

INTRODUCTION TO ENGINEERING DESIGN
FINAL PROJECT

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Product Name : The Automatic Recycler 101

Introduction :

Global warming is a major concern of the world in the present. There is a need to reduce the impact of global warming in the upcoming years. Waste disposal has been a major concern in this light. Proper waste management is heavily encouraged in all the countries.

Recycling, though frowned upon, is one of the major initiatives to reduce the inevitable pollution caused. With the technology available, introduction of ML powered recycle bins in society like in various places like IT parks, residential communities, institutions, will be the next big time initiative in the recycling world. It will ease out the process of recycling which is considered hectic for the common people.

Need to be addressed:

- Pollution caused due to careless and lethargic disposal of waste.
- Mandatory need to slow down the effect of global warming and save the earth.

Who would it delight:

- The environmentalists and people who care about the earth.
- Common people
- AI & ML engineers

User requirements:

- To segregate waste using technology (AI & ML)
- To ease out and encourage the process of recycling for common users.

Constraints:

- Should be Economical
- Should have a large capacity
- Should not pose any electrical danger
- Easy to use by any age group and people with disabilities

Initial specifications:

- Around or more than 1100L capacity
- Made of durable material
- Mechanism to segregate waste
- Portable
- Compatible shape
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Benchmarking aspects:

- Kano model

Excites user:

- Automatic garbage separator using ML & AI
- Reward system for every time you use the recycler
 - To use the recycler you have to use a card designated to you. Reward points will be gathered in that card and can be used as coupons when purchasing goods in the online stores of sponsors.

Needs:

- Material of the bin should not react with the waste

Musts:

- Has to store and dispose waste
- Should contain the foul odor
- Lid to protect garbage from animals

- House of quality

Functional decomposition:

- Main:

- Storing the garbage disposed of by users.
- Segregating the garbage into different categories

- Sub

- Recharging and reusing the bin
- Moving the bin around
- Making sure the surrounding remains odorless
- Keeping the garbage thrown away from stray animals
- Durable and unreactive material used

Means of performing sub functions:

- Recharging
 - Using the biodegradable products disposed of as rechargeable energy
 - Using solar energy for rechargeable energy
 - Using rechargeable battery
- Storing garbage
 - Container type design with different number of compartments
 - Shape of container can differ
- Mechanism used to segregate garbage
 - Using biosensors
 - Using piezo-electric sensors
 - Using a ML algorithm powered by AI interface
- Locomotion of the bin
 - Different mechanism of wheels
 - Rotating conveyor belts

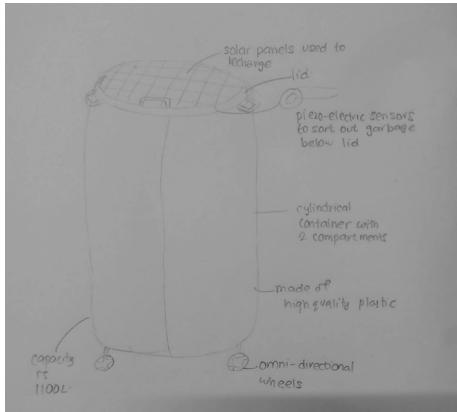
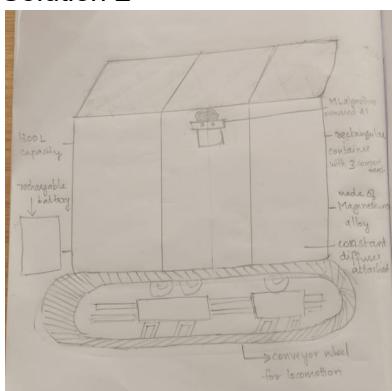
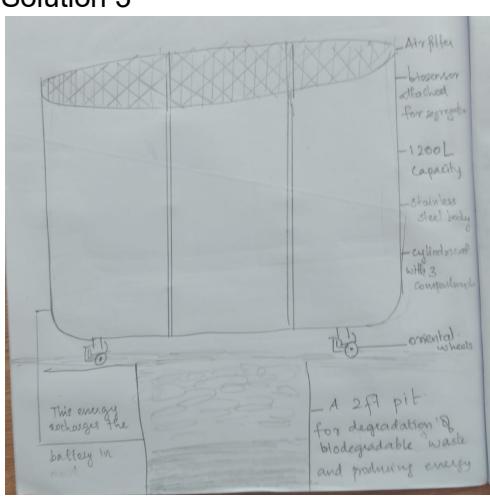
- Making sure surroundings remain odorless
 - Using lids
- Durable and unreactive material used
 - Plastic
 - Stainless steel
 - Magnesium Alloy
 - Steel
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Morphological matrix:

	Means 1	Means 2	Means 3	Means 4	Means 5
Function 1: Recharging	Solar energy 	Rechargeable battery 	Using biodegradable materials as energy 		
Function 2: Storing garbage	Rectangle with 2 compartments 	Rectangle with 3 compartments 	Cylindrical with 2 compartments 	Cylindrical with 3 compartments 	
Function 3: Mechanism used to segregate garbage	Using biosensors 	Using piezo-electric sensors 	Using a ML algorithm powered by AI 		
Function 4: Locomotion of the bin	Standard wheels 	Castor/Ball wheels 	Omni-directional wheels 	Orientable wheels  (c)	Conveyor wheels 

Function 5: Making sure surroundings remain odorless	Using lids 	Air filters 	Constant Diffuser 		
Function 6: Durable and unreactive material used	High quality Plastic 	Stainless steel 	Magnesium alloy 	Lead alloy 	
Function 7: Capacity	1100L 	1200L 	1300L 		

Combinations:

Solution	Combination of means
Solution 1 	F1- M1 F2- M3 F3- M2 F4- M3 F5- M1 F6- M1 F7-M1
Solution 2 	F1- M2 F2- M2 F3- M3 F4- M5 F5- M3 F6- M3 F7-M3
Solution 3 	F1- M3 F2- M4 F3- M1 F4- M4 F5- M2 F6- M2 F7- M2

Criteria for selection:

- Should be easy to handle
- Should be easily portable
- Odor control should be good
- Recharging capacity should be feasible
- The device should be long lasting
- Should have sufficient capacity
- Should be feasible in separating the waste
- Should be economical

Decision matrix:

Selection Criteria	Solution 1	Solution 2	Solution 3	Reference
Ease of handling	0	+	-	0
Portability	+	-	0	0
Odor control	-	+	0	0
Recharging capability	+	+	-	0
Durability	0	+	-	0
Capacity	-	+	0	0
Feasibility in separation technique	0	+	-	0
Economical	-	0	+	0

Pluses	2	6	1
Minuses	3	1	4
Sames	3	1	3
Net	-1	5	-3
Rank	2	1	3

		Solution A		Solution B		Solution C	
Selection Criteria	Weightages	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Ease of handling	5%	3	0.15	4	0.2	1	0.05
Portability	5%	4	0.2	2	0.1	3	0.15
Odor control	10%	1	0.1	4	0.4	3	0.3
Recharging capability	10%	3	0.3	4	0.4	1	0.1
Durability	10%	3	0.3	4	0.4	2	0.2
Capacity	10%	1	0.1	4	0.4	3	0.3
Feasibility in separation technique	30%	3	0.9	5	1.5	2	0.6
Economical	20%	2	0.4	3	0.6	4	0.8
Total Score		2.45		4		2.5	
Rank		3		1		2	

Final concept:

Our final concept is solution 2.

Recycling bin using Machine learning algorithm:

The recycling bin is made in the form of the rectangular shape with three compartments made of a durable unreactive magnesium alloy material . The capacity of the bin is 1300L .It has conveyor wheels to move it around when required. The bin uses a rechargeable battery as its energy.The bin is made of two layers. The top layer has an inlet for the user to put their respective waste . The second layer is the layer in which the waste is separated based on a ML algorithm. The ML algorithm consists of a linear function which can recognise the materials as biodegradable , non-biodegradable or medical depending on the appearance of the waste. There is a camera fixed on the mouth of the second layer of the bin which captures the image of the waste . The images are further analyzed by the algorithm and the waste is segregated into different compartments via various pipes inside the bin. To avoid the foul smell of waste, it is made to pass through a layer of constant diffuser before getting segregated . The waste can further be disposed from the bin via an outlet on the back of the bin by the garbage disposal team. For the benefits of the users and to encourage recycling , a machine card will be provided to every user, which shall be used for operating the bin in their comfortable languages . Each time a user makes use of the bin , rewards or points will be credited to their account in the app .The points awarded will depend on the weight of the waste disposed by that user . These points can be used to avail discounts in the online stores of the sponsors . The bin is an economical and a feasible option to recycle the waste .