SYSC 4805 Project Presentation

Done By:

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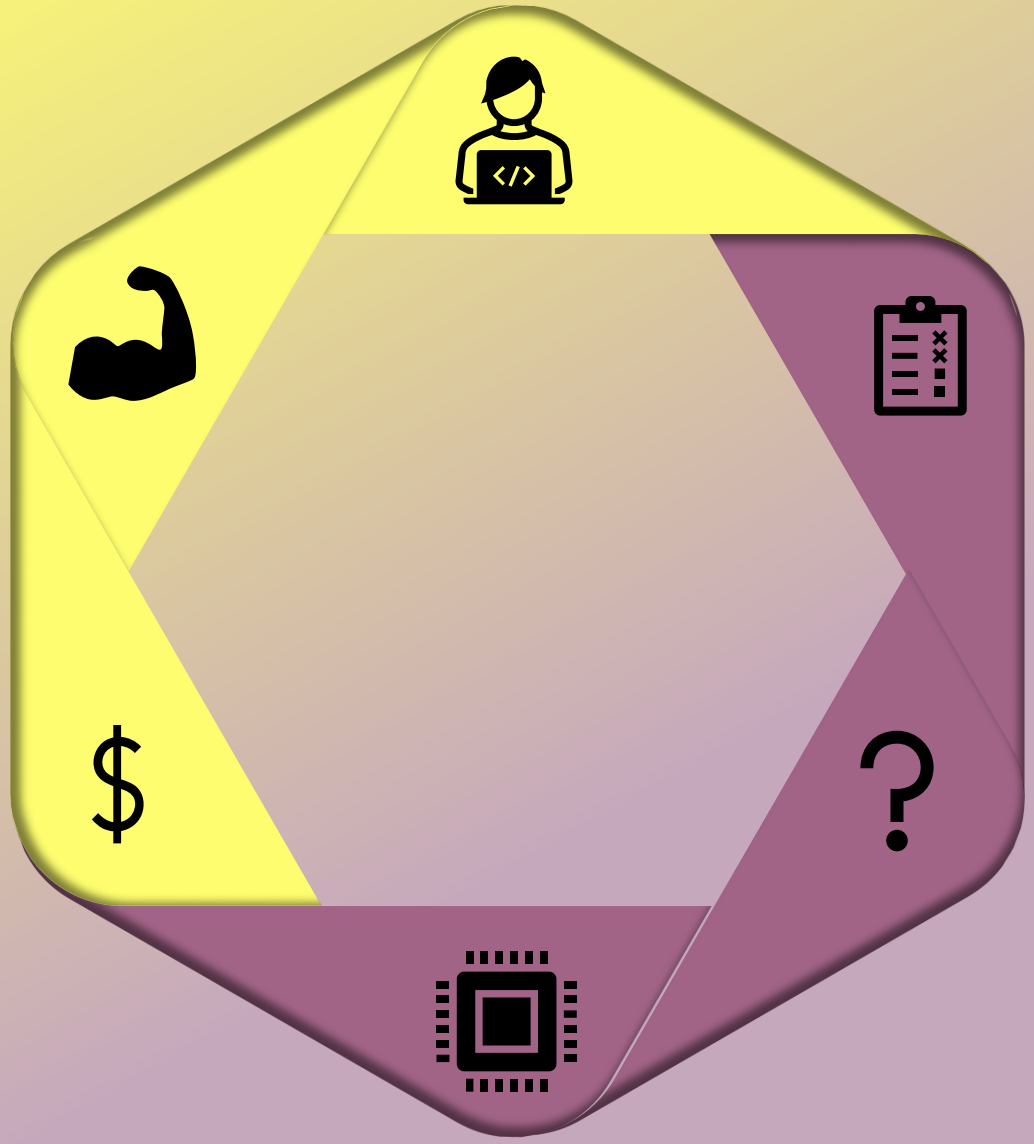
L3-G1

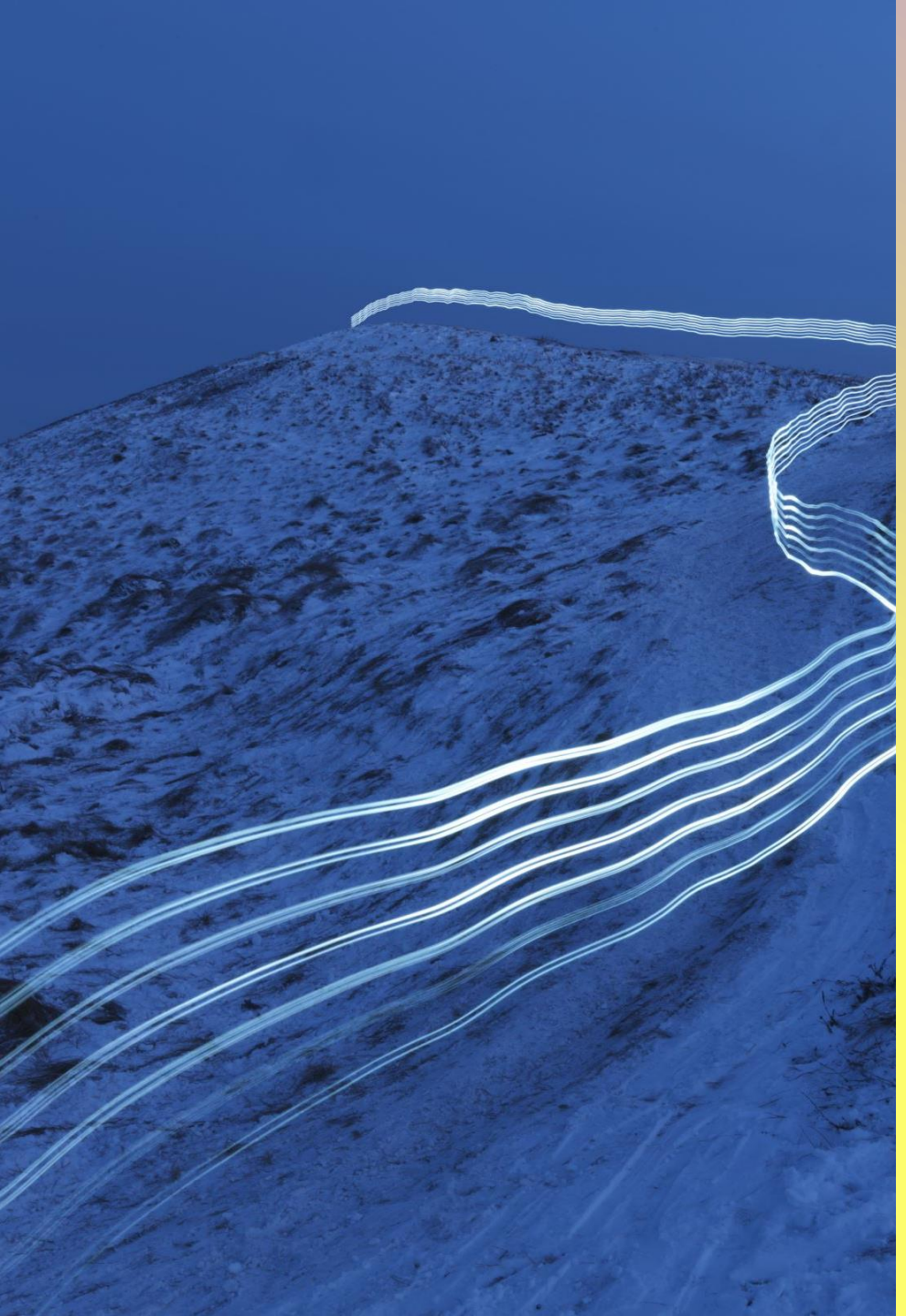
#FEFE66 / RGB(254,254,102)

Unmellow Yellow

CONTENTS



MOTIVATION & PROPOSED SOLUTION

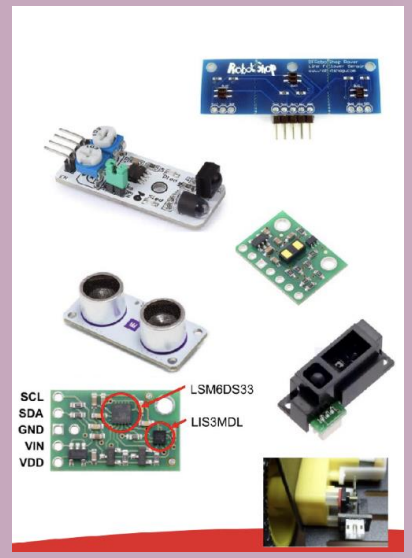


MOTIVATION FOR AUTONOMOUS SNOWPLOWS

- **Labor Shortage & Safety Risks**:
  - Shortage of snowplow drivers, especially during harsh conditions.
  - Autonomous snowplows reduce risks for operators and ensure uninterrupted operation in extreme weather.
- **Efficiency & Accessibility**:
  - Optimized routes save time, fuel, and reduce environmental impact.
  - Provides reliable snow removal for municipalities, businesses, and residential areas, including elderly and disabled individuals.

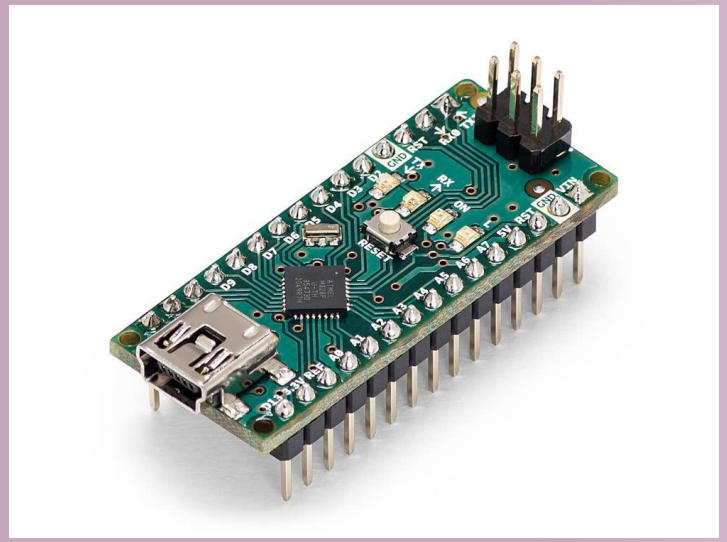
PROPOSED SOLUTION

- To create an Autonomous Snowplowing Robot that clears snow in a fixed area.



We will be using:

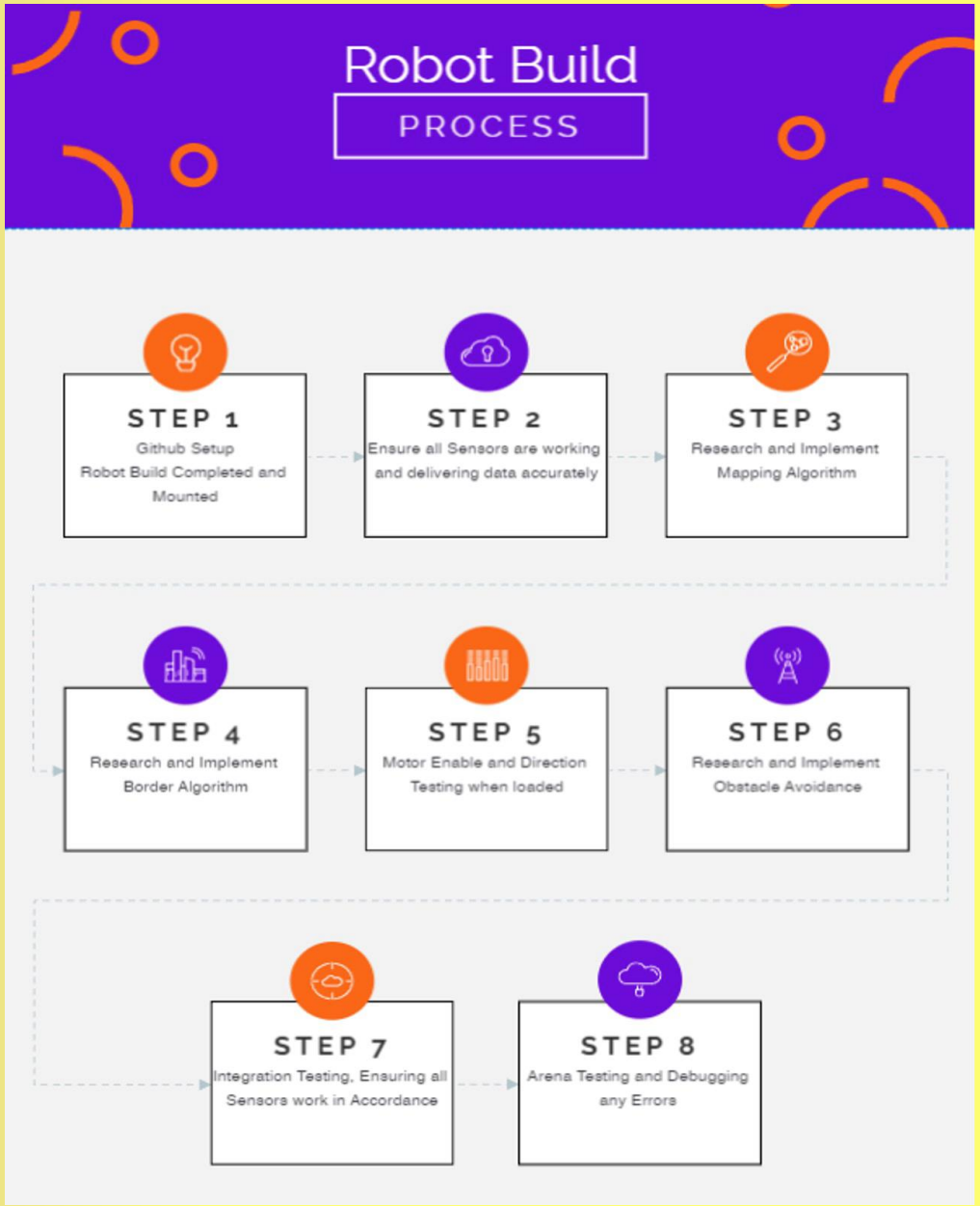
- Variety of Sensors
- Motors
- Motor Driver Board
- Microcontroller

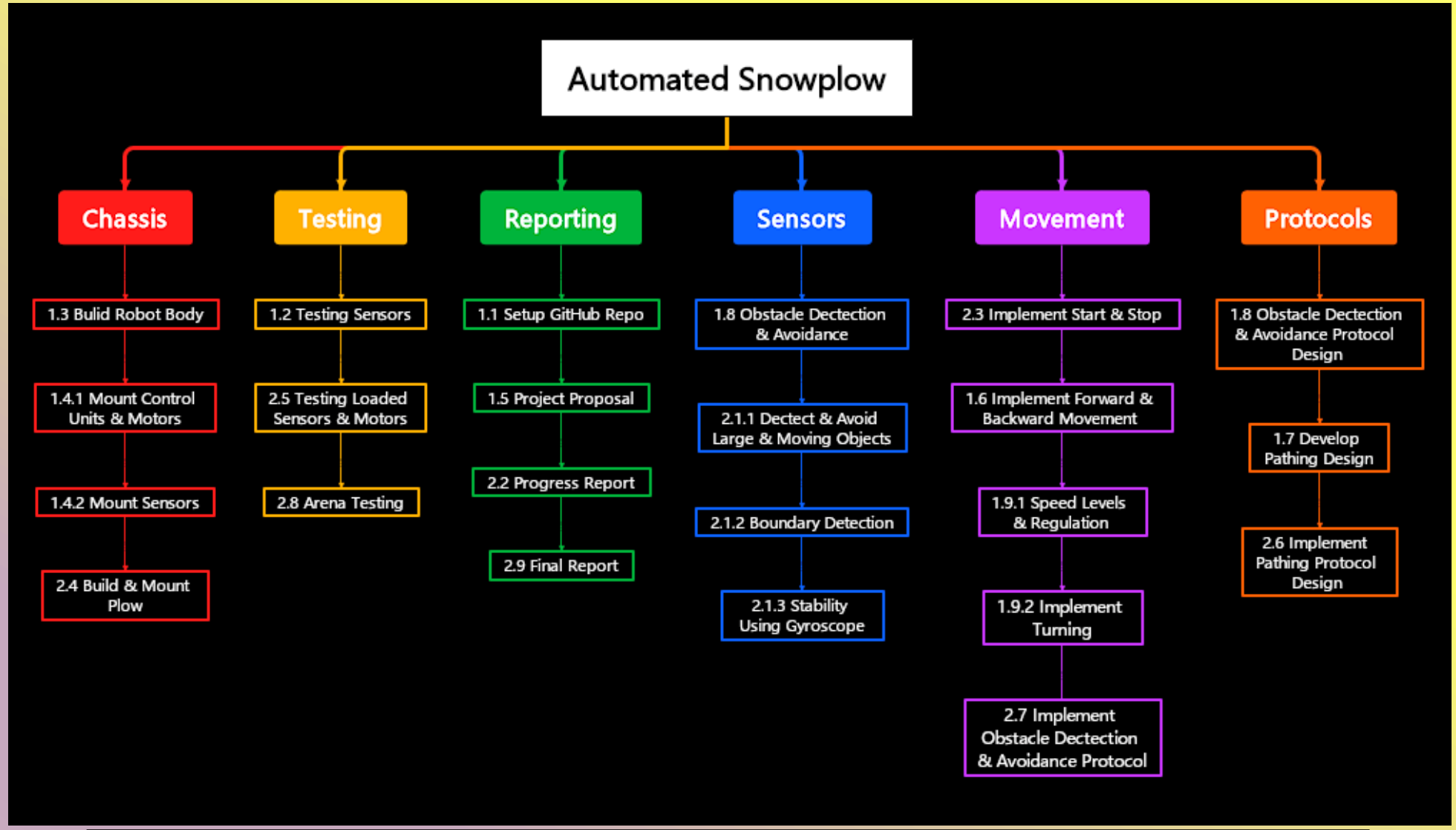



LIST OF
ACTIVITIES &
COSTS

LIST OF ACTIVITIES

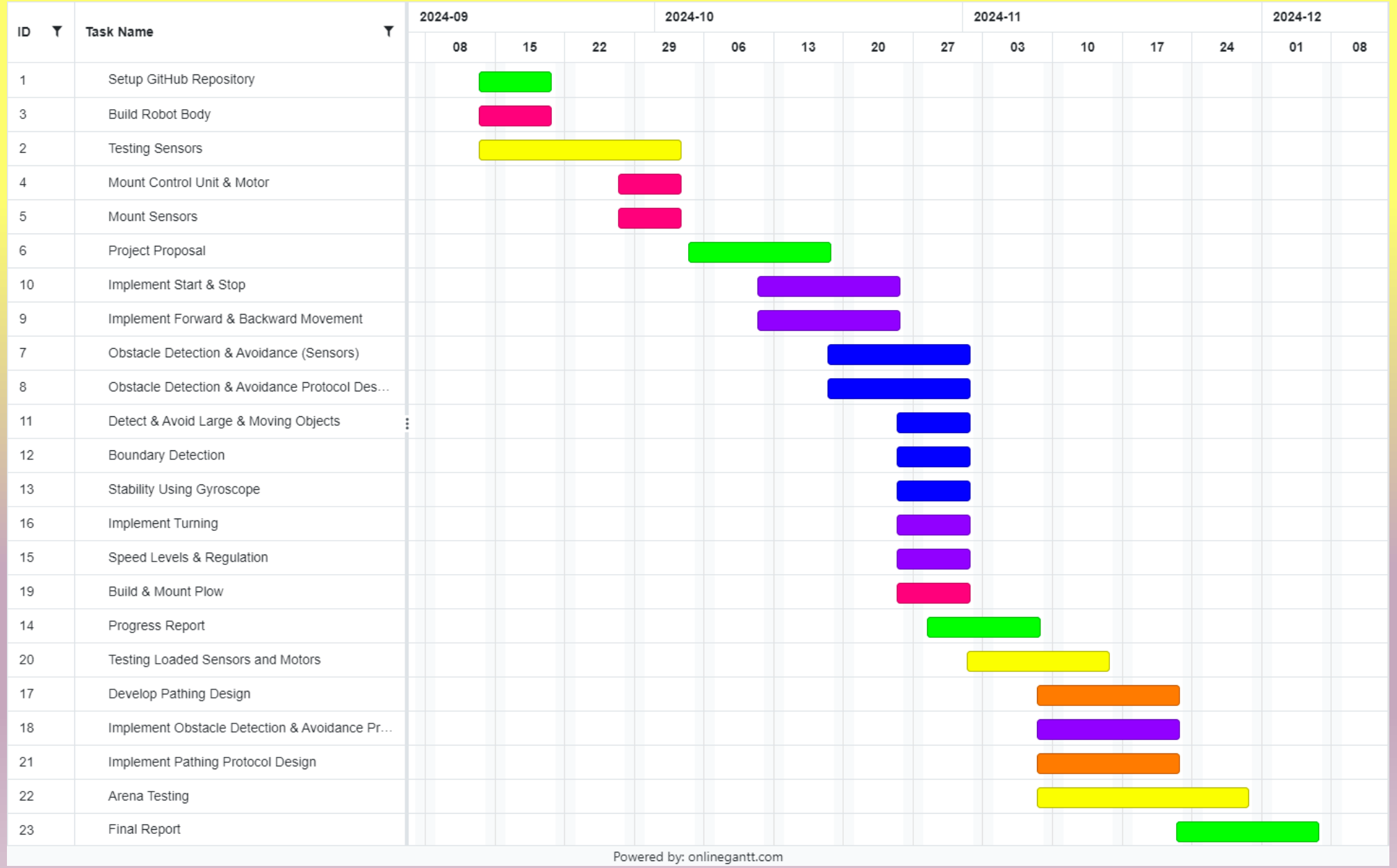
- Step 1: GitHub Setup
  - Robot Build Completed and Mounted
- Step 2: Ensure all Sensors are working and delivering data accurately
- Step 3: Research and Implement Mapping Algorithm
- Step 4: Research and Implement Border Algorithm
- Step 5: Motor Enable and Direction Testing when loaded
- Step 6: Research and Implement Obstacle Avoidance
- Step 7: Integration Testing. Ensuring all Sensor work in Accordance
- Step 8: Arena Testing and Debugging any Errors





WORK BREAKDOWN STRUCTURE

GANTT CHART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03
10
17
24
01
08
1 Setup GitHub Repository
3 Build Robot Body
2 Testing Sensors
4 Mount Control Unit & Motor
5 Mount Sensors
6 Project Proposal
10 Implement Start & Stop
9 Implement Forward & Backward Movement
7 Obstacle Detection & Avoidance (Sensors)
8 Obstacle Detection & Avoidance Protocol Des…
11 Detect & Avoid Large & Moving Objects
12 Boundary Detection
13 Stability Using Gyroscope
16 Implement Turning
15 Speed Levels & Regulation
19 Build & Mount Plow
14 Progress Report
20 Testing Loaded Sensors and Motors
17 Develop Pathing Design
18 Implement Obstacle Detection & Avoidance Pr…
21 Implement Pathing Protocol Design
22 Arena Testing
23 Final Report
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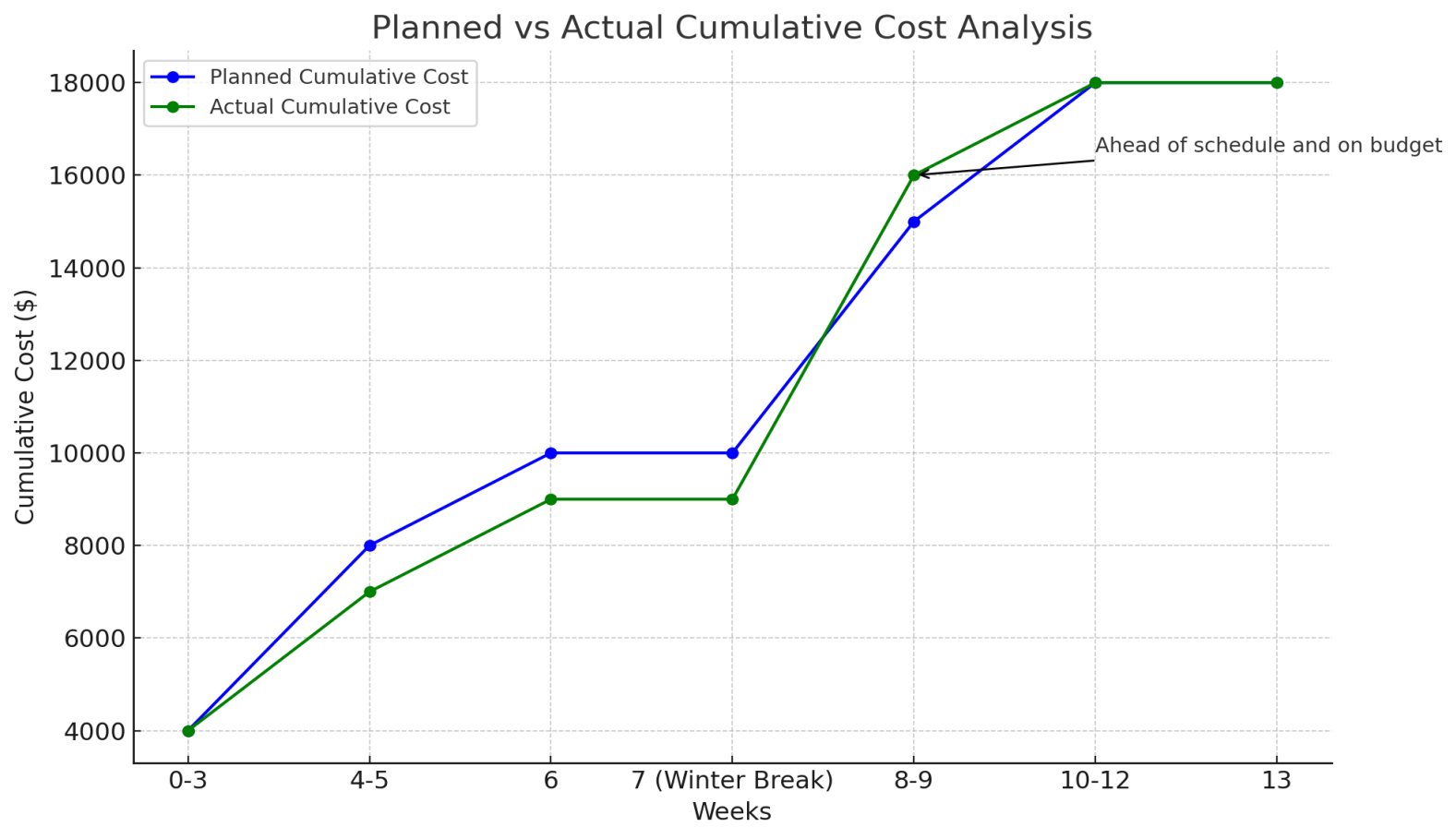
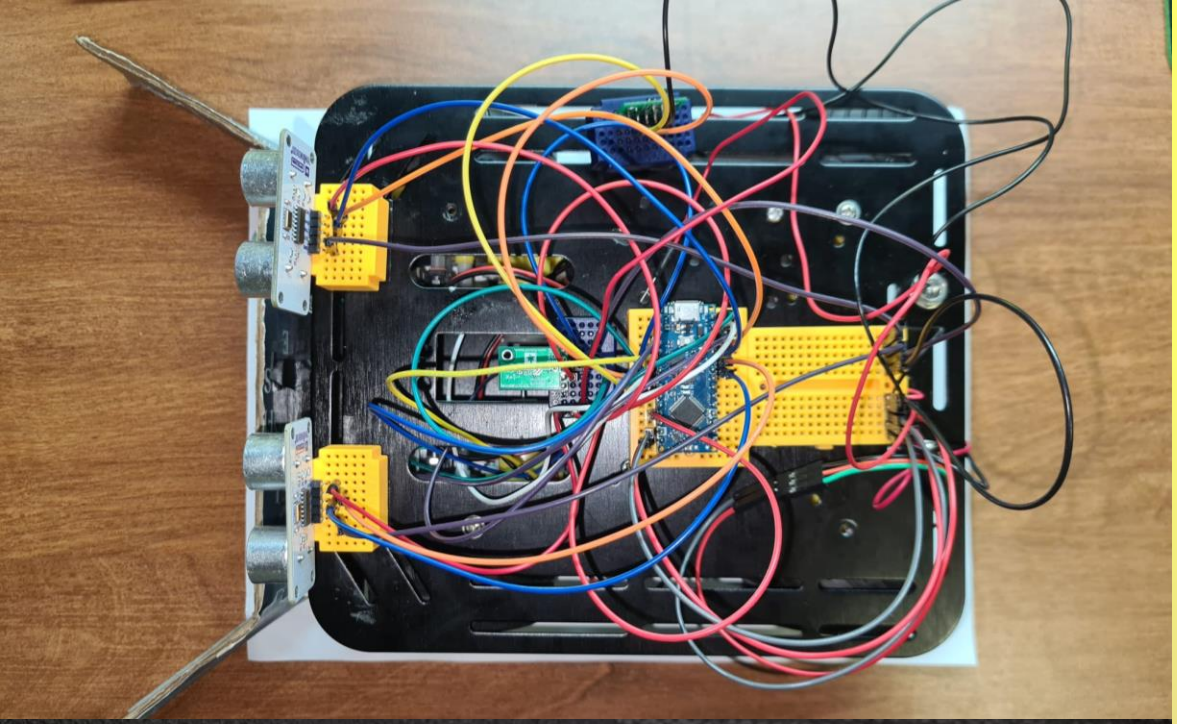
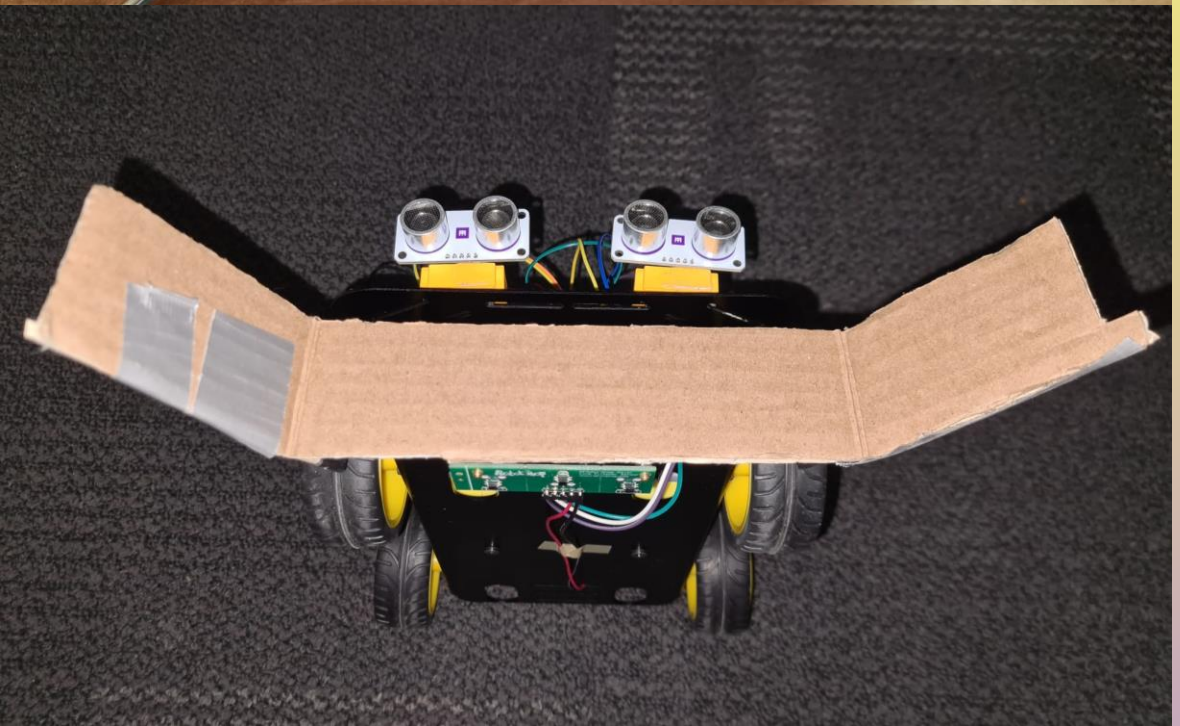
PLANNED VALUE ANALYSIS



HARDWARE





VEHICLE OVERVIEW

Micro-Controller:

- Arduino Nano Every

Motor Driver Board:

- Cytron FD04A Rev2.0

Sensors:

- Ultrasonic x2
- Time of Flight x2
- Inertial Measurement Unit x1
- Line Follower x1

Buck Converter

Battery Pack

9V Battery

Wheel Encoder

SENSOR PLACEMENT & SETUP

Ultrasonic:

- Are placed facing the front of the robot, to detect obstacles when the robot is moving forward.

Time of Flight (ToF):

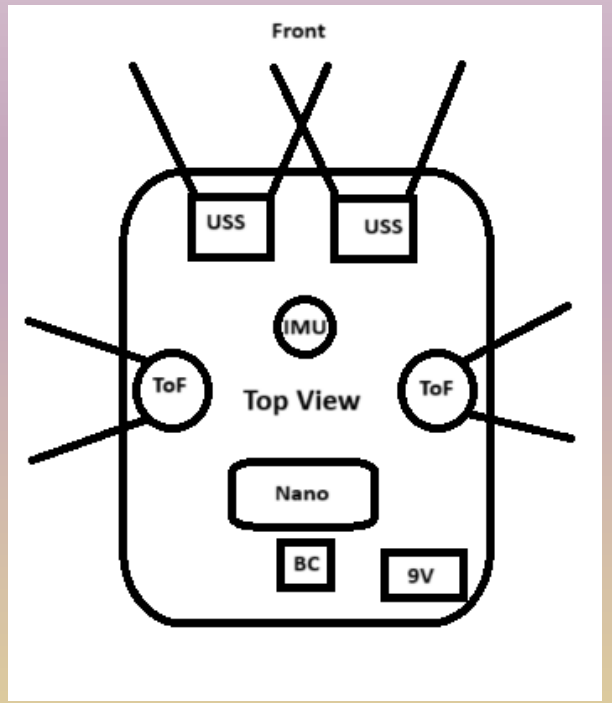
- Are the sensors on the sides, to detect object after the robot has turned.

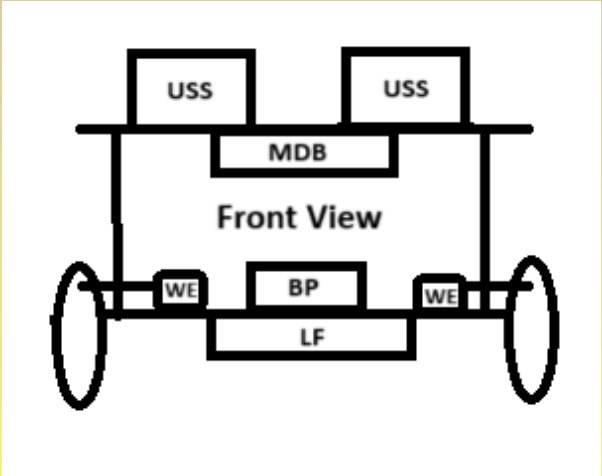
Inertial Measurement Unit (IMU):

- Is used for a precise 90° turn, using gyroscope.

Line Follower:

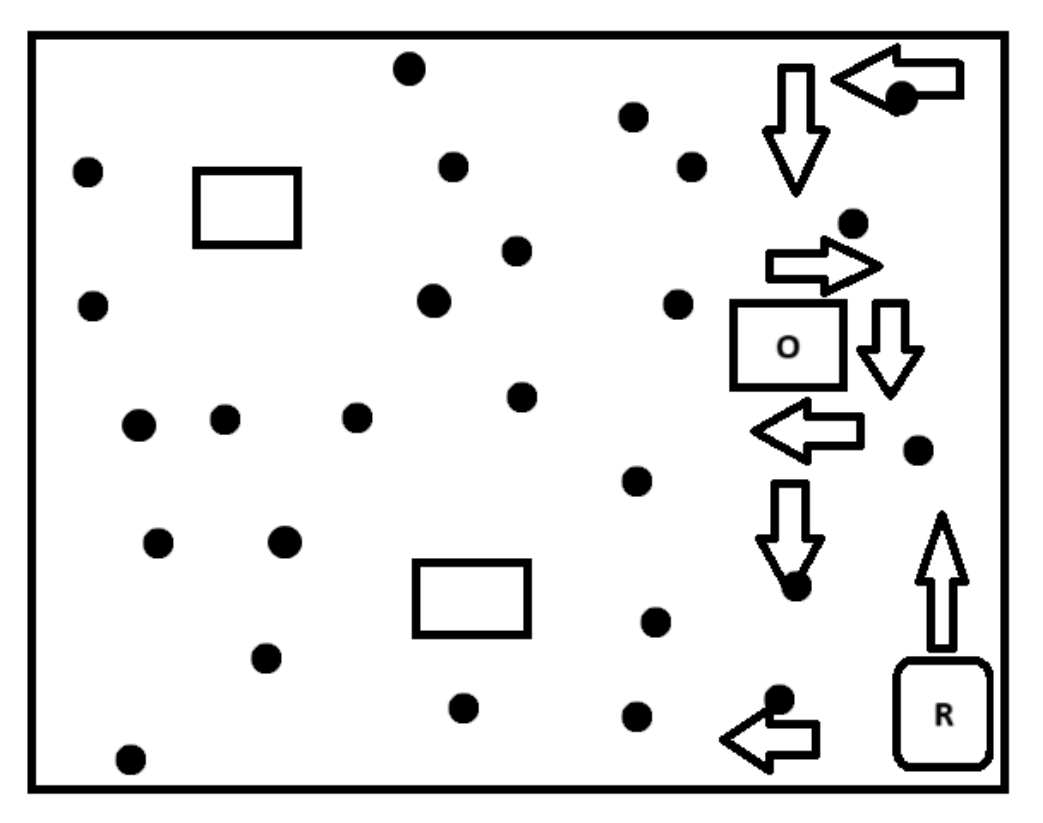
- Is underneath the robot at the front, to keep the robot within this boundary.






SOFTWARE

MOVEMENT ALGORITHM



- When a line is detected, it alternates between turning Left and Right
- Robot moves forward until an obstacle or line is detected
- IMU is used for a precise 90° turn.
- Wheel Encoders are used to bring the robot back to its original path.
- Snowballs are plowed during this process.

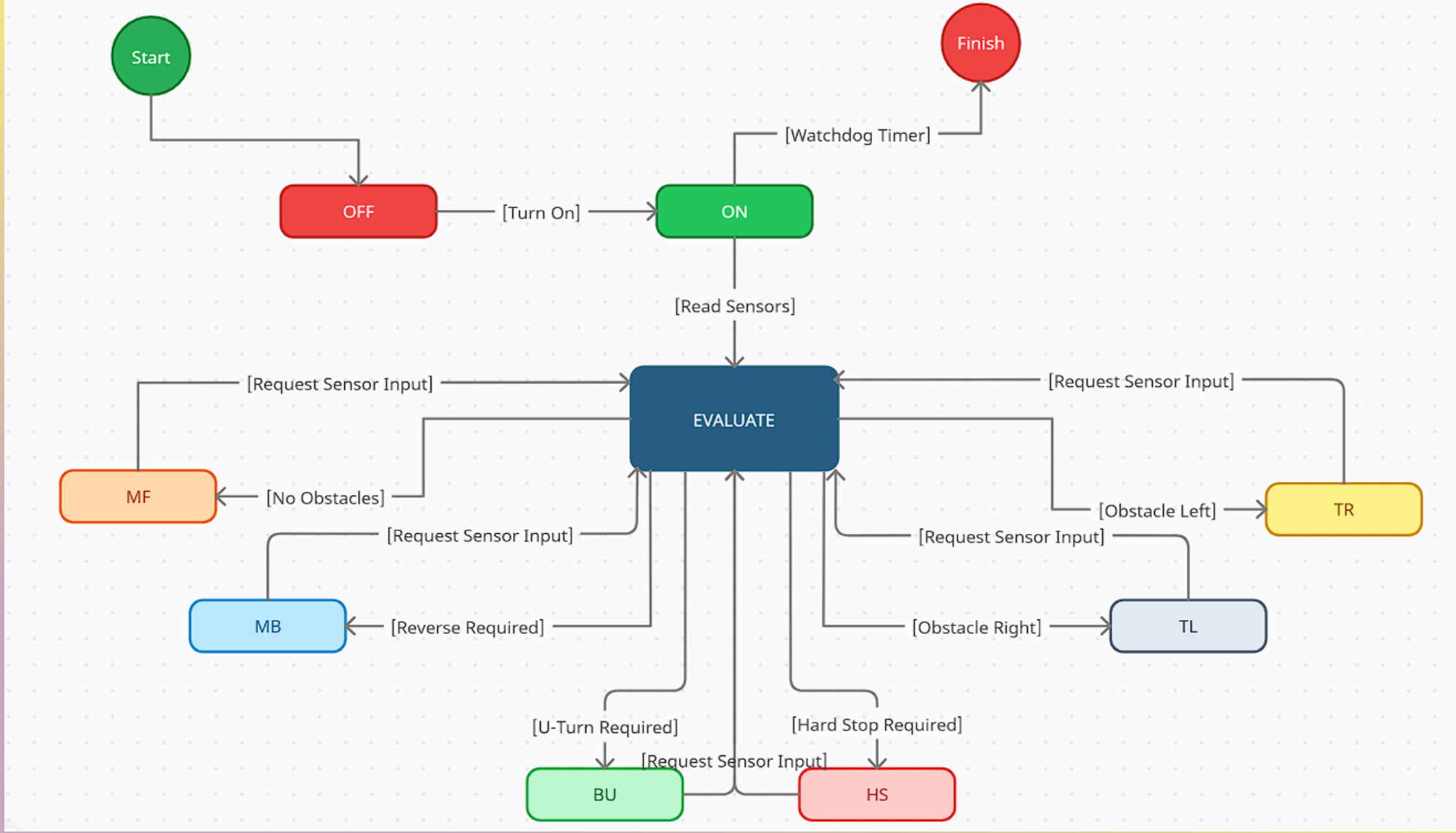
MAIN ALGORITHM

We tried to make the **main loop** as **simple** as possible:

- Default State is Move Forward.
- If a line is detected the robot turns.
- If an obstacle is detected in front the robot turns.
- The IMU performs a 90° turn.
- Tof and the Wheel Encoder jump into action.
- Robot is back in its original path.

WATCHDOG TIMER

- A Fail-Safe operation that is implemented to detect whether the system is in an infinite loop.
- The timer will aid in resetting the system to break the loop and return to functioning.



STATE DIAGRAM

ROBOT TESTING

TESTING SNOWPLOW

- Motor Movement Testing
- Line and Boundary Testing
- Object Detection Testing
- Integration Testing
- Arena Testing

WHAT'S NEXT?

➔ Enhancements and Debugging

- ◆ Create an optimized plow the robot
- ◆ Refine any algorithms
- ◆ Continuous debugging when integrating further algorithms

➔ In-Lab Demonstration (November 29th, 2024)

➔ Final Report (December 6th, 2024)

QUESTIONS