International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

A DSM BASED APPROACH FOR SOLVING ENVIRONMENT CONSTRAINED ECONOMIC DISPATCH FOR A MICROGRID SYSTEM

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Abstract - The *Microgrids, known for their integration of renewable energy sources, have become pivotal in ensuring sustainable and efficient energy use. However, balancing economic and environmental objectives, such as reducing generation costs while minimizing emissions, remains challenging. The proposed DSM-based methodology offers a systematic and modular framework to optimize energy dispatch by representing dependencies and constraints in an organized matrix format. This approach effectively decomposes problem-solving, and facilitates real-time decision-making in microgrid operations. The performance of the DSM-based method is validated through simulations on a representative microgrid model incorporating renewable energy sources, conventional generators, and battery storage systems. Results demonstrate improved computational efficiency and effective trade-offs between cost minimization and environmental impact, highlighting the potential of this method to enhance the operational sustainability of microgrid systems.*

Key Words: Dependency Structure Matrix (DSM) Economic Dispatch (ED) Microgrid Systems Environment-Constrained Optimization Renewable Energy Integration Cost Minimization Emission Reduction Energy Management Optimization Techniques Distributed Energy Resources (DERs)

1. INTRODUCTION

The developing reception of microgrid frameworks, driven by the rising entrance of sustainable power sources and circulated energy assets (DERs), presents the two open doors and difficulties for current energy the board. Microgrids offer adaptability, versatility, and further developed energy effectiveness; in any case, they likewise present intricacies in accomplishing financial and ecological objectives because of their dynamic nature, different energy sources, and functional imperatives. The financial dispatch issue for microgrids, which includes deciding the ideal age timetable to satisfy need at least expense, turns out to be significantly more testing when ecological requirements are consolidated, like decreasing ozone depleting substance emanations and different contaminations.

Customary strategies for tackling the Monetary Dispatch (ED) issue frequently battle to deal with the multifaceted cooperations and conditions among different parts inside a microgrid framework, especially under natural limitations. This paper proposes an original methodology in light of the Reliance Construction Lattice (DSM) to address these difficulties. The DSM, generally perceived for its capacity to address and oversee complex frameworks and cooperations, offers an organized structure to deteriorate and break down the monetary dispatch issue, empowering effective and versatile improvement.

1.1 Background of the Work

The Financial Dispatch (ED) issue in microgrids includes improving the distribution of force age assets to satisfy need at the least conceivable expense. Conventional techniques for taking care of this issue frequently center around limiting expenses disregarding natural requirements, for example, discharges impediments and contamination decrease targets. Lately, the center has moved towards Climate Compelled Financial Dispatch (ECED), which plans to accomplish an ideal harmony between monetary effectiveness and natural manageability.

1.2 Motivation and Scope of the Proposed Work

The Financial Dispatch (ED) issue in microgrids includes enhancing the portion of force age assets to satisfy need at the most minimal conceivable expense. Conventional strategies for taking care of this issue frequently center around limiting expenses disregarding ecological imperatives, for example, emanations restrictions and contamination decrease targets. As of late, the center has moved towards Climate Obliged Monetary Dispatch (ECED), which expects to accomplish an ideal harmony between financial effectiveness and natural manageability. In any case, consolidating natural considerationThe quick development in circulated energy assets (DERs) and the rising accentuation on coordinating environmentally friendly power into power frameworks have highlighted

ISSN 2581-7795

the significance of microgrids as a critical answer for present day energy challenges. Microgrids offer various advantages, including upgraded energy security, nearby energy age, decreased transmission misfortunes, and the capacity to consistently coordinate environmentally friendly power sources. Nonetheless, they likewise present critical difficulties for successful energy the board, especially when monetary targets should be offset with natural limitations.

As of late, there has been a developing acknowledgment of the need to address environmental change by diminishing ozone depleting substance emanations from energy frameworks. This has prompted the advancement of climate compelled financial dispatch (ECED) methodologies, which mean to limit age costs as well as natural effects. Customary improvement techniques for ECED frequently battle with the intricacy presented by the assorted parts and their interdependencies inside microgrids.

2. METHODOLOGY

The proposed procedure uses the Reliance Construction Network (DSM) way to deal with and improve the Climate Compelled Financial Dispatch (ECED) issue in microgrid frameworks. This approach models and deals with the complicated collaborations among different microgrid parts while sticking to monetary and ecological requirements. The bit by bit course of the philosophy is framed beneath

2.1 System Architecture

The proposed framework engineering for the DSM-based way to deal with Climate Compelled Financial Dispatch (ECED) in microgrid frameworks is intended to deal with the complicated associations among different parts of the microgrid while guaranteeing ideal harmony between monetary expense and natural supportability. The engineering comprises a few vital modules and utilitarian layers that cooperate to accomplish effective and economical energy dispatch. Fig-1

2.2 Data Acquisition

Deployed throughout the microgrid to continuously measure and monitor energy generation, consumption, power flows, and environmental variables the microgrid's energy resources while meeting economic and environmental goals. The data acquisition process consists of collecting, processing, and transmitting data from various microgrid components, including distributed energy resources (DERs), loads, and environmental monitoring systems.

2.3 Anomaly Detection Model

the primary purpose of an anomaly detection model is to identify, classify, and respond to unexpected behaviors, deviations, or faults in the microgrid's operation, which can arise due to equipment malfunctions, sudden changes in load demand, or fluctuations in renewable energy generation. An effective anomaly detection model ensures the reliability, efficiency, and stability of the microgrid system, while maintaining optimal economic and environmental performance.

2.4 User Interface

A well-designed UI provides operators and stakeholders with a comprehensive view of the microgrid's performance, facilitates efficient monitoring and control, and supports decision-making processes through intuitive visualization and interaction capabilities. The UI must be user-friendly, responsive, and capable of presenting complex data in a clear and actionable manner.

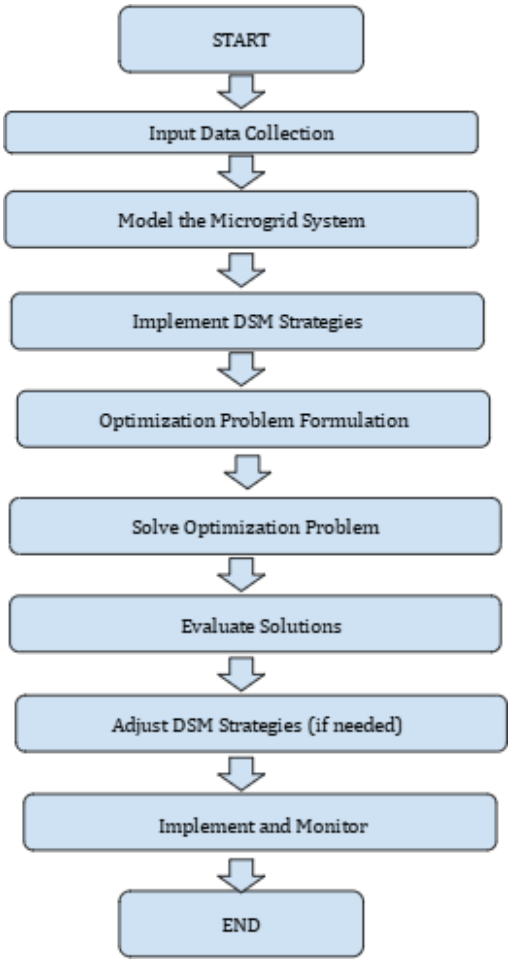

Fig -1- Flowchart

3. CONCLUSIONS

By leveraging the structured representation and modular optimization capabilities of the DSM framework, this method provides significant improvements in computational efficiency, adaptability, and environmental

ISSN 2581-7795

performance. The integration of real-time data acquisition, anomaly detection, and user-centric tools further enhances the practicality and reliability of the solution. Overall, this approach contributes to advancing sustainable, cost-effective, and reliable energy management in microgrid systems, supporting global goals for cleaner and more efficient energy use.

Suggestions for Future Work

1. **Predictive Analytics for Load and Generation Forecasting**: Implement advanced machine learning algorithms for more accurate prediction of load demand and renewable energy generation.
2. **Trade-Off Analysis Between Multiple Objectives**: Expand the DSM-based approach to handle multi-objective optimization that considers not only cost and emissions but also other objectives such as grid reliability, renewable energy integration, and power quality.
3. **Battery Degradation Modeling**: Incorporate battery degradation models into the DSM framework to optimize storage usage while prolonging battery life and minimizing lifecycle costs.

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