Facing Climate Change Crisis: Interconnection between Artificial Intelligence and Indigenous Knowledge

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Introduction

The climate change crisis, a subject extensively examined by scientists and governments, has broadened in scope due to technological advancements. This pressing issue traces its history back to the early 19th century when researchers initially started to investigate paleoclimatic variations and recognize the natural greenhouse effect. Over time, our comprehension of climate change has experienced a substantial evolution.

As more weather stations are in the work, an unprecedented amount of climate data is accessible; however, the manner in which this data is accessed, interpreted, and utilized is vital for addressing the crisis effectively. Artificial Intelligence (AI) has proven to be a valuable tool in this regard (United Nations Environment Program, 2022). AI models help by automatically establishing connections among vast datasets and making predictions. By feeding data to AI models, the algorithms can "explore" it and identify statistical correlations. The convolutional neural network algorithms employed by AI hold the potential to tackle climate change issues that span across spatial and temporal dimensions (European Space Agency, 2019).

However, despite new technology being a trend to help with climate change, the traditional knowledge from local people is still useful at present. Other than natural scientists, Native Americans are able to notice climate change the fastest. “Indigenous peoples have always been on the front lines,” says Nikki Cooley, who grew up without electricity or running water on the Navajo Nation reservation and now co-manages the Tribes and Climate Change Program for the Institute for Tribal Environmental Professionals (ITEP) in Flagstaff, Arizona. “Tribes have always been adapting to climate change. Now we have to adapt even faster.” (Jones, 2020) Native Americans are using their special ways to protect nature and eliminate the negative effects of climate change.

So it is worth investigating the way of combining AI and indigenous knowledge to overcome the climate change crisis.

Climate Change Crisis

Due to the rapidly changing global climate, the crisis emerges as a serious issue for all human beings, with its multi-dimensional impacts on the environmental, health, economic, and social spectrums.

The loss of biodiversity brought by climate change becomes the most significant challenge to the environment. According to the United States National Centers for Environmental Information's report, there was an alarming increase of approximately 1.98° (1.1°C) in global temperatures from 1901 through 2020. This upward shift in average global temperatures is engendering a deep and lasting impact on our environment, which can break the biosphere in the coming years. Sea levels are rising, droughts and flooding are becoming more frequent, and the ripple effects are being felt across every aspect of our lives. (National Centers for Environmental Information, 2021). These factors make it harder and harder for some animals and plants to live on the planet. For example, as temperatures get warmer, many plants are starting to grow and bloom earlier in the spring and survive longer into the fall. Some animals are waking from hibernation sooner or migrate at different times, too. The small changes in animals' life finally can direct to the new unbalanced biosphere which no longer provides living space for some species (Biello, 2007).

Climate change makes severe threats to human health. Heatwaves, which rank amongst the deadliest weather phenomena, are becoming more prevalent and can spark devastating wildfires. As the oceans continue to warm, hurricanes are becoming more powerful and moisture-laden, posing a non-negligible risk to people's lives. Additionally, disease propagation

is facilitated by increased flooding incidents, especially adding fatal danger to people in relatively undeveloped areas like Africa (WHO, 2022).

The stability of the food supply is closely tied to the consistency of climate conditions. While farmers and researchers can adapt agricultural techniques to some extent for combating climate change, the side effects of unstable weather are still potential to undermine all such efforts. The compounding effects of escalating temperatures, water shortage due to droughts, disease spread, and extreme weather events are making it increasingly difficult for farmers and ranchers to maintain normal food production. The precariousness of our food supply chain keeps reminding people of the need of finding ways to overcome the climate change crisis.

AI Assists to Solve Climate Problems

Leveraging the powerful ability of data processing of AI, people have the way for a comprehensive and high-efficiency approach to tackling environmental challenges. AI can enhance the understanding, prediction, and management of people in all areas deep into the climate change crisis.

AI synthesizes predictions by analyzing trends, patterns, and the vast amounts of data collected. It means different things to different people. For scientists, AI is helpful to assist with research and allows them to develop more accurate climate models and predict future climate scenarios. While for policymakers, it provides a fast aisle to evaluate the costs and benefits of a possible policy or rule. For example, during urban planning, AI's comprehensive view set up a foundation for cities' design to be more livable. AI-supported "smart cities" can reduce resource waste by optimizing water and energy use, with such technology already rolling out in fast-growing cities in places such as Brazil and the Philippines (Dwivedi, Hughes, Kar, Arpan, Baabdullah, Grover, Abbas, Andreini, Abumoghli, Barlette, Bunker & 27 others, 2022).

AI can be utilized to tackle the challenges related to climate change by using machine learning algorithms to process and analyze the massive datasets collected by Earth observation satellites. These datasets related to climate change can help researchers train the models to make accurate predictions about the future climate. The European Space Agency's Climate Change Initiative (CCI) funds research teams to create accurate and long-term datasets which provide a comprehensive view of the Earth's climate change. Random forests and convolutional neural networks backed up by AI can improve detection rates of climate phenomena, such as making it easier to detect different land cover types or areas burned by wildfires (European Space Agency, 2019).

Businesses can also better understand, predict, and prepare for climate change and make more effective decisions to slow its pace and protect the environment by using AI. It is much easier to monitor and predict emissions, optimize energy production operations, and predict when equipment needs repair to reduce carbon-emitting failures. In agriculture-related companies, AI can also be used to monitor and protect crops, maximize yields, and conserve resources. (Gonzalez, 2022)

AI serves as a valuable tool that not only uncovers insights into the uncertainties surrounding climate change but also enhances understanding of model outputs. This contributes to the development of better observation programs, model improvements, and the incorporation of AI into the modeling system itself.

Considerations of Interactive AI models

Interactive AI as a special type of AI has become popular in recent times. It is designed to engage in dynamic, two-way interactions with humans. Interactive AI is good at understanding natural language and responding in a way that mimics human conversation, with the goal of

providing useful information or assistance to the user (Mustafa Mert Çelikok; Peltola, Tomi; Daee, Pedram and Kaski, Samuel, 2019). Currently it is at the heart of research conducted by some big companies such as Google and Microsoft, experiencing continuous growth and significant advancements in recent years.

While facing the climate change crisis, interactive AI shows its great potential for sorting data and giving out detailed responses in a second. It largely increases the efficiency for scientists or normal people to quickly learn a specific point of climate change. And for organizations in the climate area, interactive AI offers a quick tool to revise advocacy materials, such as op-eds and flyers.

But some scientists express concerns about new interactive AI. The lack of transparency forms an outstanding issue (Hao, 2020). Although the interactive AI such as chatbot might appear “open” to nontechnical users based on the free public access, the actual model behind it remains closed-source, for the company provides little information about the process behind it. Without access to the inner workings of an AI model, it can be difficult to understand how the model processes information, makes decisions, or arrives at specific outputs. It can also inadvertently perpetuate biases present in the training data, leading to unfair or discriminatory outcomes. Imagine there is a strong AI model to help all countries process environmental policy. If it’s trained from biased datasets, it probably would choose to transfer the pollution from the wealthy countries to the poor ones which is not acceptable.

Training strong interactive AI models also costs a large amount of energy. A model from OpenAI used in ChatGPT, GPT-3 was estimated to produce about 500 metric tons of carbon dioxide while being trained—the equivalent of roughly 610 one-way direct flights from New

York City to Paris (Cohen, 2023). The huge emission of carbon dioxide generated during training contributes to increased global warming.

Challenges for AI

The use of AI also brings new challenges for people.

Lack of access to high-quality data is a critical challenge for AI in addressing climate change. Because a useful AI model needs to be trained with reliable and accurate data. High-quality data on climate change may come from a variety of sources, including remote sensing satellites, weather stations, oceanographic instruments, and socioeconomic databases. Data sharing and collaboration between international organizations, government agencies, research institutions, and private companies are crucial for obtaining and maintaining comprehensive, up-to-date datasets. However, plenty of organizations and countries don't want to share their data about climate due to the consideration of security. Getting access to the most climate data is necessary for AI's development to reach its full potential in combating climate change (Younanzadeh, 2022).

Another challenge for AI is to begin to truly comprehend the complexities of the living part of our ecosystem, particularly the ocean. If people want to collect complete data on the ocean such as the number of volcanoes, the largely increasing time and expense will be hardly acceptable for most institutes. Without the complete data, it can be difficult for AI to provide correct predictions. So in order to solve this problem, scientists need to improve AI to better adapt to all kinds of datasets.

At the same time, the increasing use of AI also raises concerns about the enormous computational power it consumes, possibly making the climate change problem worse. Complex AI models require vast amounts of data processing and training. This energy consumption can

lead to increased greenhouse gas emissions. So efforts should be made to optimize algorithms, improve energy efficiency, and promote the use of renewable energy sources to mitigate the negative consequences associated with the increasing demand for computational power in the AI domain (Ekin, 2019).

Integration of Indigenous Knowledge and AI

Indigenous knowledge plays a crucial role in mitigating the impacts of climate change because local communities have developed their knowledge and practices over centuries of living in harmony with the natural environment. Integrating indigenous knowledge into climate decision-making can help scientists find a better solution for climate change problems.

In North America, some indigenous groups are striving to cope with climate change by focusing on the economic opportunities that it may create. For example, in the Great Plains which is located west of the Mississippi River and east of the Rocky Mountains, the increased demand for renewable energy using wind and solar power could make tribal lands an important resource for such energy, replacing fossil fuel-derived energy and limiting greenhouse gas emissions. The Great Plains could provide a tremendous wind resource and its development could help to reduce greenhouse gas emissions as well as alleviate the management problem of the Missouri River hydropower, helping to maintain water levels for power generation, navigation, and recreation. These experiences are helpful data that can be used for training AI models (Ott, Hanberry, Khalil, Paschke, Van Der Burg, & Prenni, 2021).

Indigenous knowledge can help train AI models to understand things in a long-term vision. This helps when suggestions are given for the climate change problem by AI. Indigenous languages are rooted in an oral tradition that provides a different perspective different from the way English, which relies on the alphabet, develops AI systems in a more humane way.

Indigenous cultures also value the "seventh generation stewardship" principle, which urges current generations to work for the benefit of the seventh generation into the future. The Great Law of the Iroquois pushes people to consider whether the decisions they make today would benefit children in the future. This principle could also be applied to the development of AI, forcing people to reflect on how they should treat AI as it becomes more sophisticated and intelligent. Ultimately, integrating Indigenous perspectives into the development of AI could lead to a more humane way of developing AI (Kesserwan, 2018).

Local communities have a unique relationship with the environment, and they view the natural world as a living entity that must be respected and protected. They have developed indigenous knowledge that provides them with information on how to tackle climate change.

The indigenous wisdom to restore degraded ecosystems, manage forests sustainably, and adapt to changing weather patterns is valuable for AI training. Incorporating indigenous knowledge into climate change strategies can also help promote cultural integrity and provide different views. For instance, tribes in Minnesota use controlled burns to promote healthier forests. These prescribed burns not only help remove forest waste but also encourage biodiversity by preventing any single species of plant or tree from dominating an ecosystem (Wagle & Marohn, 2022).

To enhance the impact of Indigenous knowledge on climate change, it is crucial to train the AI models with the indigenous datasets. In this way, climate change policy can be co-developed by indigenous communities' wisdom (Samala, 2021).

Preserve Indigenous Knowledge by AI

With the assistance of AI, indigenous people protect biodiversity by monitoring the environment through the analysis of sound data from at-risk ecosystems. Specifically, advanced deep-learning neural networks can quickly analyze sound data and open up a window of time for critical intervention, especially in places plagued by illegal logging and mining. For instance, AI technology can detect the sounds of chainsaws or drills and send alerts to action-ready patrols on the ground. The partnership between Indigenous peoples and AI can also be useful in monitoring deforestation and tracking illegal fishing (Dimock, 2022)

The local language is the foundation of indigenous knowledge. There are about 250 different languages in Native American tribes and half of them are near extinction. So preserving the local language becomes an important task. AI is able to save languages by facilitating language documentation, learning, and accessibility. For example, a platform called First Voices by the First Peoples' Cultural Council (FPCC) archives linguistic data and produces teaching programs and apps for indigenous languages. Their latest innovation, the FirstVoices Keyboard App, allows users to type in over 100 Indigenous languages on their mobile devices (Ibaraki, 2018).

Indigenous languages are sacred to Native Americans' communities, and preserving their culture and speech is really important. But their reservations often lack basic resources like electricity or the internet, and Indigenous people must be given sovereignty in any data collection or AI development process to ensure that the technology really will serve the people.

Conclusion

The integration of AI and Indigenous knowledge offers a special way to overcome the complex challenges brought on by the climate change crisis. AI has the great potential to collect and sort data, make quick responses, and view a problem in a more comprehensive view.

However, people must also try to overcome the challenges AI has, such as energy consumption, data accessibility, and model transparency. And Indigenous knowledge provides valuable insights based on indigenous people's harmonious living style with nature. By incorporating Indigenous knowledge into AI models' training, people can make AI generate more sustainable and long-term solutions to combat the climate change crisis.

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