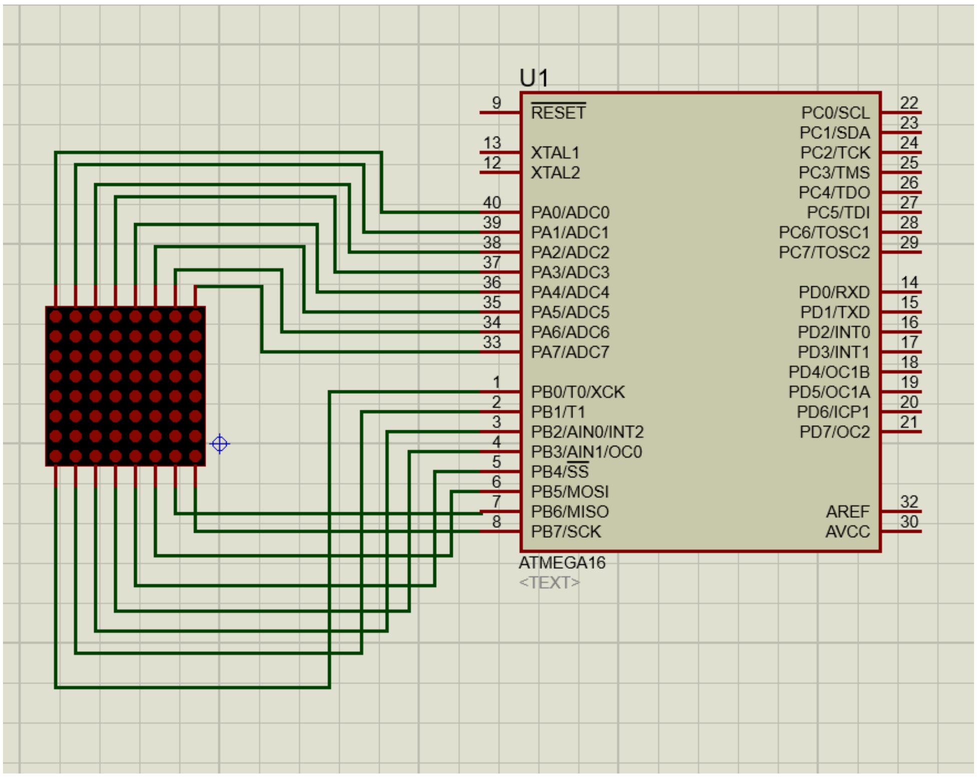
```
/*
 * P9_keyPad_Motor_LCD.c
 *
 * Created: 25-03-2021 17:19:38
 * Author : Jervis
 */

#define F_CPU 1000000UL
#include <avr/io.h>
#include <string.h>
#include <util/delay.h>

#define lcd PORTD

lcd_init()
{
	lcd_cmd(0x02);
	lcd_cmd(0x28);
```

```
        lcd_cmd(0x0c);
}
lcd_cmd(int x)
{
        lcd=(x&0xf0)+0x04;
        _delay_ms(2);
        lcd=lcd-0x04;
        lcd=((x<<4)&0xf0)+0x04;
        _delay_ms(2);
        lcd=lcd-0x04;
}
lcd_data(int x)
{
        lcd=(x&0xf0)+0x05;
        _delay_ms(2);
        lcd=lcd-0x04;
        lcd=((x<<4)&0xf0)+0x05;
        _delay_ms(2);
        lcd=lcd-0x04;
}
string_data(char *str){
        int i = 0;
        for(i=0; i<=strlen(str) ; i++){
                lcd_data(str[i]);
                _delay_ms(8);
                lcd_cmd(0x06);
        }
}
char arr[11] = "0123456789";
number_data(int number){
        int i;
        if(number>0)
        {
                i=number%10;
                number=number/10;

                number_data(number);
                lcd_data(arr[i]);
                lcd_cmd(0x06);
                _delay_ms(10);
        }
}

int key()
{
        while (1) {
                PORTB = 0b11011111; _delay_ms(20);

                if (PINA == 0xfe) { while (PINA == 0xfe); return  1;}

                if (PINA == 0xfd) { while (PINA == 0xfd); return  4;}

                if (PINA == 0xfb) { while (PINA == 0xfb); return  7;}
```

```
                    if (PINA == 0xf7) { while (PINA == 0xf7); return  10;}

                    PORTB = 0b10111111; _delay_ms(20);

                    if (PINA == 0xfe) { while (PINA == 0xfe); return   2;}

                    if (PINA== 0xfd) { while (PINA == 0xfd); return  5;}

                    if (PINA == 0xfb) { while (PINA == 0xfb); return   8;}

                    if (PINA == 0xf7) { while (PINA == 0xf7); return  11;}

                    PORTB = 0b01111111; _delay_ms(30);

                    if (PINA == 0xfe) { while (PINA == 0xfe); return   3;}

                    if (PINA == 0xfd) { while (PINA == 0xfd); return   6;}

                    if (PINA == 0xfb) { while (PINA == 0xfb); return   9;}

                    if (PINA == 0xf7) { while (PINA == 0xf7); return  12;}
          }
}


int main(void)
{
   DDRC = DDRB = DDRD = 0xff;
   DDRA = 0xf0;
   PORTA = 0xff;
         int n[5] = {2,8,4,6,0};
         lcd_init();
   while (1)
   {
                    int button = key();
                    lcd_cmd(0x01); _delay_ms(10);
                    lcd_cmd(0x83); _delay_ms(100);
                    number_data(button);
                    if (button == n[0])
                    {
                              PORTC = 0b00001001;
                              lcd_cmd(0xc3);
                              string_data(" Forward");
                    }else if (button== n[1])
                    {
                              PORTC = 0b00000110;
                              lcd_cmd(0xc3);
                              string_data(" Backward");
                    }else if (button == n[2])
                    {
                              PORTC = 0b00000001;
                              lcd_cmd(0xc3);
                              string_data(" Left");
                    }else if (button == n[3])
```

```
                {
                        PORTC = 0b00001000;
                        lcd_cmd(0xc3);
                        string_data(" Right");
                }else
                {
                        PORTC = 0b00000000;
                        lcd_cmd(0xc3);
                        string_data(" Stop");
                }

    }
}
```

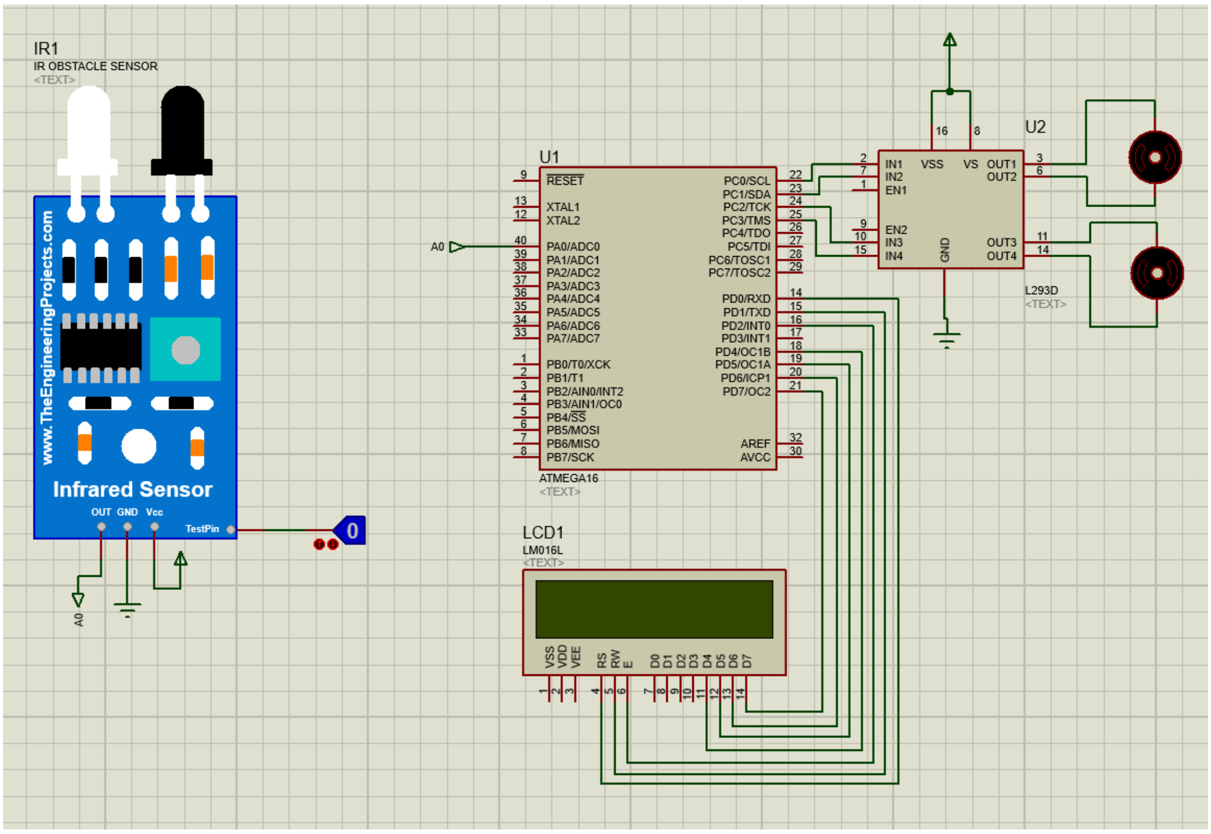
P10: INTERFACING OF DOT MATRIX DISPLAY (DMD) WITH ATMEGA16 (CUSTOM CHARACTER “T”)



```
/*
 * P10_DMD_Display.c
 *
 * Created: 25-03-2021 21:51:10
 * Author : Jervis
 */
```

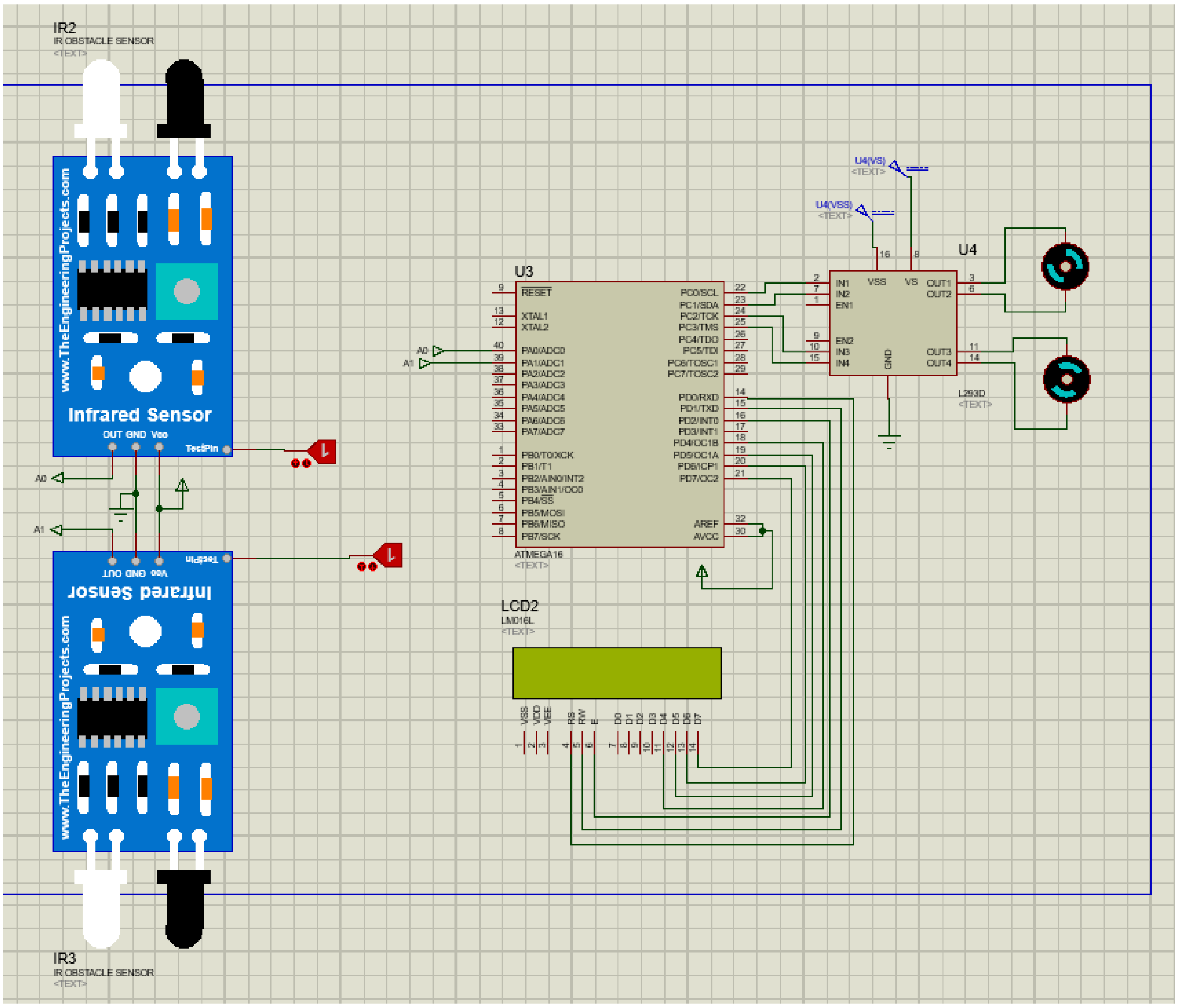
```
#define F_CPU 1000000UL
#include <avr/io.h>
#include <util/delay.h>

int main(void)
{
        DDRA = DDRB = 0xff;

        while (1)
        {
                PORTA = 0x7e;
                PORTB= 0xfe;
                _delay_ms(100);
                PORTA = 0x18;
                PORTB = 0x00;
                _delay_ms(100);
        }
}
```

P11: INTERFACING OF IRSensor, DC Motor And Motor Driver L293D WITH ATMEGA16



```
/*
 * P11_IR_Sensor_DC_Motors.c
 *
 * Created: 26-03-2021 19:22:28
 * Author : Jervis
 */


#define F_CPU 1000000UL
#include <avr/io.h>
#include <string.h>
#include <util/delay.h>

#define lcd PORTD

lcd_init()
{
        lcd_cmd(0x02);
        lcd_cmd(0x28);
        lcd_cmd(0x0c);
}

lcd_cmd(int x)
{
        lcd=(x&0xf0)+0x04;
        _delay_ms(2);
        lcd=lcd-0x04;
        lcd=((x<<4)&0xf0)+0x04;
        _delay_ms(2);
        lcd=lcd-0x04;
}

lcd_data(int x)
{
        lcd=(x&0xf0)+0x05;
        _delay_ms(2);
        lcd=lcd-0x04;
        lcd=((x<<4)&0xf0)+0x05;
        _delay_ms(2);
        lcd=lcd-0x04;
}
string_data(char *str){
        int i = 0;
        for(i=0; i<=strlen(str) ; i++){
                lcd_data(str[i]);
                _delay_ms(8);
                lcd_cmd(0x06);
        }
}

char arr[11] = "0123456789";
number_data(int number){
        int i;
        if(number>0)
        {
                i=number%10;
                number=number/10;

                number_data(number);
                lcd_data(arr[i]);
                lcd_cmd(0x06);
                _delay_ms(10);
        }
}



int main(void)
{
        DDRC = DDRD = 0xff;
        DDRA = 0xff;

        lcd_init();
        while(1){

        lcd_cmd(0x83);
        string_data("..Object..");

        while(PINA == 0x01)
        {
                PORTC = 0x00;
                lcd_cmd(0x01);
                lcd_data(0xc0);
                string_data("Detected Stoping");
                _delay_ms(100);

                PORTC = 0x06;
                lcd_cmd(0x01);
                lcd_data(0xc3);
                string_data(" Backward ");
                _delay_ms(1000);

                PORTC = 0x08;
                lcd_cmd(0x01);
                lcd_data(0xc3);
                string_data("Right");
                _delay_ms(1000);
                lcd_cmd(0x01);
                _delay_ms(10);
        }

        PORTC = 0x09;
        lcd_cmd(0xc3);
        string_data(" Forward ");
        }
}
```

Project 1 : Line Follower Car Simulation in Proteus WITH ATMEGA16, Two IRSensors and MotorDriver IC L293D:



```
/*
 * P11_LineFollower_v1.c
 *
 * Created: 26-03-2021 21:14:11
 * Author : Jervis
 */


#define F_CPU 1000000UL
#include <avr/io.h>
#include <string.h>
#include <util/delay.h>
#define lcd PORTD
```

```
lcd_init()
{
        lcd_cmd(0x02);
        lcd_cmd(0x28);
        lcd_cmd(0x0c);
}

lcd_cmd(int x)
{
        lcd=(x&0xf0)+0x04;
        _delay_ms(2);
        lcd=lcd-0x04;
        lcd=((x<<4)&0xf0)+0x04;
        _delay_ms(2);
        lcd=lcd-0x04;
}

lcd_data(int x)
{
        lcd=(x&0xf0)+0x05;
        _delay_ms(2);
        lcd=lcd-0x04;
        lcd=((x<<4)&0xf0)+0x05;
        _delay_ms(2);
        lcd=lcd-0x04;
}
string_data(char *str){
        int i = 0;
        for(i=0; i<=strlen(str) ; i++){
                lcd_data(str[i]);
                _delay_ms(8);
                lcd_cmd(0x06);
        }
}

char arr[11] = "0123456789";
number_data(int number){
        int i;
        if(number>0)
        {
                i=number%10;
                number=number/10;

                number_data(number);
                lcd_data(arr[i]);
                lcd_cmd(0x06);
                _delay_ms(10);
        }
}



int main(void)
{
    DDRC = DDRD = 0xff;
    DDRA = 0xfe;

    lcd_init();

    lcd_cmd(0x01);
    lcd_cmd(0x81);
    string_data("LINE FOLLOWER");

    while(1)
    {
        if (PINA == 0b00000011)
        {
            PORTC = 0x09;
            lcd_cmd(0x01);
            lcd_data(0xc1);
            string_data("F");
            // _delay_ms(10);
        }else if (PINA == 0b00000010)
        {
            PORTC = 0x01;
            lcd_cmd(0x01);
            lcd_data(0xc1);
            string_data(" L ");
            // _delay_ms(10);
        }else if (PINA == 0b00000001)
        {
            PORTC = 0x08;
            lcd_cmd(0x01);
            lcd_data(0xc1);
            string_data(" R ");
            // _delay_ms(10);
        }else if (PINA == 0b00000000)
        {
            PORTC = 0x00;
            lcd_cmd(0x01);
            lcd_data(0xc3);
            string_data(" S ");
            // _delay_ms(10);
        }

    }

}
```