EcoSort

✓ Use Case

- Recycling bin that automatically sorts items as recycling or trash
- Provides a quick and accurate way for people to sort their recycling at home
- Prevents recycling contamination and wishful recycling
- Encourages users to purchase recyclable materials

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✓ Design Changes

Four → Two categories: Recycling and trash

- Determine is classified objects are recyclable
- Reject items that require special procedures, ie. batteries

Game subsystem

- Displays the weekly average of recycled vs. non-recyclable items
- Keeps track of the highest average

Design Requirements

Design Requirements	Quantitative metrics
Item placement detection	100% accuracy
Classification	>90% accuracy
Drop item into the classified bin	100% accuracy
Overall process time	< 7 seconds

✓ Solution Approach

Object detection	Use YOLOv7 object detection model, fine-tune on dataset of recyclable items to improve accuracy
Error handling	If CV can't classify image, assume it's trash
Categorization	Use item classification to determine if item is recyclable Bins have predetermined locations inside the bin
Placement	Use HC-SR04 ultrasonic sensor to detect item placement on the bin
Display screen	OLED I2C IIC Display Module 12846 as a display screen

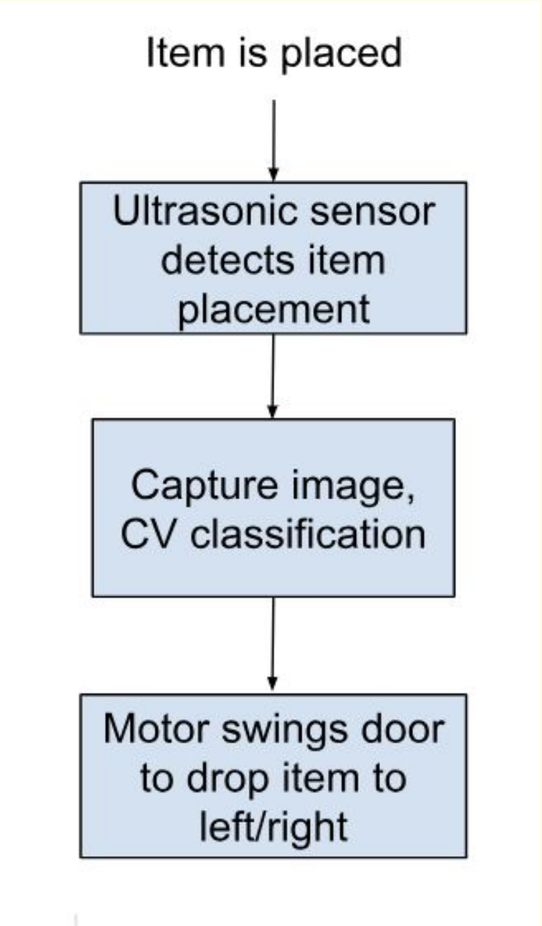
System Specification: CV

YOLO v7 model

- Identifies potential objects with a bounding box + label, assigns confidence score
- Perform classification on captured images if item is detected by the bin
- Items recognized with sufficient confidence score (>0.90) are disposed in the corresponding bin or rejected

System Specification: Item Placing

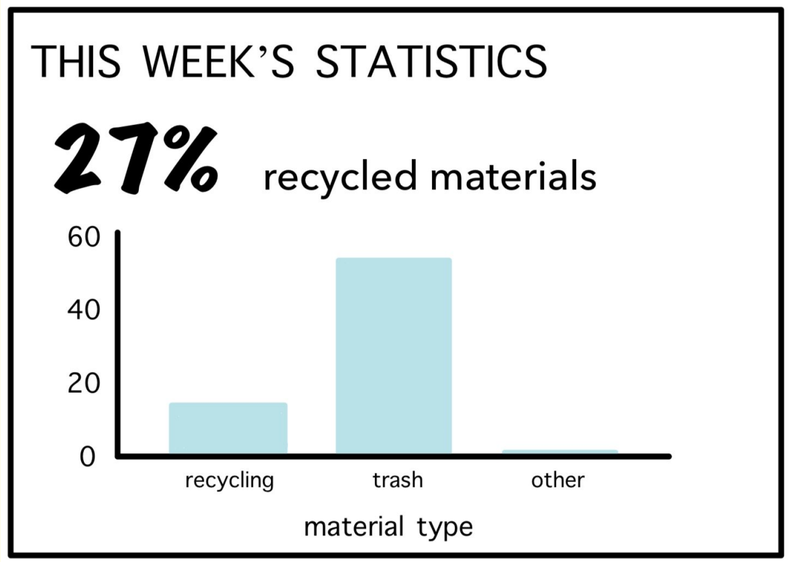
- Ultrasonic sensor measures distance to the object
- If the distance is below a certain threshold, camera will be triggered to capture the image
  - CV classifies
- Based on the output the door will either swing to the left or right



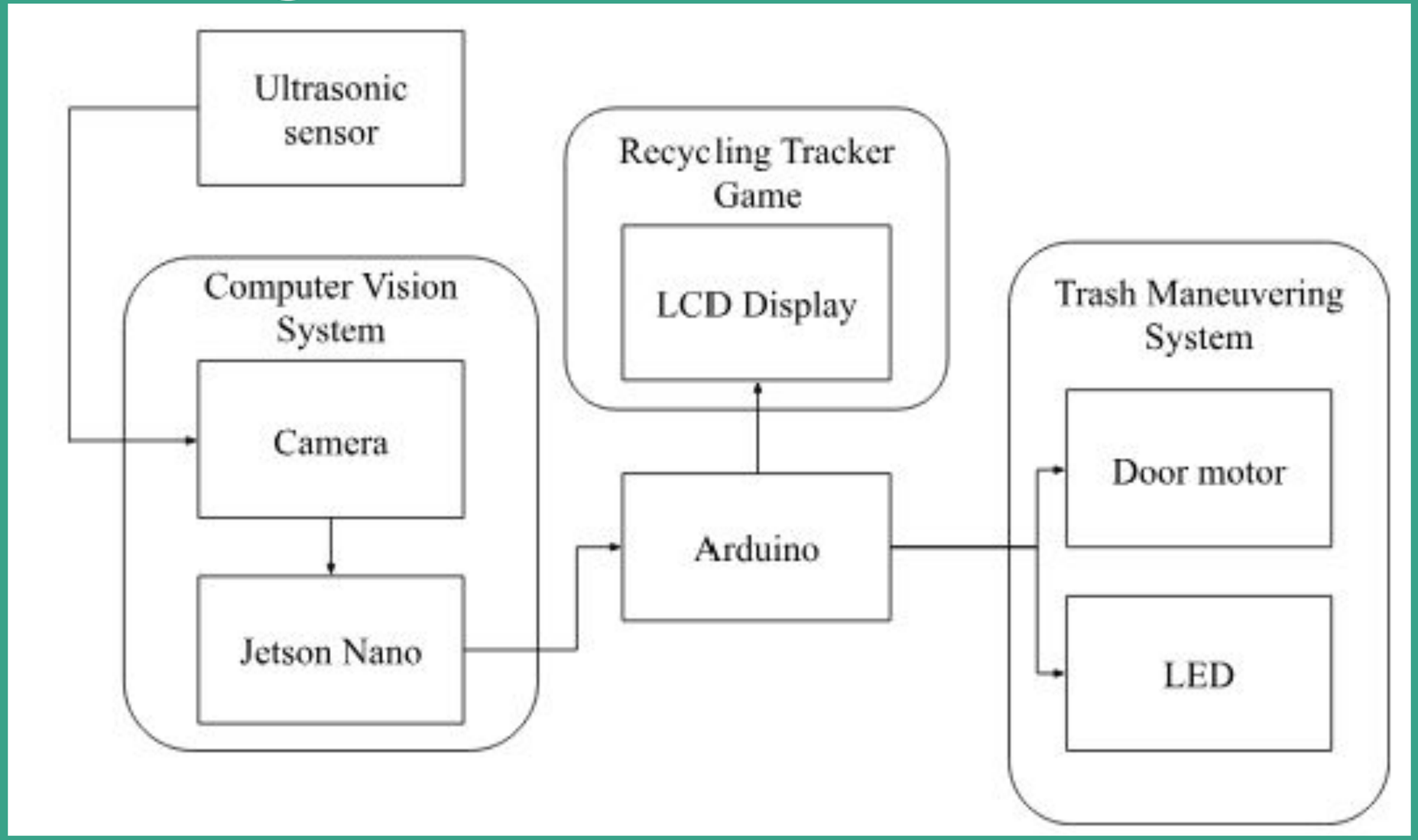
System Specification: Game

OLED I2C IIC Display Module

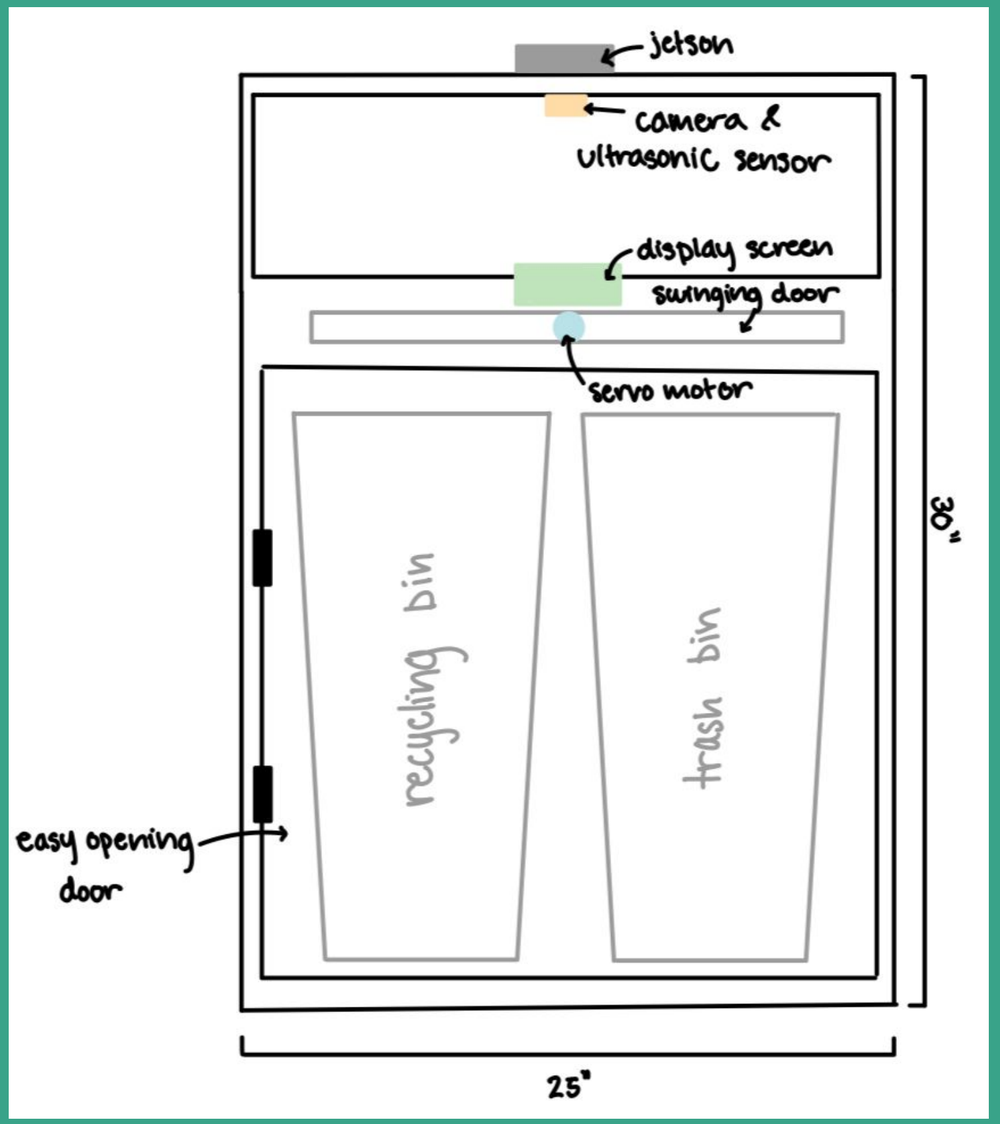
- Connects to Arduino through SDA and SCL lines
- Loops through different screens that display the recycling percentage of the current week, previous week, and overall best

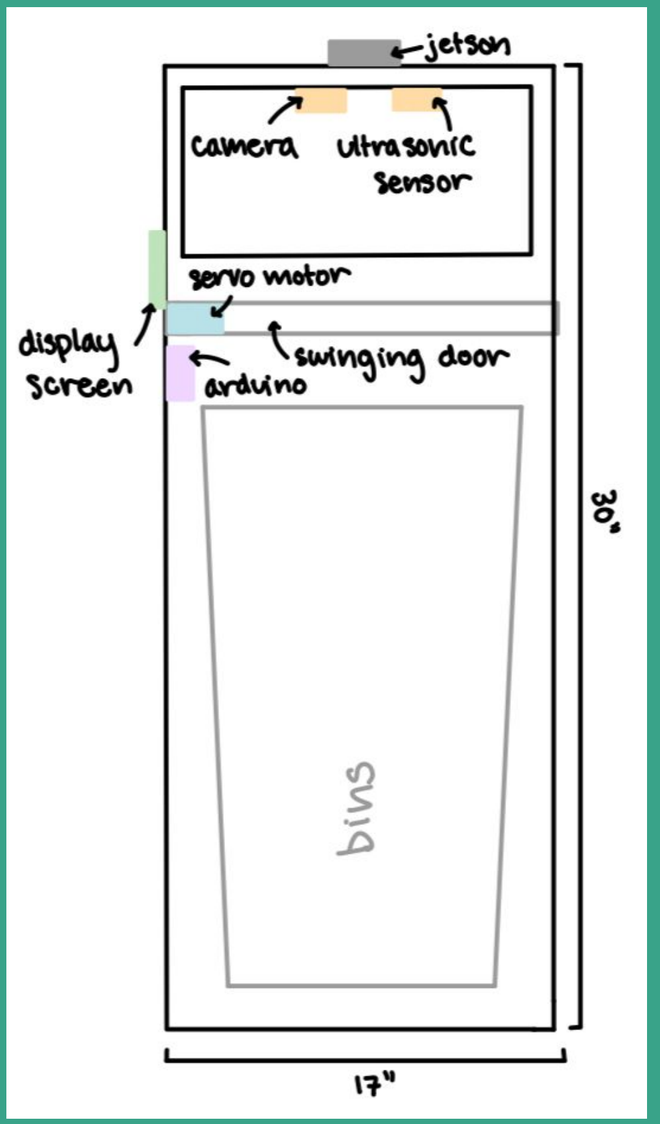


Block Diagram



Design Sketch





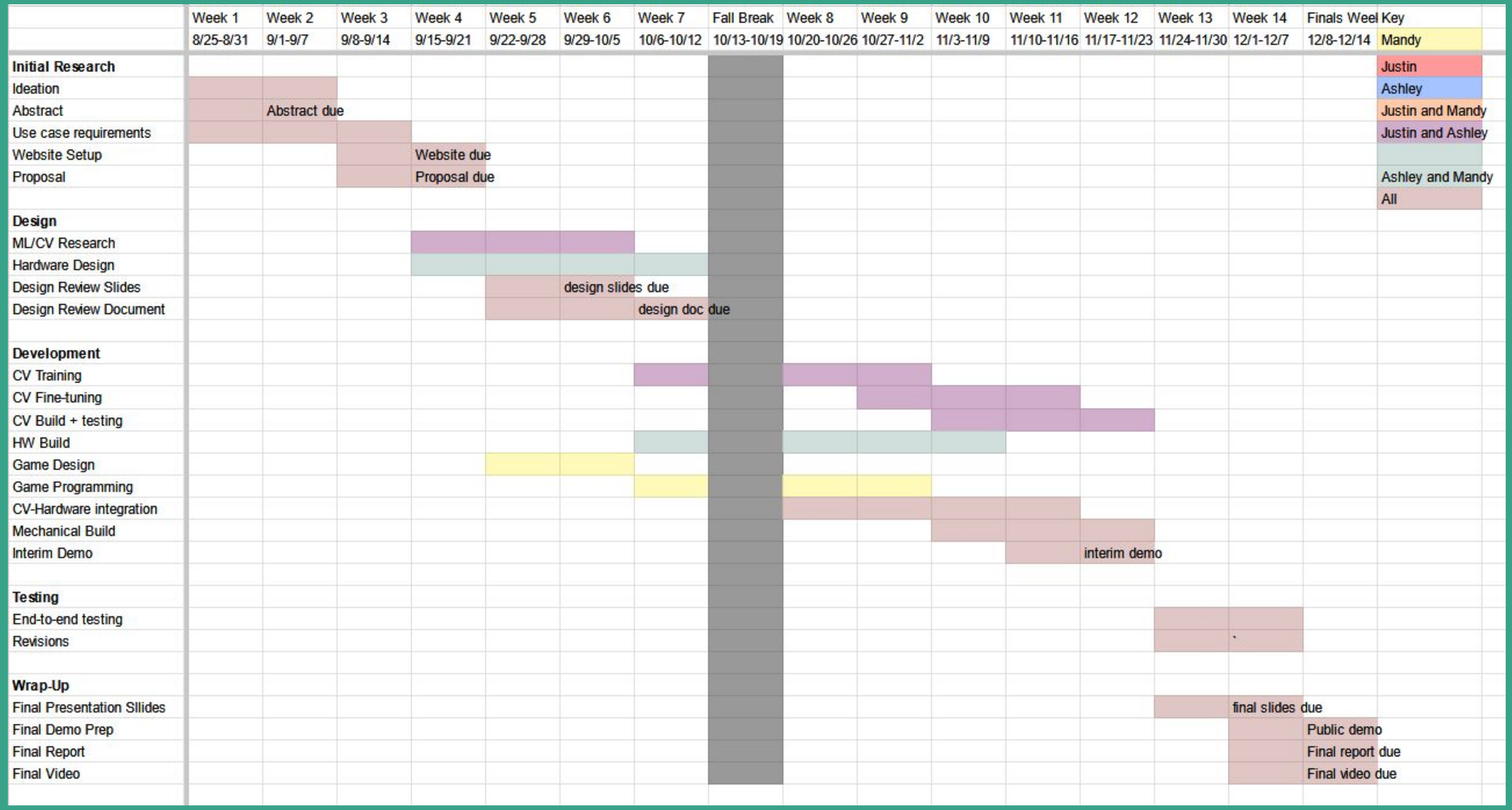
✓ Implementation Plan

Buy/Download	**Hardware:** Jetson, Arduino, Camera, Ultrasonic Sensor, LCD display, servo motor(s) **Software:** YOLOv7, dataset on recyclable material **Mechanical:** Bins, building material, door panel
Design/Build	**Hardware:** Circuitry for Arduino, serial communication between Jetson and Arduino **Software:** Modified YOLOv7 model, control algorithm for Arduino + motors, tracking + display control for recycling game **Mechanical:** Bin structure, door mechanism

✓ Testing, verification, and validation

System	Design components	Testing Plan	Metrics
Object detection	Ultrasonic sensor + serial communication	Objects of various sizes, positions on platform	100% accuracy
Computer vision	YOLO algorithm	Build testing dataset Commonly mis-recycled items	>90% accuracy
Object placing	Arduino + motor control	Objects of various sizes and shapes, verify placement algorithm	100% accuracy

✓ Schedule



	Week 1 8/25-8/31	Week 2 9/1-9/7	Week 3 9/8-9/14	Week 4 9/15-9/21	Week 5 9/22-9/28	Week 6 9/29-10/5	Week 7 10/6-10/12	Fall Break 10/13-10/19	Week 8 10/20-10/26	Week 9 10/27-11/2	Week 10 11/3-11/9	Week 11 11/10-11/16	Week 12 11/17-11/23	Week 13 11/24-11/30	Week 14 12/1-12/7	Finals Week 12/8-12/14	Key Mandy
Initial Research																	Justin
Ideation																	Ashley
Abstract		Abstract due															Justin and Mandy
Use case requirements																	Justin and Ashley
Website Setup				Website due													
Proposal				Proposal due													Ashley and Mandy
																	All
Design																	
ML/CV Research																	
Hardware Design																	
Design Review Slides						design slides due											
Design Review Document							design doc due										
Development																	
CV Training																	
CV Fine-tuning																	
CV Build + testing																	
HW Build																	
Game Design																	
Game Programming																	
CV-Hardware integration																	
Mechanical Build																	
Interim Demo													interim demo				
Testing																	
End-to-end testing																	
Revisions																	
Wrap-Up																	
Final Presentation Sllides															final slides due		
Final Demo Prep																Public demo	
Final Report																Final report due	
Final Video																Final video due	