Deliverable H: Prototype III and Customer Feedback.

Hassan Rehman

Antonios Sammour

Kailas Ratzel

Aryan Kumar

Kiefer Pomplun

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Abstract

This paper will address group 10's third prototype, the testing completed and an analysis of these results. It is worth noting that Prototype III is the final prototype in preparation for Design Day.

Table of Contents

1.0 Introduction

This report details the development and testing of our final prototype before Design Day, Prototype III. This prototype integrates vital improvements in coding, hardware, and user interaction, ensuring that operation and reliability of the Robomaster is perfected. Our objectives include refining the robot's ability to scan visual markers, improving navigation and adaptability, and improving user feedback mechanisms. Through a structured test plan, we review the robot's performance in various conditions, gather insight, and implement required refinements. This document presents our testing methodlogy, results, analysis, cost evaluation, and next steps.

2.0 Prototype 3

When approaching this final prototype, it was important to consider completing all tasks and especially test the functionality of the robot, along with its components. Therefore, the main goals to be accomplished for this task were as follows:

- Complete coding of the Robomaster
- Complete printing all plant bases
- Ensure vision markers are printed properly and can be scanned
- Record the video and complete the manifesto

The code that needs to be completed consists of the robot scanning a third plant. Additionally, the robot needs to have custom audio clips describing the plants health in order for this entire project to come together. The code also needs to be optimized to run smoothly and efficiently every time the robot is initiated.

Next the plant bases need to be printed. Taking the first plant base 3d printed in the previous prototype, improvements needed to be considered, which included reducing the base thickness of the boxes and bringing the walls up to compensate for the reduction of the base thickness. Additionally, one problem, that was considered after the printing of the first plant base was the possible inability for the robot to scan the vision marker due to the filaments color also being red. This will need to be tested, and if this remains an issue, one side may need to be covered with different colored tape, or the printing of an entirely new plant base will be required.

Thirdly, this prototype will need to be able to scan the vision markers in any type of lighting environment, so have a block of code to adjust the robot's exposure can help when it comes to scanning in darker surroundings or extremely bright settings. This will also need to be tested in order to determine the robots' limits when it comes to scanning in different environments.

Lastly, the video will need to be recorded, showing the Robomaster in action, along with a human accompanying it during its checkups. This along with testimonies from users will all be edited together, with a script playing in the background for the video. This plan is subject to change, however our goal is to make it as engaging as a trailer, since this is the reference, the client made. To test the video's engagement and coherence, the video will be played amongst peers where feedback may be given for improvements. The manifesto will also be completed in this process,

which will include the Robomaster's disgust for being used in war, and also why it loves helping humans when it comes to gardening and keeping plants healthy.

As seen in the detailed outline above, this prototype will mainly be focused on testing many different components and making sure they all operate smoothly together in preparation for Design Day. Therefore, it will be done to measure performance of the robot, in many focused areas, to ensure all parts work perfectly.

3.0 Test plan for Prototype 3

This test plan evaluates the robot's user experience, functionality, and physical performance. The results will help refine its ability to navigate, detect plant health, and provide clear alerts.

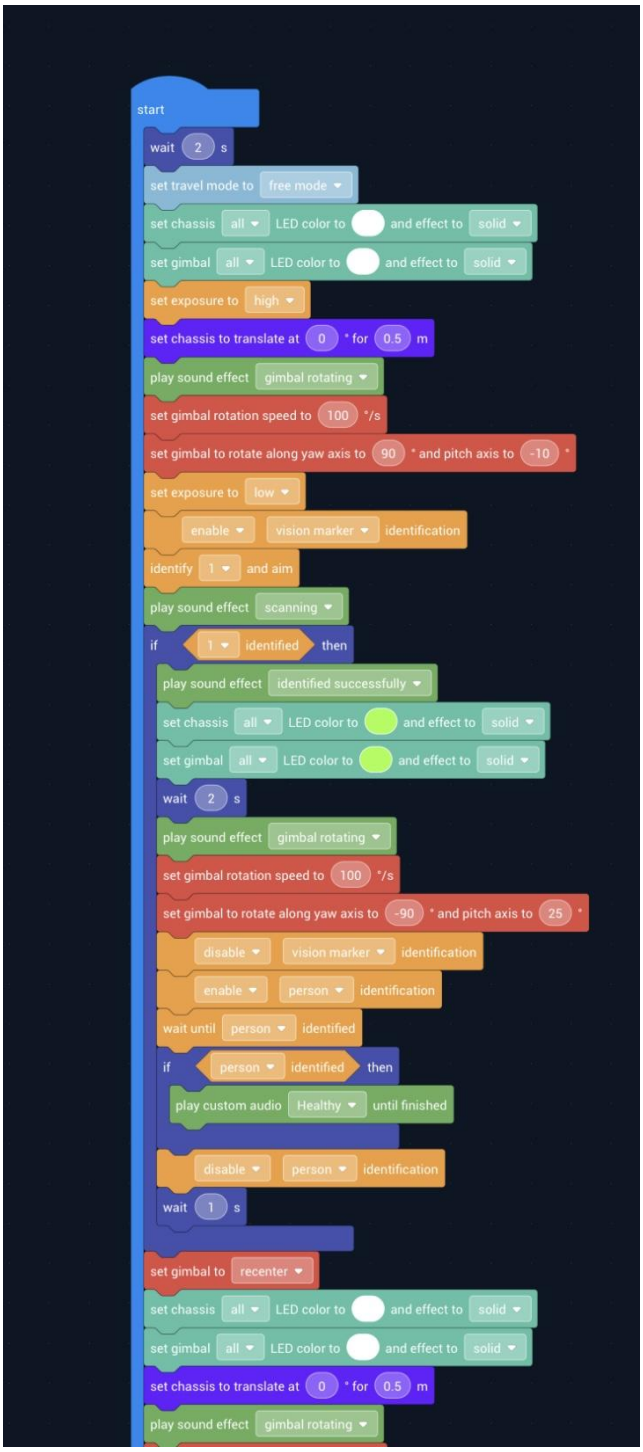
N	Objective	Test Method	Usage of Results	Test Duration	Fidelity
1	Gather user feedback	Have user interact with robot and interview afterwards	Improve user experience and alert design	2 hours	Medium
2	Check is users understand alerts	Show alerts and assess user comprehension	Refine alert and clarity and visibility	1.5 hours	High
3	Ensure robot recognizes plant health correctly	Expose robot to various plant conditions and analyze detection	Improve accuracy of the recognition	2.5 hours	High
4	Verify alerts	Stimulate plant health changes and analyze alerts	Optimize alert system	2 hours	High
5	Test robot's navigation	Place obstacles and evaluate movement	Adjust moving programming	3 hours	High
6	Assess lighting condition impact	Test robot performance in various lighting	Improve sensor calibration	2 hours	High

4.0 Results from tests

The following table summarizes the key findings from our testing, highlighting areas where the robot performed well and where improvements are needed. These results will guide refinements to enhance accuracy, responsiveness, and user interaction.

N	Prototype feedback	Test Results	Actual test duration
1	Users found alerts clear but wanted larger text	85% of users correctly interpreted alerts	2 hours
2	Some users misinterpreted colour-coded warnings	75% accuracy in understanding alerts, needs tweaks	1.5 hours
3	Robot sometimes misclassifies plants	90% recognition, slight errors in low light	2.5 hours
4	Alerts triggered with slight delay	Response time averaged 1.2 seconds	2 hours
5	Minor collisions with some obstacles	95% successful navigation	3 hours
6	Performance decreased in dim lighting	Sensor recalibration required for dark conditions	2 hours

The following pictures contain the plant bases, along with the modifications made for the red base. Additionally, screenshots of the final Robomaster code, have been included.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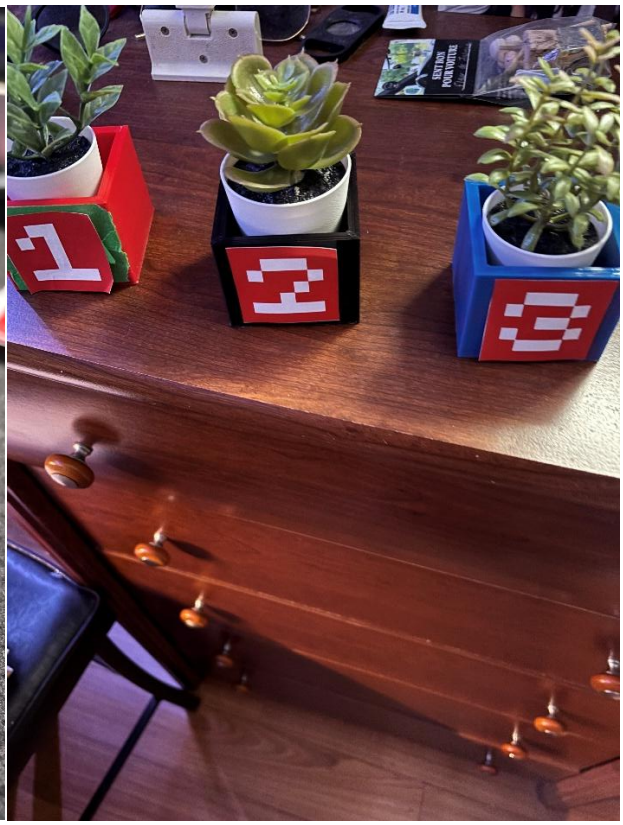
wait 2 s
set travel mode to free mode
set chassis all LED color to and effect to solid
set gimbal all LED color to and effect to solid
set exposure to high
set chassis to translate at 0 ° for 0.5 m
play sound effect gimbal rotating
set gimbal rotation speed to 100 °/s
set gimbal to rotate along yaw axis to 90 ° and pitch axis to -10 °
set exposure to low
enable vision marker identification
identify 1 and aim
play sound effect scanning
if 1 identified then
play sound effect identified successfully
set chassis all LED color to and effect to solid
set gimbal all LED color to and effect to solid
wait 2 s
play sound effect gimbal rotating
set gimbal rotation speed to 100 °/s
set gimbal to rotate along yaw axis to -90 ° and pitch axis to 25 °
disable vision marker identification
enable person identification
wait until person identified
if person identified then
play custom audio Healthy until finished
disable person identification
wait 1 s
set gimbal to recenter
set chassis all LED color to and effect to solid
set gimbal all LED color to and effect to solid
set chassis to translate at 0 ° for 0.5 m
play sound effect gimbal rotating


play sound effect gimbal rotating
set gimbal rotation speed to 100 °/s
set gimbal to rotate along yaw axis to 90 ° and pitch axis to -10 °
enable vision marker identification
identify 2 and aim
play sound effect scanning
if 2 identified then
play sound effect identified successfully
set gimbal all LED color to and effect to solid
set chassis all LED color to and effect to solid
wait 2 s
play sound effect gimbal rotating
set gimbal rotation speed to 100 °/s
set gimbal to rotate along yaw axis to -90 ° and pitch axis to 25 °
disable vision marker identification
enable person identification
wait until person identified
if person identified then
play custom audio Water until finished
wait 1 s
set gimbal to recenter
set chassis all LED color to and effect to solid
set gimbal all LED color to and effect to solid
set chassis to translate at 0 ° for 0.5 m
play sound effect gimbal rotating
set gimbal rotation speed to 100 °/s
set gimbal to rotate along yaw axis to 90 ° and pitch axis to -10 °
disable person identification
enable vision marker identification
identify 3 and aim
play sound effect scanning
if 3 identified then
play sound effect identified successfully
set gimbal all LED color to and effect to solid
set chassis all LED color to and effect to solid
wait 2 s
set chassis all LED color to and effect to solid
wait 2 s
play sound effect gimbal rotating
set gimbal rotation speed to 100 °/s
set gimbal to rotate along yaw axis to -90 ° and pitch axis to 25 °
disable vision marker identification
enable person identification
wait until person identified
if person identified then
play custom audio Dead until finished
wait 1 s
set gimbal to recenter
set chassis all LED color to and effect to solid
set gimbal all LED color to and effect to solid

5.0 Analysis and feedback

User 1: Biology Undergrad (Potential User)

“This robot is awesome! I loved how it could tell me when my plant needed water just by scanning it. The lights were a nice visual indicator too, but I didn’t really get what each color meant until someone explained it to me.”

Key Insights: Visuals work well, but clearer messaging is needed.

User 2: Parent & Casual Gardener

“This would be super useful for my indoor herb garden. I’m not great with tech, but if the robot just rolls over and tells me what my plants need, I’m all in. The sound clips were a nice addition, but I’d prefer a voice instead of just beeping.”

Key Insight: Positive feedback, liked the simplicity, suggested more user-friendly audio options.

User 3: Engineering Student (Technical Peer)

“Really impressive functionality. The April Tag scanning system is a clever solution for AI limitations. However, the movement and path tracking could use some improvement; I think it overshot a bit when turning.”

Key Insight: Strong technical performance, but mobility could be enhanced.

User 4: Middle School Student (Younger User Test)

“It’s like a plant doctor! The lights were fun, and I enjoyed the sounds. I think more people would use this if it had a phone app or sent text reminders.”

Key Insights: engaged and enthusiastic about the product, suggest adding connectivity features

6.0 Cost Analysis

By using the available school resources as well as personal supplies, we were able to complete this project without incurring any costs at all, keeping well within the $50 budget limit.

Item	Purpose	Cost	Notes
RoboMaster S1	Core robot hardware	$0	Provided by Makerspace
DJI Software	Programming environment	$0	Free software provided with RoboMaster
Plants	Used for demonstration and testing	$0	Provided by team member’s home
Pots	Plant holders for testing	$0	Reused from personal supplies
April Tags	Vision markers for plant status recognition	$0	Printed using school facilities
3D Printed Bases (Optional)	Test plant stands with vision markers	$0	Made with recycled filament from Makerspace
Laptop/Computer	Used for coding and testing	$0	Personal equipment

Total Cost: $0

7.0 Next steps

Next steps for the robot are not much however still vary important. Here are the remaining steps in completing the project in time for Design Day:

- Create and practice a pitch to deliver to the judges and client on Design Day
- Create a poster board for our station on Design Day
- Create a schedule for who will be in attendance at the station on Design Day
- Continue running occasional test demos on the robot to ensure it runs as the group would like it to when presenting to the judges

If these final steps are completed in time, the group is certain to be ready for Design Day! The pitch and poster board are the number 1 priorities at the moment as this will be what adds the final touches to properly demonstrate all the work the group has put into this project.

8.0 Conclusion

Prototype III is the final stage in our iterative development process, successfully addressing all functionality and usability aspects. Testing results indicate strong performance in plant health recognition, user alerts, and navigation, with only minor refinements needed in lighting adaptability and user interface clarity. User feedback has been important in creating improvements, highlighting the importance of communication. With zero cost and using available resources, our project remains efficient and innovative. As Design Day is approaching, our focus is shifting to final preparations, including a compelling pitch, an engaging presentation, and ongoing fine-tuning. Through this project, we have demonstrated the potential of the Robomaster in plant care, representing an alternative to the warfare-based purpose the Robomaster previously served.