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Solar Based UPS System

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Abstract: This project aims to provide an eco-friendly and reliable backup power solution using solar energy. It is especially useful in rural or semi-urban areas where power outages are common.
By integrating a 160W solar panel, 12V battery, and 600VA inverter, the system is designed to power a personal computer for approximately 1 hour, ensuring continued productivity during power cuts

I. INTRODUCTION

A Solar-Based UPS System provides an eco-friendly and reliable power backup solution using solar energy. It stores energy from solar panels into batteries and supplies uninterrupted power during outages through an inverter. This system reduces electricity bills, promotes renewable energy, and is ideal for areas with frequent power cuts.

II. LITERATURE SURVEY

Uninterruptible Power Supply (UPS) systems are essential for ensuring continuous power to critical equipment during outages. Solar-based UPS systems have gained prominence due to their sustainability and cost-saving potential. This literature review existing research on the design, implementation, and performance of the solar-based UPS systems.

Research in this area has focused on optimizing the configuration of solar panels, charge controller, Battery, UPS system, the cost of solar systems is relatively high, long-term savings in electricity bills and maintenance costs make them financially viable in the long run.

A challenges such as high initial costs, space requirements for solar panels, and battery degradation remain significant. Future research should focus on advanced energy storage solutions, efficient power management systems, and cost reduction strategies to enhance the viability of solar-based UPS systems.

Rohith Madhuraj, Rohit Kumar Kamat, Solar Powered UPS System the research and development of a solar powered UPS in India's market as an alternative source of energy. It consists of design which is done according to our research. The design of solar UPS consists of solar charge controller, inverter circuit and a solar panel. During this process many circuit simulation were done to fit the requirement of this project. It also shows that solar Ups can be highly efficient and successful in electrical UPS market. This project consists of solar panel which consist solar cell which convert solar energy into electrical energy.

J.C. Osuwa, E.C. Igwiro, Uninterruptible Power Supply Using Solar Rechargeable Battery, Uninterruptible Power Supply is critical to many sectors of the economy such as operation of units in hospitals, banking operations, information technology systems, etc. and generally, a constant power supply is cardinal to rapid economic growth and sustainable development. In developing countries in particular, where power failure is a regular feature, there is great need for improved UPS systems. A power supply system that incorporates a renewable source of energy as contained in this work provides a viable option to overcome the problem of disruption of work in progress due to power failure.

P. Venkatesh, T. Swetha, Solar Powered UPS, sudden change in voltage may cause damage for the functioning of mission critical electrical loads. To avoid these damages and to provide a steady flow of power to these electrical loads we are using uninterruptible power supply UPS.

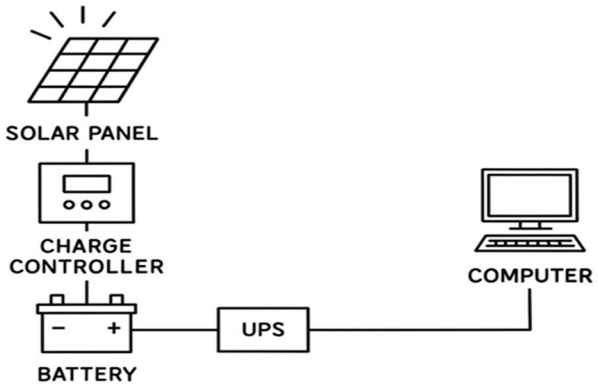
III. METHODOLOGY

1) Component Selection: Select key components such as a solar panel (e.g., 160W), a 12V battery, charge controller, 600VA inverter, and necessary wiring and protections.
2) System Design: Design the system layout to connect the solar panel to the charge controller, which charges the battery. The battery is then connected to the inverter to power the load (e.g., a PC).

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3) Installation & Assembly: Install the solar panel in a location with maximum sunlight. Connect all components following standard wiring practices and safety measures.
4) Testing: Test the system for performance, including charging time, inverter output, and backup duration during power outages.
5) Performance Evaluation: Monitor power output, backup time, and energy efficiency. Compare the system's performance against expected results.

Block Diagram and Description:-



A. Principle of Operation

A Solar-Based UPS (Uninterruptible Power Supply) System provides uninterrupted power to connected devices using solar energy as the primary power source and batteries as the backup. The main components involved are:

1) Solar Panel:

Function: Converts solar energy into DC electricity.

Working: Solar panels are made up of photovoltaic (PV) cells that absorb sunlight a generate direct current (DC) electricity. The amount of power generated depends on the panel size, sunlight intensity, and duration of exposure.

Output: Typically, solar panels produce 12V, 24V, or 48V DC power.

2) Charge Controller

Function: Regulates the voltage and current from the solar panel to prevent battery overcharging and over-discharging.

Working: The charge controller receives DC power from the solar panel and manages it before sending it to the battery. It adjusts the charging voltage and current based on the battery state to ensure optimal charging and extend battery life.

Types of Charge Controllers: PWM (Pulse Width Modulation) MPPT (Maximum Power Point Tracking) – more efficient and commonly used.

3) Battery

Function: Stores the electrical energy generated by the solar panel for later use. Working: The battery stores the DC power from the charge controller and provide backup power during power outages or when solar power is insufficient.

Types of Batteries: Lead-Acid Battery (Flooded, AGM, Gel) Lithium-Ion Battery – higher efficiency and longer lifespan. Battery Capacity: Measured in Ah (Amp-hours), it determines the backup duration.

4) UPS System

Function: Converts stored DC power into AC power and provides uninterrupted power to connected devices.

Working: Normal Operation: When solar power is available, the UPS draws power from the solar panel, charges the battery, and supplies power to the connected load. Backup Operation: When solar power is the unavailable or a insufficient, the UPS automatically switches to battery power and continues supplying power to the load. Charging Mode: During grid availability, the UPS can also charge the battery using AC power. Inverter Stage: Converts DC power to AC power (typically 230V, 50Hz) suitable for powering AC loads like computers.

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5) Computer (Load)

Function: Utilizes the AC power supplied by the UPS to operate. Working: The computer remains protected from the power interruptions due to the a continuous power supply provided by the UPS. The UPS also a regulates the output voltage, preventing damage from power surges or voltage drops. The computer receive stable AC power from the UPS system. In case of a power outage, the transition from grid power to battery power is seamless, preventing data loss and system shutdown.

IV. COMPONANTS

A. Solar Panel

Using semiconducting materials that show the photovoltaic effect, a phenomena researched in physics and photochemistry, photovoltaics (PV) converts light into electricity. However, employing solar energy as a primary source necessitates the installation of energy storage systems or high-voltage direct current power lines that add to the expense. Solar cells use sunshine to generate direct current electricity that can be used to power devices or recharge batteries.

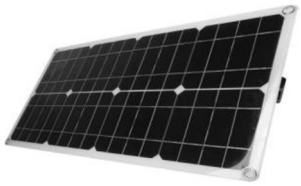


Figure 2: Solar Panel

No	Parameters	Rattings
1	Maximum Power	100W
2	Voltage At Max Power	12V
3	Current At Max Power	5.57A
4	Open Circuit Voltage	21.90V
5	Short Circuit Current	6.12A

B. Charge Controller



Sr. No.	**Parameter**	**Details**
1	Rated Charge Current	20A
2	Battery Voltage	12V / 24V Auto Recognition
3	Max PV Input Voltage	100V
4	Tracking Efficiency	Up to 99%
5	Conversion Efficiency	Up to 98%
6	Dimensions	230 x 165 x 70 mm
7	Weight	1.6 kg

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C. Lithium Battery 12 V



Figure 3

Sr. No.	Parameter	Details
1	Brand	Felix
2	Model	FF-700 (Fighter Series)
3	Type	Automotive Lead-Acid Battery (Maintenance-Free)
4	Voltage	12V
5	Capacity	Approx. 65Ah – 70Ah
6	Cold Cranking Amps (CCA)	Approx. 700A
7	Technology	• Maintenance-Free • High Starting Power • Factory Charged
8	Warranty	24 Months
9	Number of Cells	6 Cells
10	Dimensions (Approx.)	Length: 278 mm Width: 175 mm Height: 175 mm
11	Weight	Around 19 kg

D. Inverter



Sr. No.	Parameter	Details
1	Model No	SOLAR PCU 1235/12V
2	Input	220V / 3.6A AC, 50Hz, 1 Phase
3	Output	220V / 2.5A AC, 50Hz, 1 Phase
4	Capacity	935VA / 660W
5	DC Bus Rating	12V DC, 53 ± 3A
6	AC Output Voltage Range	210–220V ±10%
7	PV (Solar Panel Input)	17V / 600W Max
8	Serial No	21DF12EAA012137
9	Made in	India

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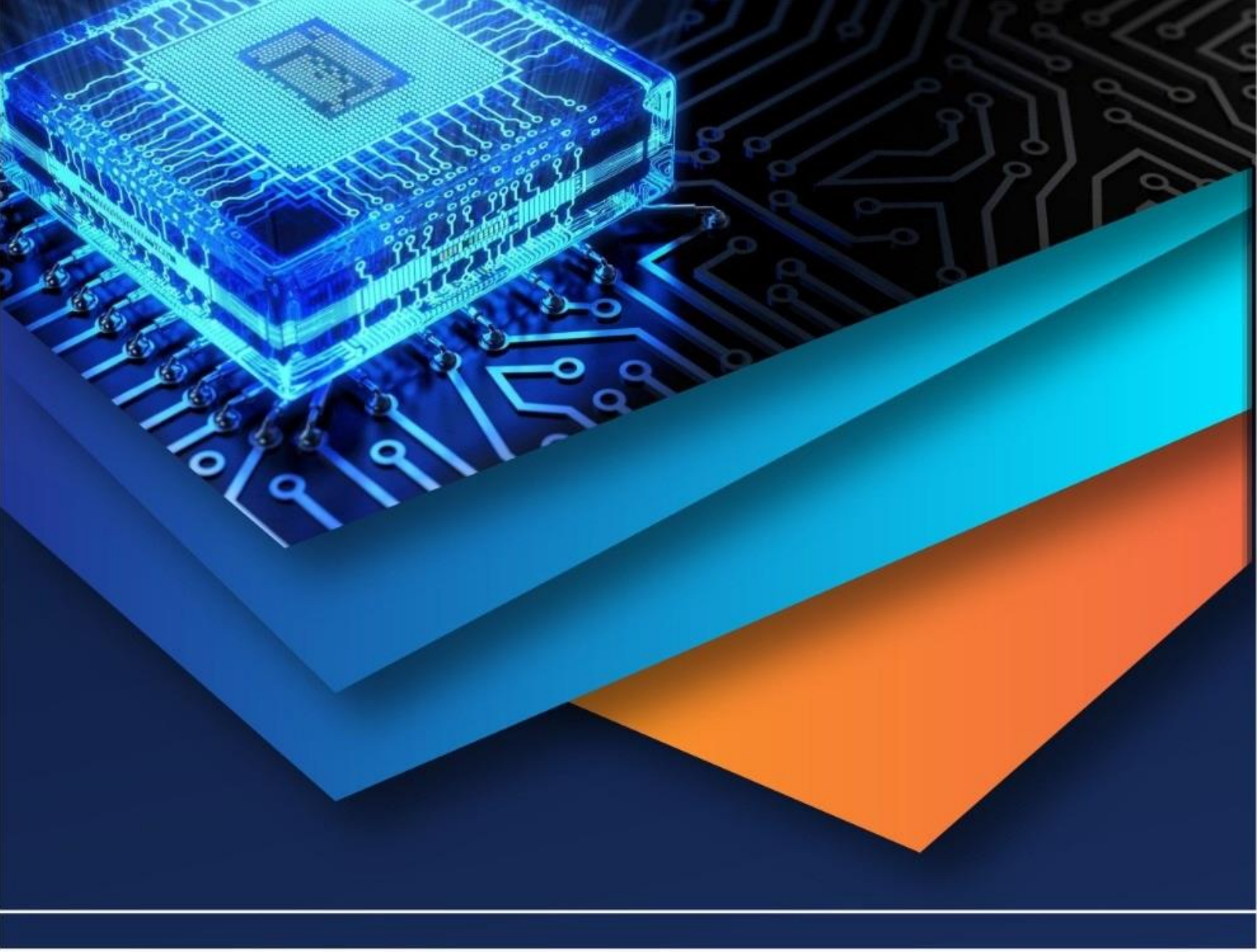
V. CONCLUSION

The solar-based UPS system developed in this project offers a reliable, eco-friendly, and cost-effective solution for powering essential electronic devices during power outages. By utilizing solar energy through a 160W panel and storing it in a 12V battery, the system provides one hour of backup for a PC. The successful implementation demonstrates the viability of renewable energy in small-scale applications and highlights the potential for reducing dependence on conventional power sources. Future improvements can focus on enhancing battery life and increasing load capacity.

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