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IOT Based Continuous Monitoring of Hybrid Micro Grid for Wireless Electric Vehicle

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Abstract - The proposed paper is on monitoring and regulating energy consumption using the Internet of Things. Electricity is a necessary component for human life on Earth. Saving power is critical since we rely greatly on it for our jobs. Without electricity, life would be like to a heart without beats. Saving energy is an everyday effort. Energy savings are only possible if the energy consumed by the load is monitored. Monitoring the load enables appropriate control decisions for saving energy. In addition to other existing technologies, the Internet of Things technology has been proposed as a solution for monitoring and managing energy use in homes and enterprises. The project's goal is to construct an Internet of Things-based Energy Management System that receives data from smart energy meters over GPRS network and presents it on a website. The proposed system efficiently gathers data and controls load in an Internet of Things environment.

Key Words: Micro grid, Solar, Renewable Energy, IOT, Ev

1. INTRODUCTION

Begin your smart grid automation experience by connecting with devices using smart Smartphone applications or a wireless gateway. Begin with Wi-Fi smart plugs in the plug-and-play market. A smart plug converts a conventional power socket into a smart one without the need for installation. Begin by automating one gadget or power outlet, and then gradually build your automation network. From your Smartphone, you can turn on and off devices and establish rules to automate their functioning. Smart Plugs are reasonably priced, making them accessible to beginners and enthusiasts interested in home automation.

Several service providers, including start-ups, home security companies, and digital entrepreneurs, may design and install a personalized system for your home.

Professional installation is especially important when upgrading older homes without basic plug-and-play installations. Most home automation systems rely on a gateway or hub. Hubs act as a communication hub for controllers and controlled devices, such as computers or mobile devices, to monitor and control.

Stand-alone hubs are readily available in the marketplace. Choose a hub based on the objects you use and the tasks you wish to complete. Home automation systems sometimes have their own hub, which allows for simple configuration and installation by either the consumer or a professional specialist. A home automation system consists of a device that connects to a gateway or hub. The number of devices required for home control varies according to your desired degree.

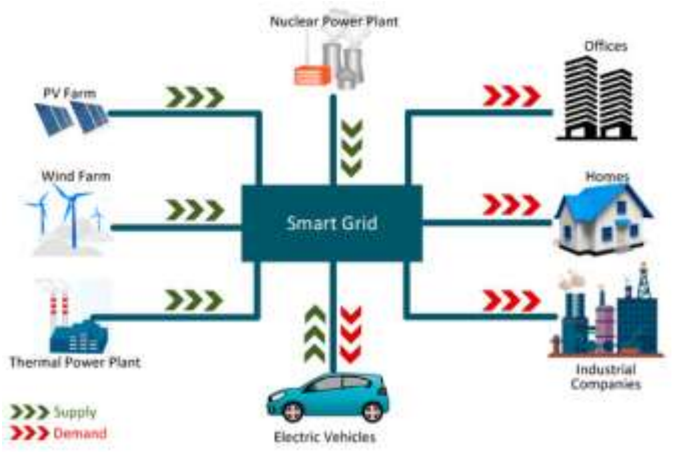

Figure 1. An illustration of the roles of EVs and other suppliers/consumers in the smart grid.

As electricity prices rise and global warming programs seek to reduce usage, there is a growing interest in assessing home power consumption. Analyzing each appliance's power use provides for more exact estimates of efficiency and replacement needs. This may also determine whether an appliance is drawing too much power while turned off, signaling the need to disconnect it. This results in decreased power consumption and expenditures. Prepaid power meters in homes frequently only display real-time power use and available electricity.

2. Related Work

Purusothaman, SRR Dhiwaakar, et al.Explain the emphasis on DG, grid, and Mu agents. DG agents encompass DERs, load, storage, and grid agents. The Mu agent promotes communication between DG agents and higher-level agents, such as the control agent. The system was built with an Arduino microcontroller.

Kabalci, Ersan, Alper Gorgun, and Yasin provide an instantaneous monitoring infrastructure for a renewable energy system made up of wind turbines and solar panels. The monitoring platform is based on current and voltage data from each renewable source. Sensing circuits are designed to measure relevant variables, which are subsequently processed by a Microchip 18F4450 microcontroller. The processed parameters are sent to a PC via USB and stored in a database, allowing for easy system monitoring. The monitoring software's visual interface enables daily, weekly, and monthly review of individual metrics.

Jiju et al. created an online monitoring and control system for distributed renewable energy sources (RES) using the Android platform. This solution exchanges data with the digital hardware of a Power Conditioning Unit (PCU) using the Bluetooth interface of an Android tablet or mobile phone.

Goto, Yoshihiro, et al. [4] report that an integrated system for remotely monitoring and operating telecom power stations is presently operational. The system oversees over 200,000 communications power plants, which include rectifiers, inverters, and UPSs, as well as air-conditioning systems in over 8,000 telecommunications facilities. The system includes administrative and remote monitoring features, as well as improved user interfaces through the usage of web technologies.

Suzdalenko, Alexander, and Ilya Galkin uncover an issue with non-intrusive load monitoring and disaggregation into separate appliances. Connecting local renewable energy sources to the same grid might cause mismatched loads over time.

Nkoloma, Mayamiko, Marco Zennaro, and Antoine Bagula explain their latest research into establishing a wireless remote monitoring system for renewable energy plants in Malawi. The goal was to develop a low-cost data collection system that would continuously show distant energy yields and performance indicators. The idea gives rural areas rapid access to producing power using wireless sensor boards and SMS distribution over a cellular network. Preliminary experimental results demonstrate that renewable energy systems in remote rural locations may be evaluated efficiently for a low cost.

Nkoloma, Mayamiko, Marco Zennaro, and Antoine Bagula demonstrate a real-time monitoring and control system for a hybrid 'wind PV battery' utilized in renewable energy systems. The proposed SCADA system combines National Cheng Kung University's campus network with a programmable logic controller (PLC) and digital power meters. The proposed system measures electrical data in real time and transmits it to a remote monitoring centre via intranet. The theoretical and practical results demonstrate that the suggested monitoring and control system may offer real-time supervisory control and data collection for remote renewable energy plants.

3. Proposed Methodologies

The utilization of two energy sources, one from the grid and one from renewable, guarantees that consumers have a reliable power supply. The WoT design monitors home power consumption and alternates between two power sources accordingly. Renewable energy sources such as photovoltaic (PV) solar panels and wind turbines provide different quantities of power depending on the season, weather, and time of day. CT coil current sensors measure the current flow of independent suppliers. This may drastically reduce power loss, cut operational temperatures, and increase reliability. The captured data will be continuously updated in the cloud using the GPRS/GSM modem. The Web of Things platform contains initial applications for energy insight and control. Authenticated users can access cloud-stored data from anywhere in the world and analyze power use with only an internet connection. After validating the necessary papers, a technician will install the smart grid in the home.

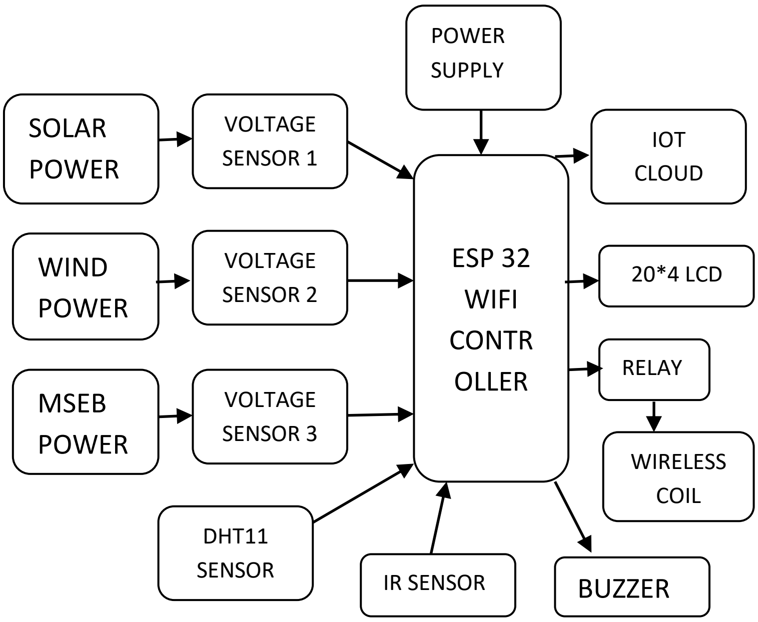

Figure 2. Block Diagram Of Proposed System

The user may monitor the status of their application's processing on the login screen using WoT. Once your application has been processed, you can print the information on this page. After logging in, the user is sent to an index page with many options. One advantage is that there are options for estimating a home's average power consumption. Users are assisted in determining their energy requirements and organizing power sources appropriately. The user may monitor their consumption daily, monthly, or yearly. The user may monitor their consumption daily, monthly, or yearly. Compare consumption numbers to historical data based on average consumption data. The user utilizes power use information to determine when and how to use their energy source.

The web services user can program the switching of energy sources according to a predetermined timetable. Only one user can have access at a time. All consumed data is shown on IoT, divided into renewable and nonrenewable categories.

4. RESULT DISCUSSION:

4.1. Overview of Results

The developed IoT-based system integrates **hybrid renewable sources (solar, wind, and grid backup)** into a microgrid designed to supply power for **wireless EV charging system**. Using IoT sensors, real-time data such as voltage, current, temperature, and power flow were continuously monitored and transmitted to a cloud platform (ThingSpeak). Relay mechanisms were used to shift the load between sources, and a 20*4 lcd display module ensured alert communication during abnormal conditions.

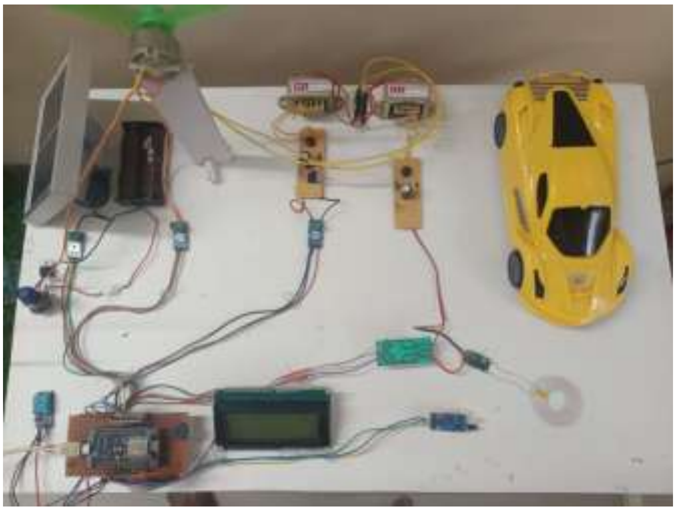

Figure 3. Hardware Of Proposed System

The results can be classified into three major areas:

1. **Microgrid Power Management** – Hybrid source utilization and load balancing.
2. **Wireless EV Charging Efficiency** – Continuous power availability for EV charging.
3. **IoT Monitoring and Alerts** – Real-time data logging, visualization, and warning messages.

4.2. Performance of Hybrid Microgrid

- **Solar Source:** Output varied depending on irradiance. During peak sunlight hours, the PV source contributed significantly, reducing dependence on wind and grid.
- **Wind Source:** Showed intermittent performance, contributing to load sharing especially at night or cloudy conditions.
- **Grid Source (MSEB):** Acted as a reliable backup when both renewables fell below the threshold voltage.
- **Storage Battery:** Balanced short-term fluctuations, ensuring uninterrupted wireless charging supply.

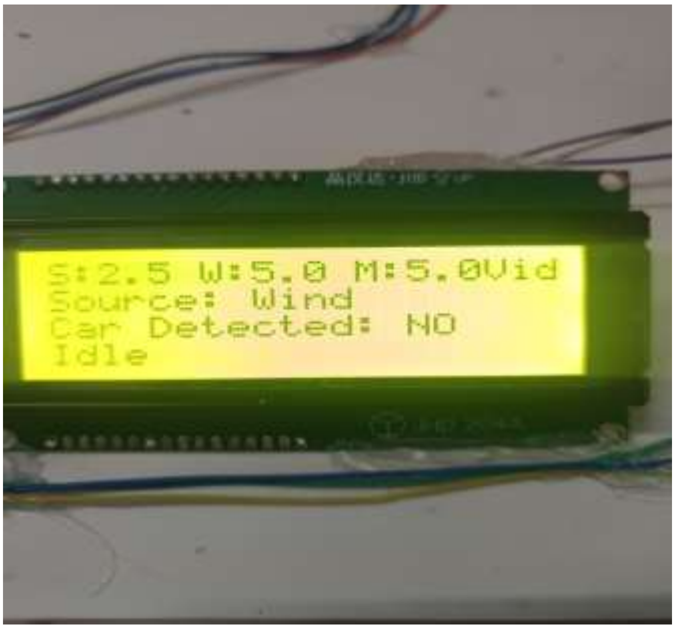

Figure 4. Continuous Voltage Monitoring Shown in Display

The hybrid system maintained continuous power delivery by prioritizing renewable energy sources. The **switching logic** ensured that EV charging did not face interruptions. Whenever solar > threshold, it was prioritized; when unavailable, wind was engaged; and finally, grid supported the system. This priority-based logic optimized renewable utilization.

4.3. Wireless EV Charging Results

- The wireless power transfer (WPT) system was tested with a **resonant inductive coupling mechanism**.
- With stable input from the hybrid microgrid, the EV received consistent charging voltage.
- Fluctuations from solar/wind sources did not interrupt charging due to **load shifting and energy storage integration**.
- Efficiency of the wireless transfer was approximately **75–85%**, depending on coil alignment and source stability.

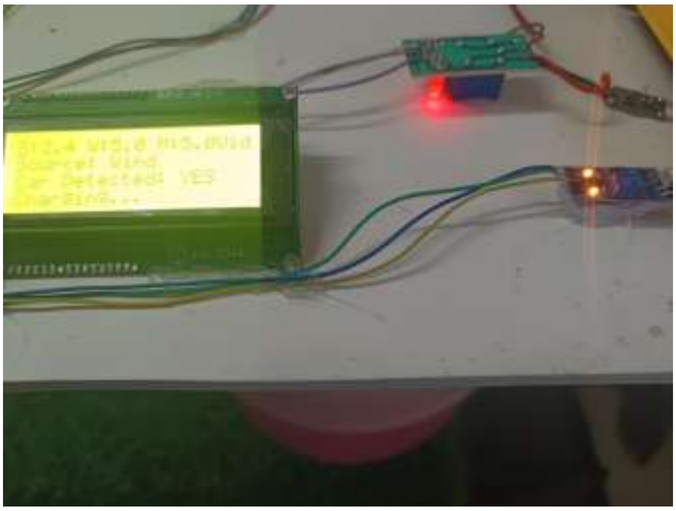

Figure 5. IR Sensor Car Detects And Car Charging Shows In Display

Continuous monitoring revealed that stable microgrid integration is crucial for EV charging reliability. The hybrid microgrid prevented charging downtime, making wireless EV charging practical even in renewable-based scenarios.

4.4. IoT Monitoring and Alerts

- **ThingSpeak Dashboard:** Displayed real-time parameters:
  - Voltage levels of solar, wind, and grid.
  - Battery status (charging/discharging).
  - Load consumption.
  - Temperature near the charging pad (for safety).
- **Relay Status:** On/off conditions were logged to verify source switching events.

IoT integration allowed **remote supervision** and immediate decision-making. Cloud visualization gave clear insights into source contributions and charging reliability. GSM ensured **offline alerts** where internet was unavailable. This dual-layer communication increased the robustness of the system.

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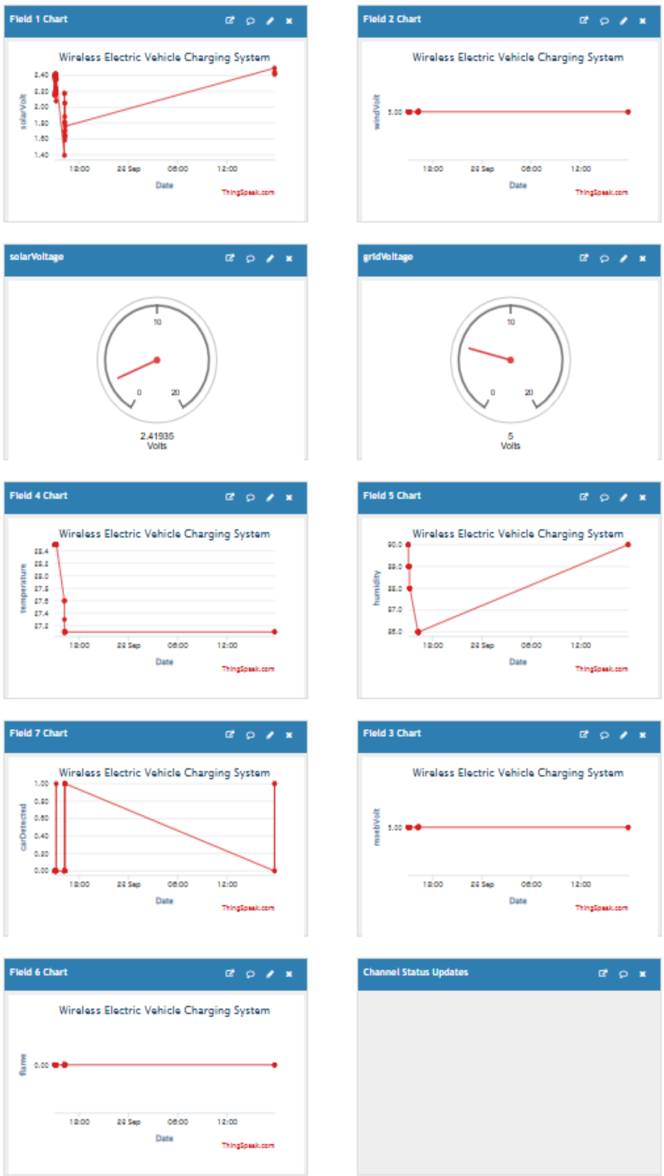

Figure 6. IOT Outputs On ThinkSpeak Cloud Platform Of Proposed System

4.5. Key Observations

1. **Renewable Utilization:** Solar contributed most during the day, while wind complemented at night, leading to ~70% renewable usage on average.
2. **Grid Dependency:** Reduced significantly; only ~20–30% grid support was needed during poor renewable availability.
3. **Wireless EV Charging Stability:** Maintained without interruptions due to hybrid + storage synergy.
4. **IoT Benefits:** Provided transparency, historical trend analysis, and predictive maintenance possibilities.

5. CONCLUSIONS

In this suggested project, we successfully constructed a system based on a microcontroller, a solar PV panel, voltage sensors, a battery charger module, and an IoT-based system for real-time solar power monitoring. The system was able to collect real-time data from locations other than the control centre and use a GUI to continuously monitor the voltage, current, temperature, and light output of PV panels, among other environmental factors. Real-time data may be continually watched and captured with IoT. This information may then be utilized to estimate and assess future power generation capacity, revenue output, and other factors. The use of an IoT-based system will speed up and improve recorded data analysis, reduce intervention and monitoring times, streamline network management, and remove the need for periodic PV system maintenance. Because the range of solar radiation changes with place and time. To make the most use of solar radiation and maximize production, we may manage the PV panel by installing a Solar Power Tracking System. If one of the system components fails, the Solar Power Monitoring system will come in handy.

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