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A Portable Multistage Solar Power Energy Convention Restorage System with IoT

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ABSTRACT: This article concentrates the new approach in mobile photovoltaic (PV) power generation that puts emphasis on cost-effectiveness, efficiency and sustainability. Tracking systems for solar panels normally use expensive gyro sensors to position them accurately towards the sun. Instead, our design suggests the usage of Light Dependent Resistors (LDRs) for tracking sun movement as an alternative, which is affordable but still accurate. Moreover, we integrate light-based generating solar panels which can collect diffused light even at night. These panels are uniquely able to capturing ambient light, consequently extending power era into nighttime hours a critical development for non-stop electricity deliver. This system coupled with SEPIC Boost Converter guarantees efficient energy conversion despite fluctuations in source intensity since it helps in ensuring high performance of the entire system. Furthermore, an inverter circuit is included so as to enable the DC to AC power conversion function that allows other devices like Laptops and cell phones to be charged externally. This makes the power system quite portable and adaptable for mobile electricity generation applications. Our research combines creative engineering with cutting edge technology yielding commercial solutions to cost effective PV cells, improved efficiency and environmental friendly energy output. The development, implementation and evaluation phases are detailed in this paper.

KEYWORDS: Arduino uno, Light Dependent Resistors (LDRs), photovoltaic (PV), SEPIC Boost Converter, NodeMCU.

I. INTRODUCTION

In recent years, the urgency of addressing climate trade and mitigating international warming has driven research efforts to enhance the results of renewable strength projects. With a pressing need to decrease reliance on fossil fuels, the implementation of renewable energy answers across numerous sectors and packages is imperative. Among these answers, the photovoltaic (PV) panel stands out as a widely adopted generation, immediately changing daylight into electrical electricity. However, the gold standard installation of PV panels calls for meticulous attention, in particular in figuring out the attitude of prevalence between the panels and sunrays to maximize energy seize. To deal with this undertaking, the usage of sun trackers will become paramount, as they make sure the maintenance of an optimal perspective of incidence among sunrays and PV panels, thereby maximizing electricity yield.

In today's quest for sustainable energy, solar energy emerges as a beacon of desire, and given the demand for renewable strength that gives easy and honestly unlimited strength answers, it has received interest the power of solar energy to dramatically reshape our power panorama. Traditional sun electricity, but, faces demanding situations in absolutely using the considerable to be had daylight. To deal with this trouble, our paintings explores regions of innovation, and we intention to transform sun electricity capture by using growing contemporary technology and modern methods.

At the coronary heart of our efforts is acknowledging the limitations of conventional sun panels. Although they've lengthy served as robust contenders for renewable electricity, their performance in top energy intake is still now not most beneficial. In reaction, we exploit the potential of light-based solar monitoring systems and propose an opportunity technique to avoid those barriers. Unlike their gyro sensor-based opposite numbers, which often come with elevated complications and prices, our system offers a easy and value- powerful alternative

At the heart of our improvements are superior sun panels and the SEPIC Boost Converter, a step forward era designed to boom power conversion performance. By seamlessly combining those functions, we intention to open new frontiers of performance and sustainability in solar energy structures. Furthermore, our work is going past just technological development; It embodies a holistic vision of sustainability, incorporating the Internet of Things (IoT) to enable wise monitoring and control. In addition, our efforts extend its scope to cellular photovoltaic (PV) structures, again promising excessive efficiency and sustainability

II. METHODOLOGY

In this Design of Proposed System. A Portable Multistage Solar Power Energy Convention Restorage System with IOT Which Show's in Fig-1 and the Proposed System Consists Two Parts: Mechanical part and Electrical Part.

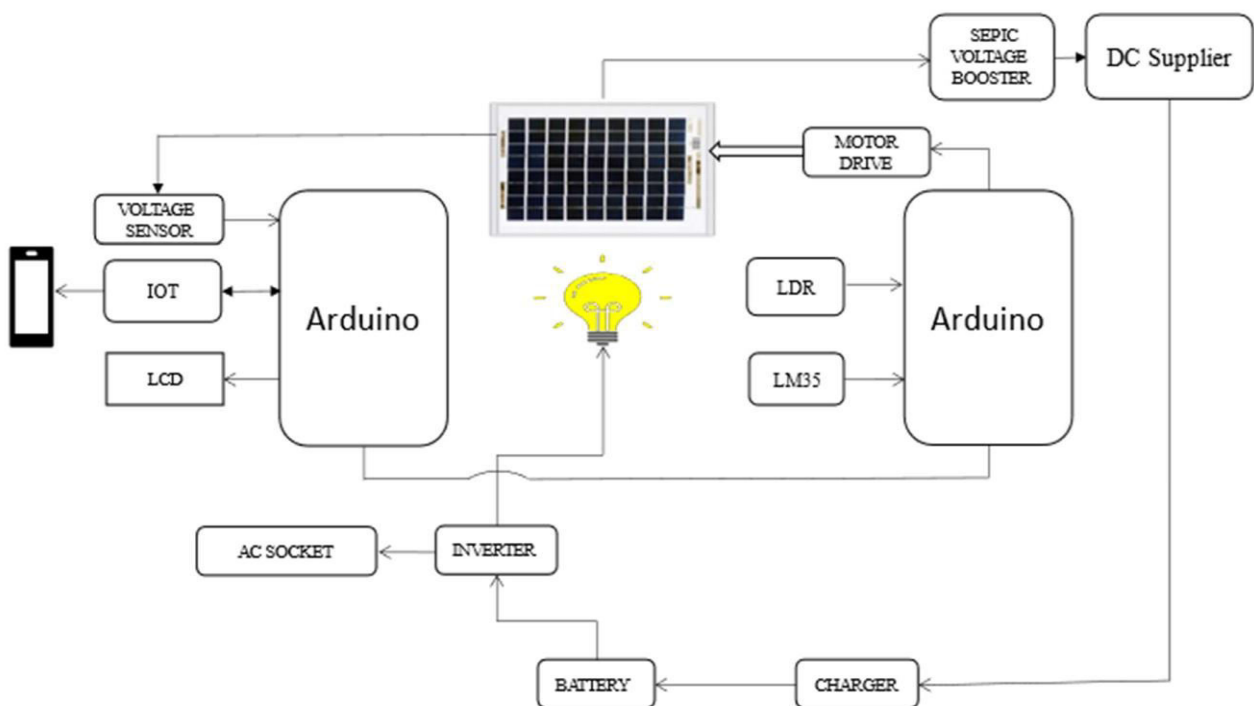


Fig 1. A Portable Multistage Solar Power Energy Conversion Restorage System with IOT

3.1 DESCRIPTION OF MECHANICAL STRUCTURE AND EQUATION

The mechanical section consists of a structure, that holds the PV panel , Gear Motor and LDR . The structure of the prototype is made of Iron .It Shows in Fig-2 In this we are Using DC Gear Motor are selected as prime mover. These high mover want to supply the torque required to regulate function of the solar panel



Fig. 2 Solar Stand

You can use a proportional control mechanism to rotate the solar panel 180 degrees based on the input of the light dependent resistor (LDR). The LDR will sense the intensity of the light on it and provide an analog voltage signal proportional to the light. This voltage signal can be used to control the rotation of the DC Gear Motor. Here is a simple mathematical equation that describes the relationship between the LDR signal and the rotation angle of the motor.

where,

$$\theta = K \cdot V_{LDR} \quad (1)$$

V_{LDR} = Voltage output from the LDR (in volts) θ = Rotation angle of the motor (in degrees)

K = Proportional gain (a constant)

In equation (1), K is the proportionality constant that determines the sensitivity of the device. It is normally determined through experimentation and tuning to reap the desired response. As the depth of light changes, this voltage sign will range as a consequence. θ represents the rotation angle of the DC Gear Motor. As the voltage from the LDR changes, it'll purpose the motor to rotate to a corresponding attitude.

By adjusting the value of K and calibrating the device, you could make sure that the rotation of the motor appropriately follows modifications in the light depth detected with the aid of the LDR, in the long run accomplishing the favored one hundred eighty-degree rotation of the sun panel.

2.2 DESCRIPTION OF ELECTRICAL STRUCTURE AND EQUATION

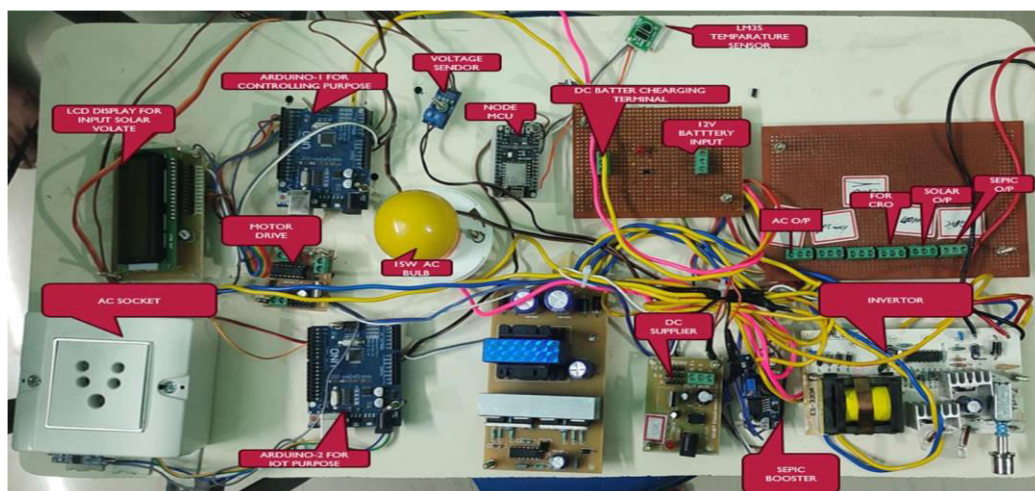


Fig. 3 Electrical Structure Kit

The figure Shows the Full Structure of the Electrical Hard ware Kit and the Components are used in this are Shown in Table-1 and the Table Consists of all Required Material to Build the Electronic Hardware Kit.

SL.NO	ITEM	DESCRIPTION	REQUIRED QUANTITY
01	LCD Display	16x2	01
02	AC SOCKET	6A-3PIN	01
03	Arduino uno	14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button	02
04	Voltage Sensor	Device that Measure Input Voltage, (0-25 v) ±0.5% to ±2% Accuracy	01
05	Inverter	12DC to 220V AC	01
06	Battery	12V DC	01
07	Temperature Sensor	LM35, -55 ⁰ C to 150 ⁰ C	01
08	NodeMCU	ESP8266 NODEMCU COMBO OF MCU WITH WIFI CONNECTIVITY	01
09	Motor Drive	L293D Motor Driver Shield	01
10	Gear Motor	12V, 125RPM	01
11	Solar Panel	Blue Chip - 22V Solar Panel	01

TABLE 1. MATERIAL REQUIRED IN BUILDING THE ELECTRONIC KIT

CIRCUIT DIAGRAM:

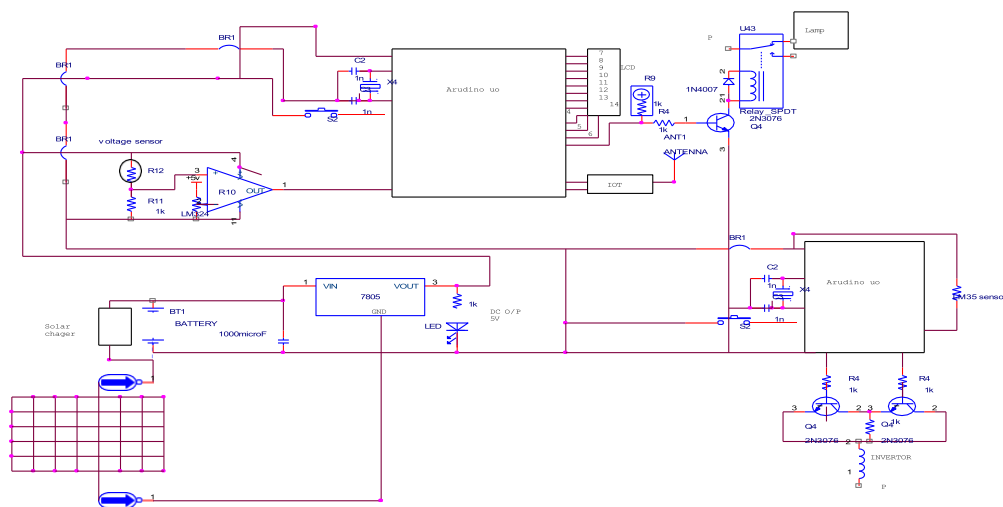


Fig 4. Circuit Diagram

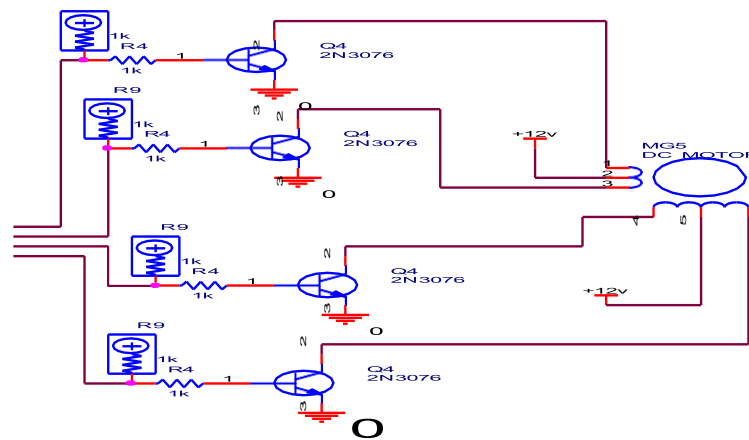
The Above Circuit Show's in Fig.4 ,The system integrates components into an automatic paper production manner, ensuring performance and manipulate. At its middle, the Arduino microcontroller interprets sensor information, along with temperature and voltage stages from the LM35, to optimize the manner. It adjusts the rate of the motor and other

variables.

The LCD display provides real-time information about the status of the system, enabling instant adjustment. Electrical management includes an AC socket, DC supplier, and 12-volt battery for stable and continuous operation, while the inverter enables the use of a 60W AC bulb, which can provide process heating. Connectivity is enhanced and controlled by a NodeMCU that provides Wi-Fi-enabled remote monitoring, extending operational flexibility.

MOTOR DRIVE CIRCUIT:

R 9



6

Fig 5. Motor Drive Circuit Diagram

The Fig.5 Show's the Arduino-guided motor drive controls the mechanical movements of the process, making it more efficient and effective. This system is an example of an integrated electronic control and mechanical system, which improves productivity, reliability and control in documentation.

Mathematical modelling

The operation of the **SEPIC converter** can be described by the following equations and the Circuit Shows in Fig.6.

i). **Output Voltage Equation (Vout):** The output voltage of the SEPIC converter depends on the duty cycle (D) of the switching signal and the input voltage (Vin). The duty cycle is the ratio of the ON time of the switch to the total switching period.

$$V_{out} = \frac{D}{1-D} \times V_{in}$$

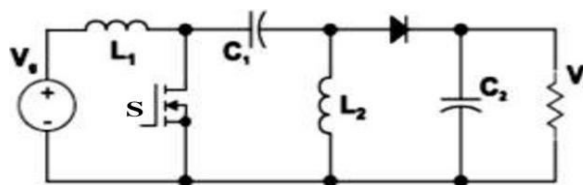


Fig 6. SEPIC Circuit Diagram

ii). **Inductor Current Ripple (ΔIL):** The inductor current ripple is a crucial parameter in the design of the SEPIC converter. It is given by.

$$\Delta IL = \frac{V_{in} \times (1-D) \times T_s}{L}$$

iii). **Inductor Peak Current (ILpeak):** The peak current through the inductor can be calculated as:



$$I_{Lpeak} = \frac{\Delta I_L}{2 + \overline{I_{Lmin}}}$$

1.1. Inverter Circuit and Simulink Modelling

12V DC to 220V AC Inverter

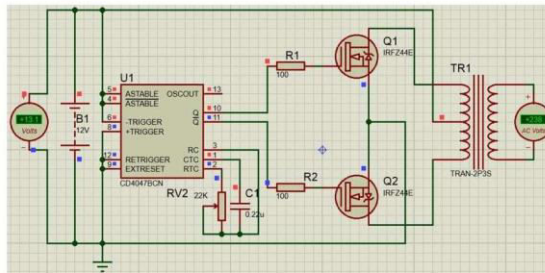


Fig 7. Inverter Circuit Diagram

The process of converting DC power from a 12V battery to an AC supply requires several steps in the inverter circuit. Although the whole process can be quite complicated, here is a simplified explanation with a basic equation. and the Circuit Shows in Fig.7

H-bridge configuration Most inverters use an H-bridge system with four switches (transistors or MOSFETs) to convert DC to AC. By monitoring the switching conditions of these switches, the polarity of the output voltage is changed to simulate the AC waveform.

Equation for output power The output voltage (V AC) of the inverter depends on the DC input voltage (V DC) of the battery and the modulation method used (such as PWM).

$$AC = D \times VDC$$

Where:

- VAC=average AC output voltage.
- VDC=DC input voltage (e.g., 12V).
- D =duty cycle of the PWM signal, representing the fraction of time the switch is ON compared to the total switching period

Frequency of use Generally, the frequency of the AC output waveform is determined by the switching frequency of the inverter circuit. Higher switching frequency has higher frequency AC output waveforms

1.3. Output Mathematical modelling

The operation of the SEPIC boost converter can be simplified with the following equation for the output voltage.

Where

Vout = output voltage of the SEPIC converter (boosted voltage). D = duty cycle of the converter.

Vin = input voltage to the converter.

Given ; To find the duty cycle(D) of the SEPIC converter, we rearrange the equation as follows.

$$D = \frac{V_{out}}{V_{out} + V_{in}} \Rightarrow D = \frac{4}{4+8} = \frac{4}{12} \Rightarrow D = \frac{1}{3}$$

=> D= 1/3

So, the duty cycle(D) of the SEPIC converter would be 1/3 or approximately 0.333.

This duty cycle indicates that the converter needs to be on for one-third of the time to boost the 4 volts DC to the desired output voltage. It shows in Fig.8 of the Output Waveform in CRO.



Fig 8.The Output CRO Waveform

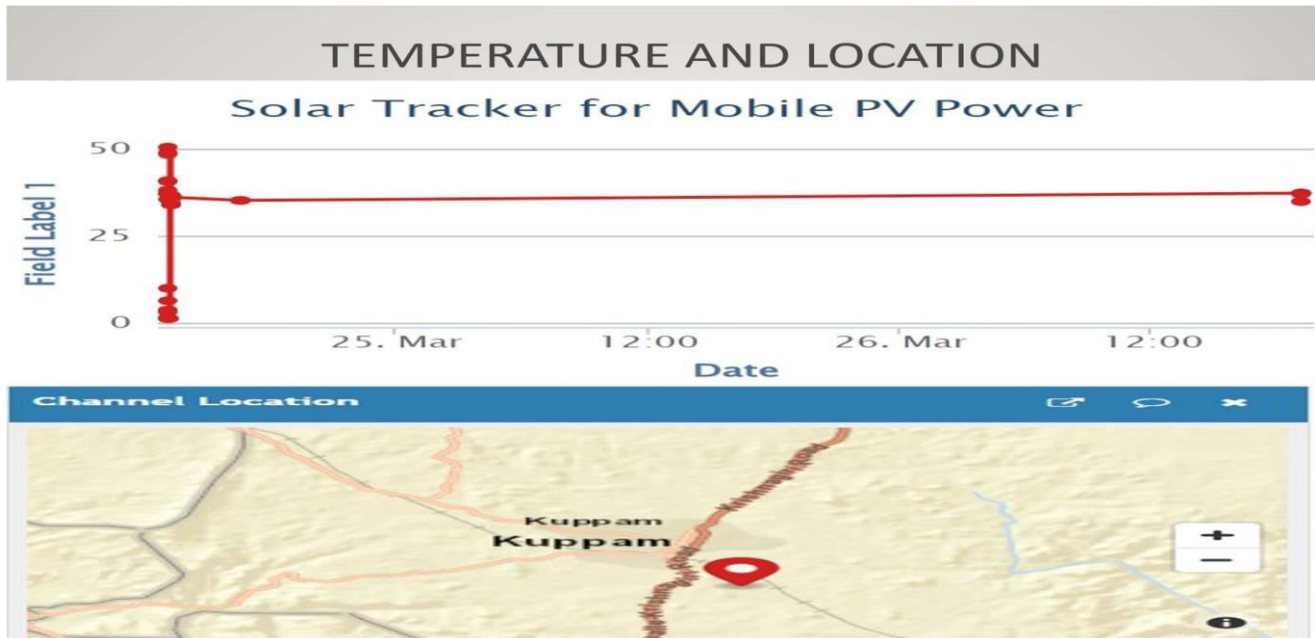


Fig 9. IOT Based Realtime Temperature And Location

III. CONCLUSION

Our project introduces a unique approach to solar power generation, which promises to be a step forward in renewable energy technology by allowing the sun to capture its energy with a lightweight bulb at night time. By simplifying traditional solar panel systems with a gentle solar base and using LDRs for daylight hours tracking, we reduce the complexity and cost of consuming IoT devices in the immediate environment more compliance, better with SEPIC Boost Converters -The integration of solar panels increases the efficiency and sustainability of the mobile photovoltaic structures Not only does this project meet the growing demand for renewable electricity not only addresses but sets a new standard for new solar energy development, highlighting the potential for significant improvements in electricity sustainability and productivity. Our findings support rigorous research and investment in renewable electricity technologies, emphasizing innovation as a key driving force for a sustainable future.

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