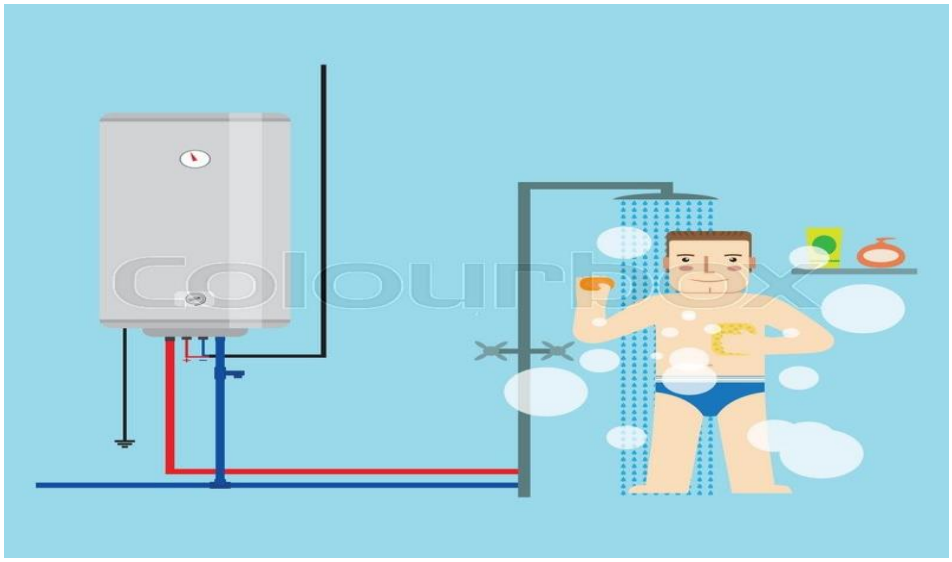


Adham Ahmed Hosney Mohammed Aboul Kheir

1)Objective:

Water heating is a heat transfer process that uses an energy source to heat water above its initial temperature. Typical domestic uses of hot water include cooking, cleaning, bathing, and space heating. In industry, hot water and water heated to steam have many uses.

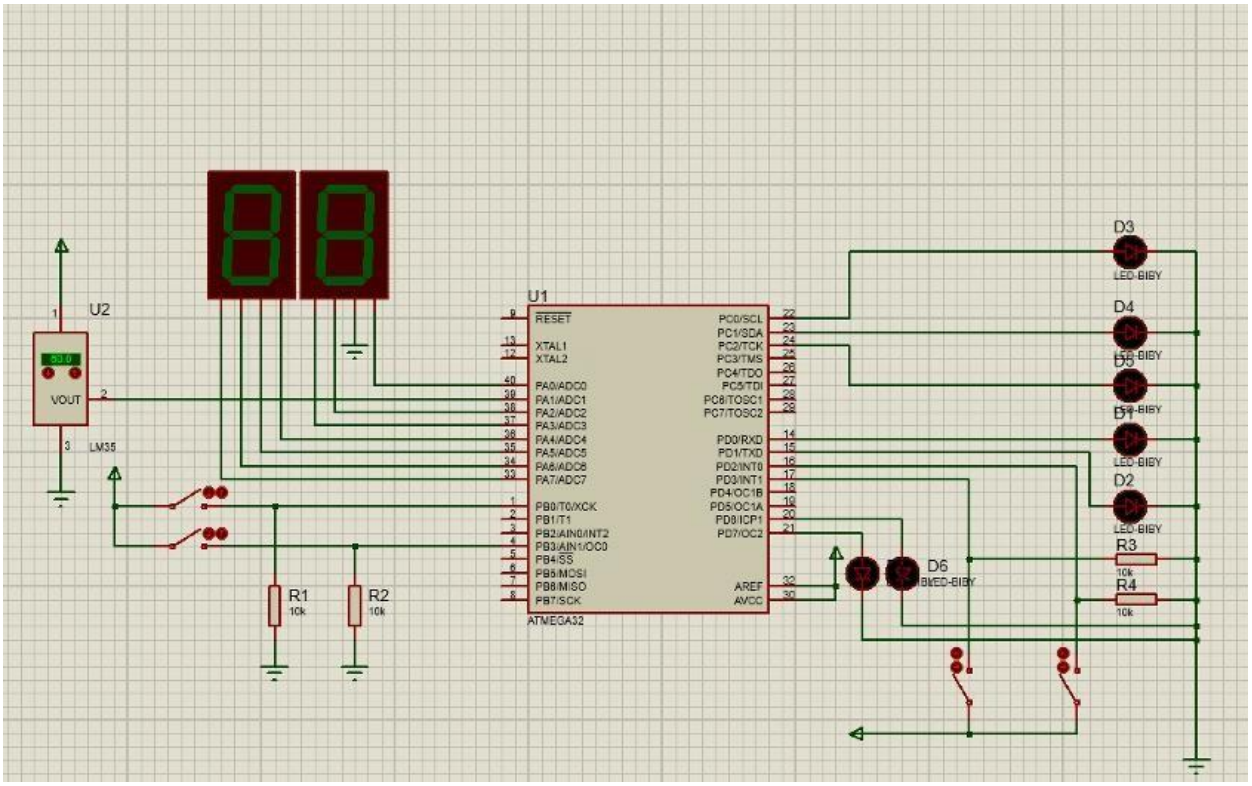
Domestically, water is traditionally heated in vessels known as water heaters, kettles, cauldrons, pots, or coppers. These metal vessels that heat a batch of water do not produce a continual supply of heated water at a preset temperature. Rarely, hot water occurs naturally, usually from natural hot springs. The temperature varies with the consumption rate, becoming cooler as flow increases.

An electric water heater, also called a thermo pot, is a consumer electronics small appliance used for boiling water and maintaining it at a constant temperature. It is typically used to provide an immediate source of hot water for making tea, hot chocolate, coffee, instant noodles, or baby formula, or for any other household use where clean hot water is required. They are a common component of Japanese kitchens and the kitchens of many East Asian countries but are found in varying use globally. Some thermo pots are designed with a feature that can purify water.

In our report, we will discuss how we designed an electric water heater using what we learned in this embedded course.

2)Project design:

After several approaches to our project we finally arrived at an effective schematic. We have included below the sketch of our project layout.



Components:

1. Temp sensor (LM35)

2.Microcontroller (ATMEGA32)

3.two 7-Segments

4.7 LEDS

5.4 Resistors 10 kilo ohm

6. 4 Switches

Hardware Interface:

Firstly, as we run our simulation, when we close our switch at port B0) On button) This turns our system on. We see that the 7-segment is set to our default 60 Celsius and the led at port D0 turns on indicating that the electric heater is in on-mode. Now other Leds will vary according to the temperature measured by the temperature sensor where temperature is sensed once every 100 ms. For example, if the current water temperature is less than the set temperature by 5 degrees the "Heating Element" which we indicated as a led at port C2 will be on, and if the current water temperature is more than the set temperature by 5 degrees the "Cooling Element" which we indicated as a led at port C1 will be turned ON. If the "Heating Element" is ON, the "Heating Element Led" at C0 should blink every 1 second. If the "Cooling Element" is On, the "Heating Element Led" at C0 should be ON. The "Up" or "Down" buttons at D2 and D3 respectively are used to change the required water temperature (set temperature). The first "Up" or "Down" button press, enters the temperature setting mode. After entering temperature setting mode, a single "Up" button press will increase the set temperature by 5 degrees or after entering temperature setting mode, a single "Down" button press will decrease the set temperature by 5 degrees. The minimum possible set temperature is 35 degrees and the maximum possible set temperature is 75 degrees. If the electric water heater is in the temperature setting mode, the 2 seven segment displays will blink every 1 second and show the set temperature. The 2 seven segment display will exit the temperature setting mode, if the "UP" and "Down" buttons are not pressed for 5 seconds. If you want to turn the heater off, the switch at port B3 is pressed this turns all the system off.

Software Design:

```
void on_mode()
{
    char x=GET_BIT(PORTD,0);/* cheaking off mode */
    if(x==0)
    SET_BIT(PORTD,0);
    Seven_Segments(60);
     Temp_of_set=60;
}
```

This function turns the electric heater on as it checks if the led is off and id it off it turns it on and set the 7-segments at 60

```
void off_mode()
{
    char y=GET_BIT(PORTD,0); /* checking on mode */
    if(y==1)
    CLR_BIT(PORTD,0);
    DDRA=0X00;
   CLR_BIT(PORTD,1);
   CLR_BIT(PORTC,0);
   CLR_BIT(PORTC,1);
   CLR_BIT(PORTC,2);
}
```

This function turns the electric heater off as it checks if port D0 is set to 1 and closes the system

```
void ADC_Init(){
    DDRA = 0xFD;
    ADCSRA = 0x87;
    ADMUX = 0x40;
}
```

Make ADC port as output except channel 1 then Enables ADC, with frequency/128. Where Vref: Avcc, ADC channel: 1.

```
int ADC_Read(char channel)
{
    ADMUX = 0x40 | (channel & 0x07);
    ADCSRA |= (1<<ADSC);
    while (!(ADCSRA & (1<<ADIF)));
    ADCSRA |= (1<<ADIF);
    _delay_ms(1);
    return ADCW;
}
```

***It** sets input channel to read then Start ADC conversion and wait until end of conversion by polling ADC interrupt flag then Clear interrupt flag and Wait a little bit then Return ADC word.*

```
ISR(INT0_vect)
{
SET_BIT(PORTD,6);
k=1;
CLR_BIT(PORTD,1);
CLR_BIT(PORTC,0);
CLR_BIT(PORTC,1);
CLR_BIT(PORTC,2);
CLR_BIT(GIFR,6);
}
```

On pressing the up switch as external interrupt flag is raised where the controller stops executing the code written in the main function and heads to execute the code lines exists in ISR(INT0_vect) function. The controller entered the temperature setting mode after the ISR function is executed the external interrupt flag is cleared automatically and an 8-bit timer is figured this timer indicates the period at which the controller will be in temperature setting mode during this mode a single press on either the up switch or the down switch changes the setting temperature and reset the setting mode timer. The same occurs for external interrupt 1 indicated by a single push on the down switch as the interrupt sense control was configured to be triggered on the rising edge.

END**.....**