Gauss Sensor for Magnet Array Filter

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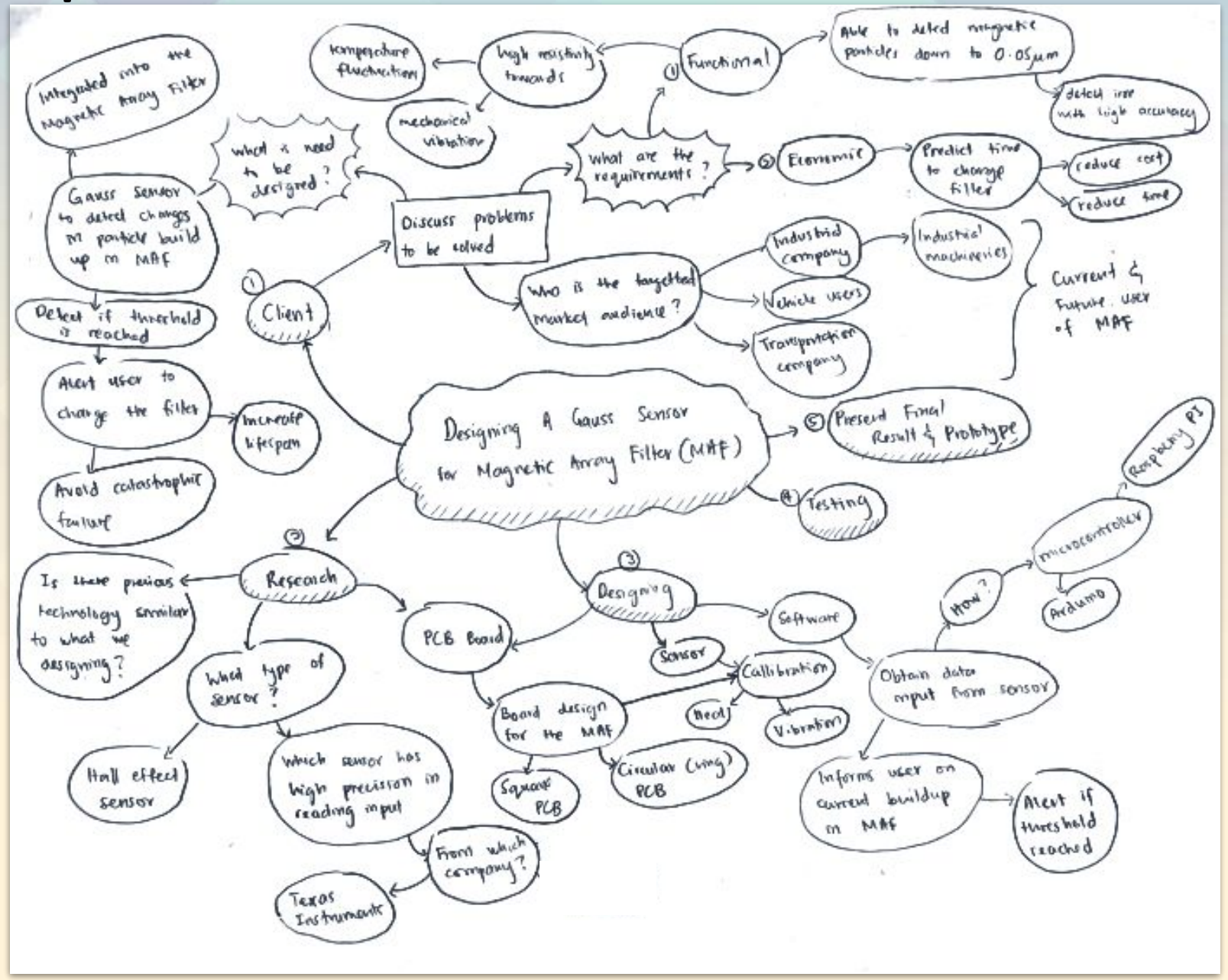
sdmay20-27

http://sdmay20-27.sd.ece.iastate.edu

Project Vision

- What is the project attempting to accomplish?
  - This project is an attachment to the magnet collar that will give an interpretation of how many contaminants are being trapped in the filter and when an optimum time is to change the filter.
- Who cares? Whose life would be improved?
  - This product would be able to be used with any machine that uses the filter collar and the life of those would be improved by extending the lifetime of the machines.

Conceptual/Visual Sketch



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Requirements

Functional

- Detect magnetic particles, iron (sensitivity **0.05 µm**)
- Withstand/ resistant to continuous vibration and temperature changes
- **Additional functionality:** detect brass and aluminium particles
- Detect when then buildups reach the threshold
- Indicate the time to change the filter
- Indicate when there is a significant change in the buildups of particle

Requirements

Non-functional

- Reduce time and money on gradually checking, changing, and replacing filter.
- Make sure metal is not going through system
- Increasing engine life
- Improve efficiency of overall maintenance process

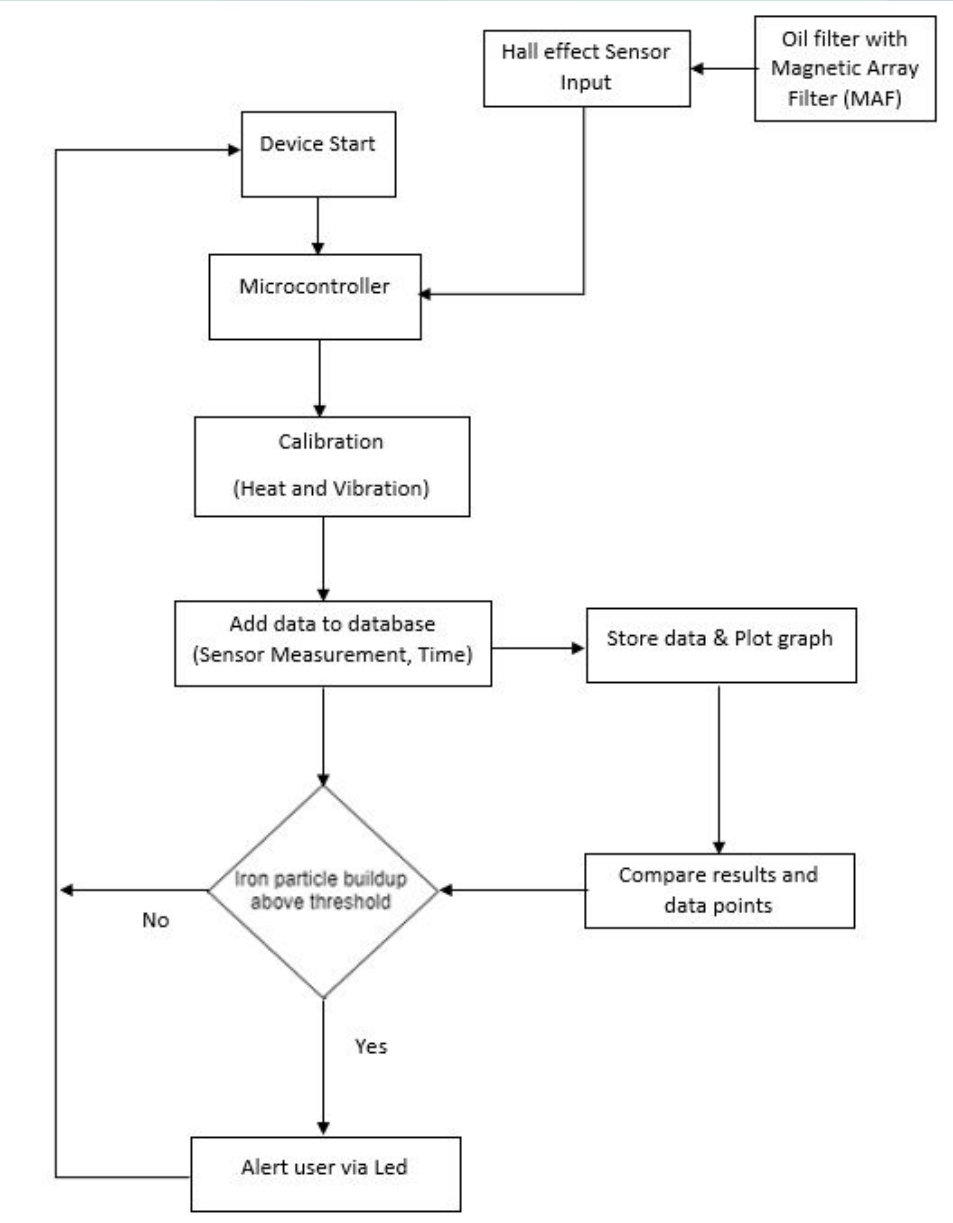
Technical constraints

- Sensor must withstand rapid temperature changes (ambient to 200 degrees Fahrenheit)

Other constraints

- Not able to test the field with increasing temperatures accurately
- Does not have direct access to a vehicle

Conceptual Design Diagram



Project Plan

- Hardware Development
- Data management
- Software development
- Testing
- Refining the system (software and hardware)

System Design

- Software

  Arduino-side(C)
  - Sensors are connected to Arduino via I/O pins
  - For testing purposes, 4 Analog & 2 Digital pins
  - Data is recorded every 30 seconds to save space
  - Connected to PC via USB

  Processing(Java)
  - Receive data from Arduino
  - Write data into table (.csv) file
  - Appends data to table rather than rewriting

  Plotter(Python)
  - Plot data over a graph for user to see

Client-side UI Software

- 2 Types of threshold:
  - Gradient-threshold
  - Amount-threshold
- User able to see threshold for alerts and current magnetic response
- User able to change thresholds
- User has to be alerted if there is a pending catastrophic failure via LED or Error Message

- Hardware

Arduino

- Arduino UNO Rev3
- Used to interface sensors and computer

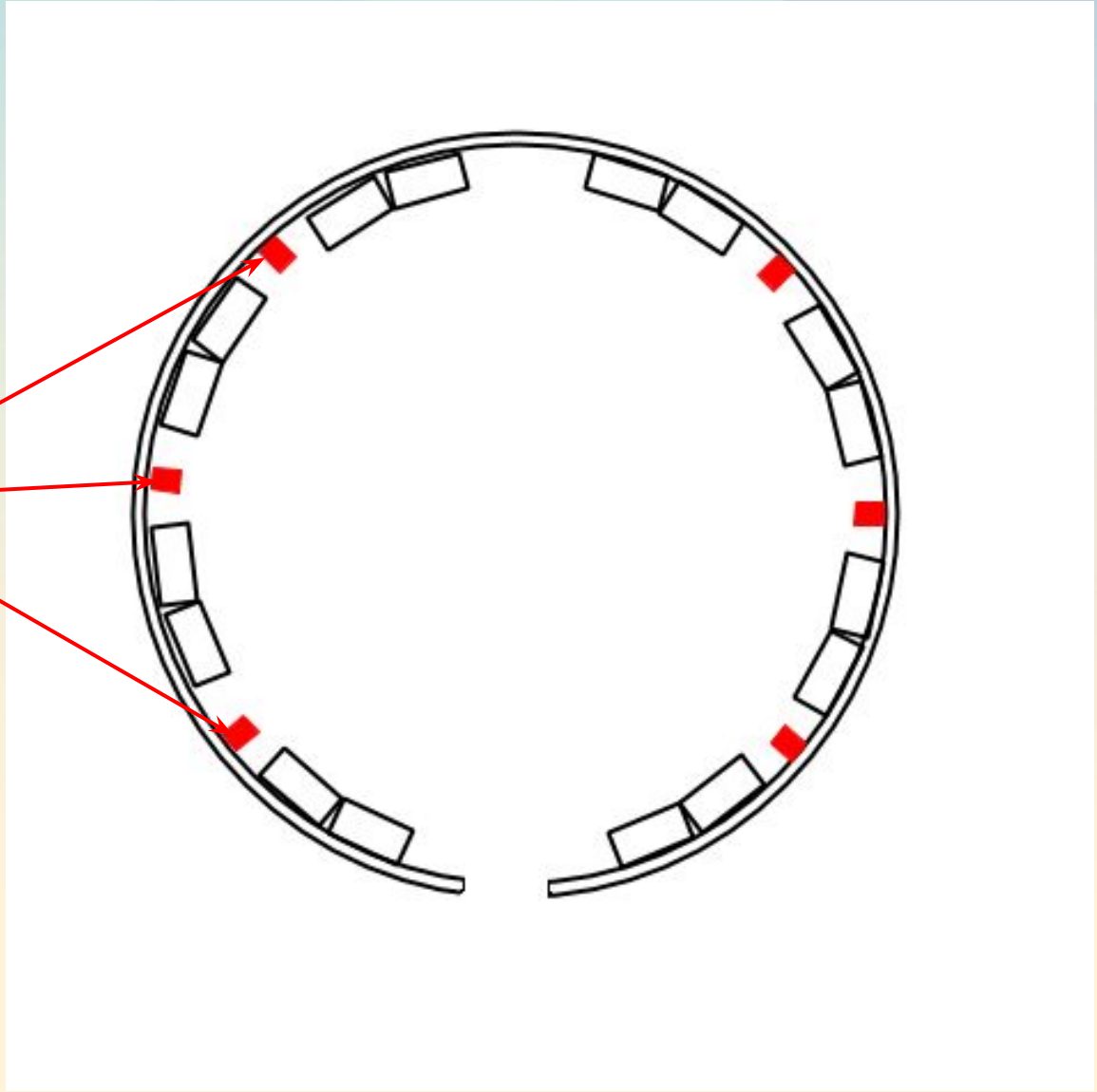
Linear Hall Effect Sensors

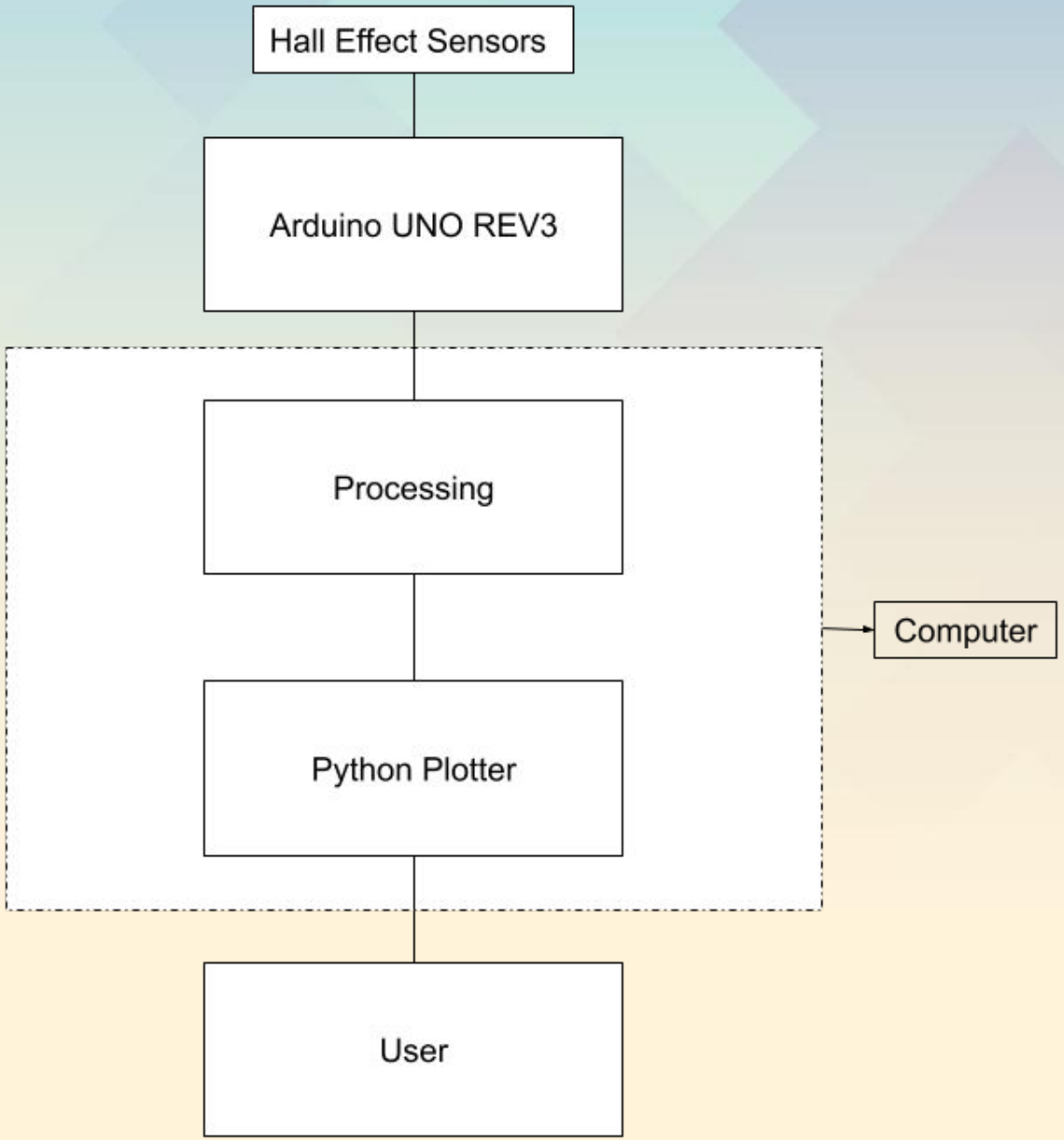
- DRV5053CA
  - Analog
  - Accuracy - 23 mV/mT
- DRV5056A1
  - Analog
  - Accuracy - 200 mV/mT
- DRV5057A1
  - Digital
  - Accuracy - 2%D/mT

Computer

- Used only to save data and plot the graph
- Will be switched to a Raspberry Pi if required on mobile uses

Hall Effect Sensor





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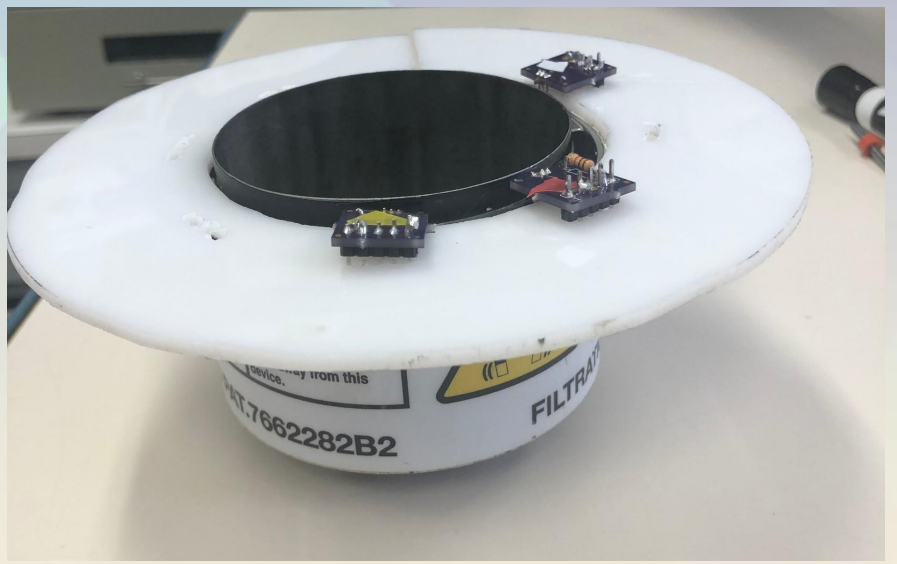
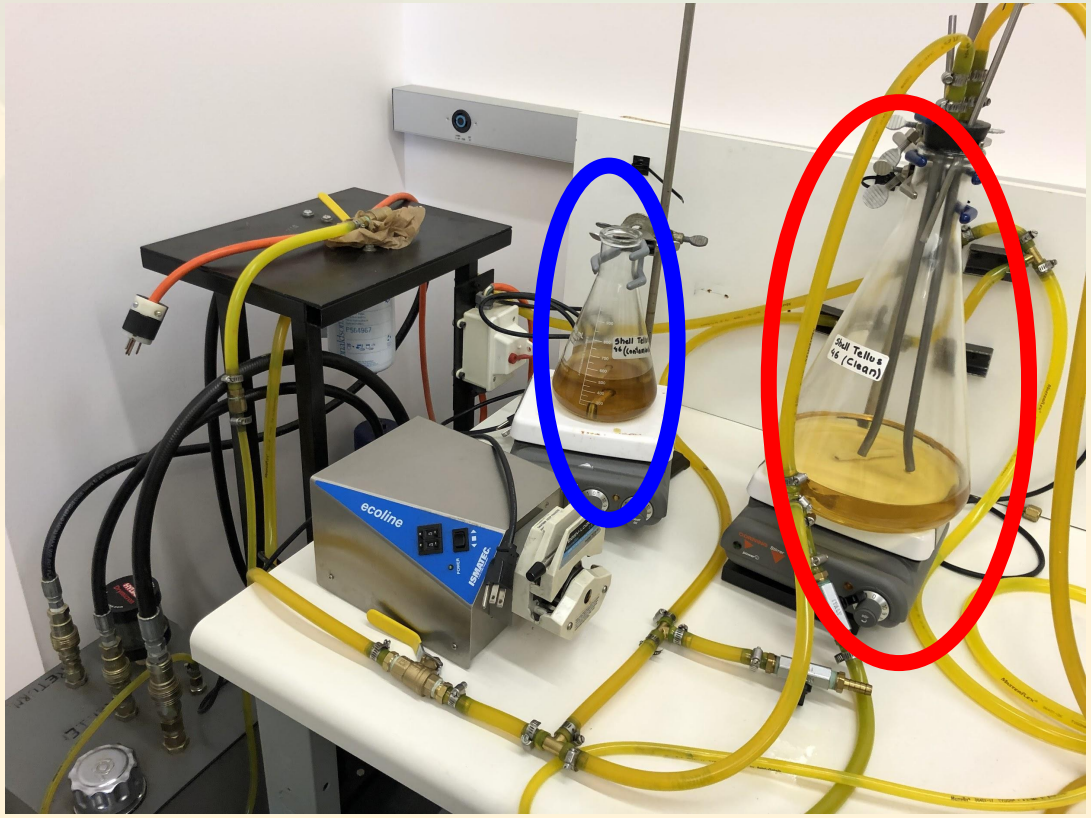
Prototype Implementations

- 1st prototype
  - 3 different sensors: DRV 5053, 5056, 5057
  - 6 sensor boards
    - Different placements
  - Arduino Uno



Test Plan I

- The Danfoss Mechatronics and Agricultural Sensing Lab 2205 Sukup Hall



- Actual system
- Donaldson P551010
- Baseline
- Introduce 5u iron particles
- Threshold

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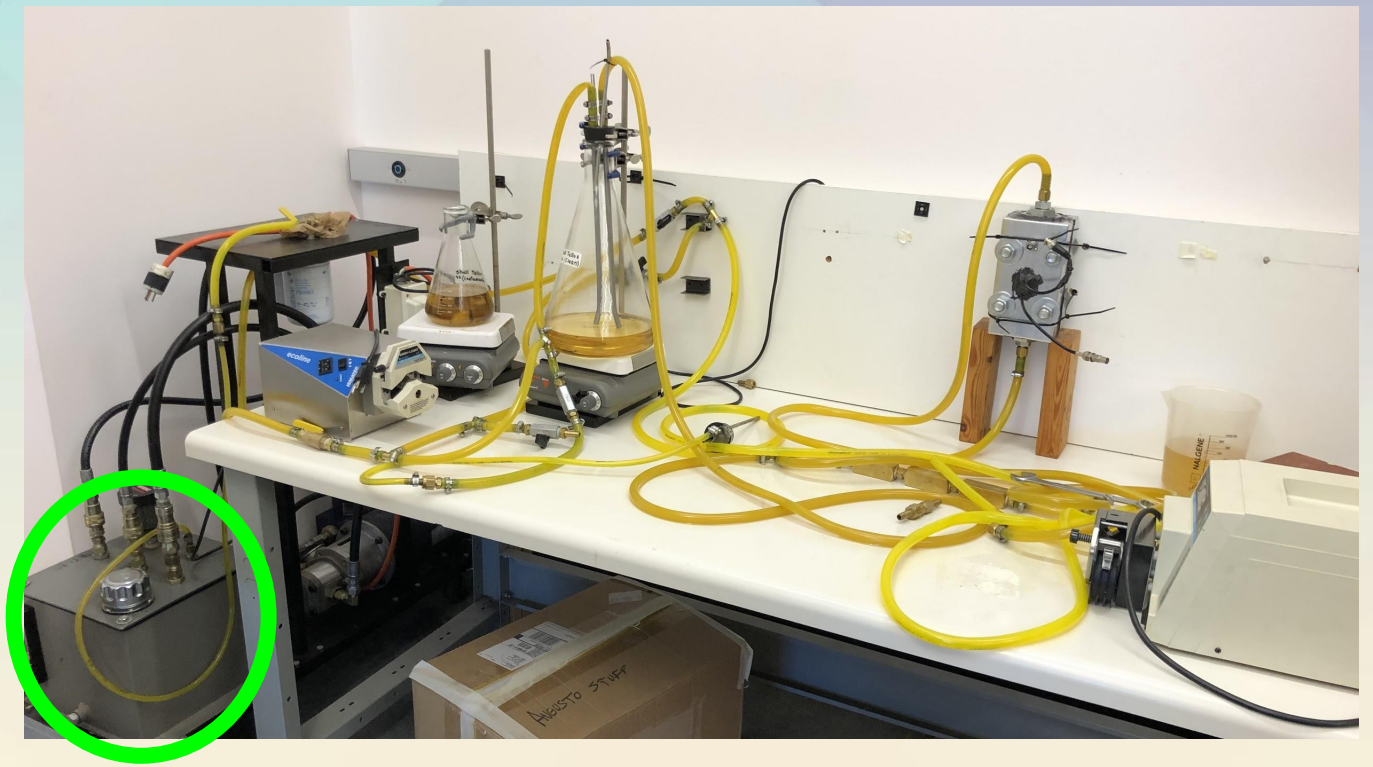
Test Plan Ⅱ

- Choose the right sensor
- Calibration
- Different sensor package



Project Plan – Schedule/Milestones

Milestone	Expected outcome
Interviewing clients	Understanding the problem faced by client Having agreement on the expected outcomes.
Defining problem statement	Understanding problem statement that represent the problem that the client faces
Research on related topics	Coming out with possible solutions of the problem
Creating first prototype	Creation of the first prototype
Testing first prototype	Test data accumulated from the first prototype testing
Presentation (Fall 2019)	Presentation of work progress
Testing final product	Test data accumulated from the final product
Final presentation (Spring 2019	Final presentation of the end product

Project Plan – Schedule/Milestones

- Schedule Planner (milestone accomplishments)

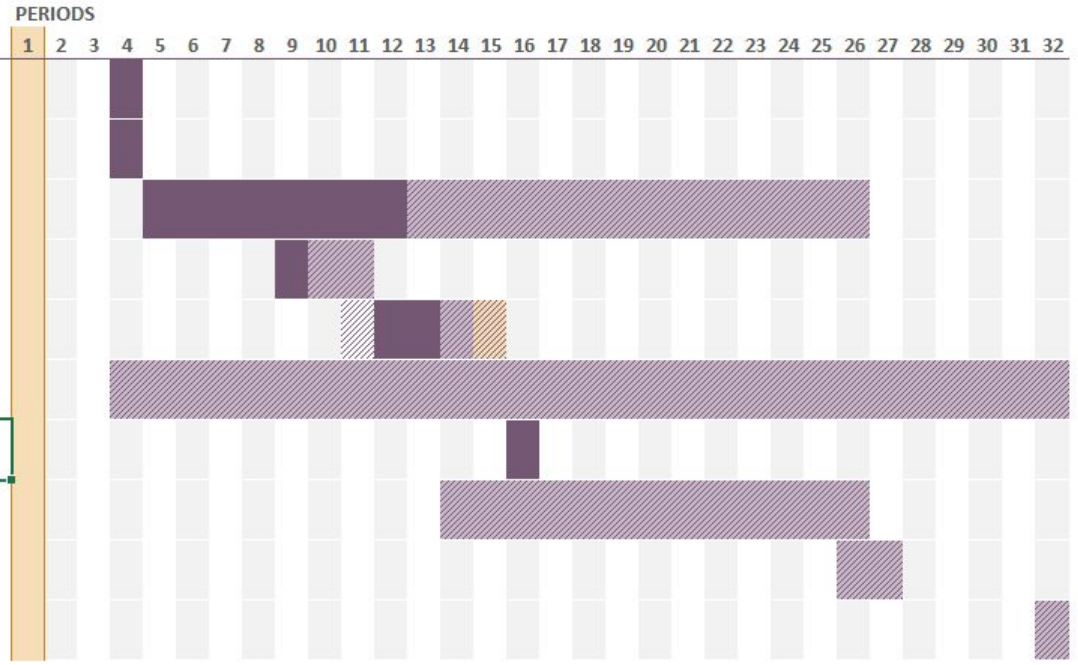
Project Planner

Select a period to highlight at right. A legend describing the charting follows.

Period Highlight: 1

Plan Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete (beyond plan

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Interviewing Client (Meeting 1)	4	1	4	1	100%
Define Problem Statement	4	1	4	1	100%
Research	5	22	5	22	40%
Prototype 1	9	3	9	3	10%
Testing 1	11	4	12	4	50%
Client Meeting	4	31	4	31	0%
Presentation Fall 2019	16	1	16	1	100%
Repeat Process (Start Spring 2020)	14	13	14	13	0%
Final Testing	26	2	26	2	0%
Final Presentation Sp 2020	32	1	32	1	0%



Conclusions

- Currently, we just finished creating our prototype and will begin testing in the near future
- Next semester, we will begin collecting datasets for our sensor at various temperatures to ensure an accurate reading
- Individual team members contributions delineated

Q&A