Ecosort

Team B7: Mandy Hu, Ashley Ryu, Justin Wang

✔ Use Case

- **Recycling bin that automatically sorts items based on material**

- **Provide a quick and accurate way for people to sort their recycling at home**

- **Prevent recycling contamination**

- **Sort recyclable materials into 4 categories**
  - **Glass, plastic, paper, metal (cans)**

- **ECE areas: hardware, software**

✔ Use Case Requirements: General

- **Recycling bin recognizes and sorts items with 90% accuracy**
  - **Recycling categories based on Pittsburgh accepted curbside recyclables**
- **Reacts within 7 seconds of user placing the item down**
- **Items that are not recyclable are rejected by the bin**

✔ Use Case Requirements: Size

- **Large enough to fit four bins, each of which can fit recyclable items of various sizes**

- **Small enough to be a convenient size for users to keep inside their houses**

- **14"x40"x30" total size with 14"x10"x15" bins + sorting apparatus on top**

- **Items must fit within individual bin and weighs under 3 pounds**

✔ Use Case Requirements: Ease of Use

- **Categorization should be automatic, without need for user to trigger sorting**
  - **User should simply need to place material in the bin**
- **Removable bins to empty the recycling**
- **Can be powered by wall outlet**

Technical Challenges

01

Detecting an item and capturing an image immediately after the item is placed

Mitigation: Ultrasonic sensor that detects item placement

02

Accurately classifying the item into the correct category within 7 seconds

Mitigation: Choose powerful CV model + hardware, choose fast motors

03

Automatically moving the trash into the correct bin and dumping it in

Mitigation: Serial communication between CV and item maneuvering systems

Technical Challenges

04

Sturdy structure and secure connections of components, but still has easily detachable bins

Mitigation: Separate bins for each category, door on side of bin to allow users to slide out bins individually

05

Maximizing allowed size of disposed items and minimizing the overall space the bin takes up

Mitigation: Use standard recycling bins and place the mechanisms above to minimize vertical and horizontal space

✔ Solution Approach

Software

- YOLOv4 tiny

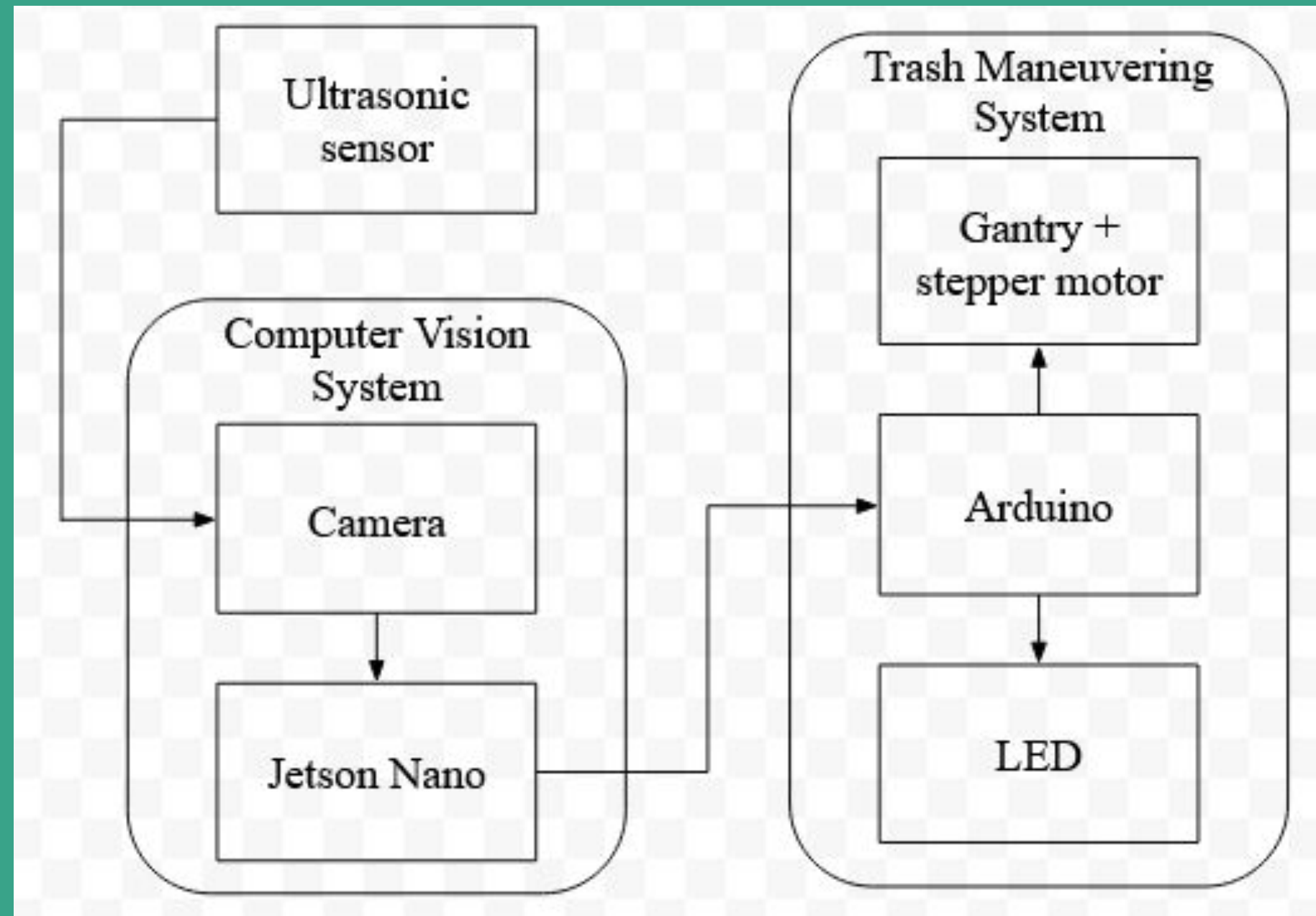- Recycling dataset, ie. Drinking Waste Classification

Hardware

- Jetson Orin Nano + camera

- Arduino Uno

- Stepper motor

- Servo motor

- LED

Mechanical

- Recycling bin(s)

- Linear gantry

- Wooden frame

✔ Solution Approach - Block Diagram

✔ Testing, verification, and metrics

- **CV system should classify items with 90% accuracy**
  - **Test with materials of different sizes and shapes**
  - **Bottle caps, ½ gal milk jug, glass jars**
- **Items placed in front of the sensor should always be detected**
- **Items should always be placed in the correct bin**
- **Entire process should take <7 seconds**

✔ Tasks and Division of Labor

- CV research
- Object recognition training
- Categorization testing

Justin

- Hardware design
- Hardware programming
- Hardware assembly

Ashley

- Integrating CV with item maneuvering system
- Integrating camera

Mandy

- General bin structure assembly
- Crafting wooden frame and door

All

✔ Schedule

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Fall Break	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Finals Week	Key
	8/25-8/31	9/1-9/7	9/8-9/14	9/15-9/21	9/22-9/28	9/29-10/5	10/6-10/12	10/13-10/19	10/20-10/26	10/27-11/2	11/3-11/9	11/10-11/16	11/17-11/23	11/24-11/30	12/1-12/7	12/8-12/14	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																	
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		