Embellisher Design Review

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PROBLEMS

- Increased pollution
- Sanitization hazards
- Intensive human labor
- High cleaning costs
- Public safety

NEEDS

- Identify garbage on sidewalks
- Pick up and collect garbage
- Navigate autonomously
- Restrictive budget
- Avoiding obstacles

REAL WORLD

- Public spaces (40' x 60')
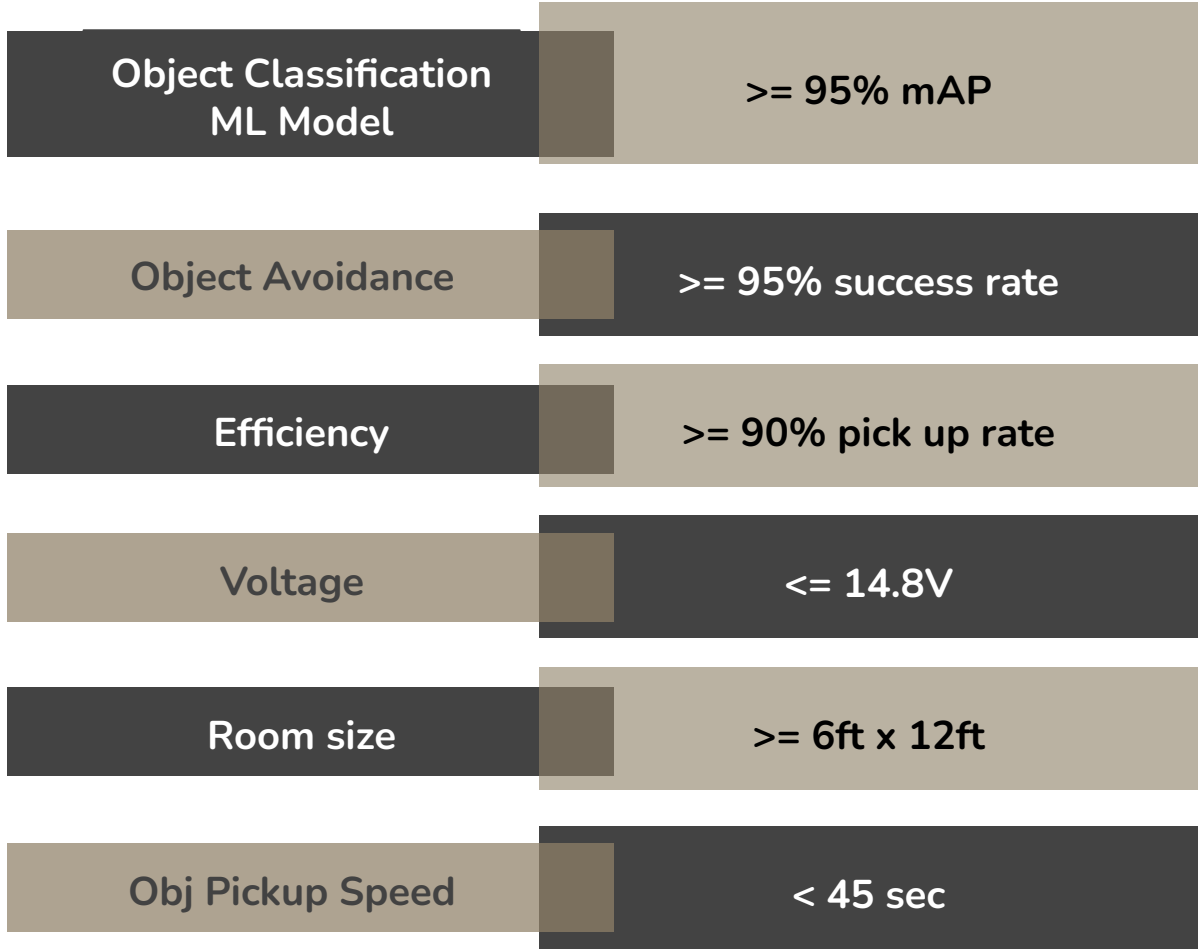- Large sidewalks (5' - 18')
- Obstacles > 1.5' in height

ROBOT PARAMETERS

- Semi-Autonomous
- Wheels meant for paved roads
- Type of trash components:
    - Water bottles
    - Soda cans
    - Crumpled paper

ENVIRONMENT/ SCOPE

Object Classification ML Model	**>= 95% mAP**
Object Avoidance	**>= 95% success rate**
Efficiency	**>= 90% pick up rate**
Voltage	**<= 14.8V**
Room size	**>= 6ft x 12ft**
Obj Pickup Speed	**< 45 sec**

QUANTITATIVE DESIGN REQUIREMENTS

01

OBJECT CLASSIFICATION

Train two models: YOLOv7 and YOLOv7-tiny
Datasets: Soda Cans, Water Bottles, and Crumpled Paper
Parts: Jetson Nano Orin, e-CAM50_CUNX
Software: openCV, PyTorch, TensorRT

02

PATH FINDING

Robot spins in place and navigates to detected trash components
Avoids obstacles and stays in boundary
Parts: RPi 5, servo motors, mecanum wheels, HC-SR04
Software: ROS

03

PICK UP MECHANISM

Rotating fan combined with a conveyor belt
Fan rolls in trash, which is dropped off in storage with conveyor
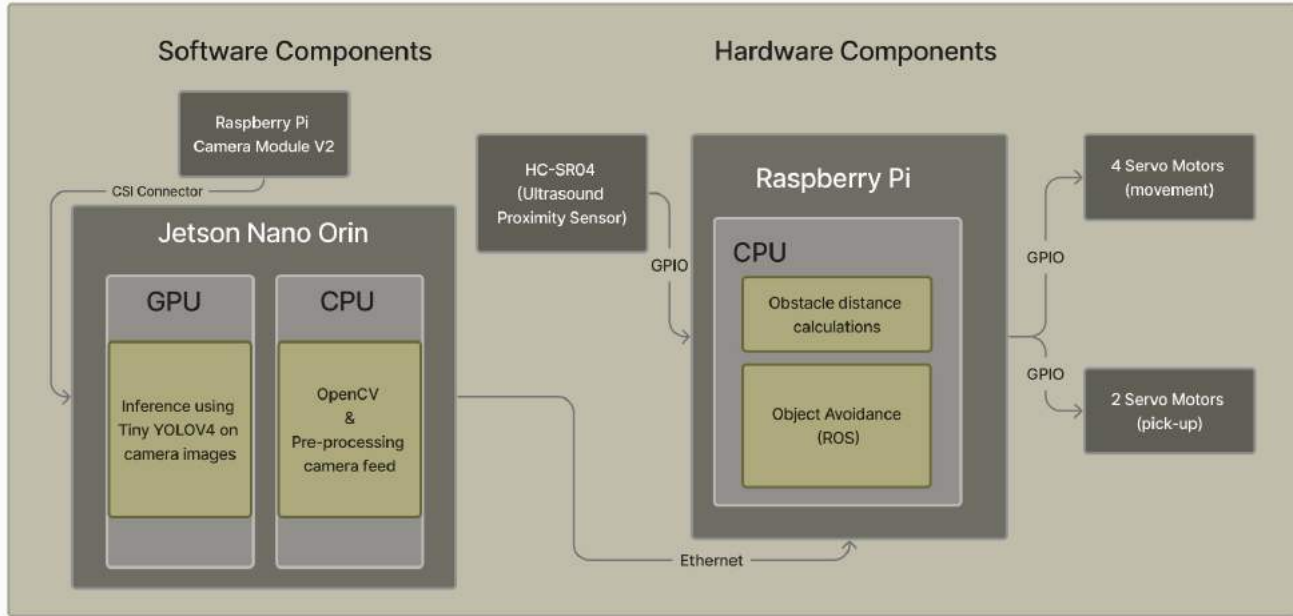**Parts**: Rollers, axle, servo motors
Software: ROS

04

INTEGRATION

Ethernet connections between two compute devices
Unit tests for each component
Integration tests defined for testing + metrics
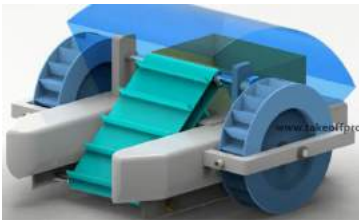
BASE STRUCTURE

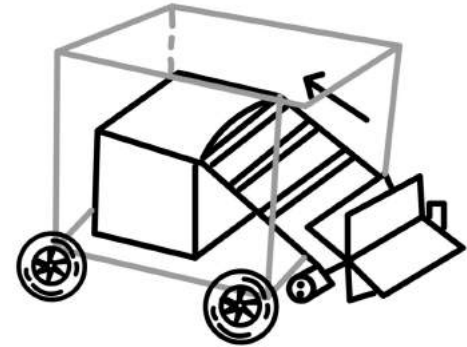Aluminum extrusions
Acrylic Boards
Mecanum wheels

PICK-UP MECHANISM

FINAL MODEL

Trash is collected at the front
Roller brings in the trash
component & pushes it onto the
conveyor belt
Conveyor belt pulls it up to
storage

http://tinyurl.com/ym7wed8a
http://tinyurl.com/3dy535jp
http://tinyurl.com/4edeekma
https://shorturl.at/elCGY
https://shorturl.at/vKOQW
https://shorturl.at/tIQUY
https://shorturl.at/epSU6

Obj. Classification

Connect camera to Jetson & run model
Test trash & non-trash items
Record accuracy, false + & false - pick up rates

Integration I

Test pick-up mechanism with obstacle avoidance
Record # of components collected

Integration II

Test path planning + rotation of camera with obj. classification
Record # of objs it detected & reached

Movement

Place in assigned area (on track) & check movement
Test obstacle avoidance
Record # of obstacles avoided & time to move

Integration III

Test obj classification + path planning + picking up component
Run multiple iterations with varying # of trash components
Record time & # of components

OUR TEAM

Ritu

Object Classification
Integration & Testing

Hirani

Design & Integration
Software for Motor Control

Ella

Hardware & Software Integration
Testing

TIMELINE

Feb 19 - 26

- Train model & run inference on Jetson Nano Orin
- Software for motor control
- Define protocol for compute power

March 11 - 18

- Test the model using new pictures from the Raspberry Pi camera
- Test integrated parts
- Test motion control & system with simple cases

Feb 12 - 19

- Run tiny-yolo + train model
- Set up Raspberry Pi & Install ROS
- Define motion and obstacle requirements
- Build CAD model & prepare base components

Feb 26 - March 4

- Write code for ML pipeline
- Motor control testing
- Make connections between RPi, motor control, and Orin

March 18 & Onwards

- Test object classification and pick up mechanism
- Test with more trash item variations