Unleashing the Potential of Artificial Intelligence for Sustainability

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Abstract- Artificial Intelligence, a word which has created quite a lot buzz around the world, how Artificial Intelligence can come as an aid towards doing something which is socially good. The United Nations met in 2015 and defined certain criteria which can measure how sustainable we are, these are called Sustainable Development Goals. Our work here was to focus on review of research work carried out so far in area of Artificial Intelligence and how it influences Sustainable Development Goals, this paper is a comprehensive review of various research papers which we have gone through. These research papers were intended to provide information on how AI can help in achieving Sustainable Development Goals and various other aspects such as Risks, Ethics and Governance.

Key Words- Sustainable Development Goals, Artificial Intelligence, SDG, Sustainability

I. INTRODUCTION

Artificial intelligence is rapidly changing the world. The speed at which these technologies is creating an impact in various areas such as healthcare, education, personalization, automation, manufacturing etc., All these areas are directly or indirectly related to Sustainable Development Goals which are outlined by the UN in year 2015. This comprehensive research review paper is focusing on how artificial intelligence can help in achieving these targets rapidly. Moreover, definitely this also comes with a cost, AI may not have positive impact on all SDG targets.

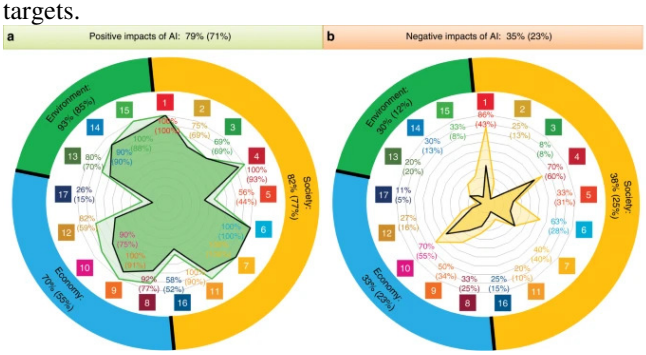

Figure 1Summary of positive and negative impact of AI on the various SDGs

Figure 1(Vinuesa et al., 2020)talks about positive and negative impact of AI on various SDGs. As defined in (Yeh et al., 2021) how people think of the linkages between AI and the SDGs and found that SDG 4, SDG 9, and SDG 3 had the highest "synergy" and lowest rates of "trade-off "Primary source of data for this review papers are mdpi, Elsevier, nature communications.

Artificial intelligence (AI) is on the verge of revolutionising many facets of our lives, and sustainability is not an exception to this trend. Artificial intelligence has the potential to play a revolutionary role in advancing sustainable development as we traverse the complexity of climate change, environmental degradation, and social inequity. We have the ability to uncover new prospects for sustainable development, improve resource distribution, and build a society that is more egalitarian and ecologically conscious through the use of artificial intelligence.

Various sources suggest that artificial intelligence can significantly contribute to sustainable development by enhancing decision-making processes, minimising waste, and optimising resource utilisation (Vinuesa et al., 2020). Additionally, artificial intelligence has the potential to assist in the creation of environmentally friendly infrastructure, improve climate modelling, and be of assistance in the transition to renewable energy sources (Lu et al., 2020).

II. Background Study

Climate change, environmental degradation, and social inequality are just a few of the extraordinary issues that the world is now trying to overcome in terms of sustainability. In the context of the global community's efforts to meet the Sustainable Development Goals (SDGs) established by the United Nations, artificial intelligence (AI) has emerged as a possible game-changer in the quest for sustainable development. Artificial intelligence has already proved its skills in a variety of fields, including education, healthcare, and finance, among others. However, we have yet to fully realise the majority of its potential to drive sustainable development.

Artificial intelligence has the potential to enhance decision-making processes, optimise resource utilisation, and cut waste, all of which may eventually lead to more sustainable results (Vinuesa et al., 2020). Additionally, artificial intelligence has the potential to assist in the creation of environmentally friendly infrastructure, improve climate modelling, and be of assistance in the transition to renewable energy sources (Lu et al., 2020).

Several studies have shed light on the potential of artificial intelligence to solve certain difficulties related to sustainability. According to Rosenzweig et al.'s research from 2020, AI-powered systems allow for the monitoring and mitigation of the consequences of climate change via the analysis of huge datasets and the identification of trends. According to Kamilaris et al. (2017), artificial intelligence has the potential to assist in optimising resource allocation in agriculture, hence decreasing waste and increasing agricultural yields.

Despite the possible advantages, there are concerns about the impact that artificial intelligence itself may have on the environment. According to Belkhir and Elmeligi (2018), the manufacturing and operation of artificial intelligence systems incur considerable amounts of energy consumption, which in turn contributes to the emission of greenhouse gases. Additionally, the development and deployment of artificial intelligence systems might contribute to the perpetuation of pre-existing societal imbalances, hence increasing situations such as prejudice and bias (Eubanks, 2018). To fully unleash the potential of artificial intelligence within the realm of sustainability, we must address these challenges and ensure that concepts of sustainability, justice, and social responsibility guide its development and deployment.

III. Applications of AI for Sustainability

Artificial intelligence (AI) has the potential to drive sustainable development across various sectors, from climate change mitigation to social inequality reduction. Here are some applications of AI for sustainability:

Climate Change Mitigation

1. **Climate Modeling**: AI can enhance climate modeling by analyzing large datasets, identifying patterns, and predicting climate-related events (Rosenzweig et al., 2020).
2. **Renewable Energy Integration**: AI can optimize the integration of renewable energy sources into the grid, reducing greenhouse gas emissions and promoting sustainable energy (Lu et al., 2020).
3. **Energy Efficiency**: AI-powered systems can optimize energy consumption in buildings and industries, reducing energy waste and promoting sustainable development.

Environmental Conservation

1. **Wildlife Conservation**: AI-powered camera traps and sensors can monitor wildlife populations, detecting poaching activities and enabling conservation efforts (Zhang et al., 2019).
2. **Deforestation Detection**: AI can analyze satellite imagery to detect deforestation, enabling timely interventions and promoting sustainable land use (Hansen et al., 2013).
3. **Water Quality Monitoring**: AI-powered sensors can monitor water quality, detecting pollutants and enabling targeted interventions to protect aquatic ecosystems.

Sustainable Infrastructure

1. **Smart Cities**: AI can optimize urban planning, traffic management, and energy consumption in cities, promoting sustainable development and reducing waste (Bibri, 2018).
2. **Green Buildings**: AI-powered systems can optimize energy consumption, water usage, and waste management in buildings, promoting sustainable architecture.
3. **Sustainable Transportation**: AI can optimize routes, reduce fuel consumption, and promote electric vehicles, reducing greenhouse gas emissions from transportation.

Social Sustainability

1. **Food Security**: AI can optimize crop yields, reduce food waste, and promote sustainable agriculture, ensuring food security for marginalized communities (Kamilaris et al., 2017).
2. **Healthcare**: AI-powered systems can analyze health data, detecting disease outbreaks and enabling targeted interventions to promote public health.

3. **EDUCATION**: AI can personalize education, promoting inclusive and equitable access to education for marginalized communities.

IV. FINDINGS

Now it is the time to articulate reviews of various research papers:

(Nasir et al., 2023)This study developed a method for measuring the relevance of Sustainable Development Goals (SDGs) with a given document and provided insights into the relationship between AI ethics and the SDGs. They also released a dataset containing information on AI ethics frameworks, research papers, projects, and curricula and their relevance to each SDG, offering a comprehensive approach to understanding the connection between these different perspectives. Paper presented by (Vinuesa et al., 2020)suggests that AI can enable the accomplishment of 134 targets across all the Sustainable Development Goals, but it may also inhibit 59 targets. The study highlights the potential of AI to contribute to achieving the Sustainable Development Goals, but also emphasizes the need for regulatory insight and oversight to ensure transparency, safety, and ethical standards. (Yigitcanlar, 2021) discusses the potential role of AI in addressing global environmental sustainability challenges and the need for a consolidated approach to support these efforts. The paper also highlights some of the ethical and practical considerations that must be taken into account when using AI for sustainability purposes. Comprehensive analysis done in paper (Palomares et al., 2021) shows of the role and impact of AI and its surrounding technologies in attaining the Agenda 2030 for sustainable development, namely its 17 Sustainable Development Goals (SDGs). Based on an in-depth analysis of relevant literature and a series of SWOT analyses to portrait the nexus between AI technologies and each of the SDGs, the study provided a position analysis of the challenges and opportunities for progress led by these technologies, under different dimensions of perspectives of human needs underlying the SDGs. The paper also presents key guidelines or priorities to adopt for ensuring positive progress towards achieving these goals by 2030.

(Cioffi et al., 2020) provides insights about how AI is considered as driving force of smart factory revolution, it also helps in achieving sustainable industrialization. (Herweijer et al., 2018) discusses how G20 countries can create the conditions for emerging technologies to benefit people and the planet, specifically in the context of the Fourth Industrial Revolution (4IR). It offers insights and recommendations on how to enable a sustainable 4IR, but it does not have a specific finding. (Yeh et al., 2021) found that there is a general lack of awareness among the public about the potential of AI to contribute to sustainable development. However, they also found that there is a growing interest in using AI for sustainability purposes, and that there are many opportunities for AI to support the achievement of the SDGs. The authors suggest that more education and awareness-raising efforts are needed to help people understand how AI can be used for sustainable development.

(Sirmacek, n.d.) paper talks about potential AI in specific area such as health care, it further talks about how AI can help in health care since there is always a shortage of heath care staff. The use of AI and data science in healthcare, also known as Health Intelligence (HI), is becoming increasingly popular. AI is being used in various aspects of HI, including syndromic surveillance, prediction of at-risk populations, medical imaging analysis, and enabling m-health services. GeoAI, which is a focused application of AI in health intelligence, is being used to extract precise location-relevant information that helps in taking concrete action to improve health and well-being. GeoAI further supports precision medicine with geomedicine, which deals with individuals' location history for disease diagnosis and treatment. However, methodological challenges related to limited availability of labeled training datasets, scarce standards and protocols for integrating diverse data sources, and data privacy concerns need to be addressed for sustainable development

V. CONCLUSION

Overall findings from each of the paper suggests that AI can help significant role in achieving sustainable development goals. It can even go further and help governments in defining policies around it. However, as a cautious note, AI does have risks such as biases, unfairness to some extents which must be addressed. Also surge of large language models in recent past can give boost to sustainable development goals with respect to spreading more awareness, developing policies around sustainable development.

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