



Intelligent power management system for optimizing load strategies in renewable generation

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Abstract

Effectively utilizing renewable energy sources while avoiding power consumption restrictions is the problem of demand-side energy management. The goal is to develop an intelligent system that can precisely estimate energy availability and plan ahead for the next day in order to overcome this obstacle. The Intelligent Smart Energy Management System (ISEMS) described in this work is designed to control energy usage in a smart grid environment where a significant quantity of renewable energy is being added. The proposed system evaluates various prediction models to achieve accurate energy forecasting with hourly and day-ahead planning. When compared to other prediction models, the Support Vector Machine (SVM) regression model based on Particle Swarm Optimization (PSO) seems to have better performance accuracy. Then, using the anticipated data, the experimental setup for ISEMS is shown, and its performance is evaluated in various configurations while considering features that are prioritized and user comfort. Furthermore, Internet of Things (IoT) integration is put into practice for monitoring at the user end.

Keywords Renewable generation · Energy consumption · Load modeling · Smart grids · Demand-side energy management · Machine learning · IoT · Energy management systems · Forecast

1 Introduction

In the upcoming years, a substantial growth and concurrent challenges are anticipated in power generation, distribution, and consumption. For maximum power use, it is necessary to smoothly integrate distributed and renewable energy sources with an intelligent energy management system on the demand side. The depletion of fossil fuels worldwide has increased the importance of renewable energy sources in response to

customer demand for more reliable and reasonably priced energy. Micro-turbines for biomass, photovoltaic (PV), wind, and other renewable energy sources are widely utilized [1]. Specifically, in cities, residential customers have a strong desire to install modest rooftop photovoltaic (PV) systems. These solar PV systems may run in two different modes: hybrid. While standalone PV systems necessitate substantial storage capacity, grid-connected PV systems are favored for their continuous supply over an extended period. Consequently, the need for hybrid systems, which combine the best aspects of on-grid and grid systems, is growing. Many grid-connected systems, on the other hand, export wasted power back to the grid because to a lack of storage. In developing countries, this poses challenges due to grid instability and frequent outages, making the export of power back to the grid problematic [2].

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2 Motivation and contribution

In contemporary grid-connected systems, the inclusion of PV storage has become imperative. Due to their intermittent and extremely variable character, renewable energy