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Editorial

Smiles of the Future: How Artificial Intelligence is Revolutionizing Dentistry

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The history of artificial intelligence (AI) spans several decades, reflecting extensive development and research. Alan Turing, in 1950, questioned whether machines could think in his essay "Computing machinery and intelligence" [1]. Pioneers John McCarthy and Marvin Minsky founded the Artificial Intelligence Laboratory at MIT, contributing significantly to the field [2]. While the term "artificial intelligence" is often attributed to McCarthy in 1956, some credit Minsky [3]. Together, they collaborated in this lab. In 1957, Newell and Simon developed the "General Problem Solver," an early AI program. A notable milestone occurred in 1997 when IBM's Deep Blue defeated chess grandmaster Garry Kasparov, highlighting AI's potential. Today, AI is a crucial part of modern life [4].

AI involves creating systems and machines that emulate human learning, thinking, and decision-making through artificial neural networks. Essentially, AI enables machines to perform tasks traditionally associated with human intelligence [5]. According to the Association for the Advancement of Artificial Intelligence, AI embodies machine intelligence fundamentals. Bruno López Takeyas from the Technological Institute of Nuevo Laredo describes AI as a branch of computer science that replicates human intelligence through reasoning and language processing using deep neural networks [6]. Once a science fiction concept, AI now allows machines to perceive their environment, make decisions, and learn, becoming integrated into daily life through applications like voice-controlled devices and image recognition systems. Stuart Russell and Peter Norvig categorize AI into reactive machines (e.g. IBM's chess-playing computer), limited memory systems (e.g. driverless cars), and theory of mind AI (interacting with humans) [7].

AI offers numerous tangible benefits, such as improving healthcare access through technologies like drones and enhancing service quality and safety. It streamlines procedures, leading to faster examination and treatment times, and supports medical and dental research by collecting vast amounts of diagnostic and treatment data. When combined with blockchain, AI can help protect privacy [8]. Subfields like machine learning and deep learning facilitate the scalability and accuracy of AI applications, particularly in tasks like radiographic analysis in dental diagnosis, reducing human error, and automating processes such as designing prostheses. These benefits demonstrate AI's significant impact across various sectors, including healthcare and technology [9].

In dentistry, AI, known as dental AI, offers benefits like quicker and more accurate diagnosis of dental caries and oral diseases. It analyzes patient history data to identify health patterns and enhances prosthesis production through CAD-CAM systems. AI can determine suitable restorative materials and predict color matching. It also improves endodontics by analyzing radiographs to detect anomalies in root canals and assists in locating apical foramen and detecting vertical root fractures [10]. AI differentiates between types of periodontitis

with high accuracy using neural networks and analyzes radiographs for abnormalities during dental diagnosis. It aids in diagnosing and predicting periodontal disease [11]. In oral implantology, AI predicts the success rate of dental implants [12]. In orthodontics, AI predicts the size of unerupted teeth and whether extractions are needed before treatment [13]. In oral pathology, AI diagnoses and tracks the progression of temporomandibular disorders (TMDs) [14]. In maxillofacial surgery, AI helps determine oral cancers [15]. In forensic dentistry, AI assists in identifying individuals through automated techniques based on convolutional neural networks and accurately determines age from panoramic radiographs. These advancements improve dental procedures' accuracy and efficiency, extending AI's applications in dentistry and healthcare.

AI has significantly impacted medicine with various applications. For instance, the UK National Health Service and Google's DeepMind have developed an AI system to reduce radiotherapy times for head and neck cancer patients, cutting cancer area mapping time from 4 hours to 1 hour. At Cincinnati Children's Hospital Medical Center, researchers are developing a machine learning system to assess the likelihood of patient participation in clinical trials, streamlining recruitment and benefiting healthcare [16]. AI also prevents diabetic vision loss through an image analysis algorithm that identifies retinal damage more accurately than traditional methods. In pancreatic cancer detection, AI helps understand the disease by analyzing extensive data, as demonstrated by the pharmaceutical company Berg. Researchers at MIT have used AI to discover a new antibiotic, halicin, by evaluating the structures of over 2,500 drugs and compounds, showcasing AI's potential in drug discovery. Overall, AI accelerates drug discovery, reducing costs and advancing the field [17-19].

AI is still developing and requires human oversight to ensure reliability through monitoring, validation, and feedback mechanisms, with scientific evidence-based evaluation and regulation. AI applications should ensure fairness and non-discrimination. Specialized personnel should be trained to work with AI systems, and standards for medical and dental research using AI should be established. International organizations like the International Telecommunication Union and the WHO are working on standardizing AI applications in healthcare.

Conclusion

Artificial intelligence, particularly in dentistry and healthcare, holds the potential for more accurate diagnostics, quicker predictive analyses, and enhanced patient care. By adopting AI, we can achieve higher-quality treatments and boost patient confidence. AI is intrinsically connected to machine learning, effectively harnessing data through advanced learning algorithms. In the future, "Smart Dentistry" powered by AI is expected to revolutionize dental practices and education, benefiting both professionals and patients. Despite its significant advantages, there are concerns about overdependence on AI. Dental practitioners must use AI responsibly and receive adequate training to minimize risks. In conclusion, AI is already transforming dentistry and healthcare, providing numerous opportunities for improvements in diagnostics, treatments, and patient care.

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