International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 07, 2020
ISSN: 1475-7192

AI's Role in Sustainable Energy

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Abstract

This study overlook on the perspective role of AI in the energy sector, with main focus on improving efficiency and sustainability. The role is to establish a realistic benchmark for AI technology, facilitating global efforts, ambitions, novel applications, and industry obstacles. The study focuses three main areas:

i. The application of AI in solar and hydrogen power creation.
ii. The utilisation of AI for contribution and demand management control of energy
iii. An overview of the latest techniques in AI technology

This research explores how AI techniques outperform traditional models across various domains, including controllability, energy efficiency optimization, cyber-attack prevention, IoT (Internet of Things), big data handling, smart grid management, robotics, predictive maintenance control and computational efficiency. The findings of this study underscore AI as a pivotal tool for the evolving and data intensive energy industry, empowering enhanced operational performance and efficiency within an increasingly competitive landscape. This research overlooks how AI techniques outperform traditional models across various domains, including
Controllability, energy efficiency optimising, cyber-attack precaution, IoT (Internet of Things), big data handling, smart grid managing, robotics, predictive maintenance control and computational efficiency. The findings of this study underscore AI as an important tool for the evolving and data intensive energy industry, empowering enhanced operational performance and efficiency within a rapid competitive landscap

Keywords: Artificial Intelligence (AI); Renewable Energy, IoT, Energy storage; Space Exploration;

Introduction:

In today's era, computer programs have to possess the remarkable abilities of reasoning and learning. When it comes to forecasting aspects like wind patterns and renewable energy resources in the most straight and efficient manner. AI emerges as the recommendation. AI can gather real-world data, much like it does with rain fall patterns and energy demand, which able the organizations to function more efficiently in society. This cost technology is renowned for its problem-solving powers, predictive ability, control mechanisms, and its applications in various related area.

AI's predictive capabilities play a vital role in shaping the energy industry's trajectory, fostering business growth, enabling multitasking, and reducing the workload associated with resource allocation. The profitability as digital assistant around the clock for day-to-day operations. Notably, AI offers diverse applications in the realm of solar technology, encompassing solar photovoltaic, passive solar, solar water heating, solar process heat, concentrating solar power, and more. Its contributions extend to real time grid monitoring, precise power generation predictions, and the development of numerous novel energy-related strategies.

- Enabling technologies encompass power plant adaptability, utility-scale batteries, IoT, big data, AI, block chain, behind-meter batteries, electric vehicles, micro-smart grids, super grids, and the conversion of renewable energy to hydrogen and heat.
- Business models include community ownership, peer-to-peer energy trading, energy service models, and online payment models.
- System operation involves dynamic line rating, virtual power lines, collaboration among distribution, transmission, and generation, energy forecasting, renewable power production, hydroelectric storage technologies, and evolving roles of utilities and system operators.
- Energy market design covers various time-of-use tariffs, increasing granularity in electricity markets, net billing schemes, regional markets.

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Literature review:

Photovoltaic Cell: A semiconductor device that converts sunlight into electrical energy which is commonly referred to as a "photovoltaic cell". The conversion of energy is known as photovoltaic effect. Photovoltaic system is connected to the utility grid which converts solar energy into DC power. The amount of DC power generated directly relies on the level of sunlight (insolation).

Hydrogen Fuel Cell: In this review, Solar hydrogen hybrid demonstration projects with the goal of providing independent electricity supply. In this research, we conducted a survey of case studies focusing on solar hydrogen hybrid energy systems designed for electricity supply. These case studies span several decades, going back as far as the 1980s. These energy systems come in a range of sizes, from as small as 1kW to as immense as over 600 kW. The researchers incorporate alkaline and PEM (Proton Exchange Membrane) electrolysers with power capacities ranging from 1kW to 320kW.

AI for supply and demand management control of energy: Long term markets, ensure that future production capacity aligns with the evolving demand. Demand response (DR) products are rarely traded in this type of markets.

Energy markets are the place where retailers purchase electricity from producers. Retailers must care for a balanced portfolio within each market time interval, equating their electricity consumption with the conception to keep the grid frequency steady. In these markets, DR is a creation used by suppliers to adjust demand and maintain evenness at various intervals.

Overview of AI in latest medicine sector: AI is already making momentous inroads in the healthcare profession, with applications spanning from appointment management, medical data digitization, to advanced tasks like assisting in pharmaceutical dosage calculations. Radiology(medical imaging) is an area where AI is showing promise, such as Germ watcher and Babylon, are being enhanced. AI is even playing a part to surgical procedures through systems like the Da Vinci robotic surgical system.

Quantum computing: It is an exciting research area at the intersection of computer science, physics, and engineering, garnering attention from academia and industry. It furnishes the potential for a cyber-evolution, leveraging intrinsic parallelism through phenomenon like superposition and entanglement. First and Foremost designed for quantum mechanics, the focus now is on achieving "quantum advantage" with algorithms that outperform classical ones. Real quantum computers are now within reach via internet, allowing experimentation with established quantum algorithms and the creation of purely new ones.

Title related headings:

AI and Autonomous Rover Robotics in Lunar Exploration:

1. **Autonomous Decision making**: AI is transforming space missions by sanctioning autonomous navigation for rovers. This self-sufficiency permits rovers to react to unexpected challenges and change their roads dynamically, increasing lunar exploration.
2. **GPS tracking and Cartography:** AI-equipped rovers makes real –time detailed maps of lunar terrain using techniques like concurrent localization land effectively.
3. **AI contribution to Scientific Exploration:** AI increases scientific discovery rapidly by independently identifying scientifically significant areas and analysing geological characteristics.

Indian Lunar Program: The Chandrayaan program epitomises AI's transformative impact on lunar exploration. AI-aided Chandrayaan rovers navigate uneven terrains and analyse the lunar surface.

Result:

With a main focus on improving efficiency and sustainability, we have inspected the potential act of AI in the energy sector. It has pinpointed crucial applications of AI , including supply and management, the formation of solar and hydrogen power, and the most present developments in AI. These data highlights how important AI in solving difficulties the data heavy energy sector improving effectiveness and efficiency. According to the findings of the research, AI strategies daily outperform models in various domains which includes controllability, optimisation of energy, prevention of cyber attacks, internet of things, handling of big data, etc. The discoveries focuses on important act that AI plays in handling the challenges by data intensive energy, increasing efficiency in environment that is marked by high compeitition.

Summation

Overall, our study focuses on the transforming potential of AI in the energy sector. AI not only shares solutions for improving efficiency but also contributes to the sustainability of energy excercises. The diverse use of AI, from solar technology to demand management, present opportunities for significant technology in the industry. AI's predictive capabilities are pivotal in shaping the trajectory of the energy sector, fostering business growth, multitasking, and reducing the resource allocation workload.

Besides, we have reviewed pertinent literature, including studies on photovoltaic cells, hydrogen fuel cells, and AI applications in various sectors. These studies focuses on the growing impact of AI in energy and other fields. As technology progresses, particularly in the area of quantum computing, AI is supposed to revolutionize variety of industries, making it a crucial driver of modernization world. Our research contributes to a deeper understanding of AI's role in energy, showcasing the way for a more sustainable and efficient future.

Future scope

It helps in enhancing energy efficiency**.** It integrates the world with renewable energy sources**.** It provides us with energy storage solutions**.** It enhances AI-enhanced grid Security**.** It impacts Environmental Mitigation**.** It makes policy and regulations for the betterment of society**.** It increases investment and research. It develops education and workplace.

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