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Recent Advancement and Challenges of Smart Grid: A Review

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ABSTRACT- This research paper provides information about smart grid also gives alternative views of a smart grid. Today the power systems become more complex than last decade, also penetration of renewable energy resources to power grid and use of electric vehicles the stability in terms of voltage and frequency are very challenging. Also use of internet and other communication networking make the smart grid less secure. As cyber security is needed for smart grid. It highlights about power plant electricity (PPE) use also provide information of electric end-use energy efficiency. It includes distributed power systems and its advantages. Also distributed energy resources and storage discussion is there. Paper reveals the role of technology in demand response. It covers policies and programs in action as well as the market planning framework. The paper highlighted efficient electric end-use technology alternatives.

KEYWORDS- Smart Grid, Renewable Energy Resources, Electric Vehicle, Automatic Generation control, Cyber Security, Micro grid.

I. INTRODUCTION

Overview of the Smart Grid- During the last decade Smart-grid or smarter grid- has experienced major hype. Also gain worldwide recognition and has carried over into other industries, adding significantly to the confusion. As smart grid reflects a significant variation in thought process for the generation, distribution, also utilization of electricity. The smart grid has come to represent an indispensable change in the way we address the energy demand, security, and the environmental challenges we face [1].

Related Work- Paper [4] worked for the diverse nodes as various communication necessities with control stations. Used as several radio accessed for equipment, as different type of service with need communication requirements. Author worked for communication requirements and formulized the CF in work. Resulted for prestige rate of each radio access technologies for a certain SG node type. Result was investigated for best radio access technologies since communication features for SG different of the node types with diverse communication requests. J. W. Bos et al. [5] worked for how to compute the estimate expectation such that the trader free from any single customer practice. The paper was discussed of the usage for forecast homomorphic ally related with artificial neural network created tactics for the cryptographic situation.

Article [6] worked for model predictive control as an operational mechanism for incorporating the smart grid using future smart structures. Paper dealt with system observing response for innovative topographies such as adaptive learning and programmed error recognition and diagnostics. A. A. Maske et al. [7] worked for brief review for the smart grid-driven tactics in energy-efficient infrastructures with others utilities as well as the collaboration among smart grid and figures of utilities and communication setups.

X. Fang et al. [8], showed the smart controlling scheme, with smart safeguard structure. They defined tasks and future investigation guidelines substance reconnoitring for individually with 3 components also into three subsystems. Paper worked for new grid paradigms: micro-grid and G2V/V2G. X. H. Guo et al. [9] worked for deep amalgamation of computer-generated scheme and power physical structure for smart supply grid. The appearance of cyber-physical system be responsible for s problem solving. The analysis of combination of data stream and power run.

Article [10] worked with real technology for the domestic level on the present low voltage (LV) system have still an area of widespread investigation. As EVs interest also united situation of electric vehicle and photovoltaic implementation have analysed for the data.

S. S. Reddy [11] proposed railroad smart grid consists of distributed generation as wind and solar power generations also the hybrid energy storage system. The hybrid storage considered in this paper includes the super capacitors and the batteries, and they are used to provide the storage flexibility. They worked for optimization as a mixed integer nonlinear optimization problem solved this by using the micro genetic algorithms.

Study of [12] used in the enrichment of ephemeral steadiness of smart grid related squirrel cage induction generators. Major with the wind power station induction generator have been used for their supremacy due to optimal in price as well as care. Authors [13] presented condition of India once the electrical business was facing vast challenges internationally, extending from a supply-demand cavity to increasing price, over-all climate change etc. the resolution to reinvent the industry as smart grid. Paper explored a modernize approach for additional forward-thinking of electricity supply with sustainable and robust economic improvement objectives.

II. REVIEW OF SMART GRID TECHNOLOGIES

Article [14] proposed estimating simulations for schedulable capability of EVs over the comparable gradient improving

resolution tree process and big data investigation for multi-time measures. Observations had done proposed PGBDT-based EVSCF models that could be more effective and logical ability of ML under a big data background and provide dominant provision for EV contribution in grid planning and additional services.

In [15] researchers showed communication design and correct statistics were the two modules for current electric power structures, rather than smart grid requirement ample and additional compound communication style for power systems. Paper [16] utilized numerous machine learning based tactics such as the provision vector technologies and neural networks for obtaining the predicting on energy usage. For [17] used of main components of smart grid contain other information shown in Table 1.

Paper [18] presented structure of process of these foundations by ideal power flow founded on power flow chart for consumer's management as a smart grid of power system. The arrangement satisfies accurate set-up for power system, centred on basics of power system, therefore an essential investigation topology was developed, with balance orders of RES for background so that consumer unable to hamper and that was confirmed for true and non-linear loads of electrical systems.

Table 1: Main components of smart grid

Sr. No.	Types of components in Smart Grid
1	Smart usage
2	Electric vehicles (EVs)
3	Smart meter
4	Smart substation
5	Distributed generation
6	Phasor measure units
7	Integrated communications
8	Sensing and measurement

T.M. Aljohani et al. [19] examined the outcome of the smart grid uses in refining the trustworthiness of the power distribution systems. The goal was to examine the feeder for the ideal settlement of the spontaneous swapping devices and measure their correct setting up also the enactment of the scattering structure. Article [20] reviewed about the core smart grid assignment also the three chief methodical systems smart grid: intelligent scheme set-up, intelligent managing structure, and intelligent shield structure. Author also worked for detailed constraints with future investigation of these three schemes.

Paper [21] highlighted the opinion of a significant model shift, with the prospect to draw new, additional intelligent approaches for generating, allotting, distributing. For [22] discussed with evolution of smart grid growth. Smart Grid has a significant also the energy freedom and naturally sustainable fiscal development. In [23] the brief introduction with big data, big data style, smart grid, big data construction for smart grid and overall rewards as well as big data uses in smart grid situation and future experiments in energy field with smart grid communication.

For [24] the worked was developed as structure with bi-directional flow of electricity and data, with healthier power grid consistency, safe keeping, and efficacy of electrical structure for power system. In [25] worked for improved execution of smart grids that incorporates tools of cutting-edge recognizing, control practices and communication proficiencies into the present power grids at equally the transmission level as well as distribution side.

B. Huang et al. [26] worked for energy-efficient supply sharing problem on behalf of machine-type communications. With the two phase energy efficient combined station range and power control optimization process by uniting a similar with externalities methodology and nonlinear fractional programming technique was suggested. In [27] worked for evolution of smart grid concept had possibly to meet for complete need of operational of energy with sinking carbon release and incorporate with extra renewable energy blend.

Paper [28] worked for communication interacting preparation, diverse communication technologies that would be engaged with these scheme, excellence of facility, elevating application of resources, control with proper management, etc. In [29] maximized the usage of network resources and accessible power, exactly how to safeguard dependability and safety, and how to provide self-healing ability necessity to be measured in the enterprise of smart grids. Paper [30] introduced an methodology to cyber-attack influence investigation related to evolving smart grids.

II. SMART GRID AND ITS CHALLENGES

Smart Grid has some technical advancement and there are some challenges are listed in given Table 2. In [31] worked for incorporation of smart devices and statistics & communication tools, the smart grid offerings a supportable choice for providing extra proficient and stable power, along with an overabundance of compensations over the present grid. Paper [32] suggested smart meter strategies include episodic transmission of power, phase, and existence data from the consumer to the electricity supply. For [33] showed as progressive metering infrastructure encompasses of group, loading and using energy practice data was expected to be the core instrument of smart grid. For [34] presented a case study in using numerous wireless internetworking resolutions to upkeep our smart grid results.

Table 2: Different Types of Technical Issues and challenges

Sl. No.	Types of Advancement in Smart Grid System	Remark
1	General Issues of Smart Grid	In advanced stage
2	Electrical Vehicle & Smart Grid Based Frequency Control	In advanced stage
3	Network Security Issues in Smart Grid	In advanced stage
4	Communication for Smart Grid	In advanced stage

Authors suggested for deployments, highlight the key issues observed during implementation, and observed the application awareness requirements for smart grids. A. K.

Singh [35] addressed critical issues on smart grid technologies primarily in terms of information and communication technology (ICT) issues and opportunities. The main objective of this paper is to provide a contemporary look at the current state of the art in smart grid communications as well as to discuss the still-open research issues in this field.

In [36] paper proposal of features and track of China's smart grid progress, and point out that the expansion of smart grid need seeks the improvement as a lot of smart grid technologies and the construction of grid configuration, and comprehensive layout the awareness of the self-correcting utility also scattered power production machinery. The As [37] tendency to be focused by one of two key ideas for ornamental electric power exchanges for both utilities and their consumers like European Union and U.S. models. For [38] recognized the benefit, development and the difficulty for smart grid. Another [39] reviewed in the effort of generation, transmission, and distribution. Also worked for new era for smart grid: G2V/V2G and microgrid. In [40] showed the idea and the piece of information for vibrant interactive, real-time infrastructure that made in appealing manner in technological order for the power system of the hope, relatively than being minimally a advertising name.

The research paper [41] showed a lifelong learning based electric vehicles and renewable energy source. The wind farms, photovoltaic stations , and electric vehicles worked for appreciably speed up the system reaction and trim down the regulation costs of balanced among generation side and demand side. For [42] EVs incorporation showed automatic generation control after instability with multi-area power system. Also [43] investigated for integration with wind power and vehicle-to-grid for constant frequency as a sudden perturbation. Paper [44] worked with transmission systems and automatic generation control and electric vehicle incorporated said system. Also [45] showed the responses of EVs, with two control strategy of AGC with EVs, as area control error and area regulation constraint by a digital filter, correspondingly. Paper [46] showed to handle charging and discharging in a fleet to track an AGC signal when aggregated. In [47] a collective model consisting of a three area system entrenched with electric.

Researcher worked [48] for improved show of data transmission with its active and adaptive spectrum distribution ability in relationship through lots of other networking technologies, cognitive radio networking technology in smart grids. In paper [49] automatic synchronizing system worked with matching as controlling several governor and exciter interfaces within the provision. In [50] worked for building stability with generation and demand as load frequency control. This paper said the exploit of recursive least square algorithm for acquiring the system rating in real moment.

In research [51] the AGC of power systems with existence of PEV. The adaptation in innovative grey wolf optimization algorithm was used which maintained a proper balance. Worked revealed that PEVs contribute in the AGC as constant frequency. Contribution of [52] research with RERs required refined scheduling and operation development for technologies. Diverse approach for handling RERs, demand response was investigated.

III. SMART GRID INITIATIVES

In India- The ministry of power has owed 14 smart grid guide project that will be implemented by state-owned allocation utilities in India under controlled accelerated power expansion & reforms program proposal for distribution reforms. Following are the list of 14 pilot projects are as:

Table 3: Smart grid pilot projects in India

Distribution Company	**Name of Scheme (Cost of project/ Units)**
1-ASSAM POWER DISTRIBUTION COMPANY LIMITED (APDCL), GUWAHATI DISTRIBUTION REGION	R-APDRP & SCADA/DMS implementation/ (Rs.29.94 Cr, 90Mus)
2-Andhra Pradesh Central Power Distribution Company Limited (APCPDCL), Jeedimetla Industrial Area	RAPDRP scheme; DAS, IT & SCADA (Rs.41.82 Cr)
3-Maharashtra State Electricity Distribution Corporation Limited (MSEDCL), Baramati Town	AMI for remote connected/disconnected of consumers, monitoring the consumption patterns, tamper detection, control load monitoring, load curtailment program. (Rs.28.21 Cr)
4-Chhattisgarh State Power Distribution Company Limited (CSPDCL), Siltara-Urla area of Raipur District	includes installing smart meters at 508 HT< industrial consumer's premises including 140 smart meters. (2140.86MU)
5-Himachal Pradesh State Electricity Board Limited (HPSEB), Industrial town of kalaAmb	PLM & OMS is proposed by implementing AMI (Rs 17.84Cr)
6-Punjab State Power Corporation Limited, Tech-II sub-division, SAS Nagar	AMI in the project area for 9818 residential & industrial consumers (Rs. 10.11Cr, 60MU)
7-Rajasthan-Jaipur Vidyut Vitaran Nigam Limited (JVVNL), Sanganer Sub Division, Jaipur city	OMS with SCADA & distributed generation from renewable sources, benefiting by reducing AT&C losses (Rs. 33.38Cr, 148.12MU)
8-West Bengal State Electricity Distribution Company Limited, Siliguri Town, Darjeeling	AT&C loss reduction & PLM using AMI for residential & industrial

	consumers (Rs 7.3Cr, 42MU)
9-Chamundeshwari Electricity Supply Corporation Limited (CESC), Additional City Division, Mysore	AT&C loss reduction & PLM using AMI for residential & industrial consumers (Rs 32.59 Cr, 151.89MU)
10-Tripura State Electricity Corporation Limited (TSECL), Electrical Division No.1, of Agartala town	RAPDRP scheme for IT implementation & system strengthening. (Rs24.08Cr)
11-Kerala State Electricity Board Limited (KSEB)	RAPDRP scheme, for LT industrial consumers is 376Mus (Rs24.08Cr, 2108Mus)
12-Electricity Department, Government of Pondicherry, Division 1 of Pondicherry	RAPDRP scheme for IT implementation & system strengthening (Rs 46.11 Cr, 367MU)
13-Uttar Gujrat Vij Company Limited (UGVCL), Naroda of Sabarmati Circle	reduction in AT&C losses, reducing the rates of failures (Rs.48.78Cr, 1700MU)
14-Uttar Haryana Bijli Vitaran Nigam(UHBVN), Panipat City Subdivision	RAPDRP scheme for IT implementation (131.8MU)

For [53] generation and handling of energy had direct impact on current power grid. In this circumstances energy supervision was a tough task since load was vibrant and also don't had control over it. For [54] worked in flexibility of work for smart grid-related approach allows micro-grids to load dependably.

Paper [55] proposed a required trade-off among the financial competence for consumers to benefit from expediency while reduction cost. Paper [56] worked, for a smart grid system with two dissimilar power supply modes. As researched to analyze the element significance of the system, aiming to discover the feeble parts of the system thereby getting better the system devise.

IV. CONCLUSION

The smart grid has come to represent an essential change in the way we address the energy demand, security, and the environmental challenges we face. Cyber security in the Smart Grid is new vicinity to follow a line of investigation that has paying attention rapidly rising attention in the government, industry and academia. The information used for cyber-physical model for smart distribution grid. The smart grid projects are the modern technology which is revolutionizing & beneficial for all. There are many research issue are discussed and give complete overview that include grid characteristics, research issue and applications.

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