

SMILE-Q: Smart Mucositis and Implant Learning Engine for Qatari Population

Project Description

Dental implants are a widely used treatment for replacing missing teeth. They are commonly fabricated from titanium alloys and placed surgically into the jawbone; once osseointegration has occurred, implants support crowns or other prostheses to restore oral function. In Qatar, implant therapy is widely available across both public and private sectors and is increasingly part of routine dental restorative care.

Peri-implant diseases are inflammatory conditions affecting the soft and/or hard tissues surrounding dental implants and highly prevalent globally, with meta-analyses indicating that roughly 50% (43–63%) of patients with dental implants experience peri-implant mucositis and approximately 15–20% (up to 25%) suffer from peri-implantitis. These complications impose clinical, social, and financial burdens on patients and can increase demands on dental services. Management of peri-implantitis is often complex, may require surgical intervention for surface decontamination and pocket management, and in some cases necessitates implant removal and re-rehabilitation. Earlier diagnosis of peri-implant mucositis is therefore a high-impact opportunity to prevent progression. In clinical practice, mucositis is primarily identified by bleeding on gentle probing alongside visible signs such as erythema and swelling.

In this proposal we aim to build an AI-enabled federated decision-support and diagnostic system that analyses standardized intra-oral photographs to detect early peri-implant inflammation. Image analysis will focus on reproducible photometric and morphological changes around implant sites. To increase clinical validity and usefulness, the outputs will be integrated with patient record meta-data. Combining image-based signals with structured clinical records will enable personalized risk stratification and support more accurate diagnosis and management decisions at the point of care.

Duties / Activities

Students will:

- Work with large-scale intra-oral image datasets
- Perform standard computer vision algorithms
- Implement deep learning architectures in PyTorch
- Train and debug GPU-based models
- Evaluate model performance and interpret results
- Conduct ablation studies and hyperparameter tuning
- Document findings and prepare reports

Required Skills

- Strong programming skills in Python
- Understanding of machine learning fundamentals
- Familiarity with PyTorch or other deep learning frameworks
- Basic knowledge of data preprocessing and evaluation metrics
- Experience with Git and version control
- Ability to debug and work in GPU environments

Nice to Have:

- Experience with computer vision algorithms.

Learning Opportunities

Students will gain experience in:

- Computer vision related methods
- AI application in Healthcare field
- GPU model training
- Large-scale image datasets engineering

Potential outcomes include:

- Research publication contributions
- Extension into other oral lesions
- Development of a reusable dental-related framework

Expected Team Size: 2-4

Mentor

Name: Dr. Mohamed Elshrif

email: melshrif@hbku.edu.qa