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ARTIFICIAL INTELLIGENCE & DENTISTRY: A REVIEW

Prothodontics

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ABSTRACT

Artificial intelligence is gaining attention all over the globe as it has marked a high impact, breakthrough in the field of intelligence innovation. As the age increases, human beings are expecting a extra accurate and all-inclusive treatment, hence the dependency on artificial intelligence can only add privilege to the quality of treatment. Machine learning does not intend to replace the dental healthcare worker, but can be a method to create a second informed opinion based on mathematical decision making and prediction. It is employed in each field, ranging from automation to dentistry. It is a rescuer for dentistry specifically in the field of Prosthodontics as it aids in the scheming of prostheses and in the creation of functional maxillofacial appliances. It is also useful in the process of record keeping of patient documents, diagnosis, treatment planning and patient managing; hence it supports the dental surgeons to work smarter.

KEYWORDS

Artificial intelligence, Robotics, Prosthodontics, Dentistry, Machine learning.

INTRODUCTION:

Smart work and not hard work is the earnest adaptation of every human. If a machine is given the power to think like a man and act like a man, it will be a windfall to help the mankind in a lot of fields to reduce the manpower. Dentistry is such a complex field that requires a lot of assistance. To lessen the taxing work and man power, growth of artificial intelligence can be a gods end to dental professionals. As the age increases, human beings are expecting a extra accurate and all-inclusive treatment, hence the dependency on artificial intelligence can only add privilege to the quality of treatment. Artificial intelligence offers pioneering decision reinforcing apparatuses.

John McCarthy first used the term artificial intelligence in the year 1955.[1] John McCarthy is known as the father of artificial intelligence and was an arithmetician by profession. Artificial intelligence means the ability of a machine to emulate humanoid data and demeanour. Machine learning is a field of artificial intelligence that was first mentioned in 1959 by Arthur Samuel and he defined as the process that enables computer to learn without definite programming.[2]

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Machine Competencies:

We experience weak AI or simulated thinking in our day-to-day life, starting with the basic computational language which we use to command the computer programme till the robotics. Robust AI or authentic thinking is only illusory currently. Computers attaining strong AI will be the biggest innovation in this field which will have a huge impact on human civilization.

KEYASPECTSOFAI:

Machine learning

With machine learning, computers are able to infer their own rules by using advanced algorithms.[3] Machine learning isused in ecommerce, automobile, internet search, sensor, robotics, speech recognition, image recognition etc. Machine learning is subdivided into four categories of learning. (1) Supervised learning: The computer has a tracing data set which is correctly labelled by a human expert. (2) Unsupervised learning: The computer does not use a tracing data set, but it tries to take up the data without the human guidance separating the data into clusters or groups. (3) Semi supervised learning: It is not easy to supervise every data set when a large amount of unlabelled data is combined with a small amount of labelled data the accuracy of machine learning can be improved. (4) Reinforced learning: According to Hal Varian, it is a form of sequential experimentation of a computer in an attempt to achieve a goal while interacting with a dynamic external environment.[4]

Neural network:

As the name suggests, it uses artificial neurons to set the algorithm. It works nearly analogous to the human brain.

Deep learning[5]:

It is a type of machine learning that utilizes the network with different computational layers to analyse the input data. Deep learning is also known as conventional neural network. An extremely popular class of DL algorithms is the artificial neural network (ANN), a structure composed of many small communicating units called neurons organized in layers. A neural network is made up of an input layer, an output layer and concealed layers between the inner and outer layers. It is conceivable to have one or a few veiled layers (shallow neural network) or countless hidden layers (deep neural network, DNN).

In medicine and dentistry, one of the most commonly used subclasses of ANN is the convolutional neural network (CNN). A CNN uses a distinct neuron assembly architecture and the scientific operation, convolution, to process digital signals, for example sound, image and video.

Clinical Application of AI in Dentistry:

Radiology[6]

CNNs have shown promising ability to detect and identify anatomical structures. For example, few have been competent to recognize and tag teeth from intraoral radiographs. CNNs have demonstrated a precision rate of 95.8–99.45% in detecting and identifying teeth, almost rivaling the work of clinical experts, whose precision rate was 99.98%.

CNNs have also been used for the detection and diagnosis of dental caries. In 3000 intraoral radiographs of premolars and molars, a profound CNN algorithm was able to perceive caries with an accuracy of 75.5–93.3% and 74.5–97.1% sensitivity. This is a extensive improvement over diagnosis by clinicians using only radiographs, with sensitivity fluctuating from 19% to 94%.11 Deep CNNs have countless probabilities for refining the sensitivity of diagnosing dental

caries and this, united with their rapidity, makes them one of the greatest effectual tools used in this field.

Orthodontics [7]

ANNs have immense potential to aid in the clinical decision-making process. In orthodontics, it is indispensable to plan treatments prudently to attain for eseeable results for patients. Nevertheless, it is not infrequent to see teeth removals included in the orthodontic plan. Thus, it is indispensable to safeguard that the best clinical choice is made before beginning irrevocable procedures. An ANN was used to assist in regulating the need for tooth removal before orthodontic therapy in patients with malocclusion.

Periodontics [8,9]

According to the 1999 American Academy of Periodontology classification of periodontal disease, 2 clinical types of periodontitis are recognized: aggressive (AgP) and chronic (CP) forms. Due to the intricate pathogenesis of the disease, not a solitary clinical, microbiological, histopathological or genomic test or amalgamation of them can segregate AgP from CP patients.

Papantanopoulos and colleagues used an ANN to distinguish between AgP and CP in patients by using immunologic parameters, such as leukocytes, interleukins and IgG antibody titers. Only a single ANN could classify AgP or CP with 90–98% accuracy. The best overall prediction was made by an ANN that included monocyte, eosinophil, neutrophil counts and CD4+/CD8+ T-cell ratio as inputs.

The study concluded that ANNs can be employed for accurate diagnosis of AgP or CP using relatively simple and conveniently obtained parameters, such as leukocyte counts in peripheral blood.

Endodontics [10]

Although mandibular molars tend to have similar root canal configurations, several atypical variations may occur. To curtail treatment failures associated to structural variances and to enhance the clinical results of endodontics, cone-beam computed tomography (CBCT) has become the benchmark. Nevertheless, due to higher dose of radiation compared with orthodox radiographs, CBCT is not used thoroughly. To overcome such encounters, AI has been introduced to categorize the specified data using a CNN to decide the number of extra canals in the distal root of first mandibular molar. Radiographs of 760 mandibular first molars taken with dental CBCT were scrutinized to ascertain the presence or absence of the atypia. Image patches of the roots obtained from conforming panoramic radiographs were processed to classify morphology by a deep-learning algorithm.

Applications of Artificial Intelligence Decision Support Systems

In healthcare systems, there is a large amount of data which gives ideal learning inputs of machine learning enabled decision support systems. Clinical decision support can improve the diagnostic accuracy and it helps the healthcare workers to sort out the complexities in clinical variabilities. It has potential application in the field of orthodontics, periodontics and oral surgery for analysing the condition and treatment planning. It is also used for reducing the feudal claims in the field of dental insurance; it checks the accuracy of the details provided by the patients. [11]

In future, the dental clinics might establish an AI comprehensive care system replacing the dental assistant. Before every appointment, the patient analyser will dictate the planning of patient's treatment with regard to his age, gender, vital signs, medical history, health conditions and drug usage.

CAD/CAM and AI

In the field of Prosthodontics, both the patient and clinician expect a gold standard quality in the prostheses. A huge set of manpower and machinery works behind the perfect output, sometimes the manpower alone can fail to meet thee xpectations. In order to expedite the process, the computer has this designing and manufacturing unit that empowers us to design mill or print best owing to the patient's wish. AI's significant advantage is the capability to evaluate and absorb from the oodles of doctor-approved crowns in the database, with cases added to the cloud on a regular basis. Esthetics are frequently appraised by gauging the possibly enormous amount of dental anatomy information available. In relation to working from a conventional template, it was.

Implant Therapy and AI

Treatment planning of dental implant can be most successful if we combine the CBCT image and intraoral scan. Introducing AI in the field of implantology has the ability to combine both together and plan the future prostheses. [12] A novel model was projected by scholar sat the Finnish Center for Artificial Intelligence (FCAI), the University Hospital of Tampere, Planmeca and the Alan Turing Institute to precisely and robotically recognize the meticulous site of the mandibular canal for dental implant procedures. Using deep learning based object detection, implant systems can be detected from panoramic radiographic images.

Clinical Environment and AI

Augmented reality can be used for refining patient well-being and to diminish the anxiety during dental procedures. AI will expand its skill on scheduling the appointment timing, temperature setting for the patient, the music and the entertainment of their taste and even the lighting that relaxes the patient. [13]

Tongue Controlled Devices

Our goal has been developing non-invasive, self-controlling, and precise tongue-computer interfaces that can compensate the arm and hand functions, which are indicated as the upper most priorities for severely disabled individuals. The tongue drive system can study the gestures of tongue in the oral cavity and act based on the instructions detailed within the guidelines. These commands can then be used to access a computer, drive a wheelchair, or control the user's environment. [14]

Maxillofacial Prostheses and AI

The bionic eye, developed in the United States, has already been tested in a dozen patients with vision damages. Deprived of the need for surgery, these devices can help the people in attaining vision with the help of artificial intelligence. In this way, a smart camera straddling on distinct glasses permits the user to read text or identify faces. With the aid of a minor ear piece,the expertise processes the information captured by the camera and alters it into audio, which is directed to the ears of the visually impaired person. [15]

Due to amputation of limbs, patients can lose the sensory capacity in those areas. Artificial skin developed by scientists from the California institute of technology (USA) and the federal polytechnic school of Zurich (Switzerland) is altering this situation.

The tissue composed with a thin, clear film of pectin and water, senses temperature variations in the range between 5and 50 degrees Celsius.

Artificial olfaction plays a crucial role in robotics by mimicking the human olfactory structure that can identify different smells that compare to arrange of fields, together with environmental monitoring, disease diagnosis, public security affairs, agricultural production and food industry. [16]

CONCLUSION:

The field of artificial intelligence has altered medicine and dentistry in numerous ways. Though Artificial Intelligence systems are a great strength in dentistry and dental training, the human biological system is composite and it is to be noted that these technological progressions are still the brain child of novelties and discoveries by mankind. Moreover, AI can only support the clinician in performing the tasks professionally, but may not swap the intellect of the human knowledge, skill and treatment planning.

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