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Solar Tree Based on Automatic Power Generation

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Abstract: ***The Solar Tree Project is an innovative approach to renewable energy generation that mimics the structure of a natural tree. It is designed to generate solar power using multiple photovoltaic panels arranged like branches and leaves on a single pole. This design helps maximize energy generation while occupying minimal ground space, making it ideal for urban and semi-urban areas where land availability is limited Unlike conventional flat solar panels, the solar tree structure allows panels to be positioned at different angles, enabling better absorption of sunlight throughout the day. It also enhances aesthetic appeal, blending technology with nature-inspired design. The energy produced can be used for various applications such as street lighting, charging stations, irrigation systems, and powering small-scale infrastructure The project promotes sustainable development by reducing dependence on fossil fuels and lowering carbon emissions. Additionally, solar trees can be installed in public places like parks, campuses, and highways, contributing to smart city initiatives and green energy solutions.***
Keywords: maximum power generation, solar controller, microcontroller, sensor monitoring, energy efficiency.

I. INTRODUCTION

With the increasing demand for electricity and depletion of fossil fuels, renewable energy sources have become essential for sustainable development. Solar energy is one of the most reliable and eco-friendly energy sources available today. However, traditional solar panel installations require large land areas, which creates limitations in urban regions.

The Solar Tree Based on IoT provides an effective solution by arranging solar panels vertically like branches of a tree. This structure saves space while increasing sunlight absorption efficiency. The integration of IoT technology enables remote monitoring of power generation, battery condition, and environmental parameters through internet connectivity. The project helps improve energy management and promotes green energy utilization for future smart city applications.

II. SYSTEM OVERVIEW

A. Solar Power Generation

- The solar panels capture sunlight and convert solar energy into electrical energy using photovoltaic cells. The panels are placed at different angles to maximize sunlight absorption throughout the day.

Workflow:

- Sunlight → Solar Panel → Electrical Energy

B. Energy Storage

- The generated power is stored in rechargeable batteries for continuous power supply during night time or cloudy conditions.

Workflow:

Solar Panel → Charge Controller → Battery Storage

C. Power Regulation

- A charge controller regulates the voltage and current supplied to the battery and connected devices. It protects the system from overcharging and power fluctuations.

Workflow:*

- Solar Panel / Battery → Charge Controller → Stable Power Output

D. IoT Monitoring System

- Sensors connected to the Arduino microcontroller continuously monitor voltage, current, temperature, and battery status. The collected data is uploaded to the IoT cloud platform for real-time monitoring.

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Workflow:

- Sensors → Arduino → IoT Platform → Mobile/Web Monitoring

E. Microcontroller Unit

- The Arduino Uno acts as the main controller of the system. It processes sensor data and manages power distribution and IoT communication.

F. Smart Load Management

- The generated energy can be used to power LED street lights, charging stations, or other electrical loads efficiently.

Workflow:

- Battery → Load → Power Utilization

G. Feedback and Protection System

The system continuously checks battery level and power generation status. If any abnormal condition occurs, the IoT platform provides alerts for maintenance and protection.

III. WORKING PRINCIPLE

The Solar Tree works on the principle of the photovoltaic effect, where solar panels convert sunlight into electrical energy. The panels are arranged in a tree-like structure to receive sunlight from multiple directions, increasing efficiency.

The generated electricity is regulated using a charge controller and stored in batteries. Sensors connected to the Arduino measure system parameters such as voltage, current, and temperature. Through IoT connectivity, the monitored data is transmitted to a cloud server, allowing users to track system performance remotely using mobile phones or computers. The system ensures efficient energy management and uninterrupted power supply.

IV. ADVANTAGES

1) Occupies less land area compared to traditional solar panel systems.
2) Generates higher energy due to multi-directional panel arrangement.
3) Provides real-time monitoring using IoT technology.
4) Reduces electricity cost and dependence on fossil fuels.
5) Eco-friendly system with low carbon emissions.
6) Easy maintenance and smart energy management.

V. APPLICATIONS

1) Smart street lighting systems.
2) Public parks, colleges, and railway stations.
3) Electric vehicle charging stations.
4) Rural and remote area electrification.
5) Smart city renewable energy projects.

VI. EXPERIMENTAL SETUP AND DISCUSSION

The experimental setup consists of solar panels mounted in a tree-like structure along with batteries, charge controller, Arduino Uno, sensors, and IoT module. Voltage, current, and temperature sensors are connected to monitor system performance continuously.

The generated power was tested under different sunlight conditions to evaluate efficiency and battery charging capability. The IoT platform successfully displayed real-time sensor data for remote monitoring. The system demonstrated stable operation and effective energy generation with improved space utilization.

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VII. FUTURE SCOPE

The future scope of the Solar Tree Based on IoT is highly promising due to advancements in smart energy systems and renewable technologies. High-efficiency solar panels and advanced battery storage systems can further improve power generation and storage capacity.

Artificial Intelligence and Machine Learning can also be integrated for automatic energy optimization and fault prediction. Future solar trees can support smart grids, electric vehicle charging, and large-scale smart city infrastructure with fully automated monitoring systems.

VIII. CONCLUSION

The Solar Tree Based on IoT is an efficient and innovative renewable energy solution that combines solar power generation with smart monitoring technology. The tree-like structure helps maximize energy generation while minimizing land usage.

By integrating IoT technology, the system enables real-time monitoring, improved energy management, and remote accessibility. This project promotes clean energy utilization, reduces environmental pollution, and supports sustainable development for future smart city applications.

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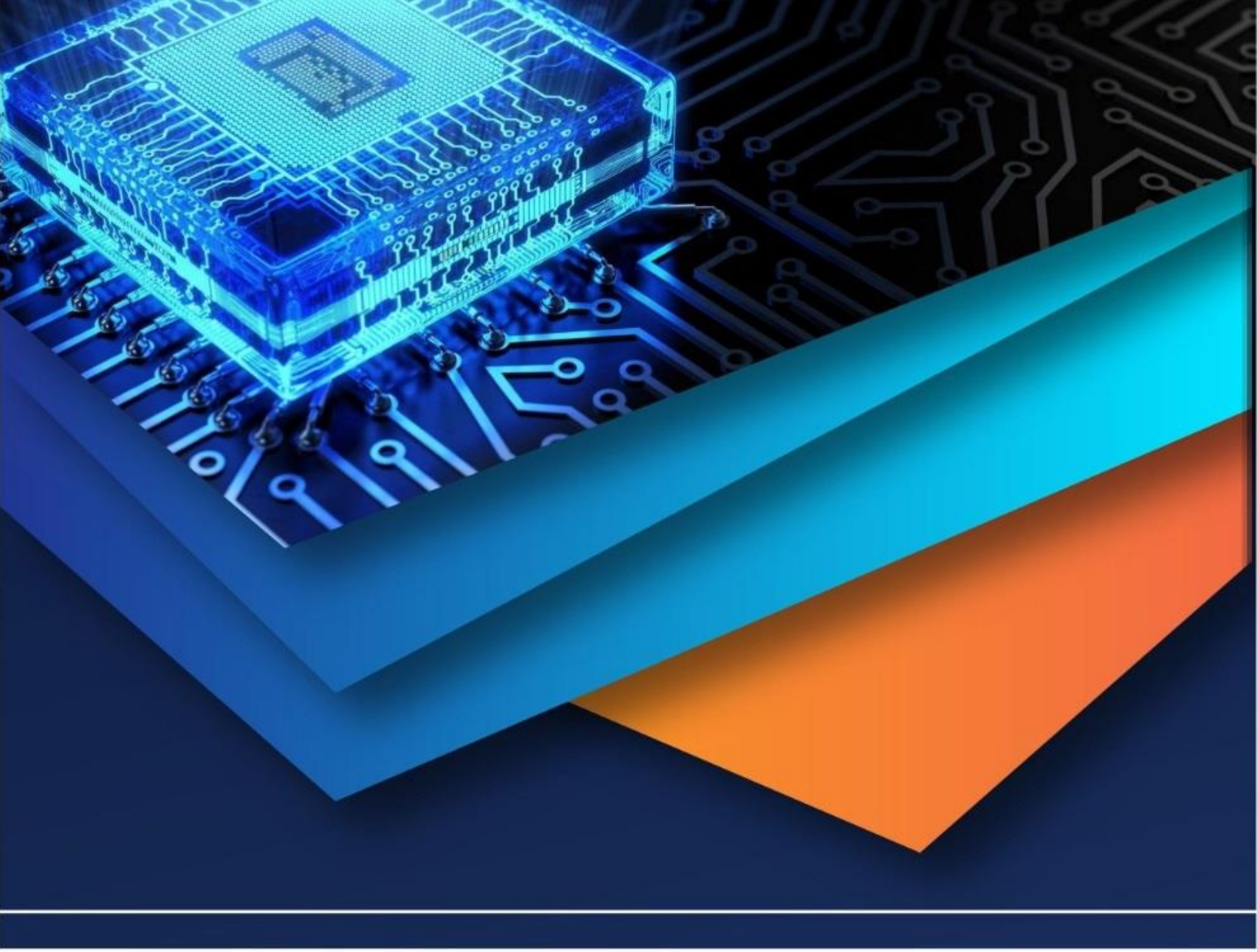

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