Traditional Image Analysis:

* Color and Intensity Analysis
  + Detect discoloration, plaque buildup, gum redness (possible inflammation).
    - RGB thresholding (e.g., red = inflamed gum area)
    - Colorimetric analysis of intraoral scans: A novel approach for detecting gingival inflammation [23]
* Edge Detection
  + Identifies boundaries between regions (teeth, gums, cavities).
  + Outline tooth contours, detect misalignment, identify gaps or missing teeth.
* Shape and Contour Analysis
  + Detect crooked teeth, missing teeth, or gum line irregularities.
    - Contour tracing and convex hull detection
    - Hough Transform
* Texture Analysis
  + Differentiate smooth enamel vs. rough surfaces (plaque, tartar)
* Thresholding and Segmentation
  + Separates objects (teeth, gums) from background. Isolate and focus on teeth only.
    - Enhancing Dental Image Segmentation Techniques: Edge Detection and Color Thresholding [24]
* Optical Flow or Feature Matching (Progress Monitoring)
  + Monitoring progression of discoloration, gum recession, or whitening.
  + Adapt for orthodontics?

References:

[23] https://aap.onlinelibrary.wiley.com/doi/epdf/10.1002/JPER.24-0389

[24] https://www.semanticscholar.org/reader/51171008eb627ec83b1a1cdd4325682bd017db28

Potential Data Sets:

ODSI-DB – Oral and Dental Spectral Image Database

<https://sites.uef.fi/spectral/databases-software/odsi-db/>

Dental Calculus Dataset [10]

<https://github.com/PKNU-PR-ML-Lab/calculus>

Kaggle Dental Caries Dataset

<https://www.kaggle.com/datasets/maazmakhdoom/dental-cavity-detection-dataset>

Roboflow Cavity Detection Sets

<https://universe.roboflow.com/search?q=class%3Acavities>

1.4 Preliminary Risk Assessment  
**• Health and Safety**: Identify risks to end-users and the public’s health and safety that may arise from your project. Risks can be associated with the implementation,

prototyping, verification, manufacturing, or deployment associated with your project

Health/Safety-> more applications on radiographs in dental industry, not applicable to our application unless hardware design is included

Safety Specifically -> Data Encryption, personal privacy

**• Ethical Concerns**: Identify ethical concerns that may arise from your project and their impact on society

<https://scanoai.com/ethical-concerns-of-artificial-intelligence-in-dentistry/>

great website for identifying risks and potential solutions

**Exploring the Ethical Landscape of Artificial Intelligence in Dentistry: Insights from a Cross-Sectional Study**

<https://pmc.ncbi.nlm.nih.gov/articles/PMC12093131/#sec4>

* **Human Oversight & Liability**  
  • AI should support, not replace, dentists’ decisions  
  • Who is liable if AI leads to error? (consensus: AI shouldn’t carry full blame)
* **Transparency & Bias**  
  • AI “black box” problem — need explainability  
  • Bias in training data could skew outcomes
* **Informed Consent & Patient Autonomy**  
  • Patients must know AI’s role in care  
  • Must explain risks, uncertainties, alternatives
* **Data Privacy & Confidentiality**  
  • Sensitive dental/health data must be protected  
  • Storing in personal devices raises red flags
* **Financial Incentives / Conflicts of Interest**  
  • Referral fees from radiology centers may bias care decisions  
  • Overuse of imaging or treatments for profit
* **Disclosure of Complications & Errors**  
  • Must inform patients of problems (e.g. broken instruments)  
  • Withholding is unethical, even if outcome “acceptable”
* **Patient Demands vs Scientific Integrity**  
  • Reject requests for inappropriate procedures (e.g. crown on failing tooth)  
  • Respect patient wishes, but not at cost of professional ethics
* **Peer Accountability**  
  • Dilemma: when noticing substandard care in colleagues, should one report / inform patient?  
  • Many prefer to avoid conflict, but patient welfare may demand action
* **AI’s Limits in Moral Reasoning**  
  • AI may know rules and facts, but lacks empathy, context sensitivity  
  • Ethical decisions often require human nuance

**Legal issues in digital oral health: a scoping review**

<https://pmc.ncbi.nlm.nih.gov/articles/PMC10765871/#Sec10>

* **Privacy & Data Security**  
   • Handling massive amounts of patient data demands encryption, anonymization, secure storage.  
   • Risk: data breaches, misuse, unauthorized access.
* **Algorithmic Bias & Fairness**  
   • AI trained on skewed data may perpetuate health disparities.  
   • Need to monitor, correct, retrain models to ensure equitable outcomes.
* **Transparency, Explainability & Accountability**  
   • “Black box” decisions reduce trust — patients & clinicians need to understand AI reasoning.  
   • Clear responsibility: who is liable when AI errs (developer, institution, clinician)?
* **Human Oversight & Autonomy**  
   • AI should augment, not replace human judgment.  
   • Patients must be informed when AI is used, with risks/limits disclosed.
* **Impact on Health Professionals**  
   • Role shifts: clinicians may become supervisors of AI.  
   • Risk of deskilling or displacement if over-reliance on AI.
* **Societal Implications & Equity**  
   • Digital divide: some populations may lack access to AI-based care.  
   • Bias in deployment may widen inequities.
* **Regulation, Legal Challenges & Governance**  
   • Need adaptive, domain-specific rules (liability, data rights, IP).  
   • Ethical frameworks must evolve with technology.
* **Limits of Ethical Reasoning by AI**  
   • AI lacks empathy, moral intuition, nuanced contextual judgment.  
   • Some decisions require human values and deliberation.

<https://jada.ada.org/article/S0002-8177(24)00301-5/fulltext>

Article on what rules or policy AI should follow

WMA pólices:

<https://www.wma.net/policies-post/wma-statement-on-the-ethics-of-telemedicine/>

Archived telemedicine ethics: <https://www.wma.net/policies-post/wma-statement-on-guiding-principles-for-the-use-of-telehealth-for-the-provision-of-health-care/>

**• Standards and Codes**: Identify appropriate standards, codes, and legal or regulatory factors associated with your project's implementation, prototyping, verification, manufacturing, or deployment. What are the risks of non-compliance?

**Standards:**

* **CDHA** national professional organization that advocates for dental hygienist and promotes the profession
  + <https://files.cdha.ca/profession/ip/2022_Service_Codes_Appendix_EN.pdf>
* A white background with black text

  AI-generated content may be incorrect.
  + **CDHA Code of ethics**:
    - <https://cdha.org/Portals/CDHA/About/Governing%20Docs/CDHA%20Code%20of%20Ethics.pdf>
* **Standards** are set by provincial or territorial regulatory authority
* **Ontario: Follows CDA**
  + Ontario dental procedure codes are standardized, 5-digit alphanumeric codes based on the Canadian Dental Association (CDA) and other systems, used to identify services for billing and insurance purposes. General classification system groups code into categories
    - Diagnostic (00000-09999)
    - Preventive (10000-19999)
    - Restorative (20000-29999).
* **CDA Canadian Dental Association**
* a federally incorporated not-for-profit organization whose corporate members are Canada’s provincial and territorial dental associations (PTDAs).
* <https://hsps.pro/DentrixCanada/Help/mergedProjects/Office%20Manager/CDA_Dental_Codes_list.htm>
  + **Diagnostic codes**
    - <https://hsps.pro/DentrixCanada/Help/mergedProjects/Office%20Manager/CDA_Dental_Codes_list.htm#Diagnostic>   
      Note: It only provides a list of codes, short description + full name; we won’t understand without an expert’s help -> this might help for the common codes https://www.kwcdental.com/blog/dental-procedure-codes-ontario
  + **Ethical principles**
    - <https://www.cda-adc.ca/en/about/ethics/>
    - Note: These are the ethics that guide a dentist’s ethical practice, they are broad traits that lie under 2 categories specifically: Trust and Health

**Meeting with Dr. Smith 2025 10.16**

More accessible in China for dental health care; different in North America

Dr . Smith’s comment:

* There are people in America that would like to monitor all their health, so it has a potential market
* Glad that we looked in
* Thresholding is a segmentation technique -> google it a lot of AI comes up
* Using an existing model is acceptable, but training an AI is very difficult and unideal
  + - We have v2net v3 net that helps with this, use transfer learning
* More data sets – good very nice
* Q: Is gag required, is it a must for photo taking?  
  A: No, just to make pictures easier, if not used will require to take multiple pictures
* Need to talk to clients, potential clients and interview them ->ask their opinion
* Make an evidence-based decision to make capstone better
* Interface design (UI/UX) needs to ask users (friends, family members; could disclose the information)
* 10 individuals will be good 8-10 are good to show we are aware to the client’s need
* Surveys 5 mins (more data，put online)
* Real insight -> focus group/mock interface for individual (figma -> paper prototype) ask and show them how to use
  + People aren’t good enough to read design document so prototypes might be better
  + Min amount of typing
* Information tosses it in appendix
* Survey questions – Chapter 2 Could plan now the survey questions ahead and send them out asking about usability
* Google survey question and tweak it to meet our needs
  + Could let user themself to provide information themself on drop down
* Worst case if the diagnostic problems don't go well. It could be a method to collect information for the dentist
* Keeping everything broad ahead -> explore more design process   
  Start more general is a better approach
* Terms are a bit different between software stream and biomedical stream
* Deign inputs = constraints, requirements -> simplied software specification documents
* Want to say something about economic -> because we are targeting low-income people
* Is it washable
* Propose ideas you don't likes is okay i.e. surveys, mobile application, image analysis
* Dont mention the gag idea yet, its a design decision
* Give agenda ahead of time
* Use git hub to create issues and send it over to Dr. Smith and assign them to Dr. Smith

<https://github.com/ShadowOfShark/SFWRBME-5P06>

**Meeting with Dr. Vincent 2025 10.16**

**Agenda**

1. Apologize
2. Update Dr. Vincent
   1. Are there enough photos? Yes
3. Receive Feedback
4. Q: If we are not submitting DHF, where would the last 20% go for Chapter 1 draft
5. Any preference for how to hand back feedback

Go to teams for DHS set up -> send link in DHF need a document on how to access repo