# START DATE:20-10-23 (Draft Preliminary Paper)

# **DentalAI**

# **Bridging Expertise and Innovation for Early Diagnosis of Dental Diseases Using OPG X-ray**

**Objective**

Imagine a collaboration where dental expertise meets cutting-edge technology. That's exactly what's happening in this project. a combination of dental professionals and tech enthusiasts working together to revolutionize how we diagnose dental diseases.

*Our focus:* The analysis of Dental digital images like Chephalograms, Intra oral periapical radiography (IOPA) and Orthopantomograph (OPG) X-ray images, aiming to create a smart neural network capable of spotting a variety of dental conditions early on.

Meet our team: A diverse mix of dental experts, from oral medicine and radiology to endodontics and Oral and maxillofacial surgery, joining forces with tech enthusiasts. Together, we're on a mission to bring AI to the forefront of dental diagnostics.

* Dr. Srikanth Putta: Bachelor of Dental Surgery, currently pursuing master’s in health informatics at the University of Limerick.
* Dr. Akshitha Tadem: Bachelor of Dental Surgery, currently pursuing master’s in dental public health at the University of Cork.
* Dr. Nagesh Ramson: MDS - Oro maxillofacial Surgeon, Consultant.
* Dr. Meghana: MDS - Endodontist, Consultant.
* Dr. Nanda Sai Krishna: Currently pursuing MDS endodontics.
* Dr. Srinidhi: MDS - Oral Medicine and Radiology, Assistant Professor.
* Dr. Supraja: Currently pursuing MDS Oral and maxillofacial surgery.
* Dr. Santosh: Currently pursuing MDS Oral and maxillofacial surgery.
* Dr. Pranay Kumar: Bachelor of Dental Surgery, Junior Dentist.
* Srujan Patel Manthena: Master’s in computing from Griffith College Dublin.
* Jayavardhan Reddy: Master’s in Computer Science from Sacred Heart University(USA)

*Our goal is simple:* to make dental diagnostics more accurate and efficient. Teaching a computer to recognize a broad range of dental conditions, from abfraction to apicoectomy, caries signs, dental calculus, attrition, and a host of periodontal issues. With input from our dental partners.

Think of this documentation as a backstage pass to our process. We spill the beans on how we collect and annotate data, why we chose the AI models we did, and the real-world impact of the conditions we're focusing on. We'll also give you a glimpse into why it's so important for us to collaborate closely with dental professionals, ensuring our AI is not just accurate but clinically sound.

Why does this matter? Picture a future where your dentist has a high-tech sidekick that spots potential issues early, leading to quicker and better treatments. That's the future we're working towards. This project is more than just pixels on a screen; it's about improving the lives of patients by making dental care smarter and more personalized.

As we navigate the intersection of dentistry and technology, this project embodies the potential of AI to transform how we care for our oral health, we’re on a journey to a future where technology and dental expertise join forces for better smiles and healthier lives.

**Project Overview:**

The project aims to detect a diverse range of dental conditions, including but not limited to Abfraction, Apicoectomy, Artificial Crown, Attrition, Canal Obliteration, Caries Signs, Cervical Resorption, Dental Calculus, Endodontically Treated Tooth, External Resorption, Extrusion, Filling, Furcation Lesion, Horizontal Displacement, Horizontal Root Fracture, Hypercementosis, Impaction, Indirect Restoration, Internal Resorption, Intrusion, Lack of Interproximal Contact, Lateral Luxation, Mixed Type, Open Margin, Orthodontic Appliance, Overeruption, Overhang, Periapical Radiolucency, Periapical Radiopacity, Periodontal Bone Loss, Pre-eruptive Resorption, Pulp Stone, Pulpotomy, Secondary Caries, Tooth Stump, Vertical Root Fracture, Voids in Filling, Crown Defect, and various Periodontal Pathologies.

*Dataset Collection:* A comprehensive dataset of OPG X-ray images is being collected from clinics in India. This dataset encompasses a wide spectrum of dental conditions, providing a realistic and diverse representation of cases. Collaborations with dental professionals ensure the inclusion of nuanced cases for effective model training.

*Annotation Schema (Collaboration with Dental Professionals):* Working closely with dental professionals, we've developed an extensive annotation schema covering newly added conditions such as Apicoectomy, Canal Obliteration, Horizontal Root Fracture, Furcation Lesion, Impaction, Overeruption, Periradicular Pathologies.

This schema ensures that our model understands the sensitivities of each condition for accurate detection.

**YOLOv3 Selection:** Our deep learning model is based on YOLOv3, chosen for its real-time object detection capabilities. The adaptability of YOLOv3 aligns well with the diverse and multi-class nature of the dental diseases we aim to identify.

**Integration with PyTorch**: Implementation of our model is carried out using PyTorch, a dynamic and efficient deep learning framework. PyTorch facilitates rapid prototyping and experimentation, enabling us to iterate quickly on model architectures and optimizations.

**Leveraging TPUs for Acceleration:** To expedite the training process, we explore the use of Tensor Processing Units (TPUs) for accelerated model training. This approach ensures efficient processing of the extensive dataset, leading to quicker model union(A big thanks to google’s generous **TPU Research Cloud program** ).

***Natural Language Processing (NLP) Integration:*** The incorporation of NLP further enhances the interpretability of our model's findings. NLP capabilities will be integrated to generate human-readable reports, translating complex model outputs into clinically meaningful insights.

**Future Work:**

In our journey to reshape dental diagnostics, we visualise seamlessly integrating Cone Beam Computed Tomography (CBCT) images into our project. CBCT, with its higher level of detail and three-dimensional perspective, holds the potential to significantly enhance the accuracy and precision of our dental disease detection model. Envision a future where we not only detect dental conditions more accurately but also generate interactive 3D images. These dynamic visuals will empower dentists to virtually rotate, zoom, and explore anatomical structures in three dimensions, a personalized, high-tech tour of their patients’ teeth conditions. This technological advancement reflects our commitment to providing dental professionals with an advanced, user-friendly tool, making diagnosis and treatment planning more insightful and efficient. As we evolve, so does our dedication to leveraging cutting-edge imaging technologies for the benefit of both dental practitioners and their patients.