JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

HARVESTING TOMORROW'S POWER :IOT-DRIVEN SMART AUTOMATION USING RENEWABLE ENERGY

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Abstract : The "Harnessing the Power of Tomorrow: IoT-Focused Smart Automation Using Renewable Energy" project aims to use Internet of Things (IoT) technology to increase the efficiency and effectiveness of new renewable energy systems. The project aims to create an intelligent automation framework that optimizes energy production, sharing and consumption by integrating IoT devices with renewable energy sources such as solar panels and wind turbines. Thanks to real-time monitoring, data analysis and intelligent control systems, the system maximizes energy harvest while reducing waste and environmental impact. This research contributes to the development of sustainable energy solutions by leveraging the potential of IoT-driven smart automation in renewable energy systems.

I.INTRODUCTION

"As we march towards sustainable solutions, we are proud to launch a project called 'HARVESTING TOMORROW'S POWER :IOT-DRIVEN SMART AUTOMATION USING RENEWABLE ENERGY.' Our work generates new energy to meet the urgent need for environmentally friendly practices through the strategic use of Internet of Things (IoT) capabilities , our work seeks to define the management of electricity through collaboration."

II. RESEARCH METHODOLOGY

The research "Harvesting the Power of Tomorrow: IoT-Focused Intelligent Automation Using Renewable Energy" includes research on the integration of IoT and renewable energy that follows a stringent methodology, including collecting data, designing and measuring performance to determine efficiency and effectiveness. .

3.1Population and Sample

"HARVESTING TOMORROW'S POWER :IOT-DRIVEN SMART AUTOMATION USING RENEWABLE ENERGY " is aimed at individuals and organizations in the fields of renewable energy, IoT and smart automation. Models could be families, businesses, or communities trying out this new technology. It will also include researchers, companies or governments investigating the effectiveness and efficiency of these solutions in energy saving and environmental protection.

3.2 Data and Sources of Data

The data of the HARVESTING TOMORROW'S POWER :IOT-DRIVEN SMART AUTOMATION USING RENEWABLE ENERGY " project covers many areas, including actual energy consumption and energy consumption from renewable energy sources such as solar panels, wind turbines. Additionally, environmental information such as weather forecast and solar measurements can be used together to improve energy harvesting. IoT devices equipped with sensors collect this information and send it to the central control system for analysis and decision-making. Additionally, historical energy consumption patterns and performance data from energy systems can be used for model prediction and continuous improvement. This integration enables the project to achieve more efficient use of renewable energy while reducing environmental impact and operating costs..

3.3 Theoretical framework

The theoretical framework of the study "HARVESTING TOMORROW'S POWER :IOT-DRIVEN SMART AUTOMATION USING RENEWABLE ENERGY" is shaped around the concepts of IoT integration, renewable energy and smart automation. The project downloads content from the Internet of Things using connected devices and appliances to collect real-time data on energy production, consumption and the environment. This information forms the basis for intelligent decision-making to improve the use of renewable energies such as solar, wind and water. Thanks to advanced algorithms and predictive models, energy systems can coordinate the efficient distribution and use of energy across the network, adapting to changing energy availability and demand. Additionally, sustainability and Environmental management principles guide the design and implementation of the framework, bringing a holistic approach to long-term energy efficiency and ecological balance.

3.4Statistical tools and econometric models

This section elaborates the proper statistical/econometric/financial models which are being used to forward the study from data towards inferences. The detail of methodology is given as follows.

3.4.1 Descriptive Statistics

The "For All Powers: IoT-Enabled Smart Automation Using Renewable Energy" project uses descriptive statistics to explain its benefits and impacts. Through qualitative data analysis, the project evaluates the importance of renewable energy systems combined with IoT-driven automation, such as energy consumption models, performance indicators and benchmarking studies. Descriptive statistics allow for a better understanding of the competitive dynamics of the project by providing information about the variance, mean trend, and distribution of the variance. By using statistical tools to interpret evidence, the project works to identify outcomes of sustainable practices, improve operational efficiency and inform strategies, develop environmentally friendly technology and improve the future to promote a safe tomorrow.

3.4.2 Fama-Mcbeth two pass regression

Our research on "HARVESTING TOMORROW'S POWER :IOT-DRIVEN SMART AUTOMATION USING RENEWABLE ENERGY" explores the relationship between various factors affecting energy optimization and sustainability using Fama-MacBeth quadratic regression analysis. In the first step, we inverse an asset's return based on a set of risk factors including market, size, price, strength, and other variables. Then, in the second step, we examine the mean time of the estimated coefficients to discover relationship patterns and make recommendations on the impacts of connecting renewable energy and IoT-driven asset recovery automation. Through this rigorous review process, our research focuses on providing insight to stakeholders in the technology marketing and distribution business.

3.4.2.1 IoT Integration Model

In this IoT Driven smart automation ,The IoT integration model requires the reintegration of IoT devices and sensors with electronic systems to facilitate instant data collection, analysis, and management. The model includes the practical use of sensors to monitor energy production from renewable sources and environmental changes affecting electricity production. The collected data is sent to central control and analyzed with state-of-the-art methods to optimize energy production, storage and distribution. Automated control systems adjust energy consumption based on real-time data and predetermined criteria, while machine learning algorithms continue to adjust energy consumption patterns. Strategic feedback provides users and managers with information about energy use, cost savings and environmental impacts, ultimately leading to a smart, self-managed energy ecosystem for maximum efficiency and security.

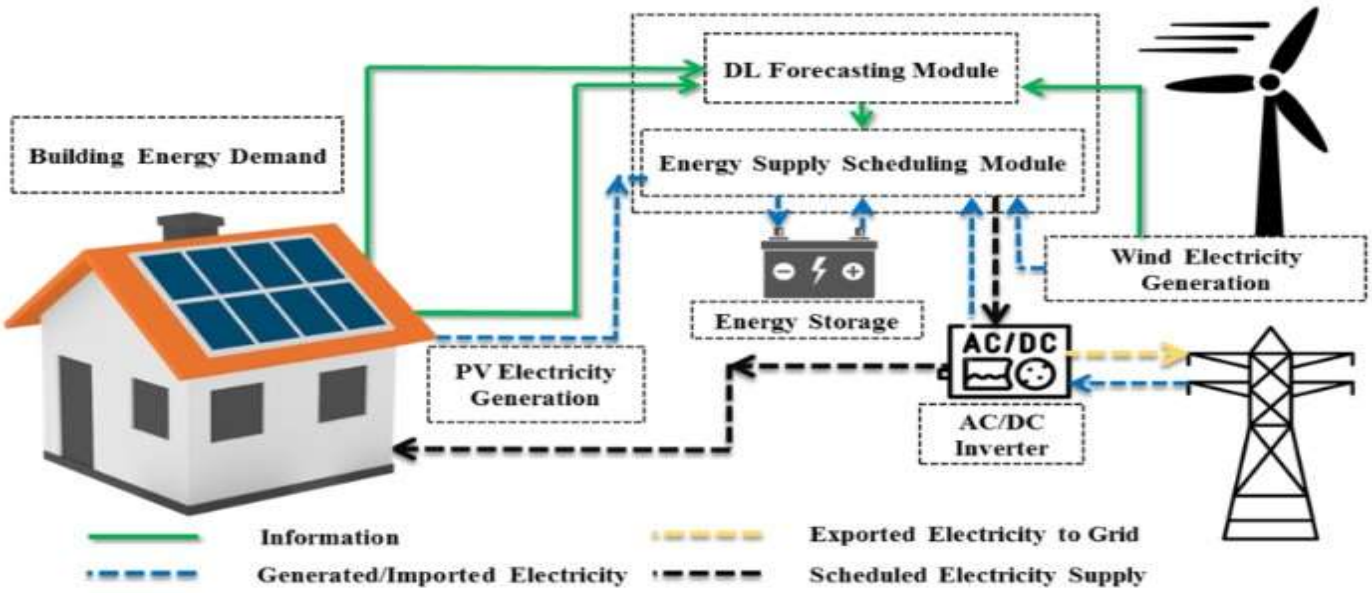

Figure 1 : Data Flow

3.4.2.2 Predictive Maintenance Model

The predictive maintenance model requires the use of the concept of IoT sensors to timely monitor events and actions running on renewable energy. The collected data is sent to a central database where advanced machine learning algorithms analyze historical patterns to predict equipment failure or damage. Thanks to fault detection and testing algorithms, abnormal conditions can be detected and diagnosed in a timely manner so that maintenance plans can be made to reduce downtime and optimize equipment. Remote monitoring capabilities enable maintenance personnel to intervene when necessary to ensure the reliability, efficiency and longevity of renewable energy. The model represents the monitoring efficiency used by IoT technology to maximize the efficiency and sustainability of renewable energy sources.

3.4.3 Comparison of the Models

The IoT integration model emphasizes real-time data collection and analysis to optimize energy efficiency and increase efficiency and sustainability through IoT-driven automation. In contrast, predictive maintenance models prioritize maintenance plans based on predictive analytics, thereby increasing reliability and reducing downtime. Meanwhile, the energy optimization model aims to maximize efficiency and reduce costs by using mathematical optimization techniques to balance energy production, storage and demand. Each model has unique advantages and applications; IoT integration models for organizations looking for IoT-focused automation, quality control models suitable for companies looking to develop vehicles gain confidence, and energy efficiency standards are suitable for companies looking to improve energy efficiency and cost. to join. Effective use of renewable energy. Although there are differences in complexity and application needs, each model contributes to the advancement of renewable energy systems through new processes and specific needs developed for these purposes.

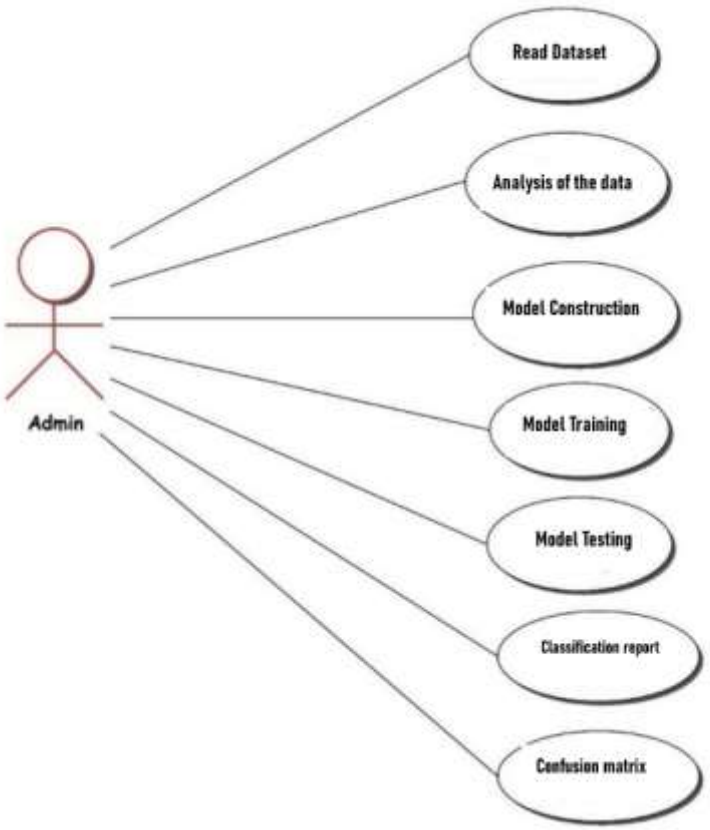

Figure 2 : Use Case Diagram

3.4.3.1 Optimizing power generation Equation

The standard equation for IoT-driven smart automation in a hybrid renewable energy system utilizing wind and solar energy could involve optimizing power generation and distribution. Here's a simplified representation:

$$P_{Total} = P_{solar} + P_{wind}$$

Where:
- P_{Total}represents the total power generated by the system.
- P_{solar}represents the power generated by solar panels.
- P_{wind} represents the power generated by wind turbines.

This equation forms the basis for understanding how much power your system is generating in total, combining the contributions from both solar and wind sources.

However, for IoT-driven smart automation, you would likely integrate sensors, controllers, and actuators to optimize energy harvesting and usage. This involves more complex algorithms and equations to manage and control the system efficiently.

These equations would be part of a larger control system that leverages IoT devices to collect data, analyze it in real-time, and make decisions to automate and optimize the operation of the renewable energy system.

3.4.3.2 Calculations based on different seasons

The Calculations varies from one season to another reason

Basically we have 365 days in a year which has totally 4 seasons

- Winter Season
- Summer Season
- Rainy Season

- Spring / Autumn Season

Every 3 months contains 3 months which is equalent to 90 days . During Winter Season the wind mill has maximum power generation , during the Summer season the Solar panel has the maximum power generation and during other seasons the extra amount of power generated during these 2 seasons will be used which will be stored in the storage batteries . The power generated during the summer and winter seasons will be maximum whereas the other seasons contribution towards power generation will be comparatively less. Hence we have arrived at an equation which can be implied to calculate the power generated in each season using both solar panels and wind turbines

$$P_{Total} = P_{solar} + P_{wind}$$

In Solar Panels : 5 panels * 6 volts = 30 volts
In Windmill : 1 mill * 3 volts = 3 volts

Total power generated = 30 volts + 3 volts

$$P_{Total=}30\ volts$$

IV. RESULTS AND DISCUSSION

The integration of IoT-driven smart automation with wind and solar energy technologies presents a promising avenue for sustainable energy management. By employing a network of sensors and actuators, coupled with sophisticated algorithms, this system optimizes the utilization of renewable resources. Solar panels harness sunlight during the day, while wind turbines generate power from the wind, ensuring continuous energy production. The IoT infrastructure enables real-time monitoring and control of energy generation, consumption, and storage, enhancing efficiency and reliability. Furthermore, data analytics facilitate predictive maintenance, fault detection, and energy forecasting, maximizing the overall performance and lifespan of the renewable energy assets. Through this innovative approach, we can realize a greener and more resilient energy ecosystem, contributing to a sustainable future.

Figures

Figure 1 : Dataflow Diagram
Figure 2 : Use Case Diagram

II. ACKNOWLEDGMENT

We extend our heartfelt gratitude to all those who contributed to the realization of this project on IoT-driven smart automation utilizing wind and solar energy. Special thanks to the dedicated team members whose unwavering commitment and expertise propelled this endeavor forward. Additionally, we express our appreciation to the authorities who provided the necessary support and resources for the implementation of solar panels and wind turbines. Finally, we acknowledge the invaluable support from our partners and stakeholders whose collaboration was instrumental in achieving our objectives and bringing this innovative solution to fruition.

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