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Africa, ChatGPT, and Generative AI Systems: Ethical Benefits, Concerns, and the Need for Governance

Kutoma Wakunuma [1,*] and Damian Eke [2]

1   Centre for Computing and Social Responsibility, De Montfort University, Leicester LE1 9BH, UK
2   School of Computer Science, University of Nottingham, Nottingham NG7 2RD, UK;
     damian.eke@nottingham.ac.uk
*   Correspondence: kutoma@dmu.ac.uk

Abstract: This paper examines the impact and implications of ChatGPT and other generative AI technologies within the African context while looking at the ethical benefits and concerns that are particularly pertinent to the continent. Through a robust analysis of ChatGPT and other generative AI systems using established approaches for analysing the ethics of emerging technologies, this paper provides unique ethical benefits and concerns for these systems in the African context. This analysis combined approaches such as anticipatory technology ethics (ATE), ethical impact assessment (EIA), and ethical issues of emerging ICT applications with AI (ETICA) with specific issues from the literature. The findings show that ChatGPT and other generative AI systems raise unique ethical concerns such as bias, intergenerational justice, exploitation of labour and cultural diversity in Africa but also have significant ethical benefits. These ethical concerns and benefits are considered crucial in shaping the design and deployment of ChatGPT and similar technologies responsibly. It further explores the potential applications of ChatGPT in critical domain areas such as education, agriculture, and healthcare, thereby demonstrating the transformative possibilities that these technologies can have on Africa. This paper underscores the critical role of AI governance as Africa increasingly adopts ChatGPT and similar AI systems. It argues that a comprehensive understanding of AI governance is essential not only for maximising the benefits of generative AI systems but also for facilitating a global dialogue. This dialogue aims to foster shared knowledge and insights between the Global North and the Global South, which is important for the development and creation of inclusive and equitable AI policies and practices that can be beneficial for all regions.

Keywords: Africa; ChatGPT; Generative AI; Ethics; Governance

1. Introduction

The discussion around ChatGPT has amplified the call for effective AI governance. The huge potential benefits and risks of ChatGPT and other emerging generative AI systems have led governments around the world to consider new AI regulations to tackle their potential dangers. The EU has since enacted an EU AI Act, the world's first comprehensive AI regulation, and this was substantially revised following the introduction of OpenAI's ChatGPT in 2022 to specifically address the unique risks of generative AI systems [1]. The Act focuses on how AI can be trustworthy and highlights aspects around considerations of high-risk systems and the use of biometrics systems with respect to the enforcement of law, among others. New revisions are also expected to be made to Canada's proposed Artificial Intelligence and Data Act. The US has announced a technical inquiry to examine appropriate AI governance approaches [2]. And recently, China moved to censor generative AI systems [3]. These regulatory efforts in the Global North are aimed at mitigating the risks and concerns associated with ChatGPT and other generative AI systems, as well as promoting the benefits of these disruptive technologies. It is important to note that while regulations are jurisdictionally constrained, ChatGPT has a wider global impact. The

impact of ChatGPT and generative AI extends beyond geographical and jurisdictional boundaries, influencing societies worldwide. As such, there is a need for an overall global awareness and implementation of AI regulations.

However, the discourse on AI governance and the subsequent regulatory efforts have predominantly focused on the Global North, raising concerns about the inclusivity and applicability of these measures to the broader global context. To this end, it becomes desirable to not only consider the implications of ChatGPT on more developed countries, particularly in the Global North, but to also be inclusive of those less developed who inhabit the Global South space, particularly Africa. This paper, therefore, explores the unique risks that ChatGPT and generative AI systems present to African societies and proposes governance as a response to these risks. From issues of digital divide, unequal access, political bias and human bias to human rights concerns, this paper identifies the risks of ChatGPT and generative AI systems while highlighting their potential benefits in healthcare, education and production, among others. The impact of ChatGPT is dependent on a number of factors that include local contexts, resources, policies and local and international collaborations and partnerships. Understanding these elements is not only beneficial for harnessing the potential of ChatGPT via governance but also contributes to a global discussion and opens up possibilities of shared knowledge and understanding between both the Global North and the Global South on a technology that has potentially far-reaching consequences for both spectrums.

The next section provides a fundamental clarification of what we mean by generative AI systems and their historical emergence globally. The paper continues by outlining Africa's relationship with the ethics of emerging technology. Subsequently, the basis for the use of the selected methodology, how it is applied, key findings and critical discussions on these are provided. The paper then concludes with discussions on the need for governance.

2. The Emerging Landscape of Generative AI

Generative AI refers to a set of AI systems designed to generate content or output (including but not limited to texts, images, audio, simulations, video and codes) [4]. These outputs are largely dependent on the data the systems are trained on. In contrast to traditional AI systems that are trained to perform specific tasks, generative AI (Gen-AI) models are designed to imitate or mimic patterns in the data. Some have argued that this mimicry happens without a sufficient understanding of the underlying meaning of the context and thus refers to these models as "stochastic parrots" [5]. The landscape of Gen-AI systems has evolved significantly in the last few decades as advancements in technology have often been punctuated by key milestones and developments in Gen-AI systems.

The earliest models that played major parts in today's thriving field of Gen-AI systems include models like MYCIN [6] and Heuristic DENDRAL [7], which relied on explicit rules and logical reasoning (often designed to imitate expert human decision-making abilities in a given domain), and ELIZA [8], designed to simulate conversation. These rule-based models are deterministic in nature, operating on a simple cause-and-effect methodology. There were then probabilistic models such as ILIAC Suite (developed for music composition) [9], Markov models [10], regression models and Bayesian models. The element of probability that represents uncertainty in the relationships between variables is embedded in these models, essentially quantifying uncertainty and variability to represent complex systems or realities. Leveraging the power of neural networks, deep belief networks (DBNs) emerged to lay the foundations of more layered frameworks such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs). These early models and architectures contributed to the introduction of today's transformer models [11], with Open AI's GPT (Generative Pre-trained Transformer) models (the latest being GPT-4), Bidirectional Encoder Representations from Transformers (BERT), DistilBERT, BART, LaMDA and Megatron-LM. These are built on transformer—a novel neural network architecture for language understanding.

These models are different from traditional sequence-to-sequence models owing to self-attention mechanisms within their unique architecture [11]. They are highly scalable, which contributed to the development of very large models such as GPT-4 and ChatGPT [12]. Their performance improves with large amounts of data and model parameters. The transformer architecture has the ability to ensure parallelized training and capture contextual information and has become the underlying foundation for many generative models.

However, like any AI system, the design and deployment of generative AI models, like ChatGPT, built on transformer architecture raise ethical, socio-cultural, economic and legal concerns [13]. Issues such as bias and fairness; autonomy; transparency and explainability; data privacy; environmental impact; malicious use; academic integrity; intellectual property; and digital divide have all been mentioned in connection with the design and use of ChatGPT. For example, these models can learn biases inherent in the training data since the data are not often sufficient to make decisions in all contexts. This leads to biased outputs, amplifying and/or perpetuating existing biases and inequities in society. We discuss these concerns in Section 5.

The introduction of transformer models has led to increased hype around generative AI systems. The glare emanating from this glitzy technology often obscures the simplicity of its fundamental abilities and profuse limitations. The transformative potential of generative AI models lies in revolutionising information discovery and consumption. While some have argued that the performance of generative AI models demonstrates that it might be the elusive "holy grail" of AI, many observe that the hype hides the obvious limitations inherent to them [14]. It is crucial to point out that the scope of what generative AI systems like ChatGPT can do is very limited. Like many AI systems, they largely depend on data they were trained on, and existing datasets for training AI models are often not representative of all contexts in all regions of the world.

3. Ethics and ChatGPT

This paper acknowledges the importance of ethics in the design and use of generative AI systems like ChatGPT. This is not a novel endeavour because ethics has always been considered in emerging technologies [15,16]. Ethics fundamentally aims to discern what is right or wrong; good or bad; and just or unjust across various contexts. Bonde and Firenze [17] argue that ethics transcends mere theoretical discussions; it demands proper actions and the establishment of responsible organisations and governments that embody ethical principles. The domain of ethics includes a broad spectrum of theories, each providing unique insights into ethical reasoning and decision-making. Some of these ethical theories include utilitarianism, a branch of consequentialism Sætra et al. [18], which evaluates the morality of an action based on its outcomes; deontology, which focuses on the adherence to duty or rules; and virtue ethics, which emphasises the importance of moral character and the virtues that form the basis of ethical behaviour. Together, these theories offer a comprehensive framework for understanding and applying ethical principles in a variety of contexts.

Utilitarianism, a theory with origins in the 18th century, suggests that the ethical value of an action depends on its capacity to maximise overall good for the most significant number of people, thereby minimising negative consequences. Mitov [19] applies this principle to the ethical evaluation of AI and argues that, given AI's extensive reliance on users' data, this technology serves as a potent tool for societal benefit, aligning closely with the utilitarian objective of achieving a greater good. When applying the principles of utilitarian ethics to the deployment of ChatGPT and other generative AI systems in Africa, it becomes crucial to ensure that these technologies positively impact a large segment of the population. The aim should be that the adoption and implementation of ChatGPT and other generative AI systems should not only align with utilitarian ethics but also significantly enhance the well-being, satisfaction, and overall welfare of the African community. This approach necessitates a nuanced understanding of local needs and contexts, ensuring

that ChatGPT and other generative AI systems solutions are both culturally sensitive and ethically sound.

Rooted in the philosophy of Immanuel Kant, an 18th-century German philosopher, deontological ethics stresses the significance of moral duties, principles, and rules in guiding ethical decision-making. Kant introduced the concept of Categorical Imperatives, non-conditional, universally applicable principles that should be adhered to unconditionally. However, Baumane-Vitolina, Cals, and Sumilo [20] highlight a common deviation from Kant's Categorical Imperatives in business practices. Baumane-Vitolina et al.'s position suggests that this might not be confined solely to business contexts but could also extend to the ethical governance of technologies like ChatGPT and other generative AI systems. In the context of Africa, a deontological evaluation of ChatGPT's actions and impact would focus on whether these actions adhere to specific moral principles or duties, irrespective of their consequences. For instance, from a deontological standpoint, the behaviour of ChatGPT would be scrutinised based on principles such as addressing inequalities, combating bias, and upholding human rights and dignity. This means that interactions between ChatGPT and its users in Africa should prioritise inclusivity, active engagement, and respect for their rights and dignity, independent of the outcomes. This approach ensures that the technology acts ethically, fostering a respectful and equitable engagement with its users.

Virtue ethics, an ethical theory that highlights the cultivation of moral character and virtues, serves as the bedrock for ethical behaviour. Distinct from consequentialist theories, which assess the outcomes of actions, and deontological theories, which stress adherence to moral rules or principles, virtue ethics underscores the importance of the individual's moral character. Thus, virtues are considered essential qualities or character traits that enable individuals to lead flourishing and ethically sound lives. Key virtues include honesty, courage, compassion, integrity, and wisdom. Smith and Vickers [21] posit that virtue ethics provides practical and adaptable guidance, making it especially suitable for navigating complex and rapidly changing interactions with AI. With respect to ChatGPT and its application in Africa, virtue ethics would focus on instilling virtuous character traits and moral values throughout the design, development, and deployment phases of ChatGPT technology. Through the lens of virtue ethics, the ethical evaluation of ChatGPT's actions and impacts in Africa would concentrate on their ability to reflect and foster virtues such as trustworthiness, transparency, inclusivity, and respect for human dignity. For instance, from a virtue ethics perspective, ChatGPT's interactions with African users should emphasise understanding and addressing users' needs and concerns and showcasing respect for cultural diversity and values. This approach ensures that the technology not only serves its functional purposes but also aligns with and promotes the highest ethical standards.

Sætra et al. [18] contend that ethical considerations can address challenges posed by new technologies by integrating three ethical theories: virtue ethics, deontological ethics, and consequentialist ethics. By harmonising these approaches, they provide a multifaceted framework to guide ethical behaviour in technology use. The authors of this paper go a step further and advocate for the incorporation of indigenous philosophies such as Ubuntu, which translates to "I am because we are". This African ethical viewpoint emphasises community and interconnectedness, offering a unique perspective that is particularly relevant to the experiences of African users with technologies like ChatGPT and other generative AI systems. Incorporating Ubuntu into ethical considerations not only highlights communal responsibilities but also deepens the understanding of specific ethical issues pertinent to Africa. For instance, this approach can highlight how AI applications might support communal growth and respect local traditions, ensuring technology deployment aligns with the collective well-being and ethical norms of African communities.

4. Africa and Emerging Technologies

Unlike in Europe, where ethics is considered an integral aspect of the governance of emerging technologies [22], the ethics of emerging technologies has remained largely neglected in Africa in academia, policy, and industry. Whereas the design and deployment

of emerging technologies such as AI are increasing in Africa, integration is not at the same level seen in the Global North [23]. Disruptive technologies are often designed and developed from and for more developed regions of the world. This means that Africa often finds itself playing catchup with current and emerging technologies, including the development of governance policies around ethics concerns [24]. There are a number of reasons why Africa is often behind, and these include but are not limited to a lack of infrastructure, a lack of technical know-how, as well as a lack of robust policies around science, technology, and innovation. As a result, in the Science, Technology, and Innovation Strategy for Africa 2024 report, the UNECA [25] encourages member states to contribute at least 1% of their GDPs to the research and development of science, technology, and innovation [26]. With better investment in technology, better results will be realised in the delivery of services, income generation, and the efficient and effective production of goods and services. Badaru and Mphahlele [27] argue that pandemics such as COVID-19 have shown a spotlight on the importance of technology, especially for Africa, where there are disparities between African nations with some doing better than others. They recommend the establishment of a legal framework that can use emerging technologies such as AI; the improvement of the digital infrastructure in order to ensure a level playing field for both rural and urban areas, as well as an improvement in tertiary education that will promote knowledge of emerging technologies and digital transformation.

Distor et al. [28] opine that, for emerging technologies to accelerate Africa's economic transformation, as has been achieved in many developed parts of the world, there is a need for Africa to take into account a responsible design and implementation strategy of emerging technologies such as AI. The lack of harmonised, structured, and culturally sensitive responsible innovation frameworks and regulations to shape the design and use of these technologies, they argue, contributes to the inadequate uptake and use of such technologies in Africa. Even where there is potential to use these technologies in, for example, health, infrastructural challenges can be a hindrance in effectively implementing such technologies. These challenges not only limit the accessibility and effectiveness of new and emerging technologies but also slow down the pace of innovation and development. Understanding these obstacles is crucial for developing strategies that can help overcome them and unlock the transformative power of emerging technologies across Africa. Some of the infrastructural challenges are digital in nature and are concerned with unreliable internet access and telecommunications infrastructure [29,30], therefore making it difficult to deploy and sustain digital technologies such as broadband services and mobile connectivity. This results in a digital divide that affects both urban and rural areas, and as Aruleba and Jere [31] assert, this can be especially acute in remote locations.

Furthermore, the erratic supply of electricity stands as a significant barrier to the adoption of technology in Africa. Regular power interruptions and the absence of electrification infrastructure in rural areas limit the utilisation of digital services, therefore making it difficult to effectively have robust technology-based solutions. Despite such challenges, solar energy and other renewable technologies present viable solutions to these power supply challenges, thereby enabling the deployment of off-grid power systems to support technology use in remote areas. For instance, Baker [32] posits that models such as pay-as-you-go (PAYGO) mobile money for solar home systems (SHS) are helping to overcome electrification infrastructure problems by providing access to the digitally unconnected. Adwek et al. [33] argued for a more robust electrification policy that takes into account SHS models because they offer long-term rural electrification and development. In addition, in the absence of more traditional infrastructure or when the infrastructure is too expensive, Perdices et al. [34] contend that satellite communication has the potential to overcome geographical barriers through the provision of internet access in remote areas.

The substantial expenses involved in setting up and preserving technological infrastructure, combined with restricted financial accessibility, present considerable obstacles for both governmental bodies and private sector entities in the digital sphere across Africa. This financial challenge is exacerbated by the relatively high cost of internet services and

technology products due to import duties and taxes. A study by Mignamissi and Djijo [35] of 34 African countries found that the digital divide contributes to a country's financial handicap, therefore making it difficult to have any meaningful digital penetration compared with those countries with more developed financial systems. However, despite a challenge such as this, emerging technologies can still be leveraged for social and economic development in Africa. For example, mobile technologies became ubiquitous in Africa over a decade ago, to the point where mobile phones, for instance, offered a platform for various solutions [36], including mobile-based solutions in finance in the form of mobile money [37,38]. This has the advantage of helping the unbanked, as well as cutting the bureaucratic processes involved in traditional banking, with Akinyemi and Mushunje [39] suggesting that mobile money operators target young and educated rural dwellers to adopt mobile money technology.

Mobile platforms also offer market and weather information, which is crucial for agriculture, a domain area that is very important in Africa. Emeana, Trenchard, and Dehnen-Schmutz [40] state that mobile agriculture (m-Agri) services are instrumental in helping "farmers access new technology or inputs and assess suitability as well as facilitate farmer-to-farmer/buyer relationships, [in addition to] how to manage financial and production risk, and where to sell their produce" (p. 12). Dodoo, Al-Samarraie, and Alsswey [41] point to the importance of telemedicine, which is offered via mobile platforms, in contributing to healthcare in sub-Saharan Africa despite user acceptance and satisfaction challenges. Furthermore, innovative financing models offered through Fintech models, in addition to innovations such as pay-as-you-go services and micro-leasing [42,43], can help overcome financial barriers to technology adoption, making it more accessible to a wider population.

This section has, so far, detailed some of the great opportunities emerging technologies present to societies in Africa, how these have been exploited, and the barriers to the effective integration of these technologies in operations. As the integration of generative AI systems continues to permeate business operations, public services, healthcare, and personal development, paying attention to these opportunities and challenges becomes more crucial. What is often missing in established integration processes and policies is ethics. This is not due to a lack of ethical traditions in Africa but instead due to factors such as lack of awareness, limited resources, dependency on external expertise, emphasis on short-term goals, and historical factors that have been described as epistemic injustice [44]. Relevant to the current discussion, generative AI systems also present great opportunities for the continent. Africa has many pressing issues, including challenges in health and well-being, poverty, education, financial inclusion, and a lack of jobs for an ever-increasingly young population. Our analysis focuses on the ethical benefits of this technology, as well as the unique challenges it poses. In doing this, the critical areas of possible applications in Africa emerge, and the ethical concerns to focus on emerge.

5. Methodological Approach

Unlike most discussions around the ethics of emerging technologies, the approach we have adopted in this paper is to focus on both the ethical concerns and the ethical benefits of ChatGPT and other generative AI systems in Africa. As Stahl and Eke [13] observed, an "ethical analysis of any novel technology is typically well advised to look at benefits as well as concerns". This is particularly relevant in the African context because Africa has unique contexts and challenges not found in many parts of the Global North. Context-specific challenges such as poverty, resource scarcity, corruption, and historical inequalities necessitate nuanced approaches to AI design, development, and deployment. AI, like other technologies, is and should be designed to address context-specific issues. Therefore, focusing on the ethical benefits of Gen-AI can proactively help to address African-centric contexts and situations; mitigate potential harms; and ensure responsible design and equitable access and implementation.

Furthermore, we believe that by highlighting the ethical benefits of ChatGPT, there is a greater likelihood of increased acceptance of and trust in this technology. Understanding its ethical benefits can dispel misconceptions and temper the hype that goes with such disruptive technology. The idea is to provide a balanced view that can inform the development of policies and regulations that not only promote innovation but also ensure responsible and human-centric AI design. There is also a case to be made that an emphasis on ethical benefits can contribute to the long-term sustainability of technology adoption, encouraging a critical approach that takes into consideration human, societal, and environmental impacts. The focus on Africa in this work aims to address an evident gap in the current narratives around the ethics of Gen-AI systems.

Exclusive focus on the ethical concerns or problems of emerging technologies often overshadows the potential ethical benefits of such technologies. Africa is not in a position to afford missing opportunities to leverage disruptive technologies to address societal challenges. Achieving a balance between ethical considerations and the need for innovation is critically important in Africa to harness the full potential of this technology. Excessive emphasis on ethical concerns can lead to unnecessary public fear and scepticism, undermining trust in the technology. It can also lead to regulatory overreach, which can stifle or impede innovation. If the negative consequences of the ChatGPT are allowed to dominate the narrative in Africa, investments in this technology may be reduced, which may affect global competitiveness. There is a need to balance the narrative by highlighting ethical benefits and concerns in a way that ensures responsible design, encourages design, and maximises the positive impacts of this technology on African society.

Our methodology builds on the work of Stahl and Eke [13], who combined three approaches to identify the ethics of emerging technologies. These approaches are "anticipatory technology ethics", or ATE [15]; the "framework for the ethical impact assessment of information technology", or EIA [45]; and "ethical issues of emerging ICT applications", or ETICA [46]. All three approaches have a list of ethical issues (many of these overlap) that can emerge from novel technologies. Using a combined list of issues from these approaches, Stahl and Eke [13] performed an analysis of ChatGPT and identified the ethical benefits and challenges of this technology. They accomplished this by providing a short narrative of how ChatGPT impacts the list of ethical issues both in positive and negative terms. They went further by allocating a likelihood of the impact happening (1 = low; 2 = medium; 3 = high), as well as a measure of severity (1 = low impact; 2 = medium impact; 3 = high impact). As they acknowledged, the possible applications of this technology are close to infinite or, better put, often unknown due to the inherent malleability of technologies. Their analysis was basically based on already existing knowledge of what this technology can or cannot do currently.

A robust review of the publicly available spreadsheet of this analysis—particularly the authors' assessment of the benefits of ChatGPT and the likelihood score they allocated to some of the ethical issues–reveals insights that are relevant to the aim of this paper, highlighting a balanced view of ChatGPT in Africa. It is our strong belief that their calculation of the positive and negative impacts and severity reveals some of the ethical benefits ChatGPT Africa needs to focus on. We, therefore, will highlight some of these ethical issues with identifiable benefits that are likely to be realised or achieved. We believe that ethical issues with high positive impact scores are critical issues that innovators, policymakers, and other users in Africa need to focus on. Issues with a total score of 3 and above were selected for this purpose. This does not mean that other issues should be ignored, but the assessment of their likelihood suggests that these issues require maximum attention. To achieve the needed balance, these issues will be discussed in the next section together with some of their identifiable negative consequences. Whereas these ethical benefits are not and should be considered unique to Africans, we discuss them in the context of Africa and its cultural dynamics. Far be it from us to consider a culturally monolithic entity in this paper, but we consider it a continent with a shared historical past that faces similar resource constraints, including limited financial resources, technological

infrastructure, and expertise, as well as common socio-cultural challenges. It is also important to note that these issues were not objectively identified but interpretively assessed and remain open to scrutiny.

This is not a novel methodology, but its foresightful nature helps to identify possible issues (positive and negative) in technology that have yet to be explored in detail [13]. It provides a systematic way of using our prior knowledge and experience with the ethics of technology to shed light on these issues, which can be interpreted differently by different researchers. While this can be seen as a limitation of this study, its transparent approach provides an opportunity for different interpretations.

6. Findings

The ethical issues that scored three and above with the highest likelihood of being achieved border on four areas, including social justice and rights, individual needs, cultural and identity, and environmental impacts (see Table 1 for the full list of issues).

Table 1. Ethical issues with the highest positive and negative impacts and severity.

ETICA	ATE	EIA	EP
a. Surveillance b. Identity c. Cultural Differences d. Role of humans e. Treatment of humans f. Collective human identity and the good life g. Uncertainty of outcomes h. Perceptions of technology i. Autonomy	a. Intergenerational justice b. Psychological harm c. Harms to society d. Just distribution of primary goods, capabilities, risks, and hazards e. Supportive of happiness, health, knowledge, wisdom, virtue, friendship, trust, achievement, desire-fulfilment, and transcendent meaning f. Other basic human rights as specified in human rights declarations (e.g., to life, to have a fair trial, to vote, to receive an education, to pursue happiness, to seek asylum, to engage in peaceful protest, to practice one's religion, to work for anyone, to have a family, etc.) g. Ability to think one's own thoughts and form one's own opinions h. Ability to make one's own choices i. Health and bodily harm j. Animal rights and animal welfare	a. Safety b. Isolation and substitution of human contact c. Universal service d. Justice e. Equality and fairness (social justice) f. Freedom of speech and expression g. Anonymity h. Dignity i. Beneficence j. Value-sensitive design k. Sustainability	a. Bias b. Trust c. Democracy d. Pollution and waste e. Fairness f. Relationships g. The labour market h. Criminal law i. Use of natural resources (except energy use) j. Impact on the financial system

6.1. Bias

Bias was one of the issues with the highest positive and negative impacts and severity. This assessment was based on the identifiable features of generative AI systems such as the ability to generate texts, images, and videos and their use in coding, translation, and summarisation. Fundamentally, generative AI systems are pre-trained on vast amounts of data to learn patterns, relationships, and representations in the input data. On a positive note, the larger and more diverse the data become, the more representative the outputs will be. As the data behind these models significantly increase to include datasets from Africa, some aspects of digital bias, especially against Africa, will be addressed. However, the non-diversity of the data (as is currently the case) results in biased, racist, and sexist outputs.

Models are mostly trained on a range of data from the internet, which, in themselves, may be biased, which means that they may learn and reproduce biases inherent in the data. Unfortunately, datasets that accurately represent cultural and societal contexts in Africa (including linguistic diversity) are not often found on the internet owing to limited internet access or a lack of digitised information. The focus of Gen-AI design in Africa should, therefore, be to increase the quantity and quality of datasets to reflect the cultural and societal variability in Africa.

6.2. Intergenerational Justice/Sustainability

According to the United Nations Secretary General's report of 2013, intergenerational justice is based on the idea that the "pursuit of welfare by the current generation should not diminish opportunities for a good and decent life for succeeding generations" [47]. This is strongly connected to the concept of environmental sustainability, which is critical to growth and development in Africa. Due to the large computational resources required for training and deploying these models, their carbon footprints are significantly high [48]. However, these models can also become powerful tools, directly and indirectly, for reducing carbon emissions. Their ability to optimise operations by analysing vast amounts of datasets across sectors and industries can lead to a reduction in energy consumption, waste, and overall emissions. For instance, they may also be used to predict maintenance needs, which can prevent unnecessary energy use. In addition to these, through model pruning and quantisation, Gen-AI models can be compressed (through approaches such as pruning [49], quantisation [50], low-rank factorisation [51], and knowledge distillation [52] for deployment, which reduces the amount of energy the model uses. While considering their obvious negative impacts on the environment, stakeholders (including innovators and policymakers) need to be aware of these positive impacts on the environment.

6.3. Cultural Diversity

Our analysis finds that Gen-AI can positively impact cultural diversity in many ways. First, it can help to preserve and revitalise diverse African languages. This can be through the creation of dictionaries and learning or translation apps for these languages or via analyses of historical texts and recordings. These systems can also help to empower underrepresented voices, amplifying narratives from marginalised ethnic groups by curating content highlighting their experiences, perspectives, traditional knowledge, customs, and languages. Gen-AI can also promote African cultural expression and understanding, generating diverse cultural art, music, literature, and stories and personalising cultural experiences in a way that eliminates or reduces stereotypes. However, all of these may not be achieved if the models are trained on nonrepresentative datasets, which can perpetuate biases and discrimination. It is also important for innovators to avoid cultural appropriation and disrespect, which can be informed by a lack of understanding of cultural values, principles, and narratives.

6.4. Supportive of Vital Social and Institutions and Structures

Gen-AI systems like ChatGPT can positively support social structures and institutions such as families, education, religion, economy, government, media, and healthcare systems. This can be achieved by improving the efficiency and effectiveness of processes and operations (automating routine tasks, personal services, and tailored healthcare interventions); enhancing public participation and engagement; promoting transparency and accountability; addressing social challenges; and promoting inclusion. An example is that these models can be integrated into operations in the financial sector to detect and prevent fraud. These models also hold the potential to revolutionise democracy. A positive impact in this sense can be in the form of increased voter engagement (e.g., through simulations of civic engagement through games and education), enhanced accessibility of information, the mitigation of mis/disinformation, and the promotion of deliberative democracy. However, it is important to be aware of how these models produce responses to ensure transparency,

fairness, and privacy and avoid bias and black-box decision-making. Bias and algorithmic discrimination, deepfakes, and misinformation are real concerns that require robust mitigation strategies as regards democracy.

6.5. Impact on Individuals and Society

Technologies have the potential to inflict physical, social, and psychological harm on humans. This includes harm to human capabilities, privacy, autonomy, identity, and security. It also includes how these technologies impact people's daily lives. From misuse in healthcare to exposure to bad content and data privacy breaches, technology can have negative impacts on humans and society. For instance, overreliance on digital technologies can lead to addiction, dependency, and social isolation. This indirectly contributes to a sedentary lifestyle that can lead to health concerns (e.g., obesity). Generative AI systems can help to mitigate some of these concerns by focusing on content moderation and personalised, culturally aware mental health support; integrating privacy-preserving techniques; and aligning with responsible innovation principles and human oversight. In Africa, this may include integration into operations in disease surveillance, medical education, translation, and documentation. While these models cannot replace human connection in all cases, they could offer therapeutic benefits for individuals who might otherwise struggle with isolation and lack access to communication.

In the area of privacy, Gen-AI models pose risks because they can be used to generate synthetic identities, as well as deepfakes, for malicious purposes. As has been proven, there are risks of personal data leakages because the training data often contains personally identifiable information. The complexity of this technology and the unpredictable nature of the outputs means that adequate informed consent is often lacking. However, these models have the potential to train data with privacy-preserving techniques such as differential privacy, federated learning, and homomorphic encryption to protect the privacy and confidentiality of people. The capacity to use context-specific and or iterative consent needs to be built into these models. The tendency to over-rely on automation, the possible loss of jobs, and the possibilities of manipulation and deception with Gen-AI systems negatively affect human autonomy. However, increased access to information and enhanced creativity, self-expression, and personalised content can have positive impacts on autonomy. It is important, therefore, to amplify these positive elements while the risks are also robustly addressed.

Furthermore, while these models pose some risks to self-identity, they also hold great promise. Through personalised education, learning, and guidance that support personal development, Gen-AI systems can provide insights and skills to help people uncover their strengths, thereby fostering a sense of authenticity and self-expression. Therefore, they can help individuals overcome their limitations and empower them to make independent choices. By democratising access to creative platforms and tools, these models can promote self-expression, which strengthens self-identity. However, it is good to note that Gen-AI systems can create echo chambers and filter bubbles that negatively affect self-identity. Based on the nature of the data it is trained on, a model can provide responses that reinforce one's existing beliefs, preventing the person from diverse viewpoints. A lack of diverse viewpoints often leads to a narrow identity development because the personal exploration of self is limited. In essence, autonomy, human agency, and control are significantly undermined when these models are overly relied on. The governance of these models ought to include the promotion of critical thinking, continued diverse interactions, and measures to prevent manipulation.

6.6. Labour Market

The negative impacts of these models on the labour market are undeniable. There are possibilities of replacement jobs related to operations that can be performed with these models, and as the integration of this technology into business operations continues to increase, employees may be expected to upskill or reskill to adapt to the ecosystem. Most

critically, there have been reports of labour exploitation in Africa as Open AI designed its model [53,54]. However, these models could help to create new jobs, assist employees via the automation of difficult tasks, and empower people to launch their own businesses.

7. Discussion of Findings

From the point of view of generative AI systems and Africa, the ethical issues discussed above could be studied through the lenses of utilitarianism, deontology, virtue ethics, and Ubuntu to effectively devise solutions to overcome the risks and opportunities they bring. Each of these ethical frameworks provides unique insights and practical strategies for exploring, such as bias, intergenerational justice, cultural diversity, institutional and social structures, and labour markets. Utilitarianism can assess the broad impacts of generative AI systems by focusing on outcomes that maximise the greatest good for the greatest number. For example, in addressing bias and labour market impacts, a utilitarian approach should prioritise actions that enhance job opportunities and economic benefits across diverse demographic groups, thereby ensuring that generative AI system development leads to positive socioeconomic outcomes. A deontological perspective emphasises adherence to moral rules or duties, regardless of the outcomes. This lens can ensure that generative AI systems are developed and operated according to strict ethical principles, such as fairness and non-discrimination. For instance, it mandates that AI systems must not perpetuate or amplify biases, regardless of the potential benefits, upholding ethical standards even in complex institutional settings. A virtue ethics lens highlights the importance of moral character and the virtues that should be embodied by those involved in generative AI system development. A virtue ethics approach encourages developers to cultivate characteristics like empathy, responsibility, and wisdom. For cultural diversity and intergenerational justice, virtue ethics advocates for the development of AI that respects and preserves cultural heritage and considers the long-term impacts on future generations. Finally, Ubuntu, with its focus on community interconnectedness and mutual care, provides a critical perspective in the African context. It promotes the design and implementation of generative AI systems that are community-centric, enhancing social bonds and prioritising the well-being of all community members. Ubuntu can guide generative AI system development to be more inclusive, ensuring that technology development involves wide-ranging consultations with local communities, thereby creating systems that are deeply attuned to the local social dynamics and specific challenges faced by these communities.

By integrating these diverse ethical dimensions, it is possible to better navigate the complex ethical landscape presented by generative AI in Africa. This holistic approach ensures that generative AI systems not only advance technological developments and uptake but also align with deep-seated moral values and social needs, thereby fostering technology that is both innovative and ethically sound. Developing robust details of how these theories can be applied to these findings is something to consider for future research.

8. Possible Application Areas in Africa

Following the above findings, we have identified some areas where this technology can be applied to achieve benefits for individuals, businesses, and society in Africa. This is a technology that has shown that it can potentially perform many ubiquitous tasks, covering a breadth of disciplines. Users in Africa can potentially perform a variety of tasks using ChatGPT and other generative AI systems. It is a technology that is permeating everyday life and can potentially have a significant impact on various sectors in Africa. ChatGPT offers myriads of opportunities for growth and development. It also presents unique ethical, legal, and socio-cultural benefits and challenges given Africa's peculiar contexts, needs, and expectations.

Some of its application areas in Africa can help address critical developmental goals, particularly the UN's Sustainable Development Goals (SDGs); enhance communication; and provide much-needed services. Examples of these application areas include education,

agriculture, healthcare, public services, businesses, personal development, tourism, and the creative arts.

8.1. Education

ChatGPT can become a valuable tool for improving education in Africa. This is because ChatGPT has been identified as a system that can provide personalised learning experiences to students and pedagogical support to teachers. It is a technology that can facilitate access to knowledge to users in places with limited resources for education. Many parts of Africa still lack the resources necessary to improve learning outcomes in different stages of education, including nursery, primary, secondary, and tertiary education. ChatGPT can become a tool to bridge this gap. Students can benefit by making it a learning assistant that can provide explanations for homework and topics of interest. It can also offer much-needed language translation services in educational institutions that are often multilingual. This can facilitate improved communication and understanding within the educational setup and other sectors, such as business and healthcare.

It can also assist educators in carrying out better assessments and provide improved feedback to students. In addition, educational institutions can use ChatGPT for administrative purposes such as document management, financial management, enrolment, and human resource management. These are use cases that show that generative AI systems can bring valuable improvement and development in Africa. Possible concerns here include the possibility of breaching the principles of academic integrity [4], the digital divide, and privacy issues.

8.2. Agriculture

Agriculture is integral to the socio-cultural life of Africans. Many countries in Africa (for example, one-third of the GDP of Ethiopia and one-fifth of sub-Saharan Africa's economic output) depend on agriculture [55]. However, barriers to sustainable agriculture in Africa abound and include weather variability and a lack of crop management. ChatGPT can provide farmers with advice on weather forecasts, crop management, and pest control. It can also provide useful information on market prices, as well as sustainable farming practices that can help them to be more productive and competitive in the global agricultural ecosystem.

8.3. Healthcare

Healthcare systems in Africa face many challenges including but not limited to poor infrastructure; inadequate funding and human resources; and poor leadership and management [56,57]. This means that patients have limited access to healthcare professionals and a lack of information on healthcare issues. ChatGPT can be useful in providing or disseminating critical information on health-related issues; offering answers to common health questions; and promoting awareness about diseases, health, and well-being. It can certainly complement existing healthcare services and assist health workers in remote regions of Africa without adequate access to healthcare.

8.4. Public Services

Since the end of colonialism, public services in Africa have faced a number of economic, social, and technological challenges. Economically, public services have been saddled with the responsibility of accomplishing more with fewer resources in the face of financial constraints and the burden of public debt [58]. They are expected to play major roles in promoting social cohesion, serving as instruments of regulation, combatting social inequities, and protecting vulnerable portions of the population. At the same, there is a dearth of technical infrastructure to make services efficient, accessible, and cost-effective. ChatGPT promises to provide this technical platform to achieve improved public services in Africa. It can be used to provide automated real-time customer support to users including in emergency services. It can certainly facilitate communication between government

agencies and citizens, especially ones that speak different languages (because it can be used for language translation). It can also become integral to public stakeholder engagement, where it can be used to gather feedback from citizens. ChatGPT can also be used in public service for education and awareness, data analysis, and reporting. In essence, it can help improve public services in Africa, most of which are moribund.

8.5. Businesses

Africa is home to emerging economies and a growing consumer market. These burgeoning economies represent an exciting future with massive opportunities, as well as unique challenges. Both small and large businesses face challenges such as price-sensitive markets (with little market data); a lack of skilled labour and technical infrastructure (e.g., electricity and internet connectivity); and tough policies and regulations [59]. More importantly, the African business ecosystem lacks cost-effective technical solutions that can make it more competitive in the global market. ChatGPT can be employed in a number of ways to improve business efficiency and to ensure the ease of doing business. These application areas include local language support; e-commerce and sales assistance; customer support and engagement; training and capacity development; automated market analysis; documentation and reporting; and improved financial services. These applications can present significant benefits to the African business landscape, which includes financial institutions, transportation, logistics, etc. Businesses here include banking, service delivery businesses, manufacturing, mining, construction, and transportation.

8.6. Personal Development

Gen-AI systems like ChatGPT can be very important tools for personal development in many ways, providing support to individuals for self-improvement. From individualised learning (including language learning) to personal goal setting and planning, health, well-being (providing information and support on health-related topics), and creative writing, Gen-AI systems are valuable resources for personal development. They can offer real-time answers to individuals on a wide range of themes and concepts. In addition to this, these systems can offer users a platform to organise tasks, set priorities, and manage time effectively. They can also help users in writing resumes, offering career support and guidance on best practices in job applications. This means that users can use these as tools to develop strategies for personal growth.

8.7. Tourism

Many countries of Africa have unique archaeological and historical sites; breathtaking and culturally diverse cities; extensive wildlife and safari adventures; many beaches and islands; and numerous UNESCO World Heritage sites that make the continent a tourist destination. Indeed, tourism is a significant economic driver and contributes immensely to many African countries' GDP, job creation, foreign exchange earnings, and general economic development. A number of studies have shown that technology is increasingly being deployed for tourism in Africa [60,61]. Adeola et al. (2019) found that technology has a positive, statistically significant relationship with recent growth in the tourism industry in Africa. In the same vein, ChatGPT can be used to enhance tourism in many ways. It can be used as a travel-planning assistant (e.g., personalised itinerary planning) and language-translation tool. It can also provide useful local information and or serve as a virtual guide at tourist sites.

8.8. Creative Arts

From poetry and fiction [62] to music, visual art, and video and animation [63], generative AI systems such as ChatGPT are providing novel methods of creative expression. As these systems continue to redefine our understanding of creativity, the entertainment industry is witnessing a renaissance. In Africa, ChatGPT offers exciting possibilities as regards the creative arts. As a language model, it can be used to restore and reconstruct

historical objects and artwork. This can also include revitalising ancient languages, stories, and narratives, although the quality of such reconstructions will depend on whether the model is trained on sufficient data from Africa. Most importantly, it can help empower new artistic voices in the region, democratising access to creative tools, providing platforms for artistic innovation, and facilitating collaboration with artists from other parts of the world, thereby expanding the reach and visibility of African artists and their works.

9. The Need for Governance

While ChatGPT and generative AI can more generally bring potential benefits, as highlighted in the previous section, they are also prone to unintended consequences, which include social and ethical concerns. To ensure that the benefits are harnessed fully, as well as to mitigate against the unintended consequences, AI governance is of crucial importance. AI governance plays a crucial role in ensuring that the benefits derived from data and AI technologies are distributed equitably across all segments of society, including more developed and less developed countries [64]. AI governance encompasses an important position when it comes to issues around data access, representation, privacy, security, and bias, among others. A consideration of AI governance can ensure fair and inclusive AI technologies, particularly for Africa. While AI offers transformative potential across healthcare, education, agriculture, and economic development, its deployment raises complex challenges, including ethical considerations, data and privacy concerns, and the risk of exacerbating existing inequalities if AI governance arrangements are not in place. For this reason, it is not only important to highlight the unique challenges the African continent faces but to also look at aspects that can lead to inclusive and effective AI governance policies that can harness the continued benefits of AI while addressing possible concerns around AI technologies.

As bias represents a significant challenge for AI in Africa, AI governance arrangements become very important in addressing this concern. Effective AI governance can combat bias, for instance, through the development of robust regulatory frameworks. The regulatory framework requirements should include AI systems that are fair and transparent and demand the mitigation of bias when AI is implemented. In developing such regulatory frameworks, Africa can draw inspiration from the recently enacted EU AI Act, which notably emphasises individual safety and fundamental human rights, therefore prohibiting AI systems capable of causing harm. The Act also addresses issues around bias and calls for the rigorous testing of datasets used to train and test AI in order to ensure that the systems are safe and transparent and avoid bias that could result in discrimination.

Beyond establishing AI regulatory frameworks, Africa must also create AI ethical guidelines that resonate with the unique experiences, values, and cultures of its citizens as AI technologies become more widespread. Typically, existing AI ethical guidelines primarily reflect the perspectives and values of their developers, who are often from more developed regions. Consequently, Africa should strive to formulate AI ethical guidelines that reflect its people's real lived experiences and needs. For example, the concept of privacy, often treated as universal in discussions about AI and digital technologies, varies significantly across different cultures and regions.

Incorporating African values, cultures, and lived experiences into AI regulatory frameworks and ethical guidelines is crucial for fostering and addressing cultural diversity in the use of generative AI—a perspective currently lacking in global AI discourse. To ensure cultural diversity, AI regulatory governance policies must ensure that datasets for training large language models are representative. Implementing such AI regulatory policies could greatly enhance potential application areas. For instance, regulatory frameworks that establish standards for AI use in education are essential. These frameworks should foster innovative education solutions that are inclusive and equitable, thus contributing to the UN's SDG 4 on inclusive, equitable, and quality education.

Furthermore, effective AI governance in Africa's agricultural sector should involve regulatory policies that offer farmers the opportunity to leverage innovative solutions,

addressing both challenges and opportunities equitably. Similarly, AI governance in healthcare presents an opportunity to significantly improve health outcomes and service efficiency. Governance strategies in this sector must address ethical issues like data privacy and security comprehensively in order to build trust in AI systems among citizens. Regulatory policies around patient records and confidentiality need to be robust in their consideration of possible mismanagement, misuse, and potential security breaches. Without these assurances and ethical standards that consider these elements, trust in health AI systems may be difficult to cultivate among citizens.

Similarly, it is equally essential to have robust AI governance when it comes to public services in order to realise the efficiencies needed and the effective operations of public services. Buy-in from the public is important if public services are to work as efficiently as desired. This calls for trust in AI systems, particularly due to the personal data that will be collected as citizens use these AI systems. As such, any AI systems deployed for public services should be transparent and allow for accountability where citizens can have the opportunity to challenge and seek redress should the system, for example, breach their privacy and data protection expectations. In addition, AI systems intended for public services should not be discriminatory and should be inclusive of all citizens, including the vulnerable and marginalised in society. These aspects ought to be considered in any AI regulatory policies.

Finally, in the domain area of business, any AI governance arrangements should ensure that the AI regulatory policies take into account innovation growth while, at the same time, ensuring economic growth and improving citizens' livelihoods. This could be accomplished by aligning with international standards and AI regulatory policies in order to ensure fair competition. Such efforts could support the UN's SDG 17 on strengthening global partnerships for sustainable development.

10. Conclusions

The paper has explored various facets of ChatGPT and other emerging generative AI technologies within the African context, with a special focus on the ethical challenges and benefits these technologies present. Unlike discussions that predominantly concentrate on ethical concerns, this study equally highlights the ethical advantages, emphasising their importance in the thoughtful design, deployment, and adoption of ChatGPT and generative AI across the African continent. By addressing ethical issues such as bias, intergenerational justice, labour exploitation, and cultural diversity, this paper effectively outlines potential application areas for these technologies that are most relevant to African needs. This comprehensive analysis was facilitated by a blend of methodologies, including anticipatory technology ethics (ATE), ethical impact assessment (EIA), and ethical issues of emerging ICT applications with AI (ETICA).

In addition, this paper explores the crucial aspects of AI governance in Africa's adoption of ChatGPT and other generative AI technologies. It posits that understanding and implementing potential AI governance frameworks are instrumental in mitigating the ethical challenges identified, including bias. These frameworks have the dual benefit of addressing current ethical issues and pre-emptively tackling future unforeseen challenges. This paper advocates for the creation of strong, culturally and contextually sensitive policies and regulatory mechanisms that promote transparency, accountability, and active public engagement in AI development and deployment. Such regulatory mechanisms are essential for ensuring that ChatGPT and generative AI can foster sustainable development and improve public services, as well as safeguard against potential harm. As fair and equitable access to AI is important, AI governance arrangements can ensure that ChatGPT and generative AI benefits are equitably accessible.

The development of AI governance frameworks is particularly important for Africa given that the continent currently lags in its development of robust AI policies compared with the Global North, notably Europe, which has pioneered this area with the first EU AI Act. It is, therefore, important for Africa as a continent to develop AI regulatory policies

that not only align with those in more technologically advanced regions but are also thoughtfully adapted to the continent's specific needs and conditions. Despite the seeming global nature of current AI regulations, their applicability is often limited by jurisdictional boundaries. Thus, creating AI policies that are both comparable to international standards and meticulously tailored to the African context is crucial. Such policies would ensure a harmonised approach to AI governance that honours the distinct socio-economic, cultural, and ethical dimensions of Africa. Moreover, customised policies can be key to spurring the continent's innovation while, at the same time, safeguarding citizens against AI risks. Additionally, customised policies can bolster Africa's role in the international AI landscape, thereby facilitating a more inclusive and equitable global AI ecosystem.

By aligning its AI governance policies with global standards while adapting them to local contexts, Africa can avoid being relegated to a mere data provider for international AI systems and, instead, emerge as a pivotal contributor to the development and ethical application of AI technologies. This strategy not only fosters equitable technological progress but also ensures that AI acts as a catalyst for sustainable development. It does so by tackling key challenges in critical sectors such as education, agriculture, healthcare, and public services in a manner that respects and responds to the unique circumstances of the African continent. Therefore, establishing AI regulatory frameworks that are on par with those in technologically advanced regions, yet are finely tuned to the specificities of Africa, will unlock the continent's potential to influence a future where AI technology is universally accessible, equitable, and advantageous for all of its inhabitants. This approach empowers Africa to lead by example in showcasing how AI can enhance societal well-being while adhering to ethical principles.

Therefore, the scientific implication of the findings in this paper is that they highlight the importance of a balanced view of emerging technology in Africa. Both research and practice around Gen-AI and other disruptive technologies in Africa need to focus on this balanced-view approach. Our findings show that a one-sided (positive or negative) approach leads to either the neglect of ethical and legal risks associated with this technology or unnecessary barriers set up against the development of relevant technologies. However, considering the limitations of this study (i.e., it involved only the viewpoints of researchers in academia), future research studies need to include insights from industry and policy. Such research studies can build on the findings of this paper and include research studies focusing specifically on one country in Africa or a specific sector (e.g., finance, telecommunications, healthcare, etc.). It may also be useful to conduct primary research that can gain insights from diverse stakeholders as generative AI systems continue to be integrated into business and public service operations.

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References

1. Volpicelli, G. ChatGPT Broke the EU Plan to Regulate AI. *Politico* **2023**, *3*, 2023.
2. Tracy, R. Biden Administration Weighs Possible Rules for AI Tools like ChatGPT. Available online: https://www.wsj.com/articles/biden-administration-weighs-possible-rules-for-ai-tools-like-chatgpt-46f8257b (accessed on 12 June 2023).
3. Sheehan, M. China's AI Regulations and How They Get Made. *Horiz. J. Int. Relat. Sustain. Dev.* **2023**, 108–125.
4. Eke, D.O. ChatGPT and the Rise of Generative AI: Threat to Academic Integrity? *J. Responsible Technol.* **2023**, *13*, 100060. [CrossRef]

5.   Bender, E.M.; Gebru, T.; McMillan-Major, A.; Shmitchell, S. On the Dangers of Stochastic Parrots: Can Language Models Be Too Big? In Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency, Association for Computing Machinery, New York, NY, USA, 1 March 2021; pp. 610–623.

6.   van Melle, W. MYCIN: A Knowledge-Based Consultation Program for Infectious Disease Diagnosis. *Int. J. Man-Mach. Stud.* **1978**, *10*, 313–322. [CrossRef]

7.   Lindsay, R.K.; Buchanan, B.G.; Feigenbaum, E.A.; Lederberg, J. DENDRAL: A Case Study of the First Expert System for Scientific Hypothesis Formation. *Artif. Intell.* **1993**, *61*, 209–261. [CrossRef]

8.   Weizenbaum, J. ELIZA—A Computer Program for the Study of Natural Language Communication between Man and Machine. *Commun. ACM* **1983**, *26*, 23–28. [CrossRef]

9.   Funk, T. A Musical Suite Composed by an Electronic Brain: Reexamining the Illiac Suite and the Legacy of Lejaren A. Hiller Jr. *Leonardo Music J.* **2018**, *28*, 19–24. [CrossRef]

10.   Yoon, B.-J. Hidden Markov Models and Their Applications in Biological Sequence Analysis. *Curr. Genom.* **2009**, *10*, 402–415. [CrossRef]

11.   Vaswani, A.; Shazeer, N.; Parmar, N.; Uszkoreit, J.; Jones, L.; Gomez, A.N.; Kaiser, Ł.; Polosukhin, I. Attention Is All You Need. In *Advances in Neural Information Processing Systems 30 (NIPS 2017)*; Curran Associates, Inc.: Red Hook, NY, USA, 2017; Volume 30.

12.   Prakash, A. Transformer Architecture: The Engine behind ChatGPT. Available online: https://www.thoughtspot.com/data-trends/ai/what-is-transformer-architecture-chatgpt (accessed on 16 March 2024).

13.   Stahl, B.C.; Eke, D. The Ethics of ChatGPT—Exploring the Ethical Issues of an Emerging Technology. *Int. J. Inf. Manag.* **2024**, *74*, 102700. [CrossRef]

14.   Katsogiannis-Meimarakis, G.; Koutrika, G. A Survey on Deep Learning Approaches for Text-to-SQL. *VLDB J.—Int. J. Very Large Data Bases* **2023**, *32*, 905–936. [CrossRef]

15.   Brey, P.A. Anticipatory Ethics for Emerging Technologies. *NanoEthics* **2012**, *6*, 1–13. [CrossRef]

16.   Stahl, B.C.; Akintoye, S.; Bitsch, L.; Bringedal, B.; Eke, D.; Farisco, M.; Grasenick, K.; Guerrero, M.; Knight, W.; Leach, T. From Responsible Research and Innovation to Responsibility by Design. *J. Responsible Innov.* **2021**, *8*, 175–198. [CrossRef]

17.   Bonde, S.; Firenze, P. *A Framework for Making Ethical Decisions*; Santa Clara University: Santa Clara, CA, USA, 2019.

18.   Sætra, H.S.; Coeckelbergh, M.; Danaher, J. The AI Ethicist's Dilemma: Fighting Big Tech by Supporting Big Tech. *AI Ethics* **2022**, *2*, 15–27. [CrossRef]

19.   Mitov, A. Ethical Use of Artificial Intelligence through the Utilitarianism Perspective. Bachelor's Thesis, University of Twente, Enschede, The Netherlands, 2021.

20.   Baumann, M.; Couffignal, S.; Le Bihan, E.; Chau, N. Life Satisfaction Two-Years after Stroke Onset: The Effects of Gender, Sex Occupational Status, Memory Function and Quality of Life among Stroke Patients (Newsqol) and Their Family Caregivers (Whoqol-Bref) in Luxembourg. *BMC Neurol.* **2012**, *12*, 105. [CrossRef] [PubMed]

21.   Smith, N.; Vickers, D. Living Well with AI: Virtue, Education, and Artificial Intelligence. *Theory Res. Educ.* **2024**, *22*, 19–44. [CrossRef]

22.   Eke, D.; Stahl, B. Ethics in the Governance of Data and Digital Technology: An Analysis of European Data Regulations and Policies. *Digit. Soc.* **2024**, *3*, 11. [CrossRef]

23.   Eke, D.; Ogoh, G. Forgotten African AI Narratives and the Future of AI in Africa. *Int. Rev. Inf. Ethics* **2022**, *31*. [CrossRef]

24.   Eke, D.O.; Wakunuma, K.; Akintoye, S. Introducing Responsible AI in Africa. In *Responsible AI in Africa: Challenges and Opportunities*; Springer International Publishing: Cham, Switzerland, 2023; pp. 1–11.

25.   UNECA. *Africa's Regional Science, Technology and Innovation Forum, 2021 on "Harnessing Emerging Technologies: The Cases of Artificial Intelligence and Nanotechnology"*; UNECA: Addis Ababa, Ethiopia, 2021.

26.   African Union Commission and OECD. Chapter 4. Digital Transformation for Youth Employment and Agenda 2063 in Central Africa. In *Africa's Development Dynamics 2021: Digital Transformation for Quality Jobs*; OECD: Paris, France, 2021; ISBN 978-92-64-60653-1.

27.   Badaru, K.A.; Mphahlele, R.S. Effects of Emerging Technologies on African Development: A Narrative Review on Selected African Countries. *Res. Soc. Sci. Technol.* **2023**, *8*, 36–51. [CrossRef]

28.   Distor, C.; Campos Ruas, I.; Isagah, T.; Ben Dhaou, S. Emerging Technologies in Africa: Artificial Intelligence, Blockchain, and Internet of Things Applications and Way Forward. In Proceedings of the 16th International Conference on Theory and Practice of Electronic Governance, ACM, Belo Horizonte Brazil, 26 September 2023; pp. 33–40.

29.   Chavula, H.K. Telecommunications Development and Economic Growth in Africa. *Inf. Technol. Dev.* **2013**, *19*, 5–23. [CrossRef]

30.   Donou-Adonsou, F.; Lim, S.; Mathey, S.A. Technological Progress and Economic Growth in Sub-Saharan Africa: Evidence from Telecommunications Infrastructure. *Int. Adv. Econ. Res.* **2016**, *22*, 65–75. [CrossRef]

31.   Aruleba, K.; Jere, N. Exploring Digital Transforming Challenges in Rural Areas of South Africa through a Systematic Review of Empirical Studies. *Sci. Afr.* **2022**, *16*, e01190. [CrossRef]

32.   Baker, L. New Frontiers of Electricity Capital: Energy Access in Sub-Saharan Africa. *New Polit. Econ.* **2023**, *28*, 206–222. [CrossRef]

33.   Adwek, G.; Boxiong, S.; Ndolo, P.O.; Siagi, Z.O.; Chepsaigutt, C.; Kemunto, C.M.; Arowo, M.; Shimmon, J.; Simiyu, P.; Yabo, A.C. The Solar Energy Access in Kenya: A Review Focusing on Pay-As-You-Go Solar Home System. *Environ. Dev. Sustain.* **2020**, *22*, 3897–3938. [CrossRef]

34. Perdices, D.; Perna, G.; Trevisan, M.; Giordano, D.; Mellia, M. When Satellite Is All You Have: Watching the Internet from 550 Ms. In Proceedings of the 22nd ACM Internet Measurement Conference, ACM, Nice, France, 25 October 2022; pp. 137–150.

35. Mignamissi, D.; Djijo, T. Digital Divide and Financial Development in Africa. *Telecommun. Policy* **2021**, *45*, 102199. [CrossRef]

36. Hellström, J.; Tröften, P.-E. *The Innovative Use of Mobile Applications in East Africa*; Swedish International Development Cooperation Agency (SIDA): Stockholm, Sweden, 2010.

37. Asongu, S.; Boateng, A. Introduction to Special Issue: Mobile Technologies and Inclusive Development in Africa. *J. Afr. Bus.* **2018**, *19*, 297–301. [CrossRef]

38. Crossan, A.; McKelvey, N.; Curran, K. Mobile Technologies Impact on Economic Development in Sub-Saharan Africa. In *Advanced Methodologies and Technologies in Network Architecture, Mobile Computing, and Data Analytics*; IGI Global: Hershey, PA, USA, 2019; pp. 1031–1039.

39. Akinyemi, B.E.; Mushunje, A. Determinants of Mobile Money Technology Adoption in Rural Areas of Africa. *Cogent Soc. Sci.* **2020**, *6*, 1815963. [CrossRef]

40. Emeana, E.M.; Trenchard, L.; Dehnen-Schmutz, K. The Revolution of Mobile Phone-Enabled Services for Agricultural Development (m-Agri Services) in Africa: The Challenges for Sustainability. *Sustainability* **2020**, *12*, 485. [CrossRef]

41. Dodoo, J.E.; Al-Samarraie, H.; Alsswey, A. The Development of Telemedicine Programs in Sub-Saharan Africa: Progress and Associated Challenges. *Health Technol.* **2022**, *12*, 33–46. [CrossRef] [PubMed]

42. Iluba, E.; Phiri, J. The FinTech Evolution and Its Effect on Traditional Banking in Africa—A Case of Zambia. *Open J. Bus. Manag.* **2021**, *9*, 838. [CrossRef]

43. Stringham, E.P. Banking Regulation Got You down? The Rise of Fintech and Cryptointermediation in Africa. *Public Choice* **2023**, *197*, 455–470. [CrossRef]

44. Eke, D.O.; Chintu, S.S.; Wakunuma, K. Towards Shaping the Future of Responsible AI in Africa. In *Responsible AI in Africa: Challenges and Opportunities*; Springer International Publishing: Cham, Switzerland, 2023; pp. 169–193.

45. Wright, D. A Framework for the Ethical Impact Assessment of Information Technology. *Ethics Inf. Technol.* **2011**, *13*, 199–226. [CrossRef]

46. Stahl, B. IT for a Better Future: How to Integrate Ethics, Politics and Innovation. *J. Inf. Commun. Ethics Soc.* **2011**, *9*, 140–156. [CrossRef]

47. UN General Assembly. *Intergenerational Solidarity and the Needs of Future Generations*; United Nations: New York, NY, USA, 2013.

48. Luccioni, A.S.; Viguier, S.; Ligozat, A.-L. Estimating the Carbon Footprint of Bloom, a 176b Parameter Language Model. *J. Mach. Learn. Res.* **2023**, *24*, 1–15.

49. Liang, T.; Glossner, J.; Wang, L.; Shi, S.; Zhang, X. Pruning and Quantization for Deep Neural Network Acceleration: A Survey. *Neurocomputing* **2021**, *461*, 370–403. [CrossRef]

50. Gholami, A.; Kim, S.; Dong, Z.; Yao, Z.; Mahoney, M.W.; Keutzer, K. A Survey of Quantization Methods for Efficient Neural Network Inference. In *Low-Power Computer Vision*; Chapman and Hall/CRC: Boca Raton, FL, USA, 2022; pp. 291–326.

51. Kishore Kumar, N.; Schneider, J. Literature Survey on Low Rank Approximation of Matrices. *Linear Multilinear Algebra* **2017**, *65*, 2212–2244. [CrossRef]

52. Gou, J.; Yu, B.; Maybank, S.J.; Tao, D. Knowledge Distillation: A Survey. *Int. J. Comput. Vis.* **2021**, *129*, 1789–1819. [CrossRef]

53. Perrigo, B. Exclusive: The $2 Per Hour Workers Who Made ChatGPT Safer. Available online: https://time.com/6247678/openai-chatgpt-kenya-workers/ (accessed on 6 February 2023).

54. Morreale, F.; Bahmanteymouri, E.; Burmester, B.; Chen, A.; Thorp, M. The Unwitting Labourer: Extracting Humanness in AI Training. *AI Soc.* **2023**. [CrossRef]

55. Woetzel, J.; Pinner, D.; Samandari, H.; Engel, H.; McCullough, R.; Melzer, T.; Boettiger, S. *How Will African Farmers Adjust to Changing Patterns of Precipitation*; McKinsey Global Institute: Chicago, IL, USA, 2020.

56. Azevedo, M.J. The State of Health System(s) in Africa: Challenges and Opportunities. In *Historical Perspectives on the State of Health and Health Systems in Africa, Volume II*; Palgrave Macmillan: Cham, Switzerland, 2017; pp. 1–73. [CrossRef]

57. Oleribe, O.O.; Momoh, J.; Uzochukwu, B.S.; Mbofana, F.; Adebiyi, A.; Barbera, T.; Williams, R.; Taylor-Robinson, S.D. Identifying Key Challenges Facing Healthcare Systems In Africa And Potential Solutions. *Int. J. Gen. Med.* **2019**, *12*, 395–403. [CrossRef] [PubMed]

58. Owusu, F.; Ohemeng, F.L.K. The Public Sector and Development in Africa: The Case for a Developmental Public Service. In *Rethinking Development Challenges for Public Policy: Insights from Contemporary Africa*; Hanson, K.T., Kararach, G., Shaw, T.M., Eds.; Palgrave Macmillan UK: London, UK, 2012; pp. 117–154, ISBN 978-0-230-39327-1.

59. Asongu, S.A.; Nnanna, J.; Acha-Anyi, P.N. Finance, Inequality and Inclusive Education in Sub-Saharan Africa. *Econ. Anal. Policy* **2020**, *67*, 162–177. [CrossRef]

60. Anwar, M.A.; Carmody, P.; Surborg, B.; Corcoran, A. The Diffusion and Impacts of Information and Communication Technology on Tourism in the Western Cape, South Africa. *Urban Forum* **2014**, *25*, 531–545. [CrossRef]

61. Adeola, O.; Evans, O. ICT, Infrastructure, and Tourism Development in Africa. *Tour. Econ.* **2020**, *26*, 97–114. [CrossRef]

62. Antar, D. The Effectiveness of Using ChatGPT4 in Creative Writing in Arabic: Poetry and Short Story as a Model. *Inf. Sci. Lett.* **2023**, *12*, 2445–2459.

63. Epstein, Z.; Hertzmann, A.; the Investigators of Human Creativity; Akten, M.; Farid, H.; Fjeld, J.; Frank, M.R.; Groh, M.; Herman, L.; Leach, N.; et al. Art and the Science of Generative AI. *Science* **2023**, *380*, 1110–1111. [CrossRef] [PubMed]

64. Wakunuma, K.; Ogoh, G.; Eke, D.O.; Akintoye, S. Responsible AI, SDGs, and AI Governance in Africa. In Proceedings of the 2022 IST-Africa Conference (IST-Africa), Dublin, Ireland, 16–20 May 2022; pp. 1–13.