Self-Tracking Solar Off-Grid Inverter

Dr Deepa J[1], Nithin Mathew Joji[2], Govind M Nair[3], Amal Kumar A[4] and Ashwin S Nair[5]

1 Department of Electronics Engineering, College of Engineering Chengannur, Affiliated to Kerala Technological University, principal@ceconline.edu

Abstract. This paper explores the significance of solar tracking devices in optimizing solar panel efficiency, emphasizing a substantial up to 40% increase in energy production. The focus is on the design and implementation of a solar tracking system integrated with a 12V to 220V inverter circuit. The system dynamically aligns solar panels with the sun's position, enhancing efficiency. Additionally, the modified inverter converts generated DC power into 220V AC for household applications. The research underscores the potential of this approach in increasing energy output and efficiency, especially in regions with varying sunlight conditions.

Keywords: Solar power, Renewable energy, Solar panels, Solar tracking system, Efficiency, Energy production

1. Introduction

Solar power is one of the planet's most abundant and promising renewable energy sources, and solar panels are growing popular for domestic and commercial use. The growing interest in solar power generation results from the rising demand for sustainable energy sources. To capture solar energy and turn it into power, solar panels are frequently employed. Solar tracking devices, however, can greatly improve the effectiveness of solar panels. Using a solar tracking system, which automatically changes the position of the panels to guarantee that they are constantly facing the sun, can significantly increase the efficiency of solar panels.

A solar tracking system is made up of several sensors and motors that cooperate to position the solar panels so that they receive the most sunlight possible throughout the day. To make sure that solar panels are constantly receiving as much sunlight as possible, solar tracking devices can be especially helpful in regions with a lot of cloud cover or where the sun's position in the sky changes quickly throughout the day. Solar tracking devices are anticipated to become even more popular as solar energy gains in acceptance and price, particularly in locations where increasing energy output is a major goal.

2. Objective

This goal of the proposed work is to create and put into operation a solar tracking system with a 12V to 220V inverter circuit. In order to optimize solar panels' alignment with the sun, the system will be able to move them automatically, boosting the efficiency of energy production overall. Additionally, the system will have an inverter circuit that will convert the DC power produced by the solar panels into AC power at 220V, making it possible to power a variety of electrical devices and appliances in the home.

3. Methodology

The methodology used for implementing the system is explained in the following section. The design, construction, and testing processes for the solar tracking system with a 12V to 220V inverter circuit involve a systematic approach. The creation of the solar tracking mechanism, control system, and 12V to 220V inverter circuit will then be part of the design phase. This will involve choosing the proper components while taking efficiency, reliability, and cost-effectiveness into account.

3.1 Selection of sensor and micro controller

Choosing the right sensors is essential for precisely tracking the sun's position for the best alignment of the solar panels. Five light-dependent resistors (LDRs) were selected in this instance to serve as the sensors for measuring the strength of the sun's rays coming from various directions are chosen for a number of reasons. LDRs are a cost-effective option for this project because they are accessible and reasonably priced. Second, the quick response time of LDRs enables real-time positioning adjustments of the solar panels as the sun moves across the sky. Accurate tracking and alignment are made possible by their sensitivity to variations in light intensity. Additionally, LDRs have a broad dynamic range, allowing them to precisely measure light intensity at all levels, from low levels at dawn and dusk to high levels during the height of the day. LDRs are a good choice for tracking the sun's position throughout the day because of their adaptability. LDRs can also be connected to microcontrollers or other control systems in a fairly straightforward manner. This multi-sensor strategy improves the sun tracking mechanism's precision and dependability, enabling exact adjustments to the orientation of the solar panels.

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. The Audrino is programmed using Audrino ide. Project aims to develop and put into use a solar tracking system with a 12V to 220V inverter circuit. Solar tracking systems are created to maximize the efficiency of solar panels by dynamically adjusting their position to line up with the path of the sun throughout the day. The solar panels can receive the most exposure to sunlight and produce more energy by continuously tracking the sun's position. The goal of the project is to create a solar tracking device that tracks the sun's position using light sensors. These sensors will be placed carefully to measure the strength of the sun's rays coming from various angles. A control system will analyse the sensor data and choose the best tilt and azimuth angles for the solar panels. These sensors will be carefully positioned to measure the strength of the sun's rays coming from various angles. A control system will process the sensor data and choose the best tilt and azimuth angles for the solar panels. The control system will direct the motion of two servomotors that are in charge of adjusting the position of the solar panels in order to achieve precise alignment. The solar panels will be able to precisely track the movement of the sun because the servomotors will react to the control signals produced by the control system. The project will also include a circuit for a power inverter that converts 12V to 220V. This circuit can power a variety of home appliances and electrical devices by converting the DC power produced by the solar panels into AC power at 220V. The power inverter circuit will be built with built-in protection mechanisms to safeguard the system and connected devices, ensuring efficient and dependable power conversion. The system's functionality, effectiveness, and dependability will be thoroughly tested in a variety of settings. The significance of the proposed project lies in its potential to use an automated solar tracking system to significantly increase the energy generation effectiveness of solar panels. The addition of a 12V to 220V inverter circuit increases the system's usability by supplying AC power for a variety of domestic applications. The project's ultimate goal is to encourage the use of renewable energy sources and support the transition to an energy system that is more environmentally friendly and sustainable.

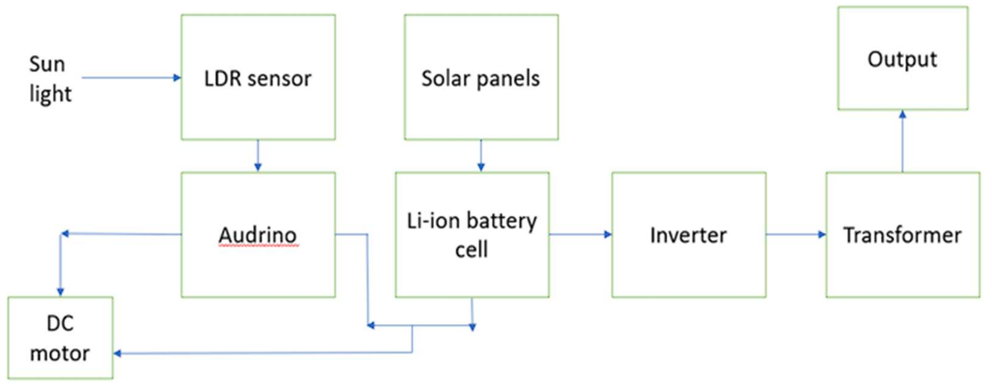

Fig. 1. Over All System Block Diagram

when the light is minimum, the micro controller reads the resistance value and the threshold value is which is set in the coding section, when the light is available and the threshold level breaks, the Arduino rotate the stepper motor. now the main work is going to progress, according the sun rotation other 4 LDRs sense the light and send data to the Arduino, and Arduino process the data and then rotate the servo motors according to the sun's rotation, the rotation position of the servo is max 170 degrees .When the sun goes down the LDR sense data again and this time the process is reverse condition, the LDR data goes down below the threshold level and Arduino Rotates the stepper motor according to the limit set within the Audrino. We are going to use 6 pieces of solar panel and each has 6V 70mAh power output, we will wire the one pair of panels in series and 3 pairs in parallel, then the voltage output will be 12v, moreover we will be generating power from solar panels and will be storing them in a battery pack (li ion or polymer battery) via battery management system. An Inverter system is used so that we can use the power to run larger devices. Here 555 timer ic is configures in an astable mode to generate around 50-60HZ ,square wave at the output and this signal is fed into the gate of the 8 mosfet to alternate 12v on to the secondary of the 12-0-12 transformer, hence we achieve 220v ac at the transformer output (max load 5amps).

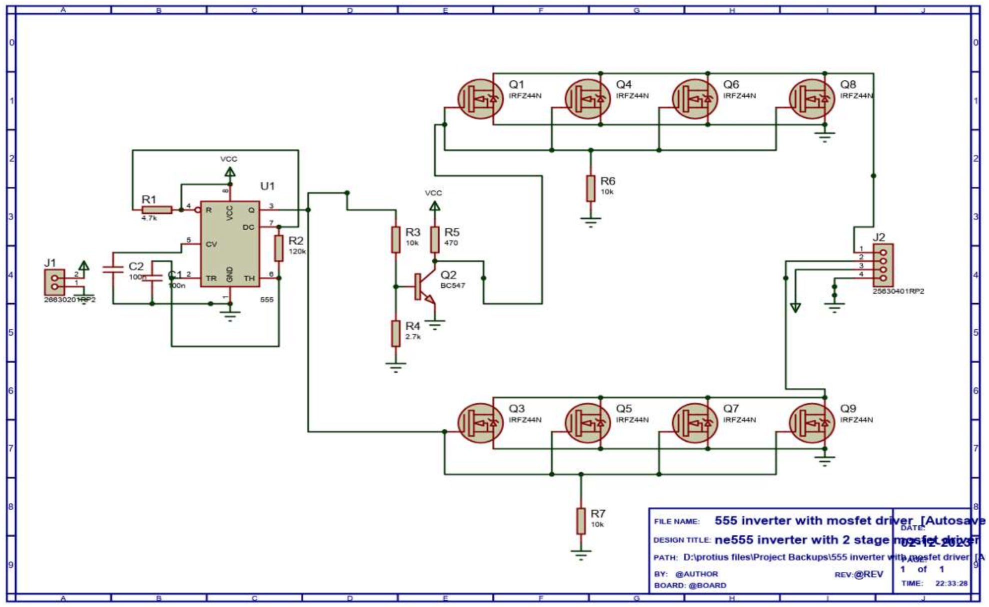

Fig. 2. Functional circuit diagram of proposed system

4. Results & Discussions

The proposed project's inverter circuit is built to convert solar panels DC power output into AC power at 220V, making it work with common electrical and household appliances. The inverter circuit makes use of a number of essential elements and procedures to guarantee dependable and effective power conversion . The Arduino program-driven solar tracking system with servo motors showed effective tracking capabilities. The system was able to move the solar panel into the proper position as a result of the LDR sensors' accurate measurement of the light intensity from various orientations. The solar panel was correctly aligned with the position of the sun throughout the day because the servo motors accurately adjusted in response to the changes that were detected. Compared to fixed solar panels, the developed solar tracking system has a number of benefits. The system maximises the amount of solar energy harvested by continuously adjusting the position of the solar panel based on the detected light intensity.

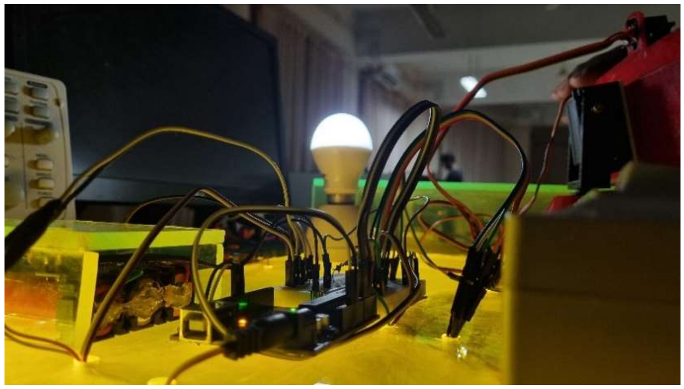

Fig. 3. Image of working prototype

Fig. 4. main inverter board pcb

5. Conclusions & Future Scope

In the pursuit of optimizing solar energy utilization, our system is designed to seamlessly align solar panels with the sun, enhancing overall energy production efficiency. Beyond this, our innovative inverter circuit facilitates the conversion of DC power generated by the solar panels into a reliable 220V AC output, catering to a diverse range of household electrical devices. Central to this endeavour is the incorporation of a precision-engineered "solar tracking mechanism," a mechanical system attuned to the sun's movement. This mechanism, orchestrated by an intelligent control system, ensures continuous alignment of the solar panels with the sun's position, thereby maximizing energy capture. The sophistication extends to our 12V to 220V power inverter circuit, meticulously designed and implemented to guarantee effectiveness, dependability, and a consistent power supply. Furthermore, our commitment to safety is paramount, with features such as temperature monitoring, short circuit protection, and overvoltage safeguards, safeguarding the system and connected devices. The system's comprehensive monitoring systems stand as a testament to our dedication to efficiency and optimal energy output. This amalgamation of technological prowess ensures a secure and efficient solar energy solution, exemplifying a commitment to excellence in sustainable energy practices.

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