# The Greenhouse Plant Checker

By Group 10

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# Empathize

First Client Meeting

- Find an alternate use for the RoboMaster S1, used for combat training
- Client's concern of the rise of autonomous weapons, raising ethical questions
- Goal:
    - Subvert combat-based ideology
    - Use RoboMaster for meaningful purposes
    - Show that robotics can be used for peaceful purposes, not for combative purposes

# Client needs

Functionality (Priority 5):

- Must serve non-combative purpose
- Demonstrate three ethical concerns related to autonomous weapons

Educational (Priority 3)

- Raise awareness on algorithmic biases and human judgement

Ethical (Priority 2)

- Cannot glorify warfare, target individuals, promote discrimination

Creative (Priority 1)

- Must always support core message

User Benchmarking

- STM Kargu – Drone made by Turkish Armed forces; locks on to targets and explodes nearby, opposes goal of the project and client needs

# Define

Design Criteria

- Functional requirements, non-functional requirements, and constraints
- Given ranking, indicates importance

Technical Benchmarking

- SPOT: Search and Rescue
- Misty II: Coding Education
- Husky A300 – Agricultural Research

Design Constraints

- Cannot physically alter robot
- Budget on materials
- All modifications must be software-based

Target Specifications

- Understand capabilities of the RoboMaster S1

Green - Functional Requirements

Blue – Non-Functional Requirements

Red - Constraints

| Criteria | Rank |
|---|---|
| Transform the Robomaster S1 into a peaceful tool | 5 |
| Demonstrate 3 ethical concerns related to autonomous weapons | 5 |
| Promote responsible robotics | 5 |
| Use creative expression to enhance user engagement | 2 |
| Ensure message will not cause offence | 2 |
| Emotional impact on viewers | 2 |
| Must be under 90 seconds | 5 |
| Must not target specific individuals | 4 |
| Avoid glorifying autonomous weapons | 4 |
| Must have no permanent physical changes done to the robot | 4 |
| No cost | 3 |

| | Importance Weighing | RoboMaster S1 | SPOT | Misty II | Husky A300 |
|---|---|---|---|---|---|
| Company | | DJI | Boston Dynamics | Misty Robotics | Clearpath |
| Speed | 2 | Top speeds of 12.6km/h | Top speeds of 5.7km/h | Top speed of 1.62km/h | Top speed of 7.2km/h |
| Range perception | 3 | Varies between 3m-6m depending on lighting | Up to 4m | Up to 1.2 meters | Up to 35 meters |
| Camera Resolution | 2 | 2560x1440 at 30fps | 640x512 at 7.5hz when opting into the Cam+IR kit | 4208x3120 at 35fps | 1200p at 60fps when opting into the vision package |
| Battery Life | 3 | Minimum 60 minutes | Has an average run time 90min | Up to 10 hours when idle and 2.2 hours when running | Extended run time of 12 hours |
| Payload capacity | 2 | Has a tested payload of 6.6lb | 30.9lb | 33lb | 220lb |
| Temperature limits | 1 | -10°C to 40°C | -22°C to 55°C | 5°C to 40°C | -20°C to 40°C |

| SPECIFICATION | TARGET VALUE | RATIONALE |
|---|---|---|
| RANGE PERCEPTION | 3-6 meters | Good obstacle detection while balancing cost |
| CAMERA RESOLUTION | Minimum 2560x1440 at 30fps | Good quality image capture for educational message |
| BATTERY LIFE | Minimum 60 minutes | Good operational time without frequent recharging |
| PAYLOAD CAPACITY | At least 6.6 lbs (3kg) | Stability if carrying additional attachments |
| TEMPERATURE TOLERANCE | -10C to 40C | Suitable for indoor or outdoor use. |
| SPEED | 5-10km/h | Good, controlled movement while having some flexibility in its performance. |

# Ideate

**Brainstormed Ideas:**

- **Aiding blind/deaf individuals**
  - Navigation Alerts
  - Challenges included additional hardware and complex software
- **Baby Monitor**
  - Monitor Baby's Environment
  - Challenges included privacy concerns
- **Greenhouse Plant Checker**
  - Acts as a tool, not a replacement for human
  - Practical and impactful

Key Takeaways:

- Greenhouse plant checker best aligns with technical feasibility, ethical concerns, and real-world applications
- Brainstorming process helped identify limitations in alternative ideas and focus on a solution

# Plan

| TASK | DESCRIPTION | DEADLINE | ASSIGNED MEMBERS |
|---|---|---|---|
| FINALIZE PROTOTYPE III | Print plant bases, integrate sound & LED alerts | March 18-22 | Entire Group |
| USER TESTING & ADJUSTMENTS | Gather feedback, evaluate scanning & interaction | March 20-24 | Entire Group |
| VIDEO & PRESENTATION PREPERATION | Film a 90-second demo, edit & finalize slides | March 22-26 | Entire Group |
| FINAL TESTING & DEBUGGING | Ensure all features work smoothly, fix issues | March 24-26 | Entire Group |
| DESIGN DAY | Present finalized project | March 27 | Entire Group |

# Estimated costs

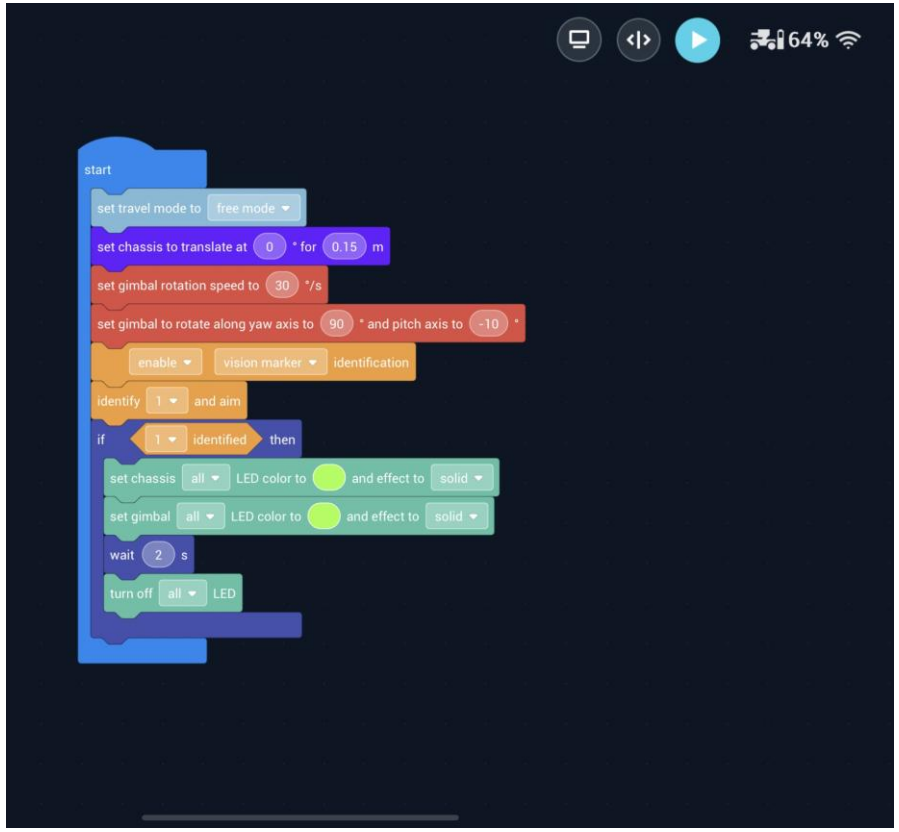
- **Estimated Budget:**
  - Plants (for video props): $10
  - April Tags (AI scanning markers): $0
  - DJI Software: $0
  - RoboMaster S1 (provided by Makerspace): $0
  - 3D Printed Pots (material cost): $10
  - Laptop/Computer (team provided): $0
  - **Total Estimated Cost:** ~$20
- Budget considerations: Kept under $50 by leveraging existing resources.

# Prototype I

- Goals of the first prototype:
  1. Basic control of the Robomaster
  2. Configure light changing
  3. Discover how the scanning worked

  Things to test:

  - ❑How accurate the robot's movement is
  - ❑Test the scanning distance
  - ❑Discover the lights tendencies




# Test for Prototype I

# Prototype II

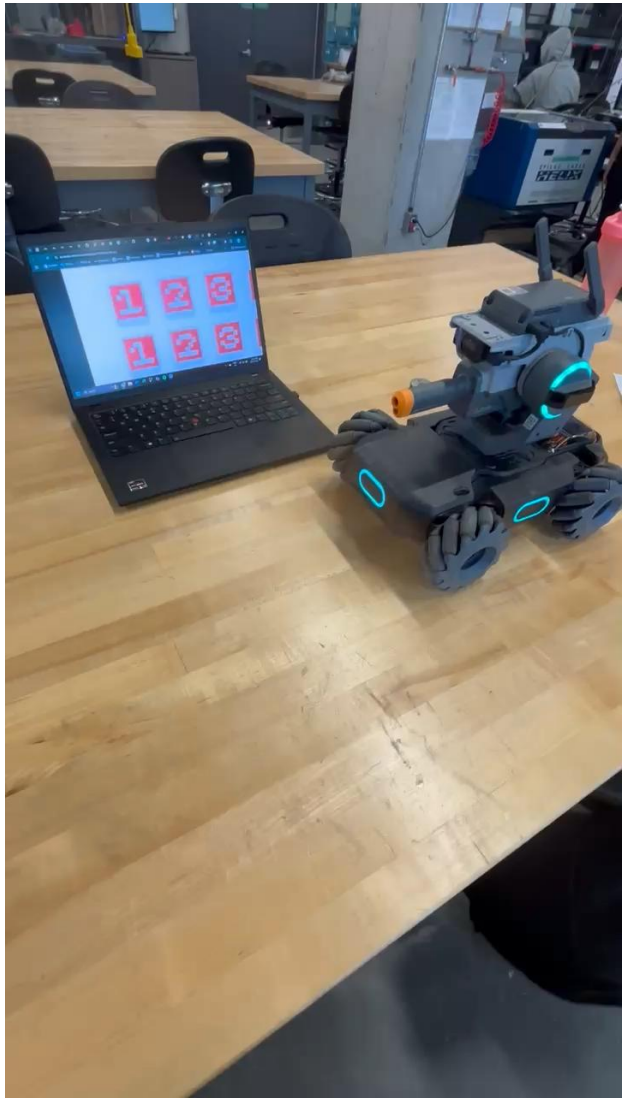
- Goals for prototype II:
  1. Build off the last prototypes
  2. Add sound clips to make the experience more immersive and fun
  3. Add a human in the loop feature
  4. Began printing plant bases and testing their size

  Things to test:

  ❑How to integrate human in the loop feature

  ❑How loud the Robomaster is

  ❑Test the plant bases size



# Test for Prototype II

# Prototype III

- Goals for Prototype III:
  1. Finalize the Greenhouse plant checkers mission and goal
  2. Print all the plant bases
  3. Put in custom sound clips to describe the plants state
  4. Optimize and finalize the robot.

# Test plans for Prototype 3

## User Testing:

- Gather feedback from various potential users
- Observe if users can interpret alerts correctly

## Functionality Testing:

- Ensure robot can recognize the plant health correctly
- Verify real-time alerts work correctly

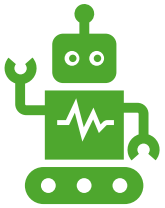
## Physical Test Plan:

- Test to see if robot can successfully navigate without crashing
- Evaluate different lighting conditions

# Video Ideas

- Concept Video:
  - Showcase the Greenhouse Plant Checker in action
  - Demonstrate the functionality of it
- User Experience Video:
  - Follow a plant owner who has trouble keep track of their plants
  - Introduce robot as problem solving assistant
- Technical Demonstration
  - Breakdown of the robot scans plants and provides feedback
  - Side-by-side comparison of plants with and without the robot's assistance

# Manifesto Ideas



## Ethical Robotics:

"Technology should serve humanity, not harm it."

The Greenhouse Plant Checker represents the shift from combat robotics to sustainable solutions

## Environmental Impact:

Encouraging better plant care reduces waste

Can contribute to eco-friendly solutions rather than violence

## Future Vision:

Autonomous robots can assist in daily life

# Lessons learned

- The importance of human-AI interaction and user engagement.
- The effectiveness of simple, visual-based scanning over complex AI models for practical applications.
- The necessity of iterative design and client feedback in shaping the final product.

# Next Steps

| STEP | ACTION REQUIRED | DEADLINE | RESPONSIBLE MEMBERS |
|---|---|---|---|
| Refine Prototype | Finalize movement, sound, LED feedback | March 18-22 | Entire Group |
| Conduct User Testing | Test with users, gather feedback | March 20-24 | Entire Group |
| Make Final Adjustments | Optimize code, fix navigation & interaction | March 24-26 | Entire Group |
| Prepare Final Presentation | Finish slides, refine talking points | March 22-26 | Entire Group |
| Complete Project Video | Edit & finalize the demo video | March 22-26 | Entire Group |
| Final Testing & Debugging | Run final system tests, ensure full functionality | March 24-26 | Entire Group |
| Design Day Presentation | Present project to the panel | March 27 | Entire Group |