Individual Weekly Report

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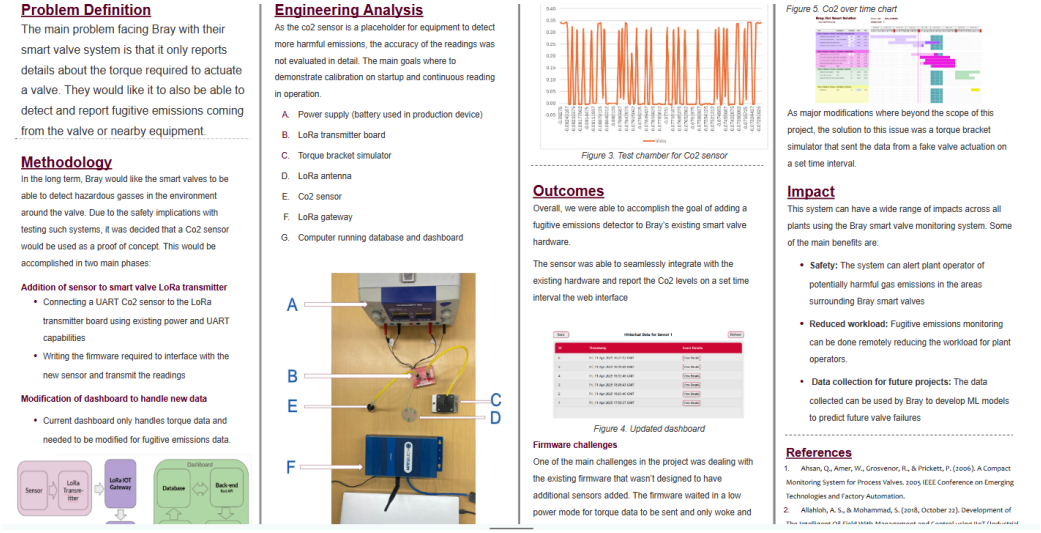
Team: Bray
Date: 4/21/25

Current Status

1. What did you **personally** work on this past week?

Task	Status	Time Spent
Finished poster	Done	1 hr
Printed poster	Done	45 min
Soldered second sensor	Done	45 min
CS Project expo	Done	3 hrs
Wrote eval results and discussion sections	Done	1.5 hrs

Include **screenshots/graphics** to illustrate what you did this past week:



Problem Definition

The main problem facing Bray with their smart valve system is that it only reports details about the torque required to actuate a valve. They would like it to also be able to detect and report fugitive emissions coming from the valve or nearby equipment.

Methodology

In the long term, Bray would like the smart valves to be able to detect hazardous gasses in the environment around the valve. Due to the safety implications with testing such systems, it was decided that a Co2 sensor would be used as a proof of concept. This would be accomplished in two main phases:

Addition of sensor to smart valve LoRa transmitter

- Connecting a UART Co2 sensor to the LoRa transmitter board using existing power and UART capabilities
- Writing the firmware required to interface with the new sensor and transmit the readings

Modification of dashboard to handle new data

- Current dashboard only handles torque data and needed to be modified for fugitive emissions data.

Engineering Analysis

As the co2 sensor is a placeholder for equipment to detect more harmful emissions, the accuracy of the readings was not evaluated in detail. The main goals where to demonstrate calibration on startup and continuous reading in operation.

A. Power supply (battery used in production device)
B. LoRa transmitter board
C. Torque bracket simulator
D. LoRa antenna
E. Co2 sensor
F. LoRa gateway
G. Computer running database and dashboard

Outcomes

Overall, we were able to accomplish the goal of adding a fugitive emissions detector to Bray's existing smart valve hardware.

The sensor was able to seamlessly integrate with the existing hardware and report the Co2 levels on a set time interval the web interface

Firmware challenges

One of the main challenges in the project was dealing with the existing firmware that wasn't designed to have additional sensors added. The firmware waited in a low power mode for torque data to be sent and only woke and

Figure 3. Test chamber for Co2 sensor

Figure 4. Updated dashboard

Figure 5. Co2 over time chart

As major modifications where beyond the scope of this project, the solution to this issue was a torque bracket simulator that sent the data from a fake valve actuation on a set time interval.

Impact

This system can have a wide range of impacts across all plants using the Bray smart valve monitoring system. Some of the main benefits are:

- **Safety:** The system can alert plant operator of potentially harmful gas emissions in the areas surrounding Bray smart valves
- **Reduced workload:** Fugitive emissions monitoring can be done remotely reducing the workload for plant operators.
- **Data collection for future projects:** The data collected can be used by Bray to develop ML models to predict future valve failures

References

1. Ahsan, Q., Amer, W., Grosvenor, R., & Prickett, P. (2006). A Compact Monitoring System for Process Valves. 2005 IEEE Conference on Emerging Technologies and Factory Automation.
2. Allahloh, A. S., & Mohammad, S. (2018, October 22). Development of

7.2.2 Evaluation Results and Discussion

The results of the user study were overall positive. Users on average scored the dashboard a 3.83 out of 5 for useability and a 3 out of 5 for data clarity.

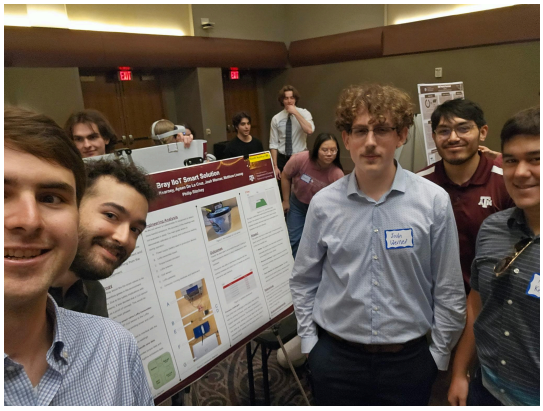
For the ease of use, most users found the dashboard to overall be fairly easy to use and navigate. Most of the issues reported came from the summary graphs being challenging to find. There are already plans to implement more clearly labeled buttons to hopefully remediate this concern.

Users reported that the clarity of the data display could be improved, as it only scored a 3 out of 5. When pushed further to elaborate, it was discovered that many of these issues came from the dashboard not handling sample torque data cleanly and the summary graphs being confusing. Confusion in the summary graphs was traced to the sample torque data creating strange looking summary graphs. Another source of confusion in the summary graphs was traced to the battery health status graph not functioning correctly due to the prototype being powered using a benchtop power supply. No major issues were reported with the display of the CO_2 readings, the main focus of this stage of the project.

When probed for general feedback on the useability and design of the dashboard two main comments began to stand out, the need for better labeling and the need for data filtering.

The need for better labeling was mainly focused on the buttons that allow users to navigate between different pages in the dashboard. Some of these navigation buttons are labeled, but some (particularly the summary graph button) are not labeled and this caused confusion with the test users. This can be easily mitigated by expanding the button sizes to allow for text labels to be added as front end UI elements.

As for the comments on data filtering, these came primarily from participants employed by our industry sponsor. The main comment was that the CO_2 graphs should allow the user to input a data range. This would be great for plant operators that want to see how different activities at a plant affect the reading and want to compare recent readings to specific historic readings more easily. Implementation of this could also be done fairly easily with tweaks to the front end UI and surrounding API calls.



2. What problems did you run into? What is your plan for them?
    a. Writing coverage testing of the front end is taking more time than expected. Not really a problem but the closest thing to a problem we are encountering at this time. Also not really a problem but there's a ton of deliverables due soon so that will be plenty of work.

3. What is the current overall project status from your perspective?
    a. Very close to completion. Lots of busy work and deliverables that need to be completed. It will get done but will take some work. Still need to button up a few things with the project but most of it is easy quick stuff.

4. How is your team functioning from your perspective?
    a. Not working as well. Some people think they've done their part of the project already and are leaving the rest to the others in the group.

5. What new ideas did you have or skills did you develop this week?
    a. I am developing my skills as a presenter.

6. Who was your most awesome team member this week and why?
    a. Aysen for working on polishing the firmware. Still needs a slight bit of refactoring but should be completed very soon.

Plans for Next Week

Finish user studies
Presentation draft
EPS
All the random deliverables due next week