Dry Waste into Useful Energy Generation: Hardware Design and Development

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ABSTRACT

Generally, day by day, the generation of dry waste is increasing everywhere. The number of landfill sites is increasing. The generation of dry waste is increasing along with the increasing of the population. We are making this project in which we have been making this for to generate electricity through a heating process from waste materials. In this project, we are producing energy by burning dry waste materials with an automatic solar tracking system to make it more efficient during the day. The automatic solar tracking system helps optimize solar panel efficiency by following the sun's movement throughout the day. We avoided glass and petroleum products, which affect the heating process. During the daytime, using the Automatic solar tracking system, it will draw energy from the sun and converts into electricity, and at night we can make electricity by burning the waste. While heating the solid waste, the heating panels observe that and convert heat energy into electrical energy and store energy for the purpose of charging the battery, which is used to supply that energy for further purposes.

Keywords: Dry Waste; Power Generation; Energy Generation, Useful Energy Generation; Dry Wate into Useful Energy Generation

INTRODUCTION

This research work aims to reduce the environmental impact of landfills by diverting dry waste from disposal sites. Generating electricity from dry waste materials can contribute to a more sustainable energy mix. By converting waste into energy also address the issue of waste management and resource depletion. The research seeks to identify the economic and environmental benefits of utilizing dry waste for electricity generation. The findings will provide insights into the feasibility and scalability of implementing such technologies on a larger scale. Ultimately, the goal is to promote a circular economy approach by turning waste into a valuable energy resource. The objective of this research is to explore the potential of converting dry waste materials into electricity. Dry waste materials include items such as project, cardboard, plastics, and textiles. The focus is on utilizing innovative technologies to harness energy from these materials efficiently.

METHODOLOGY

By following these steps, the Automatic Solar Tracking System can optimize electricity generation from dry waste, providing a sustainable and renewable energy source.

<u>Step 1:</u> Waste Collection and Sorting:

Collect dry waste from various sources (household, industrial, agricultural) and sort it into categories (organic, inorganic, recyclable). This step ensures that only suitable waste is used for electricity generation.

<u>Step 2:</u> Waste Processing:

Shred or crush waste into smaller pieces, remove contaminants (metal, glass, plastic), and dry waste to optimal moisture level. This step prepares the waste for gasification.

<u>Step 3:</u> Solar Tracker Setup and Configuration: Install the Automatic Solar Tracking System, which tracks the sun's movement to optimize energy production. Configure system settings to ensure maximum energy output.

<u>Step 4:</u> Gasification and Electricity Generation: Feed processed waste into the gasifier, gasify waste to produce syngas, and convert syngas into electricity using a generator. The Automatic Solar Tracking System optimizes energy production by adjusting the gasifier's temperature and pressure according to the sun's intensity.

<u>Step 5:</u> Electricity Output and Monitoring: Connect generated electricity to the grid or power storage and monitor system performance and electricity output. This step ensures that the electricity generated meets the

required standards.
<u>Step 6:</u> Maintenance and Upkeep: Regularly clean and maintain the gasifier and solar tracker, and replace worn or damaged components. This step ensures the longevity and efficiency of the system.

Collection Of Municipal Dry Waste: MSW have been collected from households, surroundings and various places before that solid waste are decomposing in the landfills which are useful for our project**.**

Heating Process: The separated solid waste has been taken in the heating box for the heating process. the heating sensor is connected while heating process is going on the heating sensor and the heating panel takes the heat and converts that heat energy into electrical energy. It is the first and foremost process which is the main process in which the heat energy is converted into electrical energy.

Output Load: The energy which is stored in the battery is transferred to the externally which is used as the output load.

Disposal: The remaining residue which is left in the process in the form as ash is disposed and if it is used for further process then is used and the remaining waste like ash is disposed outside.

Pollution Filter Process: The smoke which is coming from the heating box is send to the filter control which used to control the pollution.

Automatic Solar Tracking System (ASTS): This is used to optimize the efficiency of solar panels. It works by automatically adjusting the position of the solar panels to follow the movement of the sun throughout the day. By tracking the sun's path, the solar panels can receive maximum sunlight exposure, which increases their energy production. This system helps to maximize the utilization of solar energy and improve the overall efficiency of solar power generation.

INTRODUCTION OF COMPONENTS

The integrated renewable energy system depicted in the detailed block diagram comprises several key components, each playing a vital role in the generation, storage, and utilization of clean energy. At its core lies the battery, serving as the primary storage unit for electrical energy derived from solar panels. The charge controller acts as a crucial intermediary, regulating the flow of electricity from the solar panels to the battery to prevent overcharging and ensure optimal energy transfer efficiency. Converting the stored direct current (DC) into usable alternating current (AC) is the task of the inverter, enabling the system to power a diverse array of household appliances and electrical equipment, collectively referred to as the load. Ensuring the system's efficiency and environmental sustainability is the inclusion of an air filtration unit, crucial for maintaining clean air for combustion processes, such as those in the burner. The burner, fed by dry waste material like biomass or agricultural residue, serves a dual purpose of waste disposal and energy generation through controlled combustion. Complementing the solar panels is the automatic solar tracker, dynamically adjusting panel orientation to maximize exposure to sunlight throughout the day, thereby optimizing energy production.

HARDWARE COMPONENTS REQUIREMENTS

1. Dry waste
2. Burner
3. Solar panels
4. Automatic solar tracking system
5. Inverter
6. Battery
7. Load

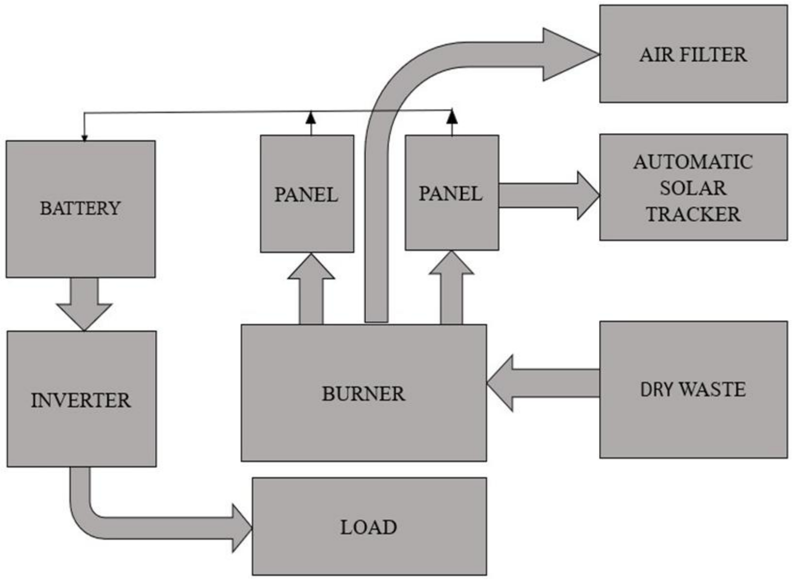

Fig.1 Block Diagram of Proposed work

1.Dry Waste

Dry Waste materials such as project, cardboard, wood, or agricultural residues serve as the feedstock for the waste-to-energy conversion process, providing a renewable source of energy for electricity generation.

These components work together to form an integrated system for electricity generation from dry waste materials with an automatic solar tracking system, ensuring efficiency, reliability, and sustainability.

Requirements:

Availability of dry waste materials for the waste-to-energy conversion process.

Compatibility with the selected conversion technology (e.g., gasification, combustion).

Minimal moisture content and contamination for efficient combustion or gasification.

The advantages of using dry waste as a feedstock for electricity generation includes Renewable Resource, Waste Reduction, Energy Independence, Local Resource, Economic Opportunities, Carbon Emission Reduction, Community Engagement, Diversification of Energy Sources

Fig 2. Dry Waste Materials

2. Burner

The burner is used in waste-to-energy conversion processes such as gasification or combustion to generate heat energy from dry waste materials, which can then be used to produce electricity or heat.

Requirements:

1. Efficient combustion of dry waste materials.
2. Minimal emissions and environmental impact.
3. Compatibility with the waste-to-energy conversion process

Fig 3. Burner

3. Solar panels

1. Solar panels capture sunlight and convert it into electricity through photovoltaic cells.
2. The solar panel model 9v3w is a 9-volt, 3-watt polycrystalline silicon panel.
3. It is designed to efficiently convert sunlight into electricity for various applications.

Polycrystalline Silicon Features

- Polycrystalline silicon solar panels are made from multiple silicon crystals.
- They are cost-effective compared to monocrystalline panels
- Polycrystalline panels have a blue hue due to the manufacturing process.

Fig 4. Solar Panels

High Energy Conversion Efficiency

- The polycrystalline silicon material used in this panel has a high energy conversion rate.
- This means it can generate a significant amount of electricity even in low-light conditions.
- The efficiency of this panel makes it suitable for both residential and commercial applications.

Table:1

Specification Parameter	Value / Detail
Model	9V,3W
Solar Cell	Polycrystalline Silicon
Dimension	14 × 1.8 × 23 CM
Output Wire	10 FT
Application Range	Charge 5V–6V batteries
VMP (Optimum operating voltage)	9V
IMP (Optimum operating current)	333 mA
VOC (Open-circuit voltage)	10.8 V
ISC (Short-circuit current)	383 mA
STC (Standard Test Conditions)	Irradiance 1000W/m², module temperature 25°C, solar spectrum AM = 1.5

Application Range

- Solar panel model 9v3w is ideal for small-scale solar projects.
- It can be used to power outdoor lighting, small electronics, and battery charging.
- This panel is also suitable for off-grid applications such as RVs, boats, and cabins.

4. Automatic solar tracking system

The sun's position is never static. It moves from East to West So, if you install a solar panel at the angle of the sun's energy, it is not enough. This is because, at one point, it won't get the sun rays as the sun shifts its angle. To address this problem, a solar tracker is installed in many solar panels. A solar tracking system (also called a sun tracker or sun tracking system) maximizes your solar system's electricity production by moving your panels to follow the sun throughout the day, optimizing the angle at which your panels receive solar radiation. There are two types of solar trackers: single axis solar tracker and dual axis solar tracker. Single axis solar tracker has one motor so it can rotate only on two dimensions. and dual axis can rotate into 4 directions.

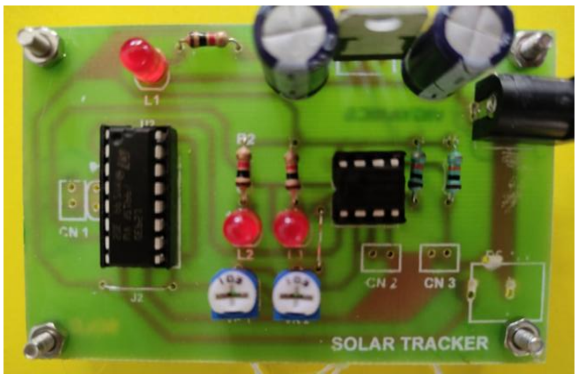

Fig 5. Automatic Solar Tracking System

Fig 6. Solar Tracker

- **Single Axis Tracker:**

Tracks in a single cardinal direction.

• single row tracking configuration.

• More reliable.

• longer lifespan.

Tracking system

Unlike rigid solar panels, these can move their angle to collect energy from the sunlight.

A single axis solar tracker can adjust in areas with less exposure to sunlight.

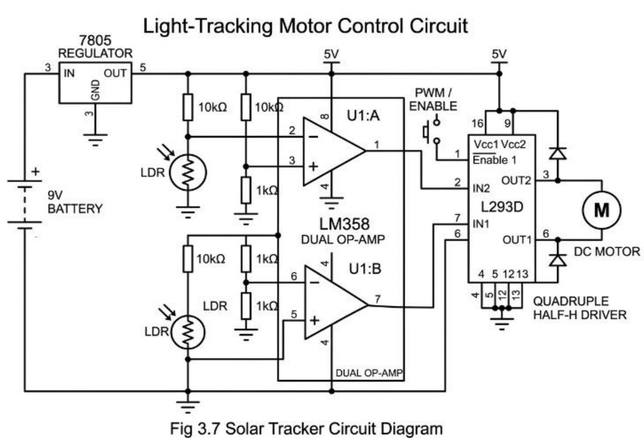

Fig 7. Solar Tracker Circuit Diagram

Solar Panel:

The solar input comprises of the solar panel and two modules of photo sensors, each of which is joined to the solar panel along its length on either side of the panel. The solar panel is supported to the wooden base by the mechanical structure. The photo sensors are hence. connected to the controlling circuit. The photo sensors used in the prototype are Light Dependent Resistors.

LDR Sensor:

The LDR Sensor is used to detect the presence of light / measuring the intensity of light. The output of the sensor goes high in the presence of light and it becomes low in the absence of light. The sensitivity of the signal detection can be adjusted using the potentiometer.

➢ Adjust the threshold (sensitivity) of digital output by tuning the on- board variable resistor (potentiometer) Simple usage as it is the digital output, so you will know the light present and decide what to do with it.

➢ Motor Driver-L293D Driver Module is a medium power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular 1293 motor driver IC. It can drive 4 DC motors on and off, or drive 2 DC motors with directional and speed control

➢ Motor is driven by 9V battery and LDR Module is powered through 5V on the L293D Module

Largest single axis solar tracker.

➢ Tata Power Renewables Energy Ltd (TPREL), a wholly-owned subsidiary of Tata Power has commissioned a 300 MW project in Dholera, Gujarat. It is India's largest single-axis solar tracker system. The project will generate 774 MUs annually.

Features:

The features of an automatic solar tracking system includes:

1. Sun Tracking Capability
2. Sensor Technology
3. Control Algorithms
4. Motorized Actuators
5. Single-axis or Dual-axis Tracking
6. Weather Monitoring
7. Remote Monitoring and Control
8. Compatibility
9. Scalability
10. Energy Efficiency
11. Ease of Installation and Maintenance
12. Safety Features

Working principle:

An automatic solar tracking system operates by detecting the position of the sun through sensors or algorithms. Once the sun's position is determined, the system calculates the optimal tilt and azimuth angles for the solar panels to ensure maximum exposure to sunlight. This calculation takes into account various factors such as the time of day, time of year, and geographical location. Using motorized actuators or servo motors, the system then physically adjusts the orientation of the solar panels to align them with the sun's position. This continuous monitoring and adjustment process ensures that the panels remain optimally positioned to capture sunlight throughout the day, maximizing energy production. Some advanced systems also incorporate weather monitoring capabilities to adapt panel orientation in response to changing weather conditions. With remote monitoring and control features, users can oversee system performance and make adjustments as necessary. Overall, automatic solar tracking systems offer a highly efficient and effective way to maximize energy production from solar installations

5. Inverter

The inverter converts the direct current (DC) electricity generated by the solar panels and stored in the battery into alternating current (AC) electricity, which can be used to power household appliances and other electrical loads.

Requirements:

1. Converts DC electricity from the solar panels and battery into AC electricity.
2. Reliable performance with minimal power loss.
3. Compatibility with the system's voltage and power requirements.

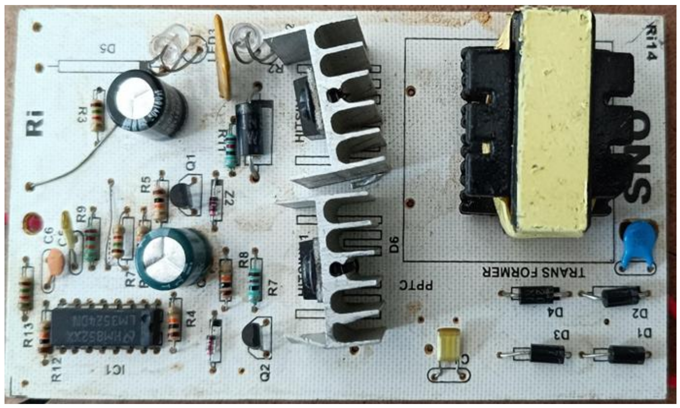

Fig 8. Inverter

Features:

1. Output Power Rating: Indicates the maximum power the inverter can deliver, typically measured in watts.
2. Input Voltage Range: Specifies the range of input DC voltage the inverter can accept from the power source, such as batteries or solar panels.
3. Output Voltage and Frequency: Determines the type of AC output and its frequency.
4. Waveform Type: Some inverters produce a pure sine wave, while others generate a modified sine wave or square wave. Pure sine wave inverters produce a clean and stable AC output, suitable for sensitive electronics, while modified sine wave or square wave inverters are more affordable but may not be compatible with all devices.
5. Efficiency: Indicates how efficiently the inverter converts DC power to AC power, typically expressed as a percentage.
6. Protection Features: Includes built-in protections such as overvoltage protection, overload protection, short circuit protection, and over-temperature protection to safeguard the inverter and connected devices.
7. Monitoring and Control: Advanced inverters may feature monitoring capabilities such as remote monitoring, data logging, and control options through smartphone apps or computer interfaces.
8. Mounting Options: Depending on the application, inverters may be designed for wall mounting, rack mounting, or installation in a specific enclosure.
9. Cooling System: Inverters often include a cooling system, such as fans or heat sinks, to dissipate heat generated during operation and ensure reliable performance.
10. Certifications and Compliance: Inverters may be certified to meet certain standards and regulations, such as safety certifications (e.g., UL, CE) and grid-connection requirements for renewable energy systems.

6. Battery

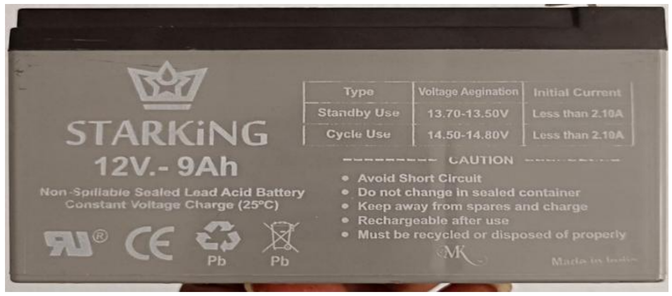

Fig 9. Battery

Battery Specifications

- Brand/Type: Starking 12V 9Ah Sealed Lead Acid (SLA) / SMF Battery
- Standby Use Voltage: 13.50V – 13.70V (Initial current less than 2.10A)
- Cycle Use Voltage: 14.50V – 14.80V (Initial current less than 2.10A)
- Applications: Commonly used for UPS systems, emergency lights, small solar setups.

HARDWARE CONSTRUCTION

Hardware construction and testing for electricity generation from dry waste materials with an automatic solar tracking system involves several components and stages:

1. Dry Waste: Converts dry waste into heat and light.
2. Burner: Produces the heat and light.
3. Automatic Solar Tracking System: Adjusts the solar panels to maximize energy absorption.
4. Solar Panels: Convert sunlight into electricity.
5. Power Conditioning Unit (PCU): Regulates and converts the generated electricity to usable form.
6. Control and Monitoring System: Oversees the entire process and ensures efficient operation.

Construction Steps:

The construction process involves designing and fabricating each component, followed by assembly and installation. The system is then integrated, and testing and commissioning are carried out to ensure optimal performance.

Testing and Commissioning:

Testing and commissioning involve functional testing of each component and the entire system, performance testing to ensure efficient electricity generation, safety testing to guarantee safe operation, calibration of the solar tracking system and control and monitoring system, and final commissioning and handover to the end-user.

Challenges:

Challenges in this project include efficient gasification of dry waste materials, reliable and efficient syngas generation, accurate solar tracking and alignment, power quality and stability, and system maintenance and troubleshooting.

BENEFITS

1. Renewable energy source from waste materials.
2. Reduced greenhouse gas emissions.
3. Increased energy efficiency.
4. Minimal waste disposal.
5. Cost-effective and sustainable energy solution.

PROPOSED SYSTEM

To generate electricity from dry waste in order to reduce the wastes by heating process and by reducing the pollution by using the pollution control filter. This project can be used in two ways in a day: By heating the dry waste and converting into electricity with the help of solar panels in the night time. Secondly In day time with the help of the Automatic solar tracking system, we can extract the energy from the sun using solar panels . Air filters help us to prevent the pollution cause by the burning so it will be an Eco-Friendly Project and also the landfill sites will be free from the wastage. By combining dry waste materials and solar energy with an automatic solar tracking system, this innovative approach offers numerous advantages, making it a sustainable and attractive solution for energy generation. Such as

1. Renewable Energy Source
2. Waste Management
3. Increased Energy Efficiency
4. Reduced Greenhouse Gas Emissions
5. Energy Self-Sufficiency
6. Job Creation
7. Reduced Energy Costs
8. Water Conservation
9. Scalability
10. Reduced Landfill Waste

CONCLUSION

In this project, the generation of electricity from the solid waste by the heating process parallelly controlling the pollution by using the pollution filter. The filter has been setup in order to control the pollution. Even controlling the pollution completely not possible but we can control the pollution to some extent. There are two ways of generating electricity explained. In day time with using the Automatic solar tracking system it will drag the energy from the sun and converts into electricity and in night time we can make electricity by burning the waste. We are reducing the solid waste and without decomposing in the landfill sites.

This proposed research totally eliminates the different kinds of waste from society and makes society neat and clean and also create awareness among the people in society about power generation in different ways. The disposal of waste can be easily done by converting it into useful energy The proposed work can be patentable, and it can be useful for commercial applications like small houses/shops/industries or institutions or municipality, power generation, where a large amount of waste is available. This Waste into Useful Energy project can also be installed in any of the institutes, paper industries, sugar cane industries, or any municipal corporation where a large amount of paper/waste is available. The Limitations of the proposer research is High capital costs, Feedstock Variability, Public Perception and Incentive Misalignment

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