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Artificial Intelligence as a Catalyst for Sustainable Development Goals: A Comprehensive Review of AI Model's Contribution to SDGs

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Abstract

Artificial intelligence is shaping the world, the use of AI in many fields have enormously increased. While challenges remain surrounding ethics, equity and best practices, AI is transforming industries, driving innovations and developing technologies. Due to the use of AI in various fields, AI models and data analysis has tremendously helped in achieving the Sustainable development goals laid by the United Nations. As the urgency of sustainable development intensifies, AI stands out not only as a technological breakthrough but also as a powerful tool to accelerate progress across all 17 Sustainable Development Goals (SDGs).

AI models like, Machine learning (ML), Deep learning (DL), Large language models (LLM) and Natural language processing (NLP) as well as generative AI are some AI models that have emerged over the past decades highly contributing in achieving the SDGs effectively and efficiently. This research paper explores the contribution of AI and AI models in achieving the sustainable development goals (SDGs).

Findings suggest that AI-enabled solutions and AI models are expanding frontiers of sustainable development globally, across all industries. AI is still debated upon due to ethical considerations; however, AI models developed of accurate data has enlarged the scope of success for SDGs. However, the use of AI is still controversial on the premises of ethical practices. This research paper aims to explore the use of AI in SDGs and laying a foundation for the importance of ethical use of AI, which needs systematic execution through global governments and equitable policies.

Keywords: Sustainable Development Goals, Machine Learning, Deep Learning, Large Language Models, Natural Language Processing, Ethical AI and Generative AI

Introduction

The millennium development goals (eight-point framework) were replaced by the sustainable development goals, a more comprehensive agenda, in 2015 including 17 goals which were to be achieved by 2030 covering broader areas. The SDGs were launched by the United Nations to achieve sustainability and world peace by 2030. Various initiatives have been undertaken to achieve these 17 goals including various technological developments.

The fourth industrial revolution (including technologies like artificial intelligence, gene editing and advanced robotics) have augmented the use of artificial intelligence (AI) in multiple fields facilitating human intelligence.

The pioneer of AI in various fields lead us towards achieving the SDGs effectively and efficiently. AI can be applied to a huge spectrum of these 17 interconnected SDGs mitigating inefficiencies and inaccuracies in systems which hinder growth towards a sustainable future. Various policy-makers, research scholars and scientists have addressed how the use of AI in achieving SDGs is beneficial for the current generations. Various UN and UN affiliated organization's reports have identified and addressed how AI is assisting various industries in obtaining a sustainable future.

Background of study

Sustainable development goals lay blueprints for a sustainable future. SDGs include 17 goals based on 5 principles, all these goals are interconnected and to ensure no one is left behind, they must be reached by 2030. To make sure this target is achieved SDGs require proper execution,

which has been difficult in the past years with uneven progress, inadequate pace of improvement and unequitable distribution. Since these 17 goals must be achieved globally it is important to ensure smooth and effective execution to attain these goals. But how does AI models facilitate the SDGs?According to UNESCO (2023a), "digital technology has become a social necessity to ensure education as a basic human right, especially in a world experiencing more frequent crises and conflicts."

According to HPE glossary in an article "What is artificial intelligence" defines benefits of AI in business and lifestyle:

· Better decision-making: AI-driven data analysis improves business strategy, keeping organizations competitive.

· Automation & productivity: Repetitive processes are automated using AI, decreasing burden and operating expenses and enhancing efficiency.

· Enhanced customer experience: Customer happiness is improved with AI chatbots, tailored suggestions, and virtual assistants.

· Fraud detection and cybersecurity: AI detects suspicious activity to safeguard enterprises from cyberattacks and financial fraud.

· Optimized supply chain management: AI optimizes inventory, logistics, and demand forecasts, eliminating delays and waste.

· Cost reduction & resource optimization: AI reduces human mistakes, optimizes resource allocation, and saves operational costs

Moreover, AI has shown paramount results in medicine. AI models are used in medical industry for accurate diagnosis and administrative purposes. Machine learning can predict the which method of treatment will efficiently work for a patient, vast measures of AI systems use precision medicine applications that require machine learning and data for training. NLP classifications help classify and understand clinical documents, this system can analyze patients unstructured medical notes, provide insights to understand quality, improve methods and prepare much better outcomes for patients.

AI models have constantly improved and shaped various industries and continue to do so. The sustainable development goals are inter-connected with each other, AI assists these goals by providing modelling techniques which facilitate humans, industries, automation and innovation. This paper aims to classify the role of ethical AI models in the progress towards SDGs.

Objective of study

The purpose of this paper is to analyze and highlight the use of AI towards achieving the SDGs. The focus of this study lies in understanding how the ethical used of AI can help to contribute towards a sustainable future. How AI models help in achieving SDGs? How does ethical use of AI matters? How can these models be developed further to ensure constant progress in achieving the SDGs? What makes one AI model more useful than other in fulfilling these goals? How can governments and global institutions confirm that AI systems contribute positively to the SDGs? Finally, Can AI solely ensure the attainment of SDGs by 2030? This study will synthesize existing framework for ethical implementation and development of AI models in regard of achieving global sustainability targets.

Research gap

This study follows a qualitative research approach, involving the use of already existing research, data and articles. The use of AI models is limited to theoretical understanding rather practical; it involves a descriptive analysis of AI models. The research is limited to qualitative aspect of AI and SDGs and does not identify quantitative variables. Addressing this gap is vital to ensure development policies for AI align with equity and human rights which quantitative study might overlook.

Need and significance of study

The scope of this study revolves around the use of AI in SDGs. With this study we will be able to classify and formulate relevant roadmap to develop AI ethically and using it for a sustainable future. This study will also highlight the use of AI in development of society as a whole and equitable distribution of resources for current and future generations. AI often looked upon as a tool which is replacing employment opportunities for humans; however, the development of AI models is a new and rising industry which in turn, have created new job opportunities.

Artificial intelligence has been facilitating various industries and have been a useful tool for our generation. Given the current gap in qualitative analysis of ethical AI frameworks for SDGs this research is significant to address AI in the realm of public policy it is necessary to align ethical AI practices with policies to progress constantly and efficiently

Literature Review

The SDGs introduced and adopted by the United Nations in 2015, is 15-year long goal to reach sustainability for everyone globally. SDGs is an important initiative for the current generation to have a sustainable and harmonious future. To achieve this by the year 2030 we can adopt various technologies, one such technology being Artificial Intelligence which has a huge scope in covering the whole spectrum of SDG. AI models like ML, DL, LLM and NLP are among those models which are highly efficient in achieving SDGs. The literature suggests that AI-enabled solutions, whether it is LLM assisting medical professions or AI technologies detecting poverty using satellite images, are expanding the frontiers for sustainable development among various industries. This paper reviews the existing academic literature to explore benefits and inherent limitations associated with leveraging AI models for achieving SDGs.

Artificial Intelligence can be used for almost each SDG, this paper explores the use of AI in reducing inequalities, providing quality education, ethical consumption and production and affordable clean energy. AI has augmented the use of technology in different fields mitigating the scope of inaccuracies and providing lucrative solutions.

Despite the documented potential, artificial intelligence has adverse effects if not enforced ethically and equitably. This constantly raises concerns and identifies a significant research gap that temper an overly optimistic view on AI's role. Additionally, the goal of equality can be reached only if AI is accessible to all nations, which is not the case as AI currently is concentrated in the hands of developed countries. The ethical concerns regarding the technology cannot be overlooked, as AI is often perceived as an unethical and inaccurate tool. It necessitates researchers to develop better upcoming models with more accurate data sets.

This paper robustly reaffirms that AI technology has immense potential in accelerating growth towards SDGs and can have a substantial impact over sustainability.

AI models like ML, DL, LLM, NLP and Generative AI can potentially transform sectors. However, to fully realize the potential it is necessary to have precise policies, governance, mitigating biases and developing better AI technologies in accordance with environmental sustainability.

Methodology

This paper follows a qualitative research approach. The subject 'AI models as an accelerant for sustainable development' is based on analyzing various AI models, interpreting existing data, reviewing global sustainable goals and their progress and most importantly, finding a common ground to operationalize AI technology for a sustainable future. The secondary data includes wide range of credible material and resources, such as, UN reports, government report and findings, SDG UN Org report and data. Policy implications by think tanks, research reports by STEM organizations, government departmental reports, UN affiliated organizations speeches, data, and reports. The UN Global Compact further challenges companies to leverage AI to maximize their contributions to the 2030 Agenda. These frameworks can be used to help assess and mitigate risks around AI development and implementation and to guide companies in leveraging AI applications to advance in key areas where they can have the greatest impact on sustainable development. This study applies qualitative content analysis to systematically review and interpret data and form conjecture for policy which align with equitable and ethical use of AI for sustainable goals.

FINDINGS AND OBSERVATIONS

Generative AI leading role in progress of private sector and sustainable development

Generative AI is a system of algorithm that can create outputs in text, images and other media forms based on user prompts. Generative AI can be differentiated from other AI models by their ability to create novel outputs. Generative AI encompasses variety of creative AI, including texts, images and music, while LLM specifically focuses on language. Which implies all LLM are Generative AI but not all Generative AI are classified LLMs to draw attention towards the use of GenAI in the progress of SDGs we start by establishing their use in the private sector.

According to the UN SDG org report, The private sector, responsible for more than 60% of global GDP, is the largest player in production of goods and services worldwide. As a driving force behind innovation and the explosion of Gen AI, the private sector has a unique opportunity to lead the way in harnessing this technology for sustainable development. By prioritizing the SDGs throughout the use of GenAI, the private sector can drive positive impact and advance the SDGs globally.

Engaging your entire supply chain on sustainable development is crucial for sector-wide transformations. Currently, companies follow multiple convoluted and tedious steps to gather the necessary data and push for transparency across their supply chains. Gen AI's ability to analyze unstructured data from across supply chains and provide insights allows companies to address their products and services' impacts more efficiently via comprehensive Lifecycle Assessments (LCAs), responsible sourcing initiatives, and effective supplier engagement. Through AI these efficacies can be obtained in private as well as public sector. Therefore, the use of ethical and equitable AI by private sector lead progress towards SDG 7 (Affordable and Clean energy), 9 (Industry, Innovation and Infrastructure) and 12 (Responsible Consumption and Production).

Use of LLM models in providing quality healthcare

Large language models are trained on extensive data sets to understand and generate human language. LLM are facilitating medicine in many ways by assisting doctors, patients and medical discovery. Extracting actionable insights from complex medical records can be labour-intensive and susceptible to error. This is where a new wave of technologies, AI and Large Language Models (LLMs), emerged. LLMs, trained in vast amounts of medical literature and research data, analyse these complex records quickly and accurately.

For the best, the impact of LLMs extends far beyond simply providing information. They empower patients to participate actively in their healthcare journey, leading to better-informed decisions, improved health outcomes and a future where healthcare is truly accessible for all. Tiga healthcare technologies mentioned in their report, using artificial intelligence to model biochemical processes and molecular interaction can boost the efficiency and effectiveness of drug discovery and reduce the time required to bring a new drug to market. It can predict how compounds will interact with biological targets, simulate the effects on the human body, and identify potential adverse reactions before physical trials begin. AI has a wide scope in medical industry which ensures providing affordable healthcare, contributing to SDG 3 (Good health and well-being).

Rise of Artificial Intelligence in education and literacy

AI and generative-AI technologies are evolving rapidly and are having a profound impact on the education system including on teachers, learners and researchers (UNESCOb, 2023; Abulibdeh et al., 2024). Artificial Intelligence has the potential to address some of the biggest challenges in education today, innovate teaching and learning practices, and accelerate progress towards SDG 4 (Quality education).

Chinese Government, organized the International Conference on Artificial Intelligence and Education in Beijing (2019) under the theme 'Planning Education in the AI Era: Lead the Leap'. They examined the system-wide impacts of AI in the context of 'SDG 4 – Education 2030 and the Future of Education Beyond 2030'. The key outcome of the conference was the 'Beijing Consensus on AI and Education' (UNESCO, 2019a).

The International Conference on Artificial Intelligence and Education in Beijing identified usage of AI can be relevant in education by facilitating three main groups:

·Students
·Teachers
·Families and communities

Students can make usage of educational chatbots, swift E-learnings and ALP; for teachers AI driven discussion systems, Monitoring and AI powered trading assistants have played a vital role; on the other hands AI models have contributed towards quality educational assessment such as, Intelligent tutoring system, Dialogue based tutoring systems, Exploratory learning environment, Automated writing evaluation, AI supported reading and language learning, Smart robots, Teachable agents, Educational virtual and augmented reality, Learning Network orchestrator and AI enabled collaborative learning.

AI high-calibre in enhancing quality education can be concluded by mentioning the common good:

·AI-driven lifelong learning companies.
·AI-enables continuous assessment.
·AI-enabled record of lifelong learning achievements.
·AI-enabled continuous assessment.

Can Artificial Intelligence predict and eradicate poverty?

'Real world application of AI and satellites in to detect poverty in African villages'

AI analytics capabilities are key to unlocking the potential of satellite imagery. Machine learning algorithms can analyze significant data sets with unprecedented speed, identify trends related to poverty and help predict future developments. This synergy between artificial intelligence and satellite images opens possibilities in the fight against poverty.

Stanford researchers have developed satellite networks to detect poverty in African villages, by analysing night and day satellite images of various village, interpreting the poverty rate and indicators of development. While efficiently providing information for eradicating poverty and developing villages with population living under the poverty line.

This technology has substantial potential to combat poverty in Africa by providing valuable economic data at local and broad scales. It facilitates improved targeting of anti-poverty programs, aids in product distribution by NGOs and supports market growth analysis for businesses. The democratization of this technology, with publicly available satellite imagery, makes it accessible for widespread use. By addressing the challenge of measuring economic progress and poverty interventions, this tool contributes to enhancing the well-being of impoverished populations in Africa. These technologies can lead progress towards an equitable future for everyone; by collecting and interpreting economic data, it provides scope for achieving SDG 1 (No poverty).

Leveraging Artificial Intelligence to accelerate progress towards a sustainable future

For fundamental goals, whether zero hunger or reduced inequality AI data sets allow policy-makers to predict and reduce extreme conditions effectively.

To put things in perspective, AI can be used to monitor fields, manage agricultural production and automate routine tasks. Researchers pioneered the idea of introducing technology in the domain of agriculture long before. However, AI takes it to the next level by automating routine task, ensuring better crop production and reducing waste thereby contributing to the SDG 2 (Zero Hunger).

As mentioned before, AI can help minimizing carbon emissions and energy consumption across supply chains. Similarly, AI can support manufacturing automation and predictive maintenance, boost efficiency and reducing downtime, by which AI enhances industrial competitiveness supporting SDG 8 (Decent work and Economic Growth).

Artificial intelligence has a wide scope for gapping the socio-economic gaps among different groups of the society. Artificial Intelligence (AI) is revolutionizing how assistance is provided to those most in need. By leveraging predictive analytics algorithms and machine learning techniques, organizations can identify patterns within populations that may not have been obvious before. This allows them to make informed decisions about where resources should be allocated and what services can be provided based on accurate predictions rather than guess work or intuitions. This allows efficient allocation of (already scarce) resources and improve social and economic inclusion by providing structured information which allows organisations and working population to make vital decisions based on the relevant inputs. Hence, AI models can reduce the scope of inequality contributing towards SDG 10 (Reduced Inequality).

Artificial Intelligence in transforming climate and biodiversity action.

In line with SDG 13 (Climate Action), AI can help control and regulate by providing information predicting climate-related events and optimize climate action. According to a report presented by google on AI in Action: Accelerating Progress Towards the Sustainable Development Goals, In 2023, natural disasters affected 93.1 million people and caused $202.7 billion in economic losses. AI is considered an effective tool to achieve climate goals. AI have proved to be an efficient tool in predicting climate deterioration and assisting to draw corrective plan of action.

Deep learning and supervised machine-learning algorithms dominate application in vegetation, clan water and clean energy. These types of AI are usually employed for system optimization. AI continues to contribute and lead towards, clean energy, clean water and vegetation through different models and data sets. Which falls in line with achieving SDG 6 (Clean Water and Sanitation) and SDG 7 (Affordable and Clean Energy).

Biodiversity loss is one of the biggest crises of our generation, but how can AI reverse the loss of biodiversity? The new era of Earth Observation (EO)- satellite-based monitoring of planet- is transforming how we forecast and manage environmental risk. EO has coupled with AI leading to meaningful biodiversity action. EO plays a central role in Target 14.1 by mapping eutrophication (the accumulation of nutrients in water, fuelling organisms that may deplete oxygen levels) and tracking floating plastic debris through high-resolution imagery and spectral analysis, such as using data from NASA's MODIS and ESA's Sentinel-3 sensors. Integration of various ocean monitoring technologies with the use of EO enables detection of any threat to the marine life and/or water bodies. Such models are efficient in managing and regulating marine life under any circumstance and help with SDG 14 (Life below water).

A very similar use of EO can transform life on land, EO technologies are essential for tracking deforestation, diversification and biodiversity loss aligning with SDG 15 (Life on land). Moreover, machine learning (computer algorithms that learn patterns from large datasets) applied to high-resolution imagery supports sustainable development, helping to detect habitat fragmentation and monitor wildlife corridors, allowing to form corrective actions for the deteriorating terrestrial ecosystems.

How does ethical consideration of AI matter for achieving SDGs?

To ensure equitable distribution of sustainable goals it is necessary to use ethical means of Artificial Intelligence. But how does ethical AI matter? As AI becomes more important to society, experts and policy makers have identified a need for ethical boundaries while implementing and creating new AI tools. It is necessary that in the age of AI, users are assured privacy and digital security. AI has a huge spectrum for SDG but unless these AI models are developed and implemented with ethical consideration it threatens digital security of potential users. Additionally, AI needs to coexist with humans harmoniously working together rather than substitutes (SDG 16 and 17). It is vital to ensure existing and upcoming AI models do not replace human mind but complement it to enhance efficiency. The Indian Government's Ministry of Electronics and Information Technology and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) teamed up to hold the National Stakeholder Workshop on the Ethics of Artificial Intelligence (AI). This workshop focused deeply into the fundamentals of AI and its ethical considerations.

Principal scientific adviser to the Prime minister, Ajay Kumar Sood, noted, "As AI raises concerns on ethics and its societal implications, India aims to adopt a balanced approach to AI. India has launched several initiatives, including the India AI mission to foster the development and adoption of AI."

Tim Curtis, the director of UNESCO's South Asia Regional Office in New Delhi, stated, "UNESCO is advocating for inclusive, transparent, and accountable AI governance. Prioritising ethics in AI development can pave the way for a future where AI serves the common good while upholding fairness, transparency, and human dignity."

This event not only took into perspective ethical consideration of AI but also India's emergence in the global AI game. If AI projects are built on inaccurate data can have harmful consequences, particularly for marginalised communities. If developers build AI machine learning algorithms slowly, it can assist engineers and product managers to correct learnt biases.

To achieve ethical considerations in AI for SDGs it is necessary to be vigilante of unethical AI and its consequences. Developing AI models with accurate data, ensuring AI does not replace humans and exist harmoniously. Throughout the course of this paper mentioned AI models contributing towards SDG are based on ethical consideration. Thus, it is vital for data sets and algorithms to be relevant and ethical for them to contribute towards a sustainable future.

Conclusion

SDGs set to be achieved by the year 2030 have a huge spectrum of different inter-connected goals which establish the foundation of sustainability for future generations. Artificial intelligence, is an effective tool for our generation to grow in various industries and systematically bring about sustainability for future generations. The ethical use of AI has substantially increased the scope of sustainability by means of AI models and data sets.

This research follows various AI models and their application in the UN SDGs along with their future implications, providing frontiers for a sustainable future. Nonetheless, the use of AI requires various considerations such as accurate data sets fair distribution and privacy for consumer's personal information. Current and developing AI models should have accurate data inputs (i.e. based on credible data and feedbacks eliminating room for errors and inaccuracies) to ensure optimum outcomes. To harmonise the coexistence of AI along with humans it is necessary to adapt AI has a facilitator rather than an impediment to humans.

This research establishes the use of AI models and technology in achieving all SDGs and ensuring equitable distribution of sustainability. AI has constantly facilitated different industries, private sector, medical professionals, farmers, scientists and other professions and industries with available models such as Machine learning, Deep learning, Large language models and Natural language processing. Henceforth, AI has a large scope presently and, in the future, to accelerate growth towards Sustainable Development Goals.

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