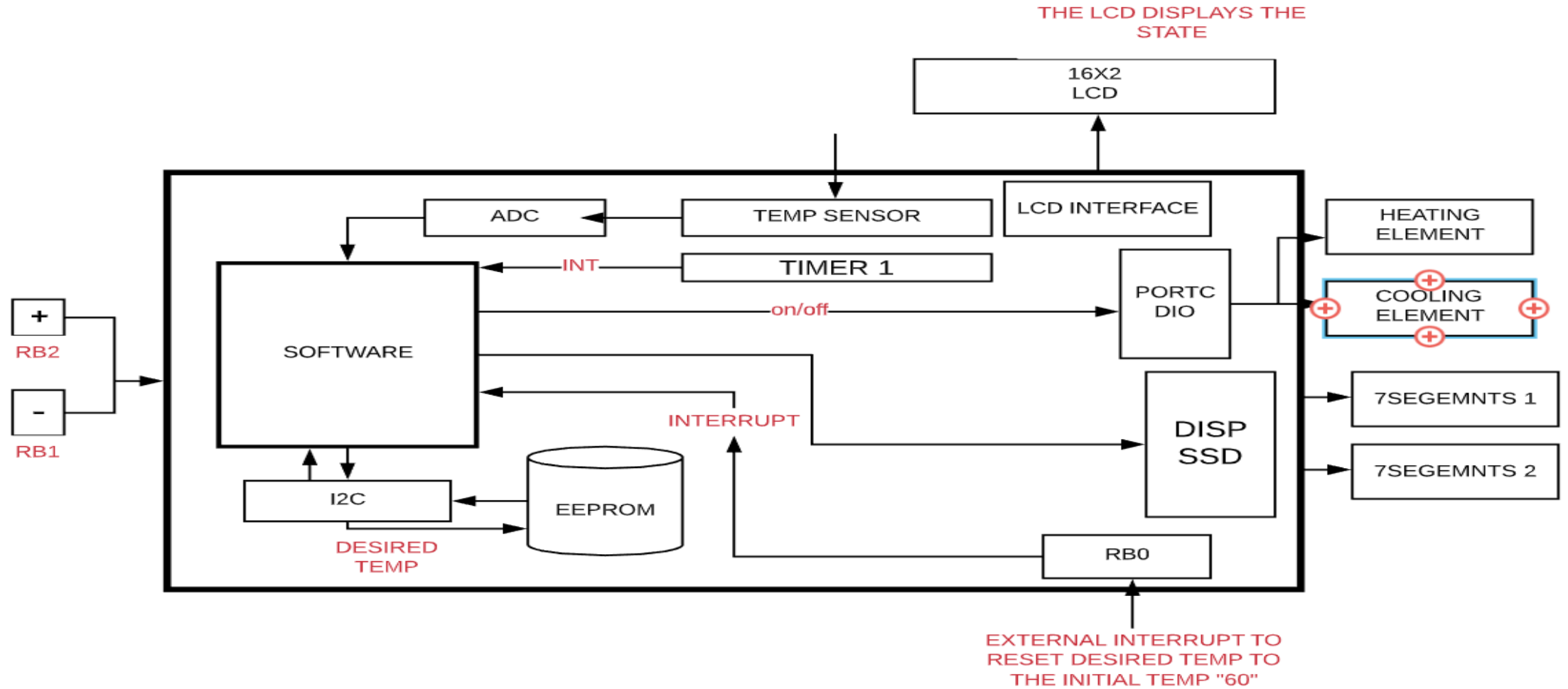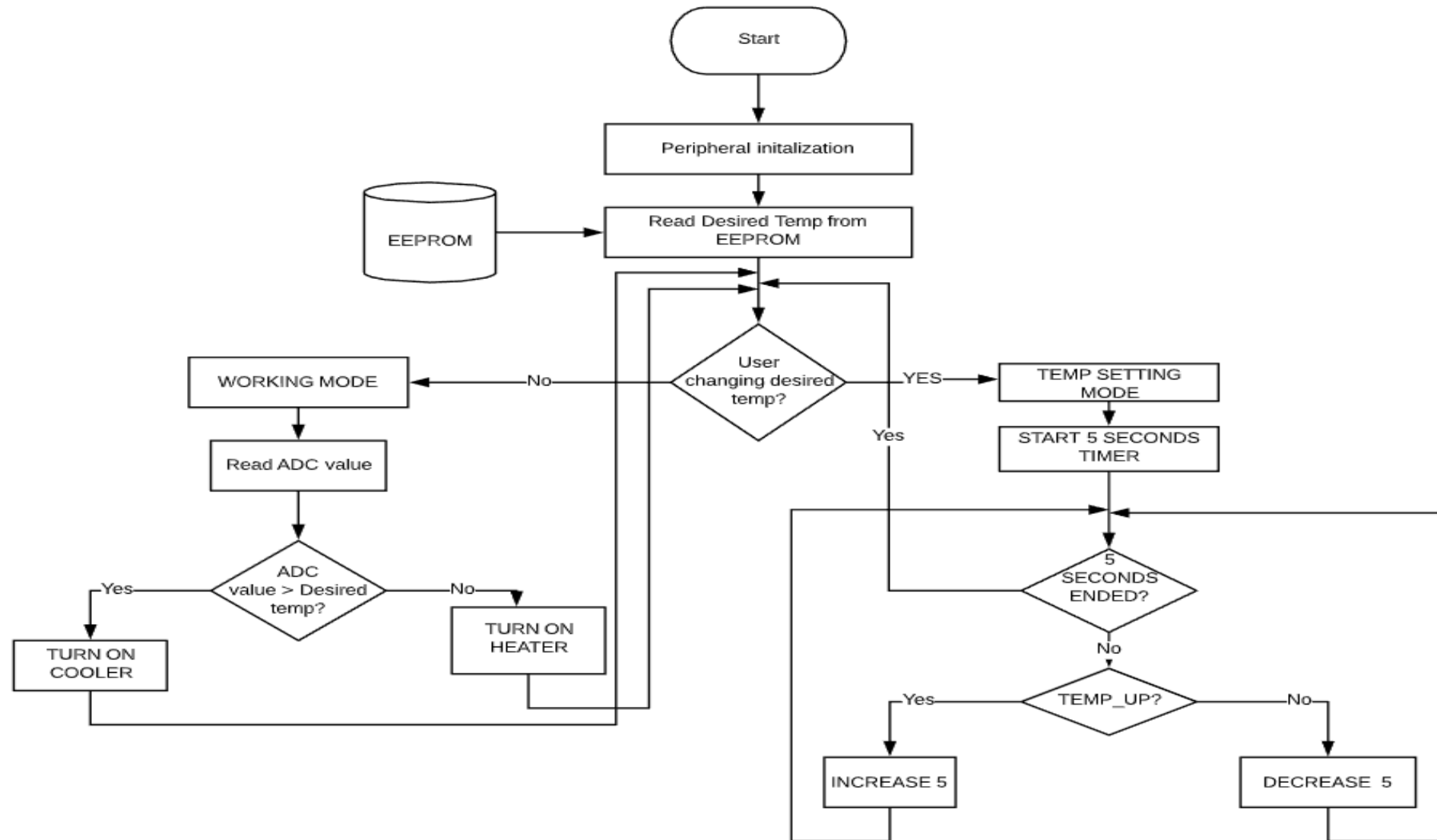# Electric Water Heater

The Project design

Project Main Flow chart

Project Main API's & functions

- ***ADC API's :***

- Void ADC_Init(void) :
        Initialize the ADC Port
- uint16_t ADC_Read () :
        Returns the value read from the ADC

- ***EEPROM API'S :***

- uint8_t EEPROM_Read(uint8_t address):
        Reads a byte from the Passed Address

- ***void EEPROM_Write*** *(uint8_t address , uint8_t data):*
        Writes a byte To the Passed Address

- I2C API'S:

- ***void I2C_INIT_MASTER ()***
        initialize the i2c as a master
- void I2C_Start ():
        Initate a start condition on SDL

- void I2C_Ack(void):
        sends an acknowledge Pulse

- void I2C_Res()
        initiates a restart condtion of the SDL

- ***LCD API's :***
- void LCD_CMD(uint8_t CMD):
        Initialize the Data Port connected to the LCD to
        send a command to the lCD

- void LCD_Init():
        sends initialization commands to the LCD as
        mentioned in the datasheet

- void LCD_Write_uint8_t(uint8_t Data):
        Writes a char on the LCD

- void LCD_Write_String(uint8_t *str)
        Writes a string on the LCD

Project Design

The 16x2 LCD Screen shows which state is currently working.
There are three Possible states only

1- Cooling : indicates that the current temperature is higher than the desired one so the cooling element is working

2- Heating :indicates that the current temperature is lesthan the desired one so the heating element is working

3-changing temp : indicates that one of the two buttons RB1 and RB2 (temp up , temp down) is clicked and the desired temp is being set.
This mode is automatically changed when 5 seconds has passed since the latest button click
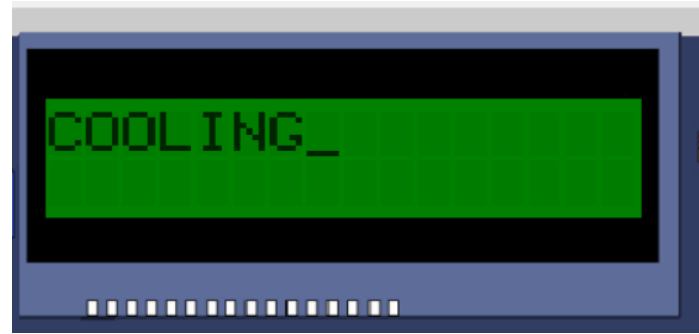
RB2 Button: every single click on the RB2 button is equivalent to a 5 degress increase for the desired temp

RB1 Button: every single click on the RB2 button is equivalent to a 5 degress decrease for the desired temp

RB0 : Can be Used to fire an interrupt to change the desired temp immediately to 60

Seven Segements Display:
The two seven segements displays , shows the desired temperature if in changing temperature mood
Or shows the current temperature if in normal working mood

LED B7 : Used as the heater LED which blinks every one second when the heater is working

As shown in the figure:

The desired temperature is saved in the external EEPROM , Occupying two byes at the first page .

At addresses 0x00 for the the first digit of the desired temprature

And 0x01 for the second one

```
0000: 04 00 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F FF
0010: 62 FF FF FF FF FF FF FF FF FF FF FF FF FF 61 FF
0020: 63 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0030: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0040: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0050: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0060: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
----: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
```

• Normal Flow Scenario:

The programs starts, Initialization functions are called to initialize used Ports and peripherals as TIMER1,ADC,LCD,Seven Segmens, I2C, EEPROM.

Then the program checks the saved temperature in the EEPROM

The inifinite loop is Entered and the programs keeps checking if RB1 or RB2 is pushed

If either one is pushed, the mode is changed into setting mode and iniates a TIMER1 counter to start 5 seconds

If the user pushes either one again the counter is restarted all over again

The TIMER1 interrupt keeps incrementing the timer counter, the ADC counter

If five seconds passes without clicking again, the programs switches back to Normal working mode

If no buttons are pushed, The programs works smoothly by checking the temperature every 100 milliseconds and stores this reading in an array of 10 elements which Is used to calculate the average of the temperature to decide if Cooling or Heating devices should be turned on.