THE CLEAN-UP
RECYCLE BOT

entry completed by
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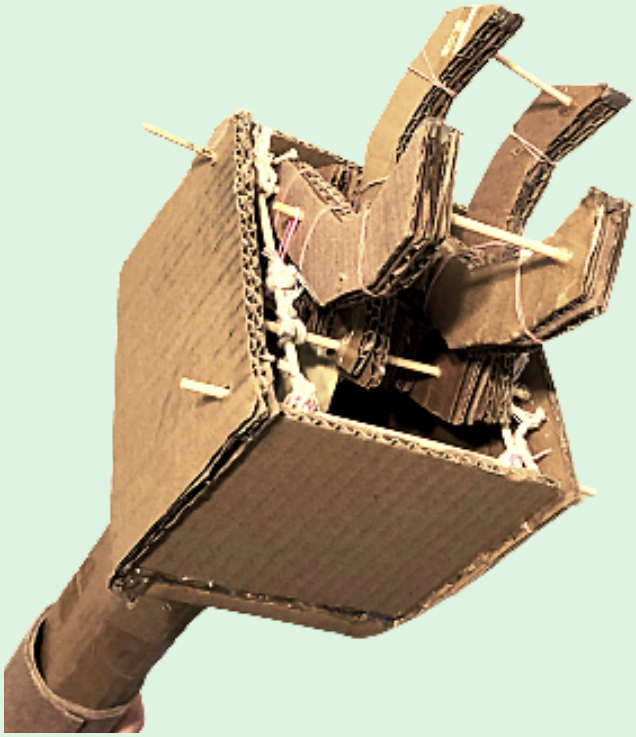
PRODUCED BY
THING ONE
97101G

ABOUT THE ROBOT



REYCLED MATERIALS

- cardboard
  - packaging from shipped orders
- disposable bamboo sticks
  - wasted barbeque skewers
- rubber bands
  - discarded, broken, lost rubber bands
- strings
  - scrap pieces

DIMENSIONS

length: (relaxed) 67.5 in.
(claw clamped) 69 in.
width: 5 in. at widest
height: 4.5 in. at tallest
weight: 492 grams (~1.08lb)

Adhesives

- hot glue
- packaging tape
- masking tape

PURPOSE

Especially during COVID-19, custodians keep us safe by sanitizing public areas. We wanted to use our recycle-bot to protect custodians, who put themselves at risk of infecting COVID-19 as they keep our public spaces clean. Our robot allows them to operate a "picker-upper" while staying a safe distance away from the scraps as they dispose of them.

THE DESIGN & CONSTRUCTION PROCESS

BRAINSTORM

We wanted to build a robot that was functional: something that had mechanical, moving parts, or something that served as a machine/tool. A few sessions of brainstorming and we had the ideas for

- solar-powered oven (without electricity)
- hand-powered fan
- coin sorter
- claw
- reassembling shelf/chair

We decided on building a claw-like mechanism instead of the others. To us, this was a project that was fun and challenging to design, especially because of its mechanical elements.

The next step to our process was to find a purpose, or a problem that could be solved by a claw-like mechanism.

- toy, like a claw machine
- human hand (prosthetics?)
- trash pick-up
- fruit picker

After reflecting on our own lives of being quarantined because of COVID-19, we realized that there are many essential workers who are risking their personal safety for us.

We chose to dedicate our project to them, as a token of gratitude for everything that they have done for us.

DESIGN PROCESS

The robot design would have to be categorized into two parts: the structural design and the kinematics/motion. Our needs could be categorized as follows:

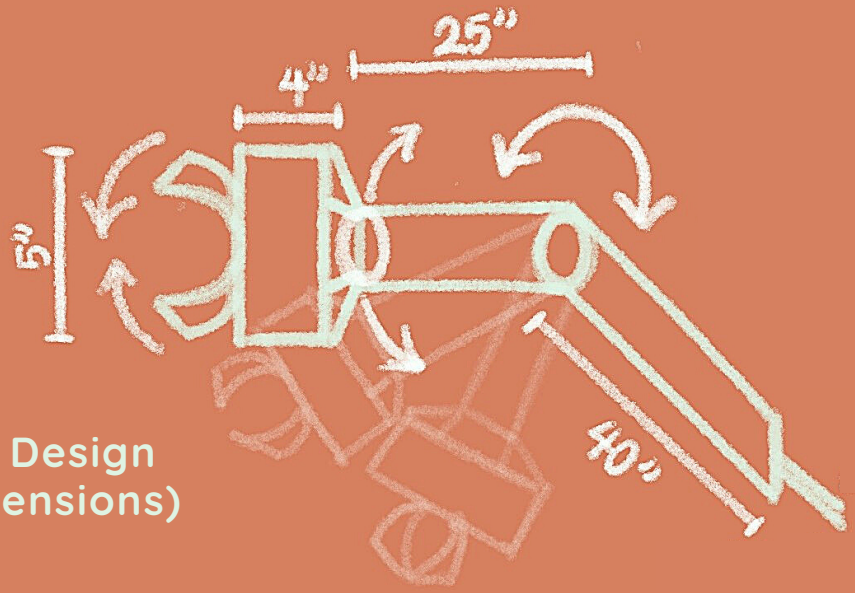
Structural Components

- The claw tip and an arm to be built of strong, durable structure
- The structure must be lightweight so it is convenient and usable
- The "arm" part must be hollow so kinematic components can travel through its center

Kinematic Component

- Each individual claw/finger must be able to bend correctly
- The force to bend the claw in must not interfere with the robot's "grip"
- Must be able to extend from the claw tip to the handheld area with minimal friction for max machine efficiency

We finalized a list of potential recyclable material for each type of component.
Structural Materials: cardboard, wood, bamboo sticks, toothpicks, disposable chopsticks, plastic scraps
Kinematic Materials: strings, rubber bands, buttons (as pulleys), paper (crafted into gears)



General Design
(with dimensions)

CONSTRUCTION

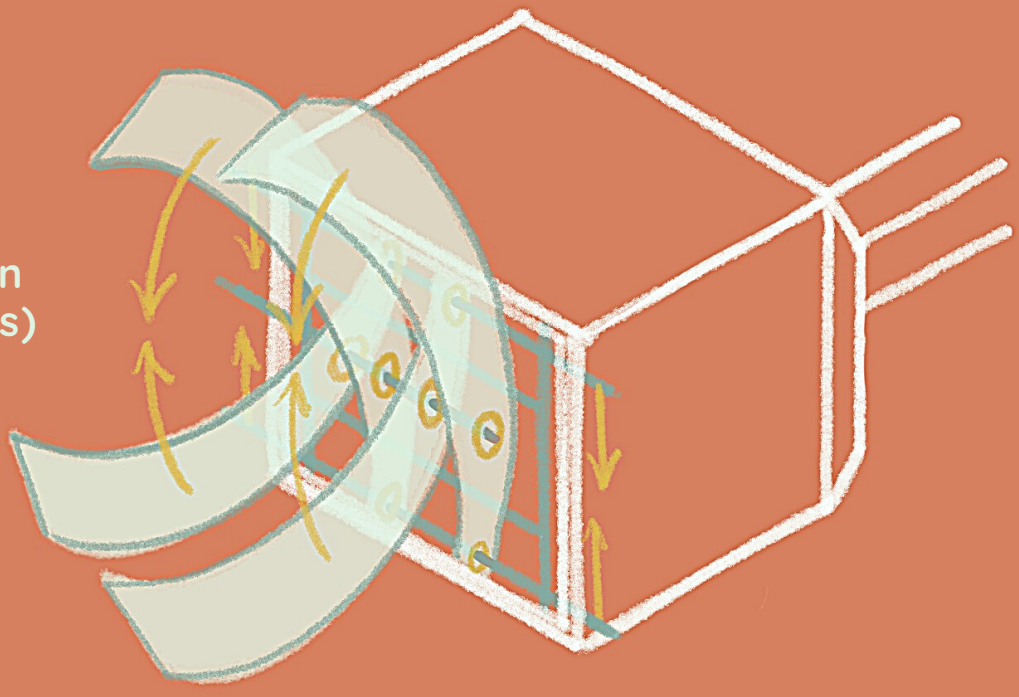
Claw design

Each extending "finger" on the claw consists of 3 pieces of layered cardboard, two thick pieces and one thin (and stronger) piece so it provides a stronger structure.

- Each connected by a wooden skewer (axle) in the center
- Each pair of "fingers" face inwards. The two "fingers" in each pair are connected by another axle at the bottom of the curve
  - the curved shape of the cardboard "fingers" allow the "fingertips" to open when the bottom two axles are compressed together

To make the claw automatically open after releasing the bottom two axles, we added two more "handles," which are pieces of cardboard on the bottom axle (one on each side, each consisting of about 5-7 layers of cardboard).

- The two pieces were then crossed and connected by another axle aligned with the center axle above it
- We placed rubber bands, connecting the two center axles, so the claw remains open when the "handles" are not pushed together.



Claw Design
(with forces)

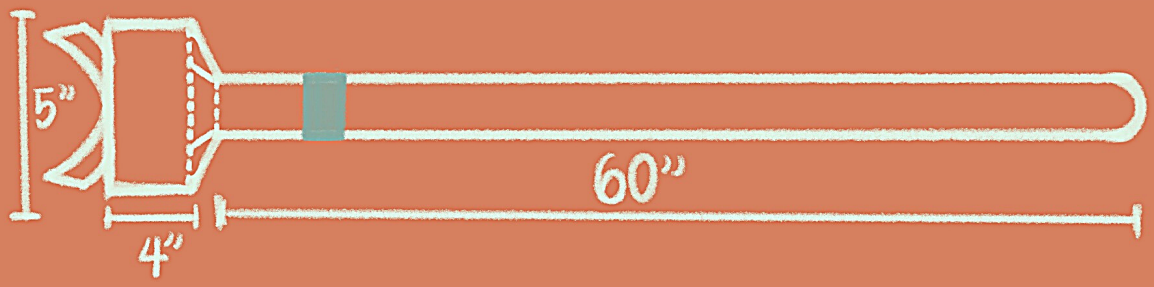
Design Challenges!!

Our original idea of having two separate "wrists" that enable the "tossing" motion of the trash did not work with the materials we chose.

- Having a "wrist" means that the direction of the force of the string would have to change.
  - To be able to smoothly integrate this change in direction, we would need to install pulleys
- For each "wrist," our robot arm increases significantly in mass.

We chose to discard the "wrist" plan and construct a lighter robot because we wanted our recycle-bot to be genuinely usable, not just mechanically complex.

Modified Design



Arm design

The arm needed to be wide enough to hold the claw, but become narrow enough to be held with one hand.

- We cut two 5" by 20" pieces of thick cardboard and left about 5" from the top before making two diagonal cuts about 1/3 the way into the cardboard from either side.
- The cardboard flaps were folded inwards to narrow the arm's width after the claw no longer needed the extra space.

We tied a long string to each "handle" and connected them together with duct tape.

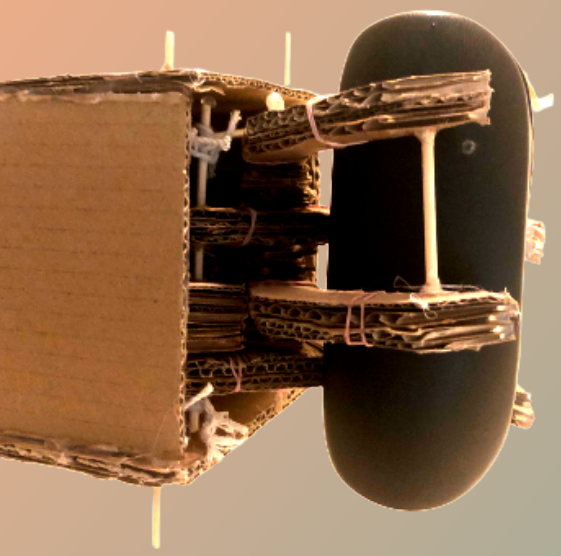
- The duct tape prevents friction between the string and the flaps of cardboard inside of the arm.

The section is then attached to a long cardboard tube.

- The string comes out the other end of the tube and is tied to small piece of cardboard for convenience.

FINAL PRODUCT & CONCLUSION

claw in action



Our recycle-bot successfully fulfills our intended purpose: to be able to pick up pieces of garbage easily and conveniently while allowing the user to be distanced from the item being picked up.

The robot is made of **100%** recyclable material, including cardboard, wood, string, and rubber bands.

Many of these materials are discarded as **WASTE** after only one or two uses.

Our recycle-bot focuses on the needs of the user - our priorities when building the bot was to design something that was easy-to-use while able to provide protection to custodians.

When faced with design challenges, we sought alternate solutions and made decisions based on our priority of usability. We believe that it is more important for our robot to be usable than complicated.

<u>Timeline of Production</u>
Research & Brainstorm: March 7 - March 21
Design: March 22 - April 5
Construction: April 6 - May 27
Written Report: May 28 - May 29