Review Article

User-Centric Adoption of Democratized Generative AI: Focus on Human-Machine Interaction and Overcoming Challenges

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Abstract - The rise of Generative Artificial Intelligence (GenAI) has triggered significant progress across multiple fields, presenting unparalleled abilities in fostering creativity, addressing problems, and simulating human-like interactions. Despite their potential, Generative AI tools present challenges in user understanding and engagement across various industries. Professionals in diverse roles encounter difficulties integrating these advanced tools into daily operations, hindering seamless adoption. The diverse reliability and accuracy of AI-generated content require stringent validation and quality assurance. Democratized Generative AI emerges as a novel strategy for expanding the reach of AI technology to a diverse user base, intending to distribute its advantages equitably and contribute to the collective well-being of society, even fostering the expansion of access to non-technical. The user-centric adoption of democratized GenAI positions at the forefront, emphasizing a crucial shift towards inclusive and interactive human-machine collaboration. The arrangement of the work enables us to not only determine the positioning of the research but also visualize the existing challenges, like ethical use, privacy, security concerns, and use cases within the domain. Finally, the researchers explore future directions in democratizing GenAI, encompassing improvements in digital prototyping, enhanced encryption methods, and the promotion of interdisciplinary insights for societal impact.

Keywords - Democratized GenAI, Deepfake technology, Explainability, Hyper-personalization, JCAS, Predictive maintenance, Privacy, SORA.

1. Introduction

The rise of large language models, such as Generative AI systems like ChatGPT, has revolutionized human-computer interaction and industrial practices. These higher models, powered by complex ML algorithms, demonstrate impressive coherence and fluency, marking a shift from traditional rule-based systems [1]. Generative AI holds significant promise for diverse applications, including natural language generation, translation, and the creation of varied and imaginative content. A clear indication of global enthusiasm for GenAI is highlighted in the '2023 Emerging Technologies Hype Cycle' report from Gartner, published on August 17, 2023 [2, 3]. Currently, the prevalence of Generative AI techniques is evident in areas such as predictive maintenance [4], assessment tools [5], inventory management [6], and customer interactions [7]. Moreover, marketers view GenAI as a significant productivity enhancer. According to a survey by a non-profit business membership and research group [8], more than 80% of respondents expect productivity to rise with greater adoption of Generative AI. In comparison, just 4% anticipate a decrease. GenAI's benefits in marketing go beyond cost-cutting, allowing brands to surpass conventional capabilities. GenAI empowers brands to achieve unprecedented feats, such as elevating marketing and sales strategies to deliver highly personalized experiences beyond human capabilities. This involves dynamic messaging, personalized text, and predictive recommendations based on valuable data, enabling efficient scaling of personalization across crucial moments [9]. However, the use of Generative AI tools poses a significant challenge in the different industry environments related to user comprehension and involvement. Employees in various roles often find themselves grappling with the complexities of these sophisticated tools, attempting to understand their practical applications and fully exploit their capabilities in their everyday tasks. The deficit in user understanding emerges as a bottleneck, obstructing the smooth integration of Generative AI tools into regular operations. Whether it's data analysts aiming for streamlined

data synthesis or marketing professionals utilizing content creation, users face the task of grasping the intricate functionalities of Generative AI. This lack of clarity not only hampers the effective utilization of these tools but also acts as a barrier to their widespread adoption across different departments [10, 11]. Additionally, the varying reliability and consistency of AI-generated content necessitate rigorous validation and quality assurance measures. The adoption of GenAI in education also raises security and privacy issues concerning student data and interactions, underscoring the need for strict privacy protocols. Although many studies have examined the effects of GenAI on different settings, there is a notable lack of research on its implementation in user-centric adoption of democratized Generative AI by focusing on human-machine interaction. Most existing literature emphasizes well-funded contexts, overlooking how GenAI can be utilized in areas dealing with infrastructural and socio-political obstacles [12]. One of the most advantageous and novel strategies for ensuring and enhancing the effective and efficient utilization of GenAI tools across various departments within an organization is the widespread implementation of democratized GenAI in enterprises. The concept of Democratizing GenAI signifies a transition from AI being exclusive to a select few to becoming a resource available to a broader audience, ushering in new opportunities for creativity, innovation, and problem-solving. By enabling a diverse range of users, including those without technical expertise, to access advanced AI tools, GenAI is poised to be a highly impactful trend in this decade. This shift holds the potential to significantly boost productivity, efficiency, and innovation [13-15].

Navigating the realm of democratizing Generative AI in various sectors demands careful consideration, prompting the essential question: "How can we adeptly empower enterprises, enhance productivity, and surmount challenges linked with widespread access to cutting-edge technologies of democratized GenAI?" As we delve into this exploration, dedicated researchers are committed to unraveling the transformative potential that technologies, spanning from language models to image-generating systems, hold for your business. The goal is to empower every individual, regardless of their role or proficiency level, with AI tools that dismantle barriers to innovation and efficiency. This vision aspires to cultivate a workplace where every employee has the opportunity to make meaningful contributions in novel and impactful ways. In this review, the researchers comprehensively explore and stand out from previous research efforts in the following ways: 1) Conduct a meticulous examination of the democratization of GenAI, assessing the transformative potential it holds in optimizing productivity within enterprises. Explore how making democratization Generative AI accessible to a broader audience can positively impact various aspects of business operations. 2) Concentrate on specific industries within enterprises and real-world application use cases, such as

manufacturing, finance, healthcare, and more, to explore how democratized GenAI strategies can contribute to enhancing productivity. 3) Provide a deeper exploration of the challenges faced by organizations in harnessing the power of this technology. 4) Delve into the future advancements and potential directions in the democratization of Generative AI. The research makes significant contributions to the democratization of GenAI in enterprise settings. Firstly, by ensuring that democratization GenAI tools are accessible to all, advocating for a user-centered strategy that encourages innovation and effectiveness in organizations. Secondly, the primary focus of the study is on the intersection of democratization GenAI with different enterprise domains, emphasizing how it can contribute to enhanced productivity and creativity. By exploring these connections, the researchers bridge the gap between theoretical frameworks and real-world applications, offering insights for industry practitioners and decision-makers. Finally, the researchers investigate the future pathways in making democratized GenAI more accessible, covering advancements in digital prototyping, improved encryption methods, and the encouragement of interdisciplinary perspectives for societal influence.

2. Related Work

Generative AI has made a significant impact globally, gaining momentum with the introduction of ChatGPT and swiftly followed by the development and launch of subsequent models like GPT-4 from OpenAI's competitors. Regardless of ethical and practical concerns raised by academics, the practical utility of GenAI in real-world applications is evident. Debating the potential influence of Generative AI has become less relevant, as its use has already found a solid footing in various domains[3, 16]. Built upon extensive pre-trained models containing billions of parameters, GenAI services aim to elevate knowledge and creative sectors that engage billions of individuals. Through the utilization of Generative AI, these domains can experience a minimum of 10% improvement in content creation efficiency, potentially resulting in the creation of trillions of dollars in economic value. GenAI/AIGC is versatile and applicable to diverse types of text generation, spanning from utilitarian uses like customer service exploration and messages to imaginative tasks such as action tracking and advertising copywriting [17]. As Generative AI becomes a widely used tool among competitors, the marginal benefits for each business decrease. As all market participants incorporate AI to streamline operations and improve their product offerings, the unique value that AI once offered when less common is significantly reduced. Nevertheless, the financial challenges of operating in an intensely competitive market affect an enterprise's ability to invest in Generative AI. With a continual focus on lowering prices to stay competitive, enterprises often operate with slim profit margins, limiting their capacity to make significant investments in new technologies. As a result, enterprises might opt for more budget-friendly, less advanced AI solutions that do not fully exploit the technology's potential

due to financial constraints. This cost-conscious approach to AI investment suggests that while enterprises may adopt Generative AI to some extent, their ability to fully leverage its comprehensive capabilities is restricted, potentially impeding the deep transformative effects that AI could otherwise have on growth and revenue [18, 19].

2.1. Generative AI Complexity

From a complexity standpoint, it can be generally asserted that GenAI is inherently more intricate than outdated AI. The intricacy stems mainly from the necessity to create fresh data that upholds statistical resemblances to the initial dataset, demanding a profound comprehension of the inherent formation and patterns within the data. The difficulties linked to GenAI encompass its early developmental phase, the lack of universally acknowledged standards, and the intricacies associated with assimilating it into determined organizational business operations and information systems. Consequently, a thorough examination of the complexity of this innovative technology becomes crucial to confirm that organizations have adequate human resources and financial to overcome potential challenges during the implementation phase [20, 21].

The complexity under consideration involves two vital elements: difficulties related to customization and the important expenses incurred. It is essential to customize GenAI systems to tailor them to particular work environments. The emphasis should be on improving the coordination between the backend system of Generative AI and the current IT systems, which include data assimilation and control. This aims to improve alignment and effectiveness [22]. The dimension of complexity is centered on the costs linked to both the initial investment and ongoing maintenance. Employing Generative AI comes with substantial expenses, encompassing skilled personnel and IT infrastructure, which can present difficulties in recouping. The lack of standardized practices for Generative AI further magnifies these costs. Consequently, organizations facing considerable technological complexity tend to approach the adoption and integration of Generative AI into their operations with greater caution. Hence, the subsequent hypothesis is proposed [23].

2.2. Domain and Technical Experts Limitation

Gen AI symbolizes a transformative innovation with the potential to significantly reshape an organization's strategic planning and operational processes [24]. However, achieving this transformation requires substantial IT and decision-making capabilities. Moreover, technologies that drive major advancements often necessitate considerable adjustments to an organization's guidelines, organizations, and practices. Implementing Gen AI requires organizational and procedural changes. However, not all companies possess the necessary decision-making abilities and expertise in modification management to cope with these adjustments effectively. Adopting GenAI involves restructuring and updating organizational approaches, as well as gaining new skills

essential for leveraging innovation. Thus, it is important to assess how these changes impact the ability to handle organizational adjustment to facilitate GenAI integration [23, 24].

3. Conceptualization of Democratized GenAI

Delve into the transformative possibilities of democratized GenAI as it becomes universally accessible, reshaping the future landscape of jobs and workflows. Envision manufacturing plants operated by intelligent GenAI systems, seamlessly designing and producing innovative products based on historical data and market trends. The benefits are clear – heightened efficiency, reduced waste, and the agility to respond swiftly to shifting consumer demands [25, 26]. In the healthcare realm, the democratization of GenAI holds the potential to revolutionize diagnosis and treatment. Envision a world where AI swiftly analyzes patient data, generates potential diagnoses, and suggests treatment plans within seconds. This promises more accurate personalized healthcare, allowing them to allocate more time to their patients [27]. Education stands on the brink of disruption as well. GenAI democratization could tailor learning materials for each student, adapting to individual learning styles for more effective personalized education. Beyond job displacement, concerns about data security and privacy in GenAI systems loom [28]. Moreover, with the ascent of democratized GenAI, there will be a shift in the demand for skills. Roles involving the creation, management, and maintenance of AI systems will surge, necessitating human oversight for the accountable utilization of AI [29].

In achieving balance, embracing the potential of democratizing GenAI while mitigating risks is essential. As democratized GenAI promises to revolutionize our world, challenges emerge. How do we prepare for this AI-dominated future? This evolving landscape signifies a transformation where repetitive tasks are automated, and the human element of work evolves. Instead of fearing this shift, we should embrace and prepare for it, discovering opportunities to thrive. In the current era dominated by the democratization of GenAI, adaptability and continuous learning have become crucial for staying relevant and competitive. Amid the GenAI revolution, the ability to adapt and acquire new skills emerges as our greatest asset, opening up opportunities for individuals from diverse backgrounds to harness AI for creative pursuits and data analysis. This stands in contrast to the historical confinement of AI technologies to experts and technically proficient individuals. [15, 30].

3.1. Democratized GenAI's Sector-Specific Impact

The increased availability of user-friendly AI tools and platforms has significantly diminished entry barriers. Consequently, individuals with limited coding experience can now easily access and employ AI-powered tools for creative pursuits and data analysis. Democratization facilitates individuals from fields like arts, journalism, marketing, and

others to apply AI algorithms and models, enhancing their work and extracting valuable insights from their data [31, 32]. This paradigm shift empowers individuals to unlock AI's potential, irrespective of their technical expertise, fostering inclusivity and innovation in AI-driven creative industries and data analysis. Exploring the widespread influence of democratized GenAI across different sectors unveils a complex terrain with unique consequences. This examination will investigate the specific impacts on sectors like SORA, healthcare, manufacturing, and hyper-personalization. Grasping these sector-specific intricacies is vital for a comprehensive understanding of how democratized GenAI is restructuring various industries and shaping the overall societal landscape [33, 34].

4. SORA: Transforming Text into Astonishing Videos

Sora is an advanced AI model that can create videos up to one minute in length, featuring detailed scenes, intricate camera movements, and expressive characters. It can generate videos based on a single image or extend existing footage by adding new content. OpenAI, an innovative AI startup, has introduced Sora as a revolutionary text-to-video model with the potential to redefine Generative AI [35].

The race in Generative AI has shifted towards text-to-video, with OpenAI [36], Google, Microsoft, and other companies competing for leadership in a market projected to generate $1.3 trillion in revenue by 2032. OpenAI's SORA, following in the footsteps of ChatGPT and Dall-E2 [37], aims to attract consumers intrigued by Generative AI. Sora demonstrates the ability to create intricate scenes with multiple characters and accurate details, understanding not only the user's prompt but also how those elements occur in the real world.

However, OpenAI acknowledges that Sora has limitations, such as struggling to depict the physics of complex scenes accurately and understand cause and effect. OpenAI plans to make SORA available for "red teamers," specialists in fields such as misinformation, harmful content, and bias, to carry out adversarial testing. The model will also seek feedback from visual artists, designers, and filmmakers. Adversarial testing is crucial to address concerns about the potential for realistic deepfakes, a significant issue in AI-generated images and videos [35, 38].

On the one hand, SORA OpenAI empowers video creators by allowing them to produce engaging one-minute videos using straightforward descriptive prompts. This innovation enables individuals such as visual artists, designers, and filmmakers to easily transform their creative visions into reality without requiring advanced technical skills. SORA's capabilities facilitate the seamless development of detailed scenes, intricate character interactions, and dynamic environments, broadening the horizons of creative expression. Its user-friendly design not only streamlines the video creation process but also fosters collaboration and storytelling exploration, making it a valuable resource for those looking to translate their ideas into visually striking content efficiently.

5. Energy Utilities

The energy sector is at a pivotal moment in integrating technological advancements, with democratizing GenAI emerging as a key driver of change. Although traditionally cautious about adopting new technologies because of regulatory limitations and the critical nature of their services, there is a rising acknowledgement of GenAI's potential benefits. A comprehensive survey by the Capgemini Research Institute, which interviewed administrators from over one thousand global companies, assessed the integration of GenAI into their operations. The results show that the Energy and Utilities sector lags behind in adopting democratizing GenAI, with 33% of respondents engaged in GenAI pilot projects, compared to the industry average of 41 percent [39, 40]. Exelon Corporation provides a notable example of democratizing GenAI adoption by using it to improve maintenance procedures for its energy architecture. The organization works on synthetic information generation to automate inspections with drones, creating realistic but artificial images of infrastructure for training AI models. By utilizing these AI systems, infrastructure deterioration is detected and evaluated more skillfully, improving inspection procedures and lowering the demand for manual labor [40].

The democratization of GenAI is set to empower a wide range of stakeholders, including both small-scale enterprises and large corporations, enabling them to leverage GenAI's capabilities for optimizing energy production, distribution, and utility operations. This broader accessibility to advanced AI tools is anticipated to elevate decision-making processes, enhance resource allocation efficiency, and foster the development of more sustainable and resilient energy systems. In this sector, the democratization of GenAI has the potential to unlock inventive solutions, expedite technological progress, and play a pivotal role in reshaping the overall energy and utilities landscape [41-43].

6. Manufacture

The integration of GenAI in manufacturing marks a new era in cognitive automation. GenAI's proficiency in natural language enables it to interpret complex data, analyze contexts, and make informed decisions. This enhances production workflows, quality control, and adaptive manufacturing. Collaboration between humans and GenAI improves decision-making, reducing errors and boosting efficiency in intelligent manufacturing. GenAI, as a conversational agent, fosters unique human-machine interaction, facilitating communication and stimulating creativity in product design, process optimization, and problem-solving through natural language interfaces. GenAI's

predictive abilities extend to maintenance and fault detection by analyzing historical data and real-time inputs. This minimizes downtime, ensuring machinery longevity for a sustainable and cost-effective manufacturing ecosystem [44]. In modern supply chains, GenAI's natural language processing aids in optimizing solutions, navigating complexities from demand forecasting to inventory management, making data-driven decisions, and streamlining operations to minimize inefficiencies [45, 46]. Major corporations possess dedicated development teams and the financial capacity to incorporate advanced technologies. According to the International Federation for Robotics, global robot sales have surged by 15% to 253,748 units, marking the highest annual record [47, 48]. However, Small and Medium Enterprises (SMEs), despite constituting a larger percentage than their larger counterparts, have not embraced these cutting-edge manufacturing technologies to the same extent. To prevent SMEs from becoming casualties of Industry 4.0, it is crucial to democratize the utilization of robotics. Democratizing technology involves rapidly providing more people with access to technological advancements. One strategy to address this issue is to simplify the integration of robotics by developing cost-effective and customizable robots suitable for easy implementation by small to medium enterprises. Given the low inclination of SMEs to invest in Industry 4.0 technologies, offering more affordable robots could potentially boost their adoption. Additionally, ensuring that robots are easy to connect and train would alleviate any reservations SMEs may have regarding the use and implementation of robotics [49]. By combining these approaches and offering a single robot platform that can be tailored to the diverse needs of SMEs, the adoption of robotics and Industry 4.0 technologies is likely to increase [50, 51]. As democratized GenAI becomes more accessible, manufacturers of various sizes can utilize its capacities to improve production workflows, elevate decision-making, and encourage innovation. This broad accessibility enables a wider array of industry participants to incorporate it into their activities, resulting in heightened efficiency, decreased errors, and enhanced product quality. Through a more comprehensive adoption of democratized GenAI tools, manufacturers can simplify processes, promote collaborative interaction between humans and machines, and ultimately propel progress in intelligent manufacturing on a broader scale.

7. Predictive Maintenance

ML and AI plays a crucial role in various applications, such as predicting cancer risk [52], voter profiling [53], driver behavior [54], and personalized content recommendations [55]. In complex manufacturing, ML and AI utilizes predictive analysis with pre-trained algorithms to process and control manufacturing data. These AI techniques enable the extraction of valuable information, automatically adapting to changes based on historical experience. The capacity to process high-dimensional data, decrease complexity, and recognize process relations is emphasized for their application in the

manufacturing industry. This intelligent approach helps forecast manufacturing outcomes, reduce production line variation, and enhance productivity and product quality. Ultimately, AI-informed decision-making promotes sustainable practices in manufacturing by improving efficiency, reducing waste, and enabling predictive maintenance [56]. Moreover, increased accessibility of Generative AI through democratization empowers businesses of all sizes to employ its capabilities for advanced predictive maintenance strategies. GenAI, through the analysis of historical data and real-time sensor inputs, improves the accuracy of predicting potential equipment failures. This proactive approach enables businesses to schedule maintenance with precision, reducing unplanned downtime and optimizing the lifespan of machinery [54, 57]. The democratization of Generative AI broadens the advantages of predictive maintenance across various industries, encouraging the adoption of cost-effective and efficient maintenance practices. Additionally, the widespread availability of user-friendly predictive maintenance solutions, facilitated by the democratization of GenAI, allows businesses lacking extensive technical expertise to easily implement and benefit from these tools. This democratized access empowers enterprises to shift from reactive to proactive maintenance, thereby enhancing overall operational efficiency and contributing to a more sustainable and resilient business environment.

8. Trillion-Dollar Opportunity for Machine Customers

In a world where machines play the role of customers, the dynamics of marketing and sales are poised for a significant transformation driven by advancements in data science. Conventional practices such as entertaining clients or relying on traditional advertising methods become outdated, given that machines lack the ability for personal interactions or susceptibility to standard promotional approaches. Nevertheless, this shift presents an immense opportunity for market expansion. The sales process is expected to shift predominantly towards programmatic and automated systems. However, human salespeople will retain their significance, particularly in B2B and large accounts where a profound understanding of human customers remains essential. Success in this evolving landscape requires sales strategies to adapt by scrutinizing machine behavior, identifying patterns, and capitalizing on insights derived from data [58, 59].

Unlike their human counterparts, machine customers operate on the basis of rules and logic, devoid of emotional influences. This logical orientation renders them more dependable and inclined toward making efficient purchases. Such efficiency is evident in preferences for smaller product sizes, substitutable items with lower shipping costs, or value-added products that may entail initial expenses but prove cost-effective in the long term. The sheer scale emphasizes the vastness of this opportunity, as machine customers present a

potential multitrillion-dollar market. The impact is on the horizon, with projections indicating a conservative estimate of at least 15 billion connected products assuming the role of customers by 2025 [60, 61]. Democratizing Generative AI transforms how Machine Customers function, enhancing interactions and efficiency. Widely accessible, it enables businesses to utilize advanced algorithms, analyzing extensive data for valuable insights into machine behavior [62]. This accessibility empowers organizations to finely customize products for machine customers, optimizing decision-making with logic and rules while facilitating personalized purchasing experiences through smaller sizes, substitutable items, lower shipping costs, and strategic recommendations. Its broad accessibility fosters collective contributions to innovative solutions, creating a dynamic ecosystem that adapts to the evolving demands of the expanding machine customer market.

9. Interpreting Radiological Reports

AI progress drives efforts to democratize Generative AI, expanding its advantages beyond a privileged minority. This involves creating user-friendly interfaces, offering educational resources, and establishing affordable platforms for diverse stakeholders, including healthcare professionals, researchers, and patients. In healthcare, the use of models, such as those in Ophthalmology and radiology, leads to transformative changes, empowering medical practitioners, researchers, and patients [63, 64]. The adoption of LLMs in healthcare, especially with the release of GPT-4 in March 2023, has generated considerable interest due to its wide range of applications. These include assisting with clinical documentation, finding insurance pre-authorization, summing up research papers, and functioning as a patient-facing chatbot. Gen AI models, powered by vast amounts of medical data and expertise, have the potential to revolutionize many aspects of the healthcare sector and usher in a new era of data management, patient communication, and clinical decision support. There is hope that they can change healthcare practices because of their aptitude for deciphering and analyzing complex medical data [65].

In the realm of clinical decision support, these models can aid healthcare professionals in optimizing decision-making by analyzing vast medical datasets. This leads to enhanced patient results and whole healthcare service quality. For instance, they can improve disease diagnosis and prognosis, allowing for earlier detection and tailored treatment approaches. Additionally, advanced tools like GPT models can help radiologists interpret medical images, enhance diagnostic accuracy, and reduce interpretation time. Generative AI models have the potential to transform drug discovery by predicting more effective and safer candidates, thereby speeding up the creation of new therapies [27]. Within healthcare, democratized Generative AI has significant potential. Accessible tools in clinical decision support aid healthcare professionals in analyzing complex medical data,

improving diagnosis, treatment planning, and personalized patient care. The technology's insight extraction from vast datasets also streamlines administrative tasks like Electronic Health Record (EHR) management, allowing more focus on direct patient care [63, 66]. Democratized Generative AI enhances patient engagement by providing interactive health information, promoting better understanding and adherence to medical recommendations. In research, it accelerates drug discovery and contributes to innovative treatments.

10. 5G and B5G Technology

With the escalating complexity and multidimensionality of 5G and B5G networks, the adoption of analogous levels of connectivity is observed as a trend, leading to disaggregated operations. In this scenario, a base station is distributed across distinct physical network elements, resulting in an increasing number of services and network slices to manage. The heightened complexity makes conventional approaches to network planning outdated, necessitating their replacement with automated methods. AI/ML technologies can play a pivotal role in guiding planning decisions in this evolving landscape. The heterogeneity of devices and applications heightens the complication of managing architecture. For instance, IoT devices require low-power connectivity, high-speed mobile connections are essential for fast-moving trains, home users demand broadband connectivity akin to fiber, and Industry 4.0 devices necessitate ultra-reliable low-latency services. Various technologies, such as Multiple-Input Multiple-Output (MIMO), antenna beamforming, Virtualized Network Functions (VNFs), and customized network slices, have been proposed to address these challenges [67]. Moreover, data-driven solutions can be employed for 5G infrastructure management. Analyzing dynamic mobile traffic, for example, facilitates predicting user locations, benefiting handover mechanisms. Another approach involves assessing historical physical station data to forecast complex passage state information. Additionally, allocating network slices based on user requirements, considering network status and available resources, is another data-driven strategy.

These solutions rely on data analysis, incorporating historical data to predict behavior or current environmental data to aid decision-making processes. Generative AI and machine learning techniques can effectively address such challenges [68, 69]. Focus is directed towards tools capable of autonomously examining the network's status and triggering alarms as needed. The contributions are categorized into solutions for forecasting network characteristics, methods for precise user localizations, and identification and prediction of security incidents. Methods discussed for forecasting network characteristics include the application of AI/ML in high-resolution synthesis and efficient prediction of mobile traffic, QoE inference [70], QoS improvement [71] through forecasting techniques, SLA prediction in multi-tenant environments, and recognition and prediction of complex events.
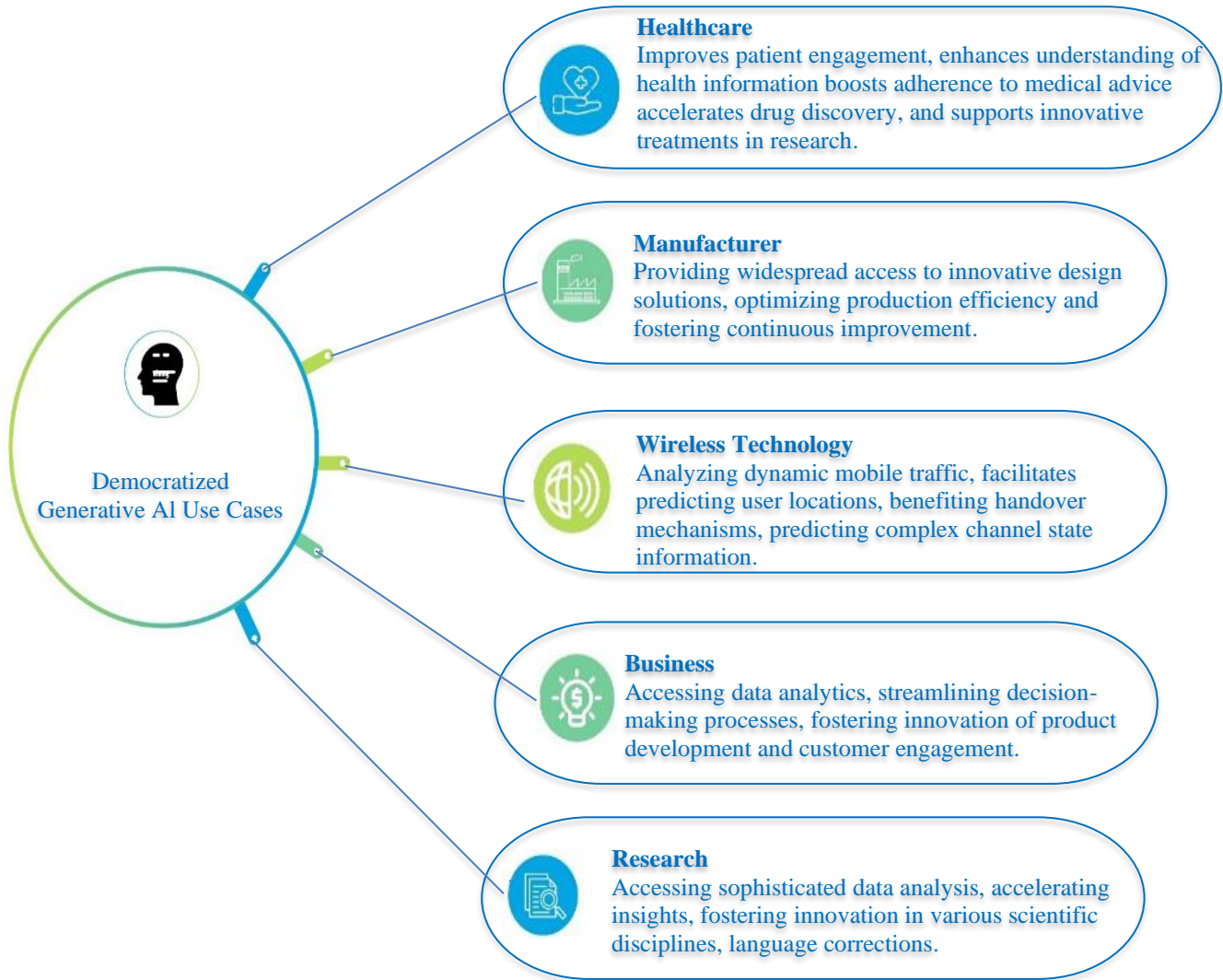
Healthcare
Improves patient engagement, enhances understanding of health information boosts adherence to medical advice accelerates drug discovery, and supports innovative treatments in research.

Manufacturer
Providing widespread access to innovative design solutions, optimizing production efficiency and fostering continuous improvement.

Democratized
Generative AI Use Cases

Wireless Technology
Analyzing dynamic mobile traffic, facilitates predicting user locations, benefiting handover mechanisms, predicting complex channel state information.

Business
Accessing data analytics, streamlining decision-making processes, fostering innovation of product development and customer engagement.

Research
Accessing sophisticated data analysis, accelerating insights, fostering innovation in various scientific disciplines, language corrections.

Fig. 1 Depicts a variety of use cases for democratized GenAI in sectors

For high-precision user localization, introduced methods involve AI-assisted sensor fusion, line-of-sight (LoS)/Non-Line-of-Sight (NLoS) discrimination [72], and 5G localization based on soft information and sequential autoencoding. Finally, when predicting security incidents, the focus includes a brief review of machine learning-based network traffic analysis and the real-time detection of Distributed Denial-of-Service (DDoS) attacks, preceded by a brief overview of contemporary attacks in mobile networks [69]. Figure 1 outlines a variety of applications for democratized GenAI in sectors like healthcare, manufacturing, wireless technology, and research, highlighting its adaptability across diverse industries.

11. Empowering Enterprise Productivity

The impact of the industrial and digital revolutions on society, daily life, business, and employment is unmistakable. Just as past innovations have brought sweeping changes, similar shifts are anticipated to affect every aspect of life.

Additionally, businesses and employment will face considerable transformations, with organizations becoming more interconnected through data analysis, leveraging "big" data, and experiencing increased global competition. The widespread use of AI inventions, such as democratized GenAI, is predicted to enable people to purchase goods and access services globally through the Internet, unlocking additional benefits and opportunities [73, 74].

11.1. Accessible to Non-Experts

The scarcity of proficient AI engineers or data scientists is frequently cited as a significant impediment to the widespread adoption of big data and AI. However, an increasing array of tools is enabling non-experts to harness these capabilities, yielding both positive and negative outcomes [75, 76]. By pulling to pieces the barriers separating technical experts and domain specialists, the democratization of Generative AI confirms that individuals from various roles and backgrounds can effectively utilize AI tools for creative

and strategic purposes. This inclusivity stimulates innovation within enterprises, as diverse teams collaborate seamlessly, bringing distinct perspectives to the advancement and implementation of Generative AI solutions. Moreover, the democratization of Generative AI cultivates a culture of incessant learning, allowing employees to improve their skills and adapt to the evolving AI landscape, thereby enhancing organizational agility and competitiveness [1, 77]. This democratization also improves decision-making processes within enterprises by granting a broader user base access to Generative AI tools, facilitating faster and more informed decisions across diverse business functions. Whether applied in product design, marketing strategies, or customer interactions, democratized Generative AI empowers enterprises to fully leverage AI, optimizing workflows, identifying patterns, and extracting valuable insights. This inclusive approach not only accelerates innovation but also ensures widespread distribution of the benefits of Generative AI, contributing to a more dynamic and responsive business ecosystem [9, 78]. Furthermore, the importance of accessibility not only authorizes individuals lacking a technical related but also cultivates a more inclusive and collaborative atmosphere within organizations. As AI becomes progressively user-friendly and approachable, teams gain advantages from a wider spectrum of perspectives, skills, and insights. This inclusivity not only democratizes the application of AI but also amplifies innovation by allowing a diverse workforce to actively participate in the creation and employment of AI solutions. In the end, facilitating AI accessibility for non-experts contributes to a more democratized and dynamic landscape where a broader range of individuals and industries can tap into the transformative potential of artificial intelligence [79, 80]. As per Gartner's report, the prevalent adoption of Democratization GenAI has the potential to foster a more inclusive workforce, embracing individuals from various age brackets, diverse educational and ethnic backgrounds, and those with neurodivergent characteristics. It is projected that by the year 2027, a quarter of Fortune 500 companies will actively seek out neurodiverse talent as part of their strategy to enhance overall business performance [60].

11.2. Hyper-Personalization

Modern omnichannel business strategies involve both physical and digital channels engaging with customers. Achieving hyper-personalization depends on the organization's ability to collect and utilize customer data to create tailored experiences. Thus, implementing a hyper-personalization strategy is prioritized to enhance personalized experiences for a broader customer base [81]. The idea of hyper-personalization in democratized Generative AI leverages the accessibility of Generative AI to create highly customized experiences. Unlike traditional methods, hyper-personalization utilizes real-time insights from Generative AI to understand individual preferences, behaviors, and context, resulting in personalized content and services. The

affordability of Generative AI tools allows individuals and smaller businesses to break barriers and innovate, enabling them to tailor marketing, design custom products, and provide personalized recommendations. This democratization empowers a diverse range of creators to use AI creatively. For enterprises, hyper-personalization becomes a transformative force, reshaping customer engagement and operational strategies [19, 20]. The widespread availability of GenAI tools enables enterprises to use advanced algorithms for deep insights into individual preferences, creating hyper-personalized experiences in various areas like marketing messages and customer interactions. Democratized Generative AI levels the playing domain for enterprises of all sizes, enabling them to benefit from hyper-personalization without extensive resources [82]. This strategic tool enhances customer satisfaction, loyalty, and internal optimization, allowing enterprises to stay competitive and responsive in a rapidly evolving business landscape.

11.3. Automating Repetitive Tasks

A key aspect of Gen AI, such as NLP, is its ability to tackle issues in a way that is understandable to non-experts. The main goal is to enhance knowledge and create new communication pathways between experts and the public, fostering non-expert involvement in the development of NLP technology. This participation can be facilitated through open-source projects involving language resources, such as software tools and datasets. Examples from diverse communities demonstrate the significant benefits of open projects that welcome contributions from enthusiastic participants, not limited to software development [83]. Moreover, Patent documents offer comprehensive details on the technology and the exclusive rights bestowed upon the patent holder. The richness of technical information within patent claims necessitates careful analysis for effective research and development (R&D) management and technology economic evaluation. Many organizations and research institutions conduct their own expert-driven patent reviews to collect, analyze, and synthesize technology-related information. The escalating number of patent documents, driven by the accelerated pace of technology development and societal changes, has become exponential. Improvements in NLP, text mining, and DL have significantly boosted the performance summarization models of text across different forms of documents. Notably, deep learning-based models, including those employing Generative Adversarial Networks, have demonstrated remarkable performance improvements in this context [84]. In automating repetitive tasks, democratized Generative AI has revolutionized business operations by leading to increased efficiency and productivity. Particularly in email communication, these AI systems excel at generating relevant and coherent responses, saving employees significant time previously spent crafting emails. The widespread access to Generative AI allows individuals across organizational levels to leverage advanced language models, enhancing communication processes. Additionally, routine tasks like

data entry, report generation, and documentation can be automated, enabling human resources to focus on more creative and strategic aspects of their responsibilities. Another significant application lies in document summarization, where Generative AI models analyze and condense extensive texts, providing concise summaries that enhance decision-making and streamline information dissemination within teams. Overall, democratized Generative AI proves to be a valuable asset for enterprises seeking to optimize workflows, reduce manual efforts, and improve operational efficiency amid the challenge of information overload.

11.4. The Rise of No-Code AI

The use of software development tools requiring minimal coding skills, known as no-code software, has seen significant growth in the past decade. Advances in Artificial Intelligence (AI), particularly in ML and DL, have been rapid. The increased processing power of digital technology, along with the abundance of available data, has paved the way for widespread AI adoption across various domains. Organizations are increasingly leveraging AI technologies capable of processing vast amounts of data, acquiring knowledge, and functioning autonomously [14]. ML, a branch of AI, involves using statistical models and algorithms to detect complicated patterns in data. ML has shown considerable value in organizational contexts. A new generation of digital environments incorporating human-AI hybrid systems is emerging. No-code AI platforms are essential for making AI accessible and cost-effective for organizations without extensive coding knowledge. These platforms assist users in creating and implementing AI models without needing a deep grasp of intricate algorithms. Furthermore, many of these platforms are cloud-based, which reduces issues related to installation, maintenance, and management [85, 86]. Major tech companies like Microsoft, IBM, Google, and Amazon at first provided AI capabilities as a service, a trend quickly adopted by smaller companies, resulting in a variety of available solutions for AI service [87, 88]. The democratization of Generative AI is essential for the growth of no-code in AI, enabling a diverse range of professionals with limited coding skills to develop and implement AI solutions. No-code platforms streamline AI development through generative models intuitive interfaces, and fostering collaboration among cross-functional teams. This democratization reduces entry barriers, broadening AI access and fostering inclusivity, ultimately contributing to a more innovative and diverse landscape.

11.5. Swift Product Innovation

During the early phases of innovative projects, organizations aim to comprehend the context in which they plan to innovate. This involves obtaining essential insights, such as gaining a profound understanding of clients, technologies, and regulatory influences, to recognize possible opportunities and challenges. ChatGPT can aid innovation teams in explor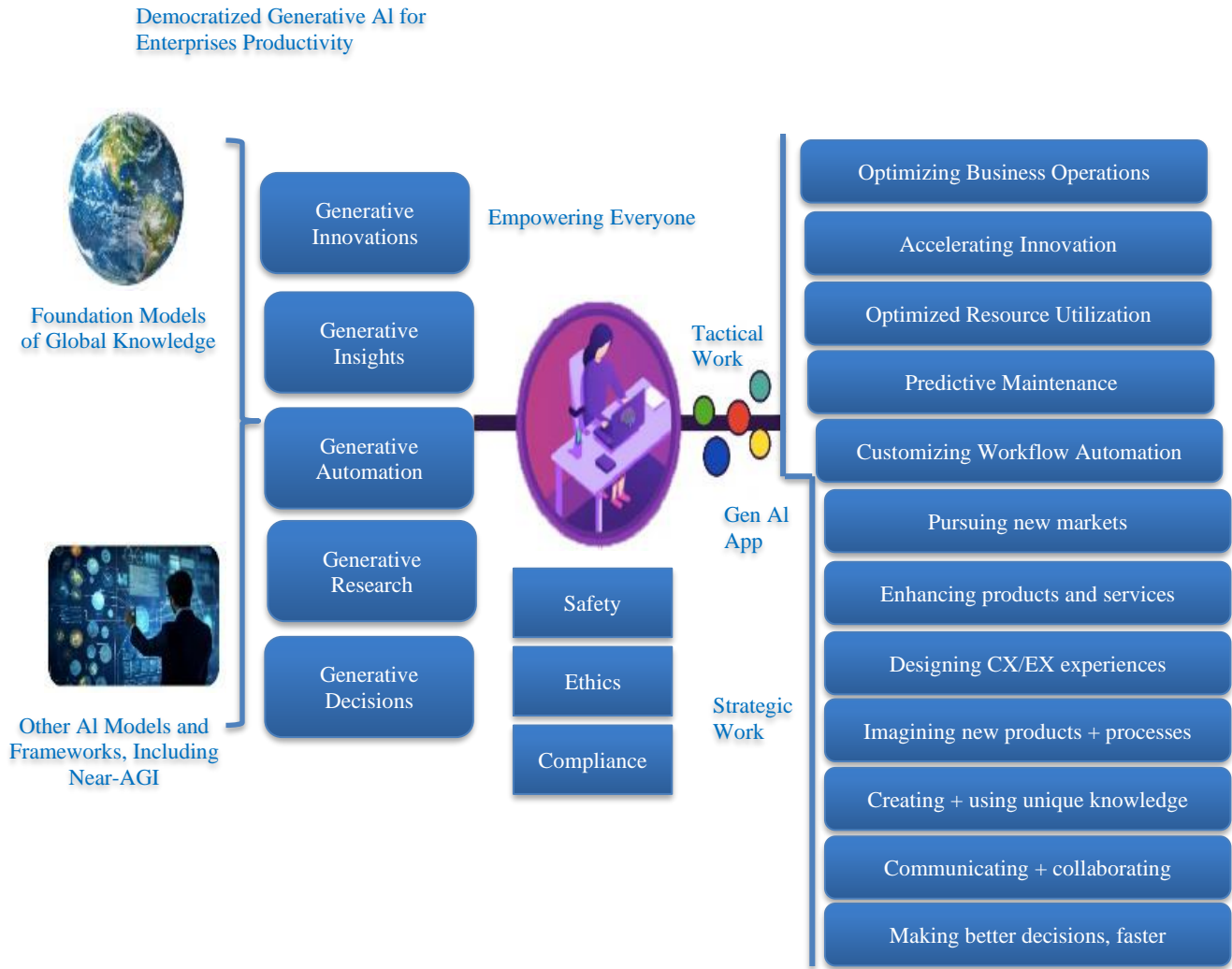ing the user perspective by offering information on significant challenges or user needs in specific scenarios or when utilizing particular products [15]. Furthermore, GenAI models, which generally utilize neural networks, apply methods such as variational autoencoders, GAN, and autoregressive models to produce new data that replicates the content, style, or context of their training information. These models find extensive use in creative domains like art, music, fashion, and product design, as well as in NLP, to create realistic and reasonable text depending on given prompts. Unlike traditional AI models that rely on supervised learning with labeled data, GenAI models often use unsupervised learning, allowing them to extract meaningful features without direct oversight. Organizations with strong management and advanced IT skills are better positioned to harness active technologies like Gen AI, providing them with a competitive advantage [23, 89]. The inclusivity of democratized Generative AI capabilities empowers a varied group of individuals, spanning from developers to non-technical stakeholders, to tap into the creative potential of generative models. Consequently, the traditionally intricate process of incorporating AI into product development becomes more efficient, facilitating faster iterations and experimentation. This breaks barriers, promotes collaboration and diverse perspectives, accelerates innovation in product development, and ensures shared benefits across departments, fostering a dynamic environment for sustained enterprise growth. Figure 2 illustrates how democratized GenAI suggestively transforms enterprise productivity by indicating the incorporation of user-friendly AI tools across diverse sectors, leading to more efficient and innovative workflows.

12. Unresolved Research Challenges and Concerns

AI has replaced traditional rule-based approaches in cybersecurity, enhancing both defenders' and attackers' capabilities. Democratized GenAI tools benefit cyber defenders by leveraging vast threat intelligence data for insights, automated incident response, and security awareness training. However, there is a risk of misuse, as cyber offenders can exploit it to perform sophisticated attacks, creating convincing social engineering, phishing, and malware [25].

12.1. Privacy

Privacy concerns arise from the use of generative data, as it has the potential to emulate the distribution of sensitive content. This emulation may lead to the recreation of sensitive training data in specific situations, posing a potential threat to privacy. The impact of generative data on the privacy of actual data can be both positive and negative. A significant amount of real data is employed in training AIGC models, which may result in these models memorizing the training data. Consequently, under certain conditions, generative data could reproduce sensitive information, leading to a breach of privacy in the context of AIGC. For example, generating a face image of a famous person using a prompt that closely resembles the training sample could easily violate privacy [90].

Democratized Generative Al for
Enterprises Productivity

Foundation Models
of Global Knowledge

Generative
Innovations

Empowering Everyone

Generative
Insights

Generative
Automation

Generative
Research

Other Al Models and
Frameworks, Including
Near-AGI

Generative
Decisions

Tactical
Work

Gen Al
App

Safety

Ethics

Strategic
Work

Compliance

Optimizing Business Operations

Accelerating Innovation

Optimized Resource Utilization

Predictive Maintenance

Customizing Workflow Automation

Pursuing new markets

Enhancing products and services

Designing CX/EX experiences

Imagining new products + processes

Creating + using unique knowledge

Communicating + collaborating

Making better decisions, faster

Fig. 2 How democratized GenAI transforms enterprise productivity

With the widespread integration of democratized GenAI tools in industry sectors, like healthcare, where personalized data plays a vital role in research and development, the democratization of Generative AI may unintentionally result in the production of synthetic data closely resembling confidential patient information. Such breaches of privacy within professional settings carry significant consequences in terms of legal, ethical, and reputational ramifications.

On an individual level, the utilization of democratized GenAI tools poses privacy threats, as people may discover their images, voices, or personal data undergoing manipulation without their consent. The application of deepfake technology, which exploits Generative AI, enables the creation of realistic simulations portraying individuals engaging in actions or uttering statements they never actually did. This capability can be exploited for malicious purposes, including disseminating false information, tarnishing reputations, or perpetrating identity theft [30].

12.2. Dynamic Nature of Threats

The ever-changing landscape of cyber threats demands continuous adaptation in threat recognition approaches. This dynamic environment frequently needs manual involvement, impacting the efficiency of these systems. Key concerns include unauthorized manipulation of sensitive data, the creation of realistic deepfakes for identity deception, and the potential generation of deceptive content. The widespread availability of Gen AI poses a risk of developing advanced cyber threats, underscoring the need for security measures to evolve in response to potential vulnerabilities. Balancing accessibility and security is crucial to mitigating the risks associated with the democratization of Generative AI and promoting responsible usage across different domains [91]. Another difficulty lies in the realm of secure learning, particularly when discriminative models are trained in real-time through online learning methods such as Reinforcement Learning (RL) and Active Learning (AL) [92, 93]. Unlike the traditional method of pre-observing data, constructing a

dataset, and training the model with the dataset, online learning involves sequential training as data becomes available. However, this approach can lead to inaccurate predictions, potentially causing adverse effects on network operations. Democratized GenAI enables the generation of deceptive content, such as convincing emails, messages, or websites, creating highly realistic social engineering strategies, phishing attempts, and malware that mimic genuine communication and interfaces, posing a significant challenge for individuals and security systems to differentiate between authentic and malicious communications. This advanced capability enhances hackers' ability to exploit human vulnerabilities, thereby increasing the success of their attacks [94, 95].

12.3. Explainability

In the last ten years, AI has advanced considerably, with algorithms increasingly used to tackle diverse issues. However, this progress has resulted in more complex and less transparent AI models. To address this challenge, Explainable AI (XAI) has been built to improve the transparency of AI, especially in crucial areas [96]. A recurring concern regarding AI algorithms is their lack of explainability, meaning there is insufficient information about how the algorithm reaches its conclusions.

This lack of transparency poses several challenges. Firstly, it can be challenging for users to interpret and comprehend the output. Identifying potential errors in the output may also be difficult for users. Moreover, when the interpretation and assessment of the output are not accessible, users may struggle to trust the system and its responses or recommendations. Additionally, from a legal and regulatory standpoint, it becomes challenging for regulatory bodies to determine whether the Generative AI system may be inherently unfair or biased [97].

12.4. Over-Reliance

The apparent ease of use and capability of ChatGPT may lead users to rely excessively on it, placing trust in the responses it generates. Unlike traditional search engines that present multiple information sources, ChatGPT provides specific answers for each query. While using ChatGPT can enhance efficiency by saving time and effort, there is a risk that users may adopt answers without thoughtful consideration or verification.

Dependence on Generative AI technology has the potential to hinder skills such as creativity, critical thinking, and problem-solving, contributing to human automation bias as users habitually accept Generative AI recommendations [98, 99]. Therefore, all users must possess AI literacy. Blindly trusting Generative AI responses is discouraged, and users are advised to undergo verification procedures before accepting them [97]. Extreme dependence may deter the cultivation of human judgment and creativity, impeding the development of critical thinking skills. This over-dependence, particularly in critical domains like decision-making and content generation, can result in unintended consequences, ethical challenges, and a diminishing sense of accountability when unquestioningly trusting automated systems.

12.5. Deepfake Technology

Deepfakes, a portmanteau of "deep learning" and "fake," are highly realistic videos manipulated through digital means to portray individuals engaging in actions and utterances that never occurred. The process entails training a deep learning (DL) algorithm by inputting footage of two individuals, facilitating the swapping of faces.

The technology utilizes facial mapping and AI to substitute one person's face with another in a video. First gaining prominence in 2017 with explicit videos of celebrities posted on Reddit, deepfakes present a challenge for detection as they utilize authentic footage, incorporate convincing audio, and spread rapidly on social media. Exploiting the susceptibility of social media to rumours and misinformation, deepfakes thrive in an environment where trust in information is eroding. The ease of access to affordable hardware and open-source software has democratized the creation of deepfakes, allowing even individuals with limited technical skills to produce realistic forgeries [100, 101]. The underlying technology, Gen Adversarial Networks (GANs), lie in two neural nets—the discriminator and the generator—working together to produce realistic media [102, 103]. With the growing sophistication and availability of deepfake technology, the democratization of AI tools empowers individuals with limited technical skills to generate compelling yet deceptive content. This not only sparks concern regarding the potential misuse of AI-generated media for spreading misinformation but also emphasizes the necessity for improved safeguards and detection methods within the broader scope of democratized GenAI. The effortless production and dissemination of deepfakes may present challenges related to trust and authenticity in AI-generated content, underscoring the rank of striking a delicate steadiness between accessibility and responsible utilization within the democratized GenAI framework.

13. Discussions and Future Research

Our review of the democratization of GenAI underscores its potential to enhance enterprise productivity by empowering a broader user base. As this democratization becomes more accessible, businesses can automate tasks, driving innovation and efficiency. This inclusive approach enables employees from diverse fields to leverage AI in creative processes, content generation, and problem-solving, unlocking new avenues for productivity. Describing the importance of democratized GenAI for the enterprise before 2026, over 80% of businesses are expected to utilize Generative AI APIs and models or implement applications powered by GenAI in production settings, a substantial increase from the less than

5% observed in 2023 [60]. Moreover, revolutionization video creation by SORA OpenAI provides simple prompts that empower creators to craft compelling one-minute videos effortlessly. This innovation caters to diverse individuals, including visual artists, designers, and filmmakers, enabling them to actualize their creative ideas without extensive technical expertise. Its intuitive interface not only simplifies the video-making process but also encourages collaboration and narrative exploration, making it an invaluable tool for efficiently translating ideas into visually captivating content. However, challenges such as ensuring ethical use, addressing algorithmic biases, managing security concerns, and reducing over-reliance emerge. Achieving a balance between opportunities and responsible implementation is crucial for realizing the genuine potential of democratized Generative AI in enterprise productivity. While AI can automate tasks, uniquely human skills such as creativity, critical thinking, and emotional intelligence become even more crucial. Critical thinking [104] involves assessing, questioning, and making connections between disparate information – a skill AI cannot replicate. Creativity [105], the ability to imagine and create, is distinctly human, as is emotional intelligence – understanding, interpreting, and responding to the emotions of others. These skills set us apart in the AI era, making us not just employable but invaluable. However, they require constant development and refinement, emphasizing the importance of lifelong learning. In the face of the AI revolution, our ability to adapt and acquire new skills will be our greatest asset. Future directions for Generative AI democratization should concentrate on overcoming challenges, enhancing AI-enhanced digital prototyping, strengthening encryption and authentication methods, and fostering interdisciplinary insights for societal impact. By tackling obstacles and emphasizing accessibility and education, the future of democratized Gen AI promises to transform enterprise productivity responsibly and inclusively.

13.1. Strengthened Encryption and Authentication Methods

Within the domain of encryption and authentication, Large Language Models (LLMs) can assist in crafting advanced protocols designed specifically to accommodate the distinctive limitations of IoT devices. For instance, an LLM can refine lightweight encryption algorithms suitable for energy-efficient IoT sensors, guaranteeing secure data transmission while minimizing the strain on the device's constrained resources [91]. The increased availability of advanced AI tools is likely to bring diverse perspectives to cryptographic development, leading to innovative and stronger encryption algorithms, authentication methods, and security protocols to tackle emerging threats. Democratized GenAI's collaborative nature enables collective intelligence, swiftly identifying and addressing vulnerabilities. By harnessing a broad and inclusive community of AI developers, democratized GenAI has the potential to advance cybersecurity, enhancing adaptability and resilience against evolving digital risks.

13.2. AI-Enhanced Digital Prototyping

Prototypes serve the purpose of facilitating acceptance testing and validating concepts with users following the generation of initial ideas. The process of software prototyping is typically intricate, involving understanding functionalities and customer needs, creating seamless user journeys, and designing wireframes and prototypes. Creating a top-notch, lifelike, clickable prototype in UX/UI prototyping tools such as figma requires collaboration across different disciplines and methods spanning several weeks. Large Language Models (LLMs) have the capability to accelerate the process of moving from an idea to a (semi-)functional prototype. This chapter illustrates the possibility that individuals without a technical background in prototyping can utilize LLM features, using a hypothetical automotive app as an example [15, 106].

13.3. Generative AI in Joint Communication and Sensing

JCAS is an emerging technology anticipated to be commercially available in the 6G timeframe. In this technology, the network, such as a gNodeB (gNB) [107], has the capability to provide a map of surrounding sensed objects using radio frequency beams. This has diverse applications, including autonomous driving and channel modeling. The effective generation of radio rays is crucial for the success of JCAS technology. Generative AI can play a role in efficiently creating relevant rays to capture and sense surroundings. For instance, this can involve generating the appropriate distribution of Azimuth and Elevation Angles for the radio frequency beam transmitted from the node (gNB or UE), as demonstrated in a GAN-based approach [108].

13.4. Interdisciplinary Insights for Societal Impact

Investigating the potential outcomes of interdisciplinary research that merges knowledge from computer science, psychology, and sociology. The objective is to enhance comprehension and governance of the societal consequences arising from democratized Generative AI. With the increasing accessibility of Generative AI across diverse communities, the incorporation of insights from various disciplines offers a comprehensive understanding of its societal impacts. Collaborative research initiatives delve into ethical, psychological, and sociological dimensions to uncover challenges and benefits. This interdisciplinary approach encourages a holistic perspective, aiding informed decision-making and responsible development. In essence, it ensures that the widespread adoption of Generative AI positively influences and shapes our societal landscape.

14. Conclusion

Recent advancements in Generative AI, exemplified by innovations like ChatGPT, have garnered significant interest, but their economic implications have received little attention. The widespread access to democratized GenAI has the potential to reshape the future dynamics of jobs and workflows across diverse sectors. Envisioning manufacturing

plants operated by intelligent democratized GenAI systems, capable of efficiently designing and producing innovative products while minimizing waste. Moreover, in the healthcare domain, the democratization of GenAI has the capacity to revolutionize diagnosis and treatment, promising more precise personalized healthcare. Education, too, faces considerable transformation with the democratization of GenAI customization of learning materials for individual students. Yet, inquiries arise regarding the future of teachers replaced by AI systems. Beyond the displacement of jobs, apprehensions about data privacy and security in democratization. Generative AI systems call for thoughtful consideration and measures to guarantee information protection and accountability.

Anticipating an increased demand for skills related to AI system creation, management, and maintenance underscores the importance of human oversight to ensure responsible AI use. Navigating this transformative terrain emphasizes the need to strike a balance between embracing the potential of democratizing GenAI and addressing associated risks.

Instead of fearing the trend toward automation, proactive preparation is crucial, recognizing opportunities to thrive in a future dominated by AI. Ultimately, by embracing the challenges and opportunities presented by democratized GenAI, we position ourselves not merely as employable individuals but as indispensable contributors to the ever-evolving landscape of our future.

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