Department of Computer Engineering
Digital Hardware Systems
CpE 3104 - Microprocessors

Systems Design

Group Name:	Intelligent Power Control in Air Conditioning with 8086 Logic	**Date Submitted:**	December 6, 2023
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I. Case Study

Based on the case study, it was concluded that integrating a microcontroller system using the 8086 could effectively regulate and save power consumption for air conditioning units. The 8086 microprocessor system can monitor and adjust the temperature of the air conditioning units based on the readings from the temperature sensor. This allows for more precise temperature control, which can lead to significant energy savings. Additionally, the system can detect and halt the operations of the air conditioning units if there are any issues with the voltage supply, which can prevent damage to the units and further save energy. Overall, the integration of an 8086 microprocessor system can provide intelligent power control for air conditioning units, leading to improved efficiency and cost savings.

II. System Overview

The Smart Thermostat project has made significant progress in implementing core features. The integration of various components along with scheduled aircon activation and temperature monitoring.

The overview of the system is shown in the following figure:

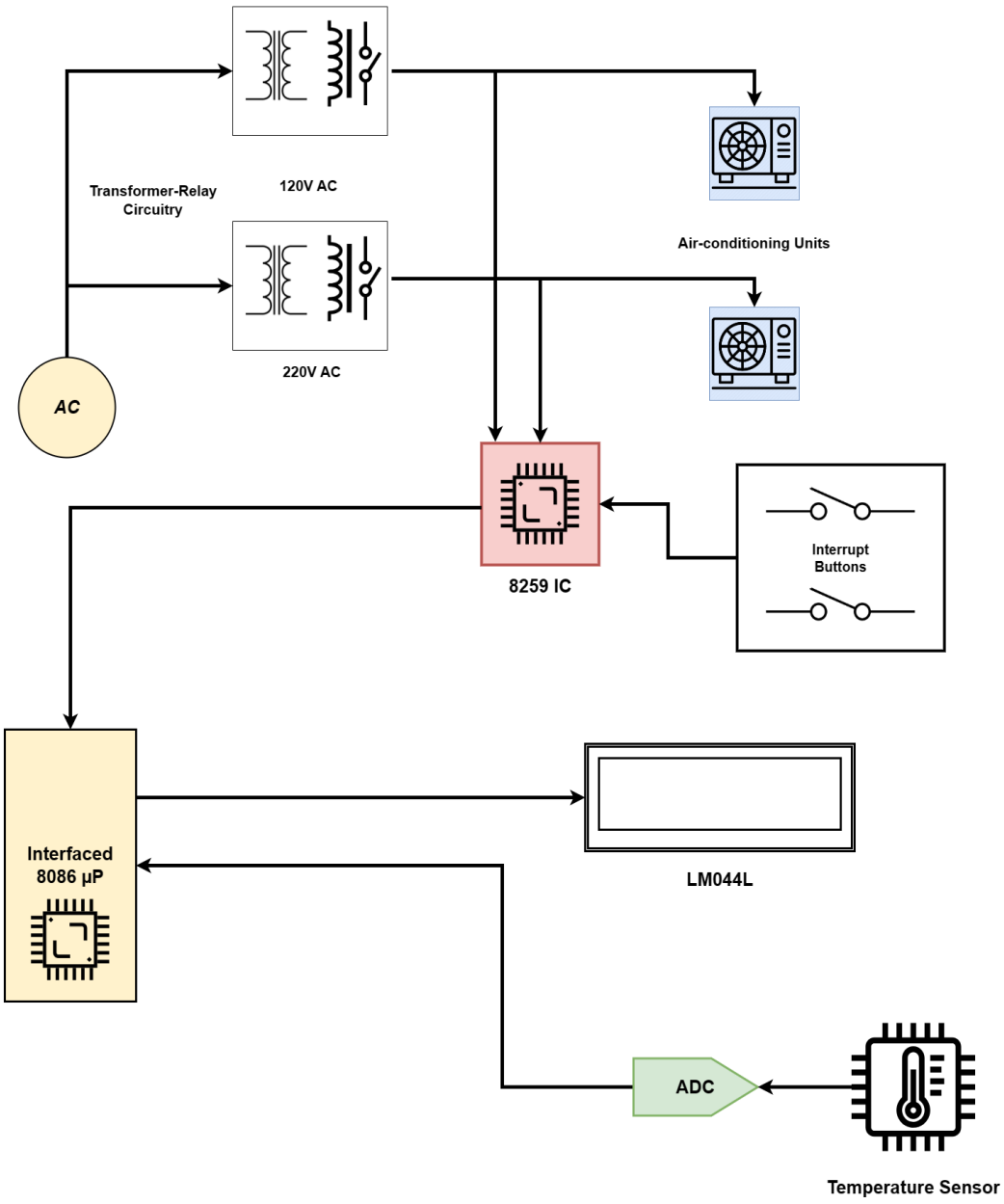


Figure 1.0 - System Diagram

For testing purposes, the air conditioning units will be supplied with different levels of AC voltages(120V & 220V AC). The output of the transformer-relay circuitry will be fed to a comparator circuit, and if the reference voltage of the comparator is not equal to the output of the transformer-relay circuitry, the 8259 IC will trigger an interrupt that will halt the operations of the air conditioning units. The interrupt buttons will toggle the air conditioner units on and off. The temperature sensor will be fed through an analog-to-digital converter, and depending on the readings from the sensor-ADC input, the 8086 microprocessor will adjust the temperatures on the air conditioning units. The LM044L will serve as the interface between the user and the system.

The system overview may not reflect the final design of the system as we may encounter problems during the integration process.

III. Hardware Design

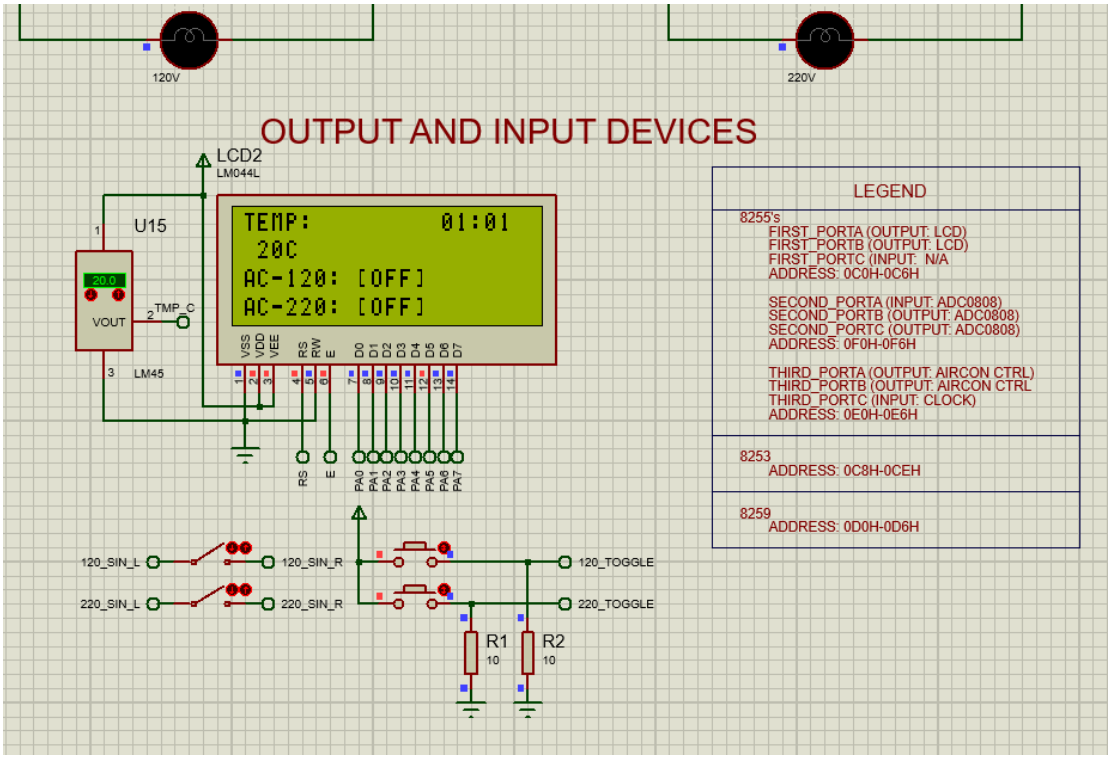


Figure 2.0 - Input and Output

To achieve the objectives of this project, we have divided the hardware design into four parts, consisting of the I/O devices, the project implementation, and the simulations of the air conditioning units and their power supplies. In **Figure 2.0**, we see the overall output of the project, which features an LCD that shows the status of the AC units and two push buttons and switches for the input. The switches allow the user to give power to the simulated AC units while the push buttons toggle the units on/off.

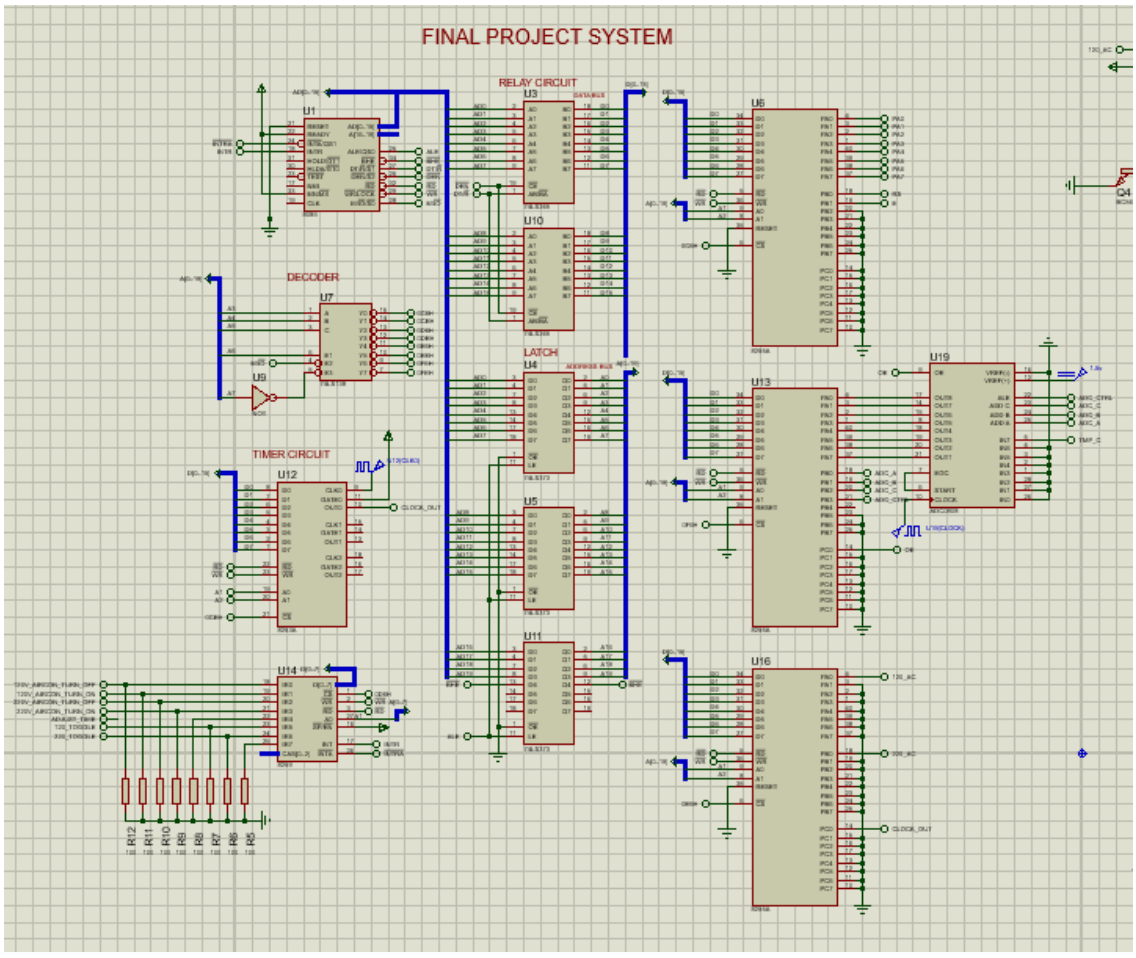


Figure 3.0 - Project Implementation

Figure 3.0 features the implementation of the project. It has all the components related to the 8086. The 8259 uses six interrupts that are edged triggered, which helps accurately detect faulty voltage.

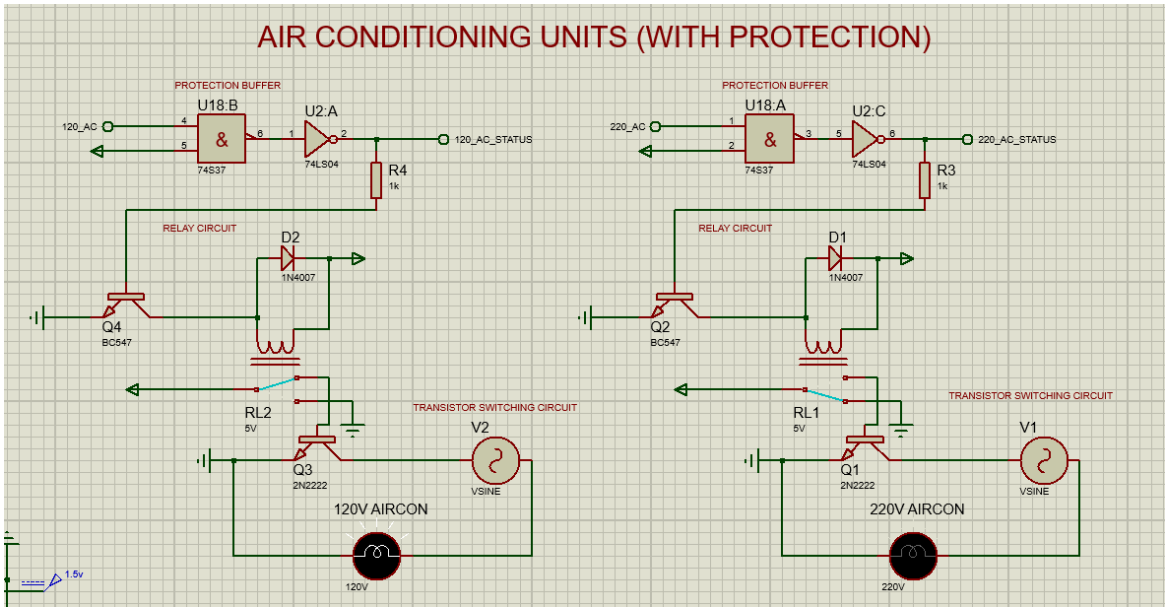


Figure 4.0 - Simulation of Air Conditioning Units

Figure 4.0 features the circuit for the simulation of our AC units. They serve as the testing components for the project's logic.

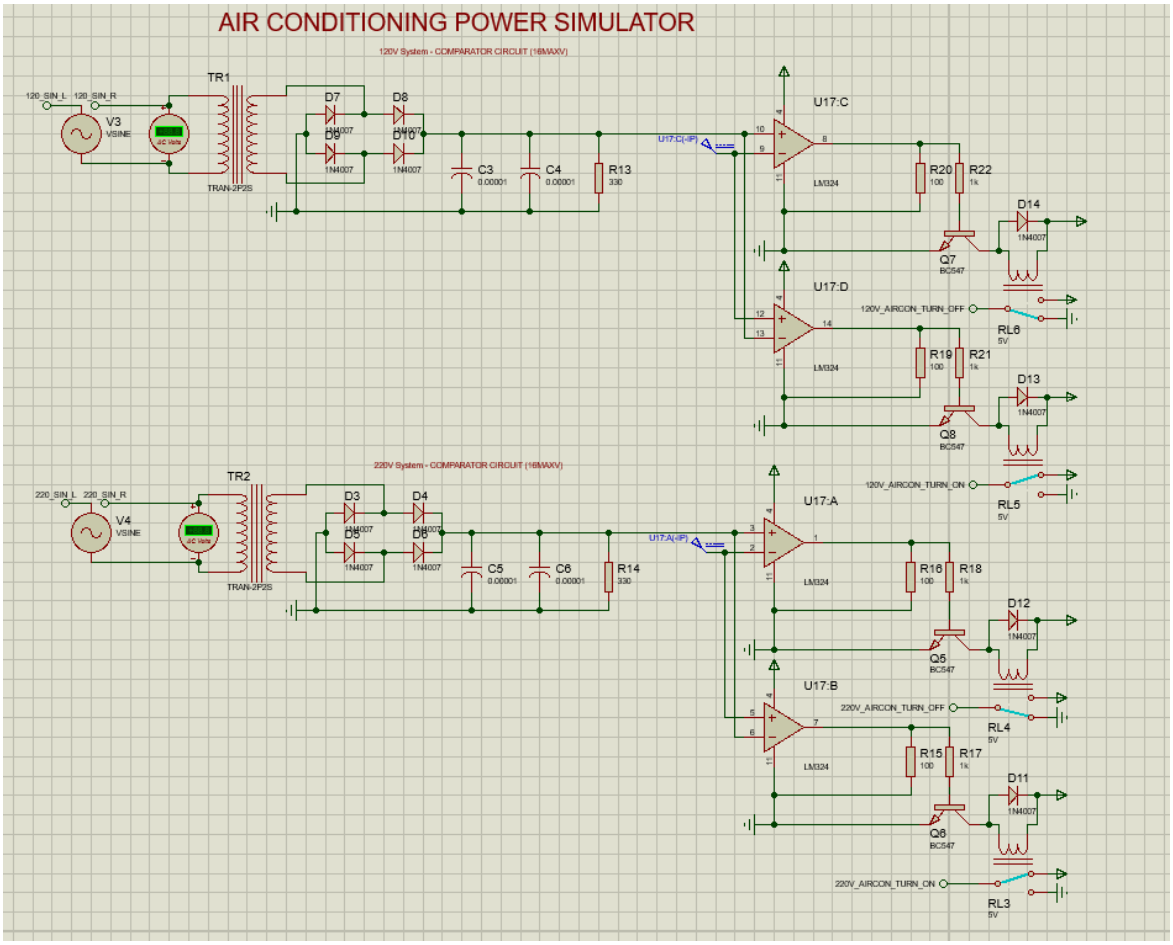


Figure 5.0 - Simulation of Power Sockets

Figure 5.0 features the power supplies for our AC units. We had to step down the voltage to adjust to the LM324 to avoid shorting it.

I/O and Memory System:

- 8086, Address Latches, and Data Buffers
- Address Decoder and 8255 PPI

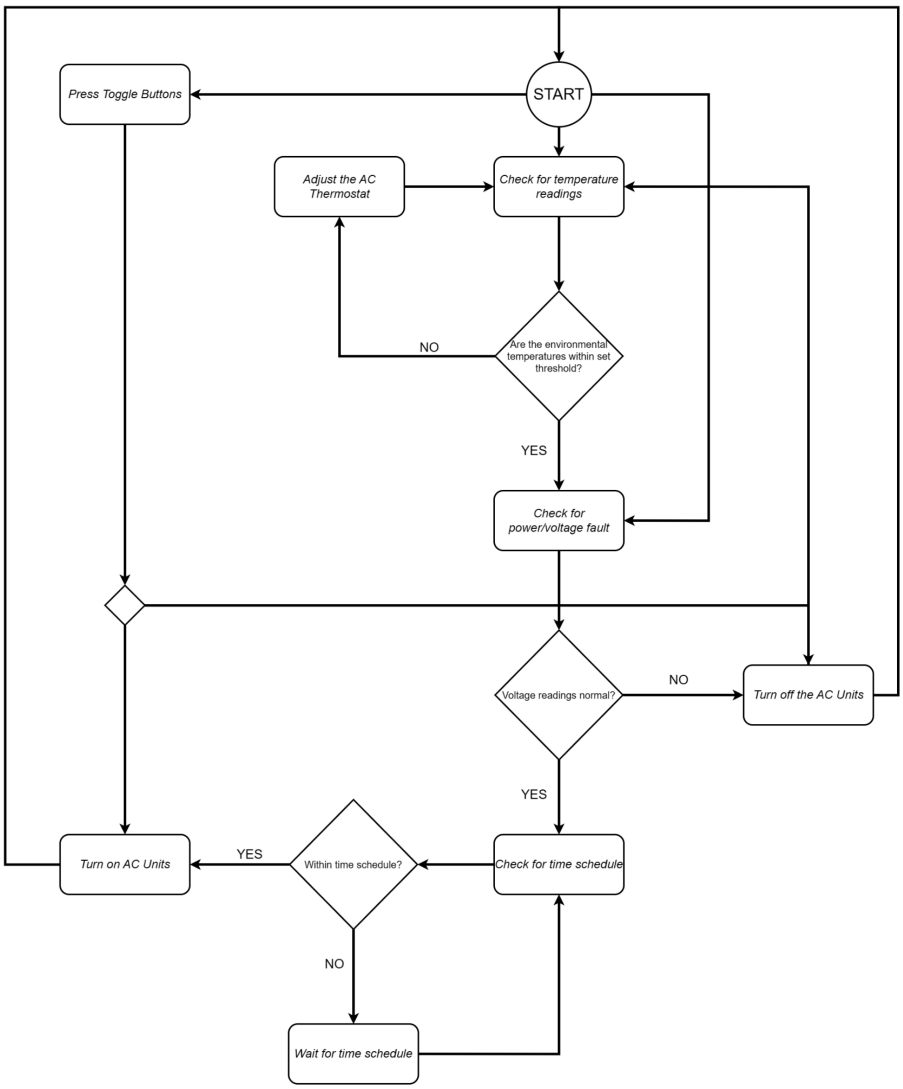
Other Components:

- 1N4007 Silicon Diode
- Transformer 2P2S
- Polar Capacitors
- LM324 Operational Amplifier
- BC547 Transistor
- 2N2222 Transistor
- Relay Component (circuit component that helps drive the switches)
- 8086 Relay (Allow data to transfer in and out of the 8086[74LS245 LATCH])
- 74C295 (keypad decoder)
- Lamp 220V

- Lamp 200V
- 8255 PPI
- 8253 PIT
- 8259 PIC
- ADC0808
- LM45 Temperature Sensor
- LCD

IV. Software Design

The following activity diagram represents how the system should run during runtime:



The software will check for temperature readings from the temperature sensor. If the temperature readings don't meet the threshold values, it will adjust the temperature of the AC units. The software will check for voltage faults if temperatures are within the threshold. If everything is normal, then the system will check if the system clock is at the scheduled time. The system will turn on the AC units when the system clock is at the programmed scheduled time. The AC units will turn on if the toggle buttons are pressed regardless of the pre-set time of the system.

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