Dentistry Section

Artificial Intelligence: Patient Care and Health Professional's Education

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ABSTRACT

Healthcare technologies have captured extensive digitised data in the form of electronic medical record. With the availability of this stored digitised data and advance computational power systems at low cost, there exists an opportunity to develop solutions that just do not follow programmed instruction, but also have some of the human traits such as the ability to reason, discover meaning, and learn from experience without being explicitly programmed. This technique where computers mimic human brain is referred to as Artificial Intelligence (AI). As current AI solutions mature and get more trained, they will assist medical experts in performing simple tasks and will free up their work schedule allowing them to focus on solving more complex cases. AI solutions can also improve the quality of education and prepare next generation of health professionals that can use the latest technology tools, and provide the best possible healthcare services to their patients.

INTRODUCTION

Advancements in technology has always benefitted healthcare, improved quality of patient services and served as a great tool available to medical experts. For instance, the advent of CT (Computed Tomography) and MRI in late 20th century revolutionised the practice of radiology and has been an important milestone in improving health services till date [1]. Healthcare technologies have captured extensive digitised data in the form of electronic medical records such as digital images, and pathology and laboratory test reports. However, these current technologies typically follow the pre-defined human instructions or perform tasks that they are specifically programmed for [2]. With the availability of this stored digitised data and advance computational power systems at low cost, there exists an opportunity to develop solutions that just do not follow programmed instruction, but also have some of the human traits such as the ability to reason, discover meaning, and learn from experience without being explicitly programmed [3]. This technique where computers mimic human brain is referred to as AI. Apart from patient care, AI can also be used in health professional's education. It will benefit both educators and students, and help prepare the next generation of highly skilled medical experts [4]. In this paper, the details on few current AI solutions and their usage in both patient care and health professional's education have been shared.

Recent Advancements

In 2016, an event (named "The digital mammography DREAM challenge") was sponsored by several private technologies and healthcare entities to develop an AI algorithm for early detection of breast cancer. All the participants had access to 6.4 million de-identified digital mammograms dataset and AUC (Area Under Curve) was the key metric to measure algorithm performance. The winning algorithm had an AUC of 0.87 [5]. Though the solution did not have a perfect AUC of 1.0, they were awarded prize money to continue research and develop a production ready solution [5]. Computer Aided Detection (CAD) methods are also being studied to perform texture analysis in the radiographs and identify patterns [6,7]. In future, integration of pathology, radiology and genetic information in to the above mentioned AI solution can assist in providing 'precise radiology reports' which may help establish the role of radiology, as the foundation of precision health care [3]. A number of AI start-ups are working on improving the medical imaging by introducing new

techniques or devices. For example, Butterfly Network is working with a goal to create a new handheld medical imaging device that will make both MRI and ultrasounds significantly cheaper and more efficient [8]. Another start-up named 'Enlitic' uses the power of deep learning technologies to interpret a medical image in milliseconds-up to 10,000 times faster than an average radiologist [9].

In dentistry, some of the recent advancements are in the development of an automatic detection system. With a combination of variational methods and convolutional neural network, the system can detect proximal dental caries in periapical images [10]. Computer Assisted Detection techniques can also assist with diagnosis of Periapical Cyst and Keratocystic Odontogenic Tumour (KCOT) in CBCT images and Osteoporosis in panoramic radiographs [11,12]. The above mentioned advancements in machine learning, does not have the ability to self-learn with experience as yet. However, with the incorporation of AI techniques they can evolve themselves by using the captured data, and can identify radiographic features that are currently beyond human detection capabilities [13]. For example, integrating radiographic, genetic, laboratory and pathology reports can help in predicting the probability of genetic hereditary disorders like Gorlin syndrome or recurrence of an Odontogenic tumour like KCOT.

AI in Education

Integration of AI technology solutions into academics can benefit both educators and students. One such solution already in use is a virtual teaching assistant named, 'Jill Watson'. The solution was developed by a professor at Georgia Institute of Technology in collaboration with IBM. Though during the testing phase it did not provide the most relevant responses, with more research and training, its performance improved significantly and currently answers student online questions with 97% accuracy [14]. Use of AI solution in academic work routine can free up teacher's calendars allowing them to spend their efforts on topics that requires high degree of analysis and student-teacher interactions. For instance, educators can leverage AI solutions that can grade short assignments and essays. In a captured data, educators can identify patterns and develop insights. One such rudimentary pattern could be identifying areas where students provide maximum wrong answers, and help plan a better course teaching. It can also assist students in recognising topics that need more reading, their areas of weakness and strengths, and identify an

area of specialisation where they can provide maximum impact [15]. As AI solutions mature, they can identify more complex patterns and help improve the quality of learning. Developing AI solutions require knowledge of topics such as statistics, data management, decision support software development and use of simulations, skills that students and medical experts should learn to be a participant in an AI ecosystem [4].

CONCLUSION

With the availability of digital medical data collected by current technology solutions and high performance technology at low cost, AI solutions can significantly improve the quality of medical services. As current AI solutions mature and get more trained, they will assist medical experts in performing simple tasks and will free up their work schedule allowing them to focus on solving more complex cases. AI solutions can also improve the quality of education and prepare next generation of health professionals to use the latest technology tools, and provide the best possible healthcare services to their patients. Last but not the least; the healthcare community should fully leverage this great opportunity to be a part of the journey that will establish them as a thought leader in the space of medical AI solutions that provide exceptional patient care services.

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