

AutoSort

By Frank Fan and William Yang

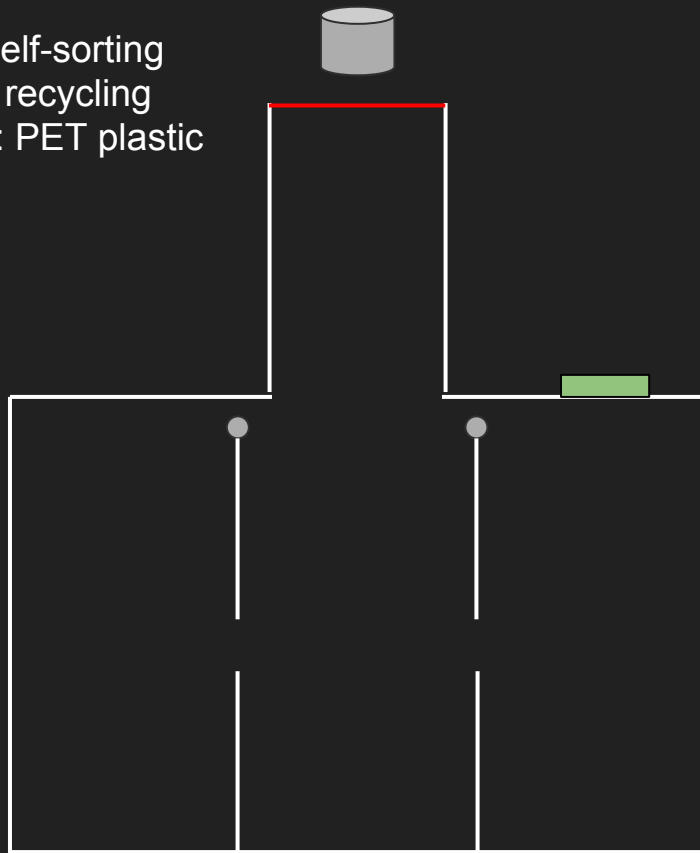
The Problem

- $\frac{1}{3}$ of the costs to recycle come from the labor needed to sort and separate recyclable material
- Automating this process upstream at the civilian level would greatly reduce this cost

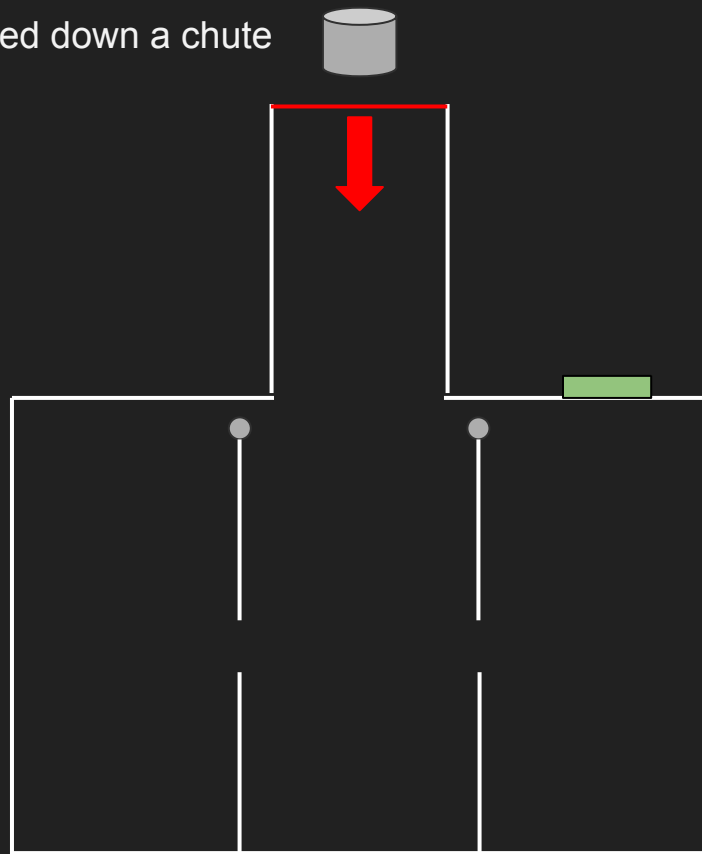


Solution Overview

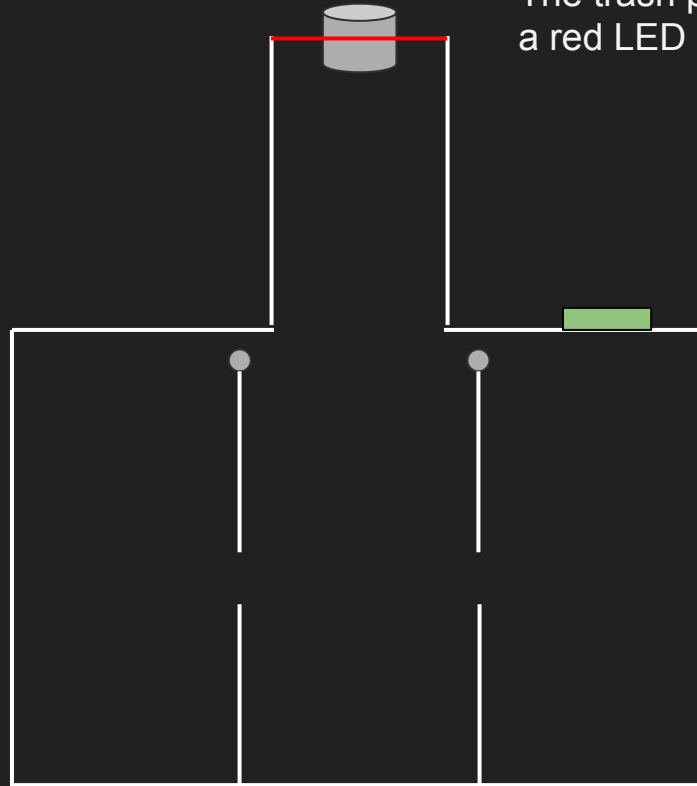
We designed and built a self-sorting recycling bin that can sort recycling materials of three classes: PET plastic bottles, paper, and metals

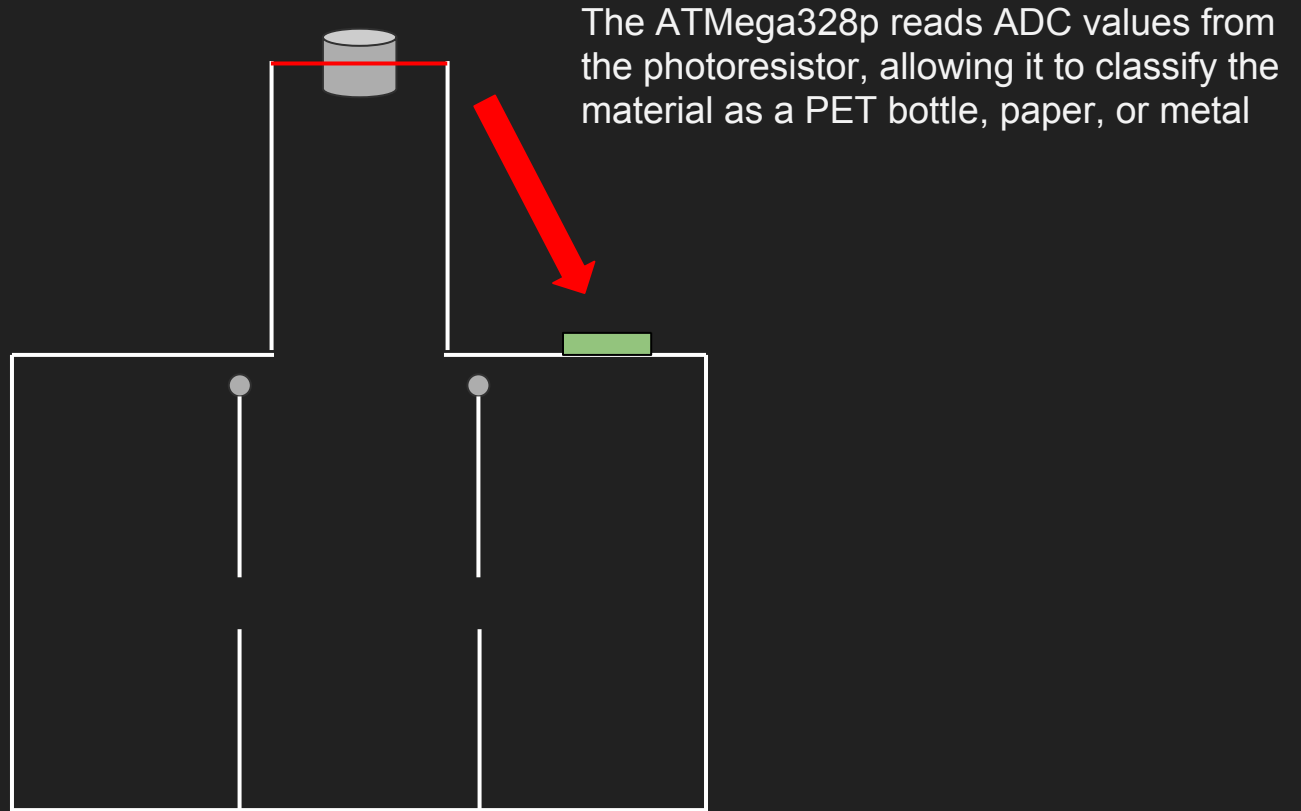


Trash is dropped down a chute

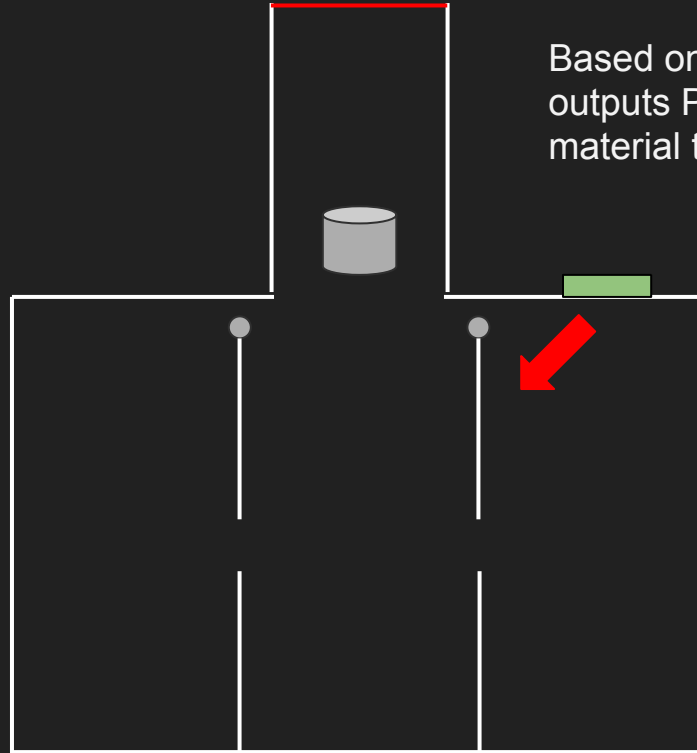


The trash passes through the path between
a red LED and a photoresistor

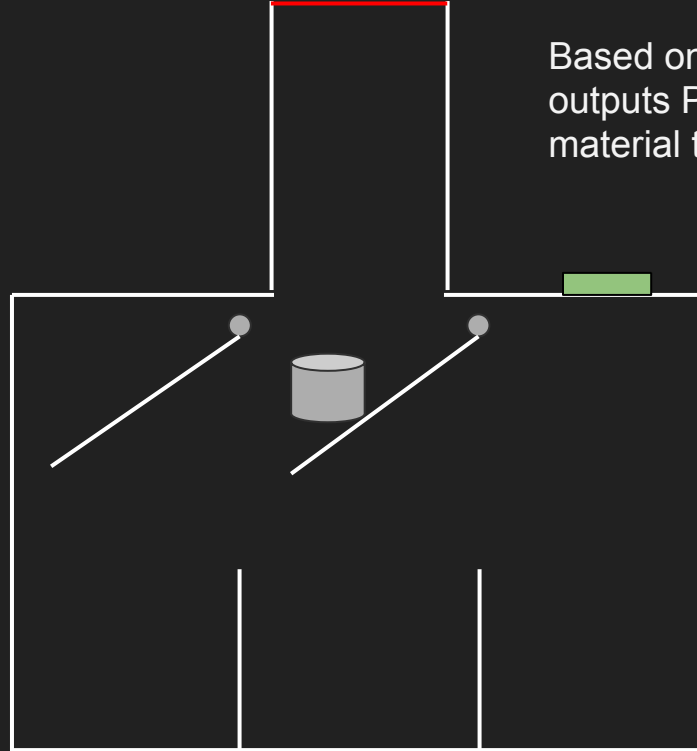




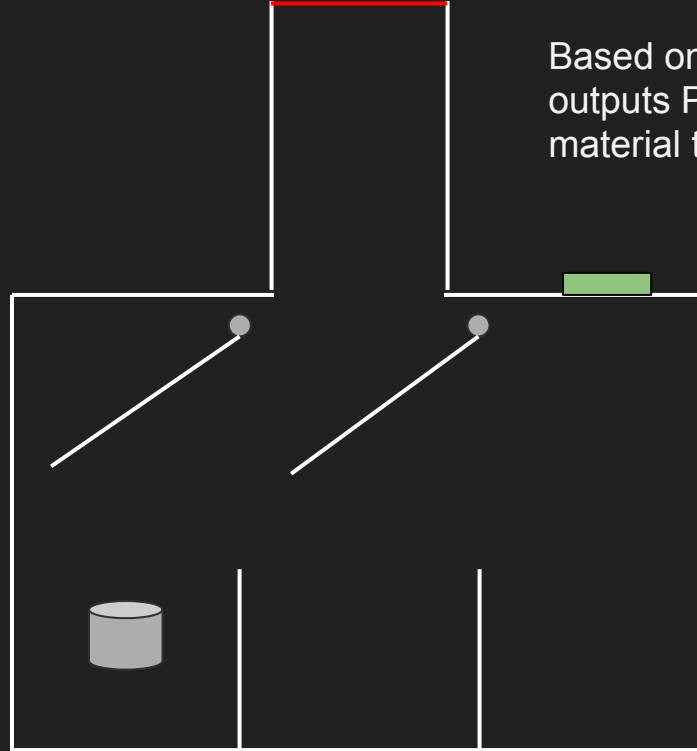
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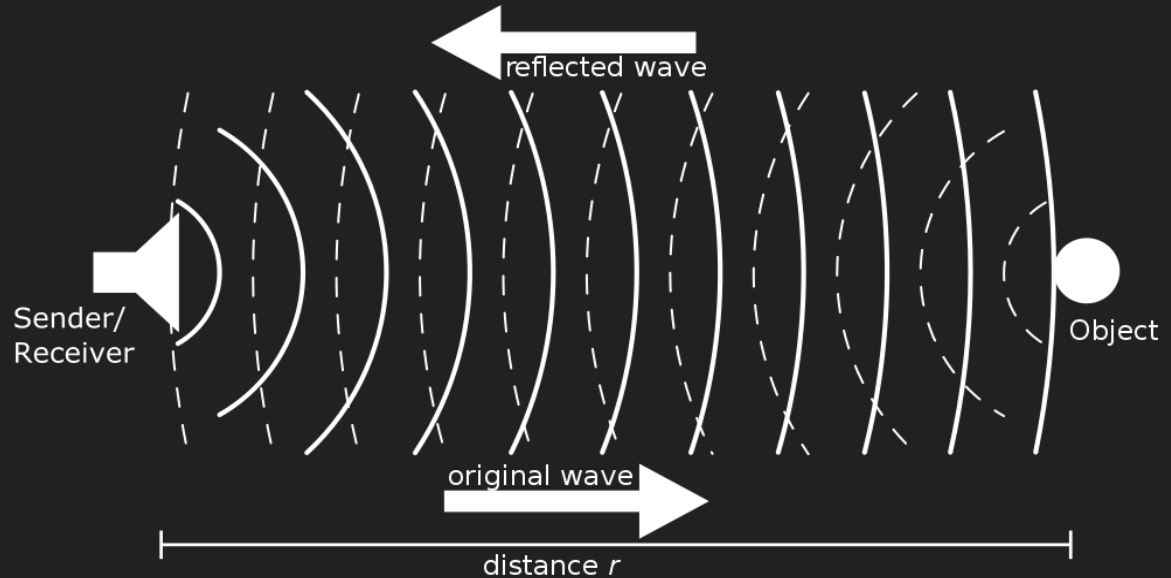


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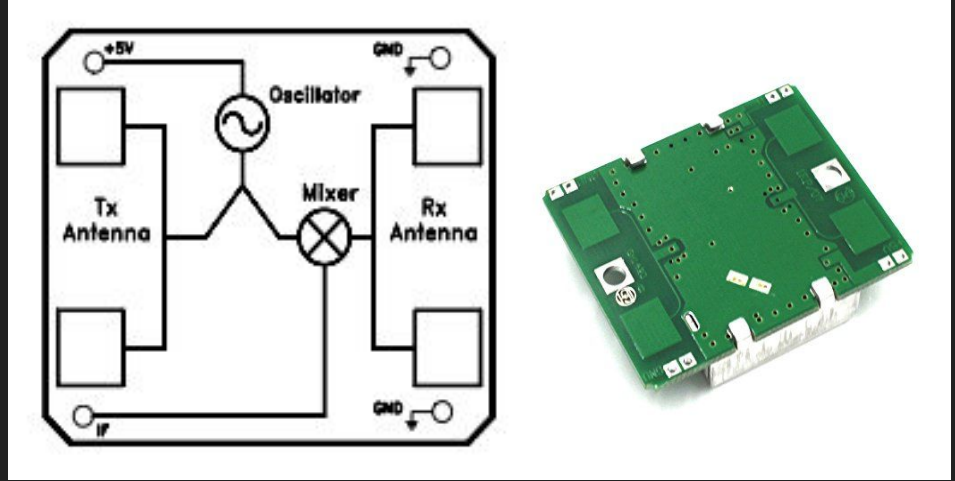
Sensing: Radar

- Interact Strongly with Metal
- No requirement for touching
- Inexpensive
- Problem: signal bouncing, hard to classify paper vs. plastic

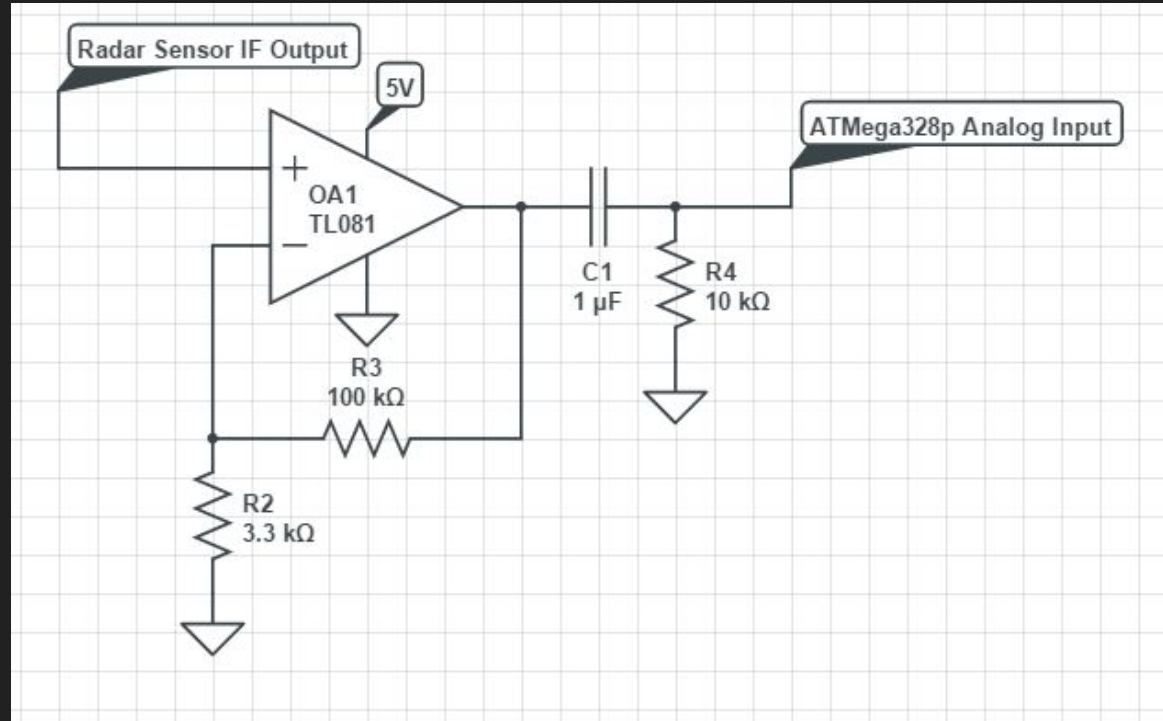


Sensing: Radar

- We considered the HB100 microwave sensor because of its low cost and user-friendliness
- The sensor outputs the doppler shift in the form of analog output through the IF pin

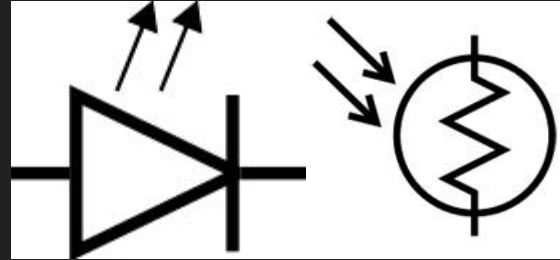


Signal Processing of Radar Output



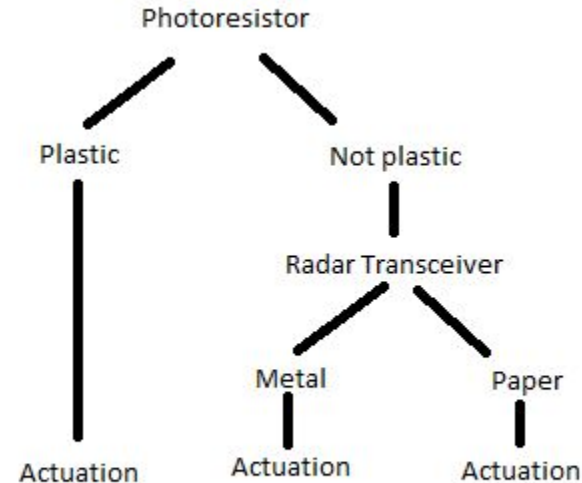
Sensing: Visible Light Transmission

- A photoresistor and red LED light were used to measure the amount of light that a material reflects and transmits. This allows for a method to classify PET bottles, metals, and paper

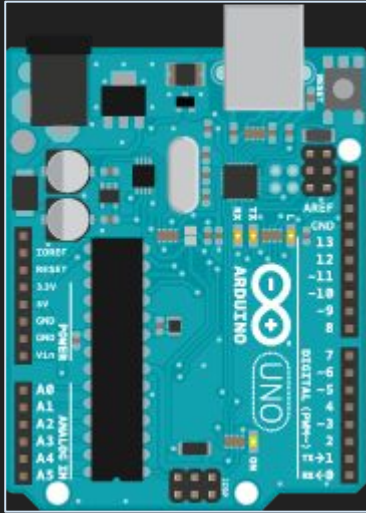


Classification

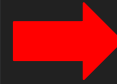
- The use of two sensors allows us to dedicate each sensor to classify one material from the rest
- Classification of materials were all based on comparing ADC readings from the sensors to predetermined threshold values
- Threshold values were calculated by measuring ADC readings from the sensors for 40 trials for each material



Actuation



Output PWM based on
classification



Servo Motors written to
certain position based on
PWM output

Mechanical Design

- The bin has a long chute in order to give the motors enough time to move to the correct position as the trash falls
- The motors rotate doors in the orange box to direct trash
- Designed in SolidWorks and made entirely of press-fitted, laser-cut acrylic to allow for design modularity and rapid prototyping



Challenges and Future Directions

- Paper and plastic analog input readings into the microcontroller were very close and hard to distinguish by the radar sensor, ultimately leading to our choice to remove it from our final design
- Motion/light in the background can cause reflections off of the surface of the walls, increasing the noise in analog readings
- Cannot handle commingled materials (i.e. a paper bag containing soda cans)
- Improvements:
 - House the photoresistor using non-reflective material to prevent ambient lighting from affecting sensor measurements