An Effective Power Dispatch Strategy for Clustered Microgrids While Implementing Optimal Energy Management and Power Sharing Control Using Power Line Communication

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***Abstract*—The mitigation of uncertainty in the availability of power generation from microgrids to enable renewable resources to be dispatched is a daunting task for the individual operators. Installing energy storage systems may reduce the impact of renewable energy intermittency. However, a peculiarity in energy management can be arisen, particularly, when different energy providers manage these resources. Hence, an intelligent utilization approach should be devised to maximize the benefits of using battery energy storage, since the cost of this system is the most expensive part. This article proposes an effective power dispatch strategy for clustered microgrids. The developed hybrid algorithm implements optimal energy management and power sharing control using binary data. The frequency-shift keying (FSK) technique has been adopted for transmitting the binary signal over the power line communication (PLC). A part of the algorithm is utilized to deal with the optimal scheduling control, whereas the other actuates the dynamic-demand-response-based photovoltaic power forecasting. The performance of the proposed approach with the formulated backup injection index has been validated using data collected from the practical network of "Bario, Sarawak." The presented results suggest that the implementation of the proposed strategy can improve the efficiency of the overall system, causing less operating cost and fast return. It was also found that the binary signal can be transferred with less distortion through PLC networks when using the FSK technique compared to other techniques.**

***Index Terms*—Battery storage, clustered microgrids, demand response, energy management, photovoltaic (PV) power forecasting.**

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I. INTRODUCTION

THE economic growth of the rural areas mainly depends on sufficient renewable energy resources (RER) to accommodate the increasing demand for electricity. The use of these resources can speed up the development of small-scale industries, agriculture, and domestic needs. However, managing the unpredictable nature of RER located in widespread areas and owned by different energy suppliers is a challenging problem. In fact, intelligent energy management in the existing systems did not receive yet any attention, nor the current configurations were designed according to the structure of local communities [1].

Numerous energy management approaches are discussed in the literature. For instance, Basit *et al.* [2] proposed a real-time home energy management scheme in which the schedulable appliances were connected with a smart meter. The authors applied the concept of a mixed integer program to formulate the optimization problem under various practical constraints. In [3], Karapetyan *et al.* proposed an approximate optimization algorithm for event-based demand response management, considering the appropriate voltage levels and network constraints in islanded microgrids. Although Karapetyan *et al.* [3] demonstrated the utilization of this approach, the management of controllable load for a large number of consumers and the microgrid structure with its capacity were not clearly stated. Reka and Ramesh [4] introduced a demand response scheme using a game theory algorithm. The loads were scheduled based on different tariffs. Here, the tariff has been calculated for all loads and hours to reschedule the peak hours. A real-time decision model was proposed in [5] for load management in industries, where a variable real-time pricing is deployed. The approach optimizes the future time pricing uncertainties and schedules the loads in future time slots, along with the load management for current time slots after receiving the current pricing. A multiobjective algorithm for energy management in ac/dc microgrid was applied in [6] using advanced metering infrastructure. The authors utilized a new concept known as an operational value factor for the improvement of microgrids efficiency. The studies in [7]–[11] focused on economic dispatch by optimally scheduling the renewable generation, energy storage, and responsive load demand. Marzband *et al.* [7] utilized an optimization algorithm based on a multiperiod artificial bee colony for solving the