International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 04 | April - 2023 Impact Factor: 8.176 ISSN: 2582-3930

Design and Implementation of Solar Vegetable Cart

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Abstract:** This research paper presents the design and implementation of a solar vegetable cart. The cart is designed to provide a sustainable solution for transporting and selling fresh vegetables in rural and urban areas. The cart is equipped with a solar panel, a battery, and an electric motor, which allows it to operate independently from the grid. The cart also features a refrigeration unit to keep the vegetables fresh and a storage area for the produce. The design of the cart is focused on being environmentally friendly, energy-efficient, and easy to use. The implementation of the cart includes the construction of the frame, the installation of the solar panel and battery, and the integration of the refrigeration unit and storage area. The performance of the solar vegetable cart is evaluated in terms of its energy efficiency, mobility, and effectiveness in transporting and selling fresh vegetables. The results show that the solar vegetable cart is a feasible solution for providing sustainable and fresh produce in rural and urban areas. The research contributes to the field of sustainable transportation and renewable energy by providing a practical solution that can benefit both the environment and the local community.

1. INTRODUCTION:

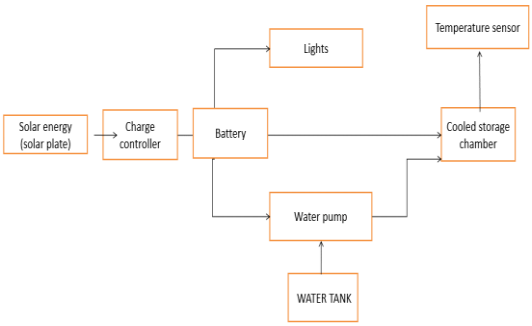
The agriculture industry is a significant contributor to the global economy and plays a vital role in ensuring food security. However, the transportation and distribution of fresh produce have become increasingly challenging, particularly in rural and urban areas with limited access to electricity and transportation infrastructure. In recent years, the use of renewable energy sources such as solar energy has gained significant attention as a sustainable solution for powering transportation systems.

This research paper focuses on the design and implementation of a solar vegetable cart, a sustainable transportation solution for transporting and selling fresh produce. The solar vegetable cart is designed to be energy-efficient, environmentally friendly, and easy to use, with a refrigeration unit to keep the vegetables fresh and a storage area for the produce [3]. The cart is equipped with a solar panel, a battery, and an electric motor, which allows it to operate independently from the grid.

The implementation of the solar vegetable cart involves the construction of the frame, the installation of the solar panel and battery, and the integration of the refrigeration unit and storage area [3 and 4]. The performance of the cart is evaluated in terms of its energy efficiency, mobility, and effectiveness in transporting and selling fresh vegetables.

The research paper aims to contribute to the field of sustainable transportation and renewable energy by providing a practical solution that can benefit both the environment and the local community. The solar vegetable cart has the potential to increase access to fresh produce in areas with limited transportation and electricity infrastructure while reducing the carbon footprint of transportation systems. The research also demonstrates the potential of solar energy as a sustainable power source for transportation systems, highlighting the importance of renewable energy in building a sustainable future.

Fig: 1 General Block Diagram



2. EXPERIMENTAL SETUP

The implementation of the solar vegetable cart involves several steps, including the construction of the frame, the installation of the solar panel and battery, and the integration of the cooling chamber unit and storage area.

A. Frame Construction

The frame of the cart is constructed using lightweight and durable materials such as bride bar and mild steel. The frame should be designed to provide adequate support for the solar panel, battery, and other components while remaining lightweight and easy to maneuver.

25×25 mm square pipes of mild steel are used for frame construction and bride bars are used for shaft.

Fig: 2 Diagram of the prototype

B. Solar panel and battery installation

The solar panel and battery are installed on the frame, with the solar panel facing upwards to receive maximum sunlight. The battery should be selected based on the power requirements of the electric motor and refrigeration unit. The solar panel and battery should be connected using appropriate wiring and charge controller to manage the charging and discharging of the battery.

C. Electric motor installation

The electric motor is installed on the frame and connected to the battery. The motor should be selected based on the power requirements of the cart and the terrain it will be operating in. The motor should also be equipped with appropriate speed controls and safety features.

D. Storage area construction

The storage area is constructed on the cart's frame to provide adequate storage space for the produce. The storage area should be well-ventilated to ensure proper air circulation and prevent spoilage of the vegetables.

E. Charge Controller

For charging two 12-volt batteries in series (24 volts total), you will need a charge controller that can handle a 24-volt input voltage. The charge controller should also be designed to work with the type of batteries you are using, whether they are lead-acid, lithium-ion, or another type.

When selecting a charge controller, it's important to consider the charging current and capacity of the batteries as well. The charge controller should be able to handle the maximum charging current of the batteries, and its capacity should be sufficient to meet the energy needs of your system.

F. Evaporative Cooling Chamber

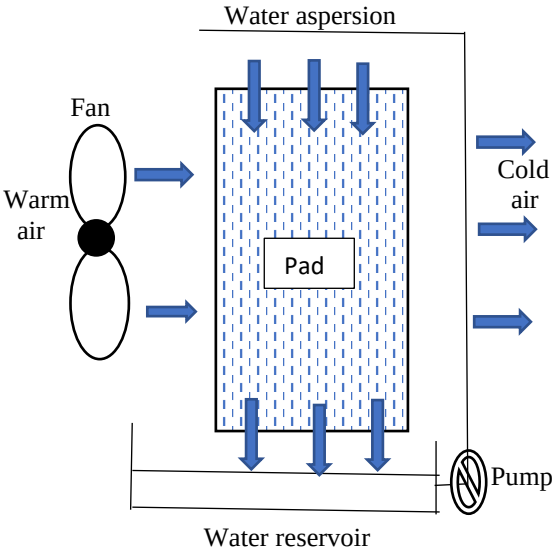
An evaporative cooling chamber is a device that uses the principle of evaporative cooling to lower the temperature and increase the humidity of the air inside the chamber. It works by evaporating water or a similar liquid into the air, which absorbs heat from the surrounding environment and cools the air inside the chamber.

The basic components of an evaporative cooling chamber include a water source, a pump to circulate the water, and a cooling pad or media that the water flows through. The cooling pad is typically made of a porous material that allows the water to evaporate and release cool air into the chamber. A fan is also used to circulate the cooled air and maintain a consistent temperature and humidity level.

Evaporative cooling chambers are commonly used in hot and dry climates where traditional air conditioning systems may not be practical or affordable. They can be used in a variety of settings, including homes, greenhouses, livestock barns, and industrial facilities. They are also an environmentally friendly alternative to traditional air conditioning systems since they use less energy and do not rely on harmful refrigerants.

However, it is important to note that evaporative cooling chambers may not be as effective in high humidity environments, and they may require regular maintenance to prevent the growth of bacteria and other contaminants in the cooling pad.

Fig: 3 Schematic diagram of evaporative cooling system



3. DESIGN CALCULATIONS

a) Selection of solar panel:

electric motor 250 watt

running (working hours) 2 hrs

Solar panel selection range is 50-100 watts.

b] Selection of motor:

The design involves the calculation of driving torque and power required for the tricycle, rating of motor, selection of motor, Battery, and number of solar panels.

vegetable cart details Cycle rim diameter d = 50 cm=0.5 m

power calculation
P=(2NT)+60-190.48 w
The motor power required for pulling the cart is 190.48 w. But motor available as per market survey is 250 watts, hence we have chosen 250 watts of motor.

c] Rate of cooling:
The rate of cooling in a honeycomb evaporative cooling chamber depends on several factors, including the size and design of the chamber, the airflow rate, the wet bulb temperature, and the dry bulb temperature.

Honeycomb pad area-2 square meters
Airflow rate=500 cubic meters per hour
Wet bulb temperature = 25 degree Celsius 1
Dry bulb temperature 35 degree Celsius -
Saturation efficiency - 80%

The rate of cooling in this honeycomb cooling chamber is 5.4 kW, which means that it can cool the air inside the chamber by 5.4 kilowatts of heat energy per hour

4. TESTING AND OPTIMIZATION

Once the solar vegetable cart is assembled, it should be tested under different operating conditions to ensure its performance and energy efficiency. The cart's components should be optimized to reduce energy consumption and improve its overall performance.
In summary, the implementation of the solar vegetable cart requires careful consideration of the design and selection of components. The cart should be optimized for energy efficiency, ease of use, and performance under different operating conditions. Proper testing and optimization are critical to ensure the cart's success in providing sustainable transportation and fresh produce to local communities.

5. CONCLUSION

design and implementation of a solar vegetable cart is an innovative and sustainable solution for promoting healthy food choices while reducing the carbon footprint of food transportation. The solar panels on the cart provide a renewable source of energy to power the refrigeration unit, ensuring that the vegetables remain fresh throughout the day.
The design of the cart should prioritize functionality, mobility, and ease of use. The cart should be equipped with sturdy wheels, brakes, and handles for easy maneuverability. The refrigeration unit should be designed to maximize space while minimizing energy consumption.
Additionally, the implementation of the solar vegetable cart requires careful consideration of the target market, location, and pricing. The cart should be strategically placed in areas with high foot traffic, such as farmers' markets, community centers, or schools. The pricing should be competitive and affordable to appeal to a wide range of customers.
Overall, the design and implementation of a solar vegetable cart provides a sustainable solution to address food deserts and promote healthy food choices while reducing the carbon footprint of food transportation.

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