REAL-TIME DATA COLLECTION FOR SMALL SCALE ETHANOL DISTILLATION OPERATIONS

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PROJECT BACKGROUND

Project Opportunity

Oregon State's Food Science and Technology department has a need for real-time monitoring of their distillation column. Monitoring temperature allows students and researchers to better understand what is happening during an experiment and providing a display allows an entire class to easily watch the experiment proceed.

Project Goals

- Install television on lab wall and mount Raspberry Pis near television and on the distillation column
- Develop Python code to collect and transmit real-time temperature data from a distillation column and graph it on the wall-mounted television
- Install 1/16" Swagelok ports on the distillation column for thermocouple probes
- Construct sensor board to connect thermocouples to Raspberry Pi for data collection

Raspberry Pi

- $35.00 each
- Quad Core 1.2 GHz CPU
- 1 GB RAM
- Wireless LAN (WiFi) and Bluetooth built in
- Raspbian (Unix) operating system
- Micro-USB powered
- MicroSD storage

Python

- Easy to use programming language
- Verbose- easy to read and understand
- Requires knowledge of libraries and classes of commands
- Strong support, default on Raspbian OS
- Learned about different IDEs: Pycharm and Anaconda

Oregon State University

Design

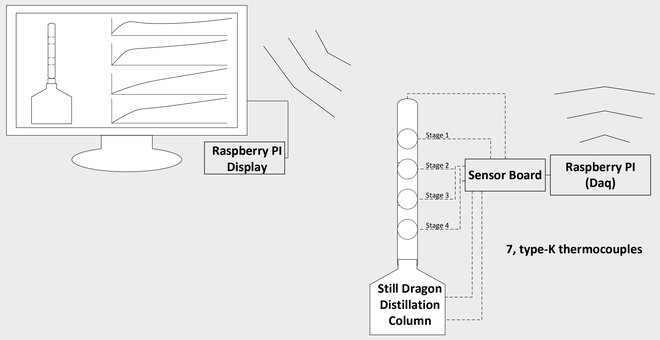

Figure 1: *Process flow diagram of final design Showing real-time data acquisition and transmission via wireless network between raspberry PI's.*

Figure 2: *50" Sony LCD television wall mounted display for easy viewing*

Thermocouple Calibration

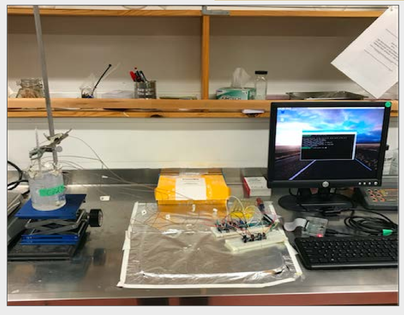

Figure 3: *Experimental setup for thermocouple calibration*

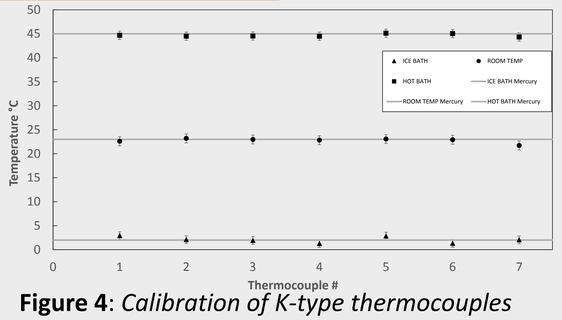

Figure 4: *Calibration of K-type thermocouples at 45, 23, and 2°C. Accurate to ± 1°C (95% CI).*

Python Code

```
Display7.py | rm5.py | rm5CSV.py | csvtest.py

import csv
import datetime as date
from mma import max31850

#Pull data from thermocouples and interpret as degrees C
x = max31850()
deviceCount=x.device_count()

i = 0
deviceNum = 0
allTemps = {}
tempList = []


#displays number of recognized thermocouples
print("Device count: ",deviceCount,"\n")

#outputs timestamp and readings of thermocouples to .csv file
with open('test.csv', 'w', newline='') as csvfile:
    writer = csv.writer(csvfile)
    while True:
        while i < deviceCount:
            deviceNum = i+1
```

Figure 5: *Sample of Python script that iteratively records temperature measurements to a data file.*

Product

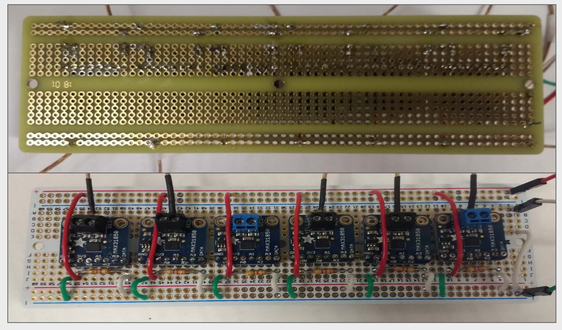

Figure 6: *Soldered final board design, increases space efficiency and fits on the distillation column*

CHALLENGES AND FUTURE WORK

Challenges

- Storage and transmission of temperature data to and from Raspberry Pi devices via Bluetooth.
- Optimizing arrangement of electronic components and wiring on thermocouple device by eliminating the breakdown GPIO ribbon cable.
- Mounting device on distillation column while reducing thermal effects on sensitive components.
- Learning python programming with no prior experience.

Future Work

- Complete programming code for data projection and display.
- Test final product by running distillation column and collect real-time temperature data.
- Add LED lighting to housing complex and improve mounting arrangement.

Figure 7: *Distillation column as set up in lab. Is used for demonstrations and graduate research.*

Acknowledgements

Dr. Paul Hughes – Head Project Sponsor

Sebastian Ramirez – Graduate Supervisor

Dr. Philip Harding – Academic Supervisor

John Cochran – Lab Engineer

Andy Brickman – Lab Engineer

Greyson Termini – COE Machinist