ARTICLE

An Overview of Green Artificial Intelligence (AI) and its Applications in India

Green AI is a vital and innovative component of artificial intelligence that primarily emphasises the appropriate use of AI techniques to mitigate environmental challenges. It mainly focuses on the proper application of AI methodology to establish an eco-friendly environment, promote effective usage of relevant resources and reduce the impact of human functionality on the environment.

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INTRODUCTION

Over the last few decades, artificial intelligence has received enormous attention from business analysts and the academic fraternity. Green AI is a vital and innovative component of artificial intelligence that primarily emphasises the appropriate use of AI techniques to mitigate environmental challenges. So, it mainly focuses on the proper application of AI methodology to establish an eco-friendly environment, promote effective usage of relevant resources and reduce the impact of human functionality on the environment. Green AI encloses several essential environmental attributes, including management, water management, carbon emission, and energy efficiency. The main goal of the Green AI technique is to reduce greenhouse gas emissions, improve energy efficiency, and promote sustainable business practices. AI has also spurred leading business practices, encouraging strategic trade and management practices that may generate a competitive business environment and promote sustainable products and services. However, AI is still in its inaugural phases in India. Green AI is a comprehensive technology that highly promotes AI innovation, is more sustainable and broadly establishes an inevitable business environment. The green technology and sustainability market in the world has been evaluated at $28.6 billion for the period of 2024, and it is supposed to raise $134.9 billion during the period of 2023, extending at a CAGR of 29.5% within the anticipated period (2024-2030).

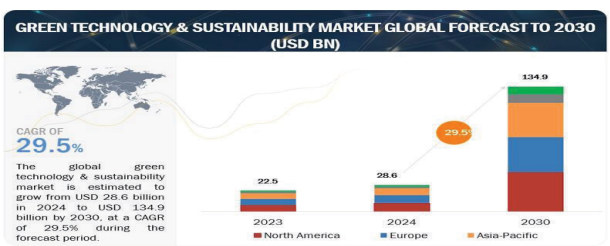

Figure:1 *https://appinventiv.com/blog/green-ai-applications/*

INITIATIVES BY THE GOVERNMENT OF INDIA IN THE PROMOTION OF AI

The Government of India has recently taken various initiatives to promote the implementation and usage of AI in different sectors. Some crucial initiatives are discussed below:

1. **Future Skills PRIME**

   The Ministry of Electronics and IT (MeitY) has launched a program called Future Skills PRIME in partnership with NASSCOM, aimed at re-skilling and up-skilling IT professionals in 10 emerging areas, including Artificial Intelligence. This program is part of the Government of India's flagship Champion Service Sector (CSS) Scheme.

   Future Skills PRIME is an innovative platform designed to revolutionize the skill development landscape in the country by modernizing traditional

training methods and embracing new-age learning approaches by offering various courses. Its goal is to empower beneficiaries with the relevant skills needed to thrive in the rapidly evolving tech industry.

2. AI FOR ALL

In June 2018, the Indian Government unveiled a strategy nationwide for Artificial Intelligence, named AI FOR ALL. This initiative, driven by the Central Board of Secondary Education (CBSE) in partnership with Intel India, aims to enhance public awareness of AI. AI For All is a 4-hour self-paced online program designed to promote understanding of Artificial Intelligence across various demographics, including students, stay-at-home parents, professionals from all fields, and senior citizens. The program is intended to cultivate a 'Digital First Mindset' among those interested in familiarizing themselves with AI. It is structured into two sections: AI Aware and AI Appreciate, each of which can be completed in approximately four hours. Both sections feature images, interactive activities, and brief, accessible quizzes.

3. National AI Portal

The Indian government, under the Ministry of Electronics and Information Technology, recently launched the National AI Portal, which is known as INDIA AI. It is a comprehensive platform that encourages collaboration within India's AI community by serving as a knowledge base, research organization, and ecosystem-building initiative. INDIA AI provides the latest news, detailed information on key ecosystem players, and insights into the global and Indian AI landscape. The platform provides students, entrepreneurs, professionals, and corporate executives with resources, opportunities for upskilling, and career insights.

4. Visvesvaraya PhD Scheme

The Visvesvaraya PhD Scheme was established to boost the enrolment of students in the field of Electronics and IT, launched by MeitY in March 2014, the initiative unfolds in two stages. In the initial phase, the scheme encompassed 97 institutions across 25 states and 4 UTs, completing 512 full-time and 100 part-time PhD's and submitting 170 full-time and 100 part-time PhD theses. The second phase, approved for a 9-year duration in September 2021, aims to provide support for 1000 full-time and 150 part-time PhD candidates and offer 225 Post-Doctoral Fellowships and 50 Young Faculty Research Fellowships. Moreover, 250 selected full-time PhD candidates can conduct research in overseas labs for six months.

In addition, the Government of India has taken several other steps to promote capacity building in AI. Some of them are as follows:

(a) The government has established multiple "Centres of Excellence" focused on Emerging Technologies like Artificial Intelligence to drive innovation through research. These centres serve as hubs connecting startups, enterprises, venture capitalists, government, and academia to collaborate on addressing problem statements and creating cutting-edge solutions.

(b) The Indian government has recently become a founding member of the Global Partnership on Artificial Intelligence (GPAI), joining other leading economies such as the USA, UK, EU, Australia, Canada, France, Germany, Italy, Japan, Mexico, New Zealand, Republic of Korea, and Singapore. GPAI is an international, multi-stakeholder initiative focused on guiding the responsible development and use of AI, with a strong emphasis on human rights, inclusion, diversity, innovation, and economic growth.

(c) In 2020, global conferences such as Responsible AI for Social Empowerment (RAISE) were convened to advance India's strategy and plan for leveraging responsible AI to drive social transformation, inclusivity, and empowerment.

GREEN AI TECHNOLOGY IN DIFFERENT SECTOR

By simulating environmentally responsible behaviour, Green AI is treated as an innovative mechanism to transform various industries entirely. Here are a few examples of Green AI application in different sectors.

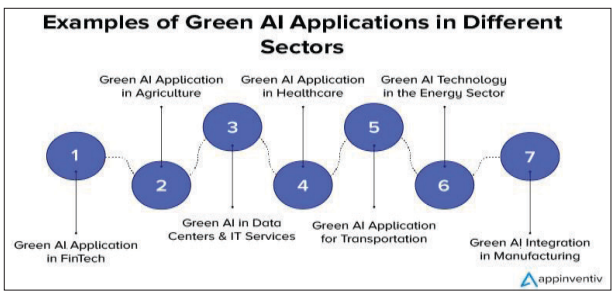

***Figure: 2** https://appinventiv.com/blog/green-ai-applications/*

USING GREEN AI TECHNIQUE IN FINTECH

(a) In the case of the FinTech sector, the primary purpose of green AI is to detect fraud and manage potential business risks that should promote sustainability by eliminating financial misconduct or fraud, which may reduce certain economic losses and spur the optimal usage of resources.

(b) AI algorithms recognize specific trends and patterns of fraudulent activities, help organizations minimize business risk and reduce substantial economic losses.

Example: PayPal has recently used AI-based technology to discover fraud or scams and protect its operation from various fraudulent transactions. To protect companies and users from economic losses, the payment app's AI system can be used to identify potentially fraudulent transactions by measuring user behaviour, the transaction's current nature and other vital data.

I. Using green AI technique in Agriculture

(a) AI techniques can help in optimize the usage of resources in the agriculture sector, as well as evolving pesticides, water, and fertilizers.

(b) Through weather forecasts and soil sensor methods, AI algorithms support farmers in optimizing irrigation activities, focusing on fertilizer utilization and reducing environmental impact.

Example: Microsoft's Farm Beats project has recently commenced using advanced AI and IoT capabilities to promote sustainable agriculture. By contributing data-driven knowledge to farmers, AI technology helps improve fertilization, irrigation, and pest control procedures, and it also helps to reduce resource usage and energy consumption to align with the environmental footprint.

II. Using green AI techniques in data centres and IT services

Introducing adjusted cooling systems, appropriate allocation of workload, and resource distribution depending on real-time data analytics; AI technology can improve utilizing energy usage in data centres.

Example: Google has recently introduced a Deep mind AI mechanism to employ the cooling system mechanism in its data centres. Deep Mind has used AI mechanisms to assess information from active sensors, decreasing energy-usage capacity to cool systems by up to 40%.

III. Using green AI technology in healthcare

(a) AI technology can provide several healthcare benefits and strengthen waste management techniques to eliminate adverse environmental impacts.

(b) By assessing relevant data on disposal techniques, segregating procedures and waste generation, Green AI technology can recognize several benefits for recycling, suitable disposal, waste reduction, and assuring exact compliance with existing environmental rules and regulations.

Example: An AI-driven waste management technique has been introduced by the University of Pittsburgh Medical Centre (UPMC) to enhance productivity and sustainability in business. With the help of crucial data on waste management methods and disposal techniques, medical centres have been using green AI technology to recognize ways to cut waste and enhance recycling rates. It provides several benefits, including cost savings, and also mitigates adverse environmental impact.

IV. Using Green AI Technology for Transportation

(a) AI technology can help to identify several possible routes for electric vehicles (EVs) based on various factors, including existing battery range, traffic availability, and charging station conditions.

(b) Based on these available variables, AI technology can also design effective and appropriate energy-efficient routes, hence reducing the requirement for charging stops and eliminating total energy consumption.

Example: Tesla adopts AI-based green technology to determine appropriate routes for its electric vehicles and systematically deals with sustainability issues. For giving suggestions to determine the fastest and quickest routes to reach the destination, AI technology can consider several factors such as actual traffic data, current battery storage of the vehicle, and charging station location. It also helps drivers optimize their EV's capacity.

V. Usage of Green AI Technology for the Energy Sector

(a) Green AI can rapidly incorporate advanced technologies to highlight several environmental issues and enhance the sustainability and efficiency of the energy and utility sectors.

(b) AI can oversee and collect information from behaviour components from drivers and consider several environmental parameters to enhance energy efficiency.

Example: With the help of AI-based technology, GE Renewable Energy can estimate turbine inefficiency at the beginning stage. Using green AI algorithms' capacity, GE can upgrade turbine capabilities and optimize energy usage by recognizing potential issues with wind turbines and informing working teams to appeal them.

VI. Using Green AI technology for manufacturing

(a) In the case of the manufacturing sector, AI technology can improve processes to decrease energy usage and environmental footprint.

(b) Green AI can help to assess necessary data from production equipment and several sensors, demonstrating the essential benefits of energy savings. Various techniques exist to improve production processes and save energy, including recognizing major fields for process enhancement, designing production schedules within off-peak hours and improving equipment settings.

Example: Siemens implemented an AI mechanism in the manufacturing process to improve energy consumption. By assessing actual data from sensors during production, Siemens can point out fraud or inadequacy and use energy savings measurement, leading to a decline in energy usage and carbon emission.

VII. Usage of Green technology for the Education sector

AI-driven predictive maintenance can significantly improve the operational efficiency of renewable energy

assets such as solar panels and wind turbines. By analysing historical maintenance records and sensor data, AI algorithms can accurately predict potential component failures, enabling proactive maintenance and minimizing downtime. This advancement has improved learning methods and facilitated better interaction between professors and students. Some of the other uses are as follows:

(a) AI could potentially advance the creation of improved teaching and learning techniques, resulting in an overall improvement in the quality of education.

(b) The effective utilization of knowledge and resources through AI technology enables greater accessibility, enjoyment, and efficiency in learning. This, in turn, facilitates the creation of more sustainable development initiatives by optimizing resource usage and integrating AI-driven green technology in the education sector, resulting in a comprehensive approach to sustainable development that is both efficient and economically feasible.

Example: Duolingo, a language learning platform, has implemented an AI-based technique to optimize its user's educational experience. Users can quickly gain various knowledge in their ways because the AI-based mechanism can balance the difficulty of study and exercises depending on the user's specific performance.

BENEFITS OF GREEN AI TECHNOLOGY FOR INCORPORATING IN BUSINESS

Green AI has enormous business advantages, from cost reduction to expanded overall performance. Some of the significant essential advantages have been discussed below.

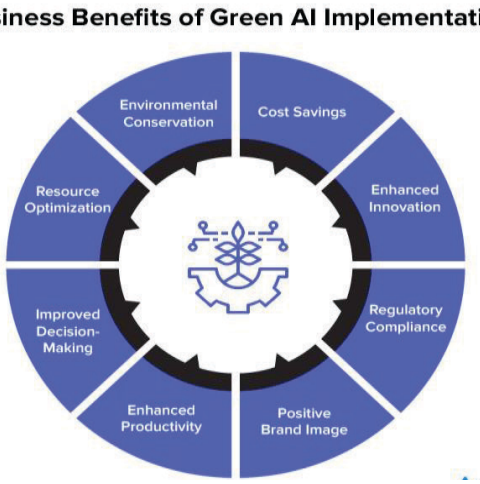

Figure: 3 *https://appinventiv.com/blog/green-ai-applications/*

1. **Cost Savings:**

   Green AI technology has the potential to optimize resource consumption, leading to cost reductions in industrial operations. This can further result in significant cost savings.

   AI technology always tries to make operational activities more sustainable and financially stable.

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2. **Introduced innovation**

   AI technology can foster innovation by promoting the expansion of advanced technical solutions that maintain business sustainability and identify several environmental challenges.

3. **Fulfilling regulatory Compliance**

   Companies can fulfil their commitment to Compliance with industry-wide regulatory requirements and other legal frameworks by adapting AI technology in their business operation so it can help companies in mitigate their legal penalties.

4. **Improved Productivity**

   With the introduction of AI technology, companies can strengthen their productivity and efficiency by using fewer resources.

5. **Optimal resource usage**

   Green AI technology promotes the proper utilization of resources, including water, raw materials and energy, in a very effective manner so that companies can optimize resource consumption and reduce waste as much as possible.

6. **Faster decision making**

   AI-driven insights and analytics help stakeholders make informed decisions, enabling them to prioritize sustainability initiatives and allocate resources effectively.

7. Protect Environment

By reducing extensive utilization of energy usage and other emission, AI technology can conserve the environment and reduce the impact of harmful human activities.

8. Sustainability and brand image

- Integrating green AI into business activities can quickly fulfil environmental responsibility and sustainability commitments.
- Promoting environmental sustainability through AI technology can increase the company's reputation and brand image, attracting more socially responsible stakeholders.

ADOPTION OF GREEN AI INTO BUSINESS: MAJOR CHALLENGES

To fully realize the benefits of integrating Green AI into business, a unique set of obstacles must be overcome to fully realize its promise. Let us examine the main obstacles to implementing Green AI in companies and how to get around them to accomplish sustainability.

Setbacks and Solutions Associated with Green AI Integration in Business

Figure: 4 *https://appinventiv.com/blog/green-ai-applications/*

1. Unavailability and insufficient data

Green AI largely depends on data quality and availability to make timely business decisions. In gathering necessary data for training, AI faces challenges, especially with industries facing poor data infrastructure.

Solution: Utilization of a robust data governance mechanism to ensure the availability and quality of data. Additionally, engagement with stakeholders to procure essential data from diverse fields will also prove to be helpful.

2. Lack of Awareness

In India, several industries are unaware of the essential benefits of the effective use of AI technology in business operations. So, companies cannot incorporate AI technology in their activities and face difficulties in maintaining sustainability in their business.

Solution: The Government of India and other regulatory bodies should undertake an initiative to conduct several programs to improve society's awareness level.

3. Shortage of Expert or professional

Trained professionals and experts must implement Green AI technology systematically for sustainable business operations. There is a significant need for more experts to run AI technology in India.

Solution: Companies should invest their funds in introducing various skill programmes or conducting training programmes about AI-based mechanisms to upgrade their employees; otherwise, companies can hire specialized experts.

4. Lack of Ethical and Regulatory commitment

Data accountability, privacy, and transparency are vital in maintaining business ethics and integrating AI technology into business operations. However, companies need to work on following those ethical issues.

Solution: Businesses should adopt responsible AI practices mechanisms for maintaining ethics in their operation. Focus on accountability and transparency by introducing several regulatory guidelines.

MANY BUSINESSES ARE USING AI TO BE MORE SUSTAINABLE

Here are some examples:

Many companies are rapidly adopting green AI technology to promote sustainable business. Several companies are incorporating AI technology into business operation. Some examples are:

I. Nest Labs

This company has recently developed a smart thermostat technology. It has used AI technology (AI) to identify consumers' behaviour and automatically balance home temperature, which can support energy savings.

II. Amazon

This company focuses on efficiency and relies mostly on robots for order picking and packing. The technology employed by these robots reduces the need for manual labour and helps prevent accidents, thereby minimizing the negative environmental effects on the business.

III. Tesla

This company manufactures a variety of electric vehicles. This vehicle cannot generate harmful greenhouse gas emissions, which may decrease air pollution.

IV. Coca- Cola

This company identifies its required distribution routes by incorporating AI tools into its business operation. This activity may decrease harmful greenhouse gas emissions and non-renewable energy consumption.

V. Nike

This company has adopted green AI tools to follow sustainable business practices. With the help of AI technology, the company can produce some materials that are more very environmentally friendly and durable that support commence waste management.

These are some companies that are incorporating Green AI technology in their daily operation in order to follow sustainable business practices. In the future, companies can be more engaged with innovations that may help to reduce the adverse environmental impact on society.

FUTURE TREND OF AI-BASED BUSINESS MODEL OPTIMIZATION

Few future projection of AI-based business model is discussed below:

1. Data Privacy Improvement

AI technology has played an essential role in detecting fraud and protecting from unauthorized access in various sectors, including finance services, the financial sector, and banking, where data privacy is essential (Mishra & Tripathi, 2020a; Rong et al.,2013).

2. Enhance consumer understanding and retention

AI-powered chatbots are prominent in elaborating faster responses and practical communication skills that may help companies to improve their relationships with existing consumers and attract more new ones (Johnson, Christensen, & Kagermann, 2008).

3. Improving effectiveness and efficiency

Companies can quickly finish their numerous works by adapting AI techniques and deep learning model in their sustainable business environment. Voice recognition, Alexa, Siri and Google Assistant are more prominent examples of universal and innovative AI technology; they have a vital rendezvous (Mishra & Tripathi, 2020). The majority of Indians, Americans, Europeans, and Chinese companies have recently witnessed the use of voice recognition software, and they have provided very positive responses for its proper implementation in their workplace efficiently (Rong, Lin, Shi, & Yu, 2013).

4. AI-based innovative business model

Nowadays, businesses are paying great attention to the adoption of artificial intelligence (AI) and providing importance to R&D facilities in business operations. Top-notch businesses and several industries worldwide are introducing AI-based power and applied artificial intelligence (AAI). In order to enhance brand image and improve consumer satisfaction, the majority of industries are revealing the pivotal role of machine learning methods in identifying business fraud (Casadesus-Masanell & Ricart, 2011). To enhance the business of innovative activities, there must be a significant upliftment of application-based tools, machine learning tools, and business platforms. These cutting-edge technologies can reduce the quality of the software industry along with the internet and other verticals, including healthcare systems, automobiles, legal and built. Most top-notch businesses, including Apple, Google, Facebook, and Flipkart, invest their funds in hiring R&D for AI technology and applied intelligence to provide opportunities to customers and companies.

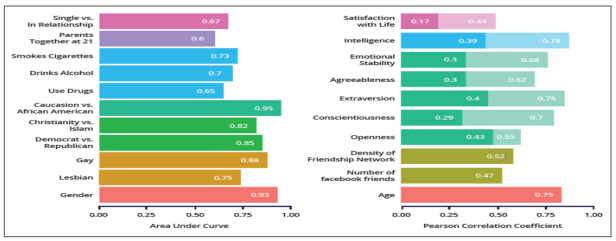

Figure: 5 Private traits and attributes by implementing AI based technology and machine learning process from digital histories of human behaviour (Kosinski, Stillwell, & Graepel, 2013)

5. Coinciding AI-based algorithms with various emerging technologies

A new innovative and advanced business model has been introduced by combining AI with blockchain and IoT with AI (Casadesus-Masanell and Ricart, 2011). Actually, without the close incorporation of IoT with AI, introducing self-driving cars will be very difficult. In upcoming years, companies may be able to launch driverless cars by systematically adopting AI and IoT technology. This technical model is indeed commencing an innovative and paradigm business model that can further strengthen the software industry, along with decision theory and optimization theory in a particular business. AI models can effectively coincide with specific software, which takes appropriate decision-making, and IoT sensors can extract required real-time data using car sensors (Mishra & Tripathi, 2020a). With the help of these essential data, AI-based algorithms and deep learning models can engage with necessary action alongside taking comprehensive and effective business decisions. The ecosystem model is elucidated below (Leon et al., 2012) (fig. 4)

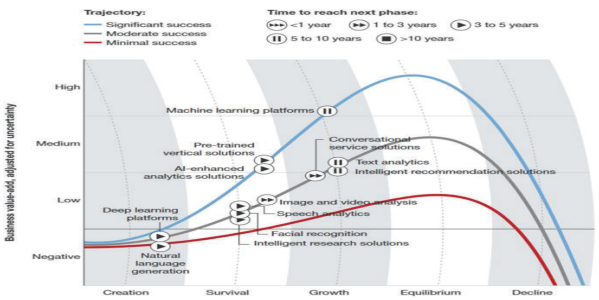

Figure: 6 Ecosystem phase (León et al., 2016)

6. **Deep learning model can be the emerging AI technique**

   AI jobs with deep learning expertise have grown increasingly valuable in the past few years. Deep learning is a significant branch of machine learning that introduces algorithms treated as AI networks, which operate by designing the infrastructure and activities of the cognitive process and human brain. (León et al., 2016; Mishra & Triptahi, 2019).

7. **Pioneering Innovation and Research Activities**

   Certain systems of governance may contain concealed imperfections in their progressions or operations. When these concealed flaws are brought to light, it can pave the way for innovation. The integration of machine learning and AI has provided organisations with the capability to address these deficiencies (Hedman & Kalling, 2003). In the field of medicine, this could involve assessing a patient's risk or introducing a new diagnostic invention to the market. In manufacturing, it entails the ability to anticipate defects before they occur.

CONCLUSION

Artificial intelligence (AI) is an innovative technology that is transforming various facets of our lives, including how we communicate and carry out work. In the business world, AI is being utilized to improve efficiency, increase productivity, and drive innovation. It plays a pivotal role in developing sustainable business practices by emphasizing the importance of companies adapting to technological advancements and contributing to sustainability goals. AI can assist companies in reducing their environmental impact, improving energy efficiency, and developing more sustainable products and services. The Government of India is continuously taking several initiatives to boost AI applications in different sectors. Thus, it can be said that the strategic implementation of AI within businesses has the potential to bring about a profound transformation in their new digital business models and practices, ultimately allowing them to reshape the global economic landscape. It becomes vitally important for top-level executives and leaders to spearhead this cultural shift within their organizations, serving as role models for embracing transformation and displaying a commitment to ongoing learning and innovation with state-of-the-art technology.

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