

## Keypad.c

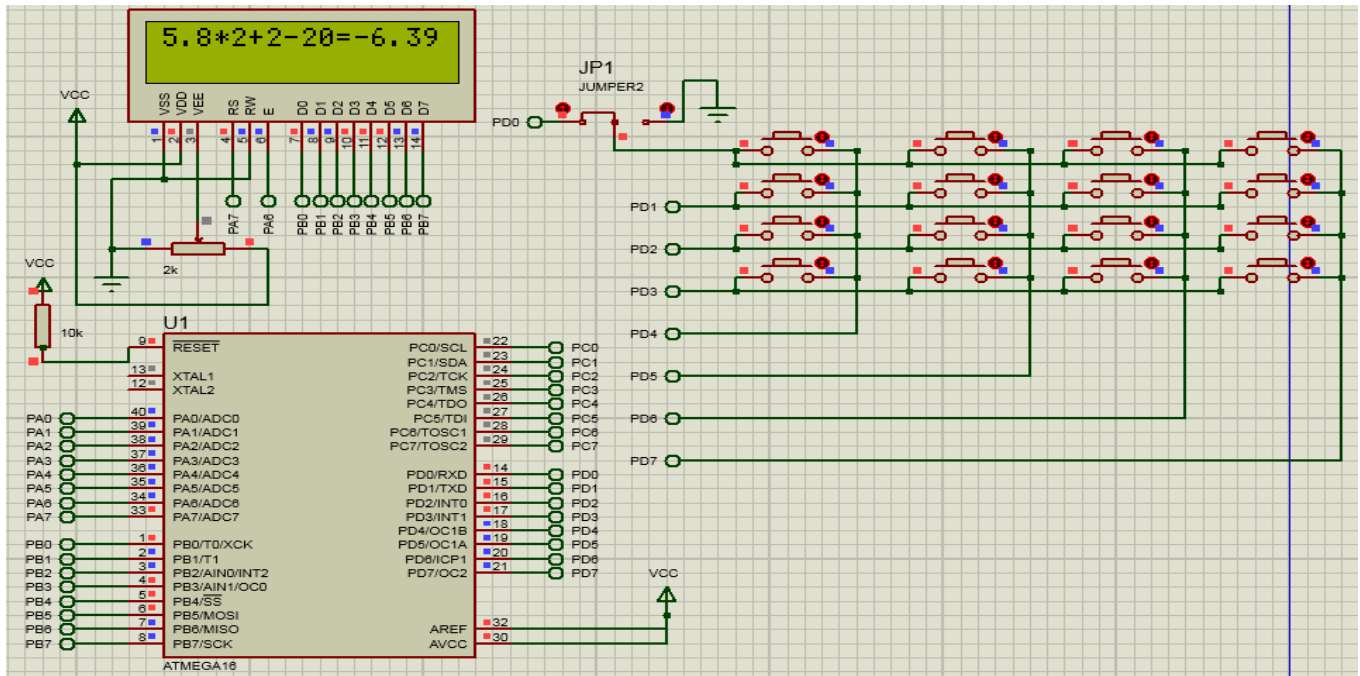
```
#include "common.h"
#define KEY1 '1'
#define KEY2 '2'
#define KEY3 '3'
#define KEY4 '4'
#define KEY5 '5'
#define KEY6 '6'
#define KEY7 '7'
#define KEY8 '8'
#define KEY9 '9'
#define KEY10 '10'
#define KEY11 '11'
#define KEY12 '12'
#define KEY13 '13'
#define KEY14 '14'
#define KEY15 '15'
#define KEY16 '16'
// Rows at PC0:PC3 and Columns at PC4:PC7

void init_keypad()
{
    DDRD=0xf0;
    PORTD=0xff;
}

unsigned char Keypad_Scan()
{
    unsigned char Key[16]={
        '1','4','7','C','2','5','8','0','3','6','9','.','+','-','*','='};
    unsigned char Code[16]=
        {0xee,0xed,0xeb,0xe7,0xde,0xdd,0xdb,0xd7,0xbe,0xbd,0xbb,0xb7,0x7e,0x7d,0x7b,0x77};
    unsigned char Button=0xff;

    while (Button==0xff)
    {
        DDRD=0x0f;
        PORTD=0xf0;
        _delay_us(5);
        Button=PIND;
        DDRD=0xf0;
        PORTD=0x0f;
        _delay_us(5);
        Button= Button|PIND;

        if (Button!=0xff)
        {
            for (int i=0;i<16;i++)
            {
                if (Button==Code[i])
                {
                    return Key[i];
                }
            }
            Button=0xff;
        }
    }
}
```



lcd.c

```
#include "common.h"
#define LCD_DATA_PORT PORTB
#define LCD_CONT_PORT PORTA
#define LCD_RS PA7
#define LCD_RW PA3
#define LCD_EN PA6

void lcd_data_write(char data)
{
    LCD_DATA_PORT = data;
    LCD_CONT_PORT |= (1<<LCD_RS);
    LCD_CONT_PORT |= (1<<LCD_EN);
    _delay_us(2);
    LCD_CONT_PORT &= ~(1<<LCD_EN);
    _delay_us(100);
}

void lcd_command_write(char command)
{
    LCD_DATA_PORT = command;
    LCD_CONT_PORT &= ~(1<<LCD_RS);
    LCD_CONT_PORT |= (1<<LCD_EN);
    _delay_us(1);
    LCD_CONT_PORT &= ~(1<<LCD_EN);
    _delay_ms(3);
}

void lcd_init()
{
    lcd_command_write(0x38);
    lcd_command_write(0x01);
}
```

```

        lcd_command_write(0x06);
        lcd_command_write(0x0e);
    }

void lcd_string_write(char *string)
{
    while (*string)
        lcd_data_write(*string++);
}

void lcd_CLR()
{
    _delay_ms(10);
    lcd_command_write(0x01);
    _delay_us(10);
}

void lcd_GoHome()
{
    _delay_ms(10);
    lcd_command_write(0x02);
    _delay_ms(2);
}

void lcd_SetCursor(unsigned char x , unsigned char y)
{
    lcd_GoHome();
    if (y==0)
    {
        for (int H=0;H<x;H++)
        {
            lcd_command_write(0x14);
            _delay_us(50);
        }
    }
    else if(y==1)
    {
        for (int H=0;H<(x+40);H++)
        {
            lcd_command_write(0x14);
            _delay_us(50);
        }
    }
}

void lcd_Print_Num(float Num)
{
    long int H_Num=0;
    float L_Num=0.0;
    signed char i=0,Polr=0,L=0;
    unsigned char N[16],N_L[10];
    /* ----- (Num==0) ----- */
    if (Num==0)
    {
        lcd_data_write('0');
    }
    /* ----- (Num!=0) ----- */

```

```

else
{
    /* -----(Num<0)----- */
    if (Num<0)
    {
        Num*= -1;
        Polr=1;
    }
    /* ----- */
    H_Num=(int)Num;
    L_Num=(Num-H_Num);
    if (L_Num>0)
    {
        /* -----(L<=4)----- */
        while(L<=4)
        {
            L_Num*=10;
            N_L[L+5]=48;
            N_L[L]=((int)L_Num)+48;
            L_Num=L_Num-N_L[L]+48;
            L++;
        }
        for (L--;L>=0;L--)
        {
            if(N_L[L]!=48 || N_L[L+1]!=48 || N_L[L+2]!=48 || N_L[L+3]!=48 || N_L[L+4]!=48)
            {
                N[i]=N_L[L];
                i++;
            }
        }
        N[i]=46; // 46=.
        i++;
    }
    /* ----- */
    while(H_Num!=0)
    {
        N[i]=(H_Num%10)+48;
        H_Num/=10;
        i++;
    }
    /* ----- */
    if (Polr==1)
    {
        N[i]=45; // 45=-
        i++;
    }
    /* ----- */
    i--;
    /* ----- */
    while(i>=0)
    {
        lcd_data_write(N[i]);
        i--;
        _delay_ms(1);
    }
}
}

```

## main.c

```
#define F_CPU 8000000UL
#include <avr/io.h>
#include <util/delay.h>
#include "common.h"

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

    lcd_init();
    lcd_CLR();

    _delay_ms(300);
    lcd_string_write("Press any key ");

    while(1)
    {
        unsigned char x;
        unsigned char y=0 , i=0 ;
        float Pow=1;
        float Num[16] , Num1[16]={0,0,0,0,0,0};
        float Sum=0.0;

        x=Keypad_Scan();
        lcd_CLR();
        _delay_ms(300);

        while(x)
        {
            while(y!='')
            {
                y=Keypad_Scan();
                lcd_data_write(y);

                Num[i]=y-48;
                if (Num[i]==('C'-48)) // clear
                {
                    // start from the value of i and clear each element step by step moving to left
                    i--;
                    lcd_SetCursor(i,0);
                    lcd_data_write(' ');
                    lcd_data_write(' ');
                    lcd_SetCursor(i,0);
                    i--;
                    _delay_ms(100);
                }
                _delay_ms(50);
                i++;
                _delay_ms(400); //FOR scanning keypad
            }
        }
    }
}
```

```

i=0;
unsigned char N=0;
while (Num[i]!=13) // '=' =61-48=13
{
    // 12.5*1+2-3=11.5
    // 12.5+2-4*2=21 solving the first mathematical operation then next els.
    // doesn't use the periority of operation
    // in case the value of Num[i] is number between 0 and 9
    if (Num[i]>=0 && Num[i]<=9)
    {
        if (Pow==1 || Pow==10)
        {
            Num1[N]=Num[i]+(Num1[N]*Pow);
            // using this equation to understand the meaning of 123 as (one hundred twenty
            // three ) not using it as (one , two , three)
            if (Pow==1){Pow*=10;}
            // by making pow=10 instead of 1(resulting the upper value of the number)
        }
        else
        {
            Num1[N]+=(Num[i]*Pow);
            // this equation using to the same target but it (result the lower value of the
            // number )
            Pow*=(1.0/10);
            // and making pow changes by 0.1
        }
    }

    // in case the value of Num[i] is a symbol
    else
    {
        // if this symbol is dot(.)

        if (Num[i]==(-2)) // '.' =46 (46-48=-2)
        {Pow=(1.0/10.0);}

        // if this symbol is one of this ( + | - | * | /
    )
        else
        {
            N++;
            Num1[N]=Num[i];
            N++;
            Num1[N]=1; // this step is an using
            requirement in the next for loop to ensure that not enter two symbols together
            (12+*3 error)

            N++;

            Pow=1;

        }
    }

    i++;
    _delay_ms(10);
}

```

```

for (int a=0;a<=N;a++)
{
    _delay_ms(1);
    if (Num1[a]==(-6) && Num1[a+1]==1)    // '*' =42-48=-6
    {
        Sum*=Num1[a+2];
        a+=2;
    }
    else if (Num1[a]==(-5)&& Num1[a+1]==1)    //'+'=43-48=-5
    {
        Sum+=Num1[a+2];
        a+=2;
    }
    else if (Num1[a]==(-3)&& Num1[a+1]==1)    //'-'=45-48=-3
    {
        Sum-=Num1[a+2];
        a+=2;
    }
    else if (Num1[a]==(-1)&& Num1[a+1]==1)    //'/'=47-48=-1
    {
        Sum/=Num1[a+2];
        a+=2;
    }
    else{
        Sum=Num1[a];
    }

}

lcd_Print_Num(Sum);
_delay_ms(1000);
x=0;
} //----- while(x)-----
} //-----while(1)-----
}

```