

Artificial Intelligence in Dentistry- The Present and Future

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Abstract— Due to our colossal workload, we've devised an intelligent learning methodology that allows us to live a life free of decision-making. As a support system for treating patients, artificial intelligence may aid with better diagnosis and comprehensive treatment, but our intelligent robots will act as a human body to give complete care. Artificial intelligence (A.I.) isn't designed to replace dentists, but A.I. may provide, more accurate opinion based on statistical decision-making and prediction. This may be accomplished via a variety of logical and procedural means. Many long-term objectives may be achieved quickly and easily with this technique. Although it is still relatively new, this method has a long history of success in the medical and dental fields [1]. A complete set of decision-making concepts and ideas has therefore been identified, which mirrors the way humans think and behave.

Keywords— Artificial Intelligence, Neural Networks, Dental care, Dentistry, Intelligent Systems, Applications of Dentistry.

I. INTRODUCTION

Artificial Intelligence (A.I.) has progressed significantly from a science fiction concept to reality. And since A.I. has become a mainstream technology in the current business and is now a part of the average person's daily life, a new argument has emerged: Artificial Intelligence vs. Human Intelligence [1].

A.I. is a subfield of data science that focuses on developing intelligent robots capable of performing various activities that normally require human intellect and deductive reasoning [1].

Human Intelligence is the intellectual capacity that enables us to learn from diverse experiences, think, comprehend complex concepts, apply reasoning and logic, solve mathematical problems, recognize patterns, make decisions, retain information, communicate with other humans, etc. [1].

Figure 1 explains human and artificial intelligence

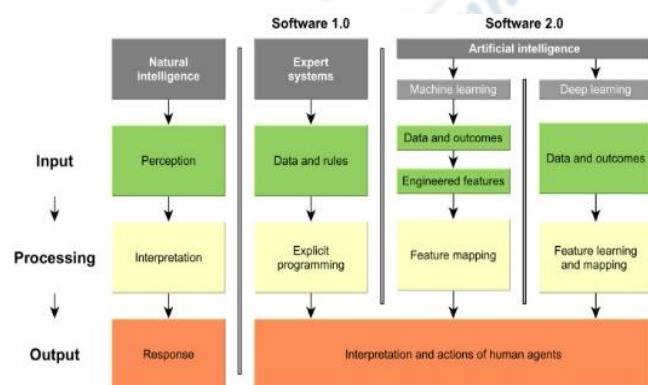


Figure 1: Human and Artificial Intelligence

II. METHODOLOGY

In 1956, John McCarthy invented the phrase "artificial intelligence," which he later described as a "field of science and engineering [2]. The fundamental slogan of the concept was to replace people, but not their skills, which was often seen in human conduct. In machine learning, algorithms discover patterns from data rather than being explicitly programmed. Machine learning techniques involve parameter tuning, such as the number of neurons, layers, or epochs in a neural network technique; membership function selection in fuzzy logic; population size, selection strategy, mutation rate, crossover rate in genetic algorithms; and hybrid techniques that use fuzzy logic or neural network or both. Some CDSS lack machine learning models like the Genetic Algorithm. This module justifies the I.E.,s findings based on the K.B. and working memory patient data.

- This was the year mathematician John McCarthy came up with the concept of artificial intelligence during a workshop at Dartmouth University. Artificial intelligence owes its illustrious "father" to him. [3]
- In 1978, Richard Bellman coined "the automation of activities associated with human cognitive skills, including learning, decision-making and problem-solving [4].
- A young British polymath named Alan Turing created the Turing test to show that computers, like humans, can use knowledge and reason to solve problems [5].
- Russell coined the term "artificial intelligence" as an example of "learning and problem solving" that people associate with other human brains (A.I.) [4].

- A self-learning supercomputer named "NAUTILUS" can look into the future, and it earned prominence when it identified Osama Bin Laden as a potential target for the U.S. government [5].

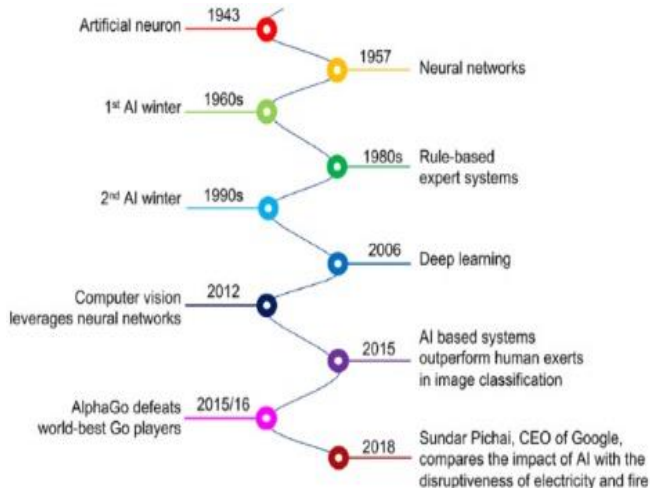


Figure 2: Milestones in the development of artificial intelligence (A.I.)

III. LITERATURE SURVEY

When it comes to Orthodontics (Dentistry), Jorge Faber has examined A.I. and machine learning in Orthodontics (Dentistry), as well as diagnostics and the future of the field. He has determined that although A.I. offers problem-solving skills, it currently overlooks oral illnesses and their occurrence. [6]

M. Makaremi studied dental surgery in A.I. and its applications in medicine, surgery, treatment planning, and follow-up and concluded that A.I. is to create a helpful link between its own and clinical sense. It must thus be seen as a tool for use rather than an existential danger for everyone to comply with this [7].

Ganesh Shetty has written extensively on the history and current state of artificial intelligence and machine learning in dentistry, concluding that oral illness is still a mystery due to the widespread lack of knowledge in the field. [8]

Abirami Vetrivelan, an expert in dentistry, has outlined the various aspects of prediction and planning, including the growth and outcomes of treatment planning, as well as the future perspective, and concluded that focusing on integrated cloud platforms, establishing extensive data to improve learning algorithms, will help in predicting the outcome faster to improve the quality of treatment [9].

When describing the future of orthodontics, Jeyaram Palanivel focused on using artificial intelligence (A.I.) and how it would be used in dentistry. A.I. also creates immediate issues like privacy, prejudice, inequality, safety, and security. Cybersecurity dangers and trends have been uncovered, and the difficulties at the crossroads of artificial intelligence,

digitization, and nuclear weapons systems have been investigated thanks to the work of CSER. Because of this, those who utilize it must have a firm grasp of models to supplement rather than replace human expertise in clinical decision-making [10].

Artificial Intelligence (A.I.) is already making progress, but healthcare experts will always make the ultimate decision since it is a question of human health, according to Anna Monill-Gonzalez .

Shajahan P A, in his explanation of the use of A.I. in prosthodontics, outlined the various types of artificial intelligence and machine learning, as well as the specific applications in dentistry. Shajahan P concluded that while A.I. can assist professionals in their work, it cannot take the place of the knowledge that can only be gained through experience.

S.T.Shan, a researcher in the field of artificial intelligence in dentistry, compared the diagnosis, treatment, and prediction methods used in different medical domains and concluded that A.I. must consider human interest as the primary development, which usually helps to handle large datasets to be successful [1]

As Thomas T.Nguyen pointed out, the future of artificial intelligence in dental care cannot be disregarded because of the new concept of "MIXED REALITY," which describes how A.I. systems can achieve certain elements. Dental practitioners can see the most significant potential results [11].

Shilpi Sharma highlighted the current principles of A.I. in dentistry by outlining the sorts of applications in real-time with examples, the benefits, and limitations; Shilpi Sharma; and because only humans are capable of incorporating and using these strategies, it cannot be controlled in any case without a framework in place.

Dr. Manshi Jaiswal offered the article, which claims that patients are aware of A.I. in Dentistry, which discusses public health and its position and concludes by noting that A.I. must link the future of public and health care delivery. Since A.I. is in charge of data storage and administration, it should answer to the general public. As a result, the quality of service will let users better comprehend the backend process revolution [12].

IV. DISCUSSIONS AND CURRENT WORK

We can get a handle on the field's breadth and depth thanks to artificial intelligence. The ups and downs in this industry may be predicted using many different methods. Allow me to aid your comprehension of the concept's density.

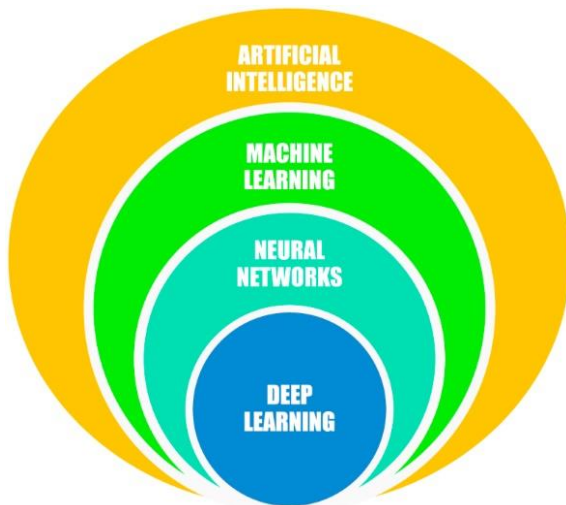


Figure 3: Key aspects of artificial intelligence.

A. Machine Learning

Machine learning is a field of computer science that deals with designing and using algorithms that enable computers to learn from data. In simple terms, machine learning allows computers to automatically improve their performance by "thinking" for themselves.

This technology can be used in many ways, including customer service, fraud detection, online advertising targeting, natural language processing (NLP), and more. Machine learning models are often built using large amounts of data sets so they can learn specific patterns and insights over time. This enables machines to make predictions or decisions based on past experiences or observations.

Machine learning has become a hot topic recently due to its vast potential benefits for businesses across all industries. As artificial intelligence (A.I.) continues to evolve exponentially, it becomes increasingly important for companies to find new ways of leveraging machine learning technologies to not fall behind the competition!

B. Artificial Neural Network

With the advancement of this technology, we can now see how the human brain works as a structure or biological brain that can discern patterns in data management and decision-making. The level can always be predicted using this method since it can determine patterns in data. The benefit of this technology is that it will link dentists all over the globe. To put it another way, an ANN gets its input from the outside world through "a pattern and picture in the form of a vector," according to one approach.

Figure 4a depicts a specific form of multilayer feedforward neural network implementation in which values and functions are calculated along the forward pass route. There are several input layers, and each layer's non-linear activation function (f) is represented by y . The subscript letters show the weights of the two units in the adjacent levels, and b is the

bias value for the unit.

RNN unrolling is shown graphically in Figure 4b. It is possible to create a 3-layer RNN by unfolding or unrolling a network three times, like in the case of a 3-word phrase as input.

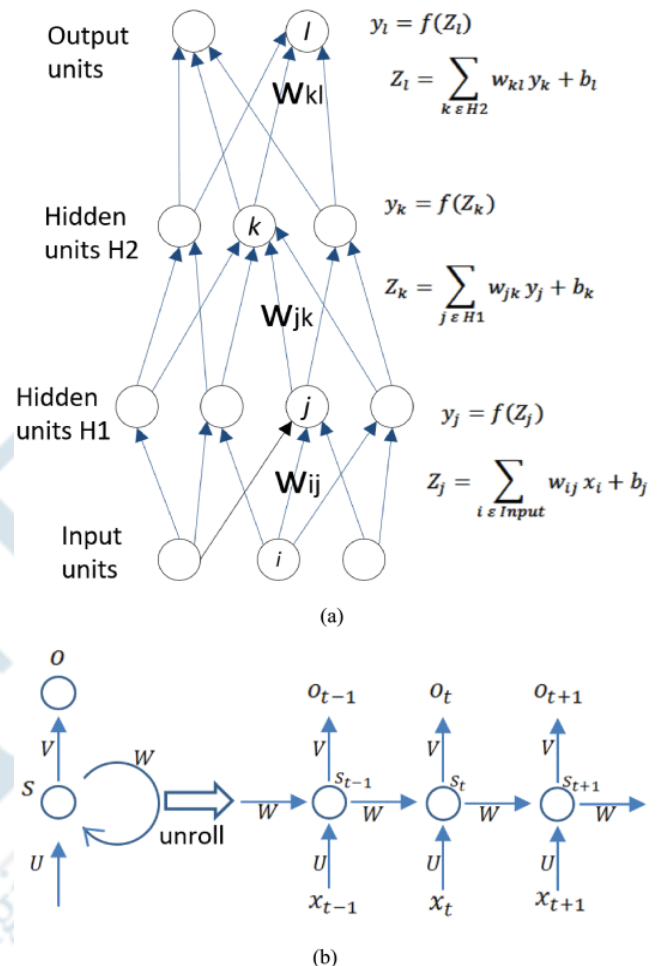


Figure 4: (a) Feedforward neural network. (b) The unrolling of RNN in time

A neural network that mimics the human brain's structure is known as an Artificial Neural Network. This approach is used in clinical diagnosis, Radiology, image analysis, data analysis in ICU situations, and waveform analysis.

C. Fuzzy Logic

In 1962, Lotfi defined it as the science of human reasoning, thinking, and inference that detects and employs real-world phenomena to understand outcomes and diagnoses. In the 1960s, Lotfi of the University of California at Berkeley proposed the concept of fuzzy logic.

He further explained that it is a subset of computer logic distinct from Boolean algebra. Many expert systems and neural networks use this idea. Rather than relying on the permutation of specific data, the practitioner can anticipate speedier outcomes.

D. Deep Learning

Deep Structured learning is another name for this approach. This technique is a member of the Machine Learning ilk. "A Class of Machine Learning methods that employ many layers to extract higher-level characteristics from the raw data input gradually" is how scientists describe this methodology. Virtual assistants, for example, or image processing.

Multiple levels in the network are referred to as "deep" here. Machines can tackle complicated issues even with access to a large, unstructured, interconnected dataset. These algorithms improve in performance as they accumulate knowledge.

E. Clinical Decision Support System

Data is analyzed by a Clinical Decision Support System (CDSS) to assist healthcare practitioners in making choices and improving patient care. If you're looking for an example of a CDSS, you may go to pharma information systems, which can flag critical care values or suggest dangerous medication interactions.

"A health information technology offers physicians, staff, patients or other persons with knowledge and person-specific information, intelligently filtered or provided at suitable moments to improve health and care units," is the general description by researchers. This helps dentists maintain track of patient data and allows future patients with comparable difficulties to be treated this way. [15]

V. APPLICATIONS IN DENTISTRY

A. Data Management

- Artificial Intelligence has a critical role in dentistry in protecting the privacy of patients' data and treating patients based on their primary data source.
- Alerts generated by this technology assist dentists keep track of their patients' regular visits and general exams.
- Maintaining the patient's name, medicine, scans, and phases they've gone through should be the first step in the database's creation.
- In recent years, Tele assistance has been widely accessible, allowing patients to use it at any time or day of the week. Patients may benefit from this even if they don't interact with dental experts. Depending on the situation, it may also recommend currently available specialists.

B. Scanning

- There are several apps in the area of dentistry that assist patients in scanning data in case of an emergency.
- Orthodontists benefit from tools like "OneCeph," which allows them to scan patients from head to chin. [16]

- An orthodontist created it to assist clear aligner patients in remembering to wear their trays so that they may complete their treatment in the allotted timeframe. The patients can follow their development using this program, enabling them to take photos from the beginning to the conclusion.
- Sharing and receiving X-rays, PDFs, and images using Rhino gramme is safe [17][18].
- In minutes, A.I.'s Scan-Box (Smile Mate) analyses various dental and orthodontic conditions.

C. Pharmacy

- As a result of A.I., it is now possible to follow a medicine from the moment it is purchased until it is completely depleted.
- Pharmacies learn about the product to be bought in this manner.
- Several apps may send alerts when a medication is being stored or will be made available.
- For patients to get all of the medicine's advantages, a mechanism might advise the medication under specified conditions. [19]

VI. ARTIFICIAL INTELLIGENCE IN MEDICAL DOMAIN

A. Orthodontics

- Intraoral scanners may be used to diagnose and treat dental issues. This will alleviate the patient's need to whirl around circles during the scanning procedure. Human perception is not as precise as the Mechanism. The therapy and its effect may also be predicted using a variety of algorithms.
- Once, researchers, Seok-kiJunga, studied to build an expert system for extraction diagnosis using neural networks and machine learning to assess the performance. According to this System, artificial intelligence and Machine Learning may be used in orthodontics. [20]

B. Prosthetic Dentistry

- Dentistry deals with the restoration of natural teeth and the repair of lost teeth with dental prosthetics.
- Mormann initially developed this idea in Germany in 1989.
- Rapid is a computer-aided design system that uses databases and information from computer-aided design systems.
- With this medium, the dentist can make the most of their time with patients.
- Digital smile design is a technology used in contemporary dentistry that helps dentists develop a plan of action before creating a new smile, making this

procedure less tedious.

C. Periodontics

- Doctors can cure gum disease in mild, moderate, and severe cases if they focus on the germs that cause it.
- The most typical symptom of severity in this sector is the loss of tissues, bone loss, and changes in bone density. [21]
- Antimicrobial Robots have been able to remove germs and biofilm via catalytic action, according to a recent report.

D. Radiology

- We use imaging techniques such as cone beam and MRI tomography to detect the tiniest deviations from normal.
- Any radiologist can easily anticipate the picture labeled normal or abnormal.
- Using this procedure, you may identify issues including dental decay, impacted teeth, and cavities. Images or X-rays relating to that will aid the dentist in planning the treatment [22].

E. Endodontics

- "Finding a method to bring the teeth back to a healthy condition in a natural manner is our (endodontist) task," one person remarked.
- This field of dentistry focuses on the tissues and pulp around a tooth's roots and is known as endodontics. An endodontist may assist salvage a tooth that has been neglected because of deterioration.

F. Oral Pathology

- "Oral Pathology" (O.P.) is the branch of dentistry that studies the causes, symptoms, diagnosis, treatment, and follow-up of illness in the oral and maxillofacial areas [23] [24].
- Pain, Cavities, Cancer, Infections, Tooth Loss, and Gum Condition are the primary causes of this disease.

VII. FUTURE OF ARTIFICIAL INTELLIGENCE

Inhumane operation in intensive care units. The use of Artificial Intelligence in dentistry may be shown in a variety of ways [25]. However, there is still a need for better data accuracy, data security, and predictive technologies. Using robots to do surgery and other medical procedures will also be more accurate in the long run [26].

VIII. PROS AND CONS

1. In every situation, there is a regular protocol in place.
2. Saves process time
3. Outcomes or outcome.
4. Cost is not predictable
5. Mechanism is huge

6. To estimate the accuracy, a massive amount of data is required.
7. Techniques should be versatile to determine which situations can be analyzed and what can be substituted.[27] [28]

IX. CONCLUSION

Alan Perlis said, "A year in Artificial Intelligence is sufficient to induce faith in God." This means that there are distinct approaches for various illnesses, which may be used in the footsteps of past researchers. These procedures will improve the treatment provided to patients. On the other side, the System will continue to demonstrate that it is in the nascent stage, albeit this may not always be the case. This development will improve patient care. A.I. will aid in several ways, but specialists will make the ultimate choice. [19]. As a result, the article concludes that using A.I. approaches and the skills and expertise of a doctor, a researcher should be able to uncover fresh insights into a particular method and a creative solution to a problem.

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