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A Review on Learning Techniques for Dental Informatics

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Abstract

Many nations aim to use information technology (IT) in healthcare research and practice. IT capabilities have advanced dramatically over the past fifty years. New and beneficial applications of IT in the medical field have been made possible by a number of developments. Software, computer science, medicine, information science, statistics, cognitive sciences, and mathematics all come together in the interdisciplinary field of medical informatics (MI). Using concepts, tools, methods, software techniques, and modelling, this field aims to reduce healthcare costs while also reducing care errors. Dental informatics (DI) can be thought of as a subfield of medical informatics (MI); Consequently, MI has some impact on DI's development. In spite of the similarities that exist between DI and MI in medical research, it is essential to carry out distinct studies that are solely devoted to DI. In the relatively new field of DI, information science and computer applications can enhance dental research, practice, management, and education. The utilization of processing in dentistry is just a single part of DI. The first practitioners of DI referred to their strategy as the application of information science to medical problems. MI has been described as a cascade from analysis to effect in more recent studies.

Keywords: Health care • Dental treatment • Digital imaging

Introduction

One prior study suggests a structure with four parts. There are four parts: formulation of the development, evaluation, medical model, and installation and modification of the system. Most of DI's challenges come from the inherent difficulties at each phase of this procedure. Unfortunately, the majority of dentists are unaware of DI, its goals, what it has accomplished thus far, and how they can participate. DI may offer a variety of tools and applications for clinical use in the oral diagnosis of illnesses, the indications, contraindications, and prescription of specific medications to specific patients, and other areas. Innovative conservative methods have been introduced into a variety of medical fields thanks in large part to technological advancements. The significant improvement in patients' psychological and physical comfort as well as the significant reduction in operating time and invasiveness make these procedures stand out. Dental treatment planning, design, and prototyping, as well as implant surgery and the creation of specialized prosthetics have all been incorporated into the digital workflow in the same way that other industries have. Advanced dentistry innovation, particularly lately, have been significant in changing patient communications and creating imaginative and sweeping supportive methodologies. Through digital radiography and data collection, cone beam computed tomography (CBCT) has made it possible to enhance diagnostic datasets. Additionally, the use of CAD–CAM technology and processes for 3D manufacturing (such as stereo lithography and 3D printing) and implant dentistry allows for the introduction of cutting-edge treatment options for procedures involving dental implants, such as computer-guided implant surgery.

Description

This strategy made significant improvements and simplified conventional surgical procedures, improving patient comfort and compliance while also increasing implant location accuracy. Modern digital technologies have the potential to fundamentally alter dentistry on an educational and clinical level by utilizing mixed reality (MR), virtual reality (VR), and augmented reality (AR) to enhance student learning and clinical training. Dental professionals might benefit from the use of these technologies in their work. Subjects like computer science, information science, statistics, biomedical informatics, and others are driving significant advancements in computational techniques for data analysis and processing. Machine learning (ML), which was initially a relatively unexplored area of artificial intelligence (AI), is used in text mining, data analysis, medical diagnosis, and hypothesis generation. Recently, more advanced techniques based on ML algorithms have been used to improve oral health. DL, which has been shown to be effective in both disease prediction and prognosis, is one of these methods that are generally accepted. DL has been the subject of numerous publications on oral disorders in recent years. The difficulties and complexities of automated diagnosis of oral diseases can be effectively handled by DL algorithms. To date, there have been a lot of review studies on the detection and classification of oral disorders, but very few of them have been able to provide scholars with a clear path forward. Although this study provided an excellent literature review of dental disorders and applications, more DL-related topics should have been covered. When feature extraction is required for diagnosis, and when feature extraction is involved for diagnosis, the majority of the review studies on dentistry primarily focused on classic ML methods or generic artificial neural networks (ANNs). They were unable to address new dental disease diagnosis DL architectures like generative adversarial networks (GANs), extreme learning machines (ELMs), graph convolutional networks (GCNs), etc. Although there are a number of review publications on digital technologies and dental medical imaging techniques, none of them cover all of the imaging modalities used in the identification and classification of dental diseases. In addition, they did not provide a comprehensive summary of the advantages and disadvantages of previous research, which made their analysis of learning-based deep approaches ambiguous. As a result, this study provides a solid foundation for an in-depth and critical examination of contemporary dental disease diagnostics and DL-based digital dentistry technology. We chose studies from 2017 to 2022 for this study because of their popularity [1-4].

In this study, the researcher advocated using a systematic review method to help future researchers understand the general framework of a DL-based dental diagnostic. The designs of deep neural networks used to

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identify dental diagnostics in a number of DI areas are detailed in this study. This study also discusses imaging methods for identifying and classifying dental diagnostics. Finally, this systematic literature review (SLR) identifies a number of open research challenges and opportunities for future researchers. We believe that the scientists, who work on medical image classification, may be involved in the transition to DL-based dentistry diagnostics, and use a variety of medical images will benefit from this study's framework.

A CNN was used to extract features from periapical dental pictures, and then short-term and long-term dependencies were calculated. This study has studied the G.V. Black categorization with the categorization of DC categories as its primary objective. The experimental examination of optimum CNN-LSTM displayed competitive performance in the categorization of dental images. To find and classify teeth in radiographs, a two-staged attention segmentation network was developed. In the first place, the consideration model is utilized to lay out the surmised arrangement of the tooth. Using a deep convolution network, the precise tooth boundaries are then identified with a precision of 96.94 percent. In a dental X-ray, the U-Net convolution network DL approach was used to automate tooth and background segmentation using the dental and background segmentation methods. The results of the experiments show that the proposed convolutional U-Net network has an average classification precision of 97.61 percent [5,6].

Conclusion

The purpose of the study was to call for a method of systematic review that would make it easier for future researchers to establish the fundamental framework of a DL-based dental diagnostic. In order to find answers to questions regarding DL techniques that are utilized in various fields of digital imaging (DI) and performance measurement as a means of evaluating DL techniques, approximately 48 research papers were examined. The representation of AI, DL, is utilized to address real-world issues in a variety of societal settings, including the dental and medical industries. Self-learning back-propagation techniques, which incrementally improve data outputs and process technology, are accelerating DL's development. Computer-assisted diagnosis will likely require more teamwork as the precision of DL algorithms in healthcare advances. The development of dental applications based on AI is absolutely fascinating. Even though a number of studies have shown that DL could be used in dentistry, these systems are still far from being able to replace dentists.

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Conflict of Interest

The authors declare that there is no conflict of interest associated with this manuscript

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