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Hue (ESE ISD) | SEAS Senior Design 2024 – 2025



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Time
Consuming



Access
Exclusive



Labor
Intensive

PAINT YOUR LOGO ANYWHERE



Hue is a



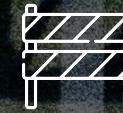
Fast



Autonomous



Accurate

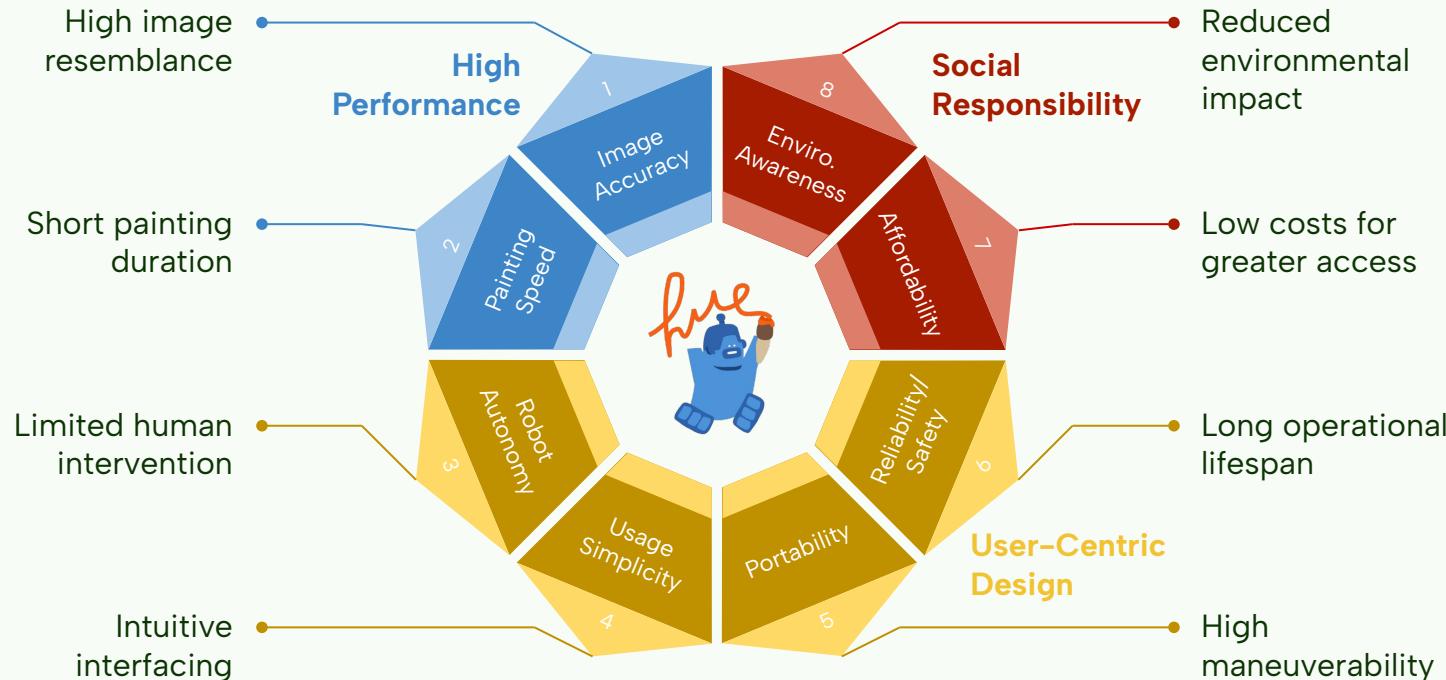


Accessible

field image painting solution

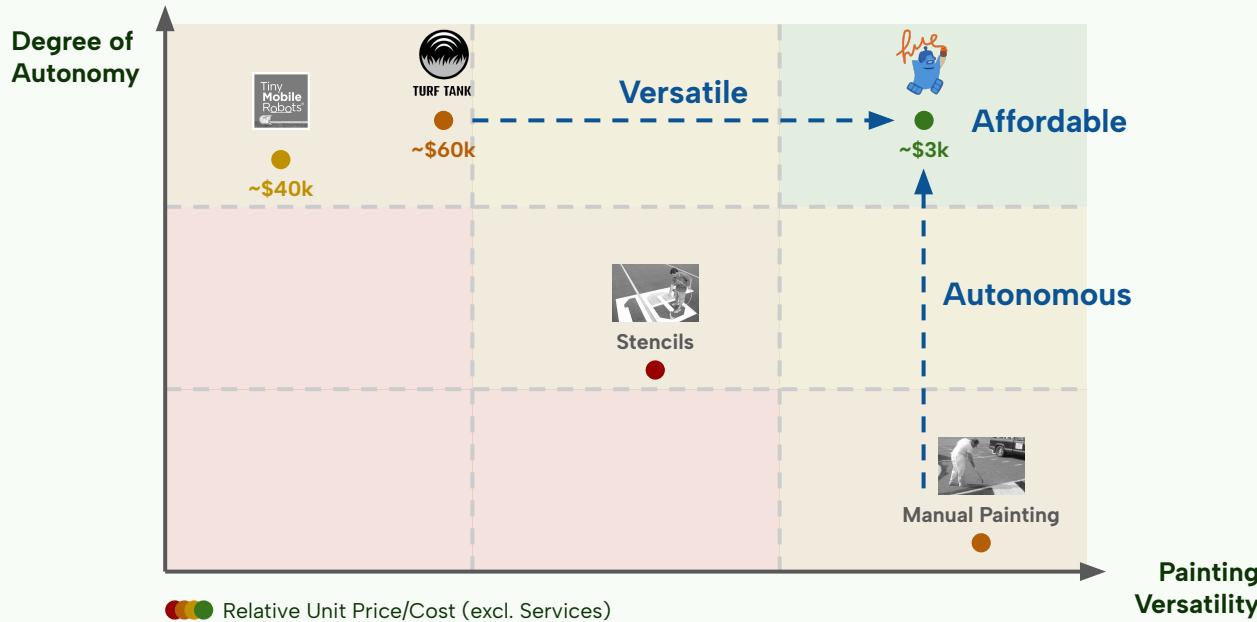


Core Principles





Hue is Autonomous, Versatile and Affordable





Effortless User Journey

1

Define

User inputs
image, location
and
specifications

2

Prepare

Add paint and
startup robot

3

Deploy

Position robot
and GPS base
station

4

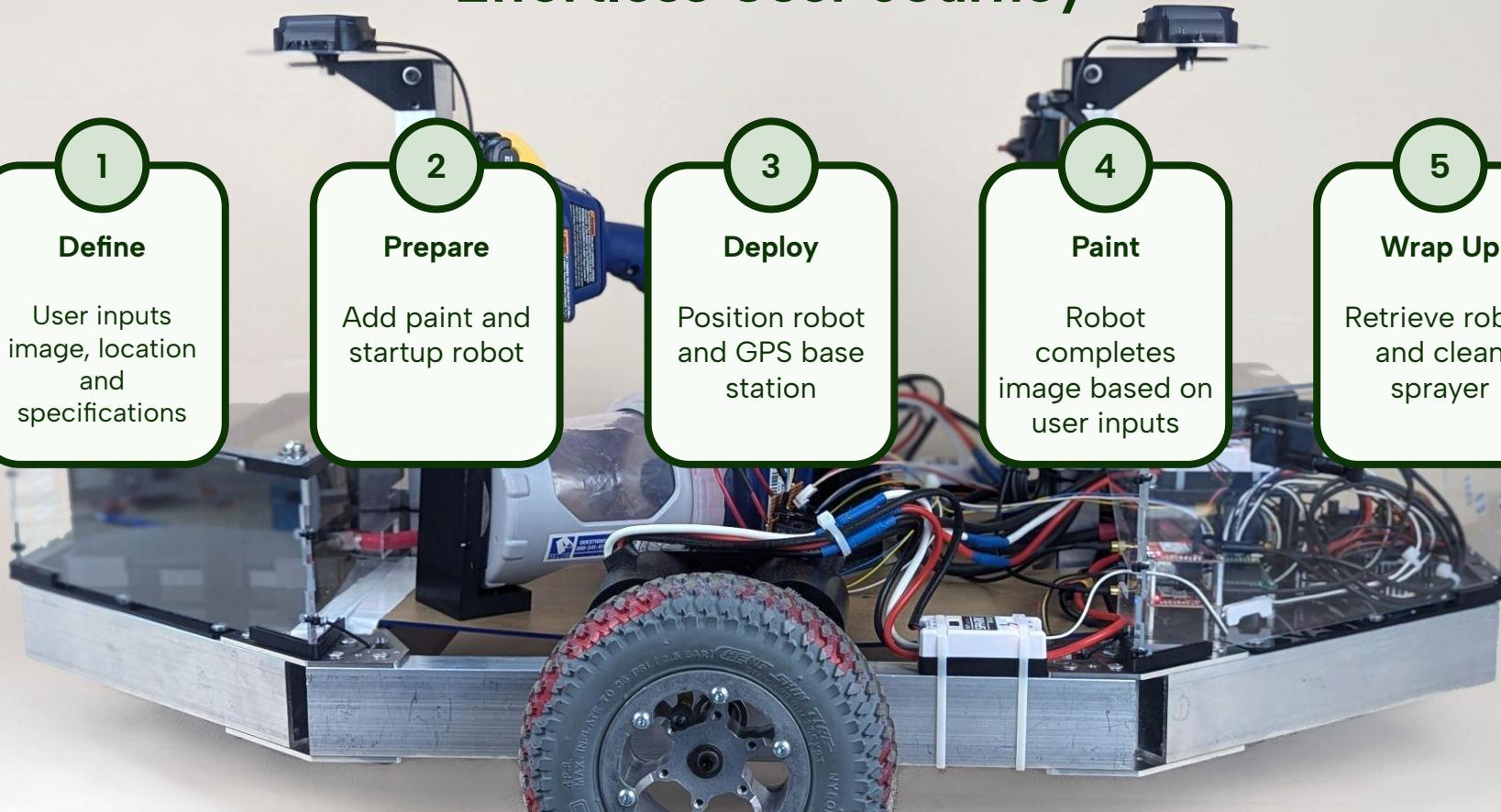
Paint

Robot
completes
image based on
user inputs

5

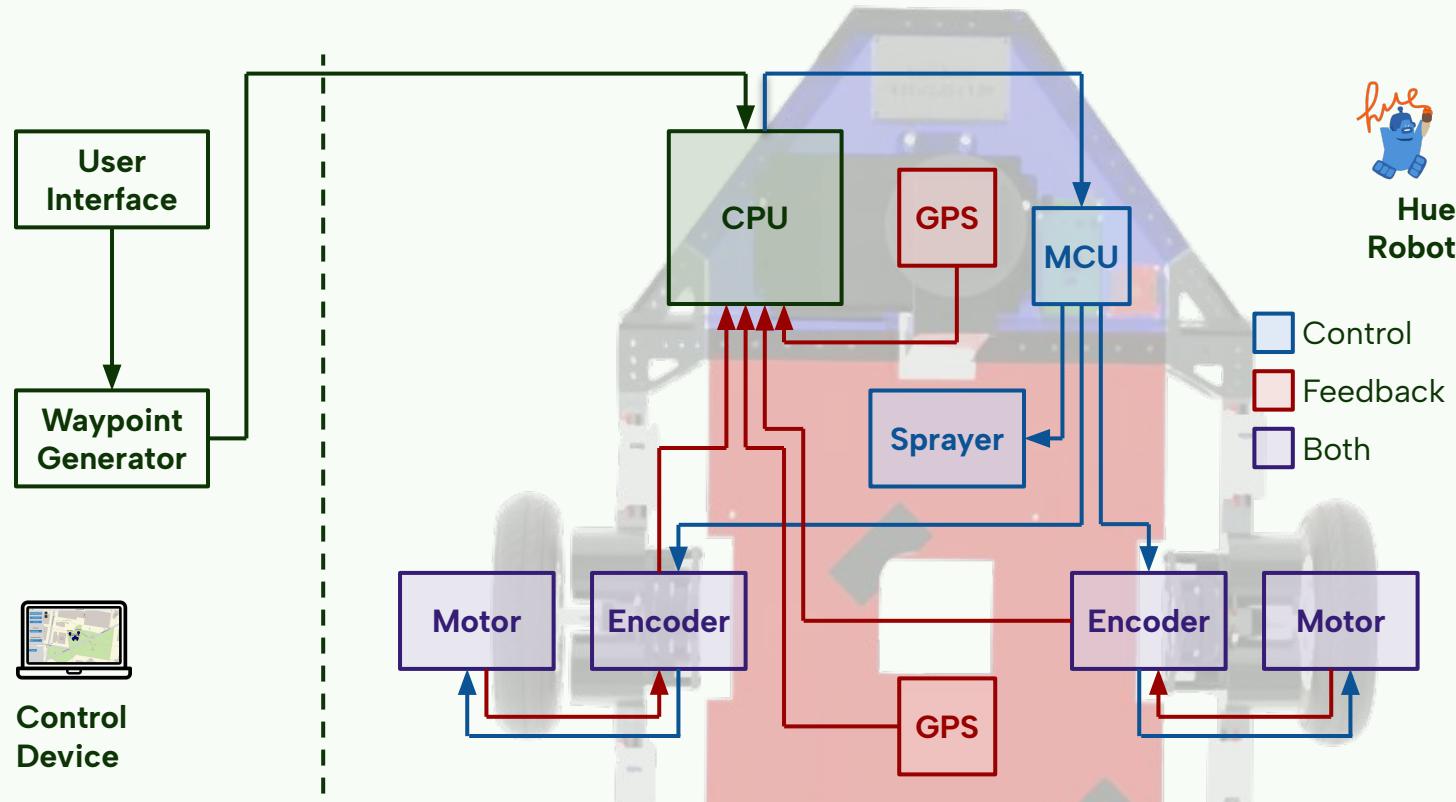
Wrap Up

Retrieve robot
and clean
sprayer



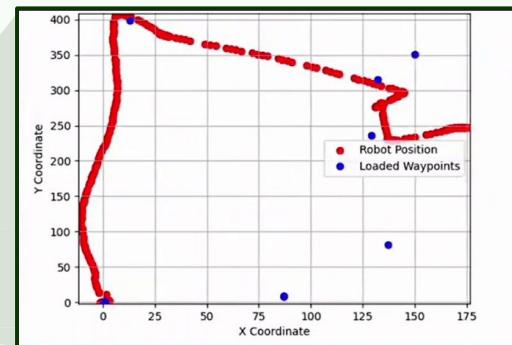
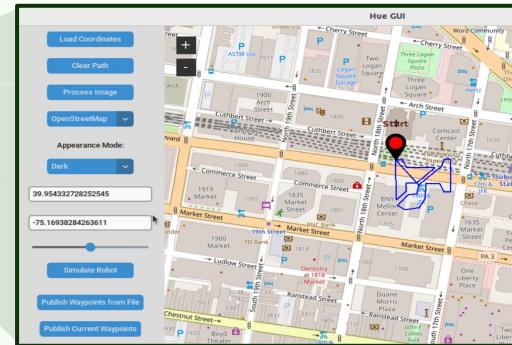
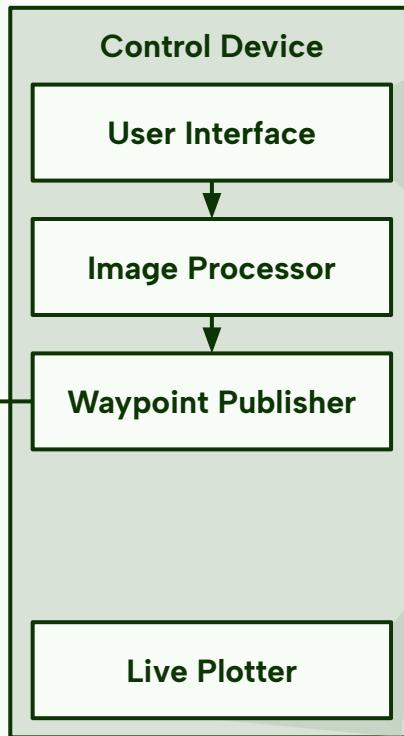
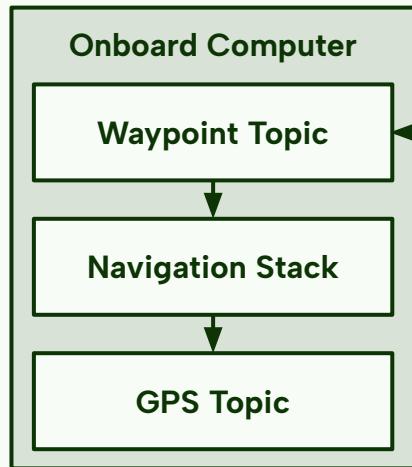


Complete Autonomous System Design



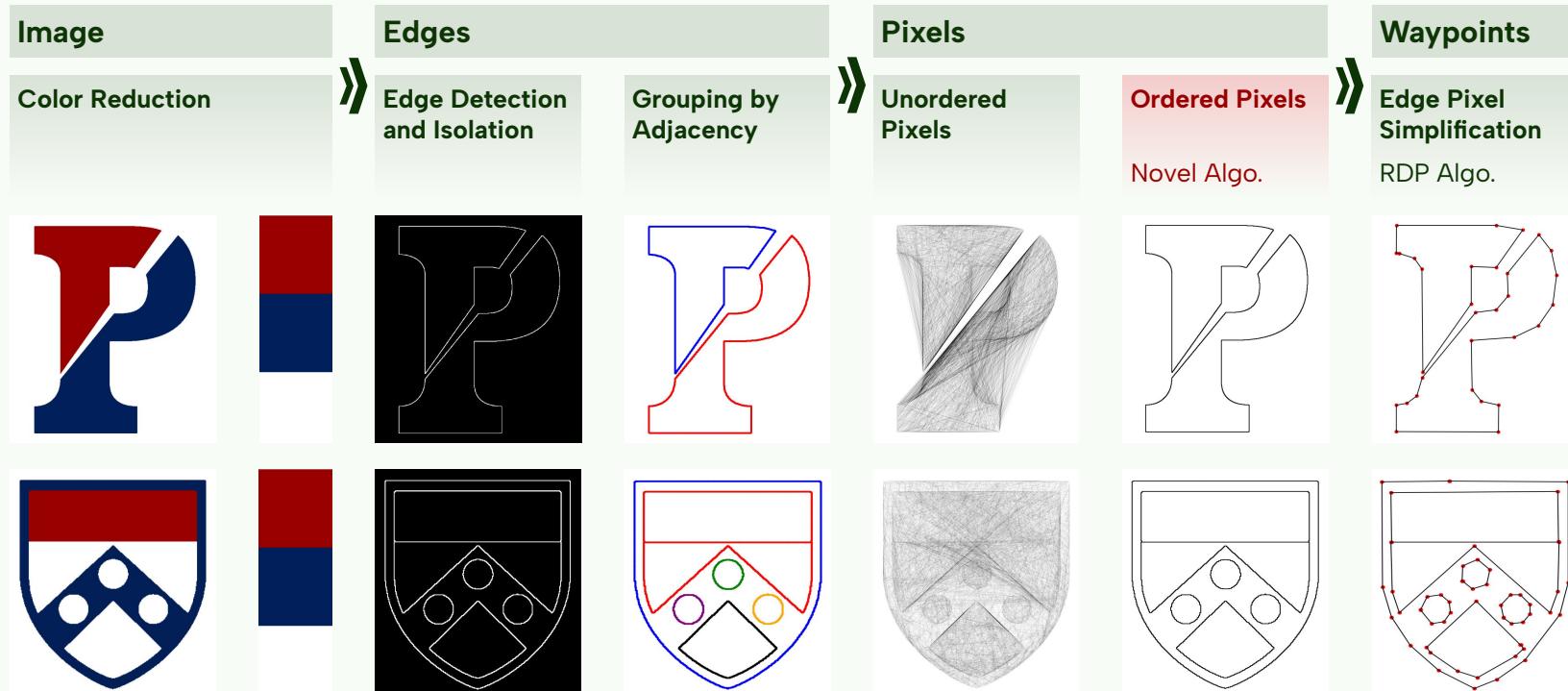


Seamless User Interface





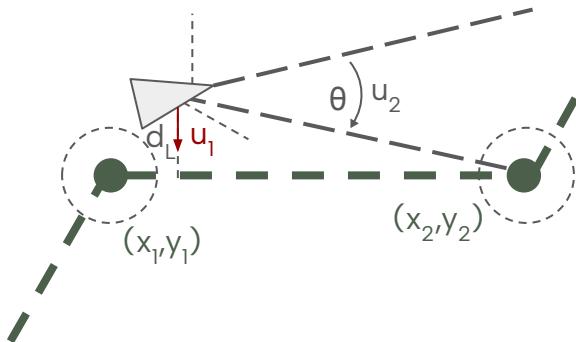
Innovative Image Processing Algorithm





Robust Navigation Algorithm

Navigation



$$\begin{aligned}U &= u_1 + u_2 \\u_1 &= K_P d_L - K_D d_L \\u_2 &= K_P \theta + K_I \theta\end{aligned}$$

Control Law: U

Line Distance PD Controller

Damp oscillations over line

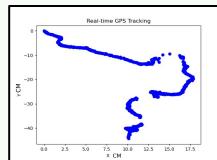
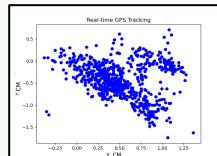
Angle Error PI Controller

Correct 0-point turn steady state error
Provide derivative feedback to u_1

Localization

RTK GPS

Correct error accumulation
in position and angle



Dead Reckoning

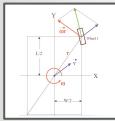
High refresh rate position
and angle measurements



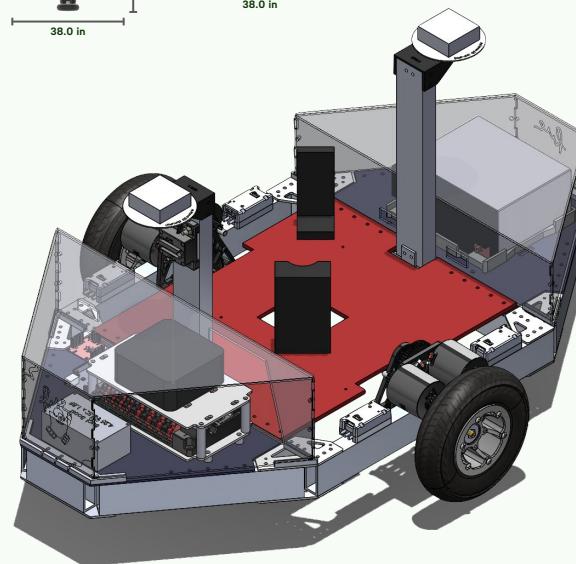
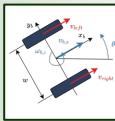
Modular Drivetrain

— Drivetrain Selection —

1. Swerve Drive



2. Differential Drive



3. Drone



— Sprayer —



4



Usage Simplicity

5



Portability/Weight

7



Affordability



Project Outcomes

High Performance



Image Accuracy

High Fidelity reproduction



Painting Speed

NFL-sized logo (outline) takes
20 minutes
to complete

User-Centric Design



Usage Simplicity

Full system setup within
10 minutes



Portability

Robot weighs
< 50 lbs

Social Responsibility



Affordability

Total cost of
USD 3.3k



Enviro. Awareness

Environmental surface
Unaffected
during application



Business Model

Low Cost



~\$3,300 enables wide access for events, venues, schools

Flexible Rentals



Ideal for one time or seasonal use – no upfront investment needed

Operated by Experts



Trained staff included to ensure smooth, high quality operations

Rapid deployment. Recurring revenue. Built to scale.

thank you



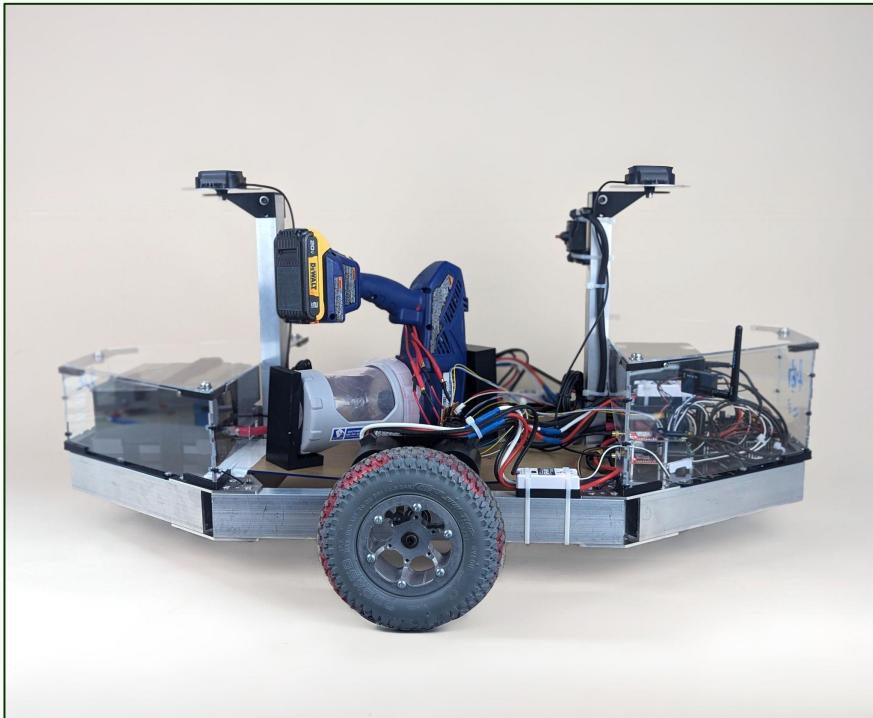


Appendix

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Appendix

Detailed Specifications



1 quart paint capacity

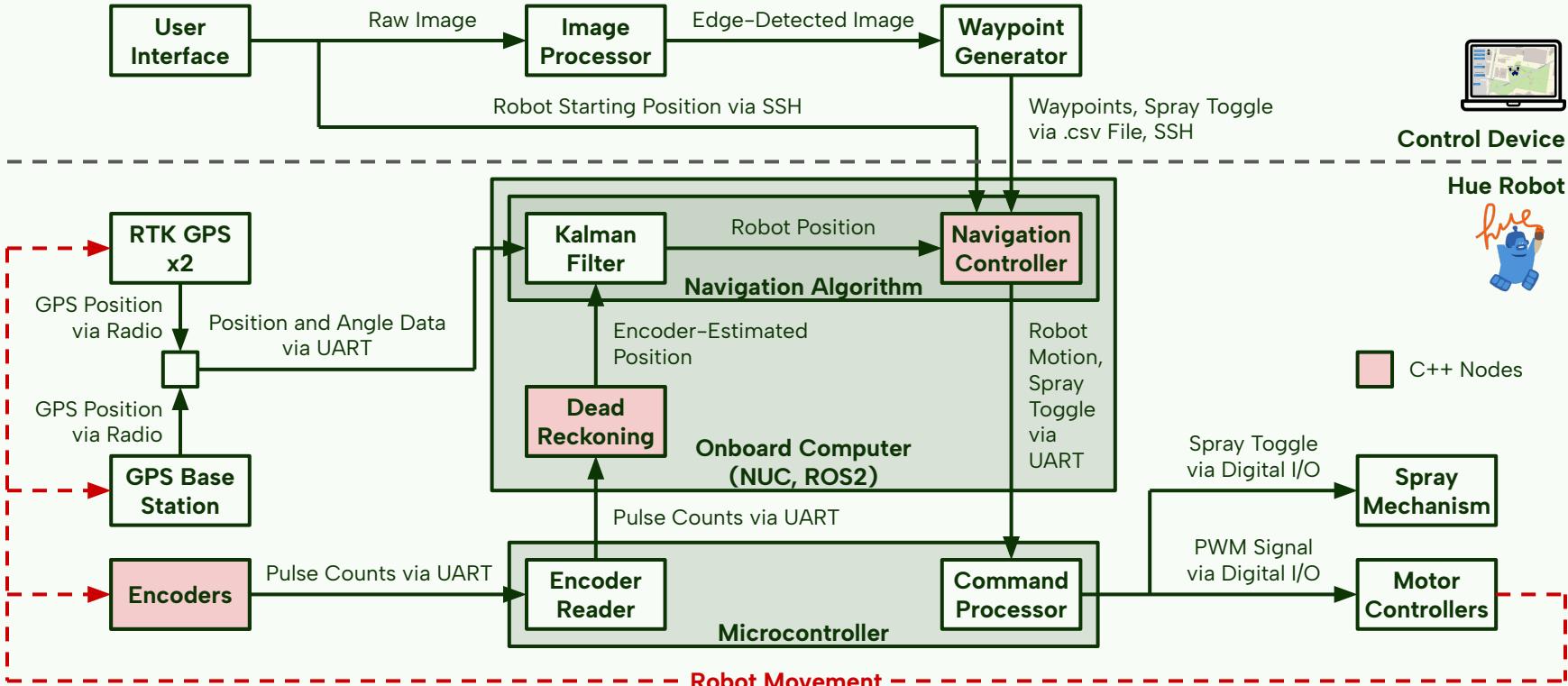
**0.14 gal/min spray rate, 7 mins
continuous spraying**

10 hr battery life

**1 m/s speed, dynamic to
waypoints**

Appendix: Detailed System Architecture

Block Diagram



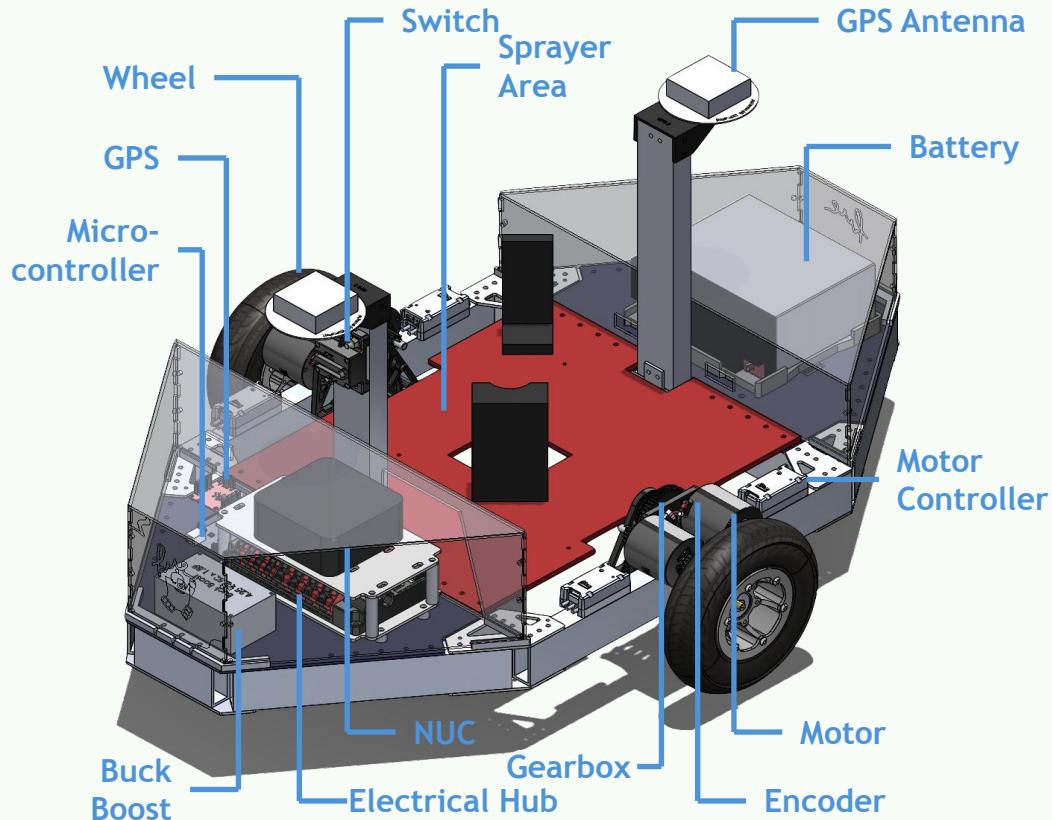
Appendix: Detailed System Architecture



Drivetrain Diagram

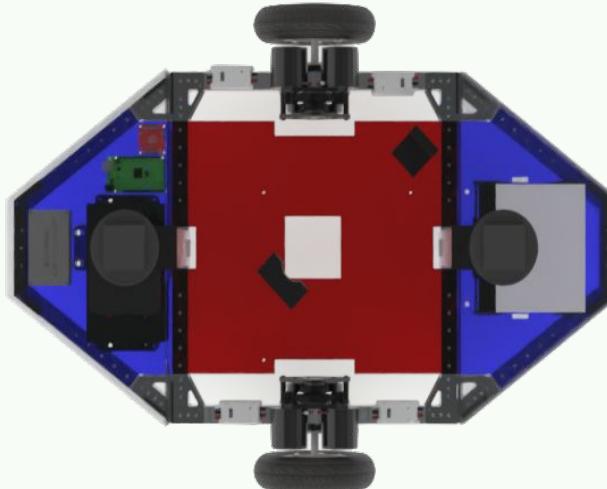
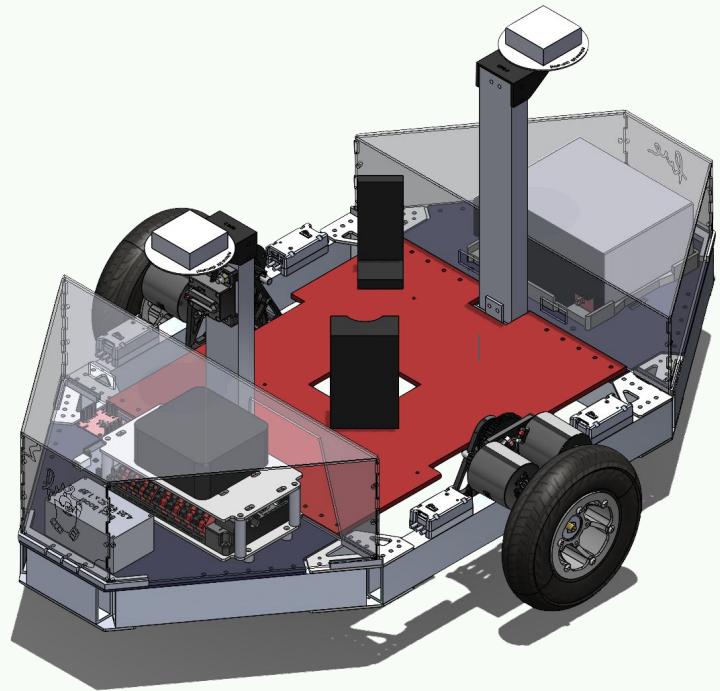
Drivetrain made out of
aluminum bars, acrylic, and
3D printed parts

Chassis dimensions:
38.0" x 25.5" x 20.0"



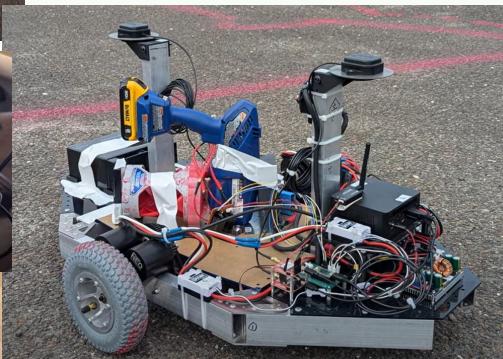
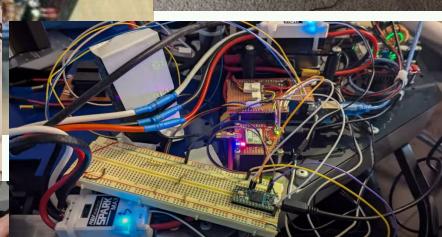
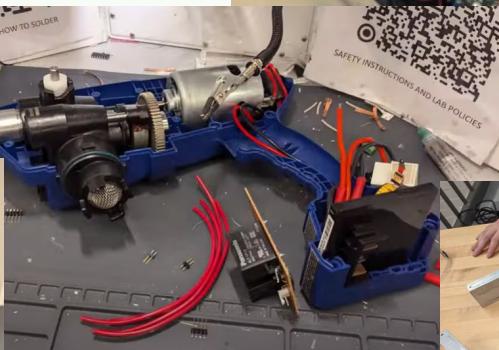
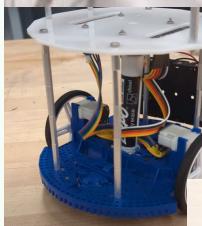
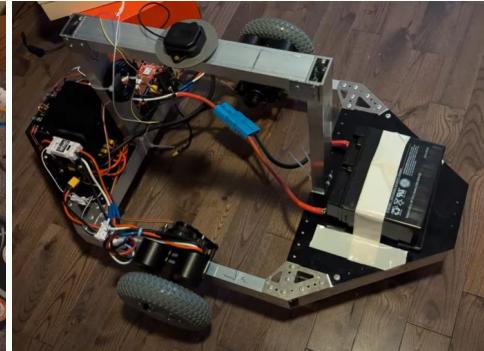
Appendix: Process Images and Videos

CAD & Rendering



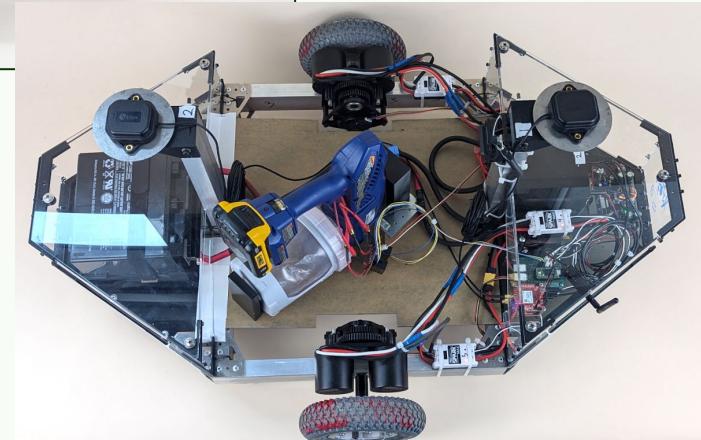
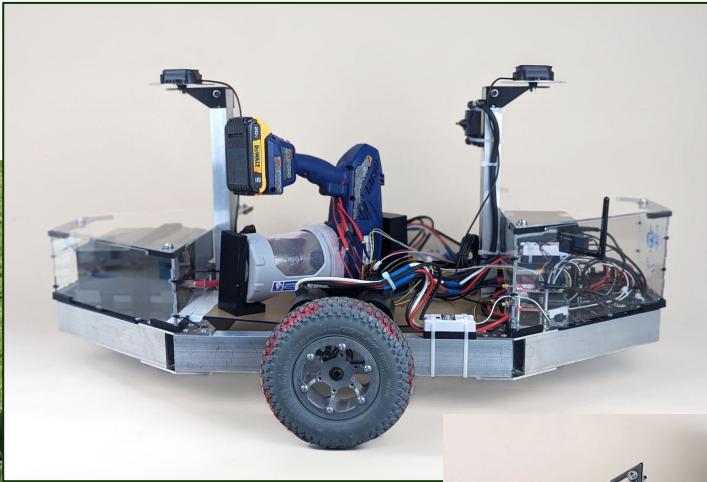
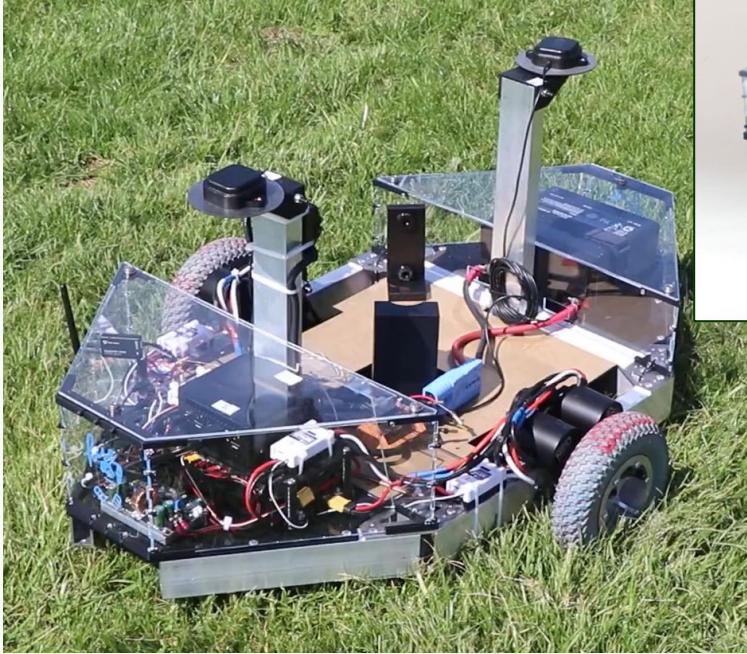
Appendix: Process Images and Videos

Build Log



Appendix: Process Images and Videos

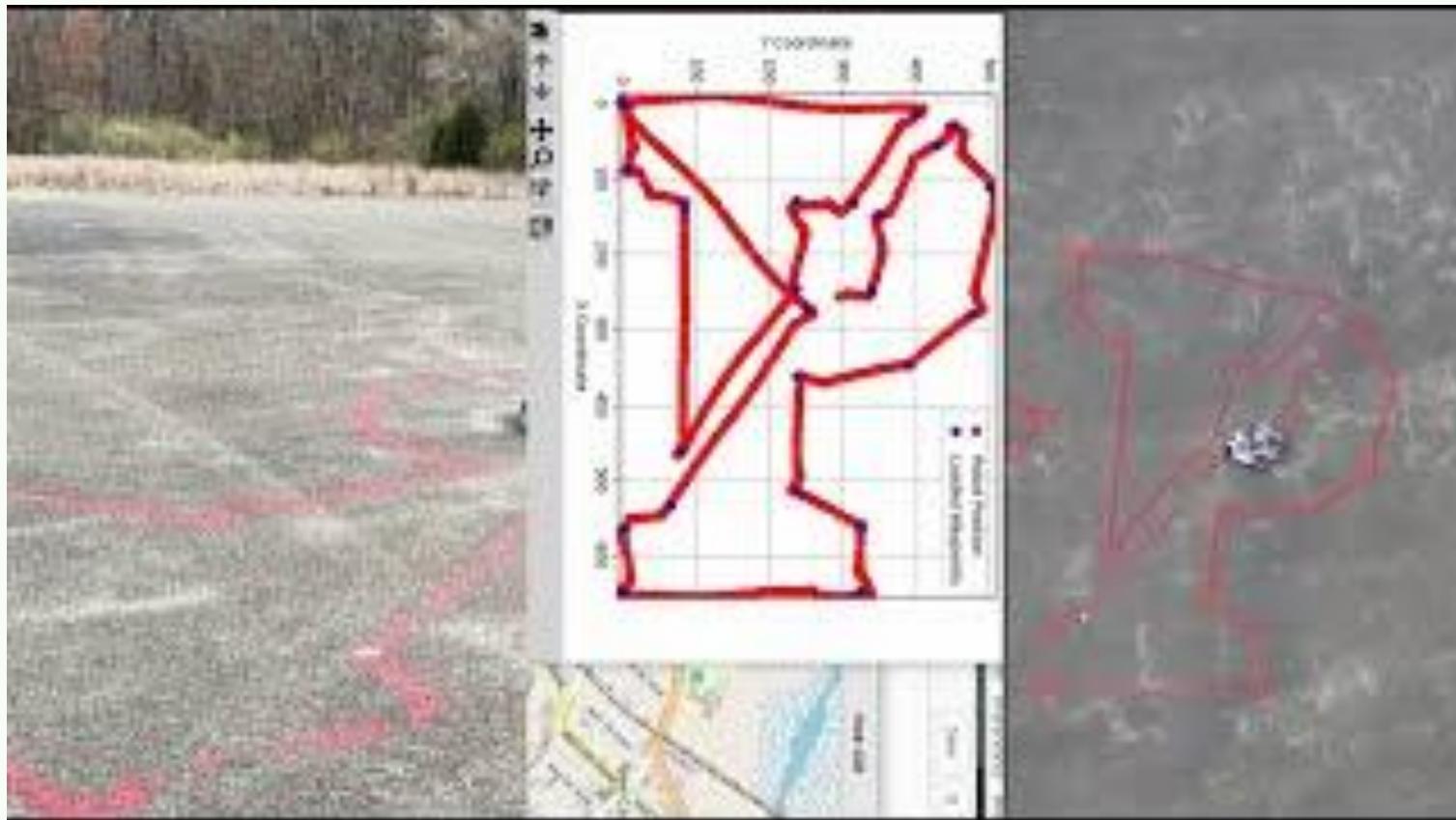
Hue Photos





Appendix: Process Images and Videos

Penn P VI



Appendix: Process Images and Videos



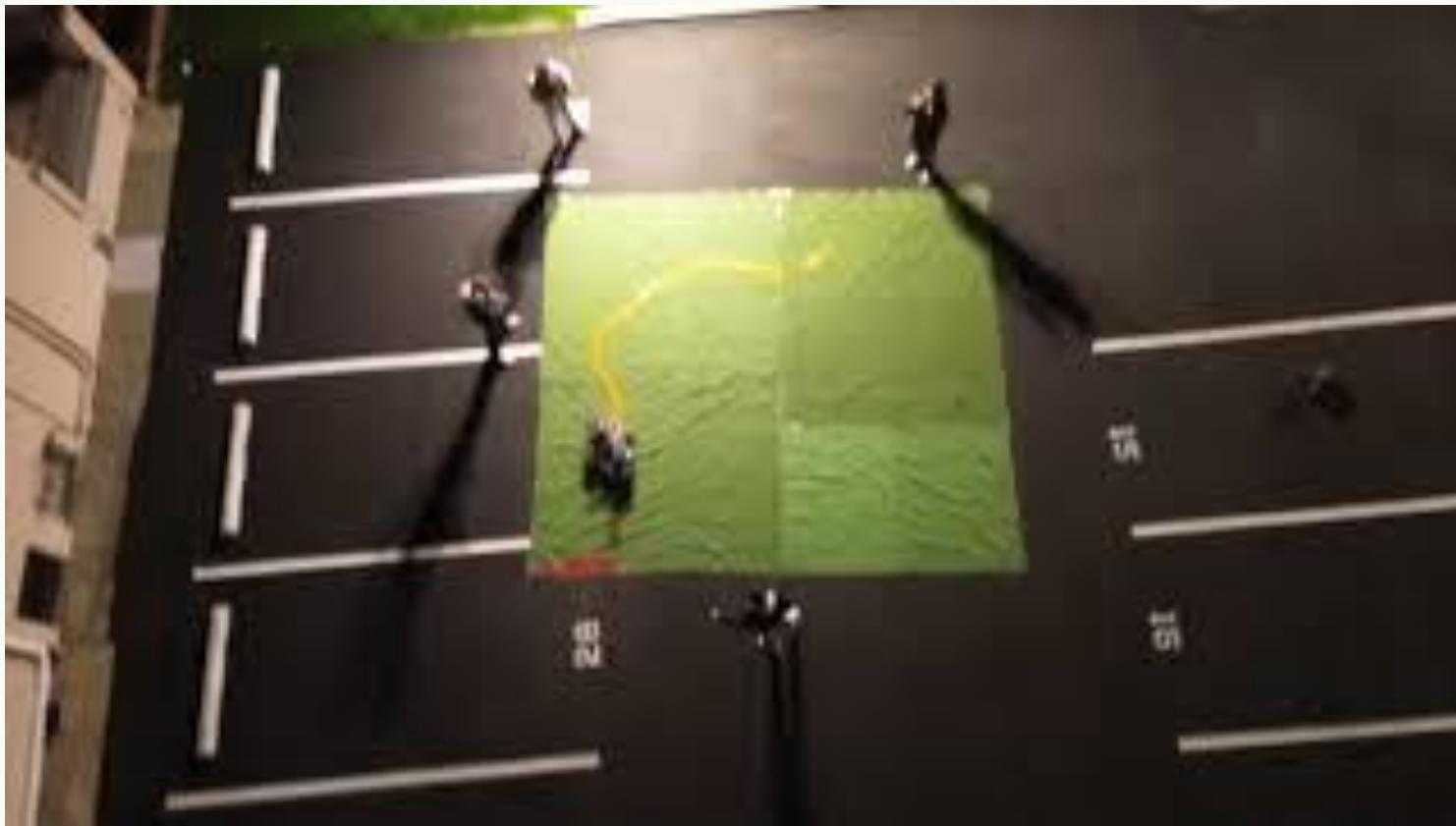
Penn P V2

A promotional image for the Penn P V2 robot. The top half features the text "PAINT YOUR LOGO ANYWHERE" in large, bold, blue letters. Below this, on the left, is a large red and blue logo (resembling a stylized 'P') with a red arrow pointing towards a green square screen. To the right of the screen is a detailed photograph of the Penn P V2 robot, which is a white mobile platform with a complex mechanical arm and spray gun assembly mounted on top.



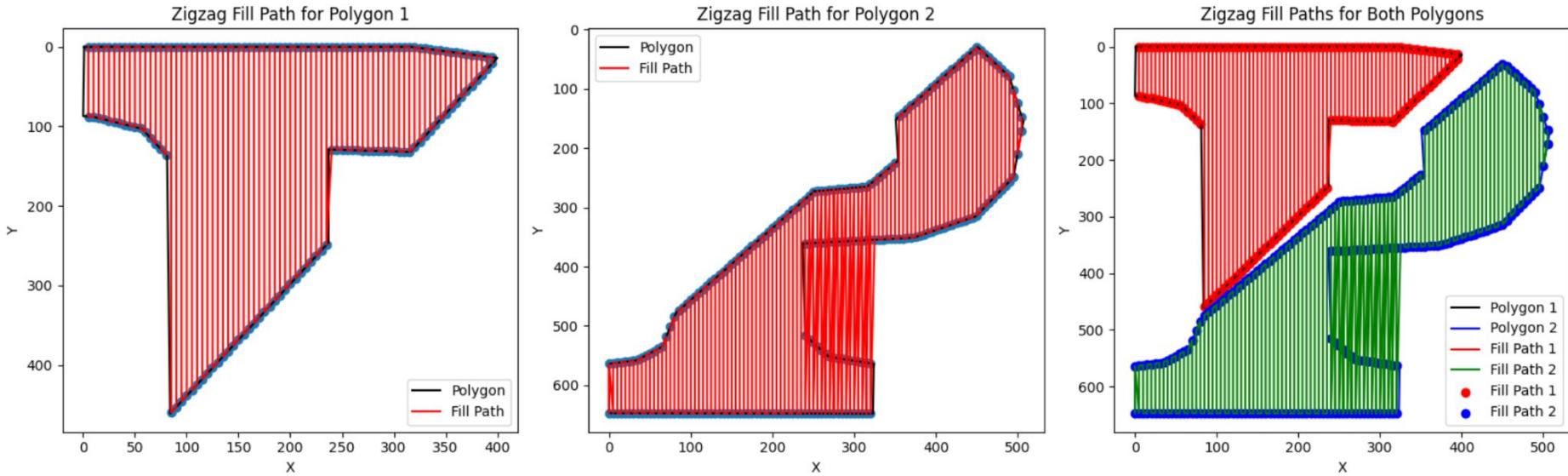
Appendix: Process Images and Videos

Apple Logo



Appendix

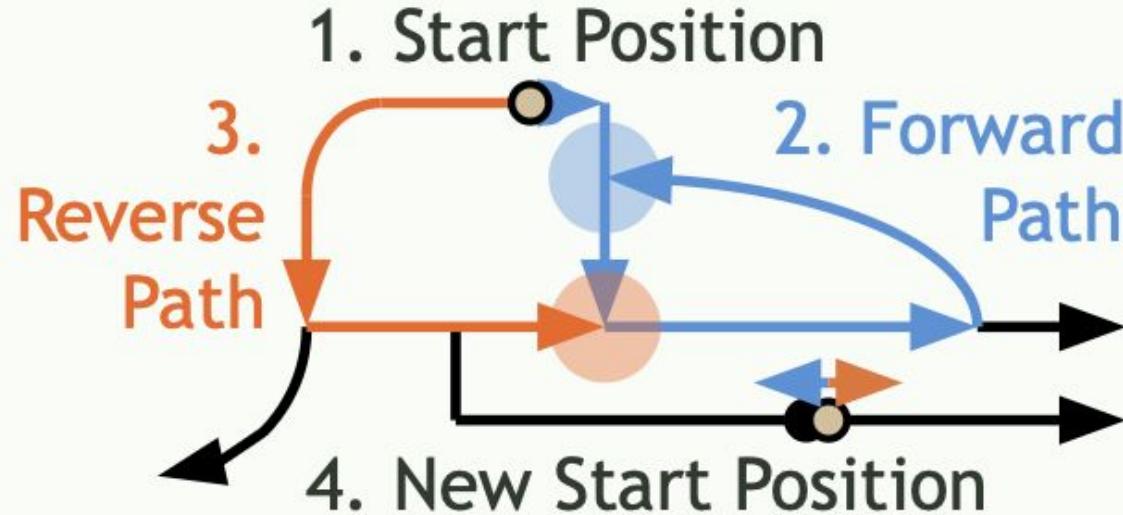
Filling Algorithm



Appendix



Novel Edge Ordering Algorithm



Waypoint Ordering Algorithm

Appendix

Engineering Standards

