ANA502 Revised Proposal: Image classification for Oral cancer detection from clinical images

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1. Introduction and Motivation

Early detection of oral cancer remains essential for improving survival rates because this condition continues to emerge as a serious public health issue. Medical specialists who practice dentistry depend on visual assessments together with biopsy screenings, although this method requires a lot of time while being subjective and requiring expert knowledge. Machine learning advancement in medical imaging offers a path toward developing automated oral cancer detection, helping clinical staff improve their ability to identify malignant oral lesions.

Experiences gained from orthodontic image classification at my Curricular Practical Training (CPT) program enabled me to work with medical images, which led me to apply this knowledge toward detecting oral cancer. Additionally, this project allows me to integrate concepts from my school program in data analytics, machine learning, and image processing, bridging academic learning with practical applications. By utilizing machine learning and publicly accessible datasets, this study aims to establish a diagnostic system that differentiates cancerous from non-cancerous oral lesions, contributing to early diagnosis and improved patient outcomes.

2. Research Question

Does Machine learning possess the ability to detect oral lesions between cancerous and non-cancerous categories therefore accelerating early detection and diagnosis?

3. Dataset Selection

The dataset I will utilize originates from Kaggle where it contains oral image with Cancer or Not Cancer label. Kaggle has 111 image of oral cancer images, and 130 images of non-oral cancer images. Data type is RGB clinical images labeled as cancerous or non-cancerous. It’s a public dataset from Kaggle, suitable for research and experimentation. **Because these images are taken from various angles, it may require trying sampling or data augmentation during data preprocessing phase.**

<https://www.kaggle.com/datasets/smahmedhassan/oral-cancer-dataset/data>

4. Methodology

The project will follow a structured deep learning approach:

4.1.Data Collection & Preprocessing

* The Oral Cancer Dataset from Kaggle will be used. It contains 111 images of oral cancer and 130 non-cancerous oral images, labeled for classification.
* Images will be resized, normalized, and augmented (rotation, flipping, brightness adjustment) to improve model generalization.
* Address class imbalance using oversampling or synthetic image generation (e.g., SMOTE).

4.2. Model Development

* Implement CNN-based architectures such as ResNet-50, EfficientNet, and MobileNet for feature extraction.
* Train models using transfer learning with pre-trained weights from ImageNet.
* Compare multiple architectures to identify the best-performing model.

4.3. Model Training & Evaluation

* Train using an 80-20 train-test split and validate using cross-validation.
* Measure performance with accuracy, precision, recall, F1-score, and ROC-AUC curves.

5. Expected and Anticipated Outcomes

* A trained model that classifies oral cancer with high accuracy
* Performance benchmarking against existing medical image classification techniques
* Lack of dataset volume and metadata

6. Conclusion & Next Steps

This project aims to build a robust AI-based system for oral cancer classification, enhancing diagnostic efficiency and accessibility. Future enhancements include:

* Expanding the dataset with more diverse clinical cases.
* Integrating an explainability module to provide insights into model predictions.

**However, these methodologies often lack interpretability, hence we may employ Grad-CAM to visualize how model captures the images to overcome this challenge.**