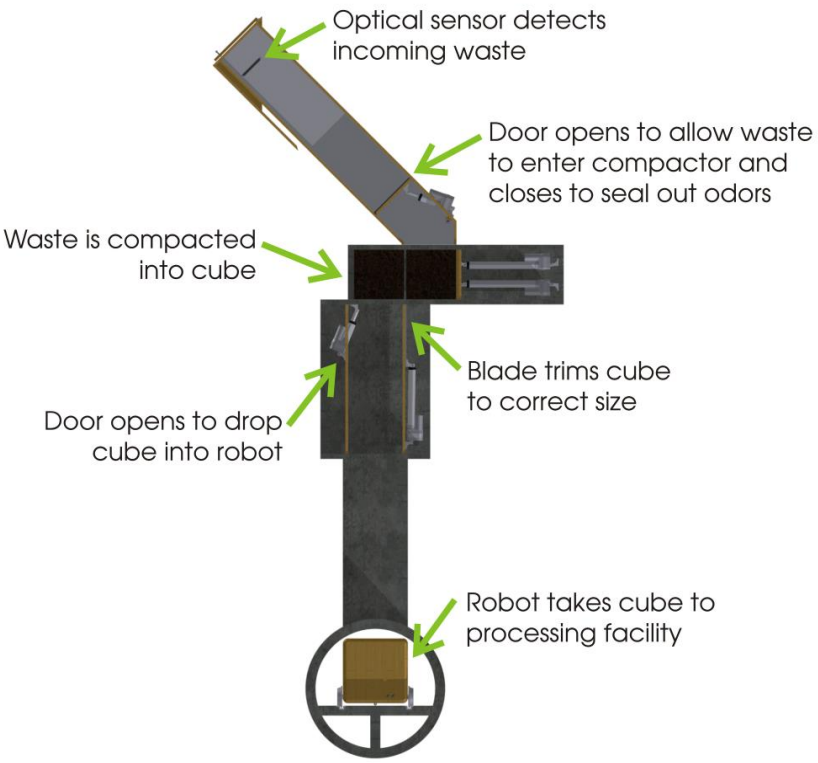
R-WARS

Robotic Waste Recycling System

Much of the waste thrown in the trash today is usable through recycling or as compost. Instead, it is filling up our landfills. Sorting of usable waste from trash is often inconvenient, and current methods for transporting waste rely primarily on large, inefficient trucks using fossil fuels. The R-WARS (Robotic Waste Recycling System) is a solution to these problems. The R-WARS is part of a larger project to create a sustainable, car-free community. Although it could be implemented on a small scale today, when used as a whole-community system alongside with waste reduction strategies, R-WARS would have its maximum impact. It would completely eliminate garbage trucks, drastically reduce landfill size, and maximize reuse of waste.

R-WARS Functions/Operation:

- Simplification of waste sorting into trash, compostables, and recycle
- Compacting of waste
- Collecting of compost
- Secure recycling of sensitive documents
- Removal of waste from home in a clean, efficient, and unobtrusive manner

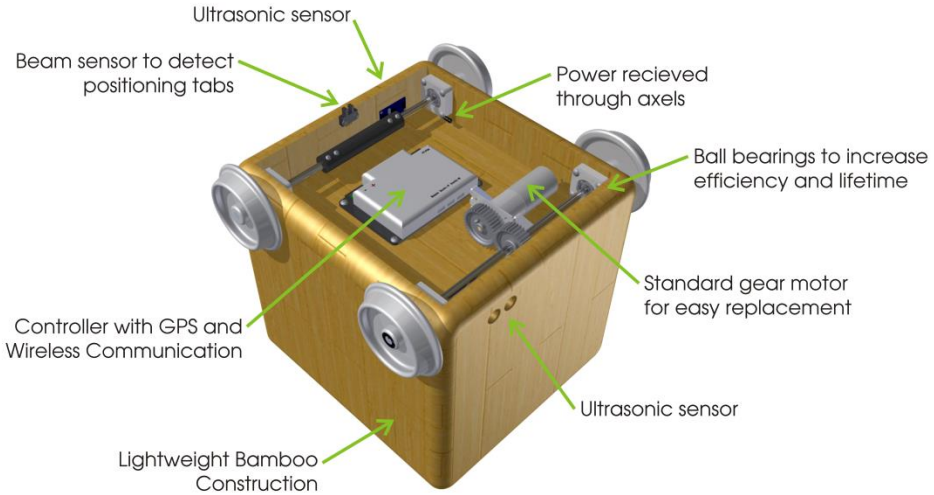


Collection Unit:

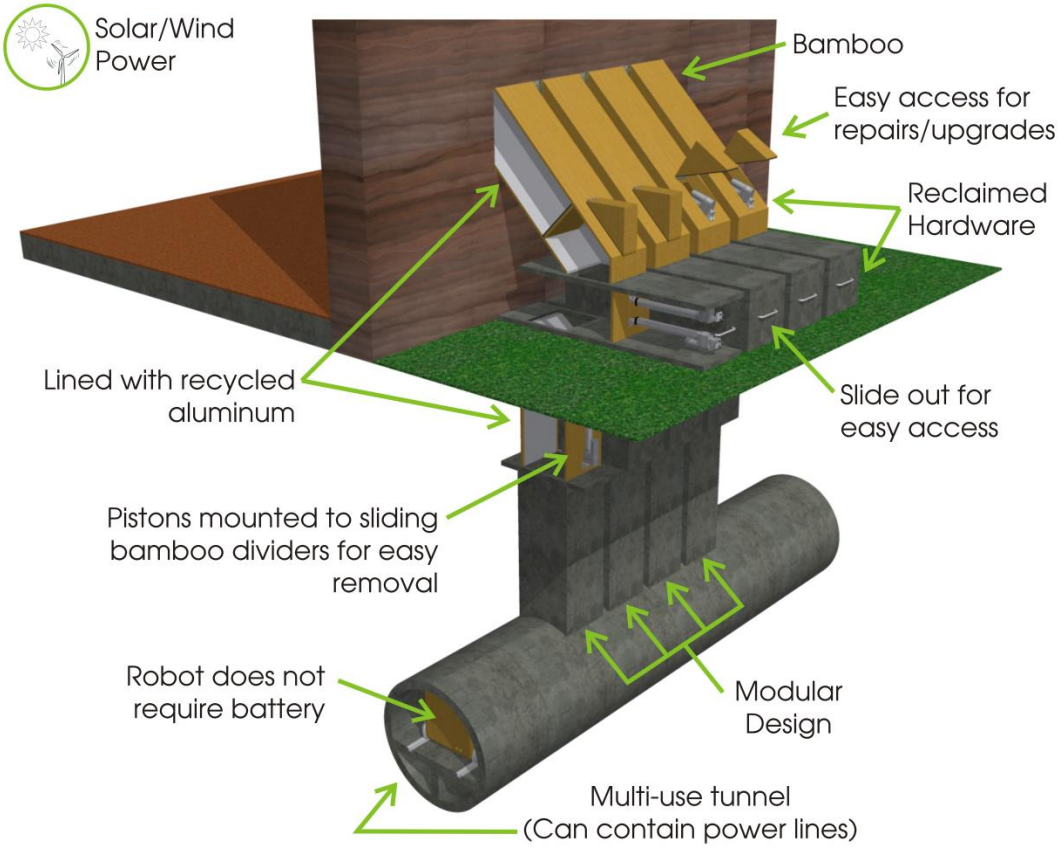
Waste is put into the R-WARS collection unit through four adjacent chutes inside the house: trash, compostables, recycle, and paper. An optical sensor at the top of each chute enables the collection unit to detect when waste is being inserted. The paper chute also has an integrated shredder to allow secure and easy recycling of sensitive documents. Each chute is connected to a compactor. Each compactor can make one 10" cube of compacted material. Sensors in the compactor pistons provide feedback as to how large and how compact the cube is (compost is not compacted as tightly.) When full, an aluminum blade trims the cube to the correct size. It is then ready for pick-up. The collection unit then signals for a waste removal robot. While waiting, additional waste is accumulated until the compaction chamber is empty. An ultrasonic distance sensor allows the R-WARS collection unit to monitor the amount of waste accumulated to prevent overfilling.

Waste Removal Robot:

The R-WARS waste removal robot is a small, simple robot capable of carrying a single compacted waste cube. Cubes are dropped into the robot from a motorized hatch in the base of each compactor. The robot has a beam sensor to detect positioning tabs under each compactor, and two ultrasonic distance sensors to allow several robots to follow each other. By forming a train in this manner, air resistance is reduced, resulting in lower energy consumption. Each robot also has a GPS unit and wireless communication to connect to a central computer. This central computer manages the fleet of waste removal robots. The waste removal robot receives power via its tracks, eliminating the need for a toxic, bulky battery.



Sustainability Features/Environmental Benefits:



Design Element	***Effects of Implementation in an Entire Community***	***Benefit to Environment***
Waste compacting	Reduced landfill size	Reduced land use
Recycle collection	Reduced amount of waste going to landfill	Reduced land use
Compostable collection	Reduced amount of waste going to landfill, compost produced for individual and community use	Reduced land use and healthier gardens/farms
Completely electric	Connection to community power source supplied by renewable energy (solar, wind, etc.)	Reduced Emissions
Simple, modular design	Allows for easy expansion, maintenance, cleaning, upgrades, and disassembly.	Extended product lifetime and reduced end-of-life impact
Sustainable construction materials	Allows for possible local sourcing (i.e. bamboo farming)	Reduced environmental impact

Design Process:

1. Understood challenge requirements
2. Researched sustainability and thoroughly reviewed the Autodesk Sustainability Workshop
3. Identified a problem that greatly impacts the environment
4. Brainstormed/sketched various robot designs to address the problem of inefficient waste removal and of excessive amounts of waste going to the landfill (see submitted sketches)
5. Prototyped ideas in Inventor and analyzed the feasibility of each
6. Chose and modeled a design. Inventor has many useful tools; however, I found the spur gear and bearing design accelerators particularly helpful for creating various components for the mobile robot.
7. Optimized design using material and stress analysis
8. Finalized design

Next Steps:

Today, much usable waste is simply thrown in the trash and goes directly to the landfill. Implementation of the R-WARS would maximize our reuse of waste material, thereby reducing our environmental impact. To further reduce our environmental impact, aggressive packaging reduction programs should be implemented. Additionally, the methane gas released by landfills should be captured and used as a power source.

Credits:

Created by: VRC Team Automata (2114a)/BEST team Cave Creek Robotics (355)

Using:

- Autodesk Inventor
- Autodesk Inventor Publisher
- Autodesk Showcase
- CorelDRAW
- Audacity
- Windows Movie Maker

In addition to parts that I created, I used:

- https://grabcad.com/library/linear-actuator--4
- https://grabcad.com/library/hc-sr04-ultrasonic-range-sensor
- https://grabcad.com/library/slot-type-through-beam-sensor-omron-ee-sx670
- http://best.eng.auburn.edu/download.php?id=315&folder=499 (generic motor)
- http://best.eng.auburn.edu/download.php?id=704&folder=501 (motor bracket)
- Various content center parts