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Solar Based Vaccine Storage System

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Abstract

A solar-powered vaccine storage is a refrigerator that runs on solar-generated electricity. In hot locations, solar-powered refrigerators can keep perishable commodities like meat and dairy cool, and they're also used to keep vaccines at the right temperature to minimise spoiling. Solar-powered freezers are more likely to be employed in underdeveloped countries to help alleviate poverty as well as climate change plug-in coolers with backup generators reliably store vaccine in developed countries, but other refrigeration technologies are required in developing countries, where electrical sources might be unpredictable. In this case, a solar-powered vaccine storage system can assist in overcoming issues such as electricity disruptions and mobility.
This overview depicts the safe storage of vaccines and other medical and home items in a cold environment without jeopardising their quality. The system will be powered by a solar panel for power, a battery for storage, and an AT MEGA 328 processor and other components.The proposed system will assist the user or owner in maintaining a cool temperature for the product's preservation. The sun's energy is captured and stored in the system for future use. The system is portable, allowing users to take it with them. The system is also designed to operate on a single phase 230 volt supply.

Keywords- Solar vaccine Storage, Med box, Portable, Blood storage, Peltier plate, At mega 328 p pu,

Introduction

Solar energy has recently become quite appealing for cooling reasons. It can provide a cheap and clean source of electricity for cooling and refrigeration all over the world. Solar refrigeration technique takes energy from the sun's radiation and uses it to chill things down.
This approach is a suitable alternative for pharmaceutical and vaccine storage facilities where the electricity supply is unpredictable but there is enough sunlight. It can also be used in places that aren't connected to the grid.
Maintaining the proper temperature for heat-sensitive vaccinations is critical, but it can be challenging in locations with limited or no electricity, as well as frequent or long-duration power outages, making grid-powered cooling impractical for vaccine storage.
Refrigerators powered by gas or kerosene, often known as "absorption refrigerators," have long been thought to be the best alternative in locations where electricity is inconsistent. These technologies, however, have a few disadvantages. Solar refrigerators were first offered in places without electricity in the 1980s as a remedy to the issues with gas and kerosene refrigerators.
The refrigeration process involves extracting heat from a specified surrounding space in order to reduce its temperature below that of the surrounding environment. Instead of employing the vapour compression or absorption cycles, the goal is to use thermoelectric effects to provide cooling.

Objective

To create a better vaccine storage option than traditional vaccine storage units by utilising solar technology in a portable vaccine storage device and extending vaccine life.

Literature review

1. In thermoelectric module refrigerator mechanical parts such as, compressor, liquid coolant, condenser coil, evaporation coil and expansion valve are replaced by thermoelectric module. Ganesh S. Dhumal, P.A. Deshmukh,

M. L. Kulkarni designed a thermoelectric module refrigerator that was powered by a solar panel and a rechargeable battery [1]. The experimental refrigerator contained a 0.5-liter insulated box, and two peltier plates with active heat sinks were utilised to dissipate heat from the peltier plate's hotter surface.

2. Palash Nakhate, Niraj Pawaskar, Purva Vatamwar , Saurabh Kalambe have worked on Eco-friendly Refrigerator built using peltier plates and active heat sinks [2]. Changing the mode a 12V switched-mode power supply (smps) was used to power peltier plates for cooling the chamber and active heat sink fans to disperse heat from the peltier plate to the surrounding. The ambient temperature for storing food in the refrigerator is 3 to 5 ℃ (37 to 41 °F). Using the microcontroller, the cabin's ambient temperature range can be maintained by turning off power.

Methodology-

Solar panel

The photovoltaic cell in a solar panel turns light energy into electrical energy. The output voltage of a solar panel was determined by the amount of light falling on it, and it was used as a vital source of energy in this project.

The photovoltaic cell, which is made out of solar panels, uses a unique process to convert photons to electrons and produce a current.

Photovoltaic cells are made of semi-conductive materials like silicon and receive their energy from the sun. When this happens, photons from the sun collide with electrons in the photovoltaic cell's substance, allowing an electrical current to flow. Within each cell, an electric field is employed to control the flow of electrons in a specific direction. It can be used as a power device while these electrons come through a metal contact placed on the photovoltaic cell.

Peltier plate

Peltier's impact is a critical concept in this system. The thermoelectric effect is the conversion of temperature differences into electric voltage and back. When the temperature on both sides of a thermoelectric device changes, it produces a voltage. Because an electrical current is applied across the junction of two metals, heat will be removed from one and redistributed to the other.

The Peltier effect, commonly known as the thermoelectric effect, is used in thermoelectric coolers. When a DC electric current runs through the Peltier, however, it generates heat from both sides, with one side becoming cooler and the other becoming hotter. The hot side is connected to a heatsink that is kept at room temperature. The cold, on the other hand, runs beneath the surface.

ATMEGA328P-PU

Based on the AVR improved RISC architecture, the ATMEGA328P-PU is a low-power CMOS 8-bit microcontroller. The ATmega328P-PU delivers throughputs approaching 1 MIPS per MHz by executing strong instructions in a single clock cycle, allowing the system designed to optimise power consumption versus processing performance.

The AVR core has 32 general-purpose working registers and a large instruction set. The Arithmetic Logic Unit (ALU) is directly coupled to all 32 registers, allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient, with throughputs up to ten times quicker than traditional CISC microcontroller.

LCD display

A liquid crystal display (LCD) is an electrical display module that produces a visible image using liquid crystal. The 162 LCD display is a fairly basic module that can be found in many DIY projects and circuits. The 162 refers to a two-line display with 16 characters per line. Each character is presented in a 577-pixel matrix on this LCD.

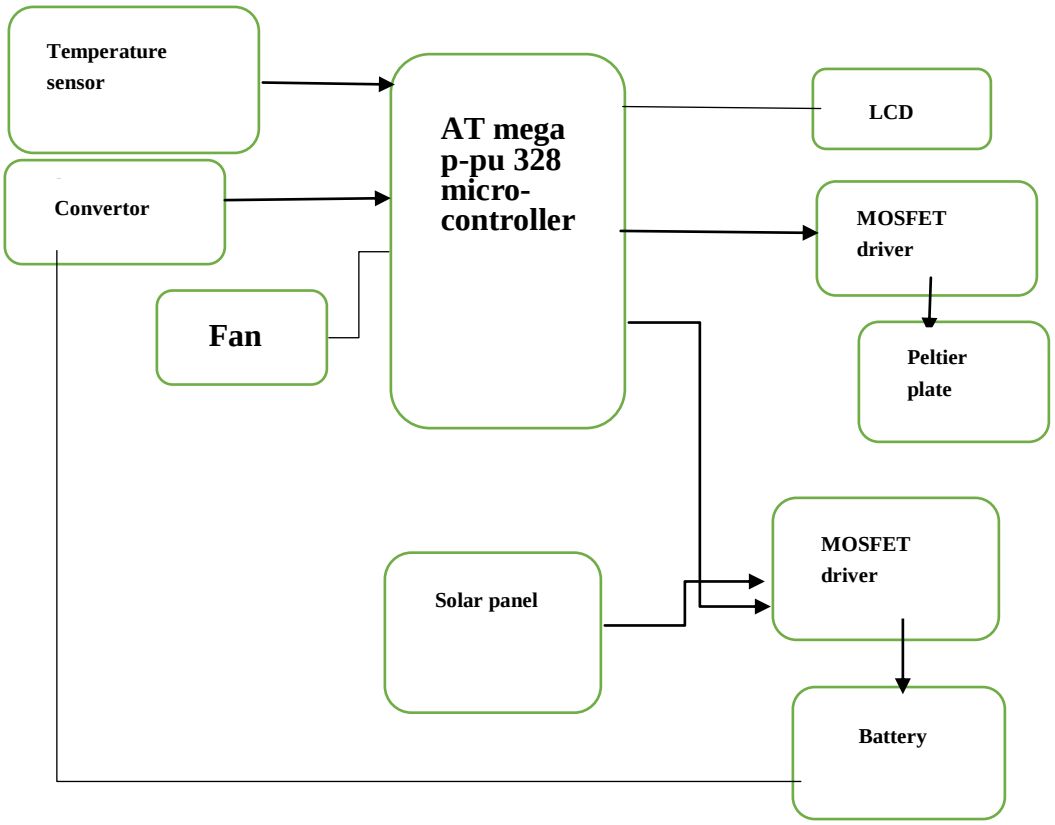
DC-DC convertor:-

For DC-DC converters, there are numerous topologies to choose from. Buck converters are becoming more common, especially in battery-powered applications, because the output voltage level may be varied in relation to the input voltage. A DC/DC power converter is the most frequent type of converter used in PV systems. It ensures that the maximum amount of electrical energy is transferred through a control action.

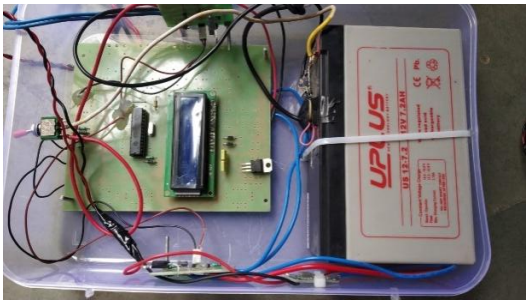
The converter's construction is governed by the load that must be delivered. The step-down DC/DC converter is the subject of this article (Buck converter). MPPT use the same converter for a variety of tasks, including controlling the input voltage at the maximum power point and load matching for maximum power transfer.

Energy Storage:

Storage device is 12v lead acid dry battery.



Experimental setup



Result-

- Desired temperature of cold compartment = 7C
- Ambient temperature = 32℃
- Dimension of cabinet =37cm × 30 cm × 16 cm
- Highest ambient temperature a heat sink can handle = Tam = 15℃

Sr. No	Time (one hour daily)	Temperature (degree Celsius)
1	9:00 AM	30
2	10:00 AM	27
3	11:00 AM	23
4	12:00 AM	21
5	1:00 PM	17
6	2:00 PM	15
7	3:00 PM	11
8	4:00 PM	7

Conclusion-

Other refrigerators are less reliable than this solar-powered vaccine storage. It is both cost-effective and environmentally friendly, which is the most desired criterion in today's world. It can be employed in a variety of industries by adjusting the chilling unit's temperature range, such as in rural areas where dairy products require special attention, or near the beaches where marine foods must be transported.

By increasing the number of peltier plate modules in the refrigerator, the efficiency can be improved, allowing the temperature to be reduced in less time. The heat transfer formula can be used to compute the number of peltier plate modules used.

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