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

Real-time data collection for small scale ethanol distillation operations

Design

Figure 1: Process flow diagram of final design showing real-time data acquisition and transmission via wireless network between raspberry Pis.

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

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.

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