

Dryer Diagnostic Unit

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Introduction

Our product measures the temperature inside a dryer.

When temperature is too high, clothes inside a dryer can reach their burning point.

Excess heat is dangerous for the dryer and the user.

Objectives

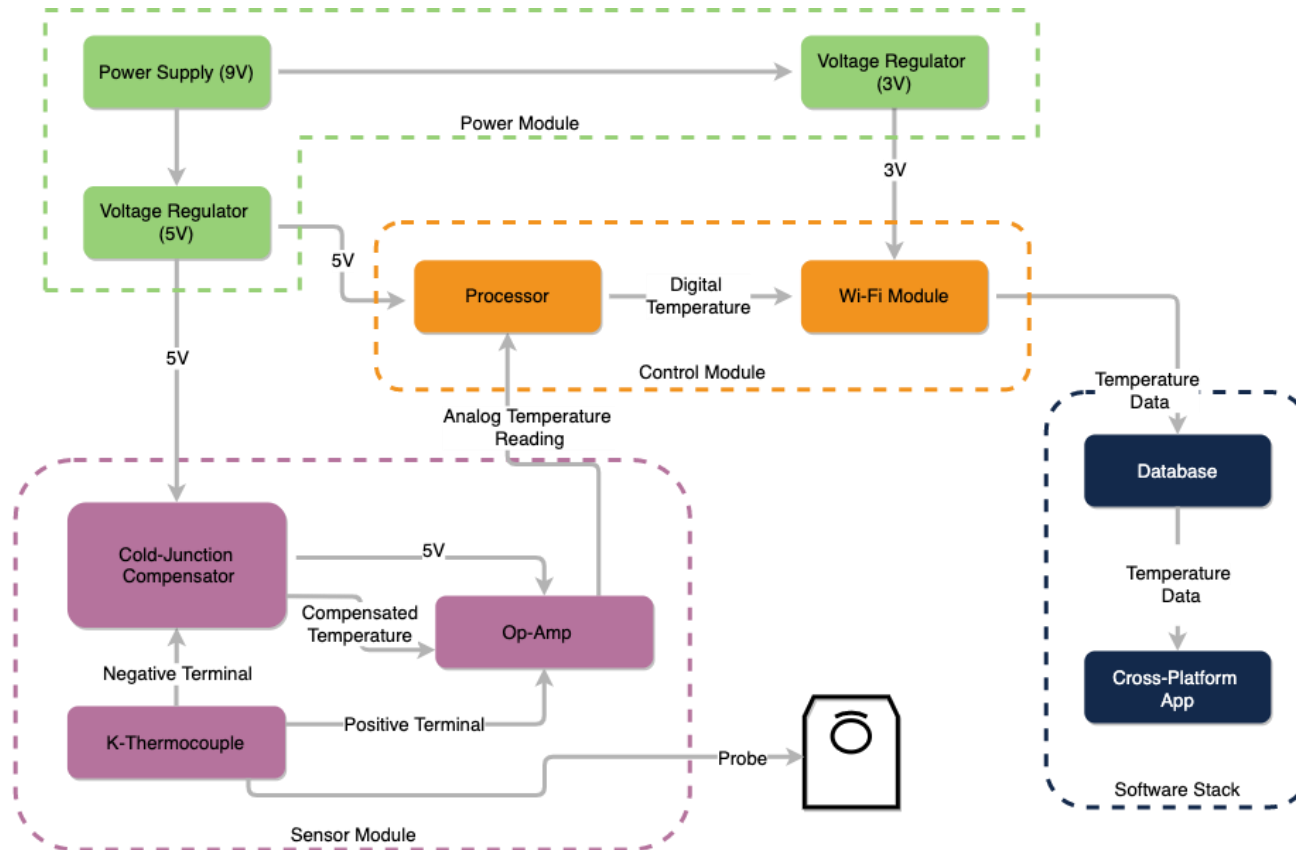
The sensor module measures the temperature inside a dryer with an accuracy of 5 °C.

The mobile app warns the user when the temperature inside the dryer is above 100 °C.

The mobile app refreshes temperature readings once per second.

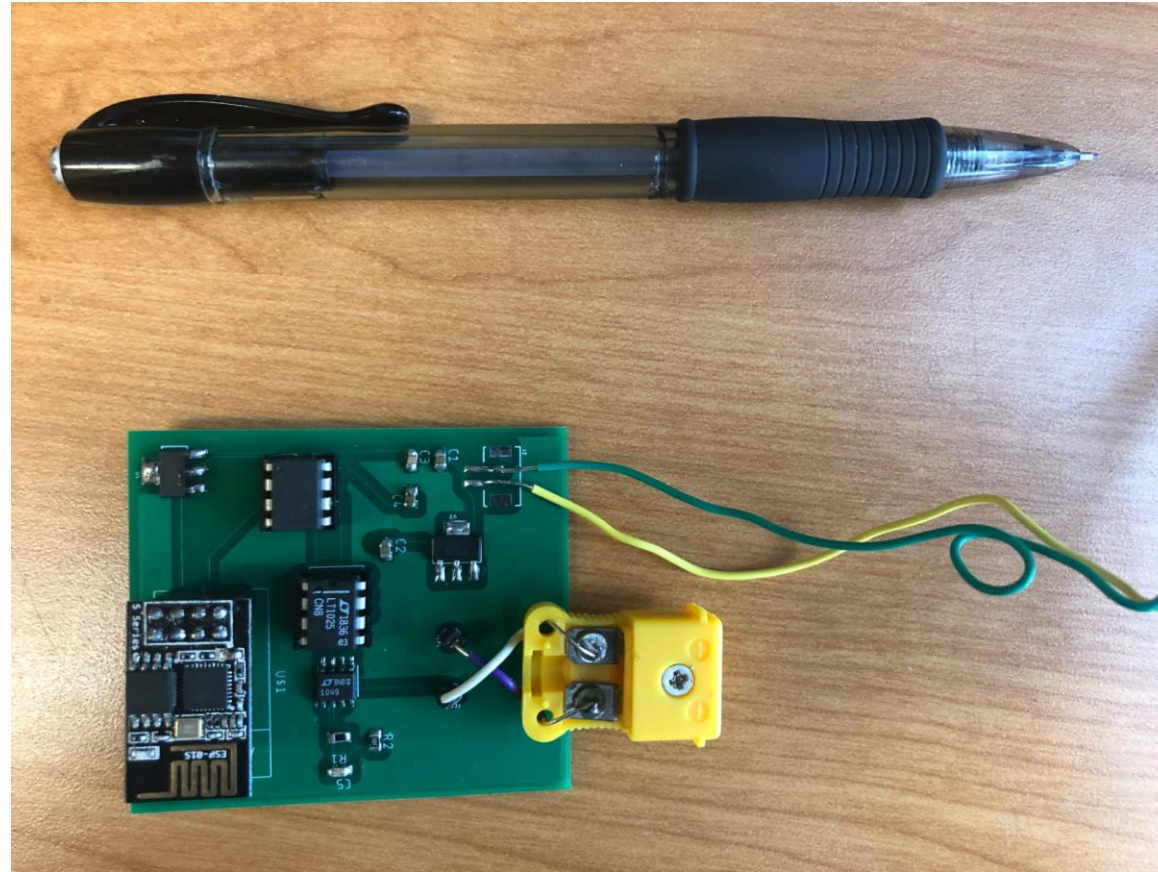
Design Considerations

(Block Diagram)



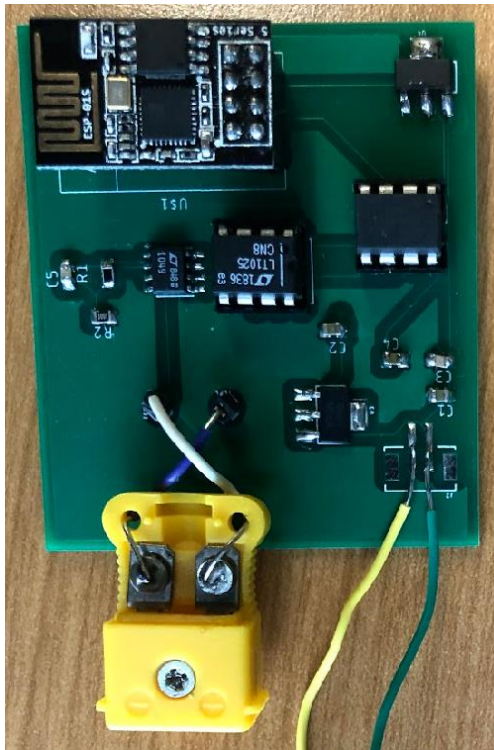
Design Considerations

(Finished PCB)

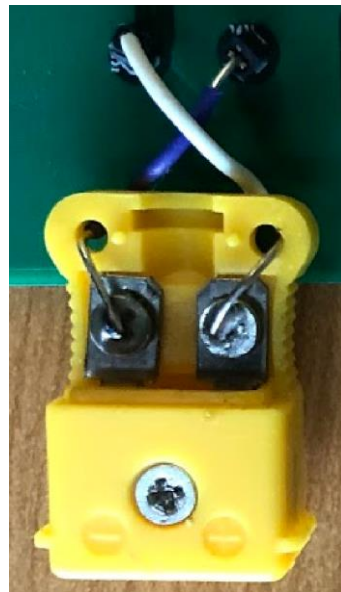


Design Considerations

(Sensor Module)



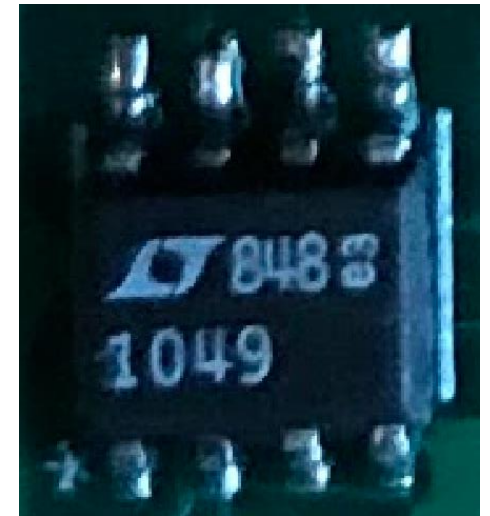
PCB



Thermocouple
Connector



Cold Junction
Compensator



Operational
Amplifier

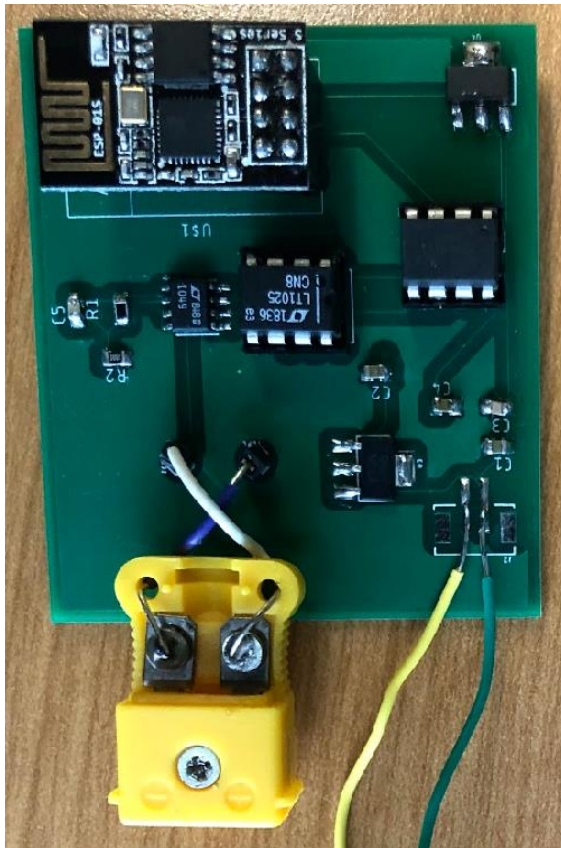
Design Considerations

(Sensor Module)

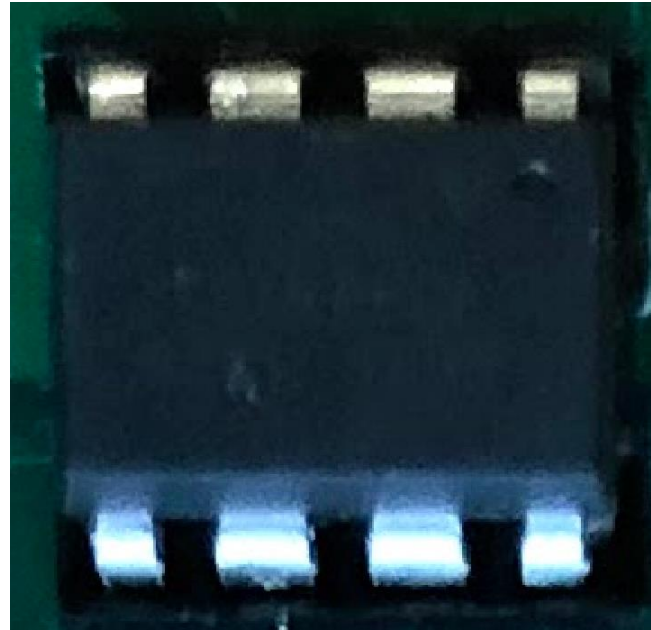
- Thermocouple: a K-type thermocouple provides accurate measurement from 20 °C to 150 °C.
- Cold Junction Compensator: simulates a 0 °C environment so that the measured temperature difference between the hot junction and the base junction is the actual temperature of the measured object.
- Operational Amplifier: amplifies the output voltage from the thermocouple so that the voltage change can be detected by the microcontroller.

Design Considerations

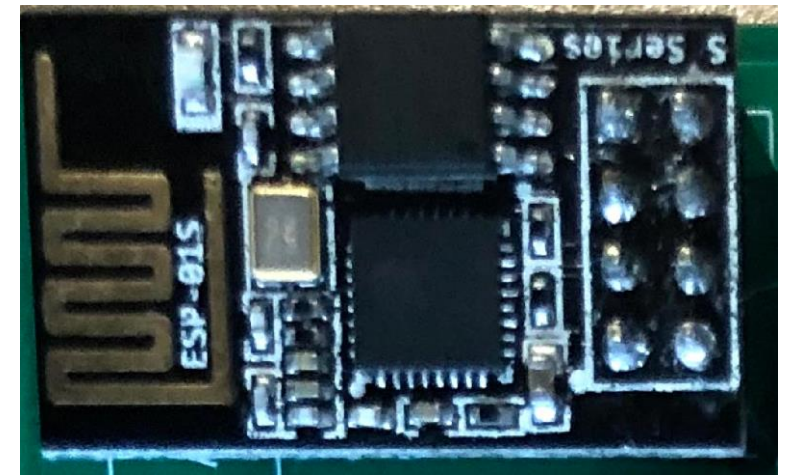
(Control Module)



PCB



Microcontroller
(ATtiny85)



Wireless Transmitter
(ESP8266)

Design Considerations

(Control Module)

- The attiny-85 is used to convert the voltage from the op-amp
 - Has a built-in programmable A-D converter
 - We use a clock rate of 125 kHz
 - And take an average from 100 readings
- The attiny-85 communicates with the ESP-01 using software serial
- ESP-01 Wi-Fi module used to transmit this data
 - In testing, the Wi-Fi network is hardcoded
 - In practice, the ESP-01 can set up a server and get the Wi-Fi credentials as input
 - It can also be used to set up the firebase database (currently also hardcoded)

Design Considerations

(Software Module)

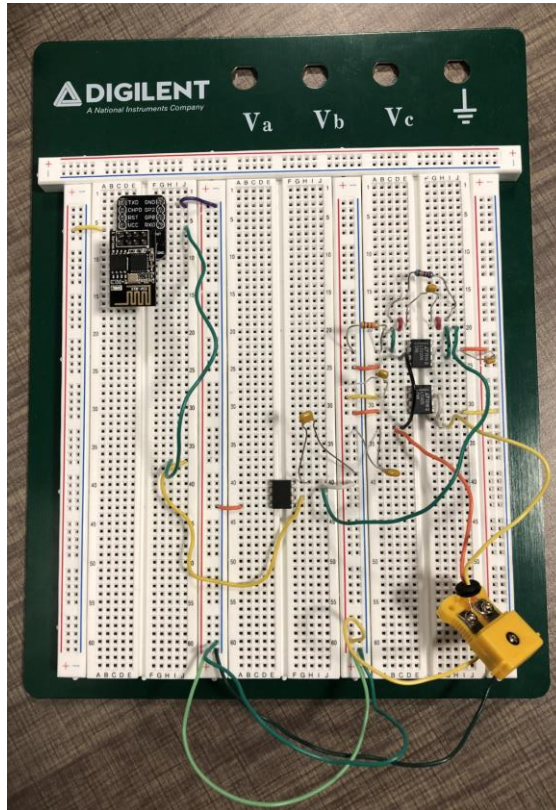
- Use Firebase as our database, collecting data from Wi-Fi module and storing real time data with nearly no lag.
- Design an iOS app using swift on XCODE, extracting data from database and presenting real time temperature on the app.
- App sends warning message to user when temperature is above normal range.

Function Tests

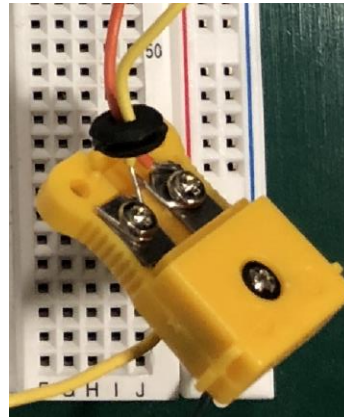
(Breadboard)

- The measured temperature by our product is close to the temperature measured by a commercial thermometer.

Function Tests (Breadboard)



Breadboard Circuit



Thermocouple
Connector

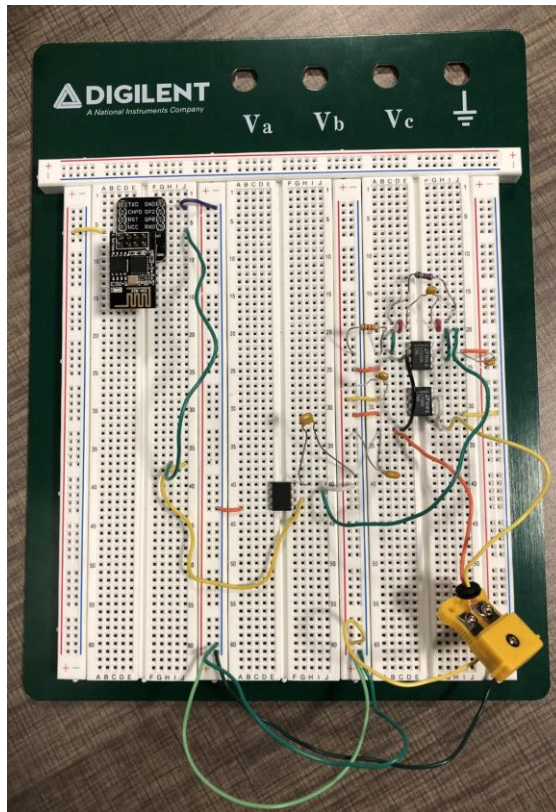


Cold Junction
Compensator

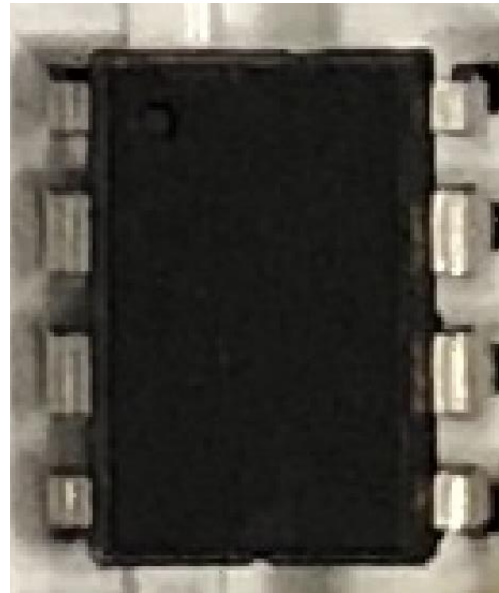


Operational
Amplifier

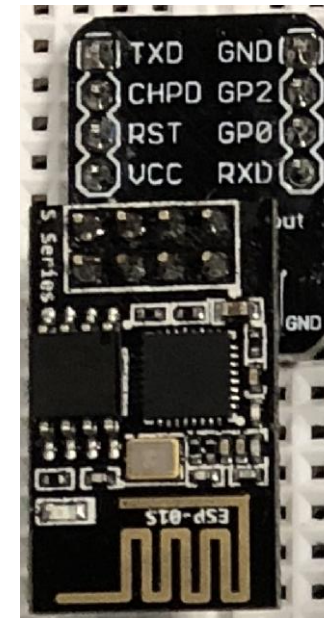
Function Tests (Breadboard)



Breadboard Circuit



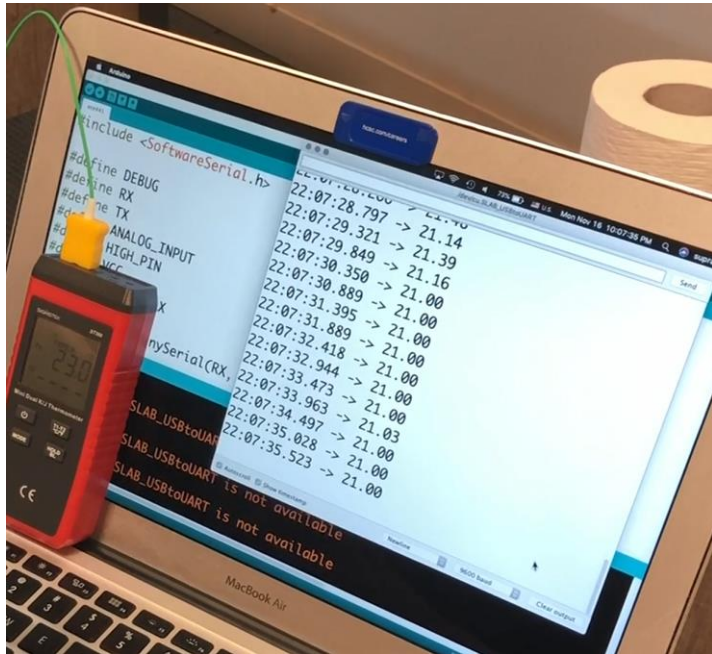
Microcontroller



Wireless Transmitter

Function Tests

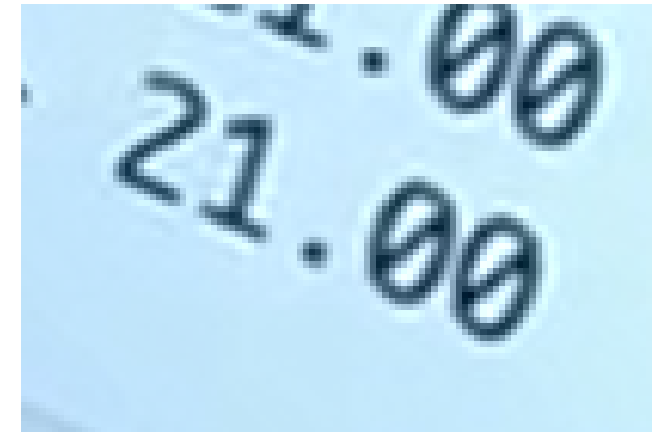
(Breadboard, Room Temperature)



Temperature Readings



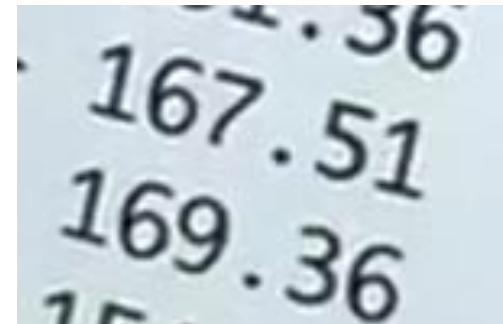
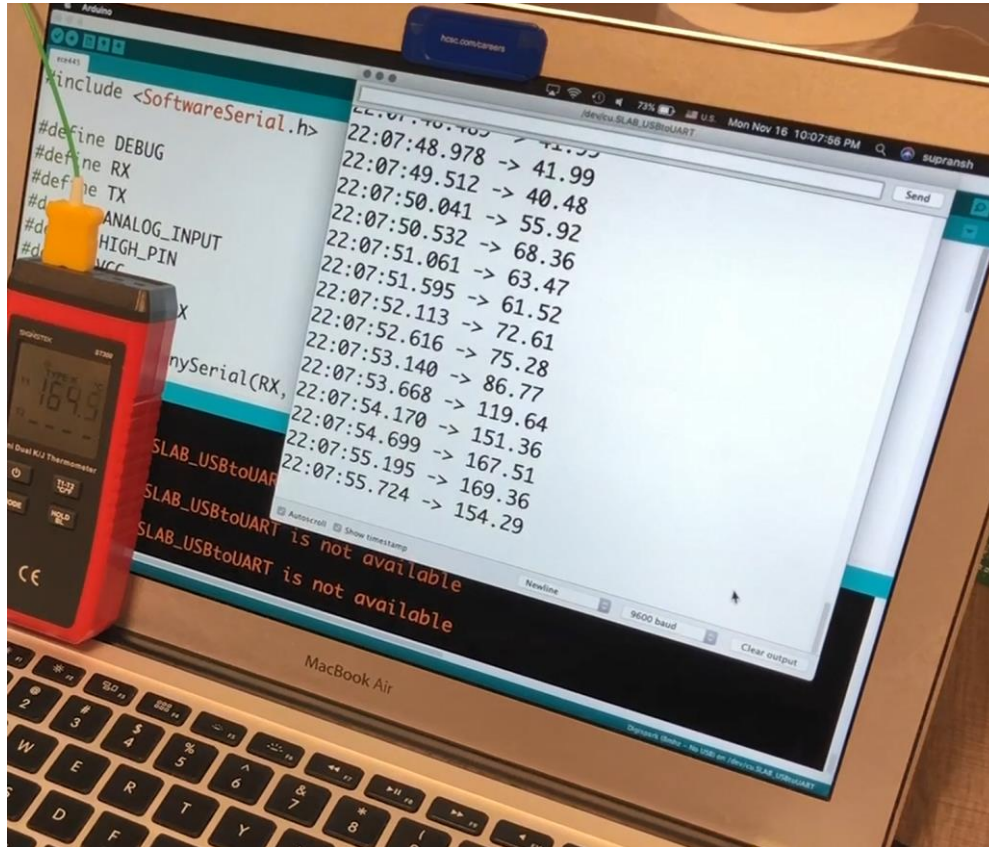
Measured Room Temperature
from a Commercial Thermometer



Measured Room Temperature
from Our Product

Function Tests

(Breadboard, High Temperature)



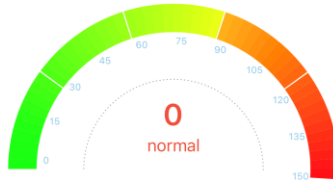
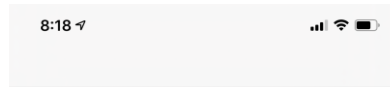
Function Tests

(PCB)

(Video)

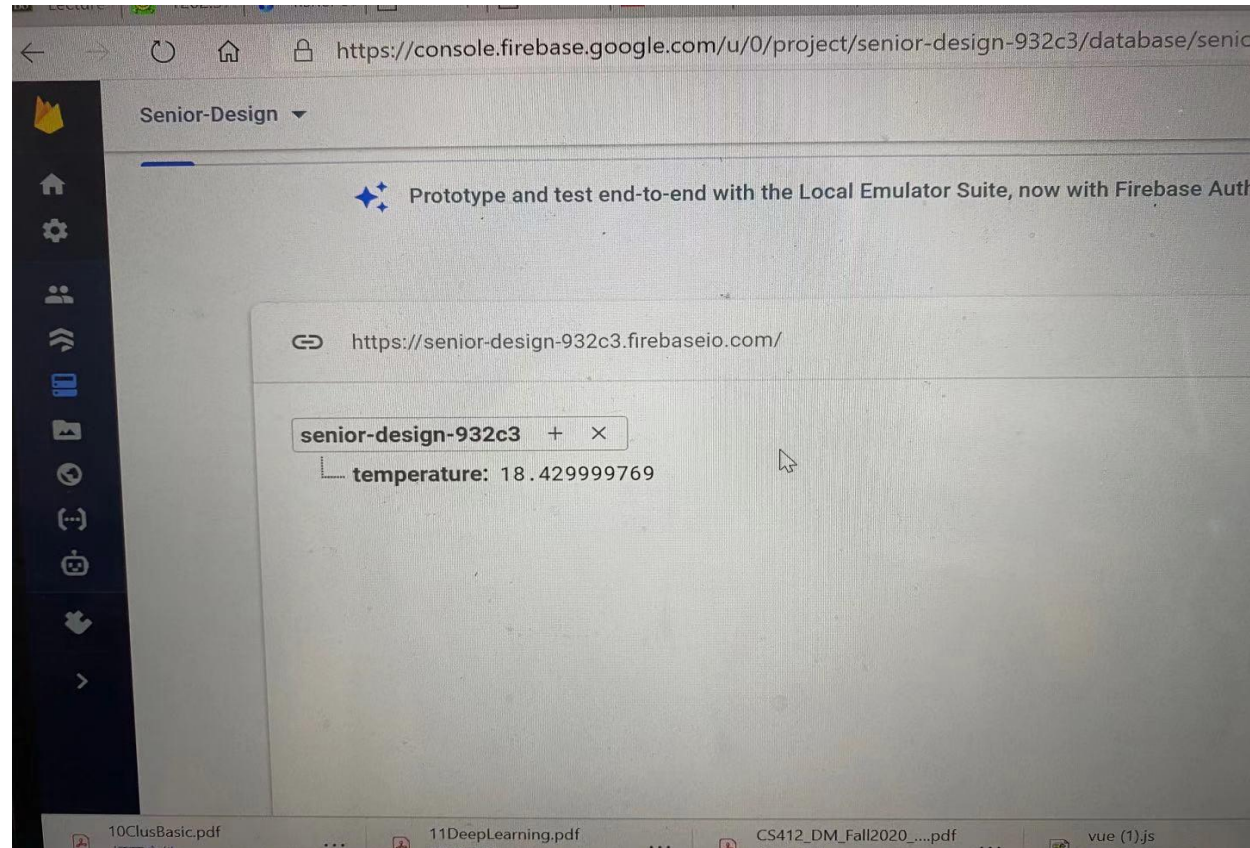
Function Tests

(App, Normal Condition, Overheating)



Functional Tests

(Database)



Successes and Challenges

- Our product measures temperature with an accuracy of 5 °C; the expected temperature range is from 20 °C to 150 °C.
- Our product measures temperature inside the lint filter; the thermocouple can be easily placed inside the lint filter.
- Our product transmits temperature data to the Internet and retrieves temperature data using an app.

Successes and Challenges

- On the PCB, the 3.3 V voltage regulator is outputting 4.6 V.
- On the PCB, the 5 V voltage regulator is outputting 4.3 V.
- For the battery, it was hard to find a connector that has the right size.
- For the app, the connection to Firebase was challenging.

Further Development

- Add a LED indicator, turning red when the dryer is overheating.
- Design a box wrapping the PCB.
- Solve the voltage issue.
- Configure the database to support multiple dryers.
- Register the app on App Store for users to download.

Thank You!
