

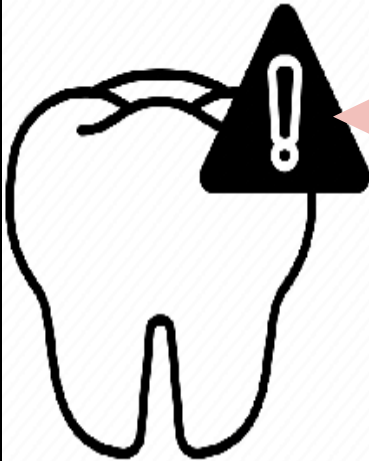
DENTAL HEALTH CLASSIFICATION USING CNNs

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Problem Statement & Solution



- Manually analyzing dental X-rays is time-consuming and prone to errors.
- Dentists require automated tools to detect cavities, fillings, implants, and impacted teeth.

- A deep learning-based CNN model that classifies X-ray images into dental categories.
- This solution provides fast, accurate, and automated analysis, assisting dentists in diagnostics.



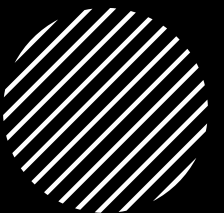
Dataset & Model

<https://www.kaggle.com/code/banddaniel/dental-x-rays-classification-test-f1-score-0-72>

Dataset consists of four categories :

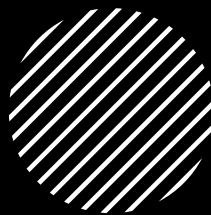
- Cavities
- Fillings
- Implants
- Impacted Tooth

Model: A Custom CNN and a Transfer Learning model





Model Comparisons and Observations



Feature	V1 (Baseline)	V2 (Initial Training)	V3 (Improvements)	V4 (Fine-Tuned)	VGG - 16	VGG - 16 (Fine - Tuned)
Number of Conv Layers	2 Conv Layers	3 Conv Layers	4 Conv Layers	4 Conv Layers	13(Pre-trained)	13(Partially Unfrozen)
Batch Normalization	No	No	Yes	Yes	No	No
Dropout Rate	0.5	0.5	0.6	0.5	0.5	0.5
Batch Size	32	32	16	32	32	32
Fully Connected Neurons	128	256	128	160	128	128
Learning Rate	0.001	0.0005	0.0003	0.00003	0.0001	0.00003
Data Augmentation	No	Yes	Yes	Yes (More)	Yes	Yes
Final Training Accuracy	36.77%	44.16%	44.52%	76.60%	58.56%	62%
Final Test Accuracy	33.34%	44.12%	45.14%	66.21%	57.84%	82.99%



Key Observations



Architecture Design

Custom CNNs (V1–V4):

- Built from scratch with gradually deeper architectures (from 2 to 4 convolutional layers).
- Fully controlled layer configuration: Conv2D, MaxPooling, Dropout, Dense layers.
- Model depth manually adjusted across versions.

Transfer Learning (V5–V6):

- Based on VGG16, a proven architecture trained on ImageNet.
- Started with frozen layers (V5), and fine-tuned deeper layers (V6).
- Rich pretrained features gave a strong head start in learning.

Key Observations



Learning Capability

Custom CNNs:

- Needed heavy data augmentation to generalize.
- Required trial-and-error for hyperparameter tuning.
- Limited feature learning capacity without large datasets

Transfer Models:

- Pretrained on millions of images → already captured low-level to high-level features.
- Fine-tuning allowed adaptation to our dental dataset, boosting performance.
- Required less augmentation due to generalizable patterns in pretrained layers.

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&
Attention



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Feedback and
Discussions