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Machine learning Algorithms in Smart Grid System – A review

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Abstract:

Artificial intelligence (AI) techniques rely on enormous volumes of data to construct intelligent computers capable of doing variety of tasks that need in the human intelligence behaviour. Machine learning is a subset of artificial intelligence, and the terms ML and AI are sometimes used interchangeably. AI can be described in smart grid applications as computers emulating grid operators' cognitive processes to gain self-healing capabilities. However, AI is unable to replace grid operators in some cases. An AI system is more precise, dependable and complicate system. The Smart grid system is having numerous challenges and problems to solve through AI. This survey presents an existing research study in AI techniques used in smart grid and power systems. It also investigates about the load forecasting, power grid stability evaluation, fault detection, and security concerns.

Keywords **—Artificial intelligence, Smart Grid, Machine learning, renewable energy sources, distribution system**

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I. INTRODUCTION

The global electricity system is preparing to transition to a smart grid system. There has been a significant acceleration in the deployment of smart grid pilot and demonstration projects around the world as a result of recent government stimulus spending programmes in 2009 and 2010. Smart grid technology is used in many countries, which are made up of a collection of distinct technologies; cover the entire grid, from generation to transmission and distribution to various sorts of power customers. The distribution system is the most important aspect of the electrical delivery network. It serves as the last link between the energy transmission system and the end user. Today's distribution systems have evolved rapidly, resulting in a significant increase in the number of active feeder lines and their overall length.

Passive distribution and sub distribution substations are getting increasingly advanced in some nations. A huge number of Distributed Generation (DG) units, such as wind turbines, fuel cells, and solar generators, as well as combined heat and power plants, are being connected into power networks as part of the deployment of smart grid systems to improve generation capacity. The penetration of renewable energy resources alters the fault current level in traditional distribution systems, as well as fault current properties such as direction, distribution, amplitude, and short circuit power.

As a result, DG connectivity provides a problem for the power grid's operation, management, and even design, as the network no longer functions as it did previously. Advanced distribution system monitoring and automation can automatically respond to the varied dynamics of the electric grid, resulting in fewer outages and improved load management, as well as active, flexible, high-

quality, and cost-effective energy. With the modern infrastructure and cutting-edge technology accessible in the smart grid environment, such a smart distribution system is viable.

Some of the most cutting-edge technologies, such as enhanced measurement, sensing, communications, and information technology, are already in use and deemed mature in terms of development and application, while others require more research and development. Smart grids, smart metres, and enhanced communication technology have all prompted researchers to look into their various proposals for monitoring tasks. Utilities have been looking for well-organized solutions to improve automation in distribution system monitoring and problem detection, spurred on by recent developments in communication and measurement technologies [1].

Among the Distribution Monitoring System (DMS) and outage management responsibilities, Fault Location (FL) is a critical application. Improving FL techniques contributes to the Department of Energy's "Grid 2030" grid modernisation programmes. The ability to precisely locate a failure in a distribution system can aid in the repair process, speed up system restoration, and accomplish network self-healing, which is a key feature of smart grid systems.

The goal of this research is to investigate the impact of a smart grid system scenario on distribution system monitoring tasks, FL methodology, and existing approaches in order to meet the needs of advanced grids. The review paper discusses how smart metering technology can be used to perform more sophisticated and effective monitoring and problem detection duties. The smart grid is based on a power transmission mode that was developed specifically for this situation, with intelligent, low-loss, high-transmission qualities, and it plays an important part in modern power transmission. Smart grid research is a multidisciplinary and multi-domain topic with a lot of promise for research. In this essay, the ultimate problems for smart grids in the future will be examined. The next part will begin with a brief overview of smart grid, then go on to a discussion of its research direction and challenges, and lastly, to a discussion of its application.

II. LITERATURE SURVEY

TABLE I
FONT SIZES FOR PAPERS

Author	Remarks
Cheng et al., 2018 [2]	The paper deals with decision-making in smart power grid system through data analysis received from various stages of data processing system.
Roya et al., 2018 [3]	Data integration techniques are implemented in this system with variety of sources into a unified view.
Di Zhua& Zhang, 2018 [4]	The unsupervised system is used to train based on various data attributes and values. In this work, data analytics system is used to identify the most likely groups among all of the data.
Siryani et al., 2017 [5]	In this work, primary purpose of smart grid based data analytics is to extract usable features from predefined benchmark data and compare it to real-time data in order to guide operation and maintenance.
Chunming et al., 2017 [6]	According to the author, energy generation optimization and demand forecasting is analysied by using the various optimization technic and fully deal with the consumption of consumer data.
Ak et al., 2016 [7]	Traditional fossil fuels are depleting in the power grid, and de-carbonization is needed for reducing the carbon emissions in the power system. Smart grids are very much useful in more cost-effective strategies and more performance in the usage of renewable energy sources.
Ye et al., 2016 [8]	The utilisation of renewable energy sources has grown in popularity as people become more conscious of the need of sustainable development. However, the intermittent nature of solar and wind energy creates substantial difficulties to a low inertia power system's safe and stable functioning.
Mishra et al., 2016 [9]	The smart grid, which is built in a decentralised framework, is driven by the desire to cut fossil fuel byproducts and keep up with ecological maintainability. The utilization of conveyed producing units in the present force

	appropriation frameworks is an effective way of exploiting broadly accessible environmentally friendly power sources like sun based and wind.
Keyan et al., 2015	As an intelligent energy and data framework, the keen matrix is a rich wellspring of information, containing information from the age, transmission, dissemination, and utilization of power. These information contain both electrical and non-electrical information, like advertising information, from dissemination stations, conveyance switch stations, and power meters.
Teng et al., 2014	The information sources portrayed above can be grouped into three classes: information from the rest of the world, information from the business world, and information from the estimating scene
D.S. Gazzana et al 2014	The creators gave a coordinated impedance and transient-based definition for FL in dissemination frameworks. The strategy utilizes an amplified obvious impedance investigation to decide the shortcoming distance, which considers unequal activity, middle burdens, laterals, and the time-differing load profile of appropriation frameworks.
Hamina Hossain et al 2013	According to this review, Wide-Area Measurement Systems are being utilized to advance situational mindfulness in the electric force lattice. These gadgets take into account the catch of minimal expense, immediately examined voltage information like recurrence, extent, and voltage point estimations.
Amir Mahdi Pasdar et al 2013	Method of discovering tricky hubs in three stage low voltage complex dispersion organizations of brilliant Grid by exactly infusing high recurrence current sign.
Kaisler et al., 2012	Big data is described as an amount of data that surpasses the capacity of technology to store, handle, and analyse efficiently, resulting in higher performance as ICT technologies advance.
Yuan Liao, 2011	By eliminating or limiting iterative methodology, the creator concocted novel shortcoming area calculations that give a brought together answer for a wide range of blemishes. Two sorts of procedures for non-outspread and spiral frameworks have been introduced utilizing voltage and current estimations at the neighborhood substation.
B. Wang, et al (2009)	To take utilization of a circulation feeder's outspread association trademark, the idea of "voltage droop state assessment" and related calculations were created. It gauges the droop profile along a dispersion line utilizing the most un-square strategy and depends on few
	metering focuses. The system is predicated on the possibility that the droops have arrived at a state of strength. This may not be the situation for hangs enduring under a few cycles.

III. CONCLUSIONS

Traditional power system framework approaches have limits in handling and understanding the big volumes of information that are presently the norm with a smart grid as the old grid network framework advances into a keen smart grid system. Subsequently, AI strategies are being created and tried in a scope of smart grid system applications, with empowering results. This review analyzes four basic subjects (load balancing and estimation, stability of power grid and security issues) that still can't seem to be tended to in past investigation. It additionally talks about the current difficulties, openings, and future possibilities of carrying out AI to make a truly smart grid. At long last, artificial intelligence (AI) is being utilized to work on the versatility and constancy of keen framework frameworks.

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