International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 03 | March - 2024 SJIF Rating: 8.176 ISSN: 2582-3930

A Survey on Dentes Condition Detection System Using Machine Learning

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Abstract - For dental health to be maintained and consequences to be avoided, early diagnosis of diseases connected to dentes is essential. Missed treatment possibilities arise from dentists' frequent inability to visually identify these problems. In response, a real-time X-ray analysis model has been created to quickly and precisely identify dental issues. This invention improves patient care by accelerating treatment planning and reducing the possibility of misdiagnosis. The concept saves time and dollars by streamlining diagnostics through the use of cutting-edge imaging technology. It increases the efficiency of dental care by doing away with time-consuming manual examinations. This model allows for early intervention in diseases connected to dentes, which represents a significant development in dental diagnosis.

1. INTRODUCTION

X-rays and other forms of medical imaging have revolutionized diagnosis in all fields of medicine, including dentistry. This technology is being used by a new area called dental informatics to create large datasets from high-resolution sensors. Treatment planning and decision-making can be enhanced by this data in conjunction with dentist competence. By sending radiation through the mouth, X-rays are able to create a two-dimensional image of the interior structures. There are two primary varieties: extraoral (patient positioned between X-ray source and film) and intraoral (film placed within mouth). A frequent extraoral type of X-ray that gives a broad view of the mouth, jaws, and head is the panoramic variety. Although these X-rays are typically manually interpreted by dentists, imprecise images can result in incorrect diagnosis. This system uses the extraoral type of x-ray in order to detect the condition of tooth and to avoid incorrect diagnosis.

2. FEATURES

A novel machine learning-based dental X-ray analysis system has multiple characteristics to enhance diagnosis. It provides instantaneous findings, indicating possible dental cavities, decrease of bone density, and other problems. The algorithm, which has been trained on large datasets, may be more accurate than conventional techniques, which could lead to fewer missed diagnoses. Workflows are streamlined by automation, giving dentists more time to treat patients. Standardized analysis also provides faster identification, which guarantees consistency and may lead to earlier interventions. With its intuitive interfaces and configurable features, this technology has the potential to completely transform dental care by improving diagnosis times, accuracy, and reduction of human error.

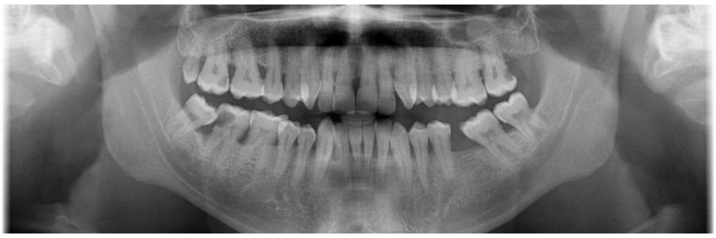

Fig -1: Panoramic X-ray Image

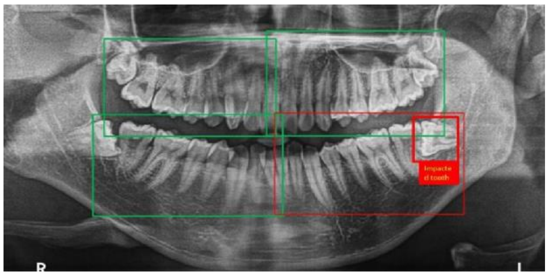

Fig- 2: Detected diseases

this advanced system offers scalability, adapting to diverse clinic settings and patient populations. Its ability to integrate seamlessly with existing dental software enhances workflow efficiency. Continuous updates and refinements ensure ongoing improvement in diagnostic accuracy and capability. By empowering dentists with comprehensive insights, it facilitates personalized treatment plans tailored to each patient's needs. Ultimately, this innovation heralds a new era in dental healthcare, promising enhanced outcomes and patient satisfaction.

3. LITERATURE REVIEW

The field of dentistry is embracing machine learning for automatic detection of cavities in X-rays. In the paper "Automatic diagnosis and detection of dental caries in bitewing radiographs using pervasive deep gradient based LeNet classifier model," G. Vimalarani and Uppu Ramachandraiah propose a system for bitewing X-rays (show both upper and lower teeth). Their system combines image processing techniques with a deep learning model called LeNet. The system first identifies the relevant tooth area and any dark spots that might indicate cavities. Then, it extracts key details from the image, such as tooth shapes, textures, and bone density variations. Finally, the LeNet model classifies the entire X-ray as normal or abnormal and pinpoints the location of any potential cavities.

Another study, "Deep learning convolutional neural network

algorithms for the early detection and diagnosis of dental caries on periapical radiographs," by Nabilla Musri, Brenda Christie, and Arief investigates the use of deep convolutional neural networks (CNNs) for early detection of cavities in periapical X-rays (single tooth image). CNNs are particularly useful because they not only classify images but also pinpoint the location of detected features, crucial for identifying the exact location of caries within a tooth. Additionally, CNNs can be trained on large datasets, allowing them to handle a wide range of cases and detect even subtle signs of early decay.
The paper "Deep Learning Models for Classification of Dental Diseases Using Orthopantomography X-ray OPG Images" by Muhammad Ramzan, Amsa Imam Din, and Khalid Mahmood Aamir explores a deep learning model called YOLOv3 for automatic detection and classification of four common dental problems in panoramic X-rays (broad view of the upper and lower jaws). Their model can identify cavities, root canals, dental crowns, and broken-down root canals within the X-ray image. This research highlights the potential of deep learning for not only detecting cavities but also classifying various other dental conditions.

4. METHODOLOGY

Pres-processing: Raw X-rays are cleaned and standardized. This might involve noise reduction, contrast adjustment, and image resizing.
Feature Extraction: Key information is extracted from the image. Features could include tooth shapes, textures within the teeth, and bone density variations.
Training: The system is trained using a large dataset of labeled X-rays. Each X-ray is labelled with the presence or absence of dental issues. The ML model learns to identify these patterns in the extracted features.
Testing: The trained model is evaluated on a separate dataset of unseen X-rays. This assesses the model's accuracy in detecting dental problems.
Improvement: The system is continuously improved. This involves analyzing errors, refining feature extraction methods, and retraining the model with more data. Additionally, incorporating dentist feedback can further enhance detection accuracy.

5. CHALLENGES AND FUTURE DIRECTIONS:

Although they have challenges, ML teeth identification methods using panoramic X-rays show promise. Data quality is crucial because biased information can harm some patients and lead to incorrect diagnoses. Existing systems address a narrow range of problems, such as cavities. Additional research and data are needed to detect a larger range. Practical issues and regulatory barriers also occur. Medical device AI approval moves slowly, thus it's important to seamlessly integrate the system with dentist workflows. Cost is a challenge, to sum up. To increase accessibility and enhance patient care for all, it is crucial to strike a balance between development and affordability, particularly for smaller practices.

6. CONCLUSIONS

The core of the system is a deep learning model called a "semantic segmentation CNN." This model is trained on the processed data and essentially analyzes the X-ray to create a new image highlighting different areas based on potential dental problems. Next, the system refines any initial errors in identifying individual teeth within this new image to ensure accuracy. Finally, for each tooth, the system analyzes the surrounding area in the original X-ray and uses a voting system to determine the most likely dental problem. This information is then compiled into a report listing the issues found in each tooth or tooth area. Overall, this approach aims to assist dentists in the diagnosis process by automating these tasks, potentially saving time and improving accuracy. Basically, machine learning is showing promise for the future of dentistry.

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