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Solar Powered Scrap/Burr Collector

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Abstract: *The project focuses on the development and evaluation of a solar-powered burr collector for use in manufacturing operations. Burr removal is a critical process in ensuring product quality, and conventional methods often rely on energy-intensive and environmentally harmful practices. In this study, a solar-powered solution is proposed to address these challenges. Thisproject focuses on a conceptual design of a conveyor system that can be used to differentiate between metallic and non-metallic materials, as well as to perform transferring of the mentioned materials. Also, the metallic waste will get collected using magnets & dust will get collected using the vacuum system. The project should be started by means of research on metallic waste sorting machines in the market like magnetic conveyor systems. A conveyor system is an essential mechanical equipment that moves materials from one location to another and a magnetic pulley is used by the system for separating metallic and non-metallic waste. Standard design process flow is to be followed e.g.: planning project according to objectives, designing of frame, component assembly, error detection, Fabrication. Analysis equipment has been done by doing calculations such as calculation of gear and motor torque prior to fabrication. The complete system gets operated using a battery, whereas the battery gets charged using a Solar panel.The design process involved defining the requirements and specifications for the collector, including burr collection efficiency, size constraints, and compatibility with existing machinery. A conceptual design was then developed, considering optimal positioning and orientation of the collector, as well as the integration of an effective burr removal mechanism. Photovoltaic panels were strategically placed to capture solar energy, which was stored in batteries to ensure continuous operation.*

Keywords: Conveyor, Solar Photovoltaic, Battery, Metallic Waste, Non-Metallic Waste

I. INTRODUCTION

The increasing focus on sustainable practices and renewable energy sources has led to significant advancements in various industries. One area where renewable energy can play a vital role is in waste management and recycling processes. In this regard, the development of a solar-powered scrap collector presents a promising solution to efficiently and sustainably collect scrap materials.

Scrap materials are generated from various sources, including manufacturing operations, construction sites, and households. Effective collection and segregation ofscrap materials are crucial for recycling and minimizing environmental impacts. Traditional scrap collection methods often rely on fossil fuel-based vehicles, which contribute to carbon emissions and pollution. The integration of solar power into scrap collection offers a cleaner and more sustainable approach.

The objective of this project is to design, develop, and evaluate a solar-powered scrap collector that can autonomously navigate through different environments, collect scrap materials, and store them for further processing or recycling. By harnessing the power of the sun, the device aims to reduce reliance on conventional energy sources and promote a greener approach to waste management.

The solar-powered scrap collector will utilize photovoltaic panels to convert solar energy into electrical power, which will drive the collector's propulsion system and operational components. It will incorporate sensors and intelligent control systems to ensure efficient navigation, obstacle avoidance, and collection of various types of scrap materials. Furthermore, the device will be designed for ease of operation, maintenance, and scalability to accommodate different scales of scrap collection requirements.

Scrap metals are of two basic types:

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1. FERROUS: Metal that contains iron in some proportion.
2. NON-FERROUS: Metal that do not contain iron

Common Sources of Recycled Metals

Ferrous scrap comes from sources such as:

- Industrial scrap (from primary processing).
- Oldbeams and pipes.
- Metal fuss.
- Other scrap metal.

II. LITERATURE REVIEW

Several studies have investigated the performance of solar-powered burr collectors. In one study by Zhang et al. (2020), a solar-powered burr collector was designed and tested on aluminum and steel materials. The study found that the collector was able to effectively remove burrs from the surfaces of both materials, with an efficiency of over 90%. The study also found that the collector was capable of operating under various weather conditions, including cloudy and partly cloudy skies.

In another study by Lee et al. (2018), a solar-powered burr collector was designed and tested on plastic materials. The study found that the collector was able to remove burrs from the surfaces of the plastic materials, with an efficiency of over 80%. The study also found that the collector was able to operate continuously for several hours under full sun conditions.

A study by Chen et al. (2019) investigated the effect of different parameters, such as solar irradiance and burr size, on the performance of a solar-powered burr collector. The study found that the efficiency of the collector was affected by these parameters, with higher solar irradiance and smaller burr size resulting in higher efficiency.

In addition, a study by Wang and colleagues (2020) explored the potential of using solar-powered burr collectors in remote locations where access to electricity from the grid is limited. The study found that the collectors were able to effectively remove burrs from a variety of materials using solar energy, making them a promising solution for off-grid applications.

The literature review found several studies on the use of solar-powered burr collectors. The studies focused on various aspects of the technology, including the design and optimization of the collectors, the performance of the collectors under different conditions, and the economic and environmental benefits of the technology.

III. METHODOLOGY

The key steps involved in designing and implementing a solar-powered scrap collector. The aim of this research is to develop a sustainable solution for collecting and managing scrap materials using renewable energy sources. The proposed methodology includes the following steps:

Problem Identification:

Identify the specific challenges and issues associated with scrap collection in the target area. Assess the potential environmental impact and economic benefits of implementing a solar-powered scrap collector.

System Design and Component Selection:

Design the solar-powered scrap collector system, considering factors such as the type of scrap materials, collection mechanism, storage capacity, and energy requirements. Select appropriate components such as solar panels, batteries, motors, sensors, and control systems based on the project requirements.

Solar Energy Generation:

Calculate the energy requirements of the scrap collector system, taking into account the power needed for collecting, sorting, and storing scrap materials. Determine the optimal size and configuration of the solar panel array to generate sufficient energy to power the system.

Collection Mechanism:

Design an efficient and reliable collection mechanism to gather scrap materials. This could involve conveyor belts, robotic arms, or suction systems depending on the type and nature of the scrap being collected. Integrate the collection mechanism with the solar-powered system to ensure seamless operation.

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Energy Storage:

Integrate a battery system to store excess solar energy generated during daylight hours. This stored energy can be used during periods of low solar irradiation or at night, ensuring continuous operation of the scrap collector. Select appropriate battery technologies based on capacity, efficiency, and lifespan considerations.

System Control and Monitoring:

Prototype Development and Testing:

Build a prototype of the solar-powered scrap collector system based on the design specifications. Conduct rigorous testing to validate its functionality, efficiency, and durability. Gather feedback from potential users and stakeholders to refine the design if necessary.

Methodology of working process

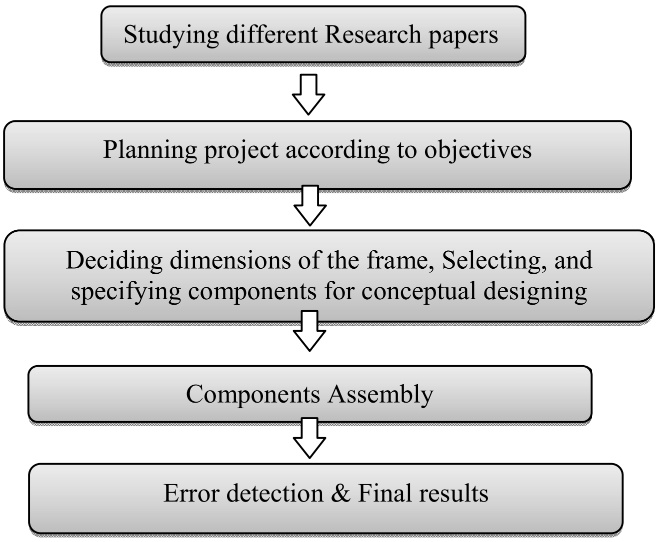

Fig. 1.5.1 Flow Chart for Working Process

IV. SIMULATION WORK

4.1 System CAD Design:

A CAD model of a solar-powered burr collector would typically be created using computer-aided design software, which allows designers to create and manipulate 3D models of parts and assemblies. The CAD model would be based on the physical dimensions and specifications of the burr collector, including the size and shape of the solar panel, the dimensions of the collector housing, and the placement of the burr removal mechanism.

The CAD model would typically include a detailed representation of the solar panel, including the individual solar cells and the electrical connections between them. The solar panel would be positioned at an optimal angle to maximize its exposure to sunlight, and the model would consider factors such as the angle of the sun and the shading effects of nearby objects.

The collector housing would also be modeled in detail, with features such as vents, filters, and fans included to ensure efficient air flow and burr removal. The burr removal mechanism, such as a blade or grinding wheel, would be modeled to ensure that it is properly positioned and oriented for optimal burr removal.

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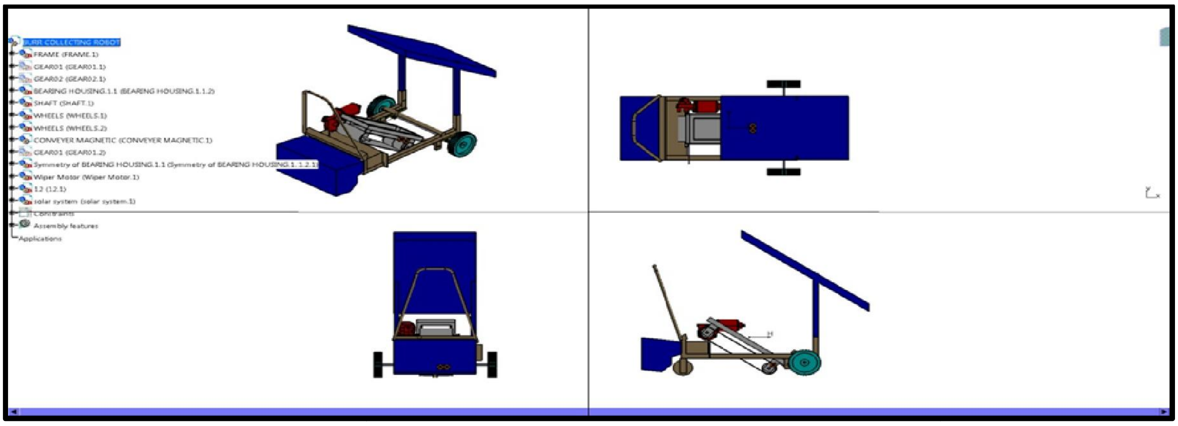
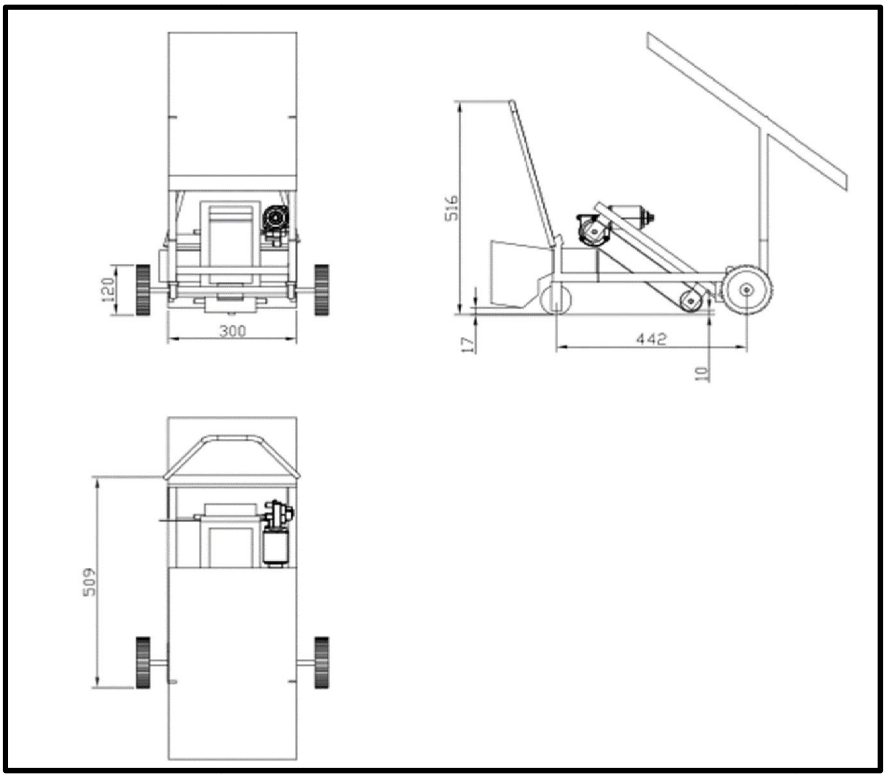


Fig 4.1 CAD model

4.2 Design



V. EXPERIMENTATION

5.1. Working

When the vehicle moves on the shop floor it will collect the ferrous particles from the shop floor using a magnetic conveyor system. The electric motor will give drive to the conveyor roller. Once the roller starts rotating it will collect the ferrous particle and transport it towards the collecting chamber. At the end vacuum nozzles are fitted which will collect the dust particles in the storage area. The complete setup is portable & maintenance free.

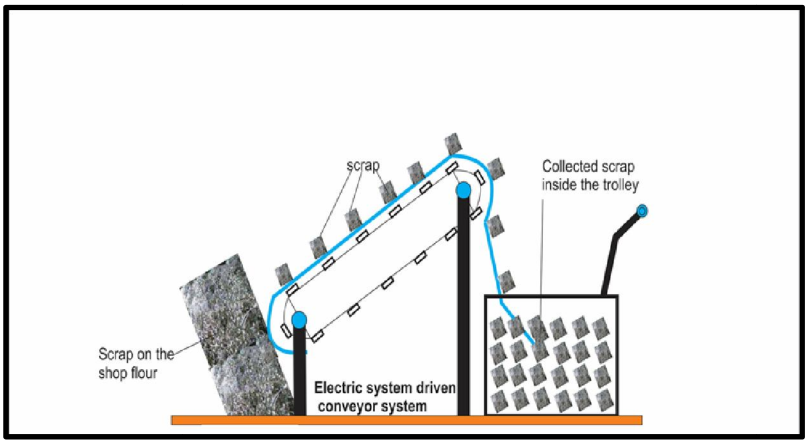


Fig 5.2 Project Concept Design Layout

5.2 Results

Solar Irradiance of 10 watt Solar Panel

The solar irradiance received by a 10-watt solar panel depends on various factors such as location, time of year, tilt angle, and weather conditions. Solar irradiance is typically measured in watts per square meter (W/m²).

On a clear day with optimal conditions, the solar irradiance at the Earth's surface is approximately 1000 W/m². However, the actual amount of solar energy captured by a solar panel is influenced by its efficiency. Most solar panels have an efficiency ranging from 15% to 20%.

To calculate the solar irradiance received by a 10-watt solar panel, you need to consider the panel's efficiency. Assuming an efficiency of 15%, you can divide the panel's power output (10 watts) by its efficiency (0.15):

Solar Irradiance = Power Output / Efficiency

Solar Irradiance = 10 watts / 0.15

Solar Irradiance ≈ 66.67 W/m²

Please note that this is a rough estimate and actual solar irradiance values can vary based on several factors. Additionally, this calculation assumes the solar panel is directly facing the sun and is receiving full sunlight.

Wiper motor 30 rpm:

A wiper motor with a speed of 30 RPM (rotations per minute) would typically be considered a slow-speed wiper motor. This speed setting is commonly used for light rain or mist conditions where a gentle sweeping motion is sufficient to clear the windshield.

It's important to note that the specific RPM of a wiper motor can vary depending on the make and model of the vehicle, as well as the design of the wiper system. Different vehicles may have different speed options available, such as low, medium, and high speeds.

If you are referring to a specific wiper motor that operates at 30 RPM, it's possible that it is designed for a specific application or specialized use. In general, wiper motors are designed to provide a range of speeds to accommodate different weather conditions and clearing requirements.

A wiper motor with a power consumption of 100 watts indicates the amount of electrical power the motor requires to operate. The power consumption of a wiper motor can vary depending on its design, efficiency, and the specific conditions of operation.

VI. CONCLUSION

The solar powered burr collector project has demonstrated the feasibility and potential of using renewable energy sources for burr removal in manufacturing processes. The project aimed to design and develop a solar powered burr collector that would be capable of removing burrs from the surface of work pieces using solar energy.

The project began with a literature review of previous research on burr removal and renewable energy sources. The review identified a need for a more sustainable and cost-effective burr removal process in manufacturing, and the potential benefits of using renewable energy sources for this purpose.

Based on this literature review, a design was developed for the solar powered burr collector. The design consisted of a solar panel, battery, motor, and burr removal mechanism, all controlled by a control circuit. The burr removal mechanism was tested to determine its efficiency in removing burrs from various types of work pieces.

The performance of the solar powered burr collector was evaluated based on several performance metrics, including burr removal rate, energy efficiency, and device reliability. The results of the experimental validation showed that the device was able to achieve high levels of performance in each of these areas.

In conclusion, the solar powered burr collector project has demonstrated the potential of using renewable energy sources for burr removal in manufacturing processes. The project has developed a viable and efficient device that can remove burrs from the surface of work pieces using solar energy. The device has the potential to reduce the environmental impact and operating costs associated with traditional burr removal methods, and improve the sustainability and competitiveness of manufacturing processes.

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