



COVID-19 Safety Door

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Introduction

- ▶ Ensure those without a fever, a symptom of COVID-19, can enter businesses
- ▶ Ensure those with a fever cannot enter businesses
- ▶ Remove recurring cost for business



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High Level Requirements

1. The Thermawave Monitor must be able to accurately measure the temperature of a person within a tolerance of 0.5°F standing anywhere from 2 to 4 inches in front of the sensor. If not in range the user will be prompted to properly adjust.
2. The signaling system must be able to easily notify the patron that they are not allowed entry if their temperature is considered to be a fever. Any temperature below 100.3°F will be considered safe, and any temperature below 96.0°F will be considered abnormally low and also not granted entry.
3. The entire process of admittance, defined as someone getting their temperature taken and walking through the door, should take less than 30 seconds.

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System Overview

Hardware:

- ▶ Power Supply
- ▶ IR Sensor
- ▶ Ultrasonic Sensor
- ▶ Alphanumeric Display
- ▶ LED

Firmware:

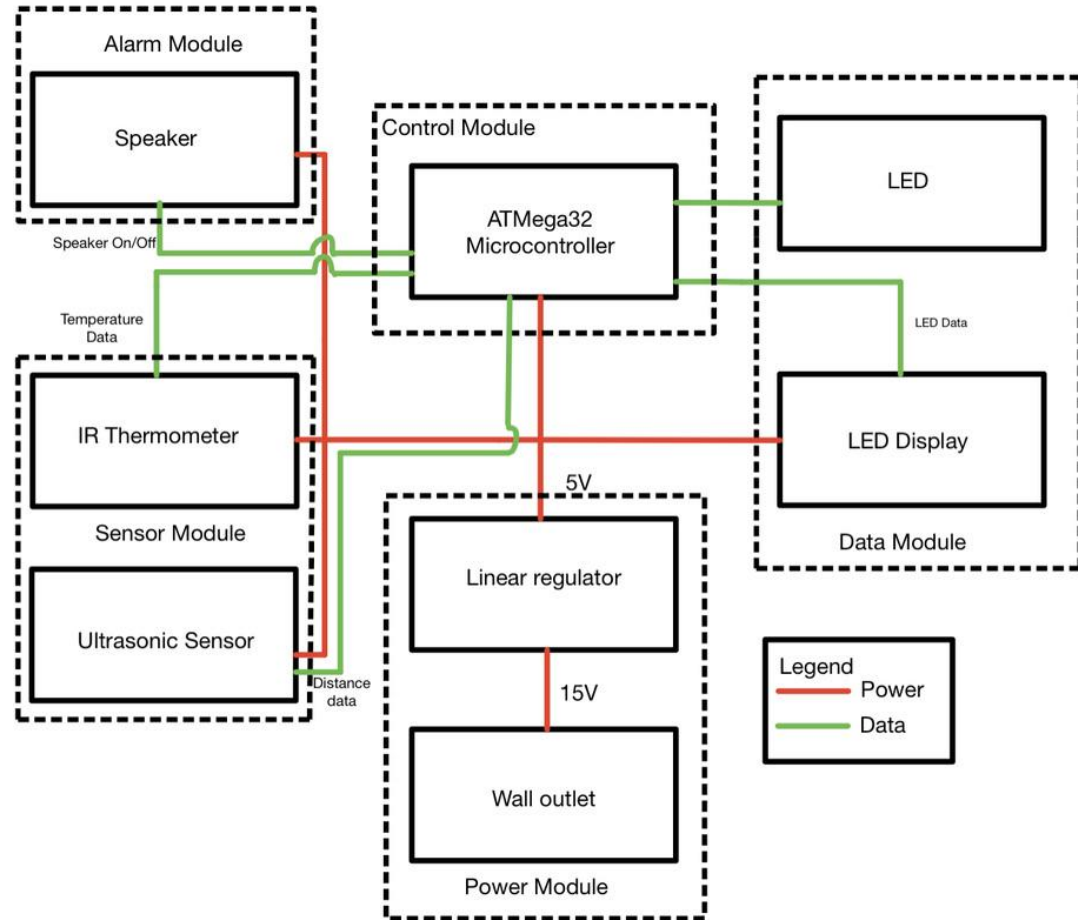
- ▶ ATMEGA328 Microcontroller

Software:

- ▶ I2C Bus
- ▶ Data processing
- ▶ State Machine

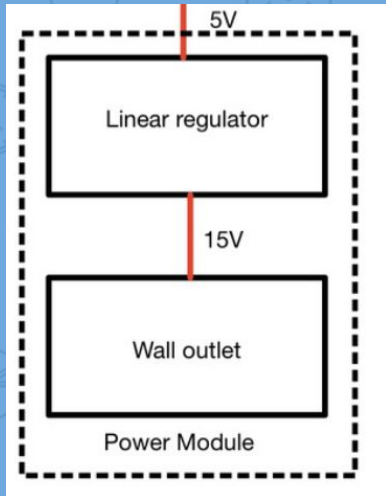
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System Overview

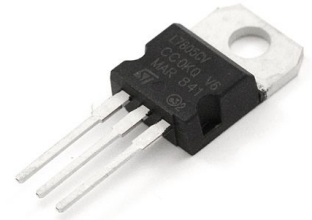


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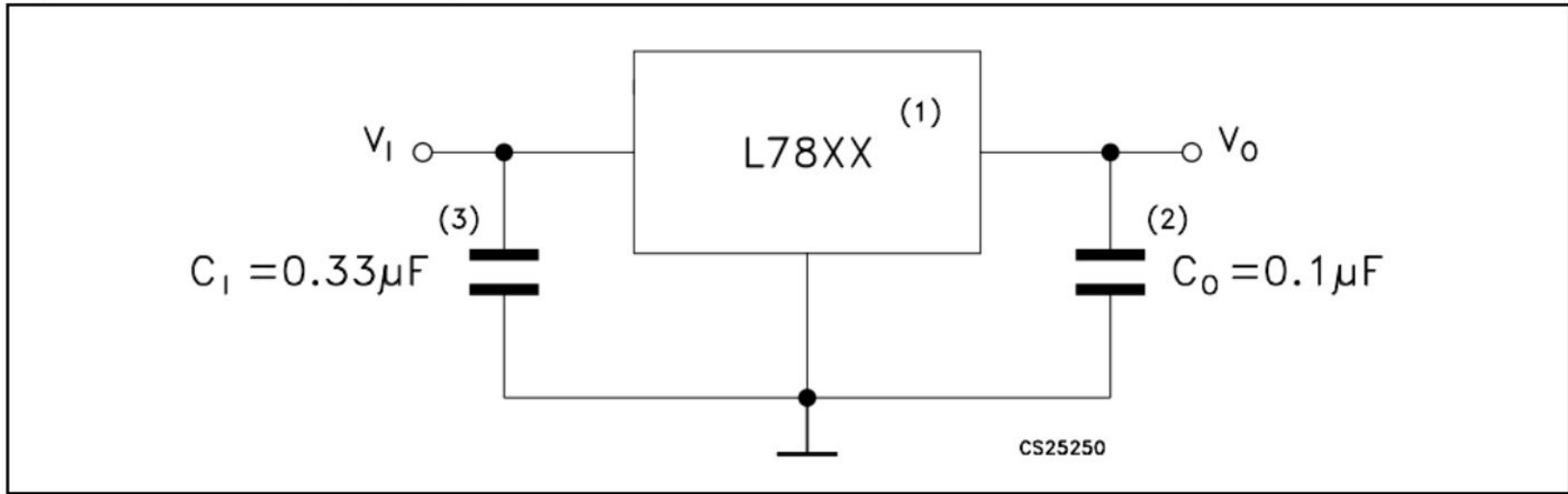
Hardware: Power Module



- ▶ AC/DC Adapter Wall Plug
- ▶ Linear Voltage Regulator (LM8705)



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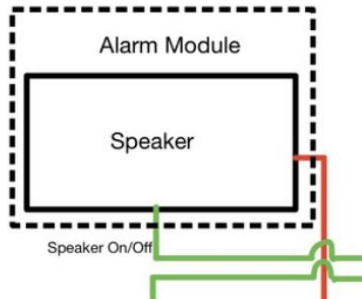
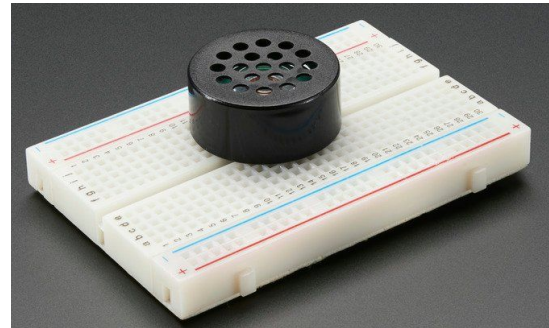


1. To specify an output voltage, substitute voltage value for "XX".
2. Although no output capacitor is need for stability, it does improve transient response.
3. Required if regulator is locate an appreciable distance from power supply filter.

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Hardware: Alam Module

- ▶ Notifies the user whether or not they are in the specified temperature range and if they are allowed entry or not
- ▶ Two distinct tones play
 - Two tone sound plays in the 400Hz to 600Hz range for entry acceptance
 - Repeating tone at 300Hz plays for entry denial.



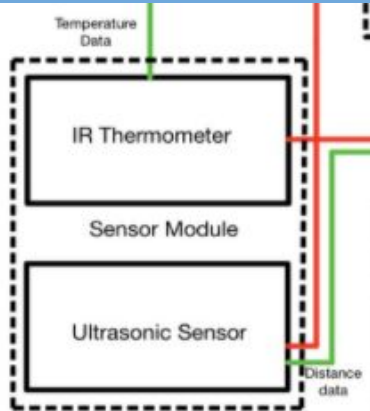
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Hardware: Sensor Module

- ▶ IR Thermometer sensor outputs a temperature of whatever is in front of it.
 - ▷ Uses the I2C bus to communicate with the ATmega328

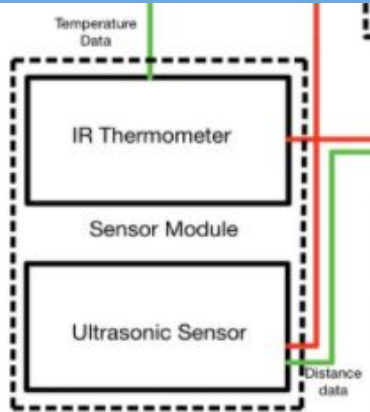


- ▶ Will accurately tell the temperature to within $\pm 0.5^\circ\text{F}$
 - ▷ Optimal testing distance of 2 to 4 inches
- ▶ In order to accurately stay within this 2 to 4 inch range the ultrasonic sensor is used
 - ▷ If the person is within the desired range, the LED in the Data module is turned on

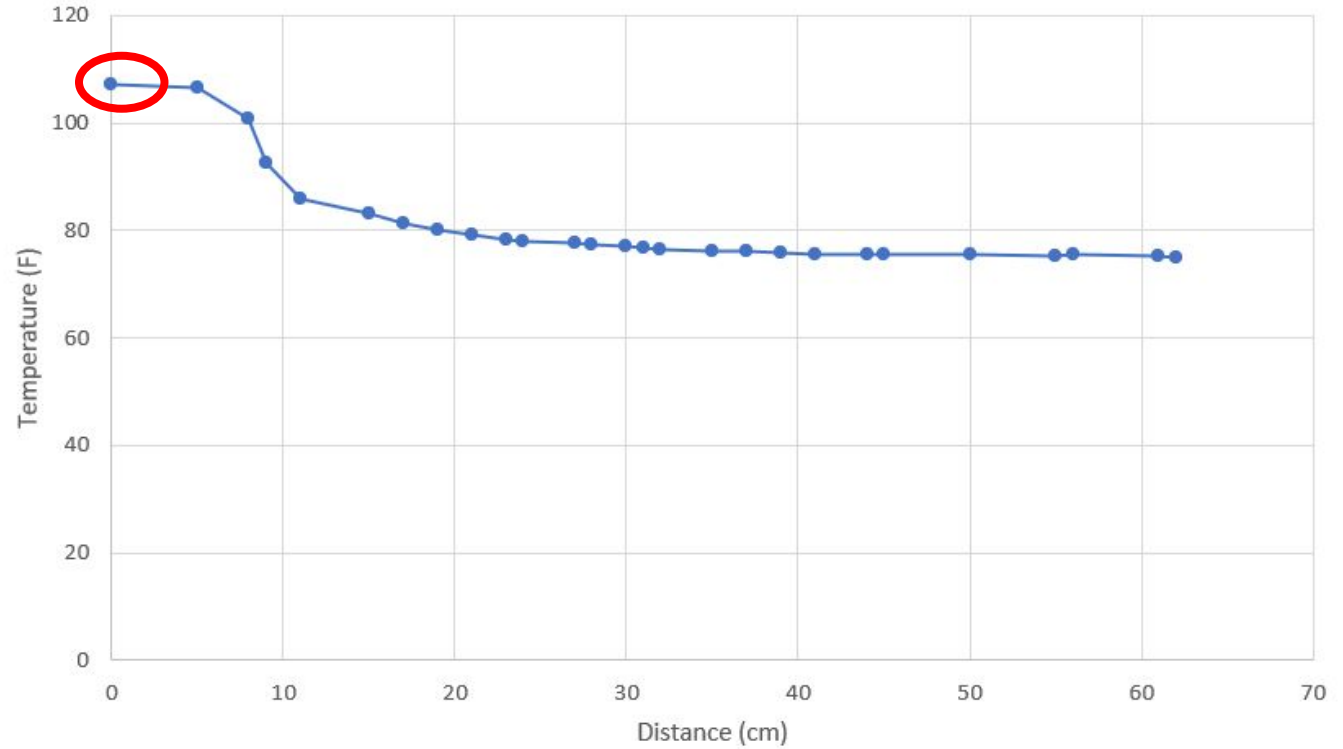


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Sensor Module Testing



Distance vs. Temperature

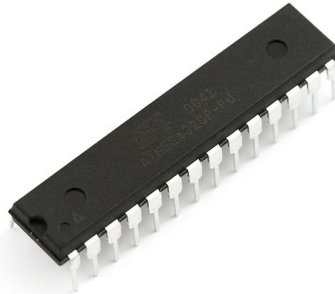
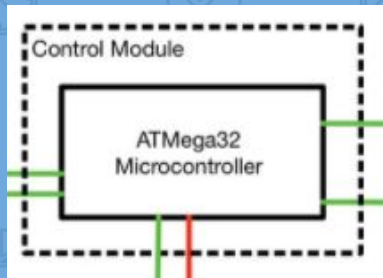


$$T = 114e^{-0.02d}$$

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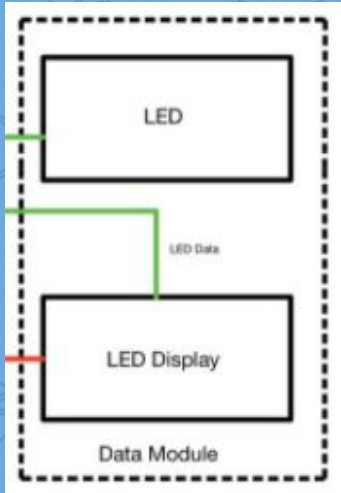
Firmware: Control Module

- ▶ ATmega328p microcontroller
 - ▷ Using internal crystal oscillator to run at 8MHz
- ▶ Takes in inputs from both of the sensors and produces outputs for the LEDs and speaker
 - ▷ Utilizes the on chip I2C bus for the IR thermometer and the LED display

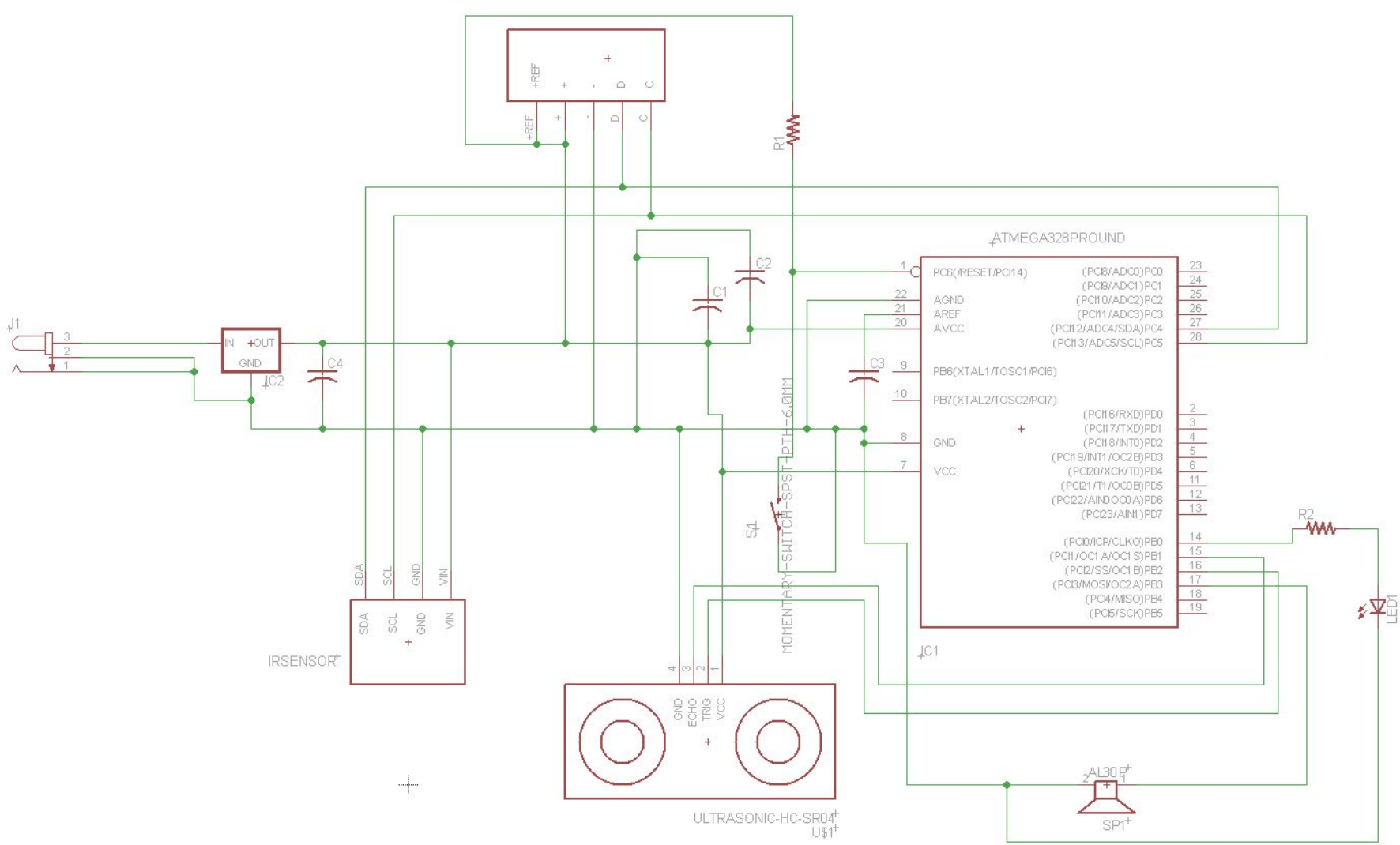


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Software: Data Module

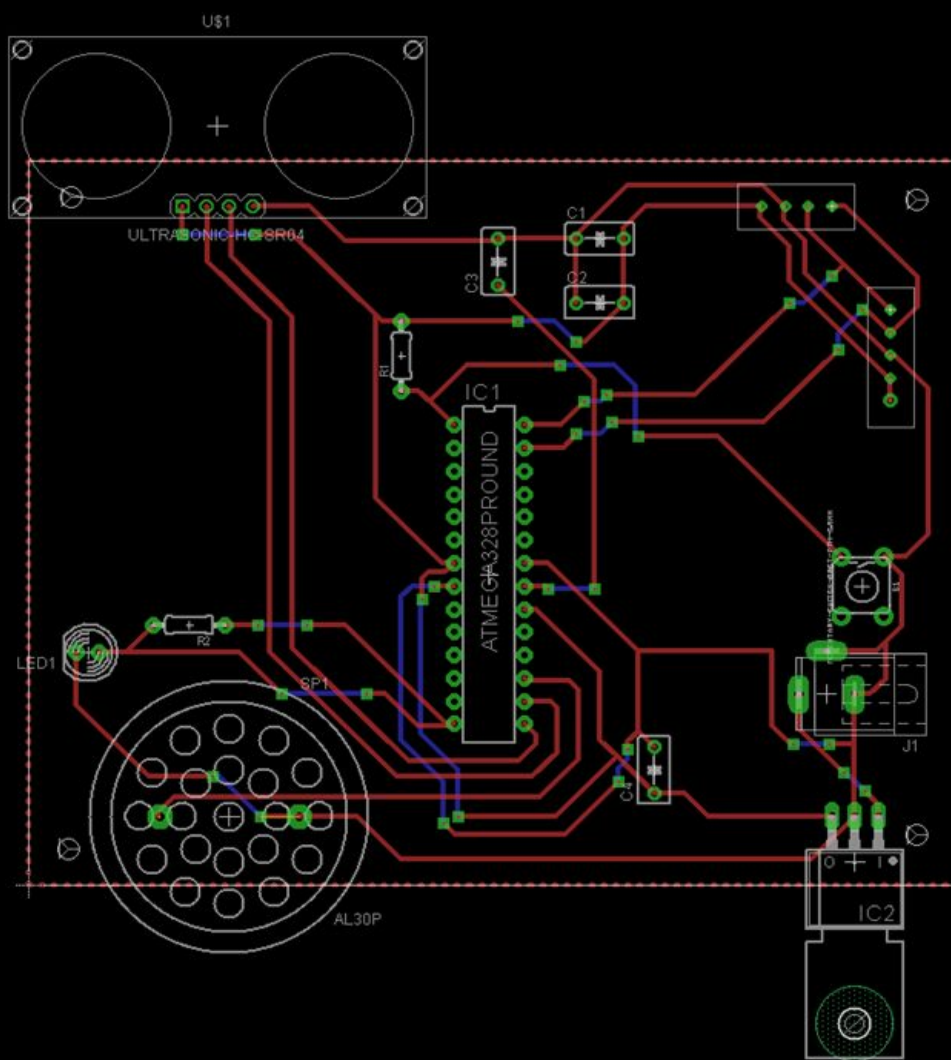


- ▶ **Alphanumeric LED Display**
 - ▷ Takes input from control unit
 - ▷ Displays 'COME HERE' when in range
 - ▷ Displays 'TEST' when in range
 - ▷ Displays 'ACPT' or 'DENY' followed by the users temperature after a successful read
- ▶ **LED**
 - ▷ Takes input from control unit
 - ▷ Powered if user in 2-4 Inches range
- ▶ **Core program loop is a state machine**
 - ▷ Each peripheral in the data module updated every cycle of the state machine
 - ▷ Data provided to control unit via Ultrasonic sensor and IR sensor



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Board Layout



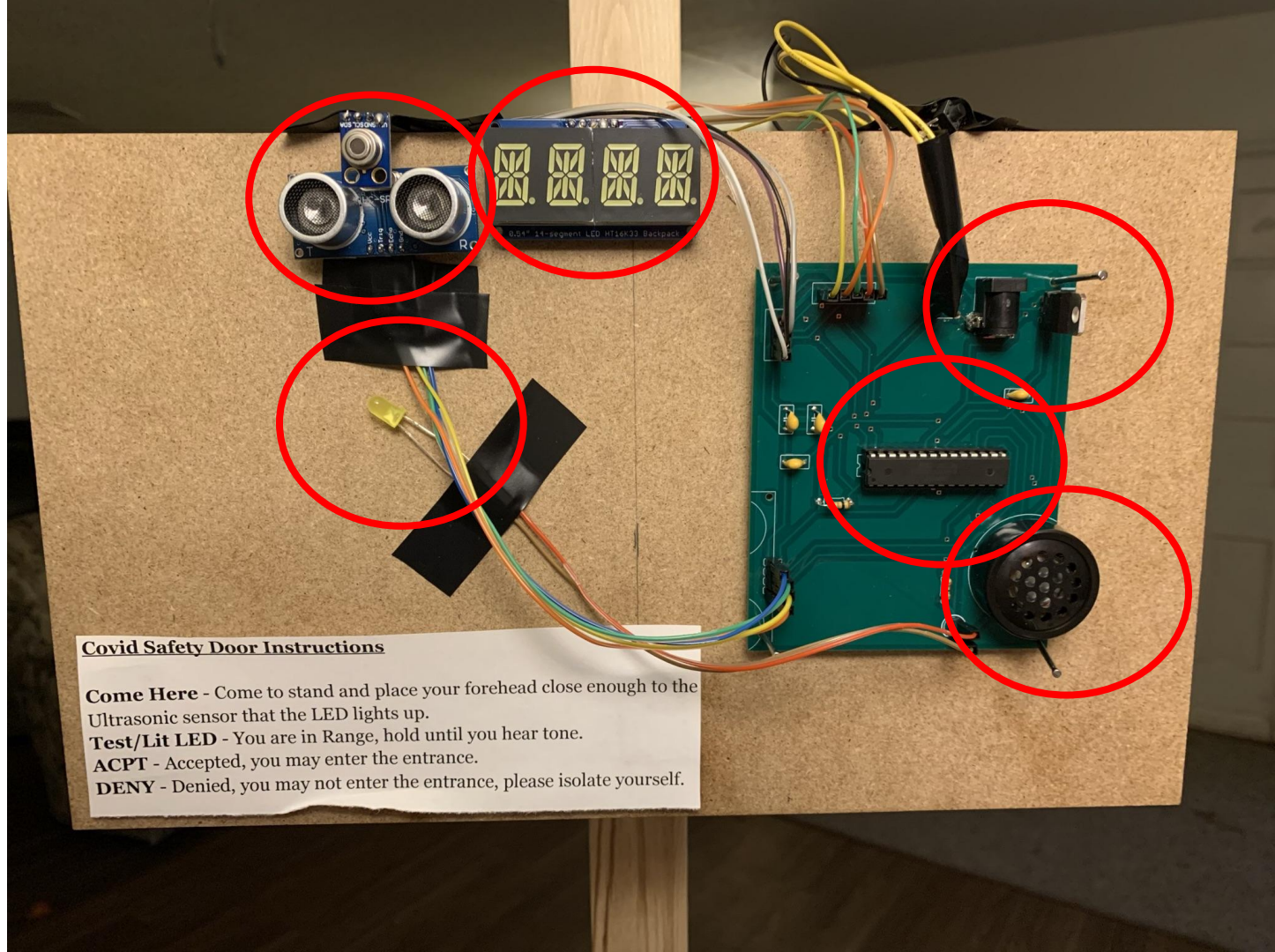
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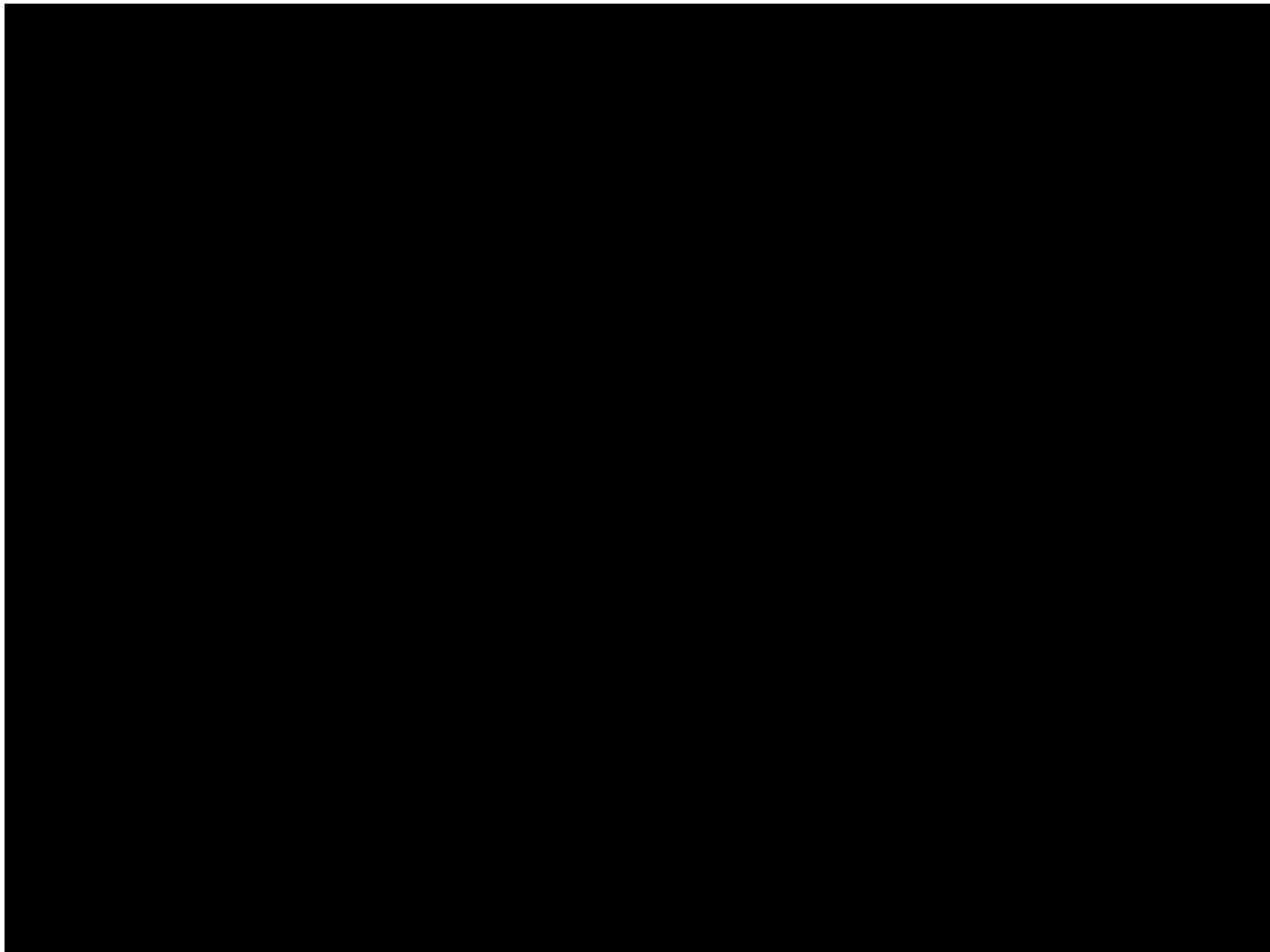
Physical Design



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Physical Design





Strengths:

- ▶ Cost effective
- ▶ Quick testing process

Weaknesses:

- ▶ Must be in close proximity
- ▶ Does not have a portable power supply

Opportunities:

- ▶ Wifi Module
- ▶ Facial Recognition/Mask recognition

Threats:

- ▶ Widespread immunity to COVID-19

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Safety & Ethical Concerns

- ▶ Ethical concerns dealing with privacy and HIPAA
 - ▷ Temperature data considered medical data and should not be tied to a person's identity in any way
- ▶ Our temperature monitor has no way of identifying a person or tying their temperature to their identity
- ▶ 110V Wall outlet is the largest safety concern

20 Questions?