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ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING ALGORITHMS FOR ENVIRONMENTAL MANAGEMENT STRATEGIES

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Abstract: In this study report, we shed light on the possibilities of the Artificial Intelligence application in the field of environment and climate change, as well as the help of machine learning algorithms in predicting climate change, determining optimal environmental management strategies and developing new energy-efficient systems.

Key words Artificial Intelligence, machine learning, ML algorithms, and environment

Introduction

During the past few decades, humankind has been facing growing environmental problems that require urgent solutions to improve the situation in the world. The necessity to employ new technologies, which could effectively deal with environmental threats, has come to the forefront. Artificial Intelligence (AI) is one of these technologies, providing extensive opportunities for solving environmental issues.

Results and discussion

Having analyzed vast datasets, AI algorithms enhance our understanding of climate patterns, enabling accurate predictions of extreme weather events, sea-level rise, and ecosystem shifts. Machine learning (ML) algorithms have all the possibilities to analyze large volumes of weather and climate data to predict future climate conditions. For example, DeepMind, a subsidiary of Google, has developed an Artificial Intelligence system that can predict wind energy distribution 36 hours ahead, allowing for the optimization of wind turbine use. As a part of the project in Burundi, Chad, and Sudan, based on the use of AI, the analysis of preceding changes in the environment is being conducted to provide forecasts of these changes in the future. At the same time Belarusian, specialists, together with their counterparts from the Arctic and Antarctic Research Institute (AARI), are set to develop a new system for long-term climate change prediction based on Artificial Intelligence.

Dr. Sergey Soldatenko, a member of AARI, a Doctor of Physics and Mathematics, and a professor, shared: “By applying artificial intelligence methods to analyze past and present climate system observations, we aim to construct a self-learning Earth system modeling system and utilize this system for ultra-long-term weather and climate forecasting.” AARI specialists and the Institute of Natural Resources Use of the National Academy of Sciences of Belarus will concentrate in their work on simulating the model of the climate conditions in the Union State territory over a 20-year time horizon. The outcomes of the developments are planned to be implemented in Roshydromet institutions. As Sergey Soldatenko elucidates, current traditional methods fall short in adequately considering hard-to-predict factors and sudden shifts in various aspects of Earth’s climate, which complicate weather forecasting from months to 20 years ahead. The scientist affirms that digital self-learning systems should address this issue.

Artificial intelligence also plays a crucial role in weather forecasting. With the help of AI, weather forecasts can be improved and the accuracy of predictions can be increased. For instance, The Weather Company used AI to forecast the weather on Florida’s beaches. They used data on air

temperature, water temperature, wind direction and speed, as well as solar activity. Using this data, the AI was trained to create weather forecasts that were more accurate than those created by humans were. Recent publications from Nvidia, Google DeepMind, and Huawei have unveiled machine-learning techniques that can forecast weather with at least the same accuracy as traditional methods, but at a much faster pace. Huawei's Pangu-Weather, Nvidia's FourcastNet, and Google DeepMind's GraphCast are prompting meteorologists to rethink the application of machine learning in weather prediction, according to Peter Dueben, the leader of Earth system modeling at the European Centre for Medium-Range Weather Forecasts (ECMWF).

In 2018, at the World Economic Forum in Davos, Dr. Celine Herweijer, the head of the Innovation and Sustainability department at PwC, presented a report. This report significantly influenced the scientific community's understanding of the potential for using Artificial Intelligence-based solutions in the context of ecology. In her presentation, Dr. Herweijer justified over 80 potential applications of Artificial Intelligence. AI can assist in determining the most effective strategies for reducing carbon dioxide emissions and adapting to climate change. For example, IBM uses AI to optimize delivery routes, which help reduce carbon dioxide emissions. The use of AI is aimed at making the process more efficient and dynamic, based not only on historic patterns but also on predicted data such as weather, competitive intelligence, supplier monitoring, supply forecasts, etc.

AI and ML can assist in the development of new technologies and systems that improve energy efficiency. For example, Google uses Artificial Intelligence system, developed by its subsidiary DeepMind, to manage the energy consumption of its data centers. This AI system uses machine-learning algorithms to automate power station management and power supply. In addition, some specialists have tried the tools of Artificial Intelligence in the field of optimizing energy consumption in relation to power demand and availability of green power in the grid. The IBM Flex Energy solution developed together with the City of Copenhagen and now being implemented by Andel in East Denmark is an example of, where AI has been used to predict as well demand of power from buildings and factory plants as the estimated generation of power from wind- and solar farms. At the heart of this system's operation is the principle of temperature regime optimization. Algorithms developed by DeepMind are used to analyze data and select the most efficient temperature regime. This significantly reduces the company's electricity costs.

According to the Internet resources, suchAI system was first used in 2016. Since then, Google has actively used AI to manage the energy consumption of its data centers, reducing energy consumption by 15%.

Conclusion

Artificial Intelligence and Machine Learning offer powerful tools for combating climate change and protecting the environment. They can help us predict future climate conditions, determine the most effective strategies for reducing carbon dioxide emissions, and develop new energy-efficient systems optimizing the consumption of power with low cost and without polluting the environment. Artificial Intelligence can be employed to analyze extensive data collected from sensors, satellites, and other sources to discern patterns and predict future climate shifts. This allows for a better comprehension of the influence of different factors on climate change and the adoption of effective actions to alleviate them. The integration of AI technologies in climate change research signifies a significant leap toward proactive adaptation and sustainable decision-making, offering invaluable insights for policymakers and researchers striving to address the global climate crisis.

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