

# Smart Oral Health Guardian: Revolutionizing Dental Care with Deep Learning



# Agenda

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FUTURE SCOPE

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# Introduction

**Oral health involves the well-being of the teeth, gums, and entire oral-facial system. It is a crucial aspect of overall health, influencing not only physical well-being but also quality of life and self-esteem.**

- **Global Impact:**

- Affects nearly 3.5 billion people worldwide.
- Most common conditions include dental cavities, gum disease, and oral cancers.

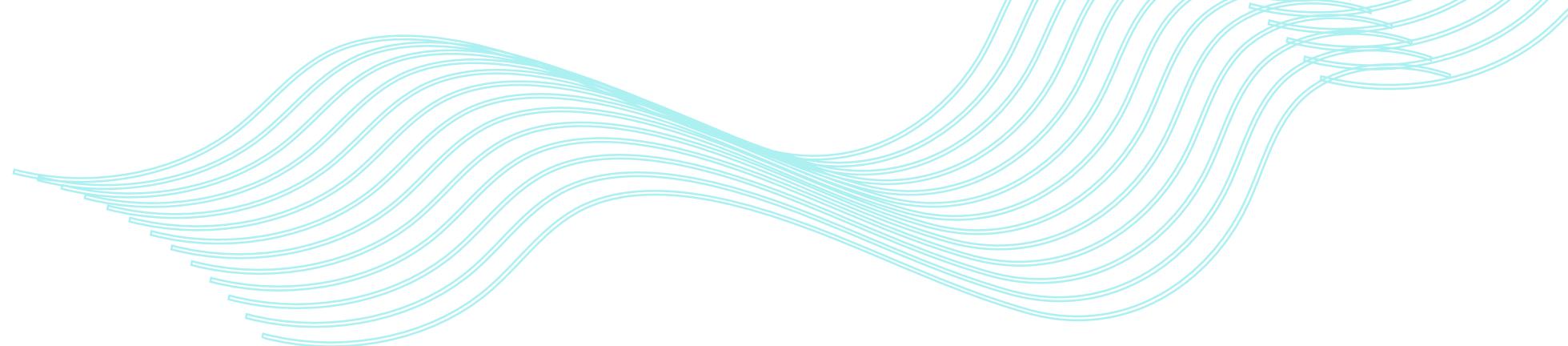
- **Importance:**

- **Disease Prevention:** Prevents cavities, gum disease, and tooth loss.
- **Overall Health:** Linked to heart disease, diabetes, and respiratory infections.
- **Quality of Life:** Essential for eating, speaking, and social interactions.

- **Neglect:**

- Often overlooked in personal care routines.
- Lack of access to dental care, especially in low-income areas, leads to widespread untreated conditions.

# Problem Statement

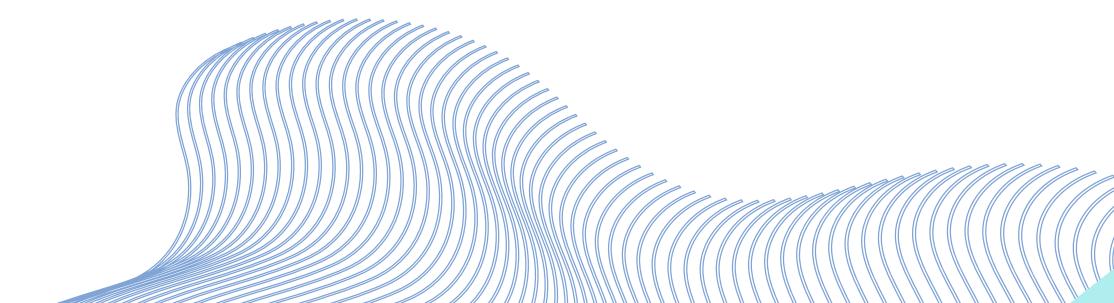


Our innovative solution addresses inadequate oral health awareness by using dental selfies and advanced machine learning for early identification of conditions like cavities and gum diseases.

By categorizing dental conditions into seven classes—

**'tooth discolouration,' 'calculus,' 'mouth ulcer,' 'caries,' 'hypodontia,' 'gingivitis,' and 'healthy'**

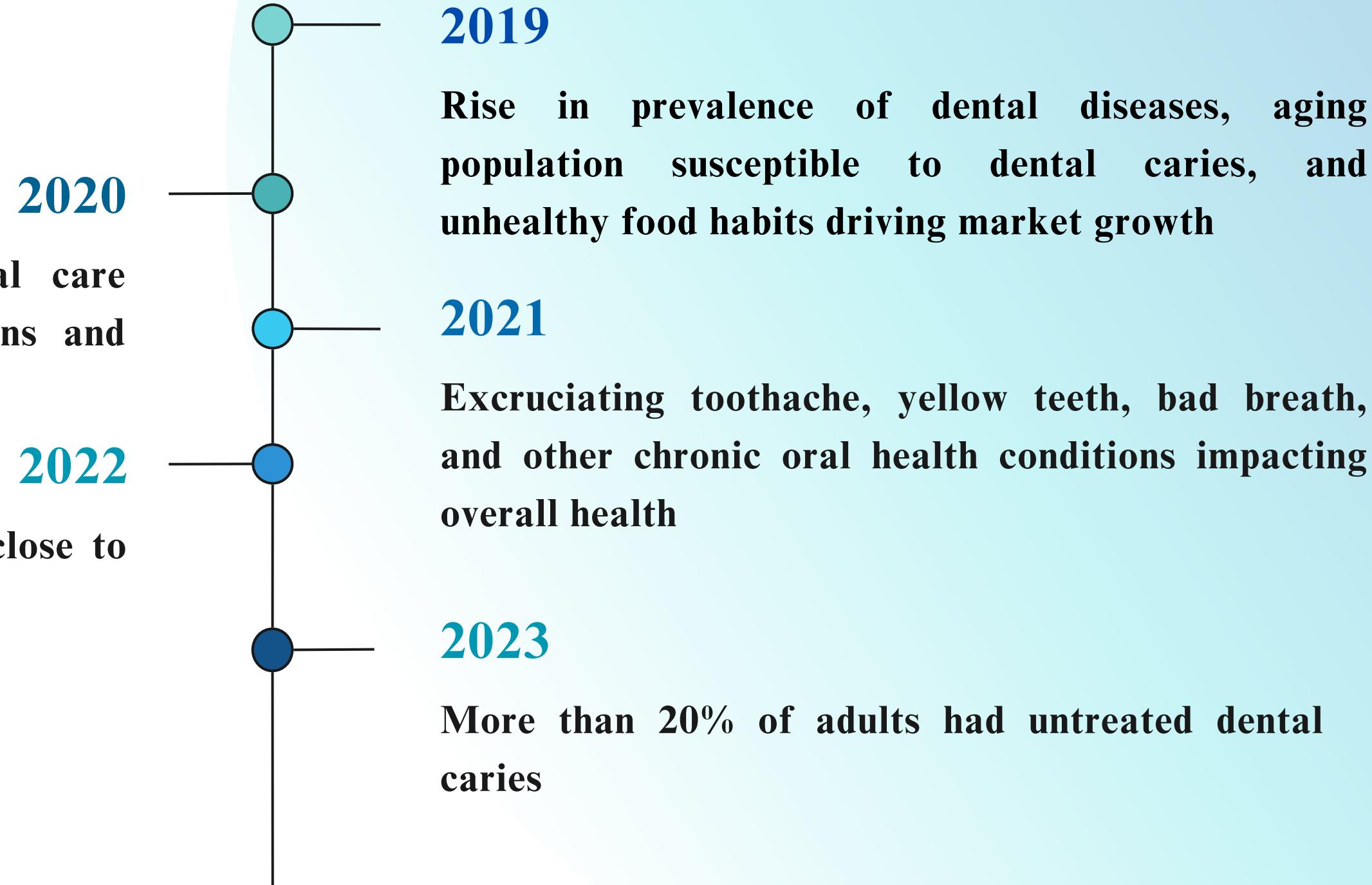
our tool aims to be accessible and cost-effective. This enables proactive detection and diagnosis of dental problems, minimizing severity and treatment costs.



# Background Survey

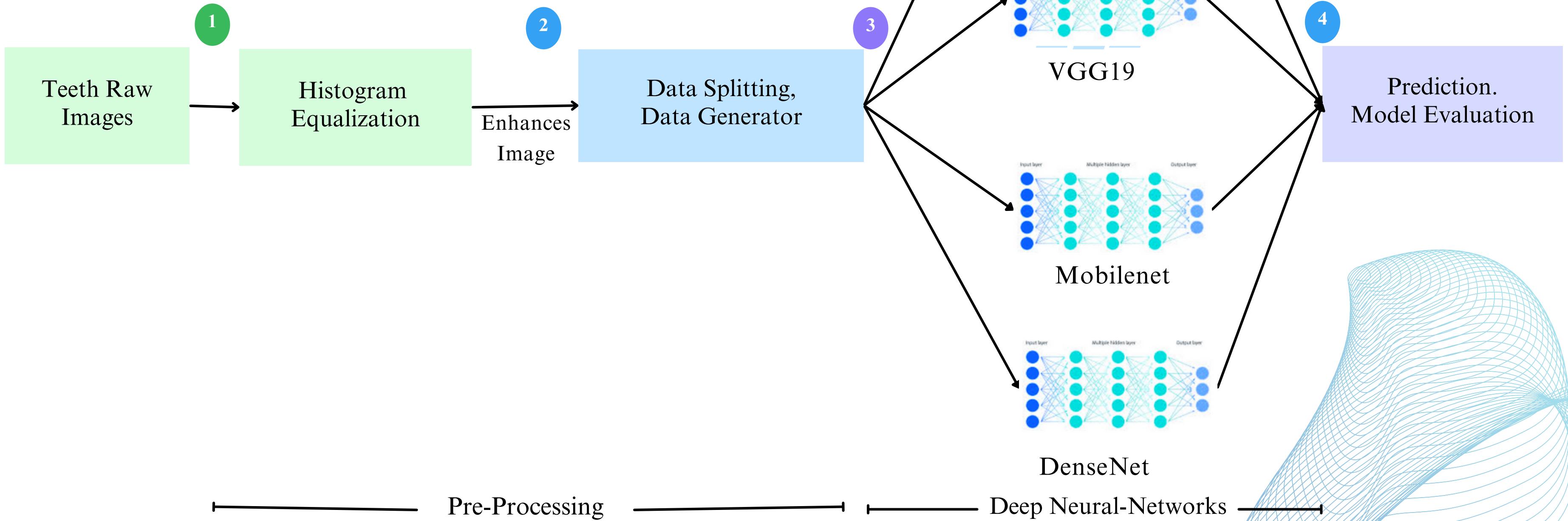
Impact of COVID-19 pandemic on oral care market, with challenges due to lockdowns and production disruptions

WHO reported that oral diseases affect close to 3.5 billion people globally



# Methodology

Let's visualize :



# Model Architecture

## 1. Motor:

- Powers the rotation of the brush head for effective cleaning.

## 2. Battery:

- Supplies power to the motor and processor for consistent and reliable Smart brushing functionality.

## 3. Processing Chip:

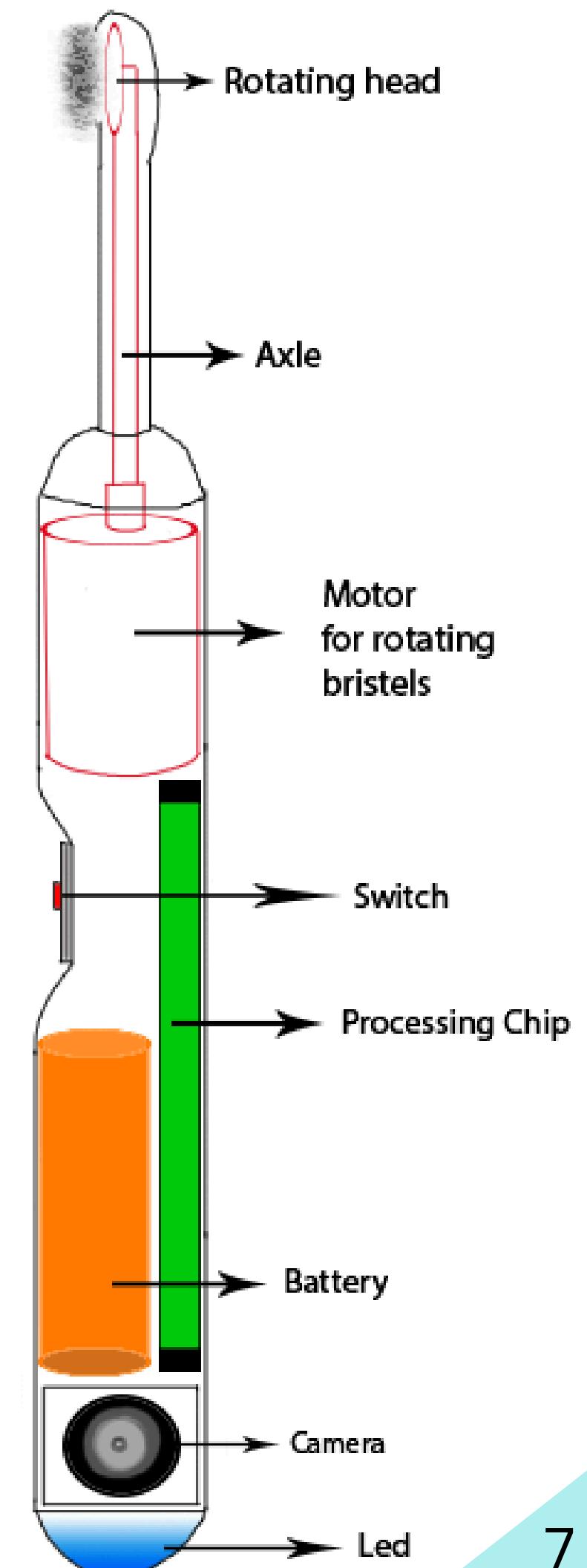
- Incorporates essential sensors (pH, Bluetooth) for saliva acidity measurement and data communication.
- Includes a built-in timer and multiple vibration modes for precise brushing and improved cleanliness.
- Processes information for efficient toothbrush operation.

## 4. Camera:

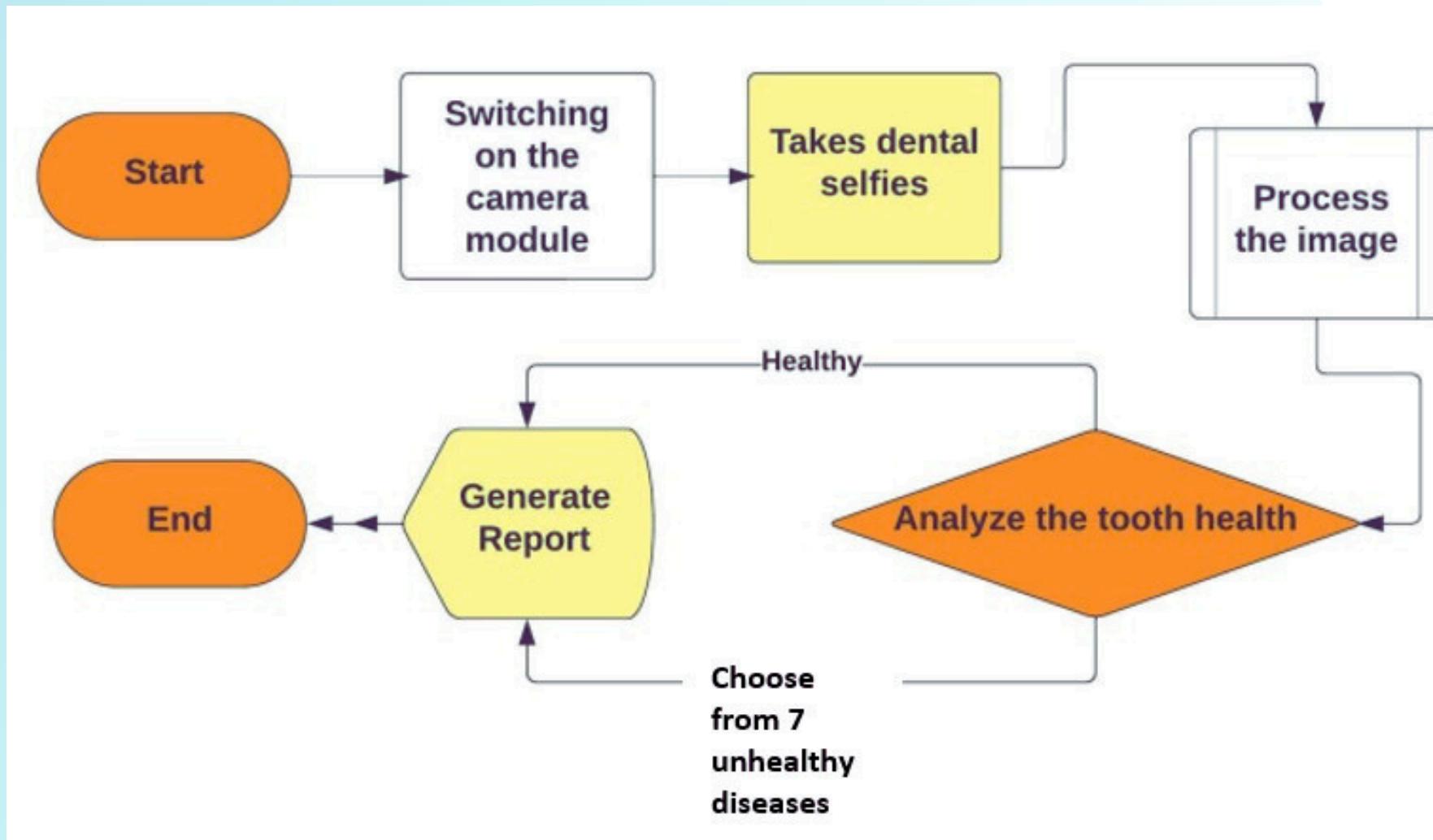
- Innovative addition for capturing dental selfies.
- Facilitates early detection of oral issues by providing clear images for analysis and diagnosis.

## 5. LED Light:

- Enhances brightness uniformity within the oral cavity.
- Ensures optimal lighting conditions for capturing high-quality dental selfies.



# Process flow



## Dataset Preparation:

Parameter	Value
Training Images	11395
Testing Images	1422
Number of classes	7
Extracted Features	Texture Features, Color Features, Spatial Features, Position Features

## Model Construction:

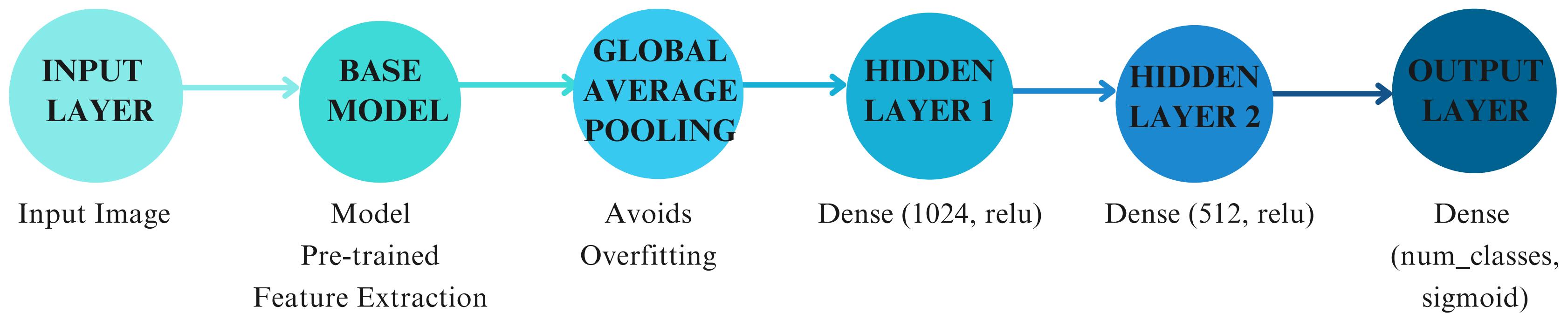
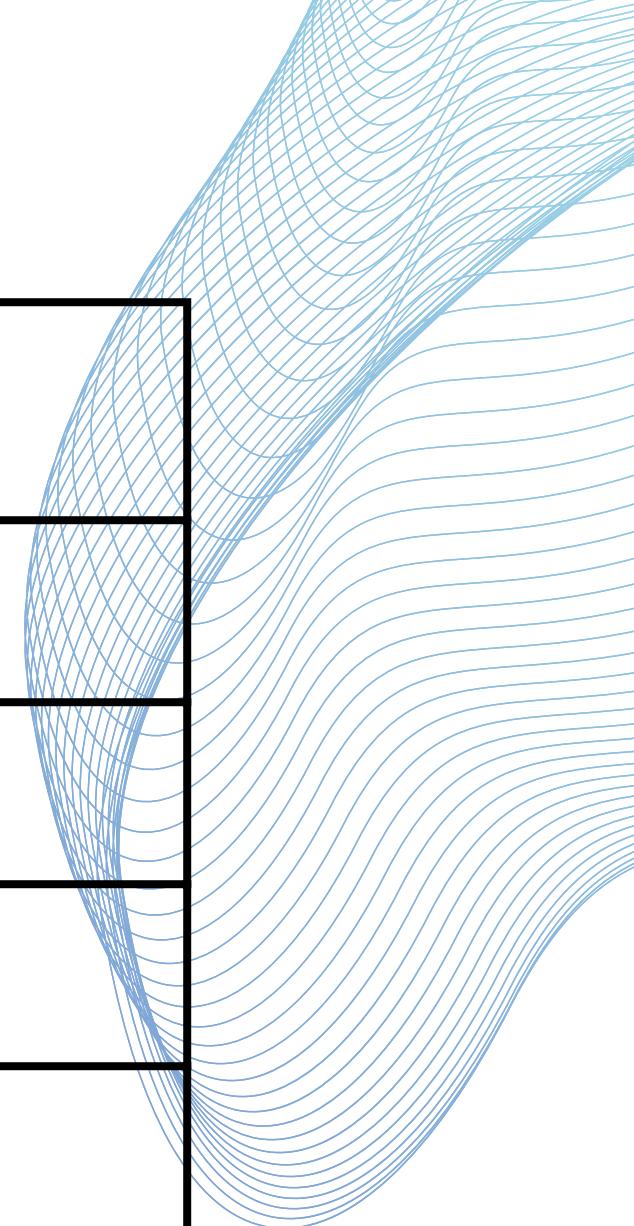
**Build a CNN architecture with pre-trained weights and optimize using Adam.**

## Training and Evaluation:

**Train the model, use validation for early stopping, and assess performance on the test dataset.**

# CNN Architecture

Parameter	Value
Number of Hidden Layers	2
Transition Function	ReLU (Rectified Linear Unit)
Loss Function	Binary Cross-Entropy
Trainable Parameters	DenseLayer1 + DenseLayer2 + Model



# Prediction Analysis

Truth: calculus  
DenseNet: tooth discolouration  
MobileNet: Calculus



Truth: hypodontia  
DenseNet: Hopodontia  
MobileNet: Hopodontia



Truth: ToothDiscoloration  
DenseNet: Healthy  
MobileNet: tooth discolouration



Truth: caries  
DenseNet: Caries  
MobileNet: Caries



Truth: gingivitis  
DenseNet: Gingivitis  
MobileNet: Gingivitis



Truth: ToothDiscoloration  
DenseNet: tooth discolouration  
MobileNet: tooth discolouration



Truth: MouthUlcer  
DenseNet: Mouth Ulcer  
MobileNet: Mouth Ulcer



Truth: caries  
DenseNet: Caries  
MobileNet: Caries



# Model Comparison

## Value of different parameters:



Model	Accuracy	Precision	Recall	AUC	F1
VGG16	0.976291	0.922365	0.910689	0.996129	0.917564
VGG19	0.974181	0.918763	0.898734	0.994559	0.908591
DenseNet	0.983625	0.941135	0.944444	0.995339	0.943884
MobileNet	0.982118	0.942390	0.931786	0.996492	0.936754

# Future Scope

At this very instant, we can effectively recognize seven dental conditions by using advanced machine learning techniques to classify them into multiple groups.

1. Currently, we are working on integrating the software with the hardware of the Smart Oral Health Guardian device for which the model is ready to implement the program.
2. In the coming days, we plan to integrate generative AI to enhance our classification method by generating synthetic data for the seven categories. This integration will support our data shape, improve version generalization, and potentially utilize generative networks for real-data development.



# Conclusion

Our revolutionary toothbrush includes the addition of dental imaging and advanced machine learning, represents a significant step forward for early detection of oral health conditions. We have tested our models, which have shown that our approach is robust and has achieved high accuracy rates of up to 98%. Consequently, our modern toothbrush stands out as a key contributor towards improving oral health outcomes through prompt restorations.



**THANK YOU  
VERY MUCH!**

