# Deliverable G

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March 12, 2023

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Link to Wrike:
https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=8NlEtZEV8SNMCYiXlOKkLY8DHFrZhzCr%7CIE2DSNZVHA2DELSTGIYA

# Feedback from Clients:

During the client meeting we realized our test plans should be more organized to clearly appeal to our main objective. In this deliverable, we need to clearly emphasize how prototypes 1 & 2 will connect to prototype 3 to have the entire project working.

The clients suggested that the components should not be inside of the filter or the silo therefore we decided to have the level sensor in a container sitting on top of the silo measuring downward, the problem being that we have to drill a hole on top of the silo for the ultrasonic sensor to work. As for the dust sensor, it will be sitting on top of the dust filter, it will measure the air quality around the filter because it will be similar to the air in the filter.

There wasn't much feedback because our prototype matched most of the criteria the client was looking for.

# Prototype 2 (concept):

Prototype 2 is to build a dust sensor located on top of the dust filter within the factory. It will be connected to an Arduino which can measure the ppm of the air around the dust filter. We are implementing this because the filter itself doesn't notify the staff when air quality is above 10 ppm, therefore adding a sensor that does alert the system will benefit the filter from overworking and clogging. We are measuring the air AROUND the filter because we can't directly put the sensor into the filter. It would be similar in air quality so it can alert the system when it is above 10 ppm.

The entire dust sensor with the Arduino is also connected to the computer just like the level sensor, having the condition of, "if" the air > 10ppm it will stop the specific silo from operating. (we'll  know which silo to stop from the level difference that our level sensor data would output)

Normal air conditions under 10 ppm for example 5 ppm would not stop the silo from outputting.

Prototype 3 (idea)

Write code that connects both the level sensor and dust sensor together, corresponding with each other to give a final output of recommendations for the staff operation cleaning out dust from silos.

# Bill of Materials

| Prototype One | | | | | |
|---|---|---|---|---|---|
| **Items Needed** | **Description** | **Unit of Quantity** | **Price (CAD)** | **Price total per item** | **Link** |
| Level Sensors | Ultrasonic level sensor - HC-SR04 | 1 | $5.00 | $5.00 | https://www.sparkfun.co |
| Microcontroller | Arduino UNO R3 | 1 | $17.00 | $17.00 | https://makerstore.ca/sh |
| LCD Display | Elegoo 16x2 LCD display module (Order latest by Friday or Ask TA ) | 1 | $16.99 | $16.99 | https://www.amazon.c |
| Jumper wires | Male to male (5 cm) | 5 | $10.99 | $10.99 | https://www.walmart.c |
| | Male to male (20 cm) | 25 | | | https://www.walmart.c |
| | Female to male (20cm) | 10 | | | https://www.walmart.c |
| Bucket&Lid | Plastic (can hold 8L volume, 9.83 inch height by 9.25 inch width) | 1 | $4.94 | $4.94 | https://www.homedep 298555526333&gclid=( |
| RGB LED lights | Red | 1 | $1.20 | $1.20 | https://makerstore.ca/sh |
| RGB LED lights | Green | 1 | | | https://makerstore.ca/sh |
| Resistors | 330 ohms (Order latest by Friday or Ask TA) | 3 | MakerLab | $0.00 | https://www.kiwi-elect |
| Potentiometer | 500k ohm **(ASK TA)** | 1 | $16.99 | $16.99 | |
| Sand | Repersents Grain and dust | 10kg | $3.99 | $3.99 | https://www.canadiantir |
| Breadboard | Half Board | 1 | $5.00 | $5.00 | https://makerstore.ca/sh |
| Box | MDF, 5 faces. (L: 20cm; W: 15cm) | 1 | $2.50 | $2.50 | https://makerstore.ca/sh |
| Power Supply | DC Power Supply 9V 1A | 1 | $14.99 | $14.99 | https://www.amazon.ca |
| Glue | PVA wood glue | 1 | $6.07 | $6.07 | https://www.homedepot |
| Computer | Computer Monitor with the interface | 1 | (Use our own) | $0.00 | |
| **Total** | | | | **$105.66** | |
| | | | | | |
| **Prototype Two** | | | | | |
| **Items Needed** | **Description** | **Unit of Quantity** | **Price (CAD)** | **Price total per item** | **Link** |
| Dust Sensor | Nova PM Sensor SDS011 | 1 | $57.35 | $57.35 | https://www.amazon.c |
| Power Supply | DC Power Supply 9V 1A | 1 | $14.99 | $14.99 | https://www.amazon.ca |
| Flour | Repersent dust | 1kg | $4.99 | $4.99 | https://www.amazon.c |
| Microcontroller | Arduino Type 2 | 1 | $17.00 | $17.00 | |
| **Total** | | | | **$94.33** | |
| | | | | | |
| **Overall Total** | | | | **$199.99** | |

# Model for prototype 2

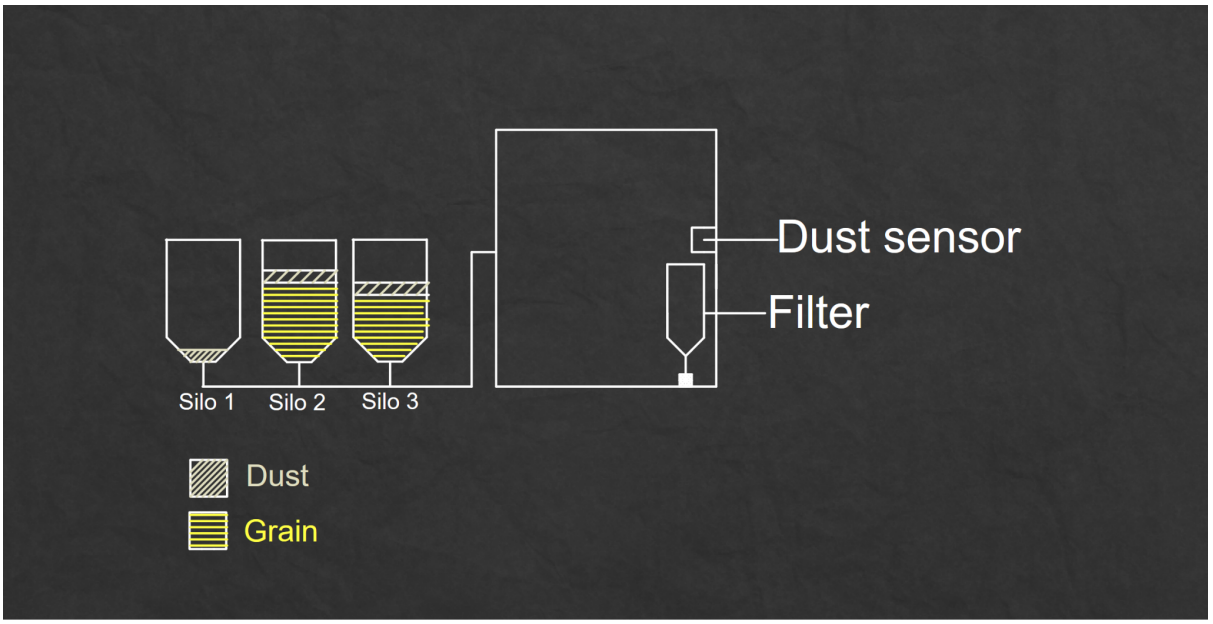
Analytical situations:

Situation 1:

If: Dust level > 10 ppm and Silo 1 level < 1500kg,

But: Silo 2 level > 1000 kg and Silo 3 level > 1000 kg

Response: Stop output from silo 1.



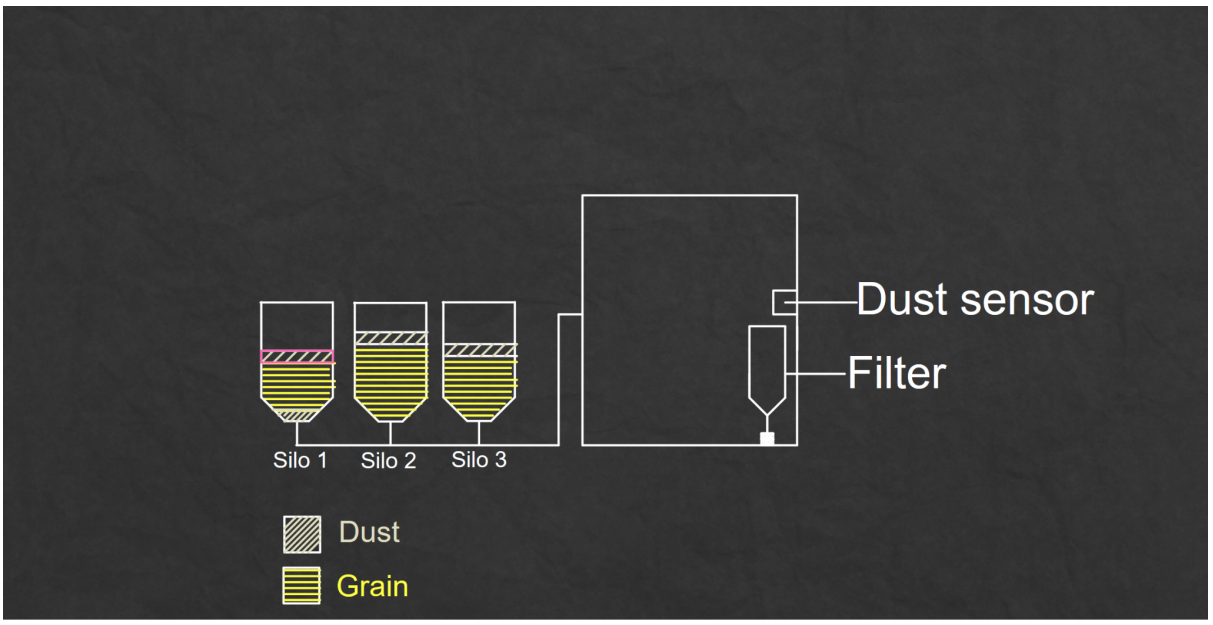

Situation 2:

If: Dust level > 10 ppm

But: Silo 1 level > 1500kg, Silo 2 level > 1000kg, and Silo 3 level > 1000 kg,

Response: Slow down the output of silos until Dust level <10 ppm

Dust from silo 1 will eventually clear out. Slowing down all silos will reduce stress on the filter.

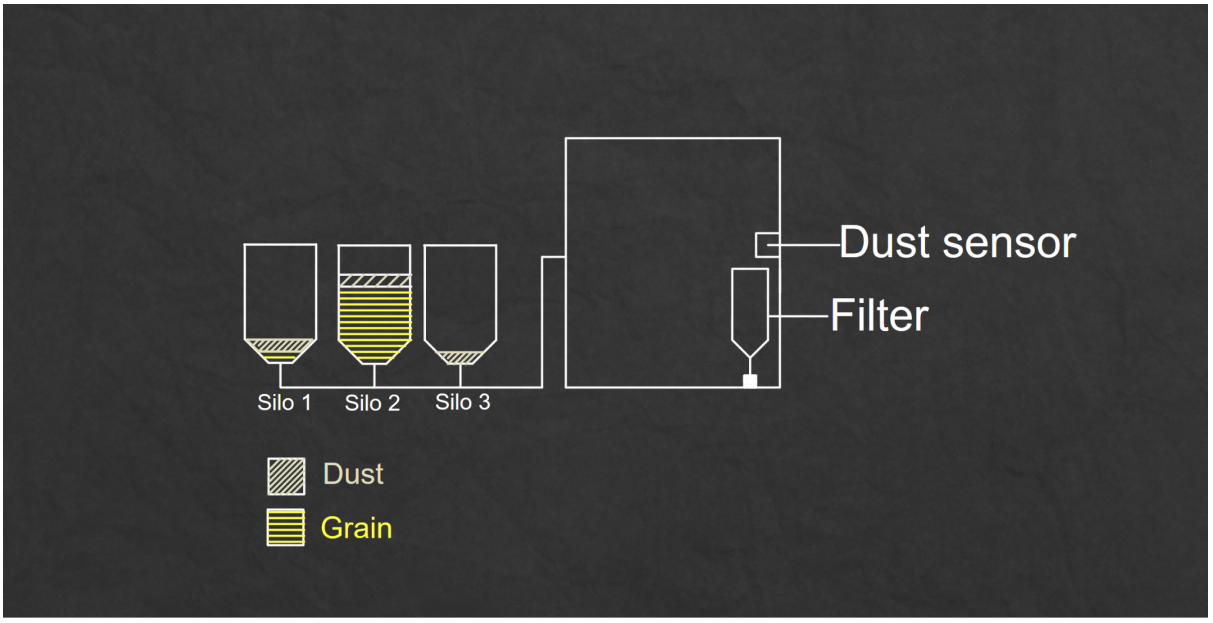



Situation 3:

If: Dust level > 10 ppm and Silo 3 level > 2000kg,

But: Silo 1 level > 2000kg and Silo 2 level > 2000kg

Response: Stop output from silo 3.




# Testing Outline:

| Test ID | Test Objective | Description of Prototype used and of Basic Test Method | Description of Results to be Recorded and how these results will be used | Estimated Test duration and planned start date |
|---|---|---|---|---|
| 1 | Level sensor: To detect low silo levels | The level sensor gives the level at which the silos are at. | The sensor provides real-time data to the control system to be evaluated. | 1 day 3/18/2023 |
| 2 | Dust sensor: To detect high dust levels | The dust sensor measures the amount of dust the filter is cleaning. | The sensor provides real-time data to the control system to be evaluated. | 1 day 3/18/2023 |
| 3 | Program (code): To gather data from level and dust | The program gets data from both sensors and evaluates it to give the appropriate response. | The program compares data from both sensors and responds according to the conditions that | 1 day 3/19/2023 |

| | | | | |
|---|---|---|---|---|
| | sensors and provide feedback. | | are met. | |
| 4. | Physical test of all components | Experimenting silo levels with sand in a bucket, Dust levels using dust(flour), and making sure the program responds to those conditions. | The physical test is used to simulate conditions or cases that can occur during normal operations. | 1 day 3/25/2023 |

# Example Table of Recordings of ppm levels

| Date/Time | Dust Concentration (ppm) | Within Safe Limit |
|---|---|---|
| 3/1/2023 12:00 PM | 5 | Yes |
| 3/1/2023 12:05 PM | 8 | Yes |
| 3/1/2023 12:10 PM | 12 | No |
| 3/1/2023 12:15 PM | 9 | Yes |
| 3/1/2023 12:20 PM | 7 | Yes |

| | | |
|---|---|---|
| 3/1/2023 12:25 PM | 6 | Yes |
| 3/1/2023 12:30 PM | 13 | No |
| 3/1/2023 12:35 PM | 9 | Yes |
| 3/1/2023 12:40 PM | 5 | Yes |
| 3/1/2023 12:45 PM | 7 | Yes |
| 3/1/2023 12:50 PM | 11 | No |

In this table, there is an additional column indicating whether the dust concentration is within the safe limit of 10 ppm or not. If the concentration is below 10 ppm, it is considered safe and marked as "Yes" in the table. If the concentration exceeds 10 ppm, it is considered unsafe and marked as "No".

By constantly monitoring the dust concentration and ensuring it stays below 10 ppm, the table can help identify potential issues early on and allow for corrective measures to be taken in a timely manner to maintain a safe working environment.