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Artificial Intelligence and Machine Learning in Renewable Energy

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ABSTRACT: Renewable energy is a source of clean, non-polluting emissions, and inexhaustible green energy. Renewable energies are different from fossil fuels specifically with respect to availability, abundance, diversity, potential, etc. and easy to use. In last decade, many countries & governments globally are investing in green energy and planning to be dependent on renewable energies. With the advancement in technology, Artificial Intelligence (AI) and Machine Learning (ML) have the power & capability to transform and empower the renewable energy industry at a great extent. By leveraging the power of Artificial Intelligence and Machine Learning, the renewable energy sector can be digitalized & automated with huge potential reducing human efforts and reducing errors in process and increasing outcome.

KEYWORDS: Artificial Intelligence, Machine Learning, Renewable Energy, Power of Technology, Automation, Digitalization.

I. INTRODUCTION

In renewable energy industry, Artificial Intelligence & Machine Learning can play the vital role and can be a key aspect to digitalize and to automate the work by increasing the efficiency and accuracy with a huge impact on energy system design, production, operation, maintenance, distribution, and consumption. In a survey, more than hundreds of renewable energy industries and their workers said that, their tasks would benefit and would become easy due to digitalization and automation. There are many areas and workflows, which could be automated and monitored by using the power and features of Artificial Intelligence and Machine Learning [2].

Artificial Intelligence is the main branch of prediction-based technologies. It includes domains like machine learning, neural networks and data science. Machine Learning is a new subset of Artificial Intelligence. In the next couple of decades, the need for learning from the data to maximize the performance of machine and predict the outcome of renewable energy industry will be the key focus and one of the primary goals. Machine Learning is an application of Artificial Intelligence that gives machines the capability to improve, acquire knowledge and learn from experience via specific algorithms from data over time with various techniques to operate on data to analyze and to find specific patterns [1]. Artificial Intelligence and Machine Learning technologies will help the world to think the innovation in renewable energy out of the box. There are several aspects or areas mentioned in Opportunities section below, through which Artificial Intelligence and Machine Learning technologies will help to transform renewable energy sector.

II. OPPORTUNITIES

Forecasting: Theunpredictability is the major and difficult challenge in renewable energy production industries. Renewable energies are fundamentally tightly coupled and dependent on natural resources like Sunlight, Airflow, Water, Water Tides etc. and these resources tied up with uncontrollable weather. By using the features of Machine Learning, it becomes easy to current weather forecasting with the help of current and historical weather data. This forecasted data is used by power generation industries to manage the power systems and to predict the resources availability. Based on the forecast data, power generation companies can takes important decisions about power generation capacity and output, power storage, distribution and accordingly load balancing. Also, forecasting helps to manage the backup power facilities in time to provide uninterrupted energy supply [3].

The powerful features of Artificial Intelligence and Machine Learning can also be used to design such algorithms, which can be used to forecast the attributes of energy resources like sunlight availability in current 24 hours, wind speed, etc to make short-term forecasting renewable energy output for minutes instead of days and months.Enhanced forecasting results in efficient, seamless, and uninterrupted working of power generation workflow with managed and well controlled process flows like starting & shutting down of specific functioning unit, optimal usage of raw material or raw resources, etc.More accuracy in forecasting leads the companies grow with well planning and reduced risks [7].

Risk and opportunity analysis: Risk and opportunities is a very important part of any business. A good Risk and opportunities analysis and management can make a business stable and can take a business to a high level competing with other market players. By leveraging the power and capabilities of algorithms designed and developed by Artificial Intelligence and Machine Learning, power producing companies can make analysis and can take appropriate decisions for the possible risks and opportunities in the market and can identify the potential of the company which will definitely help to company and the investors at a great level.Such types of algorithms, can even make analysis on the proposed financial models to predict the business growth, profits, losses, investment intensive areas identification, raw material & other resources inventories, and etc. and by using these analysis, any company will be going in the right direction with executing the business with lowering expenditure and maximizing the profits [5].

Grid Management: Grid management is one of the next crucial and critical aspect of renewable energy system. Artificial Intelligence and Machine Learning are playing a vital role by using data analytics to predict energy consumption with the help of data samples taken periodically of the year of current and previous years as well. This prediction helps energy industries to be ready to provide the required possible amount of energy without any interruption [4]. This prediction also helps, to take the decision for either to expand the energy production resources or reduce them based on the demand-and-supply ratio for upcoming days or months. By totaling this, grid management becomes very easy due to above rational.

Maintenance: Maintenance is the very important key aspect needed in every equipment or resource in industry. Maintenance is very helpful to keep complete system working efficiently and seamlessly. Artificial Intelligence and Machine Learning features can help to identify the problems, bugs, or defects in the component of the power system and can notify in early stages if there will be any problem in component functioning. With this feature availability, companies can avoid a major breakdown of resources of components of power system which will lead the uninterrupted working of power system and less maintenance cost before any major failure.With the help of algorithms designed by Artificial Intelligence and Machine Learning features, power generating companies and grid operators can forecast the scheduled maintenance and can manage power supply [6]. Now a days, with the help of smart meters and data generated by smart meters, Artificial Intelligence and Machine Learning algorithms are helping to predict the energy demand and distribution load, which help to optimize the distribution and consumption of energy by shifting or changing the actual source like Solar Energy, Wind Power, etc to generate green energy [8].

III. IMPACT

The use of Artificial Intelligence and Machine Learning as powerful technologies in the renewable energy sector, is having a long-term impact on power generating companies as well as on power consumers. Artificial Intelligence and Machine Learning are revolutionizing almost all the sectors across the various domains, becoming the integral part of renewable energy systems. As renewable energy systems and industries are growing rapidly with new inventions and requiring researches to meet the world's demand, it is very important and necessary to work with and make use of the latest, powerful, and efficient technologies exist, to achieve the desired outcome which is a very prime impact in renewable energy sector. As the processes & workflows are getting streamlined with the help of powerful algorithms, the future long-term goals can be achieved in a very short-term reducing the waiting time for the revolution in renewable energy sector. Automating and improving the processes and workflows, the error prone work or tasks will be reducing drastically resulting desired outcome in stipulated time.

IV. CONCLUSION

Artificial Intelligence and Machine Learning have the capability and potential to renovate and reshape the renewable energy industry system completely. World is already experiencing the revolutionary changes done by these technologies impacting hugely on renewable energy systems and power consumers. In the near future, these technologies are expected to outperform and benefits in various operations of renewable energy systems leading world towards green energy.

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