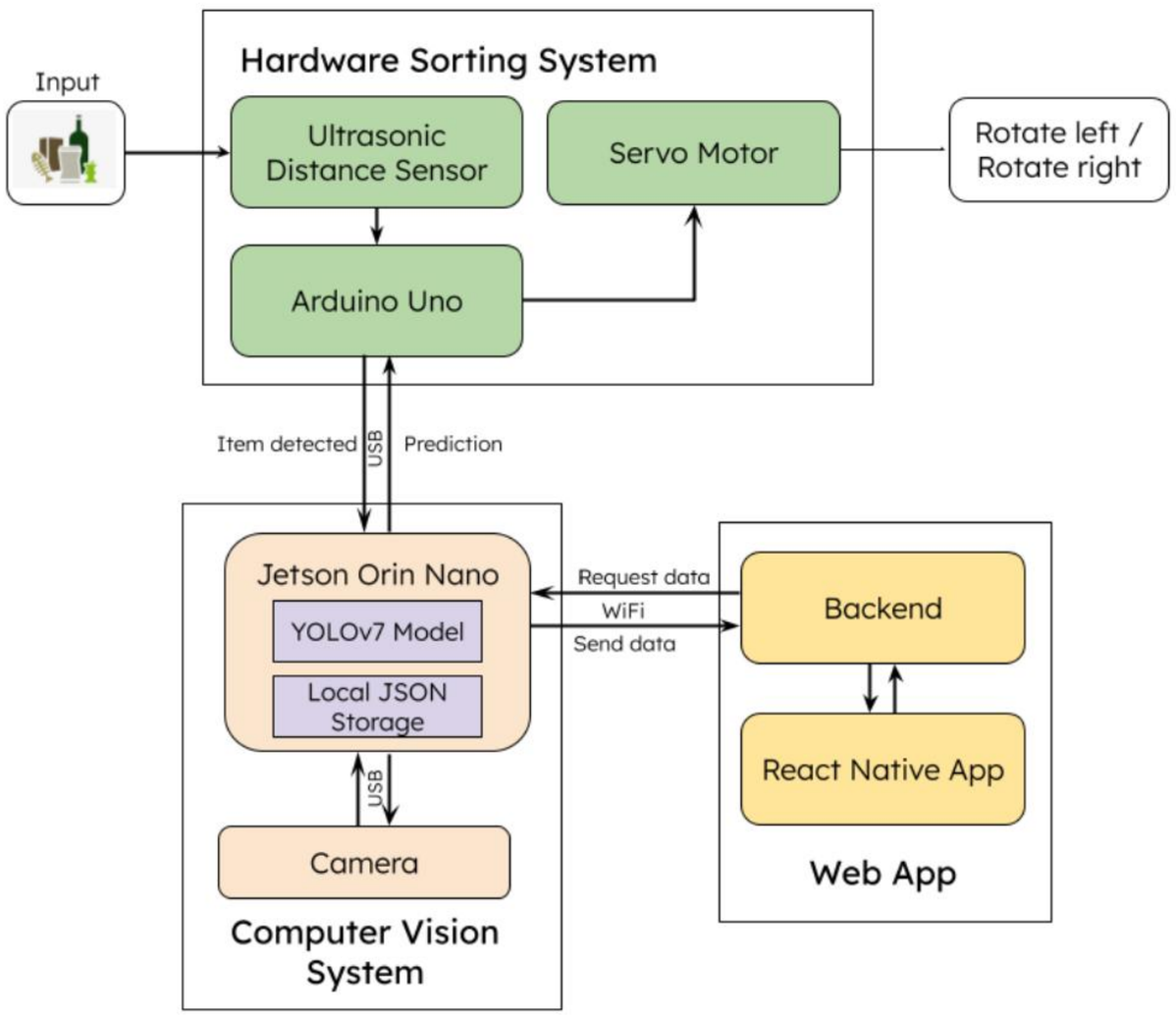
EcoSort

B7: Mandy Hu, Ashley Ryu, Justin Wang
18-500 Capstone Design, Spring 2024
Electrical and Computer Engineering Department
Carnegie Mellon University

Product Pitch

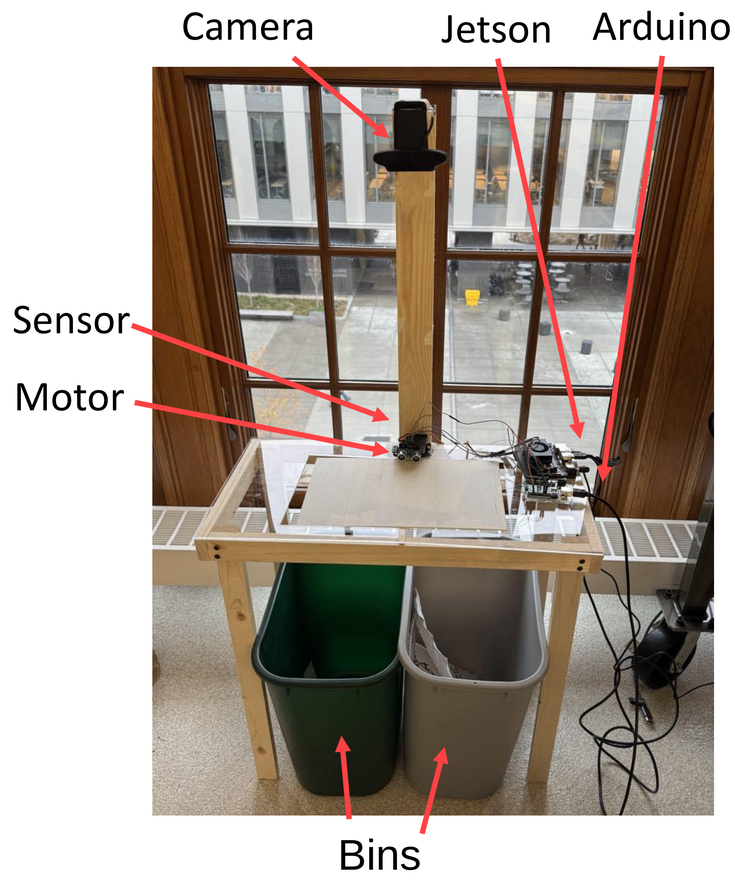
EcoSort is an automatic recycling bin that sorts disposed objects into recycling and trash based on Pittsburgh recycling laws. It aims to reduce recycling contamination and wishful recycling by accurately categorizing objects, as well as educating users about recycling laws, and the importance of it, encouraging them to use items that come with recyclable or biodegradable packaging.
EcoSort correctly identifies recyclable items with 89% accuracy, and trash with 88% accuracy. This far exceeds the current statistics of only 21% of possible recyclable materials actually being recycled. The entire process is also completed within a 5 second time limit, making it quick and efficient for users. The data collected from the recycling bin is amalgamated into a web application, on which users can track how many items they have recycled over a certain period of time.

System Architecture



System Description

Computer Vision: Uses a custom-trained YOLOv7 model running on a Jetson Orin Nano. Images are captured using a camera placed above the platform, and the model identifies recyclable objects, returning "recyclable" or "trash" depending on if it sees recyclables.
Hardware Sorting: Controlled by an Arduino Uno. An ultrasonic sensor detects placed items and sends a signal to notify the Jetson. Servo motor rotates to sort the item based on the CV's output.
Web App: Store collected recycling data on a web app. Users can see statistics about their recycling habits.



Web App UI

System Evaluation

Object detection + image capture: Place objects in front of the sensor and verify that the sensor detected the object and the camera captured an image.
CV: Evaluate model's outputs on a test dataset of fresh images.
CV-Hardware Connection: Verify that Arduino receives CV results
CV-Web App Connection: Verify that the web app can fetch data from the Jetson
Hardware Sorting: Verify that the servo motor turns the right direction based on the CV
Mechanics: Verify that the item makes it into the bin

Use-Case Requirements:

Metric	Target	Actual
Overall time	≤ 7 seconds	7 seconds
Item Detection Accuracy	100%	100%
Computer Vision Accuracy	≥ 90%	89% for recycling 88% for trash
Item Sorting Accuracy	100%	100%
Data Transmission Accuracy	100%	100%

Conclusions & Additional Information

We were successful in building a recycling bin that uses computer vision to classify waste as recyclable or not, and we were able to achieve most of the goals we initially set for our project. We learned a lot about the individual technologies that we used, as well as the overall engineering design process, and have a better understanding of how to plan such a project in the future. Next steps for this project could include exploring more powerful models, and a sorting mechanism that can handle more than one item at a time.

https://course.ece.cmu.edu/~ece500/projects/f24-teamb7/

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