Review Article

Generative Artificial Intelligence: Revolution in the field of Oral Health Care

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ABSTRACT

AI tools have been found to be quite popular in various applications. The recent AI tools, known as Generative AI, are gaining importance in several problem areas. Healthcare sector, including dentistry, produces huge amount of data in the form of handwritten text, images and videos, and require an extensive data analysis for the effective utilization of such generated information. This review aims to highlight the contribution of Generative AI tools in oral health care, side by side, pointing out the strengths and the weakness of such modern AI methods.

Keywords: ChatGPT, dentistry, generative artificial intelligence, health care

INTRODUCTION

Generative artificial intelligence (GAI) came into existence during the 1950s, but it has gained popularity in the last decade. It is the special field of AI that attempts to create new data from the existing data[1] [Figure 1]. These new data are not only unique but also quite close to the training data. Data can be anything under the sky – it can be images, music, videos, or text. GAI can be used in almost all possible application areas to generate new data. Recently, GAI has gained enormous popularity due to some intelligent products such as OpenAI's ChatGPT, Google's Gemini, and Microsoft's Copilot, to name a few. They have revolutionized the field of AI and, in almost every problem domain, GAI is now being implemented.[1] Intelligent chatbots are replacing professionals in quite a lot of fields, such as academics, health care, and consultancy.

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GAI AND HEALTH CARE

The ability to handle large and diverse datasets and the capability of creating new and unique data, such as text and images, has made GAI a very popular tool for health-care applications[1,2] [Figure 2]. Moreover, intelligent chatbots that are aiding in the diagnosis and proposing treatment for various diseases have revolutionized the entire health-care scenario.[2,3] The advent of GAI tools has revolutionized the role of AI as a helping hand to the professionals in the health-care sector.

GAI AND DENTISTRY

AI tools, such as natural language processing, computer vision, convolutional neural networks, recurrent neural networks, and many others, have been key contributors in the field of computer-aided oral health care.[4] In dentistry, such as other health-care-related fields, huge amounts of data in the form of images, prescriptions, procedure videos, and analysis are being produced.[4] Digitization of such data has opened the window for the application of AI tools such as machine learning (ML) and deep learning

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(DL).[5] This, in turn, helps health-care professionals to provide accurate and timely services. Recently, there has been a surge in the development of GAI tools, and they have found their applications in the field of health care, including dentistry.[5] GAI tools are being used to design intelligent chatbots who can diagnose oral diseases and efficiently support medical professionals in proposing accurate and timely treatment to patients. Generative adversarial networks (GAN) are being utilized to produce synthetic datasets to assist in the training of the AI models.[5] Tools such as Autoencoders and diffusion models also play a pivotal role in the creation of synthetic datasets. These tools are not only capable of diagnosing dental risks, but they are also playing crucial roles in dental education as well.[6]

The contribution of AI tools in the field of oral health care can be broadly categorized as [Figure 3]:

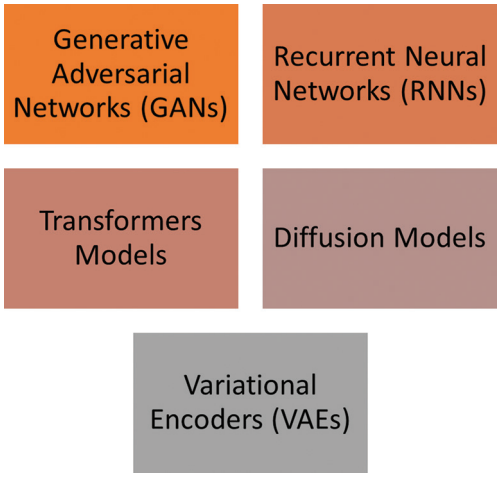

Figure 1: Some common types of generative artificial intelligence models

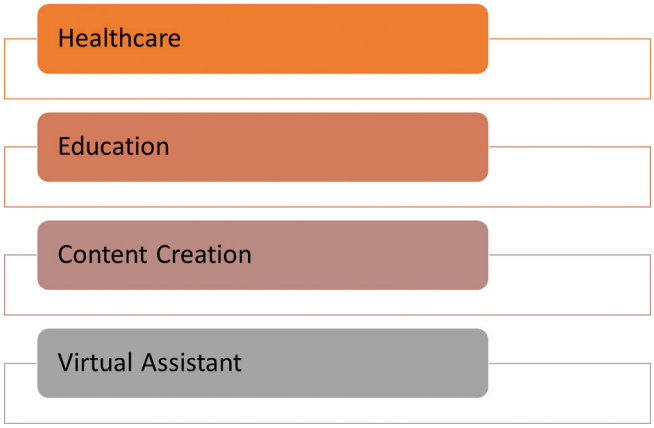

Figure 2: Popular application areas for generative artificial intelligence

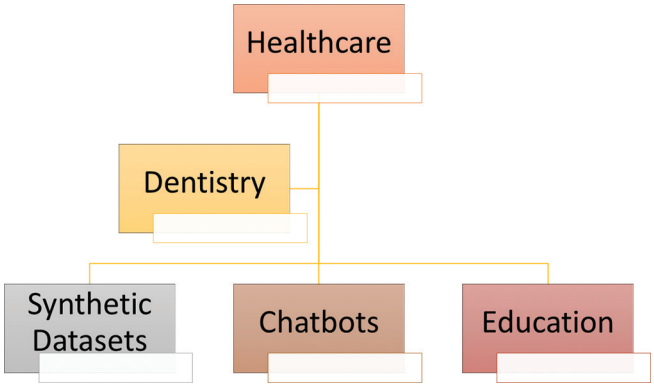

Figure 3: Generative artificial intelligence in the field of dentistry

Production of Synthetic Datasets

To implement ML and DL tools in any application area, a substantial amount of training data is required. The amount of data that is generated by dentistry, from images or text, or any other sources, is not enough for training DL models. One way to solve the problem is to use GAI tools such as GAN to create synthetic data. These synthetic data resemble the original ones and are then employed to train the DL or other AI models.

Decision Support System in the Form of Chatbots

The advent of intelligent chatbots has revolutionized the entire perspective toward AI. They are being extensively used to generate decision support systems for use by oral health-care professionals. Chatbots are being used as a communication medium between dentists and patients. Since these chatbots are intelligent, they are able to understand the sentiments of the messages from the patients.[6]

Oral Health-care Education

GAI is being expansively used in content analysis.[7] This makes analyzing several research papers and articles pretty easy to find the gaps in the research field. GAI can also participate in tutoring students and help in their assessments.[7] Simulation tools can be used to provide practical education to students about how to diagnose and treat oral diseases.[6] Educational organizations have already started considering the inclusion of GAI

courses in the curriculum so that both faculties and students can learn and implement them in the field of dentistry.[8]

CRITICAL ANALYSIS

With every blessing comes a curse, too, and this is true for GAI as well. GAI can be maliciously used to create fake data, which are popular with the name "deepfakes."[5] These fake data can be used against any individual or organization. Hence, GAI tools should be responsibly used. The protection of privacy is an important point to be considered while handling patients' data.[8] One more challenge is ending up with wrong data and trusting unknown sources for data collection.[3]

CONCLUSION

This review aims to emphasize the impact of GAI in the field of health care, especially dentistry. GAI tools have added an altogether new dimension to the field of oral health care. Be it the creation of synthetic datasets, chatbot-assisted diagnosis, or just including GAI tools in dental education; dentistry is now going through massive change. Like in any other field, GAI tools are gaining popularity in oral health care. However, the usage of such potent tools needs a word of caution, too. Patient data privacy is a serious concern, and it should be handled cautiously. Furthermore, the threat of "deepfakes" can be a major cause of worry and, therefore, should be considered a potential threat.

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