

Review

## AI: the future of humanity

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### Abstract

Artificial intelligence (AI) is reshaping humanity's future, and this manuscript provides a comprehensive exploration of its implications, applications, challenges, and opportunities. The revolutionary potential of AI is investigated across numerous sectors, with a focus on addressing global concerns. The influence of AI on areas such as healthcare, transportation, banking, and education is revealed through historical insights and conversations on different AI systems. Ethical considerations and the significance of responsible AI development are addressed. Furthermore, this study investigates AI's involvement in addressing global issues such as climate change, public health, and social justice. This paper serves as a resource for policymakers, researchers, and practitioners understanding the complex link between AI and humans.

**Keywords** Artificial Intelligence · Future of humanity · Applications of AI · Ethical implications · Challenges and risks · Global challenges

## 1 Introduction

Artificial intelligence (AI) is at the cutting edge of technological development and has the potential to profoundly and incomparably influence humankind's future [1]. Understanding the consequences of AI is increasingly important as it develops and permeates more facets of society. The goal of this paper is to provide a comprehensive exploration of AI's transformative potential, applications, ethical considerations, challenges, and opportunities.

AI has rapidly advanced, and this progress has deep historical roots. AI has experienced important turning points and discoveries that have fueled its development from its early beginnings in the 1950s to the present [2]. These developments have sped up the process of developing artificial intelligence on par with that of humans, opening up new avenues for exploration.

AI comprises a wide range of techniques and technologies, including computer vision, deep learning, machine learning, and symbolic AI [3]. These technologies provide machines the ability to think like humans do by enabling them to perceive, analyze, learn, and make decisions. Understanding the intricacies of these AI systems and their underlying algorithms is essential to appreciate the immense potential they hold.

AI has a wide range of transformational applications that affect practically every aspect of our life. In healthcare, AI is revolutionizing medical diagnostics, enabling personalized treatments, and assisting in complex surgical procedures [4]. The transportation sector is witnessing the emergence of autonomous vehicles and intelligent traffic management systems, promising safer and more efficient mobility [5]. In finance and economics, AI is reshaping algorithmic trading, fraud detection, and economic forecasting, altering the dynamics of global markets [6]. Moreover, AI is transforming

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education by offering personalized learning experiences and intelligent tutoring systems, fostering individual growth and enhancing educational outcomes [7].

However, as AI proliferates, it brings with it ethical and societal implications that warrant careful examination. Concerns about job displacement and the future of work arise as automation and AI technologies increasingly replace human labor. Privacy and data security become paramount as AI relies on vast amounts of personal information. Issues of bias and fairness emerge as AI decision-making algorithms can inadvertently perpetuate discriminatory practices. Moreover, the impact of AI on human autonomy raises profound questions about the boundaries between human agency and technological influence [8].

The challenges and risks associated with AI should not be overlooked. The notion of superintelligence and its potential existential risks demand rigorous evaluation and proactive measures. Transparency and accountability in AI systems are imperative to ensure trust and prevent unintended consequences [9]. Addressing societal disparities, such as unemployment and socioeconomic inequalities exacerbated by AI, requires careful consideration and policy interventions [10]. Regulation and governance frameworks must be developed to guide the responsible development and deployment of AI technologies.

Despite these challenges, AI has tremendous potential for the future [11]. Collaboration between AI and human intelligence has the potential to lead to extraordinary improvements in human skills and the resolution of complicated issues. AI augmentation, in which humans and machines collaborate, has potential in a variety of fields, ranging from healthcare to scientific study. Explainable AI advancements promote transparency and trust, allowing for improved understanding and ethical decision-making. In addition, ethical principles and rules for AI research and governance serve as a road map for responsible AI practices.

The purpose of this article is to provide a thorough grasp of AI's revolutionary potential for humanity. We dive into the complicated interplay between AI and society by investigating its applications, ethical considerations, challenges, and opportunities. Through careful analysis and forward-thinking, we can leverage the power of AI to shape a future that is equitable, inclusive, and beneficial for all.

## 2 Methodology

### 2.1 Research gap

Despite the burgeoning literature on the societal implications of AI, a comprehensive investigation into the intricate interplay between AI's multifaceted impacts and the development of effective strategies to harness its potential remains relatively underexplored. While existing research delves into individual aspects of AI's influence, a holistic understanding of its far-reaching consequences and the actionable steps required for its responsible integration demands further exploration.

### 2.2 Study objectives

This study aims to address the aforementioned research gap by pursuing the following objectives:

**Comprehensive impact assessment:** To analyze and evaluate the multidimensional impact of artificial intelligence across diverse sectors, including healthcare, transportation, finance, and education. This involves investigating how AI applications are transforming industries and shaping societal dynamics.

**Ethical and societal considerations:** To critically examine the ethical and societal implications stemming from AI's proliferation, encompassing areas such as job displacement, privacy concerns, bias mitigation, and the delicate balance between human autonomy and technological influence.

**Challenges and opportunities:** To identify and elucidate the challenges and opportunities that accompany the widespread integration of AI technologies. This involves exploring potential risks and benefits, as well as the regulatory and governance frameworks required for ensuring responsible AI development.

**Societal, economic, and entrepreneurial impact:** To delve into the broader impact of AI on society, economy, and entrepreneurship, and to provide a thorough discussion and argument on the ways AI is shaping these domains. This includes considering how AI is altering business models, employment dynamics, economic growth, and innovative entrepreneurship.

**Empirical exploration:** To conduct a rigorous empirical exploration through data analysis, drawing from a comprehensive collection of relevant and reputable sources. This includes scholarly articles, reports, and established online platforms to establish a solid theoretical foundation.

By systematically addressing these objectives, this study seeks to shed light on the intricate relationship between artificial intelligence and its societal, ethical, and economic implications, providing valuable insights for policymakers, researchers, and practitioners alike.

### 3 Historical overview of Artificial Intelligence

#### 3.1 Origins of AI and its early development

Artificial intelligence can be traced back to the early dreams of researchers and scientists who wanted to understand and duplicate human intellect in computers. The core concepts of AI were laid during the Dartmouth Conference in 1956, when John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon coined the name "Artificial Intelligence" and outlined the goal of building machines that could simulate human intelligence [12]. The early development of AI was focused on symbolic AI, which involves employing logical principles and symbolic representations to mimic human reasoning and problem-solving. Early AI systems, such as the Logic Theorist and the General Problem Solver, demonstrated the ability of machines to solve mathematical and logical issues. However, advancement in AI was hampered by the time's low computer capacity and the difficulties of encoding comprehensive human knowledge.

#### 3.2 Key milestones in AI research and technological advancements

Over the decades, the field of AI has seen significant milestones and technological achievements [8, 9, 12, 13]. AI researchers made significant advances in natural language processing and knowledge representation in the 1960s and 1970s, establishing the framework for language-based AI systems. These improvements resulted in the 1980s development of expert systems, which used rule-based algorithms to make choices in specific domains. Expert systems have found use in medical diagnosis, financial analysis, and industrial process control. IBM's Deep Blue defeated world chess champion Garry Kasparov in 1997, marking a watershed point in AI's ability to outperform human professionals in strategic thinking. This accomplishment demonstrated the effectiveness of brute-force computing and advanced algorithms in handling challenging tasks.

With the advent of machine learning and neural networks in the twenty-first century, AI research saw a paradigm change. The availability of large datasets and computer resources facilitated neural network training, resulting in advancements in domains such as speech recognition, image classification, and natural language understanding. Deep learning, a subtype of machine learning, transformed AI by allowing systems to create hierarchical representations from data, replicating human brain functions. Convolutional neural networks (CNNs) and recurrent neural networks (RNNs) have sped up advances in computer vision and natural language processing. These advancements fueled the development of intelligent virtual assistants like Siri and Alexa, and enabled AI systems to outperform humans in picture recognition and language translation tasks.

#### 3.3 Evolution of AI technologies and their impact on society

The advancement of AI technology has had a significant impact on a variety of societal areas. Automation powered by AI has revolutionized industries, streamlining processes and increasing efficiency. In manufacturing, robots and AI-powered systems have revolutionized assembly lines and enabled mass customization [3]. AI's presence in the healthcare sector has resulted in improved diagnostic accuracy, personalized treatment plans, and drug discovery. AI algorithms are now capable of detecting medical conditions from medical images with greater precision than human experts [2].

In finance and economics [6], AI-driven algorithms have revolutionized trading strategies, risk assessment, and fraud detection, influencing the dynamics of global markets. AI-powered recommendation systems have reshaped the entertainment and e-commerce industries, providing personalized content and product suggestions to consumers. The transportation sector is on the cusp of a revolution, with AI paving the way for self-driving vehicles, optimizing traffic management, and enabling intelligent transportation systems [5].

Despite its remarkable advancements, AI's expanding influence raises ethical, legal, and societal challenges. Concerns surrounding job displacement and the future of work have sparked discussions about reskilling the workforce and creating new job opportunities that complement AI-driven technologies. Ethical considerations around data privacy, transparency, and fairness in AI decision-making have become critical issues, prompting the need for robust regulations and ethical guidelines [9].

The responsible deployment of AI in critical domains, such as healthcare and autonomous vehicles, demands stringent safety measures and accountability to avoid potential harm to human lives. Additionally, addressing the issue of bias in AI algorithms is imperative to ensure equitable outcomes and promote societal trust [10].

Accordingly, the historical overview of AI reveals a fascinating journey of innovation, breakthroughs, and paradigm shifts. From its inception as a concept to the current era of deep learning and neural networks, AI has made remarkable strides, impacting various sectors and aspects of society. Understanding the historical context and technological advancements of AI is crucial in comprehending its present significance and envisioning its transformative potential for the future of humanity. Nonetheless, responsible development, ethical considerations, and collaboration between stakeholders will be essential in harnessing AI's power to benefit humanity while addressing its challenges.

## 4 Understanding Artificial Intelligence

### 4.1 Definition and scope of AI

AI is a multidisciplinary field that tries to develop intelligent agents capable of executing activities that would normally require human intelligence [12]. Reasoning, problem-solving, learning, perception, and language comprehension are examples of these tasks. AI aims to mimic human cognitive abilities by allowing robots to interpret data, make decisions, and adapt to new settings. AI has a wide range of applications, ranging from simple rule-based systems to powerful deep learning algorithms. While AI has made significant strides in various domains, achieving human-level intelligence, often referred to as Artificial General Intelligence (AGI), remains a formidable challenge.

### 4.2 Different types of AI systems

AI systems can be categorized into different types based on their approaches and methodologies. Symbolic AI [14], also known as rule-based AI, relies on predefined rules and logical reasoning to solve problems. Expert systems [15], which fall under symbolic AI, use a knowledge base and an inference engine to mimic the decision-making of human experts in specific domains. Another key category is machine learning [16], which enables AI systems to learn from data and improve their performance over time without explicit programming. Machine learning includes supervised learning, where the algorithm is trained on labeled data; unsupervised learning, where the algorithm learns patterns and structures from unlabeled data; and reinforcement learning, where the algorithm learns by interacting with an environment and receiving feedback in the form of rewards or penalties. Deep learning, a subset of machine learning, employs artificial neural networks with multiple layers to automatically learn hierarchical representations of data, leading to breakthroughs in computer vision, speech recognition, and natural language processing.

### 4.3 Fundamental concepts in AI

**Neural Networks:** Neural networks are computational models inspired by the structure and functioning of the human brain [17]. They consist of interconnected nodes, called neurons, organized in layers. Each neuron processes incoming data and applies an activation function to produce an output. Deep neural networks with many layers have revolutionized AI by enabling complex feature extraction and high-level abstractions from data.

**Algorithms:** AI algorithms govern the learning and decision-making processes of AI systems. These algorithms can be as simple as linear regression or as complex as convolutional neural networks [14]. The choice of algorithms is crucial in determining the performance and efficiency of AI applications.

**Natural language processing (NLP):** NLP enables AI systems to interact and understand human language [18]. NLP applications range from sentiment analysis and language translation to chatbots and virtual assistants. Advanced NLP models utilize deep learning techniques, such as Transformers, to process contextual information and improve language understanding.

## 4.4 Ethical considerations in AI development and deployment

The rapid advancement of AI raises ethical challenges that require careful consideration. One prominent concern is bias in AI algorithms [10], which can lead to unfair or discriminatory outcomes, especially in domains like hiring and criminal justice. Ensuring transparency and explainability in AI decision-making is essential to build trust and accountability. Privacy and data security are paramount, as AI systems often require large amounts of data to function effectively. Safeguarding personal information and preventing data breaches are critical aspects of responsible AI deployment. Additionally, the potential impact of AI on employment and societal dynamics necessitates thoughtful planning and policies to ensure a smooth transition and address potential workforce displacement.

Understanding Artificial Intelligence is fundamental to appreciating its vast potential and grappling with the ethical challenges it poses. AI's definition and scope encompass a wide range of tasks, from reasoning to language understanding. Different types of AI systems, such as symbolic AI, machine learning, and deep learning, provide diverse approaches to problem-solving and learning. Essential concepts in AI, like neural networks and algorithms, underpin its functionality and enable groundbreaking applications. However, ethical considerations in AI development and deployment are paramount to foster responsible AI implementation and ensure that AI benefits society equitably. By comprehensively understanding AI, we can navigate its evolving landscape with the utmost responsibility and strive to harness its capabilities for the greater good.

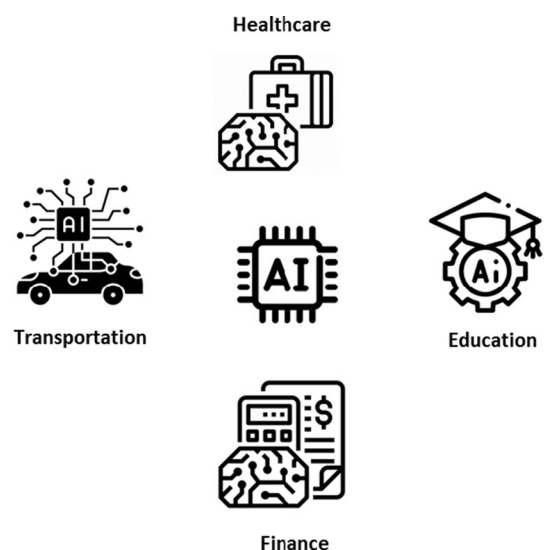
## 5 AI applications in various fields

AI's transformative impact extends across healthcare, transportation, finance, and education. This section explores these applications and addresses ethical considerations for responsible AI development and deployment. Figure 1 presents an overview of the wide-ranging applications of AI across various fields.

### 5.1 Healthcare

The use of AI in healthcare has heralded a new age of revolutionary advances, altering medical procedures and having a profound impact on patient care [2]. Machine learning algorithms are used in AI-powered medical diagnosis and treatment systems to assess massive volumes of patient data, such as medical records, imaging investigations, and genetic information [4]. These AI technologies can help healthcare personnel make more precise and fast diagnoses by comparing patient data with huge databases and patterns, resulting in earlier disease identification and more effective treatment strategies. Furthermore, AI's ability to process and interpret complex medical pictures, such as MRI and CT scans, has

Fig. 1 AI applications in diverse fields



shown outstanding accuracy in detecting anomalies and assisting radiologists in spotting probable problems that the human eye may ignore [10].

Precision medicine, powered by AI, takes personalization to a new level by tailoring therapies to individual patients' genetic makeup, lifestyle, and medical history [19]. AI algorithms can offer individualized healthcare regimens that maximize treatment efficacy while minimizing adverse effects, resulting in improved patient outcomes and a higher quality of life.

AI-assisted robotic surgeries represent another milestone in healthcare AI applications. Advanced robotic systems, guided by AI algorithms, assist surgeons during surgical procedures by providing real-time insights, enhanced dexterity, and precision [20]. These AI-driven robotic assistants can make surgery less invasive, reducing trauma to patients, shortening recovery times, and minimizing the risk of complications. The integration of AI into surgical workflows has significantly raised the bar for surgical precision, resulting in superior patient care and expanded surgical capabilities.

## 5.2 Transportation

The transportation sector is undergoing a revolutionary transformation driven by AI applications. One of the most anticipated breakthroughs is the development of autonomous vehicles and self-driving technologies [5]. AI algorithms, together with advanced sensors and cameras, enable vehicles to navigate complex traffic environments autonomously. By continuously processing real-time data, AI-equipped self-driving cars can detect and respond to obstacles, traffic signals, and pedestrian movements, significantly reducing the likelihood of accidents caused by human errors. The potential impact of autonomous vehicles extends beyond enhancing road safety; it holds the promise of alleviating traffic congestion, optimizing energy consumption, and enabling seamless transportation for the elderly and disabled populations.

Intelligent traffic management systems powered by AI offer promising solutions to tackle traffic congestion and enhance overall transportation efficiency [21]. These AI systems can optimize traffic flow, identify congestion hotspots, and dynamically alter traffic signal timings to cut wait times by collecting data from numerous sources such as traffic cameras, GPS devices, and weather conditions. Smart traffic management has the potential to improve urban mobility while also lowering carbon emissions and promoting sustainable transportation.

AI is also important in optimizing logistics and transportation networks [22]. AI algorithms can optimize supply chain operations, cut transportation costs, and enhance delivery times by evaluating massive volumes of data on shipping routes, cargo loads, and transportation timetables. Furthermore, AI's predictive capabilities allow organizations to more efficiently forecast demand variations and plan inventory management, decreasing waste and improving overall operational efficiency.

## 5.3 Finance and economics

The impact of AI on the financial and economics sectors has been tremendous, with significant changes in established processes and the introduction of creative solutions [6]. Algorithmic trading powered by AI has transformed financial markets, enabling faster and more data-driven decision-making. Machine learning algorithms automatically evaluate market data, discover patterns, and execute trades, resulting in better investing strategies and more efficient capital allocation. AI-powered trading systems can react to market movements and quickly adjust trading positions, improving trading results and portfolio performance.

AI's contribution to risk assessment and fraud detection in the financial sector has been critical in guaranteeing the security and integrity of financial transactions [23]. In real-time, machine learning algorithms may evaluate historical transaction data, find aberrant trends, and flag potentially fraudulent actions. By continuously learning from new data, these AI systems can react to evolving fraud tendencies and increase the resilience of financial institutions against fraudulent threats.

With the incorporation of AI technology, economic forecasting and predictive analytics have also seen considerable breakthroughs [24]. To provide more accurate forecasts and insights, AI-powered models may process large and diverse datasets such as economic indicators, consumer behavior, and macroeconomic factors. AI-driven economic projections can help policymakers and businesses make educated decisions, plan resource allocation, and adapt proactively to changing economic situations, resulting in more stable and resilient economies.

## 5.4 Education

AI is altering the educational landscape by bringing creative solutions to improve student learning experiences and outcomes [7, 9]. Artificial intelligence-based adaptive learning systems use data analytics and machine learning algorithms to assess individual students' strengths and weaknesses in real time. Adaptive learning platforms generate tailored learning pathways by adapting instructional content to each student's unique learning pace and preferences, increasing engagement and information retention. Targeted interventions, interactive courses, and timely feedback can help students improve their academic performance and gain a deeper grasp of subjects.

Intelligent teaching systems are yet another advancement in educational AI [25]. These systems use natural language processing and machine learning to provide students with tailored teaching and support. Intelligent tutoring systems, which can recognize and respond to students' inquiries and learning demands, provide personalised advice, promote self-directed learning, and reinforce concepts through interactive exercises. This individualized learning experience not only improves students' academic performance, but it also instills confidence and motivation to pursue interests further.

AI is also important in measuring learning outcomes and educational analytics [26]. AI algorithms can provide significant insights into learning patterns, instructional efficacy, and curriculum design by evaluating massive amounts of educational data, including student performance indicators and assessment results. These data-driven insights can be used by educational institutions and policymakers to optimize educational programs, identify areas for development, and create evidence-based policies that encourage improved educational results.

AI applications in healthcare, transportation, finance, and education have fundamentally altered their respective fields, pushing the limits of what is possible.

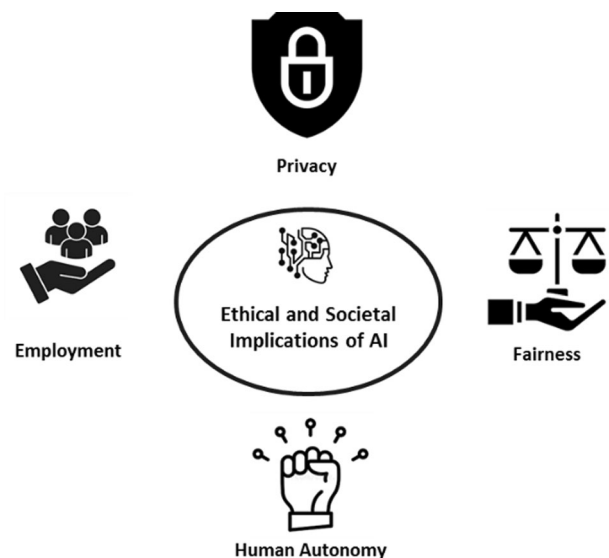
## 6 Ethical and societal implications of AI

This section investigates the ethical and societal consequences of artificial intelligence. Figure 2 depicts an in-depth examination of the ethical and societal ramifications of AI. This graphic depicts the primary areas of influence, which include employment, privacy, fairness, and human autonomy. Understanding these ramifications is critical for navigating the appropriate development and deployment of AI technology, assuring an ethical and societally beneficial future.

### 6.1 Impact on employment and workforce

Concerns have been raised concerning the influence of AI technologies on jobs and the workforce as they have become more widely adopted. Certain work roles may be vulnerable to displacement as AI-driven automation becomes more ubiquitous, potentially leading to unemployment and economic instability [27, 28]. Routine and repetitive tasks are

Fig. 2 Ethical and societal implications of AI



especially prone to automation, potentially harming industries including manufacturing, customer service, and data input. Furthermore, AI's ability to analyze massive amounts of data and execute complicated tasks may replace certain specialized positions, such as data analysis and pattern recognition, contributing to labor displacement [41]. To solve this challenge, proactive measures are required to reskill and upskill the workforce for the AI era. Investing in education and training programs that equip employees with AI-related skills such as data analysis, programming, and problem-solving will allow easier job transitions and foster a more adaptable and resilient labor market. Governments, businesses, and educational institutions must collaborate to develop comprehensive policies and initiatives that prepare individuals for the changing job landscape and ensure that the benefits of AI are distributed equitably across society.

## 6.2 Privacy, security, and data ethics

The increasing reliance on AI systems, particularly those that utilize vast amounts of personal data, raises critical ethical considerations related to privacy and data ethics [29]. The responsible and ethical use of data becomes paramount, requiring organizations to ensure informed consent, data anonymization, and stringent data protection measures. The misuse or unauthorized access to personal data by AI systems poses significant risks to individuals' privacy and can lead to various forms of exploitation, such as identity theft and targeted advertising. Furthermore, if AI technologies are not adequately regulated, they may intensify surveillance issues, potentially resulting in infringement of civil liberties and private rights [42]. To prevent these threats, legislators must enact strong data protection legislation and ethical norms that regulate AI systems' collection, storage, and use of personal data. Transparency and accountability in AI development and deployment are critical for establishing public trust and guaranteeing responsible data management.

## 6.3 Bias, fairness, and transparency in AI systems

AI systems are only as unbiased as the data on which they are trained, and inherent biases in the data might result in biased AI decision-making [30]. Algorithmic bias can lead to unequal treatment and discrimination, sustaining societal imbalances and strengthening preexisting prejudices. To address algorithmic prejudice, thorough data curation is required, as is diversity in data representation, as well as constant monitoring and evaluation of AI systems for any biases. Furthermore, guaranteeing justice and openness in AI decision-making is critical for increasing public trust in AI systems. AI systems must be built to provide explicit explanations for their judgments, allowing users to comprehend the logic underlying AI-generated outcomes. In order to encourage transparency and accountability, AI developers should share the criteria and data utilized in constructing AI models.

## 6.4 AI and human autonomy

As AI technologies advance, they have the potential to influence human autonomy and decision-making [31]. AI-powered recommendation systems, personalized marketing, and social media algorithms may impact human behavior, preferences, and views, creating ethical concerns about individual manipulation and persuasion. In the design and deployment of AI systems, striking a balance between improving user experiences and protecting human agency becomes crucial [43]. Policymakers and technologists must consider the ethical implications of AI-driven persuasion and manipulation and implement safeguards to protect individuals from undue influence. Additionally, AI developers should adopt ethical guidelines that prioritize human autonomy and empower users to make informed choices and maintain control over their digital experiences.

Accordingly, as AI technologies continue to advance and permeate various aspects of society, addressing the ethical and societal implications of AI becomes paramount. The impact of AI on employment and the workforce necessitates proactive efforts to reskill and upskill individuals, ensuring that the benefits of AI are shared inclusively. Privacy, security, and data ethics demand responsible data handling and robust regulations to safeguard individuals' personal information [44]. Addressing bias, ensuring fairness and transparency, and preserving human autonomy are crucial in building trust and fostering the responsible development and deployment of AI technologies. By navigating these ethical challenges thoughtfully and collaboratively, we can harness the potential of AI to shape a future that prioritizes human well-being and societal values.



## 7 Challenges, risks, and regulation of Artificial Intelligence

Section 7 discusses the challenges, risks, and regulation of AI. It explores an overview concerns related to superintelligence, transparency, unemployment, and ethical considerations. Understanding these complexities is vital for guiding responsible AI development and governance.

### 7.1 Superintelligence and existential risks

As AI technologies advance, the prospect of creating Artificial General Intelligence (AGI) or superintelligent systems raises existential risks [32]. Superintelligence refers to AI systems that surpass human intelligence across all domains, potentially leading to unforeseen and uncontrollable consequences. To avoid disastrous outcomes, it is vital that AGI is developed with rigorous safety mechanisms and is linked with human values. The fear is that AGI will outpace human comprehension and control, resulting in unanticipated acts or decisions with far-reaching and irreversible repercussions. To solve this, researchers and governments must engage in AGI safety research and form worldwide partnerships to construct governance structures that prioritize the safe and responsible development of AGI.

### 7.2 Lack of transparency and accountability in AI systems

One of the major issues in AI is the lack of transparency and accountability in the decision-making processes of AI systems [30]. Complex AI systems, such as deep neural networks, can be difficult to analyze and explain, giving rise to the "black box" AI problem [16]. This lack of transparency raises worries about possible biases, errors, or discriminatory effects from AI judgments. Researchers and developers must focus on constructing interpretable AI models that can provide explicit explanations for their actions in order to establish confidence and ensure the responsible usage of AI. Furthermore, building accountability frameworks that hold businesses and developers accountable for AI system outcomes is critical in addressing potential legal and ethical repercussions.

### 7.3 Unemployment, socioeconomic disparities, and the future of work

The rapid deployment of AI-driven automation has ramifications for employment and social inequities. As AI replaces certain job roles and tasks, there is a possibility of job displacement, leading to unemployment and income inequality [28]. Low-skilled workers in industries highly susceptible to automation may face the most significant challenges in transitioning to new job opportunities. Addressing these challenges requires a multi-faceted approach, including retraining and upskilling programs, social safety nets, and policies that promote job creation in emerging AI-related sectors. Additionally, measures such as universal basic income and shorter workweeks have been proposed to alleviate the potential socioeconomic impact of AI-driven automation on the workforce.

### 7.4 Ethical, legal, and regulatory considerations for AI development and deployment

The rapid advancement of AI technologies has outpaced the development of comprehensive ethical, legal, and regulatory frameworks [33]. Ensuring that AI is developed and deployed responsibly and ethically is crucial to avoid potential harm to individuals and society at large. Ethical considerations include addressing algorithmic bias, ensuring fairness, and safeguarding privacy and data rights. Legal and regulatory considerations encompass liability issues, data protection laws, and intellectual property rights related to AI systems. The need for international cooperation in formulating AI governance frameworks is paramount, as AI's impact transcends national boundaries. Policymakers, industry stakeholders, and experts must work collaboratively to establish guidelines and standards that promote the ethical development and use of AI technologies while striking a balance between innovation and protecting the common good.

In conclusion, while AI technologies hold immense promise, they also present significant challenges and risks that must be addressed proactively and responsibly. Superintelligence and existential risks demand focused research and governance to ensure AGI development is aligned with human values. The lack of transparency and accountability in AI systems necessitates efforts to create interpretable and accountable AI models. The potential impact of AI-driven automation on employment and socioeconomic disparities requires comprehensive policies and safety nets to support

workforce transitions. Ethical, legal, and regulatory considerations are vital in fostering the responsible development and deployment of AI while balancing innovation with societal well-being. By addressing these challenges and risks collectively, we can harness the transformative potential of AI while safeguarding the welfare of humanity.

## 8 Opportunities and future directions

### 8.1 Collaborative intelligence: human–AI collaboration

The future of AI lies in collaborative intelligence, where humans and AI systems work together synergistically to achieve outcomes that neither could achieve alone [34]. Human-AI collaboration has the potential to revolutionize various fields, from healthcare and education to scientific research and creative endeavors. By combining human creativity, intuition, and empathy with AI's computational power, data analysis, and pattern recognition, we can tackle complex challenges more effectively. Collaborative intelligence enables AI systems to assist humans in decision-making, provide contextually relevant information, and augment human capabilities in problem-solving and innovation. However, realizing the full potential of collaborative intelligence requires addressing human-AI interaction challenges, ensuring seamless communication, and fostering a human-centric approach to AI system design.

### 8.2 Augmentation and amplification of human capabilities with AI

The role of AI in the future is not to replace people, but to maximize human potential. AI technology, through augmentation and amplification, can enable humans to thrive in their fields, whether in healthcare, creativity, or professional activities [35]. AI-powered technologies can let professionals focus on higher-level jobs that involve human creativity, empathy, and critical thinking by streamlining workflows, automating repetitive operations, and providing real-time insights. Furthermore, AI-powered personalized learning and adaptive tutoring systems may tailor to individual learning demands, allowing students and lifelong learners to reach their full potential. Augmenting human talents with AI creates a symbiotic connection in which AI acts as a necessary tool that complements human expertise, resulting in greater productivity, creativity, and overall well-being.

### 8.3 Explainable AI: advancements in interpretability and trustworthiness

To overcome the "black box" aspect of large AI algorithms, explainable AI is a vital area of research and development. As AI systems grow more common, it is critical to understand how they make judgments and make predictions. Advances in interpretability approaches enable AI to provide unambiguous explanations for its thinking, increasing the transparency, trustworthiness, and accountability of AI systems [36]. Not only can explainable AI increase user trust, but it also allows subject experts to assess AI-generated outputs and uncover potential biases or inaccuracies. Researchers are investigating novel ways for improving the explainability of AI systems while preserving high performance, such as interpretable machine learning models and transparent AI algorithms. We can bridge the gap between AI's capabilities and human understanding by creating explainable AI, making AI more accessible and helpful across a wide range of applications.

### 8.4 Ethical frameworks and guidelines for AI development and governance

The future of AI necessitates strong ethical frameworks and norms that value human well-being, fairness, and transparency [37]. Establishing thorough ethical guidelines is critical for navigating the ethical issues of AI, such as algorithmic bias, privacy problems, and the influence of AI on society. Policymakers, industry leaders, and researchers must collaborate to create AI systems that conform to ethical principles while respecting human rights and values. Furthermore, global cooperation is critical for addressing cross-border ethical quandaries and ensuring a consistent approach to AI regulation. To set norms that safeguard individuals, promote societal good, and prevent AI exploitation, ethical AI development necessitates a multi-stakeholder approach encompassing academia, industry, governments, and civil society. Furthermore, accountability frameworks that hold businesses accountable for the acts and consequences of their AI systems are critical in creating trust and responsible AI implementation.

The future of AI is full of potential to make breakthrough advances that benefit humanity. Collaborative intelligence, in which humans and AI systems collaborate, has potential for addressing challenging challenges and achieving

breakthroughs across multiple areas. AI can help humans achieve unprecedented levels of efficiency and creativity. Advances in explainable AI will increase openness and trust, allowing for the responsible integration of AI into key applications. However, realizing this vision requires a strong foundation of ethical principles and norms to guarantee AI is created and deployed ethically, with human welfare at its core. By embracing these opportunities and adopting a human-centric approach, we can design a future in which AI serves as a powerful tool for positive change while respecting the values and principles that characterize our shared humanity.

## 9 AI and global challenges

### 9.1 Climate change and environmental sustainability

The use of AI technology to climate change and environmental sustainability opens up new avenues for addressing some of the world's most critical issues. AI's data processing and pattern recognition capabilities make it a strong tool for climate modeling and prediction. Artificial intelligence-powered climate models can examine massive amounts of environmental data, such as temperature records, carbon emissions, and weather patterns, to produce more accurate and actionable predictions of climate change impacts [38]. Furthermore, AI has the potential to optimize energy usage and resource management, thereby contributing to a more sustainable future. AI-powered systems can assess energy use trends, detect inefficiencies, and offer energy conservation and renewable energy integration options. Furthermore, AI-enabled solutions, such as autonomous drones for environmental monitoring and analysis, can help with environmental conservation efforts by monitoring deforestation, wildlife habitats, and illegal poaching activities, allowing for more effective conservation strategies and the protection of biodiversity.

### 9.2 Public health and pandemic response

The ongoing COVID-19 pandemic has emphasized the potential of artificial intelligence in public health and pandemic response. AI-based techniques for early diagnosis and control of infectious diseases are critical in preventing outbreaks from spreading. AI algorithms may evaluate a wide range of data sources, including social media, medical records, and mobility patterns, to detect early indicators of disease outbreaks and pinpoint high-risk locations for targeted interventions [39]. Furthermore, AI-driven vaccine development and distribution strategies can speed up the vaccine discovery process and optimize vaccine distribution based on parameters such as population density and vulnerability. The power of AI to analyze massive amounts of healthcare data can lead to better public health decisions and resource allocation. AI models, for example, may predict disease patterns, identify high-risk population groups, and optimize healthcare supply chain operations to ensure timely and efficient delivery of medicinal supplies.

### 9.3 Social justice and equity

AI has the ability to play a critical role in advancing social justice and equity by tackling systemic biases and inequalities. AI applications can be used to discover and correct biases in domains such as criminal justice, recruiting processes, and resource allocation. By harnessing AI's data-driven insights, governments and institutions can create evidence-based policies that minimize discrimination and enhance outcomes for underrepresented people [40]. When employing AI for social justice, ethical considerations are crucial because critical decisions affecting people's lives are involved. To guarantee that AI technologies have a beneficial impact, they must be developed and used in a transparent, fair, and accountable manner. Furthermore, AI can be used to encourage inclusivity and diversity in decision-making processes. Organizations may build more fair policies and foster a more inclusive society by utilizing AI algorithms that examine multiple perspectives and prioritize representation.

AI's new contribution to global concerns is a transformative chance to address humanity's most critical issues. In the fight against climate change, artificial intelligence (AI) can provide vital insights for better decision-making, optimize resource management, and aid in environmental conservation efforts. AI-powered solutions in public health can increase early identification of infectious diseases, speed up vaccine research, and improve healthcare data analysis for better public health outcomes. Furthermore, AI has the ability to promote social justice and equity by eliminating biases, increasing transparency, and utilizing technology for inclusivity and diversity. As we use AI to address global concerns, it is critical

that we approach its development and deployment responsibly, ensuring that the advantages of AI are dispersed equally and line with the ideals and ambitions of a better, more sustainable world.

## 10 Conclusion

### 10.1 Recapitulation of key points and contributions

In this paper, we looked at the multidimensional environment of AI and its profound impact on humanity. We began by reviewing the historical evolution of AI, from its origins to the current state of cutting-edge technologies. The key types of AI systems, including symbolic AI, machine learning, and deep learning, were elucidated, along with their fundamental concepts like neural networks and algorithms. We identified AI's potential to revolutionize various fields, including healthcare, transportation, finance, and education, with applications ranging from medical diagnosis and autonomous vehicles to algorithmic trading and personalized learning. We highlighted AI's ethical implications, including concerns related to bias, fairness, transparency, and human autonomy.

### 10.2 Discussion of the transformative potential of AI for humanity

Throughout this work, it became clear that AI has enormous revolutionary potential for humanity. AI has already demonstrated its ability to improve medical diagnosis, optimize transportation, enhance financial decision-making, and revolutionize education. Collaborative intelligence between humans and AI opens new frontiers, amplifying human capabilities and fostering creativity and innovation. Furthermore, AI can contribute significantly to solving global challenges, including climate change, public health, and social justice, through climate modeling, early disease detection, and reducing bias in decision-making. The transformative potential of AI lies in its capacity to augment human abilities, foster data-driven decision-making, and address critical societal challenges.

### 10.3 Implications for policymakers, researchers, and practitioners

The advent of AI brings forth profound implications for policymakers, researchers, and practitioners. Policymakers must proactively address AI's ethical, legal, and societal implications, crafting comprehensive regulations and guidelines that protect individual rights and promote equitable access to AI-driven innovations. Researchers bear the responsibility of developing AI technologies that prioritize transparency, interpretability, and fairness to ensure that AI aligns with human values and is accountable for its decisions. For practitioners, the responsible and ethical deployment of AI is paramount, ensuring that AI systems are designed to benefit individuals and society at large, with a focus on inclusivity and addressing biases.

### 10.4 Directions for future research and responsible AI development

As AI continues to advance, future research should prioritize several key areas. AI safety and explainability must be at the forefront, ensuring that AI systems are transparent, interpretable, and accountable. Additionally, addressing AI's impact on employment and the workforce requires research into effective reskilling and upskilling programs to support individuals in the AI-driven economy. Ethical AI development should be ingrained into research and industry practices, promoting fairness, inclusivity, and the avoidance of harmful consequences. Collaboration and international cooperation are vital to develop responsible AI frameworks that transcend geographical boundaries and address global challenges.

AI stands at the threshold of reshaping humanity's future. Its transformative potential to revolutionize industries, address global challenges, and augment human capabilities holds great promise. However, realizing this potential requires a concerted effort from policymakers, researchers, and practitioners to navigate the ethical challenges, foster collaboration, and ensure AI benefits humanity equitably. As we embark on this AI-driven journey, responsible development, and the pursuit of innovation in alignment with human values will lead us to a future where AI enhances human life, enriches society, and promotes a more sustainable and equitable world.

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**Ethics approval and consent to participate** This study was exempt from ethics approval because it did not involve human or animal subjects. The data used in this study were publicly available and did not require informed consent from participants.

**Consent for publication** Not applicable.

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