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Artificial Intelligence (AI) in Healthcare: Blessing in Disguise?

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Abstract As we stand on the brink of a new era, artificial intelligence (AI) heralds an unprecedented revolution in how we live, work, and think. AI, with its ability to analyze vast swathes of data and learn with an efficiency beyond human capability, promises to solve some of our most intractable challenges, from healthcare to environmental sustainability. This paper briefly explores the various aspects of AI in healthcare, how healthcare benefits, its cons, challenges, and AI future in healthcare. The rise of artificial intelligence in healthcare has revolutionized and reshaped the methods of diagnosing, monitoring, and treating patients. According to Statista, the AI market size is projected to rise from 241.8 billion U.S. dollars in 2023 to almost 740 billion U.S. dollars in 2030, accounting for a compound annual growth rate of 17.3% [1]. AI tries to solve the problem of how the human brain does with its all senses, vision, hearing, speech, and thoughts. Healthcare immensely utilizes AI potential in every aspect but not limited to patient care, disease management, workflow automation, fraud detection, drug discovery, robotic surgery, cyber security, etc. Although AI has stepped up on the right foot, evidencing a good team player but still managing huge amounts of data, data privacy, and security, the immature rollout of AI models are some of the protuberant challenges for the AI industry, and handling them inappropriately may risk humans. Let us sail not into the storm, but towards a bright horizon of possibility.

Keywords AI, Artificial Intelligence, Machine Learning (ML), Healthcare, Robotics, Deep Learning

1. Introduction

Artificial Intelligence is a tool that amplifies human potential, liberating us from mundane tasks and opening new frontiers for creativity and innovation. In 1980 Expert systems like MYCIN, an early medical AI system, provided decision support for bacteremia and infections and influenced later healthcare applications. In 1997 after the increases rise of computational power, IBM tested Deep Blue defeated world chess champion Garry Kasparov. In 2000 around AI entered main steam and began to be used in logistics, data mining, medical diagnosis, “deep learning” was introduced in 2006 by Geoffrey Hinton. After 2010 AI started reinvigorating into every stream of human life, introduction of Electronic Health Records (EHRs) and the digitization of healthcare data facilitated the growth of AI applications in healthcare.

Artificial Intelligence (AI) has begun to transform healthcare, offering novel solutions to longstanding challenges. 2016 inwards, AI applications in healthcare started expanding rapidly, including diagnostics (e.g., IBM Watson for Oncology), drug discovery, personalized medicine, and patient care (e.g., virtual assistants). In 2021 FDA provided approvals for AI-based diagnostic systems in radiology and cardiology suggested a growing trust in AI-assisted healthcare. Its role spans from early diagnostics to personalized medicine, enhancing patient outcomes while streamlining healthcare delivery. 2022 onwards, Discussions on the ethics, transparency, and accountability of AI became central as its applications continued to grow in healthcare. AI algorithms can process vast datasets, identifying patterns invisible to the human eye, thus aiding in early disease detection. This predictive capability is crucial in conditions like cancer, where early intervention can be lifesaving. It has become an integral part of advancing personalized medicine, improving diagnostic accuracy, and predicting patient outcomes. However, with these advancements, it is crucial to navigate the ethical landscape that

accompanies the adoption of AI in sensitive sectors like healthcare. A famous quote by Andrew Ng, a leading figure in AI, states, "AI is the new electricity." Just as electricity transformed industries in the past, AI is poised to be a transformative force in healthcare.

A survey among U.S. healthcare leaders revealed that, as of 2021, 41 percent stated their artificial intelligence capabilities were operating at a fully functional level. Additionally, 26 percent described their AI system as moderately functional, while five percent reported they had not yet implemented an AI system [4].

Although numerous cases exist where AI matches or surpasses human performance in healthcare tasks, various implementation challenges will hinder the widespread automation of healthcare professional roles for a significant time [5]. Tim Cook, Chief Executive Officer, Apple: *'[Healthcare] is a business opportunity ... if you look at it, medical health activity is the largest or second-largest component of the economy*' [2]. Ethical issues in the application of AI to healthcare are emerging and foremost critical concerns are rising rapidly

2. Under the umbrella of AI

AI is a broad and umbrella term, there are many things that come under AI and each one has a significant and special purpose to act intelligently. AI is nothing but solving problems through continuous learning the way human brains do through their cognitive ability. As AI is a computational model, there are sets of rules and algorithms that machine follows faster than the human brain, however with few exceptions like emotional intelligence. It takes a lot (everything effort, disk space, computational speed, etc.) to build emotional intelligence in the machine and AI is not there yet completely. Sometimes ML (Machine Learning) is used as another term for AI. Let's see the association of ML, AI, and DL (Deep Learning) through the Venn diagram. For simplicity, the figure below depicts the high-level components of the AI architecture and their subcomponents.

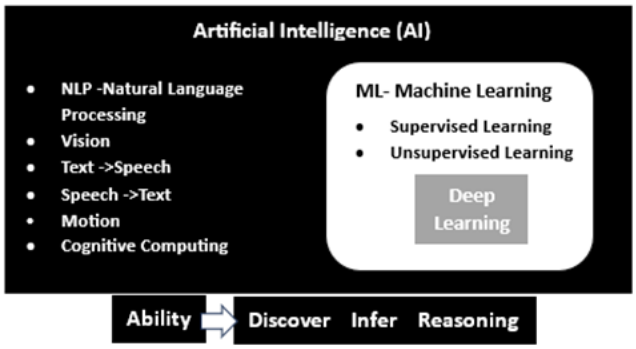

Figure 1: Components of Artificial intelligence and its ability to deliver intelligence.

Source: Author

Whereas Machine Learning is nothing but a subset of AI, as you see in the above diagram. Machine learning is empowered with supervised and unsupervised learning. Deep learning (Neural Network) is part of Machine Learning. All-inclusive learning with the addition of NLP, computer vision, Speech recognition, Text detection, Motion, and cognitive computing makes Artificial intelligence a whole. Data seats at the top of the food chain and AI's primary food is Data. Data Ingestion, Storage and Processing layers ensure the data is housed and ready for consumption. ML frameworks like TensorFlow or PyTorch build and train models using algorithms like deep learning. The model is then evaluated for accuracy and performance using techniques like A/B testing or cross-validation. The model must be continuously tracked for performance after it's deployed in production. To enable the modal more vocal it can be interfaced with API integration. The security later ensures data privacy and model security through encryption, access controls, and compliance with standards like GDPR. Kubernetes can scale the model, manage dependencies, and automate the AI pipeline. However, each layer of the AI model plays a distinct role and functions independently like the human body, but they work in concert to process data and deliver intelligent outcomes through their ability to discover, infer, and reason.

3. AI Anatomy

Correlating human anatomy with artificial intelligence (AI) involves drawing parallels between the functions of human organs and AI technologies. This analogy can help us understand AI's capabilities and limitations in comparison to human beings. Here's a look at some correlations:

Table 1: Explains the relation of AI to the human anatomy.

	Brain - Central Processing Unit (CPU)/Neural Networks	
	Human Brain	**AI Equivalent:**
1	The control center for the human body; it processes information received from the senses, manages bodily functions, and facilitates thought, memory, and emotion.	The CPU in a computer or more aptly, neural networks in AI, which process vast amounts of information, make decisions, and learn from data, somewhat akin to human thinking and learning processes.
	Human Eye	**AI Equivalent:**
2	The organs of sight capture light and convert it into electrochemical impulses in neurons.	Cameras paired with computer vision algorithms, which can interpret and analyze visual information.
	Human Nose	**AI Equivalent:**
3	The organ for the sense of smell, detecting and differentiating odors	Electronic noses or sensor arrays that can detect and distinguish between different chemicals and compounds. E.g CO2 sensor in the home
	Human Skin	**AI Equivalent:**
4	Contains receptors that allow us to sense touch, pressure, and temperature.	Touch sensors in robotics mimic the sense of touch, allowing machines to feel physical interactions. Like Apple Watch, Fitbit, etc.
	Human Mouth and Vocal Cords:	**AI Equivalent:**
5	Produce sound and enable speech	Text-to-speech systems that convert written text into spoken words, allow AI to 'speak.'
	Hands - Robotic Manipulators	
	Human Hands	**AI Equivalent:**
6	Allow manipulation of the environment through fine motor skills.	Robotic arms or manipulators that can perform tasks requiring precision and control
	Human Legs and Feet	**AI Equivalent:**
7	Provide the ability to move, walk, run, and balance.	Mobile robots or drones that can move through various environments.
	Human Heart	**AI Equivalent:**
8	Pumps blood to supply oxygen and nutrients throughout the body.	The power supply unit in machines that provides the necessary energy to function.
	Human Immune System	**AI Equivalent:**
8	Protects the body against disease and infection.	Cybersecurity measures in AI systems that protect against digital threats and maintain system integrity.

Source: Author

This analogy highlights how AI systems are inspired by human biology but also underscores the complexity of human physiology which AI still strives to emulate in many aspects. While AI can perform specific functions that are comparable to human senses and actions, the holistic integration seen in human beings is a feat of complexity that AI and robotics are yet to fully achieve.

The purpose of outlining this section here is to demonstrate the intricacies of how the human brain is evolving, with the help of manufactured and programed brain outside of human body, trying to benefit the human health. This illustrates the profound intersection of artificial intelligence (AI) and neuroscience, suggesting that AI and technologies external to the human body are becoming instrumental in understanding and enhancing human brain function and health. The human brain is evolving in a socio-technological context where AI and machine

learning (ML) tools are becoming extensions of human cognitive processes. This symbiosis offers unprecedented capabilities in processing information, decision-making, and learning.

AI systems can take over repetitive or data-intensive tasks, reducing the cognitive load on humans and allowing more focus on creative and complex problem-solving activities. This could lead to a redefinition of cognitive labor and learning processes.

4. Potential of AI in healthcare

Satya Nadella, chief executive officer, Microsoft: '*AI is perhaps the most transformational technology of our time, and healthcare is perhaps AI's most pressing application*' [3]. In the realm of healthcare, AI technologies are revolutionizing diagnostics, treatment plans, and patient monitoring. AI-driven algorithms can analyze medical data with remarkable accuracy, aiding in the early detection of diseases such as cancer or neurological disorders. Advanced AI-driven prosthetics and brain-computer interfaces (BCIs) are bridging gaps in neurological functions, offering mobility and communication solutions to individuals with disabilities. These technologies are not just restorative but are also evolving towards enhancing human cognitive and physical capabilities. In 2022, AI in healthcare made significant advancements that benefited patients across various aspects of medical care. These innovations aimed at improving diagnostics, treatment, patient care, and operational efficiency within healthcare settings. The enhancement of mRNA vaccine technology has expanded beyond COVID-19 to target other diseases, showing the potential for rapid development and deployment of vaccines for various health challenges. The introduction of PSMA-targeted therapies has improved the precision in diagnosing and treating prostate cancer, offering more effective and personalized treatment options. AI tools have been developed to rapidly detect sepsis by analyzing real-time patient data from electronic medical records, leading to earlier intervention and potentially saving lives. RPA has been increasingly utilized in healthcare to streamline processes, from administrative tasks to patient care management, enhancing efficiency and reducing the burden on healthcare professionals. The implementation of AI in creating task-based workflows has improved the management workflow efficiency, allowing healthcare teams to work more cohesively and effectively. AI technologies, including medical chatbots and advanced imaging analysis, have been used to improve diagnostic accuracy and efficiency, reducing the potential for medical errors. AI and machine learning technologies are being applied to tailor pain management and care plans to individual patient needs, as seen in partnerships like Harvard Pilgrim's collaboration with Kaia Health for back pain relief. AI systems offer continuous updates on new treatment options based on the latest research, aiding in the treatment and potential reversal of diseases like Type 2 diabetes through personalized nutrition plans and remote medical care [6]. Emerging AI options are being developed to assist caregivers of chronically ill patients, integrating with voice devices, remote monitoring, and virtual reality to provide education and support. These advancements underscore the transformative potential of AI in healthcare, from enhancing patient care and treatment options to supporting healthcare professionals and caregivers. The ongoing development and integration of AI technologies promise to further revolutionize the healthcare industry, making care more accessible, personalized, and effective for patients worldwide.

5. Future of AI

The future may see a more collaborative form of intelligence, where human intuition and creativity are enhanced by AI's data-processing capabilities. This could lead to innovations in science, art, and technology that were previously unimaginable. AI will play a key role in developing smart cities and improving urban services like traffic management, energy distribution, and public safety through intelligent automation and analytics. Advances in AI will revolutionize diagnostics, personalized medicine, and patient care, making treatments more effective and accessible. AI will provide early warnings for conditions like seizures or sepsis. AI may also enable "virtual biopsies". AI will enhance our ability to monitor and combat environmental challenges, from climate change to wildlife conservation, by analyzing data on an unprecedented scale. AI will drive further automation, improving efficiency in manufacturing, service industries, and daily life, significantly reducing human error and operational costs. Autonomous cars are a great example of progressive AI adopted by the car manufacturing industry.

However, on the other hand, AI also expresses some challenges and concerns. Stephen Hawking's said that "*the progressive development of complete AI could fully demolish the human race as this disruptive technology has the potential to fully re-design itself at a constantly increasing rate, while humans that exhibit steady biological evolution rate would not be able to compete and therefore could be potentially superseded*"[3]. The displacement of jobs due to AI automation is a major concern, along with ethical issues around privacy, surveillance, and decision-making in AI systems. AI poses new security risks, including the potential for AI-powered cyber-attacks and the challenge of securing AI systems from manipulation. The integration of external, programmed "brains" raises ethical questions about identity, privacy, and the nature of intelligence. It challenges our understanding of what it means to be human and how we interact with technology that can mimic or augment human thought processes. Moreover, it is becoming more evident that AI technologies are unlikely to replace human clinicians broadly, but instead, will enhance their capacity to provide patient care. Over time, human clinicians may move toward tasks and job designs that draw on unique human skills like empathy, persuasion, and big-picture integration [5]. Computer literacy, awareness, and capability of using computational devices in daily life will also decide the future of AI. Still there is a large set of the population who are not comfortable using technology on their own. Also, the availability of funds to invest in AI technology could hinder the implementation of AI in fewer countries. Chatbots is another popular example of AI used widely in almost all businesses. AI-driven chatbots have introduced various drawbacks, such as the absence of expressiveness, no emotional engagement, limited insight, discrepancies, and inaccuracies. (Susnjak, 2022). Hence, AI-based chatbots do not behave as intelligently as people expect. Forbes reported that around 80% of consumers using e-commerce platforms hesitate to interact with AI chatbots, as these bots fail to understand their real needs and even do not satisfy them. (Forbes, 2021) [7]. The video app like “Tik-Tok” based on “dark patterns”, such technologies designed to purposely manipulate and confuse users, a sophisticated deceptive technique to turn the knowledge collected from users ultimately used against them. There is an ongoing need for regulatory frameworks that balance innovation with protections against misuse, privacy infringements, and other potential harms. AI systems can perpetuate biases present in their training data, raising concerns about fairness in critical areas such as criminal justice, hiring, and lending. Ensuring the ethical development and use of AI is paramount, requiring global cooperation among governments, industries, and communities to address societal impacts, ensure transparency, and maintain human oversight. The future will likely see AI systems that can collaborate with humans and each other, enhancing creativity and problem-solving in joint human-AI endeavors. The future of AI holds the promise of substantial benefits but also necessitates careful consideration of its challenges and impacts on society. Balancing innovation with ethical considerations and regulatory oversight will be crucial to harnessing AI's full potential while mitigating its risks.

6. Conclusion

While AI has the potential to revolutionize the world, realizing this potential will depend on our ability to navigate its benefits and pitfalls with foresight and wisdom. The goal is to harness AI's power to complement human expertise, not to overshadow it. However, ensuring that AI is a tool that enhances, rather than detracts from, the healthcare profession will require careful management, ongoing oversight, and a commitment to ethical practices.

As stewards of this powerful technology, we must guide its development with ethical foresight, ensuring that AI serves to enhance the human experience and foster a more equitable world. Indeed, as we harness the winds of AI.

In conclusion, the co-evolution of the human brain with AI and external cognitive technologies represents a frontier of both opportunity and challenge. It holds the promise of significant benefits to human health and cognitive capabilities while also necessitating careful consideration of the ethical, social, and psychological impacts. This synergy between human and artificial intelligence could define the next phase of human evolution, marking a shift in how we understand and harness the brain's capabilities.

Appendix

AI- Artificial intelligence is the science of making machines that can think like humans.

Chatbot- a computer program designed to simulate conversation with human users, especially over the internet.

EHR – Electronic Health Record is an electronic version of a patient's medical history.
GDPR - an organization that falls within the scope of the General Data Protection Regulation (GDPR) meets the requirements for properly handling personal data as defined in the law.
ML- Machine learning, branch of artificial intelligence and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy.
Neural Networks - a computer system modeled on the human brain and nervous system.

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