R³ — REDUCE REUSE RECYCLE

MESA Mathematics Engineering Science Achievement — JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY

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Grade: 6th
State: Maryland
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Problem Statement

- As per 2013 EPA(Environmental Protection Agency) study, an average American wastes about 4.4 lbs of materials per person every day. Majority of the recyclable items are filled in landfills.
- Based on our research, there is no distinct product that can identify all types of recyclable items with appropriate prompts to avoid intermix of trash and recyclable items.

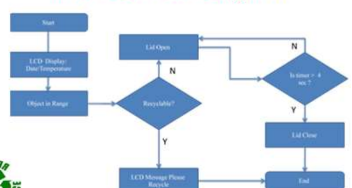
Objective

- Efficiently segregate recyclable items from trash to save energy and the environment

User Requirements/Goals/Constraints

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

Process flow Diagram



Engineering Design Process

Ask:
- Durability of the device, condition of recyclables.
- Too many recyclable items in landfills can lead to pollution.
- Recycling can save a lot of energy.

Imagine: We considered 3 solution approaches and shortlisted option - Designed a device to identify recyclable items thrown into a trash bin with a lid

Plan: Design and development work is split into 3 modules - Metal Detector, Motion detector and Display Panel.

Create: Implement above 3 modules.

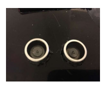
Test and Evaluate:
- Performed the unit test for each module separately and captured the test results for the relevant scenarios.

Improve:
- In future, the prototype will be enhanced for plastic, cardboard, paper and glass.

Share Solution:
- The key strength of the current prototype model is uniqueness of the product to deliver various capabilities like metal detection, LCD display and auto lid open/close.

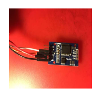
Input Devices:

Ultrasonic Sensor



Inductive Proximity Sensor

RTC/Temperature Sensor



Output Devices:

LCD

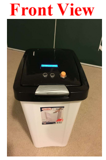
Piezo Buzzer

DC-Servo

R³ Prototype

Arduino Mega 2560

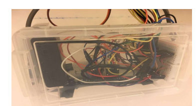
Front View



Top View

Open View

Integrated Device Box



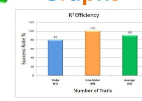
BUDGET

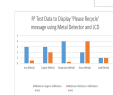
Reduce landfills, use R³ device, to save the environment

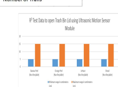
Facts

- Recycling 1 ton of plastic can save an equivalent of 2 peoples energy for 1 year.
- Manufacturing products for recycled paper and plastic reduces water pollution by **35%** and **air** pollution by **73%**.
- One plastic bottle can save enough energy to power a 60 watts light bulb for 6 hours.
- It takes about 25 recycled bottles to make a fleece jacket.

Graphs







Conclusion

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

Key Advantages
- Minimizes intermixing of recyclable with trash in turn helps
  - Reduction of chemical toxic gases generation from Landfills
  - Increased Opportunity on recycling and saves energy

Key Strengths
- 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

Recommendations

Consider below capabilities for future enhancements for multi iteration releases for full blown product
- ✓ Plastic, cardboard, paper and glass sensing are must have capabilities
- ✓ Notification to user's phone with recyclable data is nice to have future
- ✓ Extend product capabilities from residential to commercial usage.