MESA Mathematics Engineering Science Achievement
JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY

R^3

(Reduce, Reuse, Recycle)

Prototype Pitch

School: Patapsco Middle School
Grade: Middle School (6th)
State: Maryland
Designed by: The RoboKnights Team
2017-2018
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Problem Definition

- A lot of recyclable items are being thrown into the trash and being sent to landfills everyday, this creates toxic chemicals that heat up the earth and contributes to global warming.
- Another issue with recyclable items in landfills is that they don't biodegrade quickly. In fact, it takes an average aluminum can takes 200-500 years to biodegrade.
- Currently have no device that can restrict recyclable items from intermixing with the trash
- **Bottomline is inability to efficiently segregate recyclable items from trash causes environmental pollution and opportunity lost in saving energy**

Client and Current Impact

Client

Gemma Evans, the Recycling Coordinator, for Howard County Public Works.

Market

Howard County Residents (population of 313,414)

Current Impact

- Toxic chemicals are leaching into the ground
- Indirectly affecting climate change
- Reduction in the amount of materials recycled and reused for other purposes
- 49.9% Diversion rate of materials being diverted from Alpha Ridge Landfill to a recycling facility
- 1.7% of recycled materials are made of metal

Requirements and expectations for our device

R^3

- Need a tool to identify recyclable items and restrict recyclable items to be intermixed with the trash
- Efficient Proximity sensing of recyclable items
- Needs to be weatherproof and avoid damage from trash inside the container
- Needs to have display panel for friendly usability and buzzer prompting
- Recyclables should be fed individually to container
- Scope is limited for home usage - Needs further improvements for commercial usage

Current Solutions and their Weaknesses

Below are key findings based on our market research on existing solutions

- There is no distinct product in market that can identify all types of recyclable items
- None of the devices in the market, surprisingly is user friendly - don't have display, prompting and notification capabilities.
- No device that can identify recyclable items that settled in trash bin, free flow to trash bin(W/O lid) and thrown into trash bin(with lid).
- Bottomline is there is no efficient device that can restrict recyclable items from intermixing with trash.

Choices Made for Prototype

We considered the following solution choices for protype and selected Design Option 3

- **Option 1:** A device to identify recyclable items from the settled items of the trash bin
- **Option 2:** A device to identify recyclable items thrown into (free flow) the trash bin without lid
- **Option 3:** A device to identify trash and recyclable items thrown into the trash bin with lid

Given defined timeline we considered the following capabilities for this iteration but it has foundational framework that can be extendable for future releases.

- Identification of few selected recyclable items - metal detection scope only
- Individual loading of the items in trash bin
- LCD display for prompts and RTC along with buzzer
- Lid auto open/close based on identification of items
- Residential usage only

Prototype Demonstration

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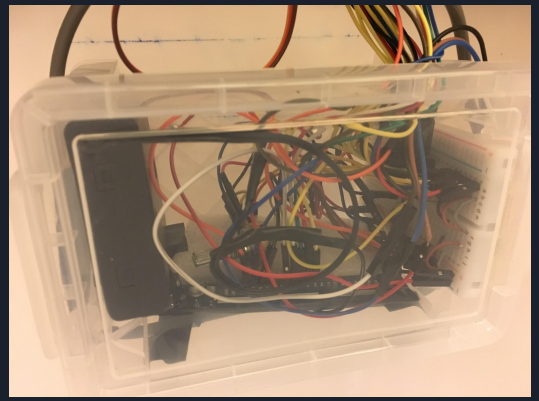


Advantages of R^3 Prototype

The device has foundational framework with focused capabilities but has potential to be fully extendable to meet broader diversified needs

<u>Key Advantages</u>

- Minimizes intermixing of recyclable with trash in turn helps
  - Reduction of chemical toxic gases generation from Landfills
  - Increased Opportunity in recycling and energy saving
  - Real time clock (RTC) with day, date, time
  - Not expensive product
- Scalability of product - Potential to increase the size of the trashcan without redesigning because the product is part of the lid of the trash can

Key Strengths of R^3 Prototype

The device has foundational framework with focused capabilities but has potential to be fully extendable to meet broader diversified needs

<u>Key Strengths</u>

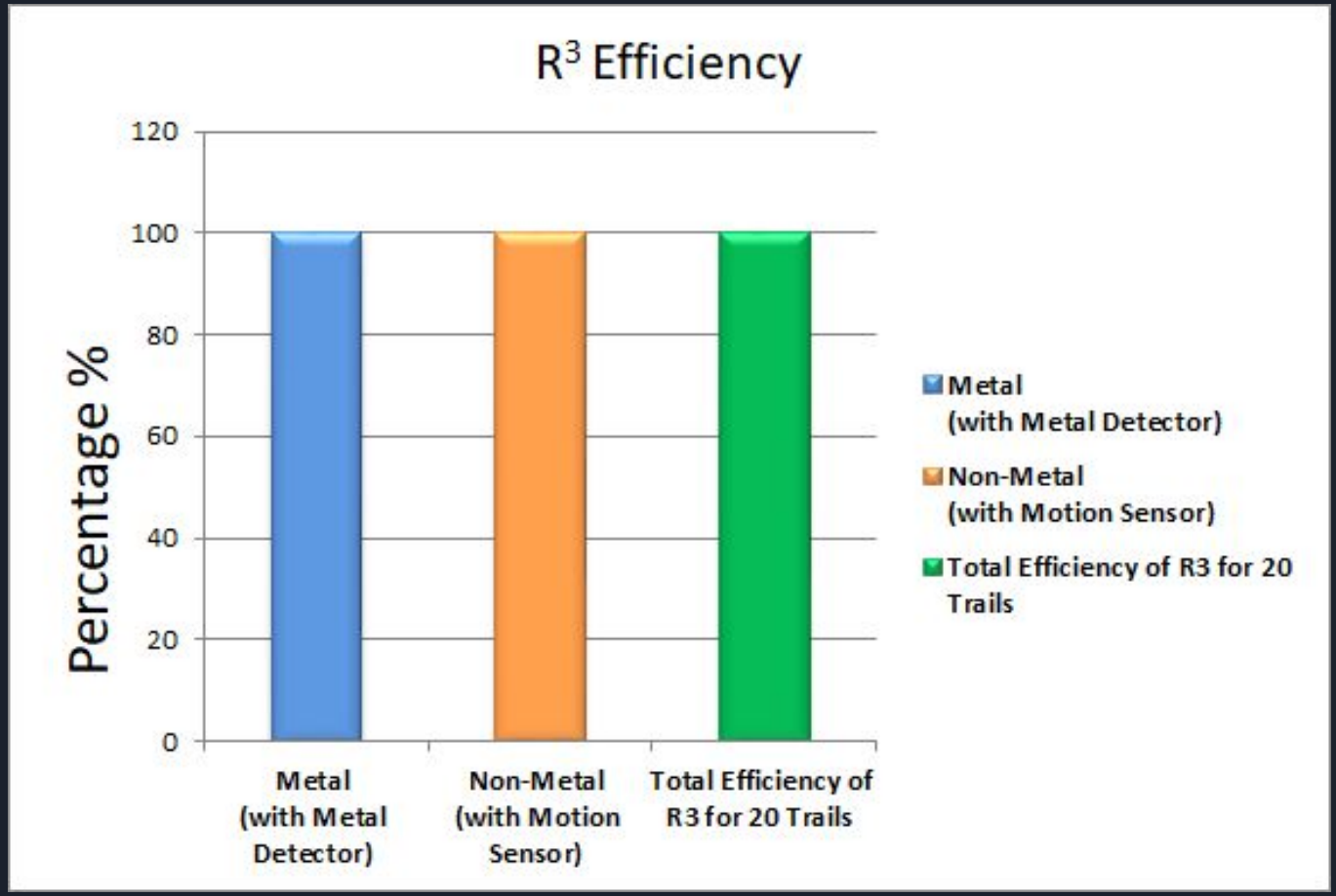
- Supports metal detection to avoid intermixing with trash and provides recycle opportunity
- The device is very user friendly - displays a LCD message and buzzer to prompt user to recycle the item
- If the item is recyclable, the lid does not automatically open
- Displays the temperature inside the trash can on LCD

Additional Advantages/Facts about R^3

Below are the additional advantages about R^3:

- One coke can can run a television for 2 hours or power a light bulb for more than 4 hours
- Our product had a 90% success rate and would increase the per household average of metal items recycled
- Recycling metal items reduces greenhouse gas and carbon emissions compared to using new metal
- Recycled metals can continue to be recycled and will not lose their structural value
- 92% of energy is saved using recycled aluminum.

R^3 Efficiency



Next Steps for R^3

Enabling below capabilities are been considered for future enhancements for multi iteration releases for full blown product

- Plastic, cardboard, paper and glass detectors are additional capabilities
- Monthly reports as notifications to user's phone with data and reports on how much they have recycled
- Extend product capabilities from residential to commercial usage.
- Temperature sensor can be used to detect temperature over 80 degrees Fahrenheit inside trash bin, to notify user with a message on LCD - "Please Empty Trash Bin!"

Any Questions?