R³

REDUCE REUSE RECYCLE

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Grade: Middle School (6th)
State: Maryland
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Problem Statement

➢ As per a 2013 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.
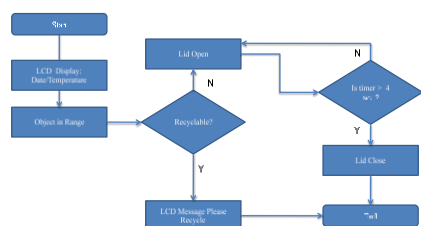
Objective

➢ 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 one option - Designed a device to identify recyclable items thrown in trash bin with 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

BUDGET

Front View | **Top View** | **Open View** | **Integrated Device Box**

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 <u>water pollution by **35%**</u> and <u>air pollution by **73%**</u>.

♲ 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
  o Reduction of chemical toxic gases generation from Landfills
  o 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 recycled material data would be a valuable addition in the future.
➢ Extend product capabilities from residential to commercial usage.