Advancements and Applications of Artificial Intelligence Technologies: A Comprehensive Review

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Abstract

Artificial Intelligence (AI) is a broader branch of Computer Science that encompasses Machine Learning and Deep Learning. The goal of AI is to create machines that can adapt and improve their performance over time, allowing them to handle complex and dynamic situations. Over the years, many groundbreaking developments have brought changes in the way AI is used in all spheres of life. The primary purpose of this comprehensive review is to study the major breakthroughs in AI research. The study extends to analyse transformative potential of AI through practical applications of AI across diverse domains. This paper also considers ethical issues such as bias, fairness, transparency and responsible AI practices and emphasizes on the importance of responsible AI development and deployment.

Keywords

Breakthroughs in Artificial Intelligence Research, Applications of AI, Ethical AI

Introduction

According to John McCarthy, the father of Artificial Intelligence (AI), AI is the combination of science and engineering fields to make intelligent systems which can perform tasks requiring human intelligence [1]. These tasks include learning, reasoning, problem-solving, perception, understanding natural language and even interacting with the environment. AI systems are designed to simulate certain aspects of human intelligence by leveraging algorithms, data and computational power. AI with its subsets, Machine Learning and Deep Learning, is new normal for human kind. With the impact of AI in all aspects of life, it has become pertinent to review fundamental breakthroughs in AI research, its real-world applications across diverse industries and shed light on the ethical considerations and challenges associated with the responsible development and deployment of AI technologies. This review paper can serve as a valuable resource for researchers, policymakers and industry leaders by providing insights that can help them in decision-making processes related to the adoption and regulation of AI technologies.

1. Breakthroughs in Artificial Intelligence Research

The groundwork for AI was laid with the development of electronic computers. In 1943, Warren McCulloch and Walter Pitts proposed the first mathematical model of a neuron, laying the foundation for Artificial Neural Networks (ANN) [2]. In 1950, Mathematician and logician Alan Turing proposed the Turing Test as a measure of a machine's ability to exhibit intelligent behaviour indistinguishable from that of a human. In 1952, Arthur Samuel developed a self-learning checkers program and hence pioneered Machine Learning (ML) [3]. In 1956, the term "Artificial Intelligence" was coined at the Dartmouth Conference, where researchers, including John McCarthy, Marvin Minsky, Herbert Simon and others discussed the possibility of creating machines that could simulate human intelligence. It marked the birth of AI as a field of study. John McCarthy also invented the LISP programming language in 1956, which is instrumental for AI research [4]. In 1957, Frank Rosenblatt introduced the perceptron, an algorithm for pattern recognition. The perceptron could learn to distinguish between different classes of patterns and was the first step

towards practical ANN. The limitations of perceptron were highlighted by Marvin Minsky and Seymour Papert in the book "Perceptrons" leading to reduced interest in neural networks [5]. Early AI researchers focused on symbolic reasoning. They developed rule-based systems and used symbolic logic to represent human knowledge and problem-solving. So, the period between 1960s-1970s mainly belonged to Symbolic AI and Expert Systems. In 1964, Joseph Weizenbaum developed ELIZA, an early Natural Language Processing (NLP) program [6].

In the period of 1970 –1980, many rule-based Expert Systems were designed to emulate human expertise in areas like medicine and finance. The popular examples of Expert Systems are Dendral (for chemical analysis) and MYCIN (for medical diagnosis). But AI field could not meet the overhyped expectations built around it and funding for AI research decreased, resulting in a period known as the AI winter [7]. During 1980-1990 period, researchers started using ML algorithms like Support Vector Machines (SVM) and Decision Trees. They realized the importance of data-driven approaches. In 1986, David Rumelhart, Geoffrey Hinton and Ronald Williams introduced the backpropagation algorithm which allowed for the training of multi-layer neural networks, addressing some of the limitations of earlier models [8]. Though Neural Networks gained attention, computational limitation was still a major bottleneck. In late 1990s, the development of more powerful computers and the availability of large datasets led to a resurgence of interest in neural networks.

During 1990-2000 period, researchers began exploring more complex architectures, such as Recurrent Neural Networks (RNNs) and Long Short-Term Memory Networks (LSTMs) [9]. In 1997, IBM's Deep Blue defeated world chess champion Garry Kasparov in a historic match [10]. The year 2000, was the time of practical applications and data-driven AI. Transfer learning became a key paradigm, allowing pre-trained models on large datasets that can be fine-tuned for specific tasks. In 2005, Stanley, a self-driving car, won the DARPA Grand Challenge [11]. The availability of massive amounts of data, powerful GPUs and improvements in neural network architectures paved the way for the Deep Learning (DL) revolution in 2010. DL enabled by neural networks, became the driving force behind breakthroughs in image and speech recognition applications.

In 2011, IBM's Watson defeated human champions in Peril, showcasing NLP capabilities [12]. In 2012, AlexNet, a Deep Convolutional Neural Network (CNN), won the ImageNet competition, sparking the DL revolution [13]. CNNs proved highly effective in image recognition tasks. Although CNNs were invented in the 1980s, their breakthrough in the 2000s required fast implementations on Graphics Processing Units (GPUs). In 2014, Generative Adversarial Networks (GANs) were introduced by Ian J. Goodfellow and co-authors [14]. GANs consist of a generator and a discriminator. They are used for creating realistic data (e.g., images) by training against each other. They perform unsupervised learning tasks in ML. In 2016, AlphaGo, developed by DeepMind, defeated world champion Go player Lee Sedol and demonstrated advanced AI capabilities. Breakthroughs in NLP, such as Google's use of DL for language translation, demonstrated the broader applicability of neural networks. In 2017, Vaswani et al. introduced the Transformer Architecture, a type of Neural Network Architecture in the paper "Attention is All You Need" [15]. Since then, it has become a fundamental building block for various NLP and ML tasks replacing RNN models such as LSTM. In 2018, OpenAI's GPT-3 (Generative Pre-trained Transformer 3) showcased the power of large-scale pre-training in NLP [16]. In 2020s, AI models like BERT and T5 contributed to significant advancements in NLP. In 2021, OpenAI's DALL-E generated diverse and creative images from textual descriptions. Combining ChatGPT, DALL-E and Stable Diffusion has resulted in a system capable of generating both textual and visual content, for example, generating a story with accompanying illustrations or creating a multimedia presentation. Researchers are also exploring the

potential intersection of Quantum Computing and AI for solving complex problems. Researchers are working on Edge AI that involves running AI algorithms directly on edge devices, for example, smartphones and IoT devices without relying heavily on Cloud Computing. It enables quick decision-making without relying on a centralized server.

AI models of pre 2010 period were often simpler and rule-based, making their decision-making processes relatively transparent. After 2010 period, AI evolved especially with the rise of ML & Neural Networks which gave rise to more complex models with numerous parameters, hence leading to lack of transparency. The growing need for transparency, accountability and interpretability in AI systems has led to the development of Explainable AI (XAI) to make AI models more interpretable and understandable. These milestones represent just a fraction of the rich history of AI which reflects a continuous cycle of enthusiasm, setbacks and resurgence.

2. Major Categories, Components and Techniques of AI

AI is broadly divided into three categories -Narrow, General and Super AI. Narrow AI is also called weak AI. Algorithms and technologies of this type of AI are designed and trained for a single specialized task or a combination of related tasks such as weather applications, digital assistants like Siri or Alexa, image recognition software, recommendation systems, chatbots, among others. Narrow AI is powerful but narrow in scope as its abilities are limited to a specific domain. General AI or strong AI is a more advanced form of AI that can understand, learn and apply knowledge across a broad range of tasks at a human level i.e., it focuses on making responsive machines that can imitate human behaviour of understanding, learning, thinking and performing. Super AI is expected to exceed human cognitive capacities. The full awareness of super AI is yet to come [17]. The major components of AI are as follows.

2.1. Machine Learning

Machine Learning (ML) is a specific subset of AI that focuses on developing algorithms that enable machines which can learn from data, identify patterns and make decisions with minimal human intervention. There are three major types of ML algorithms such as Supervised Learning, Unsupervised Learning and Reinforcement Learning. Supervised Learning algorithms learn from labelled data, make predictions or classify based on patterns. Unsupervised Learning algorithms identify patterns and relationships in unlabelled data without explicit guidance. In Reinforcement Learning, agents learn through trial and error, receiving feedback in the form of rewards or penalties. Its key algorithms are Support Vector Machines, Decision Trees and Neural Networks. The application areas of ML include personalized recommendation to fraud detection.

2.2. Deep Learning

Deep Learning (DL) is a subfield of ML that involves Neural Networks with multiple layers (Deep Neural Networks). It has been particularly successful in tasks such as image processing and speech recognition. It trains machines to perform human-like tasks, such as recognizing speech and images or making predictions. Here, data does not work on predefined equations, but basic parameters are set about the data and the computer is trained to learn on its own by recognizing patterns. DL has made possible the beating of human champions in games like chess and Go. It has enhanced image and speech recognition systems. Popular Systems like Siri of Apple in 2011 and Cortana by Microsoft in 2014 are made using Deep Neural Networks.

2.3. Natural Language Processing

Natural Language Processing (NLP) helps machines to understand, interpret and generate human language. NLP helps machines in reading text, hearing speech, interpreting it, measuring sentiments and filtering important parts.

Its key techniques are sentiment analysis and named entity recognition. It plays a crucial role in applications like language translation, chatbots and information extraction.

2.4. Computer Vision

The purpose of Computer Vision is to train machines to interpret and understand visual information from the world, making it valuable for tasks such as image and video recognition. Image or video recognition enables machines to identify and classify one or more objects within images or videos. It helps in facial recognition by identifying and verifying individuals based on facial features. Such systems use digital images from cameras, videos and DL models and then accurately identify and classify objects. The key algorithms are based on CNN. Its applications areas are object recognition, facial recognition and autonomous vehicles.

2.5. Robotics

The objective of the robotics field is to create intelligent machines that can assist humans in a variety of ways. Robotics can take on a number of forms. Joseph F. Engelberger, an American Physicist, Engineer and Businessman, Father of Robotics developed the first industrial robot in the 1950s. This branch of AI enhances communication between humans and robots, making collaboration more intuitive. Robotics enables robots to navigate and interact with their environment without human intervention. Robots can grasp, move and manipulate objects in various settings. Robots can perform repetitive and precise tasks with high speed and accuracy, leading to increased efficiency. Robotics has Impacted industries like manufacturing, healthcare and logistics. The popular examples of Robots are Unmanned Aerial Vehicles (UAVs), commonly known as Drones, Automated Guided Vehicles (AGVs), Robotic Arms, Spacecraft and Rovers. Sophia, social humanoid robot, first activated on February 14, 2016, developed by the Hong Kong-based company-Hanson Robotics, is the world's first robot citizen and the first robot Innovation Ambassador for the United Nations Development Programme. [18-19]. AI techniques, their tools and major tasks are summarized in Table1.

Table 1. AI techniques, their tools and major tasks

AI Technique	AI Tools	Major Tasks
Computer Vision	OpenCV, YOLO and Amazon Rekognition	Image processing, object detection and feature extraction
Machine Learning Framework	PyTorch by Facebook, TensorFlow by Google and Azure Machine Learning by Microsoft	Building, training and deploying ML models
Predictive Analytics Tools	DataRobot, Rapid Miner, SAS Analytics	Automated ML platforms for building & deploying predictive models
Natural Language Processing	Google's BERT, OpenAI's GPT, Natural Language Toolkit (NLTK) and SpaCy Python libraries	Sentiment analysis, text classification & question answering
Reinforcement Learning Libraries	OpenAI Gym	Developing and comparing RL algorithms

Robotic Process Automation	UiPath, Automation Anywhere and Blue Prism	Automating manual tasks and processes
Speech Recognition and Synthesis Tools	Speech-to-Text service by Google, Microsoft Azure Speech Services suite of speech APIs and IBM Watson Text to Speech service by IBM Watson, Amazon Connect	Speech recognition, speech synthesis and speaker recognition

3. Significance of AI Tools in Diverse Domains

AI tools are used to perform various tasks which have significantly impacted diverse domains such as agriculture, business, healthcare and education etc. AI helps in automating repetitive tasks, increasing operational efficiency and allowing humans to focus on more complex and creative aspects of work. It helps in processing vast amounts of data quickly, extracting meaningful insights and patterns that may be challenging for humans to discern. The significance of AI Tools across diverse domains is given in Table 2 [20-24].

Table 2. Use of AI based Tools in diverse Domains

Domain	Commonly used AI based Tools	Significance
Agriculture	YOLO object detection tool, UAVs equipped with Computer Vision	Crop & soil monitoring, Livestock health monitoring, Plant disease detection, Intelligent spraying of pesticides or fertilizers uniformly across a field, aerial survey and imaging and Checking crop maturity among others
Banking & Finance	Booke for bookkeeping automation, Nanonets Flow for finance related tasks, Trullion tool for automating accounting processes, Microsoft Bot Framework and Dialogflow by Google for Chatbots, Alphasense AI-based search engine to discover market trends and analyze keyword searches	Analyse market trends, assess risks and optimize investment portfolios, Chatbots such as SIA by SBI, EVA by HDFC, Axis Aha by AXIS and Yes Robot by YES Bank are used for better customer interaction, Banks such as Capital One, JPMorgan Chase, Goldman Sachs and Merrill Lynch have started leveraging AI technologies.
Cybersecurity	Darktrace for cybersecurity threat detection and response, Cylance by BlackBerry for cyber threat prevention	Strengthened security through advanced threat detection, Biometric authentication, Anomaly detection through detection of unusual patterns in user behaviour
Data Science and Analysis	Pandas, a library for Python, IBM Watson Studio	Help in developing data science applications and analysis, accelerates research by analysing massive datasets and identifying patterns

Education	Grammarly - a writing assistant tool for improving writing skills; Eduaide.Ai & Curipod - lesson-development tools for teachers; Audio Pen - a voice-to-text tool; Canva Magic Write - a text to image generator tool, Adaptive learning tools such as Designing Digitally, Pearson Interactive Labs, Smart Sparrow, Realizeit, EdApp, CogBooks, Knewton and Adaptemy	Few tools help in improving writing skills, few help in creating lesson plans, others help in streamlining administrative tasks, such as grading and scheduling. Adaptive Learning tools help in customizing educational contents according to student needs, improving engagement and learning outcomes. Voice to text, text to image generation tools or translating text/speech from one language to another helps in making the world a global village.
Electronic Media Industry	DL algorithms to simulate human-like expressions and deliver news in different languages by mimicking the appearance and voice of a real news anchor.	AI news anchors by Xinhua in 2018, “BBC's Project Beeb” in 2019, the South China Morning Post in 2020, The India Today’s “Sana”, CNN News’s “AI Kaur”, Odisha TV’s "Lisa” in 2023 and Aaj Tak’s AI Anchor modeled on a 'living' anchor Anjana Om Kashyap are popular examples.
Entertainment	Scriptbook & HyperWrite for scriptwriting & storytelling, Adobe Sensei & Magisto for video editing and post-production, Autodesk’s Maya with Bifrost	Help in Creation of virtual characters, special effects and immersive gaming experiences, simulating complex effects such as water, fire and cloth
Healthcare	PathAI for pathologists in diagnosing diseases, Zebra Medical Vision for analysing medical imaging data	Used for early disease detection and streamlined workflows and improved patient outcomes,
Manufacturing	Predictive techniques, UAVs for repetitive tasks	Predictive maintenance by analysing sensor data for anticipating equipment failures, hence reduced downtime, enhanced quality control processes by identifying defects in real-time, enhanced product quality, improved efficiency, reduced costs and optimized inventory management
Recruitment	Textio Flow, Nowsta, Paradox, Upwork, Hirevue, Jobvite and ClearCompany	AI powered tools help in Streamlining the recruitment process by analysing resumes, conducting initial screenings and identifying suitable candidates.
Recommendation Tools or Business	Amazon Personalize, Canvs and Zefr, Phrase Localization Platform, SAP	Provide audience analysis & recommendation capabilities, Personalized

& Personalized Marketing	HANA Cloud, Google Cloud TPU and Personalizer for recommendation, Jasper.ai, seventh sense and Surfer SEO for Digital marketing	content in streaming services like Netflix, YouTube etc., music platforms and online gaming
Research	ResearchRabbit, Semantic Scholar, Connected Papers, Scholarcy, Scite etc.	These AI-powered tools help in mapping literature, discovering, exploring and summarizing related research
Shopping Assistant Tools	Tidio AI live chat app, Intercom AI Chatbot and Infichat shopping chatbot for enhancing customer support, Giosg for sales acceleration solution, Synthesia for video making, OptiMonk AI for Personalizing Shopping	AI-based chatbot tools help online stores in understanding what customers like and make shopping easier and better for everyone, improving team efficiency and resolving customers' concerns
Transportation Industry	Predictive analytics and real-time video monitoring	AI based techniques are used for optimized traffic flow and navigation, reduced congestion on roads, improved road safety. In autonomous vehicles, AI helps in detecting and reacting to hazards faster than a driver.

4. AI in India

The Indian government has shown interest in promoting AI technologies. Initiatives like National Education Policy (NEP) 2020, the National AI Portal and the National AI Mission aim to drive research, development and the adoption of AI technologies in the country. However, in case of existing IT manpower, reskilling and upskilling are required on a continuous basis.

AI Supercomputer AIRAWAT (AI Research, Analytics and Knowledge Assimilation Platform) stands as India's largest and fastest AI supercomputing system, with a remarkable speed of 13,170 teraflops. It is installed at C-DAC, Pune. It has been ranked at No. 75 in the world at the International Supercomputing Conference (ISC 2023) in Germany. Several Indian companies, research institutions and startups have been contributing to the advancement of AI technologies.

Interdisciplinary Cyber Physical Systems (IM-ICPS) has suggested a four-tier framework for promoting AI research that encompasses ICON (International Centres of New Knowledge), CROSS (Centre for Research on Sub-Systems), CASTLE (Centre for Advanced Studies, Translational research and Leadership) and CETIT (Centre of Excellence in Technology Innovation and Transfer). Two-tier integrated approach is also proposed to boost both core and applied research in AI by establishing COREs (Centres of Research Excellence in Artificial Intelligence) and ICTAI (International Centre for Transformational Artificial Intelligence). CORE will focus on core research of AI managing the tasks of both ICON and CROSS. While ICTAIs will focus on application-based technology managing the tasks of both CASTLE and CETIT. Here are some examples of AI tools and applications developed and used by different entities in India given in Table 3 [25-27].

Table 3. AI based Tools developed and used by different entities in India

AI based Tools	Purpose
Active.Ai	Provides conversational banking solutions. Their virtual assistant enables banks and financial institutions to engage with customers through natural language conversations, enhancing the overall user experience
Haptik	A conversational platform, offers chatbots and virtual assistants for businesses to engage with customers across various industries, including finance, e-commerce and healthcare
Jugalbandi	A chatbot launched by AI4Bharat centre that can answer questions on welfare schemes in several Indian languages
Qure.ai	It is also used for medical imaging interpretation. Its algorithms assist radiologists in diagnosing medical conditions from imaging data, including X-rays, CT scans and MRIs.
SigTuple	It automates the analysis of medical images and pathology slides, aiding healthcare professionals in faster and more accurate diagnostics.
Translation tools	These tools by Bengaluru-based EkStep Foundation are used at the Supreme Court of India
Wysa	It is a mental health chatbot, designed to provide emotional support and therapeutic interventions. It uses principles of cognitive-behavioural therapy and mindfulness to assist users dealing with stress and mental health issues.

Besides above tools, many companies are involved in providing AI based solutions. Innovaccer, a healthcare technology company uses AI for data analytics and population health management. Netradyne specializes in AI-based solutions for the transportation and logistics industry. They have developed technology for fleet management, driver safety monitoring and road analytics using Computer Vision and ML. A company, Drishti utilizes Computer Vision and AI to improve manufacturing processes. Their tools focus on enhancing productivity and quality in manufacturing by providing real-time insights and analytics. WhatsApp chatbot "MyGov Corona Helpdesk" by Government of India was used to provide information on Covid-19. These examples illustrate the diverse applications of AI in India. The Government of India has taken several initiatives in AI based emerging areas.

5. Ethical Considerations of AI technologies

AI technologies have found their applications in everyday life, from virtual assistants and recommendation systems to autonomous vehicles and medical diagnostics. But, the rise of AI has led to increased awareness of ethical considerations and responsible AI deployment.

Job Displacement: AI has automated routine tasks, impacting industries like manufacturing and customer service. Automation driven by AI may lead to job displacement for certain job sectors which will result in economic inequality, unemployment and the need for reskilling to adapt to changing job requirements. A report by the McKinsey Global Institute in 2019 stated that while automation could lead to job displacement, it could also create new job opportunities requiring more skilled workers who can maintain AI based applications [27]. A study by the World Economic Forum (WEF) in 2020 predicted that by 2025, machines and algorithms in the workplace would be performing 50% of the

tasks, which is an increase from the estimated 29% in 2018. However, managing the transition ethically and ensuring fairness in AI systems are critical challenges [28]. Such scenario will have psychological, ethical and legal impact on coming generations. A study published by the European Parliament in 2020 highlights the need for legal frameworks to ensure the responsible use of AI technologies, including considerations for employment and labour rights. Governments should invest in reskilling and upskilling programs and make policies that support a smooth transition in the job market and foster the creation of new jobs in AI-related fields [29].

Digital Addictions: Digital addictions affect relationships of young people, quality of their life, academic or professional performance. AI enabled social media applications like Facebook, Instagram and YouTube engage people online. It wastes not only time but also affect people mentally. For example, a study published in JAMA Pediatrics in 2019 found a significant association between high social media use and an increase in the risk of depression symptoms among adolescents. However, the percentages may vary across studies [30].

Video and Audio Impersonation: Sharing data online is becoming a nuisance. The wide-spread use of deepfakes through publicly available apps raise a number of legal, social and ethical questions. Deepfakes are AI-generated videos or images that manipulate or replace the content of a person's likeness in existing media. They are created using DL techniques, particularly GANs. ZaoApp, a face-swapping app introduced in 2019 has been the most successful adoption of the 'deep-fake' technology. While deepfakes can be entertaining and used for creative purposes, they also raise concerns about misinformation and the potential for malicious use. In addition to visual deepfakes, there are also audio deepfakes that can imitate someone's voice. This technology can generate realistic-sounding speech, raising concerns about voice-based impersonation [31].

Biased Interpretations: AI is not neutral as AI algorithms can inherit biases present in training data, AI systems based on that data can perpetuate and amplify biases present in training data, leading to discriminatory outcomes like unfair treatment based on race, gender, ethnicity, or other protected characteristics. Decisions based on AI are susceptible to inaccuracies. Moreover, complex AI models like Deep Neural Networks, are perceived as black boxes, making it challenging to understand their decision-making processes resulting in lack of transparency which hinders understanding and trust, especially in critical applications like healthcare or finance. However, Biases can be avoided with regular audits and evaluations for bias using diverse and representative training datasets and implementing fairness-aware algorithms. Transparency can be maintained by establishing clear guidelines and encouraging industry-wide transparency standards and use open-sourcing AI models where possible.

Privacy and Security Breaches: AI systems often process large amounts of personal data, raising concerns about the unauthorized use or misuse of sensitive information. So, invasion of privacy, unauthorized surveillance and potential for data breaches are major concerns in the adoption of AI. Users may not fully understand the implications of AI-driven decision-making or data collection. So, lack of informed consent can undermine individual autonomy and privacy. Vulnerabilities in AI systems can be exploited, leading to malicious uses or attacks that may pose risks to individuals and organizations. It becomes difficult to fix accountability when AI systems make erroneous or harmful decisions as there is lack of clarity on who is responsible for the actions of AI systems. The potential solutions are to develop Privacy-preserving AI techniques and implement strong encryption and anonymization adhering to privacy by design principles.

Digital Divide: Access to and benefits from AI technologies may not be distributed equitably across different demographics or socioeconomic groups that further results in digital divide i.e., widening the gap between those who

have access to AI advancements and those who do not. AI systems may lack cultural understanding, leading to culturally insensitive or inappropriate outcomes resulting in reinforcement of stereotypes, cultural insensitivity and potential harm to diverse communities.

Dual-use Dilemma: AI technologies developed for benign purposes may be repurposed for malicious use such as the use of AI and robotics in autonomous weapons or surveillance systems and hence resulting in unintended consequences. Such technologies involve dual-use dilemma. The concept of meaningful human meditation and control over such systems has gained widespread attention.

Environment Footprint: The computational demands of training large AI models can have a significant environmental footprint resulting in energy consumption and associated environmental effects, contributing to climate change [32-33].

6. Discussion

Implementing AI technologies can be complex and resource-intensive, requiring specialized expertise and significant investments. Public fear of AI technologies may impact their adoption, necessitating efforts to build trust and awareness. AI systems are vulnerable to adversarial attacks and exploitation, posing risks to sensitive data and critical infrastructure. Achieving seamless collaboration between humans and AI systems can be challenging, requiring effective communication and integration into existing workflows. Robust cybersecurity measures should be followed using adversarial training to make models more robust and applying regular security audits and updates. It should be ensured to develop AI which is used ethically and responsibly, with no room for unintended consequences by implementing ethical guidelines and standards and having Industry-wide commitment to responsible AI practices [34-36]. Militarization of AI raises concerns regarding bias in algorithms, privacy issues and the responsible use of AI in decision-making. Though efforts are underway to establish ethical guidelines and regulations, the rapid development of AI has outpaced the establishment of comprehensive regulations, leading to legal and regulatory uncertainties to ensure responsible AI development and deployment. However, addressing ethical considerations requires collaboration among researchers, policymakers, industry leaders and the wider public. Establishing ethical guidelines, promoting transparency and integrating ethical principles into the design and deployment of AI systems are essential for realizing the full potential of AI technologies while mitigating associated risks.

7. Conclusion

The evolution of AI has been characterized by cycles of excitement, setbacks and renewed enthusiasm. As AI continues to progress, its societal impact will depend on how ethical considerations are addressed and how society adapts to the changing landscape of work, privacy and decision-making. The challenges of AI include job displacement, digital addictions and divide, bias in algorithms among others. While opportunities lie in addressing societal challenges, fostering innovation and improving efficiency across sectors. Given the interdisciplinary nature of AI, the paper has explored its evolution and its impact on various domains, including healthcare, finance, manufacturing and beyond, showcasing the versatility and transformative potential of AI technologies. Hence, this review has made contribution to the collective understanding of the dynamic and rapidly evolving field of AI.

8. References

[1] Available at: https://hai.stanford.edu/sites/default/files/2020-09/AI-Definitions-HAI.pdf

[2] Negnevitsky, Michael. Artificial Intelligence: A Guide to Intelligent Systems, pp.1-483

[3] Russell,Stuart J. & Norvig, Peter. (2021), Artificial Intelligence: A Modern Approach, Pearson series in Artificial Intelligence, pp. 1-947

[4] Wiederhold, Gio & McCarthy, John. (1992), Arthur Samuel: Pioneer in Machine Learning, IBM Journal of Research and Development, 36(3), pp.329 – 331

[5] Toosi, Amirhosein et al.(2021), A Brief History of AI: How to Prevent Another Winter (A Critical Review).16(4), pp.449-469

[6] Khyani, Divya & B S, Siddhartha. (2021), An Interpretation of Lemmatization and Stemming in Natural Language Processing, Shanghai Ligong Daxue Xuebao/Journal of University of Shanghai for Science and Technology, 22. pp.350-357.

[7] Haenlein, Michael & Kaplan andreas. (2019), A Brief History of Artificial Intelligence: On the Past, Present and Future of Artificial Intelligence. California Management Review, 61, pp.1-10

[8] Jhaveri, Rutvij & A., Revathi & Kadiyala, Ramana & Raut, Roshani & D, Rajesh Kumar. (2022). A Review on Machine Learning Strategies for Real-World Engineering Applications. Mobile Information Systems. pp. 1-26.

[9] Alex Sherstinsky, 2020, Fundamentals of Recurrent Neural Network (RNN) and Long Short-Term Memory (LSTM) Network, Physica D: Nonlinear Phenomena, Volume 404, pp.1-43, Available at: https://arxiv.org/pdf/1808.03314.pdf

[10] Available at: https://www.ibm.com/ibm/history/exhibits/vintage/vintage_4506VV1001.html

[11] Thrun, S. et al,(2006), Stanley: The robot that won the DARPA Grand Challenge, Journal of Field Robotics, 23(9), pp.661–692

[12] The Promise of Artificial Intelligence, Available at: https://www2.datainnovation.org/2016-promise-of-ai.pdf

[13] Alom, Md. Zahangir & Taha et al. (2018). The History Began from AlexNet: A Comprehensive Survey on Deep Learning Approaches. https://www.researchgate.net/publication/323570864_The_History_Began_from_AlexNet_A_Comprehensive_Survey_on_Deep_Learning_Approaches

[14] Fatma Ben Aissa, Mahmoud Mejdoub, Mourad Zaied (2020), A survey on generative adversarial networks and their variants methods, Proc. SPIE 11433, Twelfth International Conference on Machine Vision (ICMV 2019)

[15] Ashish Vaswani et al. (2017), Attention is all you need, NIPS'17: Proceedings of the 31st International Conference on Neural Information Processing Systems, Available at: https://arxiv.org/abs/1706.03762

[16] Available at: https://chat.openai.com/

[17] Aishwarya, Gadde & Satyanarayana, V. & Singh, Mahesh & Kumar, Sanjeev. (2022). Contemporary Evolution of Artificial Intelligence (AI): An Overview and Applications. Advanced Production and Industrial Engineering, pp. 130-136

[18] Mohsen Soori, Behrooz Arezoo, Roza Dastres (2023), Artificial intelligence, machine learning and deep learning in advanced robotics, a review, Cognitive Robotics, Volume 3, pp. 54-70

[19] Should robots be citizens?, Available at: https://www.britishcouncil.org/anyone-anywhere/explore/digital-identities/robots-citizens

[20] Kumar, Krishna. (2023), Impact of AI in Today's World: A Systematic Review, International Journal of Innovative Science and Research Technology, Vol 8, Issue 7, pp. 1281-1285

[21] B., Patel & Kansara, Prof. (2022). Current Trends and Applications of Artificial Intelligence and Machine Learning, Gradiva Review Journal, pp.329-335

[22] Eli-Chukwu. N. C. (2019). Applications of Artificial Intelligence in Agriculture: A Review, Engineering, Technology & Applied Science Research,Vol 9 , Issue 4, pp. 4377-4383

[23] https://viso.ai/computer-vision/the-most-popular-computer-vision-tools/

[24] https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare

[25] Malik, Poonam & kavita, Dr & Singal, Kusum. (2020). AI Initiatives By Indian Government: Journey Towards Becoming Global Technology Leader, Journal of Critical Reviews, 7(19), pp.4921 - 4930.

[26] Available at: https://www.niti.gov.in/sites/default/files/2023-03/National-Strategy-for-Artificial-Intelligence.pdf

[27] Available at: https://www.indiascienceandtechnology.gov.in/sites/default/files/AI%20Trend %20story.pdf

[28] The future of work in America: People and places, today and tomorrow; Available at: https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-in-america-people-and-places-today-and-tomorrow#section-header-5

[29] Availabe at: https://www.weforum.org/press/2018/09/machines-will-do-more-tasks-than-humans-by-2025-but-robot-revolution-will-still-create-58-million-net-new-jobs-in-next-five-years/

[30] Maciej Jarota, Artificial intelligence in the work process. A reflection on the proposed European Union regulations on artificial intelligence from an occupational health and safety perspective,Computer Law & Security Review,Volume 49, 2023,105825,ISSN 0267-3649, https://doi.org/10.1016/j.clsr.2023.105825.

[31] Boers E, Afzali MH, Newton N, Conrod P. (2019), Association of Screen Time and Depression in Adolescence, *JAMA Pediatr,* 173 (9), pp.853–859

[32] Meskys, Edvinas & Liaudanskas, Aidas & Kalpokiene, Julija & Jurcys, Paulius. (2020), Regulating deep fakes: legal and ethical considerations. Journal of Intellectual Property Law & Practice, 15, pp.24-31

[33] Renz and R. Hilbig, (2020), Prerequisites for artificial intelligence in further education: identification of drivers, barriers and business models of educational technology companies, International Journal of Educational Technology in Higher Education, vol. 17, pp. 1–21

[34] Anna-Katharina Ferl (2023) Imagining Meaningful Human Control: Autonomous Weapons and the (De-) Legitimisation of Future Warfare, Global Society

[35] Bhbosale S, Pujari V, Multani Z (2020) Advantages and disadvantages of Artificial Intellegence. Aayushi International Interdisciplinary Research Journal, 77, pp. 227–230

[36] Chattopadhyay, H.K. & Majumdar, D. (2020). Artificial intelligence and its impacts on the society, 6, pp. 306-310.

[37] Rowena Rodrigues, Legal and human rights issues of AI: Gaps, challenges and vulnerabilities, Journal of Responsible Technology, Volume 4, 2020