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SOLAR POWERED STREET SWEEPING MACHINE

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Abstract : This research paper represents the development of a Solar power street sweeping machine designed to generate electricity through the solar energy. A street sweeping vehicle powered by solar energy is a sustainable and energy-saving machine that utilizes solar panels to produce electricity for street cleaning. It functions without sensors, depending on manual or mechanical controls to move and gather waste, thus decreasing dependence on fossil fuels and lowering its environmental footprint.

Key Terms **- eco-consciously, energy harvesting, carbon emission**

I.INTRODUCTION

The introduction of solar-powered street sweeping machines marks a significant advancement in sustainable urban maintenance. These innovative machines harness solar energy to power their operations, reducing reliance on fossil fuels and minimizing carbon emissions. Equipped with efficient brush systems and debris collection mechanisms, they effectively clean streets, sidewalks, and public spaces while operating quietly and eco-consciously. Solar-powered street sweepers are particularly beneficial for cities aiming to enhance cleanliness and reduce environmental impact, as they offer a cost-effective, energy-efficient, and low-maintenance solution. Their adoption aligns with global efforts to promote green technology and sustainable practices in urban development.

II .OBJECTIVES

- To develop a machine that helps in easy and quick cleaning.
- To provide the alternative method for road cleaning.
- To reduce the cost anyone can use and easy to operate.
- To remove grit and sand which scratch and wear down the surface

III. BLOCK DIAGRAM

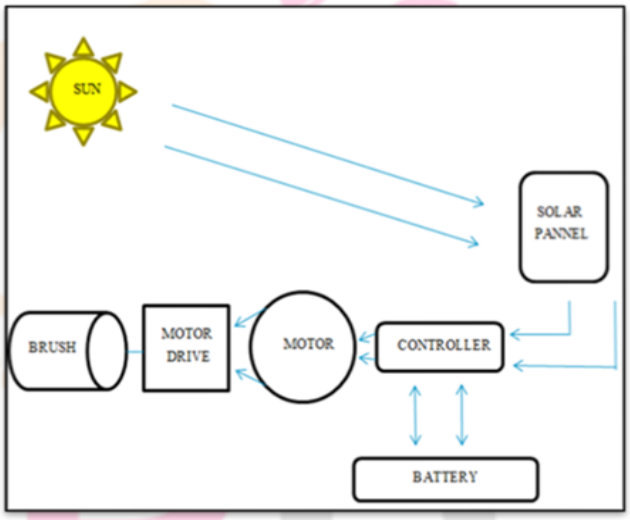

Fig.no 01 Block Diagram

The diagram illustrating the solar-powered street sweeping machine starts with solar rays being absorbed by a solar panel, which transforms sunlight into electrical energy. This energy is then managed by a charge controller to make certain the battery is charged safely and effectively, avoiding overcharging or harm. The regulated energy is stored in a dry battery, serving as the energy reservoir for the entire system. When the machine is in operation, the stored power from the battery energizes a motor drive that adjusts the speed and torque of a BLDC motor. This motor powers the nylon brushes, which are specifically designed to efficiently sweep debris from streets or other surfaces. The brushes rotate or move in a designated pattern to gather dirt, dust, and waste, ensuring thorough cleaning. Together, these elements create an eco-friendly and energy-efficient system that utilizes solar power to carry out street cleaning tasks without depending on fossil fuels.

IV. WORKING PRINCIPLE

The solar-powered street sweeping machine operates on the principle of transforming solar energy into mechanical energy to facilitate its cleaning function. The process initiates with a 50W solar panel that harnesses sunlight and converts it into electrical energy. This electrical energy is managed by a 12V charge controller, which optimizes battery charging and safeguards against overcharging or damage. The energy is stored in a 12V dry battery, serving as the power source for the system. While the machine is in use, the energy collected in the battery powers a motor drive that adjusts the speed and torque of a 12V, 30Ah motor. This motor propels the nylon brushes, making them spin to clean debris from the surface. The brushes gather dirt, dust, and litter, which are funneled into a waste collection bin attached to the apparatus. The entire system aims to be energy-efficient and eco-friendly, operating independently of the electrical grid while minimizing carbon emissions and reducing operational expenses.

Table 1- Comparison between Bldc Motor with Pmdc Motor

Parameter	Bldc motor	Pmdc motor
Rotor	Permanent magnet On rotor	Winding on rotor/armature
Controller	Controller is Required	No Controller require
Torque	Suitable for High torque application	Suitable for low torque application
Efficiency	High Efficiency up to 90%	Typically 60-70%
Noise	Low electric noise generation	Brushes emit audible noise during rotation

V. METHODOLOGY

1. Requirement Analysis
- Identify the project objectives: eco-friendly, energy-efficient, and cost-effective street cleaning.
- Define the functional requirements: solar power operation, battery storage, motor-driven brushes, and mobility.
- Determine the target environment: urban streets, sidewalks, or parks.

2. Component Selection
- Solar Panel: Choose a 50W solar panel to harness sufficient energy for the system.
- Charge Controller: Select a 12V charge controller to regulate the power flow and protect the battery.
- Battery: Use a 12V dry battery for energy storage, ensuring it can power the motor for extended periods.
- Motor and Drive: Select a 12V, 30Ah motor with a compatible motor drive to control the speed and torque.
- Brushes: Use durable nylon brushes for effective sweeping and debris collection.
- Additional Components: Include wheels, a frame, and a waste collection bin.

3. System Design
- Block Diagram: Create a block diagram to visualize the flow of energy and components.
- Circuit Design: Design the electrical circuit connecting the solar panel, charge controller, battery, motor drive, and motor.
- Mechanical Design: Design the mechanical structure, including the brush assembly, waste collection system, and chassis.

4. Prototype Development
- Assemble the solar panel, charge controller, and battery to form the power system.
- Connect the motor drive and motor to the battery, ensuring proper voltage and current ratings.
- Mount the nylon brushes onto the motor shaft and integrate them into the chassis.
- Build the waste collection bin and attach it to the chassis for debris storage.

5. Testing and Calibration
- Test the solar panel's efficiency under different lighting conditions.
- Verify the charge controller's functionality in regulating power and protecting the battery.
- Check the motor's performance and ensure the brushes rotate effectively.
- Conduct trial runs on different surfaces to evaluate cleaning efficiency.

6. Optimization
- Adjust the brush speed and motor torque for optimal cleaning performance.
- Improve the waste collection mechanism to handle different types of debris.
- Enhance the solar power system to maximize energy harvesting and storage.

7. Final Assembly and Deployment
- Integrate all optimized components into the final prototype.
- Perform field tests in real-world conditions to ensure reliability and efficiency.
- Deploy the machine for practical use in urban or public spaces.

8. Documentation and Reporting
- Document the design, development, and testing processes.
- Record performance metrics, such as cleaning efficiency, battery life, and solar energy utilization.
- Prepare a final report summarizing the project outcomes and potential improvements.

VI. FUTURE SCOPE

1. Energy Harvesting: Exploring additional energy sources (e.g., kinetic energy from movement) could supplement solar power.

2. Recycling Capabilities: Future models could incorporate systems to sort and recycle collected waste, contributing to circular economy initiatives

VII. APPLICATIONS

1. Urban Street Cleaning
- Clean streets, sidewalks, and public spaces in cities and towns.
- Reduce dust and debris, improving air quality and urban aesthetics.

2. Parks and Recreational Areas
- Maintain cleanliness in parks, gardens, and playgrounds.
- Ensure a safe and pleasant environment for visitors.

3. Industrial Complexes
- Clean factory premises, warehouses, and industrial areas.
- Handle heavy debris and dust generated in industrial settings.

4. Airports and Railway Stations
- Maintain clean runways, taxiways, and platform areas.
- Ensure safe and debris-free operations in high-traffic zones.

VIII. ADVANTAGES OF BLDC MOTOR

- High efficiency and low energy consumption.
- Low noise and smooth operation.
- Long life and low maintenance cost.
- Wide application range and good control effect.
- Ability to operate at much higher speeds than a conventional DC motor.

IX.CHALLENGES IN IMPLEMENTATION

1. High Initial Cost-The cost of solar panels, BLDC motors, batteries, and advanced components can be high.
2. Energy Storage Limitations-Batteries have limited capacity and may not store enough energy for prolonged operation.
3. Dependence on Weather Conditions-Solar energy generation is affected by weather, such as cloudy or rainy days.

X. CONCLUSION

Cleaning using side brushes is more efficient compared to just the center brush, according to studies conducted. The ultrasonic sensor senses the barrier and the system can be controlled. Machine speeds are controllable and can be varied. The machine moves without any deviation on a single straight path. Using this machine, effective cleaning is done. The architecture is simple and lightweight, and the design is simple and compact and can be used without skilled labor on any flat surface. The machine is primarily powered by solar energy, so there is no risk of emissions. It helps reduce human efforts to improve overall cleanliness and encourages safe well-being. However, certain modifications in the machine can increase its scalability.

XI. APPENDIX

This appendix offers further information about the solar-powered street sweeping machine, comprising technical specifications, diagrams, energy calculations, and performance metrics. The machine runs on a solar panel system that charges a battery, which powers the sweeping and vacuum functions. Important specifications include the [solar panel capacity], [battery storage], and [motor power]. Additionally, the appendix features material lists, system diagrams, and maintenance instructions. Performance testing results, such as energy efficiency and cleaning performance, are recorded to support the design's efficacy. Troubleshooting procedures and maintenance suggestions are provided to guarantee long-term operation and dependability.

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