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UPS SYSTEM USING PV PANELS

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Abstract **-- The goal of this project is to create a solar-powered UPS system with a solar tracking system. Due to the demand for electricity and the desire to lessen the carbon impact in the atmosphere, solar energy and UPS systems are two rapidly increasing technologies. The key rationale for choosing this system is that UPS systems can invert and correct electricity. Solar energy can be delivered to a DC section of the system rather than an AC grid, avoiding the need for a large number of inverters. The solar tracker is used to increase the amount of energy gained by the panel or payload, allowing the system to produce more electricity while maintaining high efficiency. Solar energy and an uninterruptible power supply (UPS) are two technologies that can help you save money.**

I. INTRODUCTION

Alternatives to the usage of non-renewable and polluting fossil fuels must be studied in today's atmosphere of growing energy needs and increasing environmental concern. Solar energy is one such option. Simply said, solar energy is the energy created directly by the sun and collected somewhere else, usually the Earth. The sun gets its energy from a thermonuclear reaction that transforms around 650,000,0001 tonnes of hydrogen into helium per second. Heat and electromagnetic radiation are produced throughout the process. The heat from the sun stays in the sun and helps to keep the thermonuclear process going. Electromagnetic radiation (which includes visible light, infrared light, and ultra-violet radiation) is emitted in all directions into space. Only a small percentage of the total radiation produced makes it to the Earth.

II. GENERATION OF ELECTRICITY FROM SOLAR ENERGY

Photovoltaic cells transform light into electricity by their inherent nature. This phenomenon has been known for more than half a century, but the amounts of power created were only useful for gauging radiation intensity until recently. The majority of solar cells on the market today have an efficiency of less than 15%, which means that less than 15% of the light that strikes them is converted to electricity, as illustrated in fig 1.2. Although a photovoltaic cell's maximum theoretical efficiency 5 is just 32.3 percent, solar energy is relatively cost-effective at this level. The efficiency of most of our other types of electricity generation is lower than this. Regrettably, reality continues to fall behind the theory, with a 15% efficiency rate.

A.Basic principle of solar inverter

A solar inverter, also known as a PV inverter, converts the fluctuating direct current (DC) output of a solar panel into a utility frequency alternating current (AC) that can be supplied into a commercial electrical grid or used by a local, off-grid electrical network. It is a crucial component of a solar system that allows typical business appliances to be used. Solar inverters contain features like maximum power point tracking and anti-islanding prevention that are tailored for use with photovoltaic arrays.

B. Use of Solar Inverter

There are two sorts of electrical power generation sources. One is traditional, while the other is unconventional. The majority of electrical power is now generated by conventional sources such as coal, gas, and nuclear power plants. To generate electricity, certain traditional sources degrade the environment. Nuclear energy is also not a good option because of the dangerous radiation it emits. After 10 years, conventional sources will no longer be sufficient to meet humanity's needs. As a result, non-conventional energy sources such as solar and wind should be used to generate a portion of the electrical power. PV power generation technology is gaining more and more applications as the cost of PV power generation continues to fall and the energy problem continues to worsen.

C. Standalone Inverters

Inverters that are utilized in isolated systems get their DC electricity from batteries charged by solar arrays. Many stand-alone inverters have built-in battery chargers that can recharge the battery from an AC supply if one is available. Anti-landing protection is usually not necessary because these do not interface with the utility grid in any way.

D. Grid

Grid-tie inverters are inverters that match phase with a sine wave supplied by the utility. For safety reasons, grid-tie inverters are designed to shut down automatically if there is a lack of utility power. During power outages, they do not supply backup power.

E. Backup battery

Battery backup inverters are specialized inverters that pull energy from a battery, regulate the battery charge with an onboard charger, and export excess energy to the utility grid. These inverters mustinclude anti-islanding protection and be capable of supplying AC energy to chosen loads during a utility outage.

III. LITERATURE SURVEY

A. Energy sources

A source of energy is anything that can generate heat, power life, move items, or generate electricity. Fuel is a substance that preserves energy. Throughout human history, human energy consumption has risen continuously.

B. Clean Energy

While burning fossil fuels releases a variety of damaging pollutants into the atmosphere, contributing to issues such as global warming and acid rain, solar energy is completely pollution-free. While a fossil fuel energy plant requires many acres of land to feed its required fuel, a solar energy plant simply requires the area it stands on to be destroyed. Indeed, if every business and residence had a solar energy system, no land would have to be destroyed in the name of energy. Solar energy's potential to decentralize is something that fossil fuels can't match.

C.Production of Energy on remote locations

They can generate electricity in isolated areas where there is no electricity network. Off-grid facilities are the other sort of installation, and they are sometimes the most cost-effective way to offer electricity in remote locations. The majority of PV power generation, however, comes from grid-connected installations.Regrettably, solar energy generation at this scale would have some unforeseeable severe environmental consequences. If all of the solar collectors were concentrated in one or a few regions, they would almost certainly have a significant impact on the local environment, as well as a global impact. The effects of creating solar energy on this scale have been anticipated to range from changes in local rain patterns to another Ice Age. The issue is the change in temperature and humidity around a solar panel; if the energy-generating panels11 are kept non-centralized, they should not cause the same local, mass temperature change that could harm the environment.

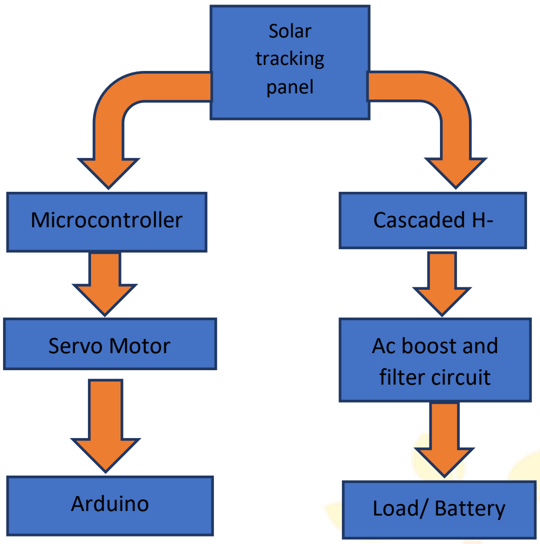
D. Background study

The utilization of high-efficiency photovoltaic solar cells has emerged as a key solution for energy saving and demand control. Users who can purchase cheaper electrical energy from the utility grid have not found them to be an appealing alternative due to their initial high costs. They have, however, been widely employed in remote and isolated places where grid electricity is either unavailable or prohibitively expensive to transport for pumping and air conditioning.Even though solar cell prices have dropped significantly in recent years as a result of breakthroughs in film technology and the manufacturing process, PV arrays are still regarded as pricey when compared to the prices of utility-generated fossil-fuel electricity. The PV array should be operated at its best conversion efficiency by continually utilizing the array's full attainable output after constructing such an expensive renewable energy system. Because of the variable nature of the solar power generated as a result of unanticipated variations in weather conditions that impact the solar radiation level as well as the cell operating temperature, an electrical system powered by solar cells necessitates particular design considerations.

IV. EXISTING SYSTEM

For the production of power, the current system employs a fixed panel. The single-stage PV inverter can be a Buck-type transformer-less inverter, such as the bipolar modulated H-bridge inverter, the H5 inverter from the previous analysis, with an extra switch S6 added between the positive terminal of the PV array and the terminal (B) to generate a new current channel. As a result, a novel

H6 transformer-less full-bridge inverter topology has been developed. Similarly, the H5 inverter topology can have an extra switch S6 between the H6 inverter, the HERIC inverter, and so on.



Block Diagram

V. PROPOSED SYSTEM

As illustrated in the block diagram, a solar tracking system is utilized to improve power output. Each PV panel is connected to an H-bridge inverter, and each DC link voltage is regulated by the matching H-bridge. The voltage-boosting function of the inverter is provided by the centralized unregulated AC Boost converter. Because the cascaded H-bridge is in charge of controlling all of the individual PV panel voltages, it must be a regulated stage at all times. This study proposes that the AC Boost be used as an unregulated stage, similar to a "transformer." When combining the two phases, making the AC Boost work without regulation reduces the control structure greatly.

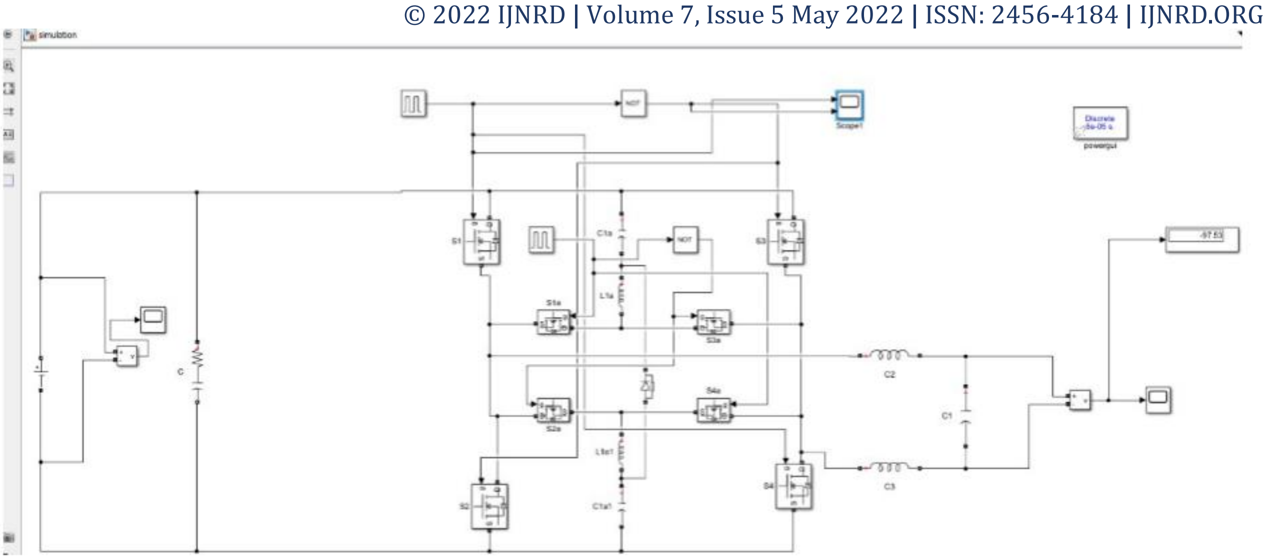
A. Working

With the use of PV panel rotation in different directions, the proposed tracking system can track a lot of solar energy during the day, as illustrated in fig 3.1. We can track the sun in four different directions using a dual-axis system because the sensors are located on either of the panel's corners. As a result, we can get more energy from solar panels. We can absorb more sun rays during this time.The dual-axis system is equally effective as the single-axis system, but the former rotates in both axes and captures more energy when compared to the latter. The former captures solar energy more efficiently by rotating in both horizontal and vertical directions, as the name implies. The corner sensors send a signal to the controller, which starts the motor and orients the panel in the precise location where the radiation intensity is highest.

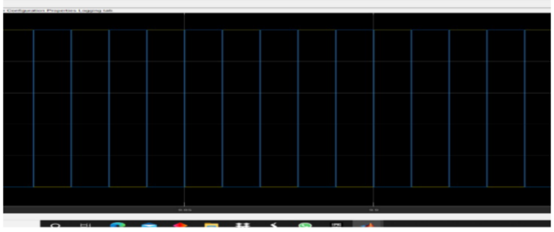
The actuator is used to position the panel.Because the Sun's position moves by 22 degrees from north to south due to the Earth's movement, solar energy produced by the fixed panel will be ineffective. To follow the path of the sun, the servo motor is in motion. The servo motor and LDR sensors are connected to a microcontroller, which controls the servo motor based on the sensor readings. LDR sensors detect sunlight and transmit a signal to the microcontroller. The microcontroller receives signals from the LDR sensor and determines the rotation direction of the servo motor and sets the panel towards the sun for maximum output based on the received input signal.This energy can be stored in a battery for later use, sent directly into the grid, or utilized to power household appliances such as televisions, refrigerators, and washing machines, among other things. To convert DC to AC and vice versa, they have an inverter and converter setup.

B. Simulation

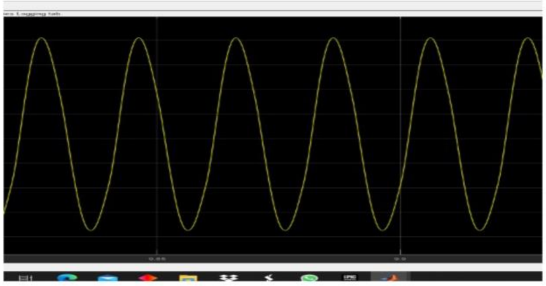
The simulated circuit of the UPS system employing PV panels is shown in the simulation, where the input power is generated by a flexible panel that moves according to the intensity of the sunlight, generating a DC supply that is then inverted by an H-bridge inverter. This inverter consists of a boost circuit that improves the input supply, then inverts them to AC supply, which then passes through a filter circuit to remove harmonics, and finally an LC circuit that acts as a storage unit in the system. The energy produced can be used to supply, stored for future use, or fed to the grid using a two-phase inverter.



C. Waveform



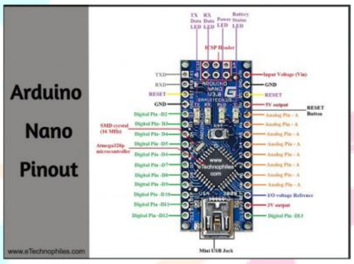
The solar panel's input, as indicated in fig. 4.2, is a DC input, which is depicted in fig. 4.2 since the panel provides us with direct current, which is passed through the inverting and boost circuit for further processing. This method uses a boost circuit with a PWM link to flip both cycles.



In the simulation, the controller is implemented as an embedded MATLAB function, as seen in the waveform. The initialization section is displayed, which switches on power to all components. The east and west tracking cells' output voltages are then combined to determine whether it is day or night. The application will repeat the loop if it is night. The application will exit the loop after sunrise and enter the daytime tracking loop. Based on the output voltage from east and west tracking cells, there are three scenarios. The controller will switch to night mode if the maximum rotation steps are achieved.

D. Hardware

1. *Arduino Nano*

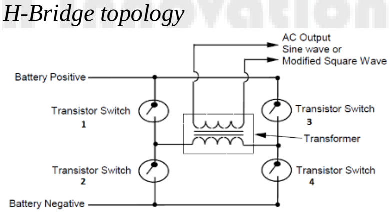


2. *Solar panel*

3. *Servo motor*

4. *LDR Sensor*

5. *H-Bridge topology*



E. Fixed Panel System

The system is run in a set manner as described so that the output can be checked. Because the sun changes its position throughout the day and the intensity of the sunlight decreases as the day advances, the efficiency of the panel output is affected. During the fixed panel system, the panel is retained at a 10-degree angle for energy production.

Time	*Voltage (V)*	*Current (A)*	*Power (W)*
8:00	*7.55*	*0.03*	*0.22*
10:00	*8.70*	*0.10*	*0.87*
12:00	*17.22*	*1.12*	*19.28*
14:00	*17.79*	*0.92*	*16.36*

The output of Fixed Panel

F. Flexible Panel System

A solar tracker is a device that directs a payload, such as a solar photovoltaic panel or a focusing solar reflector or lens, toward the Sun. The sun's position in the sky changes with the seasons, from summer to winter, due to changes in time of day as the sun moves around the Earth due to its rotation and revolution. Solar-powered equipment performs best when it is pointed towards or near the sun, hence a solar tracker can boost the generation output of such equipment over any fixed position but at the cost of increased system complexity. Solar trackers come in a variety of price points, sophistication levels, and performance levels.

Time	Voltage (V)	Current (A)	Power (W)
8:00	4.57	0.03	0.13
10:00	8.97	0.16	1.43
12:00	17.31	1.30	22.5
14:00	17.50	0.95	16.65

Output of Flexible Panel.

G. Single-axis photovoltaic tracking system

There are three different types of single-axis photovoltaic tracking systems. There are three types of single-axis tracking systems: horizontal single-axis tracking, vertical single-axis tracking, and tilted single-axis tracking. • HSAT (horizontal single-axis tracking system) (see fig. 6.3) The HSAT's rotating axis is perpendicular to the earth.Single-axis vertical tracking system (VSAT) The VSAT's rotating axis is parallel to the earth. During the day, these tracking systems cycle from east to west. Energies 2020, 13, 4224 9 of 24 Tilted single-axis tracking systems (TSAT) Tilted single-axis tracking systems include all tracking systems with a horizontal and vertically rotating axis. Tracking systems' tilt angles are frequently controlled in order to lower the elevated end's height off the ground and lessen the wind profile. PASAT (polar-aligned single-axis tracking system) is a variant of the tilted single-axis tracking system. In this example, the tilt angle is equal to the installation's latitude, which matches the earth's rotating axis with the tracking system's rotating axis.PASAT (polar-aligned single-axis tracking system) is a variant of the tilted single-axis tracking system. In this situation, the tilt angle is equal to the installation's latitude, aligning the earth's rotating axis with the tracking system's rotating axis.

H. Dual-axis Photo-voltaic tracking system

Dual-axis photovoltaic tracking systems are grouped into two variants based on the azimuth of their principal axes in relation to the ground. Azimuth-altitude tracking systems and tip-tilt tracking systems are two common types. Dual-axis tip-tilt tracking system (TTDAT). The primary axis of a tip-tilt dual-axis tracking system (TTDAT) is horizontal to the ground, while the second axis is normal to the primary axis.Dual-axis tracking system for azimuth and elevation. The primary axis of an azimuth-altitude dual-axis tracking system (AADAT) is vertical to the ground, while the second axis is normal to it.

ADVANTAGES

1. The strength of the sun can be used to determine the position of the sun at any time of day.
2. It improves the production of clean, emission-free electricity.
3. When compared to generators, they are portable and may be deployed anywhere.
4. Increased efficiency by 40% as compared to fixed panels.

DISADVANTAGES

1. The cost of the solar panel is expensive at first.
2. Installation necessitates a lot of area.
3. In the event of damage, moving parts and gears may need to be replaced.
4. Inverters of this kind are prohibitively expensive.

APPLICATIONS

1. They can be utilised to replace fossil fuel and non-renewable energy sources in the production of power.
2. They can be utilised to generate electricity in rural, isolated, and steep places where transmission pole installation is problematic.
3. They can be utilised for a variety of purposes, including residential use or as a stand-alone system.

VI. RESULT

As shown in the analysis, the solar module with tracking system improves efficiency by roughly 24% over a static solar module. As a result, incorporating this technology into the construction of solar systems will significantly increase utility performance.

VII. CONCLUSION

They can be utilised to generate electricity in rural, remote, and steep places where transmission pole building is challenging. They can be used for a variety of purposes, including residential use or as a stand-alone system. They can be utilised to replace fossil fuel and non-renewable energy sources in the production of power. There are various ways to improve the efficiency of a solar power generator, but solar tracking based on sensor intensity is the most effective technique to increase production.Photovoltaic tracking systems are a field in which a lot of study has been done. However, because the area is so vast, there is always room for new ideas and improvements. The low efficiency of solar modules, and hence the reduced generation of electrical energy, is one of the key reasons for the development and production of photovoltaic tracking systems. Photovoltaic tracking systems, PV systems with concentrating mirrors (CPV), and photovoltaic/thermal hybrid systems (PV/T) are all systems that boost the yield of standard PV systems. Each of these systems has the potential to boost electrical energy production.Based on the findings of this project report, it has been determined that using a solar tracking system to acquire optimal solar energy from the sun is both efficient and practicable. By keeping the photovoltaic panel aligned with the sun, it receives direct sunlight falling on its surface, creating more electricity. Different strategies were used in the development of this system, but the way used in this project is basic, easy to maintain, and does not require any technical expertise to operate. The software created for this project can be used outside of the mechanical part, making it adaptable to future changes.This concept could be expanded in the future by merging other renewable energy sources, including as wind and hydro power, for generating and storing electricity in order to fulfil future demands due to the world's growing population and to minimise carbon emissions. This system can be used as a stand-alone system, a grid-connected system, or for total electricity generation. It can be utilised to generate power in rural, isolated, and hilly places where transmission poles are difficult to install. They can be used for a variety of purposes, including residential use or as a stand-alone system.

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