RESEARCH ARTICLE

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Empowering Remote Communities with Solar Power Flour Milling Solutions

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Abstract

This study addresses the growing demand for electricity in India, particularly in remote villages. With biomass and other non-commercial fuels constituting a significant portion of energy requirements, the need for alternative energy sources is evident. The aim of this research is to explore the use of solar power as a sustainable energy solution for remote villages in India, specifically for powering grain milling activities. The methodology involves the design and implementation of solar panel systems to capture solar energy and convert it into electricity for use in grain milling. The study includes participants from remote Indian villages who currently rely on traditional, time-consuming milling techniques. The results indicate that solar power can significantly improve the efficiency of grain milling, reducing the time and effort required. The implications of this research are far-reaching, as it high lights the potential for solar power to address energy needs in.

Keywords: India, Electricity demand, Remote villages, Biomass, Non-commercial fuels, Alternative energy sources, Solar power, Sustainable energy solution, Grain milling, Solar panel systems, Energy conversion, Efficiency, Livelihoods, Socioeconomic conditions, Research implications.

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Introduction

India is the second most populous country in the world. With a growing population the needs of people is also growing, in such cases demand for electricity is very high here. Biomass and other non-commercial fuels constitute around 40% of energy requirements in India. Around 85.49% of the Indian villages are electrified, but many of the remote villages are still without electricity. People in villages mainly use bicycles as their means of transport for small distances, in such places our system is of great use. Solar cells are devices which convert solar energy directly into electricity, either directly via the photovoltaic effect, or indirectly by first converting the solar energy to heat or chemical energy. Assemblies of cells used to make solar modules which are used to capture energy from sunlight, are known as solar panels. The energy generated from these solar modules, referred to as solar power. Cells are described as photovoltaic cells when the light source is not necessarily sunlight (lamplight, artificial light etc). The amount of power available from a PV device is determined by the type and area of the material, the intensity of the sunlight, the wavelength of the sunlight. In particular, grain milling using saddle stone, pestle or mortar is arduous and time consuming, carried out exclusively by women and children. These milling techniques are more than 3000 years old (Pomeranze, 1986) and allow only low grinding rates of less than 1 kg per hour (Carruthers and Rodriguez, 1992). Therefore, milling 2.5 kg of grain which is the average daily consumption of a family takes about three hours (Chinsman, 1985).

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Problem Definition

The concern about the high electricity costs associated with flour mill machines. Our project aims to address this issue by incorporating solar panels, which will significantly reduce the electricity expenses. Additionally, we are taking a modern approach by making the machines more portable and compact through the use of wheels. This enhanced mobility will make it easier to operate and transport the machines. Moreover, by incorporating adjustable blades, we are ensuring that the machine meets the diverse needs and preferences of the market. This combination of energy efficiency, portability, and adaptability is truly remarkable.

Energy Storage

Effective storage solutions are necessary to ensure a steady energy supply during periods of low production.

Grid Integration

Upgrading the existing grid infrastructure to handle the influx of renewable energy sources.

Environmental Impact

Evaluating the environmental footprint of large-scale solar and wind installations, including land use and wildlife impact.

Economic Feasibility

Balancing the costs of implementing and maintaining renewable energy systems with the economic benefits.

Methodology

Working Principle A flour mill machine primarily utilizes mechanical force, including impact, compression, and friction, to grind grains into flour, with centrifugal force aiding in propelling grains towards grinding surfaces for efficient milling.

Major components

Solar Panel

A solar panel is a device that converts sunlight into electricity by using photovoltaic (PV) cells. PV cells are made of materials that produce excited electrons when exposed to light. The electrons flow through a circuit and produce direct current (DC) electricity, which can be used to power various devices or be stored in batteries. Solar panels are also known as solar cell panels, solar electric panels, or PV modules.

Inverter (photovoltaic transport powered)

This process is turning the direct current (DC) which generated from photovoltaic to alternating current (AC) which suitable with electric motor that used with experiments, The current DC was turning to current AC through three steps as follow :

A- The rectifier converts the AC voltage (three- phase) to DC voltage.

B- B- The capacitor bank of the intermediate circuit stabilizes the DC voltage.

C- C- The inverter converts the DC voltage back to AC voltage for machine motor

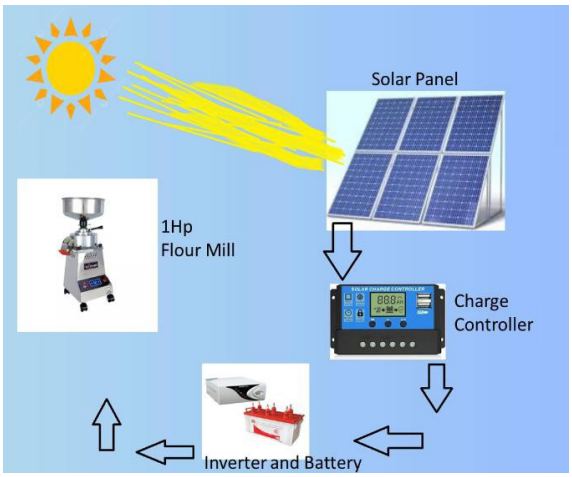
Switch

It is used to operate the milling machine. The switch type is three phase and their specification was switch type, maximum ampere output 16A to 64A and Maxie volt output (380 – 415 V)

Battery

A sealed lead acid battery or gel cell is a lead acid battery that has the sulfuric acid electrolyte coagulated (thickened) so it cannot spill out. They are partially sealed, but have vents in case gases are accidentally released for example

Hardware Setup



by Overcharging. They can be used for smaller applications where they are turned up side down. They are more expensive than normal lead acid batteries, but they are also safer.

Controller

A solar controller is an electronic device that controls the circulating pump in a solar hot water system to harvest as much heat as possible from the solar panels and protect the system from overheating. The basic job of the controller is to turn the circulating pump on when there is heat available in the panels, moving the working fluid through the panels to the heat exchanger at the thermal store. Heat is available Whenever the temperature of the solar panel is greater than the temperature of the water in the heat exchanger. Overheat protection is achieved by turning the pump off when the store reaches its maximum temperature and sometimes cooling the store by turning the pump on when the store is hotter than the panels

Working

A solar panel flour mill operates by harnessing solar energy to power the milling process. Solar panels are installed to capture sunlight and convert it into electricity through the photovoltaic effect. The energy generated by the solar panels is typically in the form of direct current (DC), which is then converted into alternating current (AC) using an inverter. This AC power is used to run the electric motor of the flour mill. If the system includes battery storage, excess energy produced during the day is stored and can be used to power the mill during the night or cloudy days. The flour mill itself consists of a motor- driven grinding mechanism that crushes grains, like wheat or corn, into flour. The solar power system reduces or eliminates reliance on grid electricity, making the milling process both cost-effective and environmentally friendly. By using solar energy, the mill operates in a sustainable manner, reducing greenhouse gas emissions and lowering its carbon footprint. This makes solar panel flour mills especially

advantageous in rural areas or regions with abundant sunlight, as they provide a reliable and eco- friendly solution for flour production

Result

The results of the solar mini flour mill machine are: the solar mini flour mill has the capacity to process 1.5 kg of wheat at a time.1 kilogram of wheat takes 15 to 20 minutes to grind. One kilogram of rice takes about fifteen minutes to mill. Our tiny flour mill machine took 15–20 minutes, whereas the pedal flour mill machine required 25–30 minutes. Our machine requires 12 volts to operate and takes approximately 15 minutes, comparing to the machine available in the market that runs on 230 volts and takes nearly 10 minutes for 1 kg.

Conclusion

The main aim in developing the small flour mill machine was to develop an inexpensive, simple-to- use system that could be assembled with minimal electricity using easily accessible materials. As a result, we proposed a simple structure that could produce a trustworthy, productive, and efficient flour mill that would be useful in a rural as well as an urban environment. Additionally, this equipment can be placed in areas with inadequate power supplies with convenience.

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