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Design and Development of Garbage Collector

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Abstract: *Cleaning is the predominant fundamental want for all human beings and it is essential for every day routine process. The conventional street cleaning machine is most broadly used in many purposes such as example roads, railway stations, airports, hospitals, Bus stands, in multi floor buildings, faculties etc.lot of effective time is lost in garbage collection in many firms. In our assignment we are aimed to use without problems handy substances with low price and it can be effortlessly fabricated and convenient to use and control. The intention of this mechanical engineering task is to fabricate a garbage collecting machine.*

Keywords: Low price, invention, convenient, routine.

I. INTRODUCTION

In latest years, cleanliness is turning into an essential thing for betterment of nation. To guide to reason, we havecarried out a study, put together a layout and working of street cleaning vehicle. In current years, most of the humans decide on to use trains or buses for commuting and for this reason these locations are littered with biscuits covers, cold drink bottles etc. Hence, it is essential to clean the bus stands and railways stations at regular interval. There is no onesingle cleaning technique that is appropriate for all areas and occasions and effective cleaning relies upon type of cleaning device, cleaning method and additionally the equipment need to be user friendly. Cleaning machine is method to deliver effortless in time efficient cleaning of roads, by means of lowering human efforts. The simple concept to generate machine which works on basic principle of physics, the use of mechanical vehicle component and devices. This device is help to smooth roads in minimal time. The development of road cleaning and Garbage collectingmachine is a great deal more cost-effective than the Traditional methods. The fabricated machine can serve twin in the purposes, it can be managed permanently at a stationary position or it could be shifted to the from one region to some other as the case might also be. One excellent advantage of using chain drive is to minimise sleep and creep losses.The simplicity of operation of this laptop ensures that no too a great deal technical abilities required running it.

"Design and Fabrication of Garbage Collector Machine," addresses the critical need for efficient waste management solutions in today's society. With the global challenge of waste accumulation posing significant environmental and health risks, our project aims to provide a practical solution by automating the process of garbage collection.

II. OBJECTIVES

The need for modifications in your garbage collector machine project can arise from various factors aimed at enhancing its overall performance and usability. One crucial aspect involves improving efficiency through rigorous field testing to identify areas where the machine's collection process can be optimized. Additionally, focusing on durability is essential, ensuring the machine withstands prolonged use in demanding environments by addressing any weak points in its design or materials. Optimizing power consumption is another key consideration, achieved through fine-tuning the power transmission system, motor efficiency, and battery management to maximize operating time between recharges. Incorporating user feedback is vital, as it helps identify areas for improvement in terms of ease of operation, manoeuvrability, and overall user experience.

Furthermore, adapting the machine to different environments may necessitate modifications to ensure it performs effectively across various terrains and climates. Finally, ensuring compliance with safety standards and environmental regulations mayrequire adjustments to certain design elements or components to meet regulatory requirements. By carefully evaluating these factors and implementing necessary modifications, you can enhance the performance, durability, and usability of your garbage collector machine.

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III. LITERATURE REVIEW

Vivek Dhole et.al.[1] "Design and fabrication of beach collecting machine", had suggest need to develop equipment not only for collect the waste, those are also able to do the disposal of waste. The equipment primarily having an engine which operates by a fossil fuel which is caused to entire process.

Akshaya Mancy et.al.[2] "Design &fabrication of amphibious seaboard trimmer" International Research Journal of Engineering and Technology, Volume: 5, Issue: 4, April2018, this work is dust collector which is used in beaches to collect the dust. In that manner to clear challenges in the operation, a beach cleaning equipment is developed and fabricated in a cost- effective manner.

Arun. A, et.al.[3] "Design and fabrication of garbage collector" on the beach using solar power", Internal Journal Research of Engineering and Technology, Volume: 7, Issue: 3, 2018,There is a need to produce equipment to solve the related problems which are solved automatically. The technology growth now a days increased a lot. By this there is a chance develop new machines which is better than previous machines. The cleaning of beach sand is done by some mechanical equipment like gears, chain drives, conveyors etc., which gives good performance and results.

IV. PRODUCT DESIGN AND DEVELOPMENT

Customer Survey and Analysis

The process of identifying customer needs is an integral part of the larger product development process and is most closely related to concept generation, concept selection, competitive benchmarking. And the establishment of product specifications. The customer needs activity can be collectively thought of as the concept development phase.

As per instructions from references, customer needs are found out and their ratings were found as found in following table.

Table 1: Needs and their ratings

Need	Rating
Material should be anticorrosion	4.82
Ease of operations for both skilled and unskilled labour	4.76
Required for both Road and Garden Purpose	4.71
To collect and separate both the wet and dry waste	4.59
Functioning should be done manually	4.59
To compress the garbage in the carry bag	4.53
Costing should be range at 20000/- to 30000/-	4.35
Vacuum suck facility for collection	4.29
Need for Tubeless tyres	4.18

Mind Mapping

Mind mapping is a versatile tool extensively used in product design and development. It facilitates idea generation by visually organizing concepts, features, and requirements. Through concept visualization, it aids in clarifying complex design elements and technical specifications. Mind maps also serve as effective workflow planners, outlining project milestones and tasks. They play a crucial role in problem-solving by breaking down challenges into manageable components.

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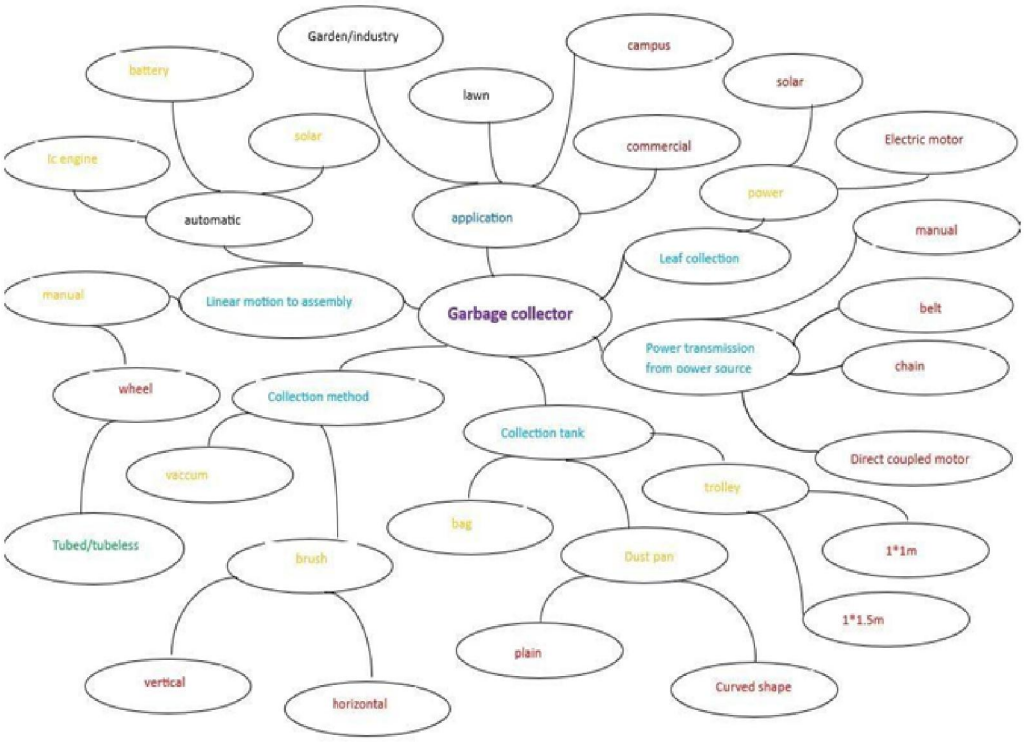

Fig No 1: Mind Mapping

Above diagram is used to generate ideas in free flow and creative mind. Each member of the team involve in generation of multiple solutions. This method improves team work to enhance product quality.

After mind mapping, we will get multiple options to fulfil each objective. In order to generate concepts options are arranged in tabular format and combinations are created as shown in figure no 2. This diagram helps us to generate a greater number of combinations for rethinking about project.

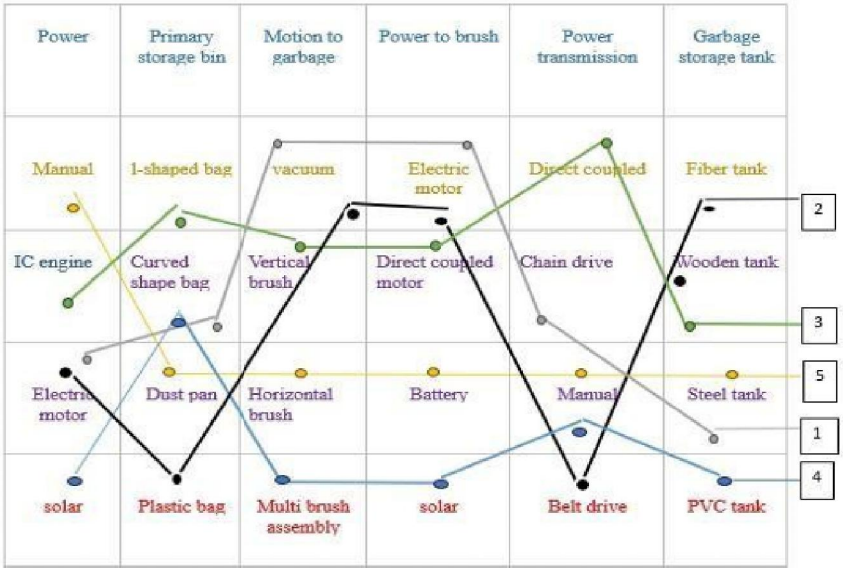

Fig No 2: Concept Combination table

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Concept Selection

Early in the development process the product development team identifies a set of customer needs. By using a variety of methods, the team then generates alternative solution concepts in response to these needs. Concept selection is the process of evaluating concepts with respect to customer needs and other criteria, comparing the relative strengths and weaknesses of the concepts, and selecting one or more concepts for further investigation, testing, or development.
Above procedure carries in two phases namely concept screening and concept scoring.

Concept Screening

Concept screening is a critical phase within the product design and development process, aimed at identifying the most promising ideas for further refinement and implementation. To begin, clear criteria are established, encompassing factors such as feasibility, market potential, technical viability, and alignment with strategic objectives. These criteria serve as benchmarks for evaluating a range of generated concepts, which are derived from methods like brainstorming, user research, and market analysis. During preliminary evaluation, concepts are scrutinized for their feasibility, potential risks, and benefits.

Table no 2: Concept Screening

		concept			
SELECTION CRITERIA	CONCEPT-1	CONCEPT-2	CONCEPT-3	CONCEPT-4	CONCEPT-5
1.VERSATILITY	0	0	0	+	0
2.EASE OF OPERATION	+	_	0	+	_
3.ADAPTIBILITY	+	0	0	0	0
4.EASE OF MECHANISM	+	0	_	+	0
5.EASE OF MAINTAINANCE	0	_	_	+	_
6.DURABILITY	_	0	+	_	0
7.EASE OF ASSEMBLY	+	0	+	_	0
8.EASE OF HANDLING	+	_	0	+	0
9.ENVIRONMENTAL FACTOR	+	_	_	+	+
SUM + 'S	6	0	2	5	1
SUM 0 'S	2	5	4	1	6
SUM – 'S	1	4	3	2	2
NET SCORE	5	-4	-1	4	-1
RANK	1	5	3	2	3
CONTINUE	YES	NO	NO	YES	NO

Concept scoring

concept scoring is used when increased resolution will better differentiate among competing concepts. At this stage, the team weighs the relative importance of the selection criteria and focuses on more refined comparisons with respect to each criterion. The concept scores are determined by the weighted sum of the ratings.

Table 3: Concept Scoring

		Concept			
		Concept A		Concept B	
Selection criteria	Weight	Rating	Weighted Score	Rating	Weighted Score
Ease of handling	5 %	3	0.15	3	0.15
Ease of use	15 %	3	0.45	4	0.3
Readability of settings	10 %	2	0.2	3	0.6
Dose metering Accuracy	25 %	3	0.75	4	0.75
Durability	15 %	2	0.3	5	0.75
Ease of manufacture	20 %	2	0.6	3	0.6

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Portability	10 %	3	0.3	3	0.3
	Total score rank	2.752		3.451	
	Continue?	No		Develop	

From table it clear that concept B need to be develop.

V. ASSEMBLY AND COMPONENTS

Brush Selection

Figure no 3: Brushes to be used in cleaning

Brushes are tools composed of bristles that are fixed into a mounting board, and, like other types of brushes, they are elastic, flexible, and conform to irregular or flat surfaces. Due to these features, a gutter brush can reach difficult or specific areas without damaging the bristles or the surfaces to be swept.

By leveraging the advantages of the horizontal brush system, project can achieve efficient and effective street cleaning, meeting the desired objectives while minimizing potential drawbacks associated with other brush systems.

Motor Selection

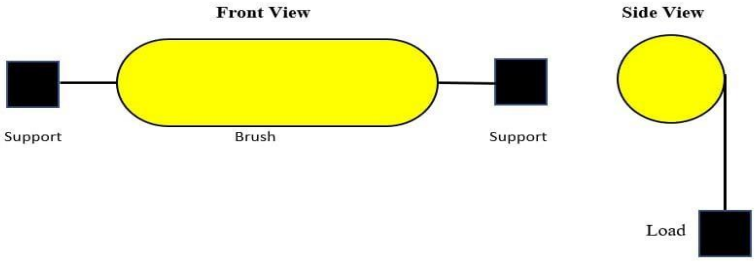

Figure no 4: Experimental setup for Torque calculation.

For calculation of torque required to rotate the brush we performed the experiment using weights as shown in above figure.

In experiment, on both side of the brush we provide supports to ends of the brush shaft and provide pulley over it. after that we vary the load. after the number of trials, we found that initial weight required to rotate the brush is 7kg.after the experiment we conclude that 7 kg weight is required to give initial torque to the brush.

Motor calculations : $P = 2\pi NM_t/60$

Assuming : N = 960 RPM

Bearing diameter = 40 mm

$M_t = w \times 9.81 \times R$

By considering number of weighted trial 7 kg weight required to perform the experiment

$M_t = 7 \times 9.81 \times 2 = 137.34$ N.m

P = 150 W

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By considering drag force we go for standard motor of 250 W
So, we selected 250-watt24-volt standard motor

Battery Selection

A 24V, 250W motor requires a power source that can supply 10A at 24V for about 250 Watts of power. The power consumption of a 24V, 250watt DC motor depends on several factors, including: Efficiency and load:
The motor's efficiency depends on the load. At full load, the motor is about 75–80% efficient.
Wheel diameter: Influence driving torque.
Wheel RPM: Motor RPM x gear ratio.
For example, 2750 x 11/68 = 440 RPM.
You can calculate the torque in kg.m using the formula: Watts = kg.m torque x RPM.
For example, if the wheel diameter is 12 inches = 0.3m,
the force at road surface is:
0.1/0.15 = 0.66 kg force.

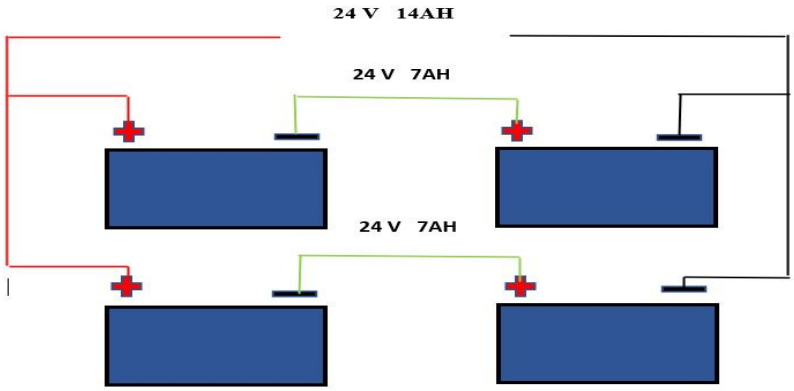

Figure no 5: Battery Pack

Ergonomics considerations

Incorporating ergonomic considerations into the design of your garbage collector machine is crucial for ensuring operator comfort, safety, and efficiency, especially since the operator will be standing on the road surface during operation. Here's how you can address standing ergonomics and hand position:
Standing Ergonomics: Design the machine's operating platform to provide adequate space and support for the operator's feet, ensuring stability and comfort during prolonged use. Consider incorporating anti-slip surfaces or footrests to minimize the risk of slipping or fatigue. Hence according to location and force diagram, height of handle decided.
Adjustable Height: Provide options for adjusting the height of the operating platform to accommodate operators of different heights comfortably. This ensures proper posture alignment and reduces the risk of strain or injury.
Hand Position: Optimize the placement of control interfaces, such as levers, buttons, or joysticks, to ensure intuitive operation and minimal strain on the operator's hands and arms. Positioning the controls at a 90-degree angle from the operator's body allows for natural wrist alignment and reduces fatigue during extended use.
Handle Design: If the operator needs to manoeuvre the machine manually, design ergonomic handles with non-slip grips and ergonomic contours to reduce hand fatigue and enhance control. Ensure that the handles are positioned at a comfortable height and distance from the operator's body for ease of use.
By considering these ergonomic principles and integrating them into the design of your garbage collector machine, you can create a user-friendly and comfortable operating environment for the operator, enhancing overall efficiency and safety during waste collection activities.

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CAD Model

The photograph depicts a 3D model created in CATIA software, enhancing conceptual clarity. CATIA's commands, such as Sketcher for 2D sketches, Part Design for solid modelling, and Assembly Design for component integration, enable precise mechanical design and assembly simulations.

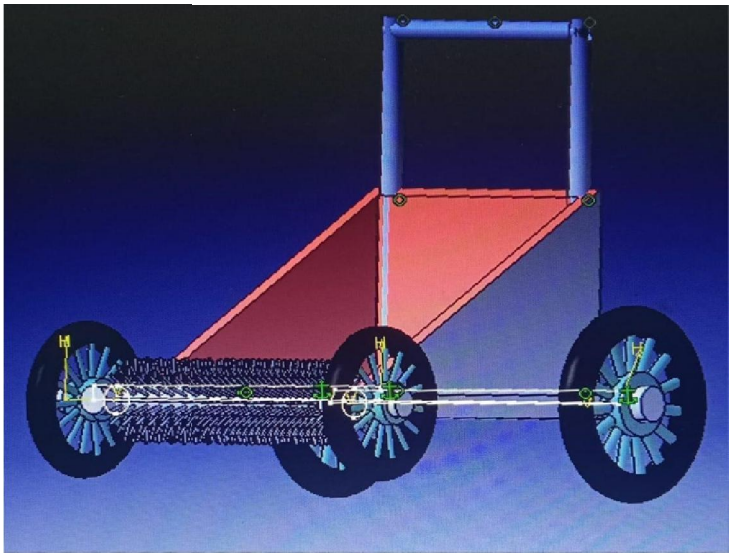

Fig No 6: 3D CAD Model of Machine

Final Fabricated model

Final model is fabricated with some modifications and considering cost reduction in to the mind.

Fig No 7: Actual fabricated model for testing

Figure shows location of designed components on chassis and complete assembly ready for use.

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Fig No 8: Actual model while testing

Figure shows testing of model to collect garbage. Garbage was collected efficiently as designed. The problem occurs due to high speed of rotary brush which creates dusty air which strikes on operator's face for same reason shield is to be provided on top of brush.

VI. CONCLUSION AND FUTURE SCOPE

Conclusion

The successful design, fabrication, and testing of the garbage collector machine represent a significant milestone in addressing waste management challenges. Through meticulous planning and execution, the model demonstrated efficient garbage collection capabilities, validated by real-world trials conducted within the college campus environment. The achieved runtime of 1 hour and 15 minutes, coupled with a charging time of approximately 2 hours per battery, underscores the model's operational viability and potential for practical use.

Furthermore, the integration of design features such as the brush, motor, and control unit proved instrumental in achieving the desired outcome of effective garbage collection. The project's success highlights the importance of interdisciplinary collaboration, innovative problem-solving, and practical application of engineering principles. Moving forward, continued efforts will focus on refining the model's design, optimizing operational efficiency, and exploring opportunities for scalability and sustainability. By addressing feedback from trials and incorporating advancements in technology and materials, the garbage collector machine project aims to make a meaningful contribution to environmental conservation and community welfare.

Future Scope

In considering the future scope of our project, "Design and Fabrication of Garbage Collector Machine," several promising avenues emerge for further exploration and development. After several trials it is observed that shield is to be provided on top of brush in order to reduce dust in atmosphere. One more thing is speed adjustment can be done by providing knob like devices for different type of garbage like dry and wet, leaves and paper etc. One area of interest lies in the integration of artificial intelligence (AI) and machine learning algorithms to enhance the machine's autonomy and adaptability. By leveraging AI-driven systems, we can optimize waste collection routes, predict maintenance needs, and improve waste sorting accuracy, thereby increasing overall efficiency. Additionally, the implementation of advanced sensor technologies, such as lidar and hyperspectral imaging, holds potential for enhancing waste detection and characterization capabilities. Furthermore, the incorporation of Internet of Things (IoT) connectivity and cloud-based analytics could enable remote monitoring and data-driven insights into operational performance and resource utilization. Collaborating with smart city initiatives presents an opportunity to align our project with broader urban sustainability goals, while a modular design approach allows for scalability and customization to meet diverse waste management needs. Exploring alternative power sources, such as solar energy, and enhancing user interface and

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experience are also key considerations for future development. By pursuing these initiatives, we can further advance the capabilities, efficiency, and sustainability of our garbage collector machine, contributing to more effective waste management practices and environmental stewardship in the future.

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