ELECTRIC WATER HEATER

EMBEDDED SYSTEMS GRADUATION PROJECT

AMIT LEARNING

BY: AMON GROUP

Electric Water Heater System

Content: -

Electric Water Heater System

Introduction: -

Electric water heater can be found in many systems, such as factories and in smaller applications, we have chosen this topic to make our project for many reasons as it's easy to be developed and imported to a larger system, the main function of system is clear and easy to obtained, also it will be a good way to express what we have learned.

The main function of the system is heating water and keep it in desired temperature that is selected by the user according to the operation, after desired temperature is selected the system will work automatic to adapt changes of the field ambient temperature (heat exchange). To make the system more reliable we added a cooler that will be needed if the actual temperature exceeded the required temperature, and this will help in using it in critical application that temperature should be stable.

Our system will be managed by a microcontroller, that will make our system reliable, small size, fast and cheap at the same time.

This report will discuss how the system works, main components, results and simulation of the system, how the system can be improved according to the application.

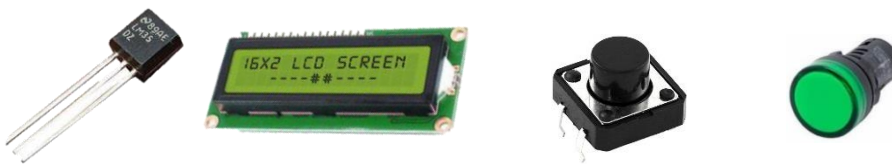# Electric Water Heater System

System Overview: -

As mentioned earlier the system will be managed by a microcontroller, we choose High-performance, Low-power, RISC Architecture, Atmel AVR 8-bit Microcontroller **Atmega32** with specs:

32Kbytes Flash memory, 1024Bytes EEPROM, 2Kbytes internal SRAM, 32 Programmable I/O Lines, 4.5V - 5.5V Operating Voltage, External and Internal Interrupt Sources, 8-channel, 10-bit ADC, Two 8-bit Timer/Counters and One 16-bit Timer/ Counters.
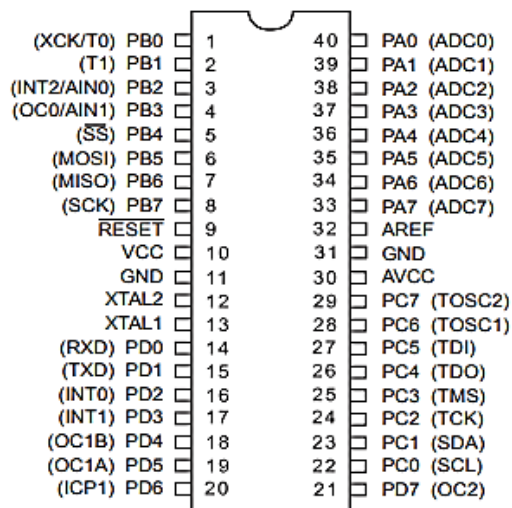
System also contains:

Heater, Cooler, Temperature sensor (LM35), two seven segments, LCD (16 x 2), three Push buttons and three indication LEDs.

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How the system works: -

The System has 4 modes, STARTING STATE (when system is powered). OFF state (system is on sleep mode and isn't working since System ON/OFF switch is pressed), ON STATE (System is working after System ON/OFF switch pressed), SETTING STATE (setting required temperature that microcontroller will control heater and cooler to obtain it).

1- **STARTING STATE:** When the system is powered a welcome message is displayed on the LCD (Welcome to AMIT graduation Proj.) (Electric Water Heater System), the system will be in stand-by mode till the user press System ON/OFF switch.

2- **ON STATE:** after the System ON/OFF switch is pressed the system will be running, set temperature will be initialized by a default value of $60\,^{\circ}C$ (the system will save last set temperature after system is shut down and this value will be the default value), the system will keep working to obtain temperature at the desired value by measuring water temperature every 100 millisecond, and display the average of last 10 readings on LCD and two Seven Segments. The printing of average instead of current temp reading will lead to increase precision and eliminate errors in measuring.

If actual temperature decreases five degrees than the set temperature, heater will work and heater indication light will blink every 1 sec until heater is off (actual temperature = set temperature). Also, for the same way if actual temperature is higher than set temperature by five degrees the system will turn on the cooler and cooler indication light will keep ON until cooler is stopped (actual temperature = set temperature). At the state which actual temperature = set temperature indication lights will be off since heater and cooler aren't working.
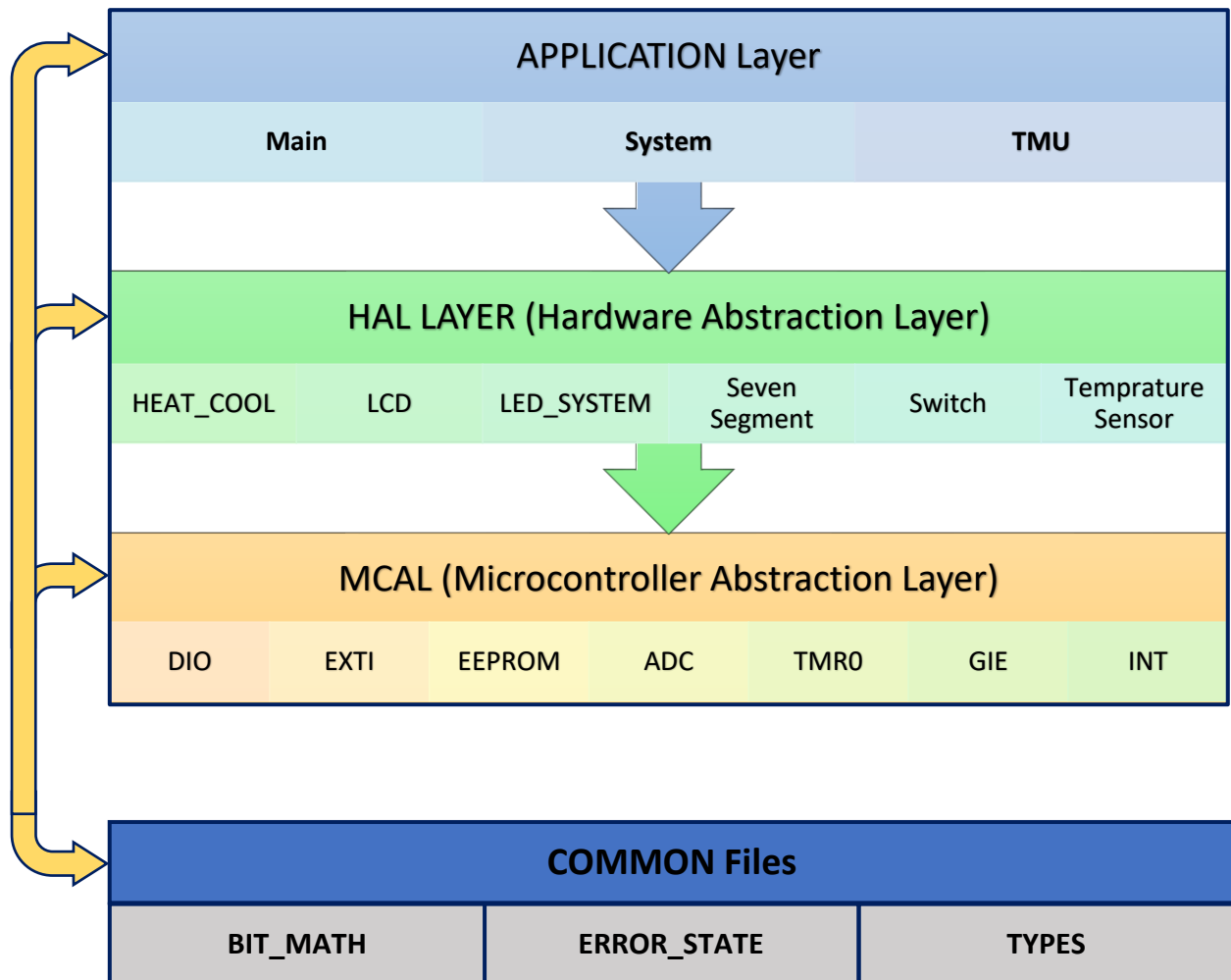
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3- **SETTING STATE:** System exit ON STATE and enters SETTING STATE when user press on control push buttons (Temp-Up switch or Temp-Down switch control push buttons pressed, is the setting mode, the user will be able to increase or decrease set temperature by 5 degrees resolution. If no pushbutton pressed for 5 seconds the system will automatically exit the SETTING STATE to ON STATE.

4- **OFF STATE:** while system is in ON STATE or SETTING STATE and ON/OFF switch is pressed the system will go to sleep mode (OFF STATE). In OFF STATE all LED indication lights, LCD and Seven segment will be disabled and will not consume power. To reactivate system, you have to press ON/OFF switch again to exit sleep mode and back to working.

The system can be improved by using higher components as: faster microcontroller, selecting temperature sensor with higher resolution and lower affecting to the changes in ambient field to make system errors less. Also improve isolation of the tank contains water to make heat exchange with outer atmosphere lower.
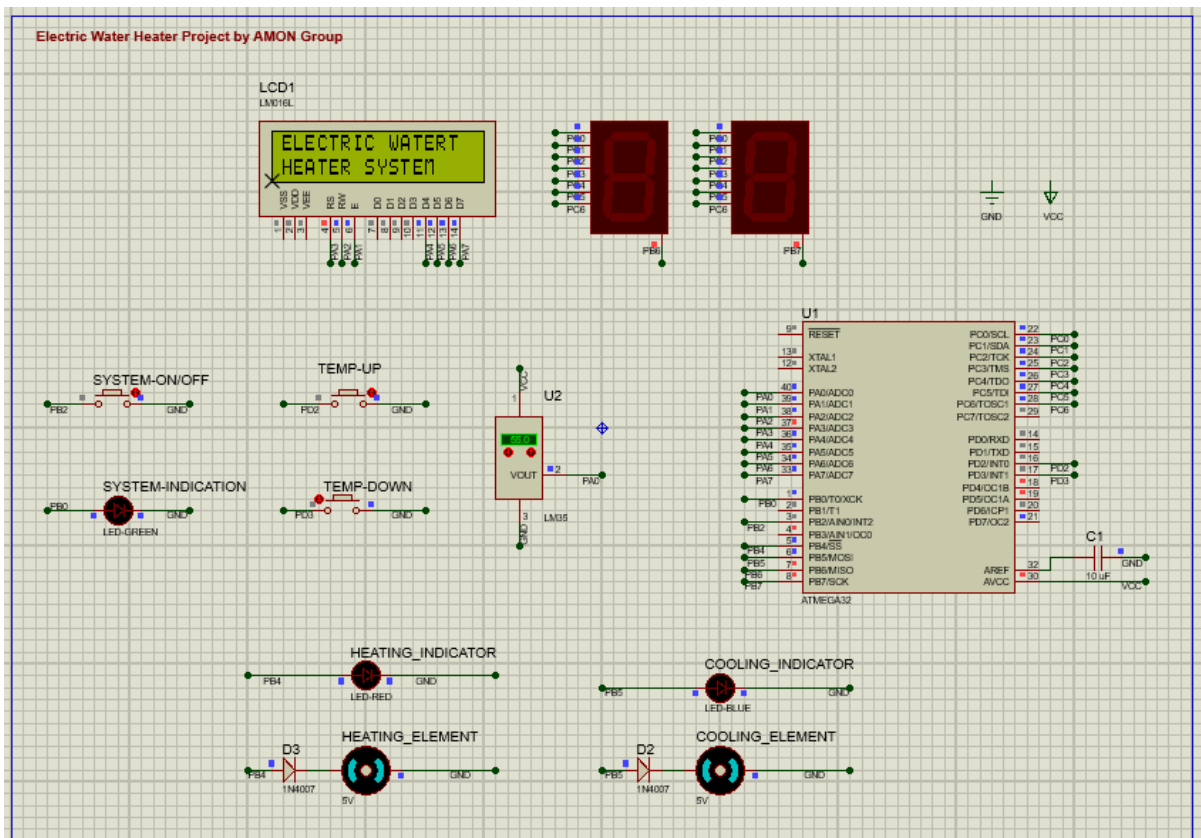
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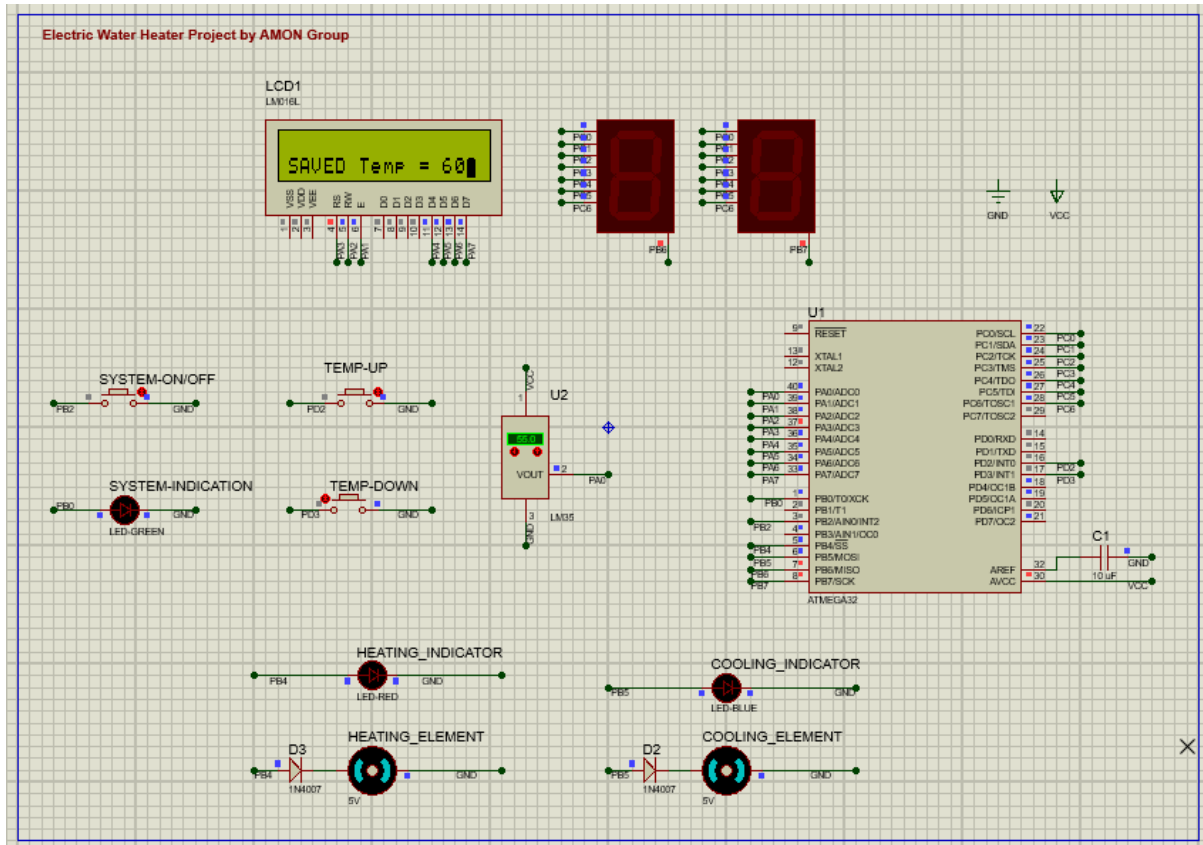
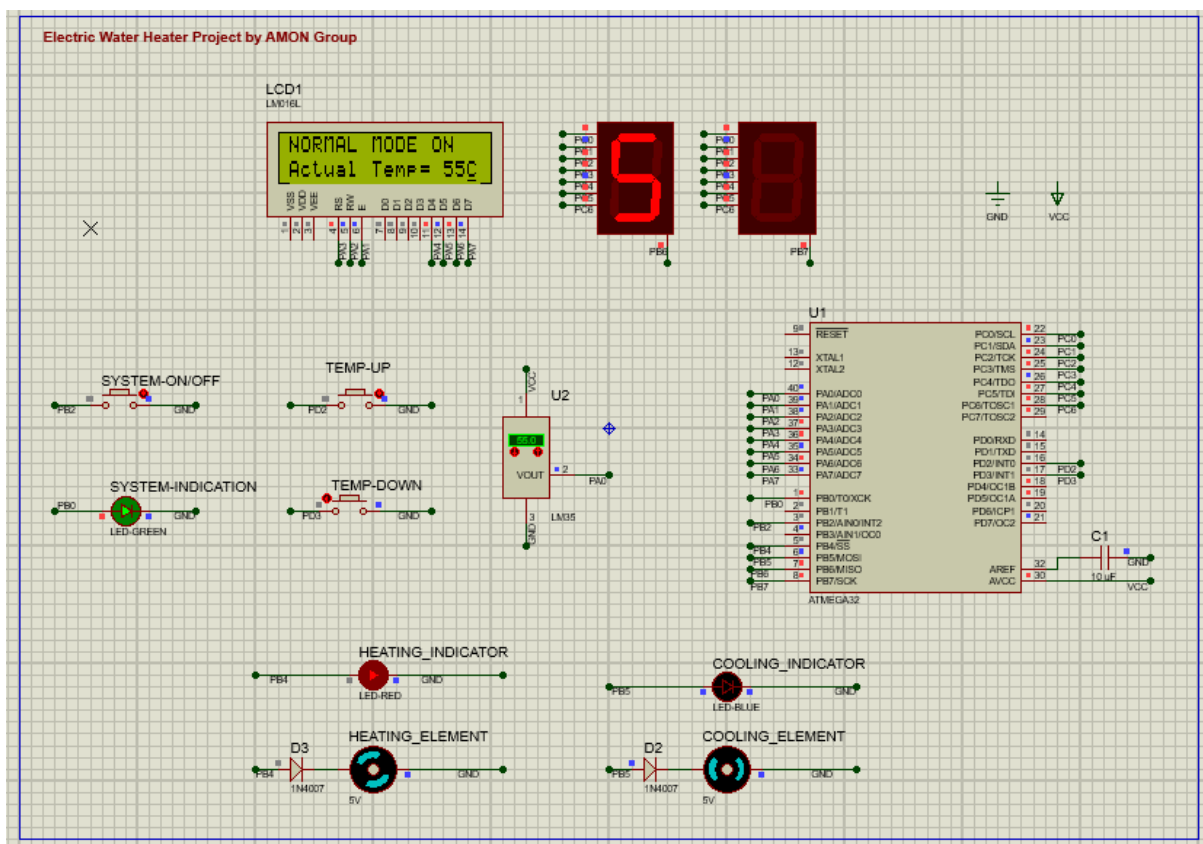## System Software Architecture: -

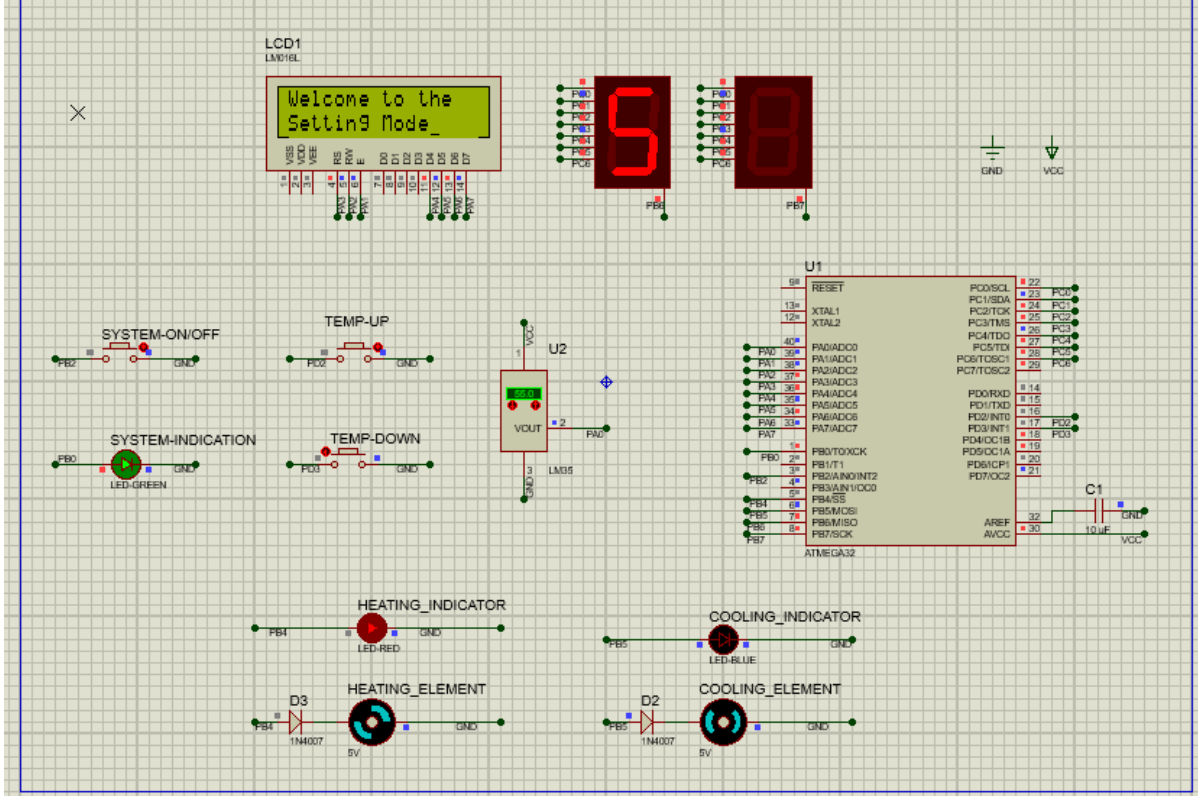# System Simulation
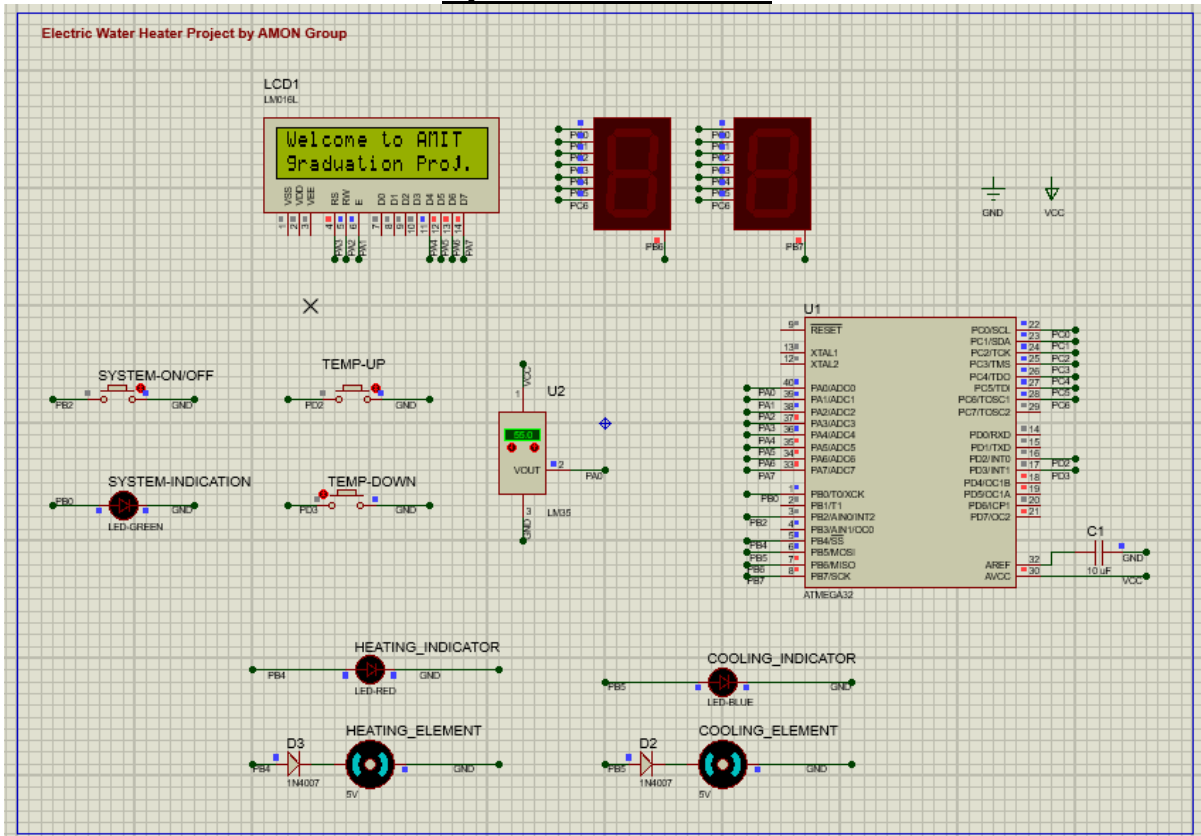
Welcome Message
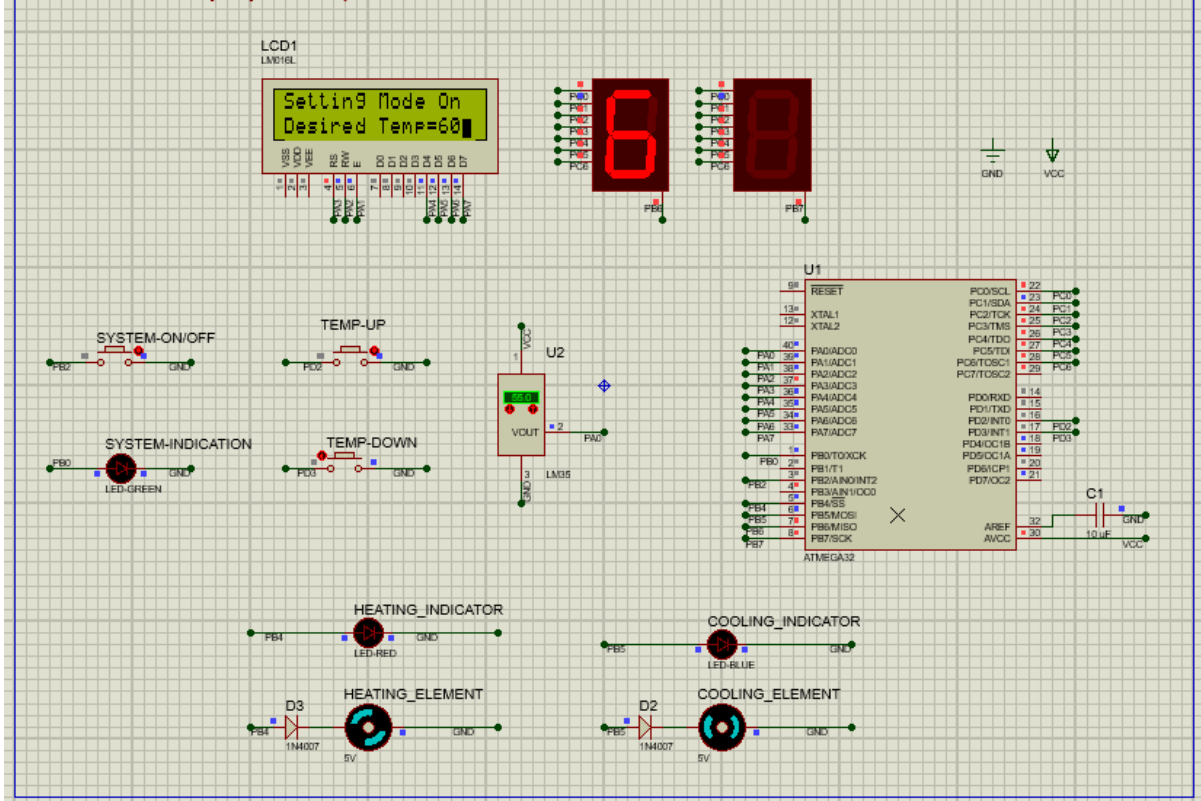

Welcome Message

Initial Operating Temperature

Normal Operating Mode (ON State)

Setting Mode Welcome Message

Setting Temperature (SETTING State)

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System Flow Chart: -
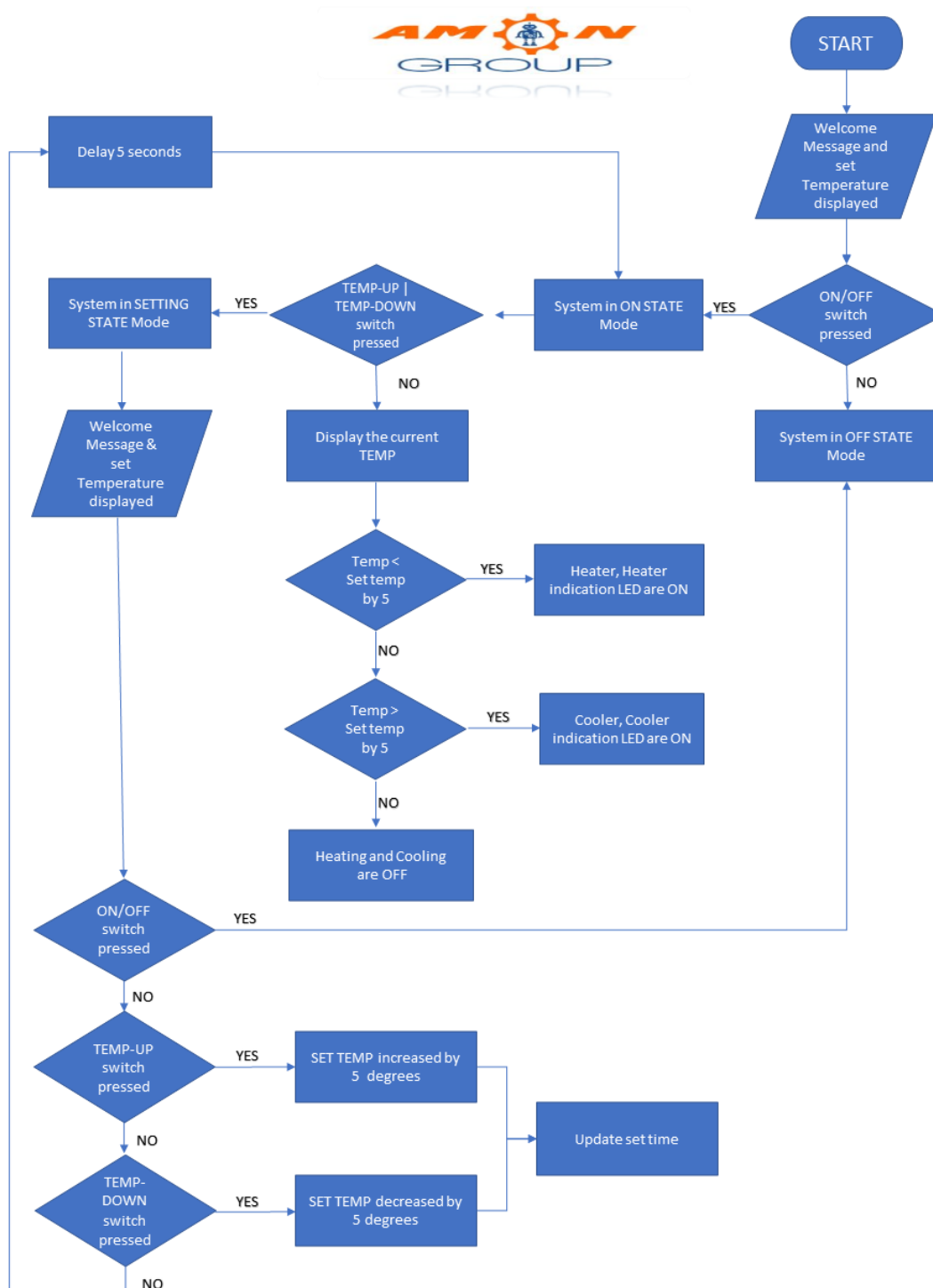
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ACKNOWLEDGMENT

This Report was written at the end of Embedded Systems Diploma from AMIT Learning. The project was a good way to express our skills and apply what we did learn in a real project that can be made by hardware after debugging of code and simulation of the whole system works fine.

We learned how to build a system from scratch and making main libraries of microcontroller peripherals and external hardware.

Special thanks

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