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Bringing a new era in oral medicine and radiology- Artificial intelligence

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Abstract
AI is a highly evolved system capable of mimicking the human brain function. There are many applications of AI in Oral Medicine and Radiology which includes automated dental radiograph interpretation, Caries detection, visualization of orthodontics in three dimensions, assessment of bone density, Forensic Dental imaging etc. There is no denying the rise of AI in dentistry, but it will never be able to fully replace a dentist's function in clinical practice.

Keywords: Denture adhesives, awareness, knowledge, attitude, questionnaire

Introduction

AI is described as a branch of science and engineering that studies the computational comprehension of what's typically referred to as intelligent behaviour and with the development of objects displaying such behaviour. Computer-automated diagnosis is becoming more popular because of its capacity to identify and classify lesions that could be invisible to the human eye, opening the door for a clear procedure. AI is a highly evolved system capable of mimicking the human brain function.

Techniques of Artificial Intelligence used in Oral Medicine and Radiology

- Clinical Decision Support System (CDSS)
- Principal Component Analysis (PCA)
- Data Mining technique
- Fuzzy Logic
- Belief Merging
- Genetic Algorithms (GA)
- Artificial neural networks (ANN)
- Atlas based techniques
- Deep Learning (DL)
- Machine Learning (ML)
- Probabilistic and General Regression Neural Network
- Dynamic Bayesian Networks

Clinical Decision Support System (CDSS)

Interactive computer systems called CDSS are made to assist medical professionals in making decisions. A dynamic knowledge base and an inferencing mechanism are the fundamental parts of a CDSS, and they are implemented using medical logic modules that are built on a language like Arden syntax (Fig 1) These systems evaluate patient data and make recommendations about orofacial problem diagnosis, prevention, and treatment based on imbedded clinical knowledge. This technique cleverly gives experts the required prognoses, such as the possibility that a lesion will become malignant, and suggests the required actions to the experts. Oral cancer is diagnosed and detected using a clinical decision support system.

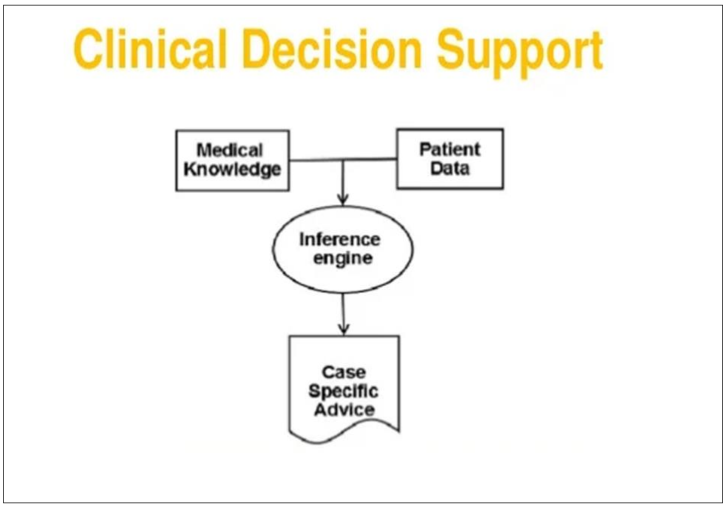

Fig 1: Components of CDSS

Principal Component Analysis (PCA)
A non invasive diagnostic method for differentiating between normal and malignant oral tissues is laser-induced fluorescence (LIF) spectroscopy and fluorescence imaging. This method uses tissue autofluorescence or exogenous fluorophores, and records the fluorescence spectrum. Classification is done using both PCA and artificial neural networks [2].

Data Mining technique
The technique of finding patterns in large data sets is computational. It extracts information from a collection of data and transforms it into an understandable structure for later usage. It's the knowledge discovery in databases, or KDD, process's analysis stage. It includes grouping, classification, regression, summarization, association rule mining, and anomaly detection [3].

Fuzzy logic
An input data set is nonlinearly mapped to a scalar output data set via a fuzzy logic system (FLS). The ability of this machine algorithm to incorporate language words that are simpler for human users to comprehend and converse with into the decision-making process is known as fuzzy logic, and it is used in medicine. Rules, the inference engine, the defuzzifier, and the fuzzifier are the four primary components of a FLS, used for oral cancer detection and diagnosis, risk assessment prediction, and diagnostic precision [4].

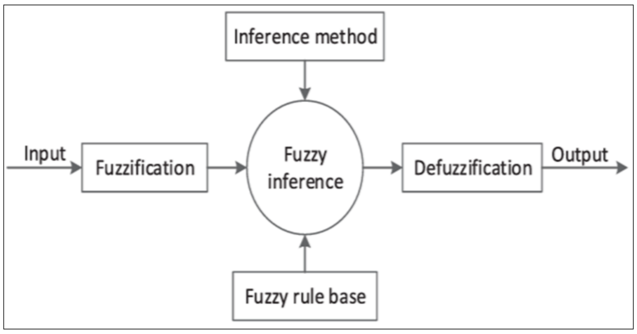

Fig 2

Belief merging
Belief merging examines methods for fusing symbolic data from several sources that is articulated in propositional logic. The techniques seek to obtain a consistent belief foundation that represents the group. Each source is coded as a set of propositional formulae, known as a belief base. The group of belief bases together may be inconsistent. It is used in the diagnosis of oral cancer [6].

Artificial neural networks (ANN)
The ANN's composition and operations closely resemble those of the brain. It is made up of perceptrons that mimic neurons in terms of functionality. The fundamental idea behind artificial neural networks (ANNs) is to create a decision-making unit by connecting perceptron units, which allows for nonlinear analysis. Two varieties of ANN exist. The multilayer perceptron is one of the most often used ANN formats (MLP). It has been demonstrated that the MLP is a reliable tool for investigating the potential predictive value of biomarkers for oral cancer [1].

Artificial intelligence in the IMRT planning process
Dose prediction
Clinical workflows involved in IMRT treatment planning would be significantly impacted if the volumetric dose of a prospective patient receiving radiation therapy was known in advance. This is because the information would provide dosimetric expectations that could be used to help identify outliers and plan cutoff criteria.
There are three primary categories of volumetric dose prediction methods:

Atlas Based
Three sub-steps are necessary for atlas-based dosimetry to function: first, a set of imaging and contouring data must be reduced to a subset of descriptive data points; second, a machine learning method that connects a patient to a selection of descriptive data points, and a deformable image registration technique warps a previous dose volume to a new patient geometry.

Fully Connected Neural Networks
An option to atlas-based approaches is to use artificial neural networks to learn a collection of hierarchical features and then use those features to directly forecast dosage. ANNs were used by Shiraishi *et al*. for IMRT treatment planning that emphasized the use of a semi-unstructured approach [9, 10].

Convolusional Neural Networks
In order to forecast volumetric information, CNN-based architectures have been employed as an alternative to fully linked ANNs. Although CNN-based dosage prediction techniques are still in the early stages of development, given their widespread use in industry, it is expected that these techniques will soon find widespread use in volumetric dose prediction for head and neck IMRT.

Deep Learning
will significantly help to reduce the intense effort that doctors and radiologists in disciplines like molecular imaging for early diagnosis of oral cancer metastases to the cervical lymph nodes. Can evaluate cervical lymphnode metastasis from oral cancers.

Machine Learning
A subset of artificial intelligence (AI) known as "machine learning" allows computers to learn from past data, gain understanding, and forecast future data based on the knowledge acquired. The main focus of statistics is inference, which explains the relationships between a system of components.

Probabilistic and General Regression Neural Network
The following judgments benefit from the use of (PNN/GRNN) models:
Based on clinical findings and patient demographics, diagnoses of cancer and the kind of cancer symptoms, a thorough examination, and medical and personal history.
To estimate the stage and scope of oral cancer from symptoms that are verified by pertinent tests and investigations.
To forecast a patient's probability of survival after the recommended course of care and monitoring [5].

Genetic Programming

GP redesigned the process of addressing issues with previous machine learning techniques by looking for a highly suitable individual program within a population of candidate programs. This search space includes a variety of functions and terminals that are pertinent to the problem area. It is used to assess the prognosis of oral cancer [7].

Dynamic Bayesian Network

Time-series gene expression data gathered during the follow-up study of patients who had or had not experienced a disease relapse is taken into account by the dynamic Bayesian networks. Using that information, one may deduce the corresponding dynamic Bayesian networks and then make assumptions about the causal links between genes both within and between time slices. The primary goal of this program is to give crucial knowledge regarding the disease's underlying biological mechanisms [8].

Applications in Oral Radiology

- Automated dental radiograph interpretation and radiographic lesion interpretation
- Caries detection: To help dentists identify and characterize proximal caries, the Logicon Caries Detector TM application was created.
- The identification of vertical root fractures on CBCT scans of teeth that have received endodontic treatment but are still intact.
- The visualization of orthodontics in three dimensions utilizing OPGs and patient models.
- The assessment of bone density using OPGs to forecast osteoporosis.
- Mandibular canal segmentation performed automatically.
- Forensic dental imaging: Metaheuristic algorithm-based dental panoramic radiographs used as part of a personal identification system.

Conclusion

The uses of AI in daily life are expanding exponentially. Surgeons who specialize in dentistry have always been at the forefront of integrating technology. While there is no denying the rise of AI in dentistry, it will never be able to fully replace a dentist's function in clinical practice, which involves not just diagnosis but also correlation with clinical findings and the provision of individualized patient treatment.

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