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Applications, Scope, and Challenges for AI in healthcare

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ABSTRACT

Artificial Intelligence (AI) is a digital technology that has been creating numerous breakthroughs across a variety of fields such as Gaming, Mathematics, Education, Natural Language Processing, Computer Vision, Robotics, healthcare, and so on. The field being dealt with in this article is healthcare which is still an emerging and if not, the most challenging one. This paper goes through a few breakthroughs of AI in healthcare from an industry and research perspective. Some of the ways how AI is being used across various healthcare domains are explained. The discussion goes on by briefing the future scope of AI and how it can make life simpler and more efficient for the stakeholders. Finally, it wraps up by uncovering ways in which AI for healthcare can still be a challenge to software companies and medical practitioners alike by addressing a few major challenges.

Key words: Artificial Intelligence, Healthcare Challenges, Healthcare Applications, Healthcare Survey

1. INTRODUCTION

The modern era has seen many emerging technologies such as IoT, Big Data, Cloud, Robotics, etc come into the picture with applications across a variety of disciplines, and Artificial Intelligence is one of them. Considering the bulk of data that is being generated every minute and if not every second, the necessity to deal with such data and generate interesting patterns influencing future decisions is on the rise. The advent of AI in healthcare applications is likely to be one of the game-changing developments in the history of medicine, with implications for an array of medical specialties, and potentially for all healthcare service users in the future[1]. AI has two major branches which deal with the statistical modeling of data and decision making and those are Machine Learning and Deep Learning. These technologies are capable of making sense out of different kinds of data, be it labeled or unlabeled. The added leverage of dealing with missing data and anomalies is also there for the taking.

One field involving massive uncertainty in data and the need for AI-based solutions is the healthcare industry. AI has been used in various fields in healthcare and some of them are drug discovery, diagnosis, disease prediction, personalized healthcare, etc. Mainly, health-related Artificial Intelligence applications are designed to analyze the relationship between prevention or treatment techniques and actual patient outcomes[2]. “Recently AI techniques have sent vast waves across healthcare, even fuelling an active discussion of whether AI doctors will eventually replace human physicians in the future”[3]. Numerous tech companies are investing in AI for healthcare like Google, IBM, Amazon, InformAI, SaliencyAI, Samsung, CloudMedX, Innovaccer, etc, just to name a few. Although there is a lot of history, present, and future to talk about this field, it also comes with a lot of challenges which are to be discussed later in this article.

2. SOME APPLICATIONS OF AI IN HEALTHCARE

In this section, various ways in which AI is being used in the healthcare domain are disclosed, both from an application perspective and a research perspective.

Samsung Health is a fitness app by Samsung which provides personalized healthcare to individuals. It has specialized functionalities such as tracking blood pressure, oxygen and stress levels, water tracker, suggesting healthy BMI, etc. It can also be integrated with a smartwatch for additional functionalities. “We use advanced sensor technology to capture physiologic responses and make use of our AI/ML framework to build algorithms that detect and trigger alerts for specific health conditions. We employ data analytics to supplement clinical care and facilitate remote patient monitoring, thereby helping patients make behavioral changes that improve their health and daily lives”[4].

Google is another MNC that has collaborated with a lot of institutes on healthcare research. An interesting case is using AI in Breast Cancer screening. Millions of women undergo breast cancer screening each year. The results can take days or weeks and the patients may want to undergo more scans. Google Health, along with Northwestern Medicine, is conducting a new clinical study to see if artificial intelligence (AI) models can help shorten diagnosis times, close the assessment gap and improve the patient experience[5]. If this comes to fruition, the time for diagnosis can be reduced drastically.

An interesting model in the field of medical imaging is the supervised transfer learning model at scale, where the models are pre-trained on a source dataset and fine-tuned on the target task[6]. This study involved pre-training on different datasets containing 1 million to 100 million images and parameters between 25 million to nearly 1 billion. These studies showed that supervised transfer learning at scale can lead to improved performance on medical imaging tasks. But the problem with a model like this could be obtaining perfectly labeled data.

Annotating medical images is in general time consuming and expensive. The solution to this problem came in the form of a self-supervised model needing lesser labeled data. Google Research and Health came up with a big self-supervised pre-trained model which outperformed the traditional supervised learning model. "We observe that self-supervised pretraining outperforms supervised pretraining, even when the full ImageNet dataset (14M images and 21.8K classes) is used for supervised pre-training"[7].

"IBM's Watson uses natural language capabilities, hypothesis generation, and evidence-based learning to support medical professionals as they make decisions"[8]. FDNA, a US start-up in Boston created an app named Face2Gene that uses facial analysis, AI, and genomic information to improve the diagnosis and cure of rare diseases. In 2017, they released a new tool for doctors. Using unidentified patient data, clinicians can now share results in Face2Gene's Research application to test and analyze other clinical patient populations around the world[9].

A Russian company named Botkin.AI uses AI to create and develop products. "The system produced by this company is designed to recognize medical images from CT and MRI"[10].

Ada is a Germany-based start-up founded by a team of doctors, scientists, and engineers. It provides an Artificial Intelligence-powered health platform launched in 2016 and has become the best medical application in more than 130 countries. It provides personalized chats with user interaction to collect the required user information and compare the answers in-terms similarities with thousands of other answers and offers suggestions on what to do next, accordingly. This may involve visiting a doctor, pharmacist or seeking emergency healthcare. "It is supported by a sophisticated knowledge base, covering thousands of symptoms and conditions"[11].

Innovaccer is an AI-based healthcare startup from India. Founded in 2014, Innovaccer is a provider of a cloud and AI-based patient health data analytics platform. The company has developed a data-driven cloud-based platform to collect, analyze and provide information on patient health. The company's products are InNote, InConnect, InGraph, and InCare[12].

Aknamed is another cloud-based AI startup from India which provides material management software for hospitals. The product smart buy provides a suite of ML-based tools that analyze purchase and consumption data to provide data[12].

PharmEasy is a popular Indian start-up based on delivering medicine is dedicated to applications suggesting alternative medicine, dependency testing, and dietary applications based on test results in other key areas[13].

Researchers from the Massachusetts Institute of Technology CSAIL (Computer Science and Artificial Intelligence Laboratory) and MGH (Massachusetts General Hospital) have created a new deep-learning model which predicts the likelihood of developing breast cancer in the next 5 years based on mammograms [14]. "We developed a deep learning (DL) model (hybrid DL) that used full-field mammograms in addition to traditional risk factor information to assess breast cancer risk"[15].

DeepMind worked with experts from the U.S. Department of Veterans Affairs (VA) to develop a technology that allows doctors to pre-emptively treat Acute Kidney Injury (AKI), a medical condition, within 48 hours. AKI is estimated to have affected over 100,000 UK residents each year[14]. "Our model was developed on a large, longitudinal dataset of electronic health records that cover diverse clinical environments, comprising 703,782 adult patients across 172 inpatients and 1,062 outpatient sites"[16].

EMPaSchiz, a Machine Learning ensemble model using speech recognition and functional magnetic resonance imaging (fMRI) was built to detect schizophrenia. "The final ensemble model EMPaSchiz (stacked-multi) showed the best performance with an accuracy of 87%, the sensitivity of 80%, specificity of 93%, and precision of 92%, each with standard errors of 1-2%"[17].

3. HOW AI MAKES LIFE SIMPLER IN HEALTHCARE

3.1. Error Reduction

One of the major benefits of AI in healthcare is to reduce humanoid errors. There are so many case studies that prove AI models give more accurate predictions compared to doctors. One such study was carried out by Miguel Paredes using the US and Peruvian ICU data.

The study involved two experiments. The first trial (U.S. intensive care unit trial) aims to help evaluate whether diuretics should be administered to patients with sepsis based on the effects of diuretics on mortality and length of hospital stay. For the US ICU trial, 9 trials were performed for each outcome, tuning different model parameters, and found that diuretics reduced mortality by 10% to 18% and were associated with an additional 5.9 to 8.4 days of ICU days. When comparing these results, the effectiveness of diuretics was underestimated, but confusion and selection bias by matching and machine learning were not considered. This model predicts with an accuracy of 78%, the probability that a sepsis patient will die 30 days after discharge from the intensive care unit[21].

The second experiment (The Peru ICU experiment) was to predict child mortality and thus guide doctors on who to admit and who not to. The PRISM mortality rate was predicted to be 169 survivors compared to the observed 261 survivors and 173 compared to the observed 81 survivors, which was

observed to show a significantly overestimated result. When the AI model came into play, it predicted 230 survivors and 111 deaths respectively. This clearly shows much more improved accuracy in terms of prediction which can be a crucial factor when it comes to allocating a necessary number of resources to the patients[21].

3.2. Reduction in Expenses

For low and middle-income countries where a well-developed health infrastructure can be considered much more expensive, Artificial intelligence applications can reduce the cost of pathology screening and treatment plan selection, which requires expensive equipment and expertise that are not available in most hospitals, especially in rural or isolated areas. AI can also help predict the spread of pathogens in a given area. For example, you can identify dengue-related weather and land use patterns, and use social media to identify epidemic outbreaks.[22].

AI-powered automatic translation solutions can improve service access and utilization and treatment compliance in areas where culture or language is a barrier to healthcare[23].

3.3. Increased Accessibility

The accessibility of healthcare services is one of the key benefits of using AI for healthcare. A common application of that would be to have a conversational bot integrated with a website for instant support.

One of these bots is the multilingual "Aapka Chikitsak" bot. It was developed to advise chronic patients and women receiving prenatal care. It was developed on Google Cloud Platform with the goal of providing free medical education and advice in response to COVID 19 restrictions without actually going to the hospital. The app provides medical services by providing precautionary measures, family therapy, health tips, symptoms, and location-based nutritional advice[24].

3.4. Educating Healthcare Professionals

There is concern that AI could overwhelm human educators over the next decade and affect the roles of clinical nurse educators (CNEs), resident mentors, and other professional educators. However, AI could also revolutionarily support this role of clinical educators who are currently facing the growing demand for workloads in increasingly resource-constrained, demanding, and complex medical environments[25].

In the future, AI will carry the most important adjustments withinside the process of surgical procedure. It can offer robot-assisted surgical procedures and end up beneficial to reinforce the scientific workforce. A most important position can also be performed in coaching and educating new illnesses with the assist of to be had virtual data. AI assists effective surgical strategies carried out to make a hit surgical procedure. It assures the affected person of first-rate treatment, which will increase self-belief all through the complete process[26].

4. CHALLENGES IN AI FOR HEALTHCARE

Although the multi-disciplinary nature of AI proves to be a revolution in technology and a catalyst of complex tasks, it comes with a lot of debated challenges. Firstly, the availability of healthcare data itself is a concern. "Data is balkanized along organizational boundaries, severely constraining the ability to provide services to patients across a care continuum within one organization or across organizations"[27].

After obtaining data mostly through (Electronic Medical Records) EMRs, the next challenge is with meeting the system requirements to store, maintain and manage the data. One alternative would be to maintain dedicated hardware and software. Although this may be a promising solution for data of a small scale, data of a massive scale such as healthcare data would lead to a huge spike in costs. Cloud Computing answers this concern with a "pay only for what you use" policy. "The growth of cloud computing, which provides high-performance and secure data infrastructure and services over the Internet ("the cloud"), has become a driving force of technology companies large and small, providing considerably lower fixed prices and superior performance and supporting most of the real-world AI opportunities and applications"[27].

The next concern is security and legal issues of accessing healthcare data. "Recognizing the value of the data industry, issues such as anonymity, data security and dissemination, and legal standards for health care and oversight remain important"[19]. The Data Ethical framework is a protocol that consists of "defining the clarity, transparency, accuracy, accountability, and purpose for which data would be used for, to eliminate potential data violations"[28]. At the same time, many AI and Healthcare based companies have to adhere to a lot of rules and regulations to legally collect the required data ensuring patient privacy. It is recommended that Governmental organizations and industries jointly formulate data trust strategies to establish a basic framework for data sharing[29].

The next concern is with AI gaining the trust of the patients. Emily LaRosa and David Danks have clearly explained the kind of role that trust has on healthcare AI. For example, it can strengthen the relationships between parents and children by achieving more fruitful interactions (as the robot handles trivial tasks); or it can be weakened by reducing the number of interactions (as the child is not needed)[20]. A few other possible flaws in terms of the AI model itself were depicted by "Christopher J. Kelly, Alan Karthikesalingam, Mustafa Suleyman, Greg Corrado, and Dominic King" in their research[30].

5. CONCLUSION

There is a lot of future scope for AI for healthcare considering the number of healthcare start-ups that have been on the rise. The volume of research articles continues to increase as well. Digital technologies such as Cloud, IoT, Robotics, and Blockchain along with AI offer the kind of partnership

needed to address most of the challenges from acquisition to modeling and finally to the deployment of such models. However, the challenges in this domain continue to increase as well. While some of them may have been addressed through means such as new norms, privacy statements, protocols, and procedures, many others are yet to find a practical solution apart from many solutions which were supposed to be optimal in theory.

REFERENCES

1. M. C. Forney and A. F. McBride. **Artificial Intelligence in Radiology Residency Training,** *Seminars in Musculoskeletal Radiology*, vol. 24, no. 1, pp. 74–80, 2020, doi: 10.1055/s-0039-3400270.
2. E. Coiera, **Guide to medical informatics, the Internet and telemedicine**, Chapman & Hall, Ltd., 1997.
3. F. Jiang *et al.*, **Artificial intelligence in healthcare: Past, present and future,** *Stroke and Vascular Neurology*, vol. 2, no. 4, pp. 230–243, 2017, doi: 10.1136/svn-2017-000101.
4. **Digital Health – Samsung,** https://www.sra.samsung.com/digital-health/ (accessed Nov. 19, 2021).
5. **Using artificial intelligence in breast cancer screening,** https://blog.google/technology/health/artificial-intelligence-breast-cancer-screening/ (accessed Nov. 19, 2021).
6. B. Mustafa *et al.*, **Supervised Transfer Learning at Scale for Medical Imaging,** Jan. 2021, [Online]. Available: http://arxiv.org/abs/2101.05913
7. S. Azizi *et al.*, **Big Self-Supervised Models Advance Medical Image Classification,** Jan. 2021, [Online]. Available: http://arxiv.org/abs/2101.05224
8. **IBM Watson Health | AI Healthcare Solutions | IBM,** https://www.ibm.com/watson-health (accessed Aug. 17, 2021).
9. **FDNA launches app-based tool for clinicians using facial recognition, AI and genetic big data to improve rare disease diagnosis and treatment | MobiHealthNews**, https://www.mobihealthnews.com/content/fdna-launches-app-based-tool-clinicians-using-facial-recognition-ai-and-genetic-big-data (accessed Aug. 17, 2021).
10. **Botkin.AI | AI-Powered Radiology Platform,** https://botkin.ai/en/ (accessed Aug. 17, 2021).
11. **Health. Powered by Ada,** https://ada.com/ (accessed Aug. 17, 2021).
12. **AI in Healthcare Startups in India | Tracxn,** https://tracxn.com/explore/AI-in-Healthcare-Startups-in-India (accessed Aug. 17, 2021).
13. **Deep Dive: Online Healthcare Platform PharmEasy Is Using Machine Learning To Build A One-Stop Solution**, https://analyticsindiamag.com/deep-dive-online-healthcare-platform-pharmeasy-is-using-machine-learning-to-build-a-one-stop-solution/ (accessed Aug. 17, 2021).
14. **Here's A Look At All The Recent Advancements In Medical AI** https://analyticsindiamag.com/all-the-recent-advancements-in-medical-ai/ (accessed Aug. 18, 2021).
15. A. Yala, C. Lehman, T. Schuster, T. Portnoi, and R. Barzilay, **A deep learning mammography-based model for improved breast cancer risk prediction,** *Radiology*, vol. 292, no. 1, pp. 60–66, 2019, doi: 10.1148/RADIOL.2019182716.
16. **A clinically applicable approach to continuous prediction of future acute kidney injury | Nature,** https://www.nature.com/articles/s41586-019-1390-1 (accessed Aug. 18, 2021).
17. S. V. Kalmady *et al.*, **Towards artificial intelligence in mental health by improving schizophrenia prediction with multiple brain parcellation ensemble-learning,** *npj Schizophrenia*, vol. 5, no. 1, pp. 1–11, 2019, doi: 10.1038/s41537-018-0070-8.
18. **R. Shah and A. Chircu, "Iot and Ai in Healthcare: a Systematic Literature Review,** *Issues In Information Systems*, vol. 19, no. 3, pp. 33–41, 2018, doi: 10.48009/3_iis_2018_33-41.
19. I.-P. Efthymiou, S. Sidiropoulos, D. Kritas, P. Rapti, A. Vozikis, and K. Souliotis, **AI transforming Healthcare Management during Covid-19 pandemic,** *HAPSc Policy Briefs Series*, vol. 1, no. 1, p. 130, 2020, doi: 10.12681/hapscpbs.24958.
20. E. LaRosa and D. Danks, **Impacts on Trust of Healthcare AI Roles for Healthcare AI,** *AAAI/ACM Conference on Artificial Intelligence, Ethics, and Society*, 2018, [Online]. Available: http://www.aies-conference.com/2018/accepted-papers/%0Ahttp://www.aies-conference.com/2018/contents/papers/main/AIES_2018_paper_132.pdf
21. M. Paredes, **Can Artificial Intelligence help reduce human medical errors? Two examples from ICUs in the US and Peru**, 2018.
22. H. Alami *et al.*, **Artificial intelligence in health care: laying the Foundation for Responsible, sustainable, and inclusive innovation in low- and middle-income countries,** *Globalization and Health 2020 16:1*, vol. 16, no. 1, pp. 1–6, Jun. 2020, doi: 10.1186/S12992-020-00584-1.
23. D. D. Luxton, "**Recommendations for the ethical use and design of artificial intelligent care providers,** *Artif Intell Med*, vol. 62, no. 1, pp. 1–10, 2014, doi: 10.1016/j.artmed.2014.06.004.
24. U. Bharti, D. Bajaj, H. Batra, S. Lalit, S. Lalit, and A. Gangwani, **Medbot: Conversational Artificial Intelligence Powered Chatbot for Delivering Tele-Health after COVID-19,** pp. 870–875, Jul. 2020, doi: 10.1109/ICCES48766.2020.9137944.
25. G. K. Randhawa and M. Jackson, **The role of artificial intelligence in learning and professional development for healthcare professionals,** *Healthcare Management Forum*, vol. 33, no. 1, pp. 19–24, Jan. 2020, doi: 10.1177/0840470419869032.

26. M. Javaid, A. Haleem, I. Khan, R. Vaishya, and A. Vaish, **Extending capabilities of artificial intelligence for decision-making and healthcare education,** *Apollo Medicine*, vol. 17, no. 1, p. 53, 2020, doi: 10.4103/AM.AM_10_20.
27. T. Panch, H. Mattie, and L. A. Celi, **The 'inconvenient truth' about AI in healthcare**, *npj Digital Medicine*, vol. 2, no. 1, pp. 4–6, 2019, doi: 10.1038/s41746-019-0155-4.
28. M. Taddeo, L. F.- Science, and undefined 2018, **How AI can be a force for good,** *science.sciencemag.org*, vol. 361, 2018, doi: 10.1126/science.aat5991.
29. N. Yolande, **Integration of Artificial Intelligence in electronic health records : Impacts and challenges,** pp. 5–8.
30. C. J. Kelly, A. Karthikesalingam, M. Suleyman, G. Corrado, and D. King, **Key challenges for delivering clinical impact with artificial intelligence,** *BMC Medicine*, vol. 17, no. 1, pp. 1–9, 2019, doi: 10.1186/s12916-019-1426-2.