INCREASING MICROGRID CONTROLLING SYSTEM AND SAFETY BY USING ARTIFICIAL INTELLIGENCE

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ABSTRACT

As the demand for reliable and resilient energy sources continues to rise, microgrids have emerged as a promising solution for localized power generation and distribution. This article explores the integration of artificial intelligence (AI) into microgrid control systems to bolster their efficiency, responsiveness, and safety. The traditional approaches to microgrid control often face challenges in adapting to dynamic and diverse energy landscapes. By harnessing the capabilities of AI, we can optimize the operation of microgrids by intelligently predicting, managing, and responding to fluctuations in energy production and consumption.

Keywords: microgrid, artificial intelligence, control systems, energy resilience, predictive analysis, machine learning, adaptive control, real-time monitoring.

Microgrids, a newer form of power grid architecture, are gaining popularity among researchers and enterprises. The ability to integrate renewable generation, electric vehicles (EV), energy storage, and distributed energy resources into the power grid and connect them with effective communication [1] links gives a potential to increase power grid efficiency. Furthermore, by operating in an isolated mode, microgrids may power localized loads.

Renewable energy generation is supported in the electricity industry to reduce carbon emissions, while the transportation sector is moving towards vehicle electrification. To meet sustainable development goals, there is an aim of integrating 8000 GW of renewables by 2030 (compared to the 2800 GW now integrated). At least 100 countries will attempt to shift to 100% renewable energy by 2025. Norway now has the highest rate of renewable energy integration (99%), followed by New Zealand (81%), Brazil (79%), Colombia (74%), Canada (68%), Sweden (67%), and Portugal (65.5%). Saudi Arabia has the lowest level of integration (0.1%).

Between 2020 and 2021, the global percentage of renewable energy increased from 26.30% to 28.1%. The transportation sector is responsible for 17% of worldwide CO2 emissions; the global EV market has received tremendous support, resulting in over 16.5 million EVs on the road. EVs are estimated to account for 2% of worldwide electricity demand by 2030. In terms of grid integration with RES and EVs, microgrids are the best option to conventional networks; Figure 1 depicts the range of sources and loads that can be connected into a microgrid.

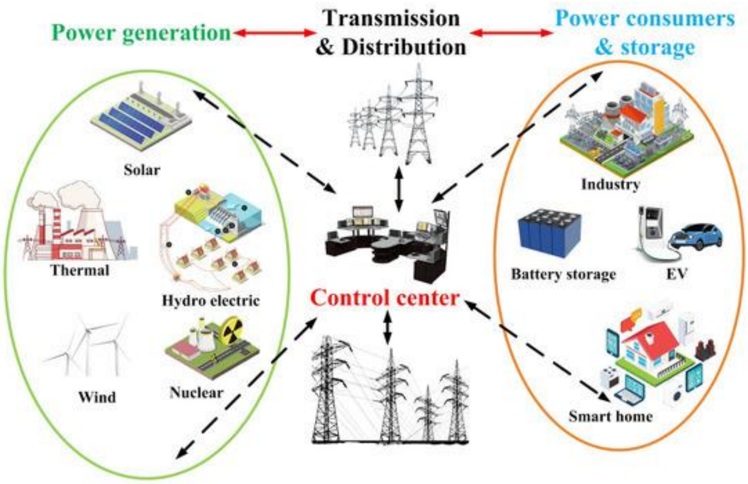

Figure 1. Overview of a microgrid.

Because of the wide range of intermittent distributed energy resources available, information on load availability and demand on the grid should be continuously monitored and relayed to the controller for successful operation and control. The open system interconnection (OSI) model, transfer control protocol/internet protocol (TCP/IP) model, extensible authentication protocol [2] (EAP), and microgrid communication are used to build the communication network. **Figure 1** depicts the various protocol structures. The advancement of Internet of Things (IoT) devices and architectures makes it possible to use smart metering, smart health, smart transportation, and smart grid services.

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