1. Feedback from First Prototype

1.1. Client/User Feedback Summary

The first prototype received valuable feedback, categorized as follows:

- **Functionality:** Users reported that certain features may not perform as expected, such as the clamping system, or movement of the Robomaster S1
- **Usability:** The interface was not intuitive for some users, indicating a need for better user experience design.
- **Performance:** Some components functions were not clearly understood.
- **Durability:** Materials used in the first prototype were not robust as requested, requiring an improvement to material selection and design

1.2. Application of Feedback to Second Prototype

The feedback led to the following design changes in the second prototype:

- **Improved Materials:** More durable materials were selected to enhance longevity. Instead of using a paint stir stick, a 3D printed arm was proposed to improve both structural integrities, as well as being a more aesthetically pleasing solution
- **Optimized Performance:** Key components were replaced or refined to ensure better efficiency. As an example, the marker being used was finalized to a King size Sharpie, allowing for measurements to be taken, allowing for the 3D printed piece to completed
- **User Interface Refinement:** The use of scratch code to program the robot was completed, and revised.

2. Development of Second Prototype

2.1. Purpose of the Second Prototype

- **Why?** The objective of this prototype is to test a critical subsystem that exhibited inefficiencies in the first iteration. The primary goal is to reduce risks related to performance and ensure feasibility for final integration.
- **What?** The second prototype includes key design modifications focusing on material selection, user interaction, and component performance.
- **When?** The prototype will be built and tested over the next two weeks, with iterative refinements based on performance testing results.

2.2. Prototype Design and Construction

- **Design Description:**
    - Structural enhancements were made to improve durability (Changing from wood to 3D filament
    - Adjustments to code were made to Improve the accuracy of the robot
- **Materials and Components:**
    - Stronger, lightweight material to replace less durable one from the first prototype.
    - Improved code and cosmetics
- **Manufacturing Methods:**
    - 3D printing for structural components.
    - Standardized assembly process for improved consistency.

2.3. Analytical, Numerical, or Experimental Model

- **Justification:**
    - A simulation model is used to predict component performance and optimize system integration.
    - Experimental tests will validate the durability and efficiency of new materials and subsystems.
- **Model Implementation:**
    - Onshape INTACT simulations
    - Bench tests for system accuracy and durability.

3. Prototyping Test Plan

3.1. Test Objectives

- **Durability:** Assess the wear and tear resistance of the new materials.
- **Usability:** Evaluate user interaction and ease of operation.

3.2. Test Procedures & Metrics

- **Procedures:**

    - Conduct stress tests under various conditions and run trials of the robot drawing
        - Adjust the distances the robot goes to ensure the lines meet the edge of the circle
        - If necessary, change the way the robot draws the circle, ie spinning/ rotating in one spot or moving forward in a circular motion (options depend on how the marker performs at certain angles and code complexity)
        - Test if turret needs to be moved up to lift the marker off the page when moving to a location to draw or if retracing over lines is doable
        - Test paper stability to have a marker draw on with limited pressure and have the robot make movements over (wheels should not move or damage the paper)

- **Metrics:**
    - Performance benchmarks for efficiency.
    - User satisfaction scores for usability.

3.3. Data Collection & Analysis

- **Recording Methods:**
    - Comparison to images of peace signs, to determine accuracy
    - Video analysis of user interaction.
- **Analysis Techniques:**
    - Statistical evaluation of performance metrics.
    - Qualitative analysis of user feedback.

4. Feedback & Iteration

4.1. User Feedback Collection

- **Process:**
    - Surveys and direct interviews with users.
    - Observation of real-world usage.

- **Insights:**
    - Identification of areas needing further refinement.

4.2. Refinements Based on Feedback

- **Changes:**
    - Additional ergonomic adjustments.
    - Fine-tuning of system performance based on test results.
- **Bill of Materials (BOM) Update:**

Item	Cost ($)
3D filament	1
A4 paper (4 pieces)	0.02
Sharpie fine point marker	3.5
Robo master S1	0
Cosmetics (Wig)	15
Robomaster app	0
Total	20.48

5. Planning for Third Prototype

5.1. Key Objectives for Third Prototype

- Full system integration based on the refined second prototype.
- Validation of usability improvements.

5.2. Updated Design Considerations

- Adjustments based on second prototype results.
- Balancing cost, manufacturability, and performance.

5.3. Testing Plan for Third Prototype

- **Experiments:**
    - Extended usability trials.
    - Performance benchmarking under real-world conditions (concrete floor, normal room conditions)
- **Expected Outcomes:**

- Confirmation of system reliability.
- Identification of final refinements before full-scale production.
    - Do the lines meet the edge of the circle every time with accuracy?
    - Does the paper stay in place?
    - Does the marker have the right angle and pressure to make sufficient lines and curves?
    - Is the speed of the robot ideal to prevent skipping of the marker?

6. Budget & Resource Management

- **Total Expenditures:** Within the $25-$100 budget.
- **Cost-Saving Strategies:**
    - Bulk purchasing of materials.
    - Utilizing open-source software solutions.

7. Prototype 3 Test Plan

Tests					Prototypes			
N°	Objective (Why)	Test Method (What)	Usage of Results (How)	Test Duration (When)	Type (What)	Objective (Why)	Fidelity	When to realise
1	Stability of new attachment	Observe RoboMaster movement with the new fully printed attachment while drawing	Identify any stability issues and adjust the attachment if needed	1 hour	Focussed physical	Ensure RoboMaster moves without wobbling or instability	Low	2025-03-18
2	Drawing precision with the attachment	Run RoboMaster on a pre-defined path and assess line accuracy	Determine if adjustments to weight distribution or software paramete	2 hours	Focussed physical and digital tests	Improve RoboMaster's ability to create smooth, precise lines	Medium	2025-03-20

			rs are needed					
3	Attachment durability	Conduct repeated drawing sessions with the final 3d-printed design	Test for wear and tear, adjust materials if necessary	2 hours	Focussed physical	Ensure long-term functionality of the attachment	Medium	2025-03-23