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Design and Fabrication of Portable Waste Treatment Bin

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Abstract: As a developing country with such a huge population, India faces a lot of issues in managing the daily waste. Popular cities are expanding their boundaries but Municipal Corporations do not have the technology to handle the waste generated. Looking at this, the need of technological development is a must. Hence to cope up with these issues, the aim was set to develop household waste treatment bin, which can help to reduce the harm caused by garbage on the environment as well as on humans. In this project design of household waste treatment bin is carried out using simple techniques and design methodology to convert waste into biologically stable compost in an effective way so as to cope up with problems faced during handling daily household waste.

Keywords: Composting, Household Waste, Waste Management.

I. INTRODUCTION

The designed Compost bin aims at reducing the municipal solid wastes generated at houses and it helps the users to make their own natural fertilizer (Compost) for the plants they grow at home, which is easy to use, ergonomic, odour free and can compost quickly.
What seems natural to us is probably just something familiar in a long tradition that has forgotten the unfamiliar source from which it arose. Yet this unfamiliar source once struck man as strange and caused him to think and to wonder. (Heidegger, 2001, p. 24).
Today solid waste management is one of the biggest problems in the world. Around 50% of the waste in the world is organic waste. India is the second-largest populated country in the world; it produces more than 100 tons of solid waste a day. It is the mixture of both organic food waste and inorganic waste. Around 78% is food waste, which can be recycled. Some of them are landfilled but it is not segregated properly and it mixes organic and inorganic waste, which produces bad odour, and it will spoil the soil. To manage the solid waste, it should be properly segregated at the source (houses). The organic and inorganic waste needs to be separated, the organic waste can be treated to make compost, and inorganic waste can be segregated and given for garbage collection. There are many companies who take in the waste and segregate and convert the organic waste into compost but as the waste is very high; they are unable to achieve all the targets so it is better to compost at home.
Compost is organic matter decomposed as fertilizer. Compost is the key to organic farming. The process of composting requires wet organic matter is known as green waste (leaves, food waste) and waiting to break down into humus for a certain period. Modern methodical composting is a multi-step, closely monitored process with measured inputs of water, air, carbon and nitrogen-rich materials. The decomposition process is carried out by shredding the plant matter, maintaining the right amount of water and ensuring proper aeration by regularly turning the mixture.

Compost is rich in nutrients. It is used in small gardens, agriculture, rooftop farming etc. The compost itself is beneficial for the land in many ways, such as soil conditioner, fertilizer, the addition of vital nutrients to the soil and as a natural pesticide/insecticide for soil. In ecosystems, compost is useful for controlling soil erosion, land and stream reclamation, wetland construction and as landfill cover. Compost is commonly known as Black gold by gardeners. Anaerobic compost results in black colour of the soil due to the presence of methane. Aerobic composting results in dark brown colour/ chocolate colour of the soil after composting.

II. METHODOLOGY

Brainstorming was the base for the idea development. Study and research on current issues regarding waste disposal at Home, Restaurants and Parties were considered. Technological reach in the currently developed system was studied and possible improvements were noted. The average quantity of garbage collected from houses, various constituents contained in it, sizes and weight of categorized garbage was evaluated. Various methods for composting were studied and selection of optimum technique. Possible outcomes from a system was defined. Conceptualized outline of the design and required sub-systems were noted. [availability, specifications, their outcomes, cost, inputs required and efficiency]. Research on sub-systems readily available in the market considering its cost and possible outcomes were made. Development of conceptualized 3D model with all system assembled. Finalization and approval of the design. Fabrication and assembly. On-field testing: Testing of a machine on-field and modifying according to the test results.

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III.COMPOST BIN MODEL DESIGN.

The compost bin consists of two parts mainly. The top unit is storage-chopping part and lower unit is a heating-composter part. The top unit is provided with highly efficient cutting blades to ensure proper waste chopping and to increase the area of decomposition. Simple lid with lock is provided to ensure the safety of the user. A simple sliding door between the top and lower unit allows chopped waste to flow down for the next process. Lower unit is provided with a heating coil to maintain a healthy environment for quick composting. Hand operated stirrer ensures uniform heating and mixing of carbon-nitrogen waste.

A. Design of Crusher.

1.1	Volume capacity of crusher chamber (Vc)	0.02827	m^3
1.2	Weight of organic waste settled down in volume	110.3	*N*
1.3	Force required to cut organic waste (Fs)	19.5	*N*
1.4	Total load acting on cutting blade (Wt)	49.31	*Nm*
1.5	Power estimated (motor) (P)	6.863	*HP*

B. Design of Shaft

2.1	Material used for shaft	30C8	
2.2	Diameter of shaft (d)	*15*	mm

C. Design of Belt Drive

3.1	Diameter of larger pulley (D1)	360	*mm*
3.2	Diameter of smaller pulley (D2)	125	*mm*
3.3	Speed of larger pulley (N1)	500	*rpm*
3.4	Speed of smaller pulley (N2)	1440	*rpm*
3.5	Length of belt (L)	1750	*mm*
3.6	Centre distance between pulleys	475	*mm*

D. Design of Heating Chamber

4.1	Power supplied to heating element (p)	480	*Watt*
4.2	Gauge diameter of heating wire (d)	7.35	*mm*
4.3	Length of required heating element (l)	11.2	*m*

E. Bearing Selection

5.1	Radial load (Fr)	70	*N*
5.2	Axial Load (Fa)	20	*N*
5.3	Speed of shaft (N)	500	*rpm*
5.4	Effective Load (Pe)	70	*N*
5.5	Dynamic Load (C)	468.6030	*N*
5.6	Bearing series selected	61802	-

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IV. CAD MODEL DRAFTED IN X CAD.

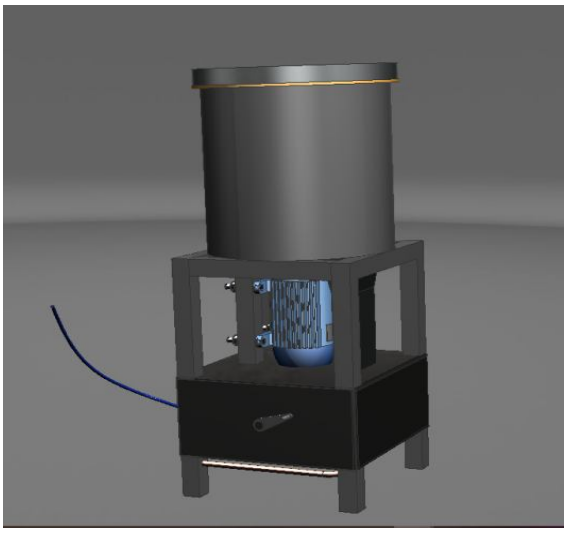

Fig. 1 CAD model drafted in NX CAD.

V. COMPOST BIN WORKING FLOWCHART.

This explains the working of the designed compost bin for household waste. The process starts with the collection of daily food waste which acts as a nitrogen component and dry leaves/ saw dust which acts as a carbon component I ratio 1:25 respectively. Food waste stored in the cylinder is chopped into fine particles and then dry leaves/sawdust is added maintaining adequate moisture. This mixture chopped is then transferred into the lower unit to maintain the required temperature (in range of 45℃-55℃)to activate the composting process. For uniform heating and mixing of both constituents, the hand-operated stirrer is used. This is left for 2-3 working days until the compost is ready. This I then removed and used for gardens and plants.

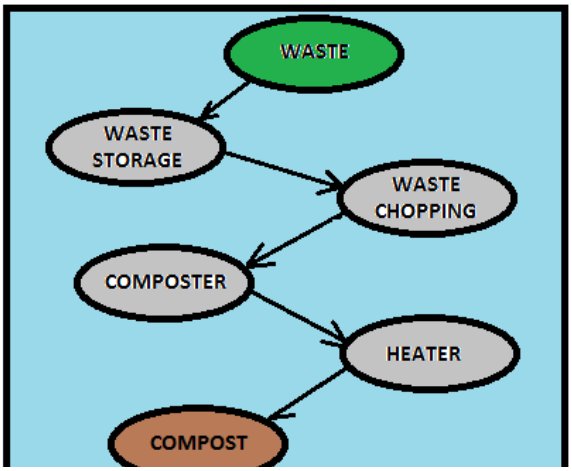

Fig. Working Flowchart of waste treatment bin.

VI. CONCLUSION

This newly designed organic waste treatment bin can handle and treat the kitchen and other household waste. It has three compartments doing three main tasks chopping, squeezing with compacting and heat drying for making garden compost. Now with this bin one can manage household waste very easily with just a small power consumption of 0.48 Kilowatt. Its gravity-driven design effortlessly produces the compost ready for the garden plants which is enriched in nutrients, free of any odour. Now it is a need of the hour to take a responsible step for self waste management for protecting our environment by making people aware of the use of such devices with an innovative design.

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VII.FUTURE WORK

Based on the suggestions of professors and users this machine can be further developed for below listed improvements:

A. Blade setup can be made with multiple sizes for thick and thin vegetables.
B. Making a device to operate on solar energy like heater and stirrer.
C. Using lightweight and aesthetic material.
D. The mechanism to remove material easily.

VIII. ACKNOWLWDGEMENT

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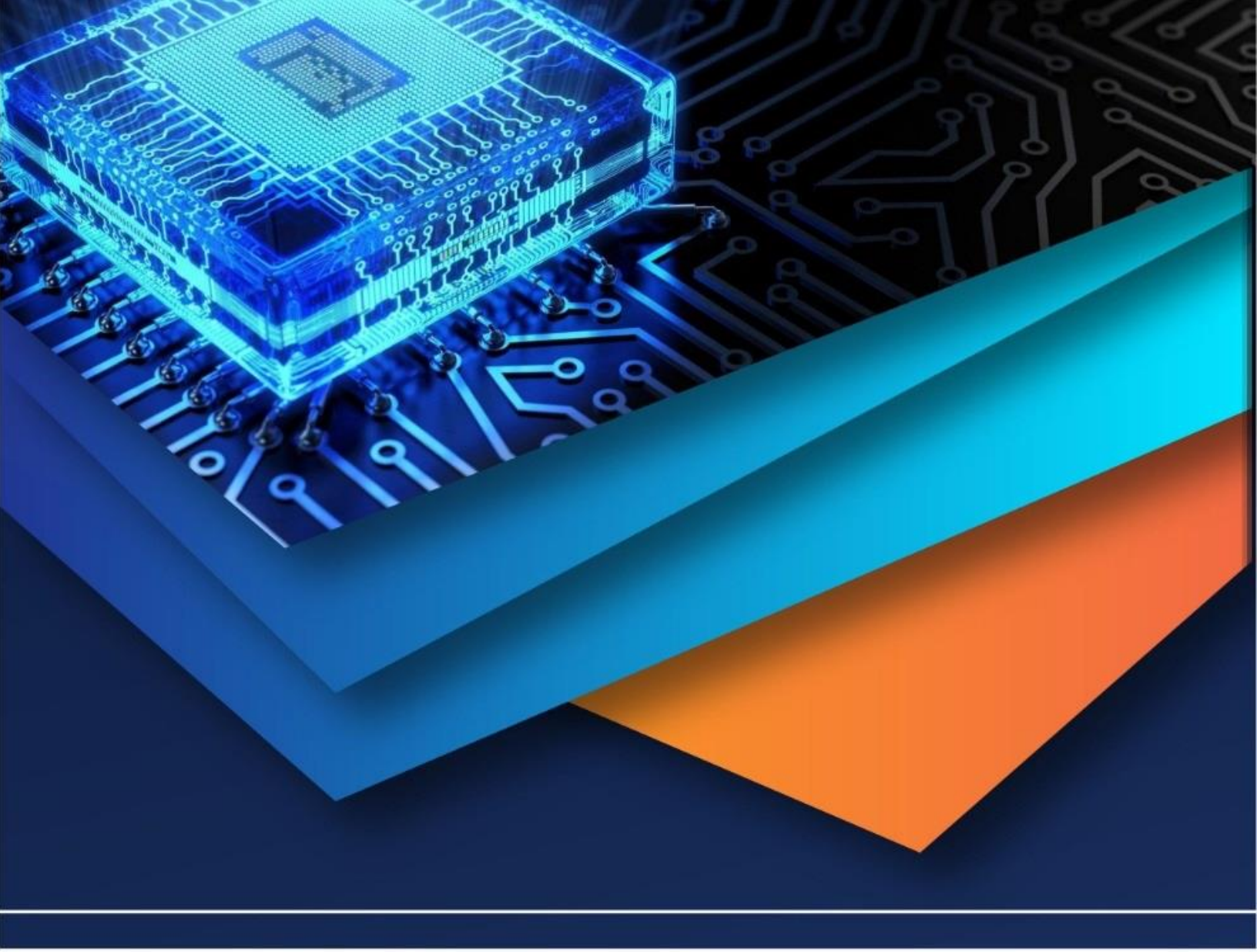

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