



# OralOptix

INTELLIGENT ASSESSMENT OF INTRA-ORAL RADIOGRAPH QUALITY

SUPERVISED BY  
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# Problem Definition

manual review is :



time-  
consuming



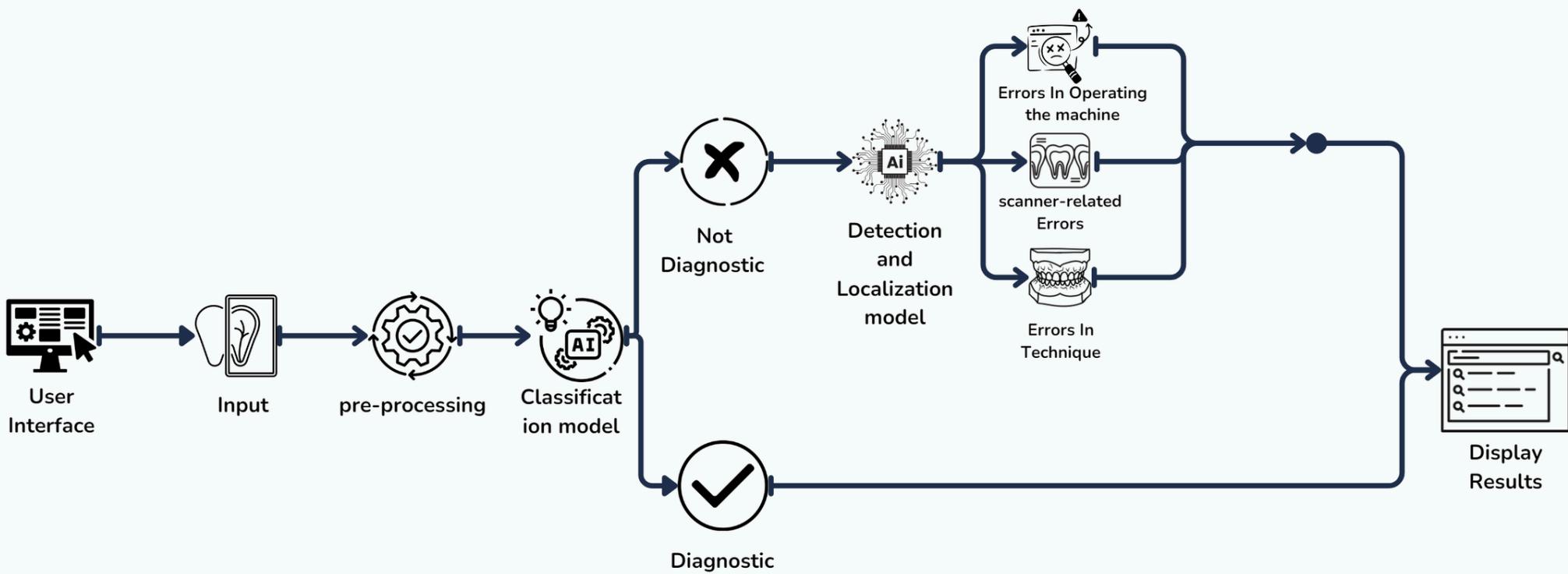
requires significant  
expertise.



can lead to  
inefficiencies



# Problem Solution



10cm

# Summary of previous work



# Front-End Implementation

A web-based system for assessing intra-oral radiographs



# Key Features of the Front-End

## 01 User-Friendly Interface

Simple and easy to navigate.

## 02 Smooth Navigation

Guided workflow with step-by-step interactions.

## 03 Interactive Elements

Buttons, form validation, and dynamic UI updates.

## 04 Responsive Design

Works across different screen sizes.



OralOptix

**Sign Up**

Full Name  
Email  
Password  
Confirm Password

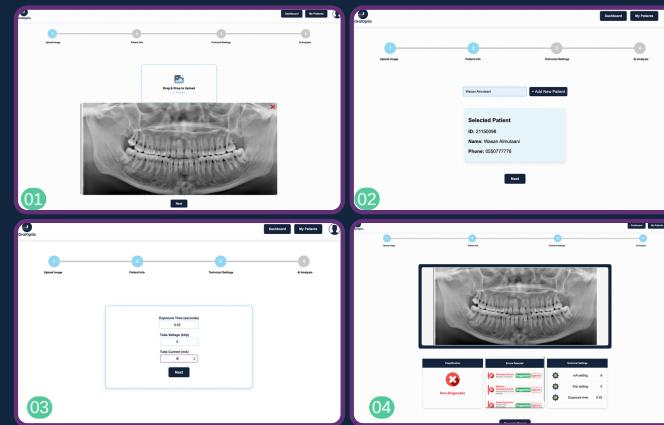
Already have an account?  
[Log In](#)

OralOptix

**Log In**

User ID or Email  
Password

[Forgot Password?](#)  
[Don't have an account? Sign Up](#)



All Patients

New Patient

ID	First Name	Last Name	Mobile No.	Sex	Action
11234567	Airi	Satou	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Angelica	Ramos	658543469	Female	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Ashton	Cox	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Bradley	Greer	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Brenden	Wagner	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Brielle	Williamson	658543469	Female	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Bruno	Nash	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Caesar	Vance	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Cara	Stevens	658543469	Female	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Cedric	Kelly	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>

Showing 1 to 10 of 20 entries

Medical Imaging Center  
Radiograph Quality Assessment Report  
Report ID: REP-75076 | Date: 2023-08-15 10:00 AM UTC

1. Patient Information

Project Name	Oral Assessment
Patient ID	21234567
Radiograph ID	RAD-4567
Radiograph Type	Bitewing
Examined by	Dr. John Smith

2. Radiograph Classification

Classification Status	Normal
Diagnostic Status	Non-diagnostic

3. Technical Assessing Parameters

Percent	Value
Exposure Time (ms)	0.05
Kilovolt Peak (kVp)	4
Milliamperes (mA)	2

4. A-Z General of Corrective Actions

- Suggested Corrections
- Optimize exposure time by repositioning teeth.
- Ensure correct patient positioning.

All Patients

New Patient

ID	First Name	Last Name	Mobile No.	Sex	Action
11234567	Airi	Satou	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Angelica	Ramos	658543469	Female	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Ashton	Cox	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Bradley	Greer	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Brenden	Wagner	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Brielle	Williamson	658543469	Female	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Bruno	Nash	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Caesar	Vance	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Cara	Stevens	658543469	Female	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
11234567	Cedric	Kelly	658543469	Male	<input type="radio"/> <input checked="" type="checkbox"/> <input type="checkbox"/>

Showing 1 to 10 of 20 entries

User Profile

New Patient

ID	Enter your ID
First Name	Enter your first name
Middle Name	Enter your middle name
Last Name	Enter your last name
Email Address	Enter your email
Password	Enter your password

Save

# Data

## Tabular Data:

Key Label: Diagnostic Status (3 classes):

0: Poor quality (unusable).

1: Minor issues (usable).

2: Ideal quality (suitable for diagnosis).

Other Features: Region, Area of Interest (AOI) coverage, Proximal Contact, Overlaps, Occlusal Plane Centering...

## Image Data: Dental X-rays (BW-Xrays).



## Tabular Data:

BW-Xrays	agnostic Stat	Region	AOI covered	proximal contacts	proximal overlap of proximal	distal plane	cenone cut (OAO)	one cut (WAO)	ratches (OAC)	ratches (WAC)	exposure (O)	exposure (W)	inner error (O)	inner error (W)	density	receptor posititng of plate	AOI
s	0	2	1	0	1	0	1	1	1	1	0	0	1	1	1	1	0
4	0	1	1	0	0	0	1	1	1	1	0	1	1	0	0	1	1
5	0	2	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1
6	0	1	1	0	0	0	1	1	1	0	0	1	1	1	1	1	0
7	0	2	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1
8	0	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1
9	0	1	1	1	-	-	1	0	1	0	0	1	1	1	1	1	0
10	0	1	1	1	-	-	0	1	1	1	1	1	1	1	1	1	1
11	2	1	1	1	-	-	1	1	1	1	1	1	1	1	1	1	1
12	1	2	1	0	1	0	1	1	1	0	1	1	1	0	1	1	1
13	0	2	1	0	0	1	1	0	1	0	0	1	1	0	0	1	0
14	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1
15	0	2	1	0	0	0	1	1	1	1	1	1	1	0	1	1	1
16	0	1	1	0	0	0	1	1	1	1	1	0	1	0	0	1	1
18	2	2	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
19	2	2	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
20	0	1	1	0	0	0	1	1	1	1	1	1	1	0	0	1	1

## image Data:



# Processing techniques used:

**Tabular Data** : Handling missing values, scaling features, encoding labels

**Image Data** : Resizing, normalization, and augmentation.

**Train-Test Splitting** : 80%-20% split.

**Augmentation** : Rotation, shifts, shear, zoom, flips, brightness changes.

**Learning Rate Scheduling** : Adaptive LR reduction.

# Hyperparameter Settings:

- Consistency: Ensures fair comparison across models.

Model	Learning rate	Optimizer	Batch size	Epochs	Dropout
EfficientNet -based Model	0.001	adam	16	20	0.5
Vision Transformer (ViT)	0.001	adam	16	20	0.5
MobileNet V3Small	0.001	adam	16	20	0.5

Table 5.3: Hyperparameter Settings

# AI Models

- Multimodal Approach: Combines image and tabular data for improved accuracy.
- Objective: Classify X-rays into 3 categories (0, 1, 2) based on Diagnostic Status.



- EfficientNet-based Model:

Highest training accuracy (94.73%).

Generalizes well to validation data (91.67%).

- Vision Transformer (ViT):

Slight improvement in validation accuracy (91.76%) over training (88.77%).

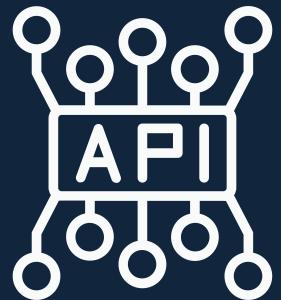
Shows robustness.

- MobileNet V3Small:

Notable drop in validation accuracy (89.25%) compared to training (93.16%).

Potential overfitting.

# Back-end Implementation



API Implementation

Database Implementation



# Back-end Tools

phpMyAdmin, XAMPP



PHP



Netbeans



# Database Tables

Table	Action	Rows	Type	Collation	Size	Overhead
<input type="checkbox"/> evaluation	<a href="#">Browse</a> <a href="#">Structure</a> <a href="#">Search</a> <a href="#">Insert</a> <a href="#">Empty</a> <a href="#">Drop</a>	5	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> patient	<a href="#">Browse</a> <a href="#">Structure</a> <a href="#">Search</a> <a href="#">Insert</a> <a href="#">Empty</a> <a href="#">Drop</a>	5	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<input type="checkbox"/> radiograph	<a href="#">Browse</a> <a href="#">Structure</a> <a href="#">Search</a> <a href="#">Insert</a> <a href="#">Empty</a> <a href="#">Drop</a>	5	InnoDB	utf8mb4_general_ci	48.0 KiB	-
<input type="checkbox"/> report	<a href="#">Browse</a> <a href="#">Structure</a> <a href="#">Search</a> <a href="#">Insert</a> <a href="#">Empty</a> <a href="#">Drop</a>	5	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> user	<a href="#">Browse</a> <a href="#">Structure</a> <a href="#">Search</a> <a href="#">Insert</a> <a href="#">Empty</a> <a href="#">Drop</a>	6	InnoDB	utf8mb4_general_ci	16.0 KiB	-
5 tables	<b>Sum</b>	26	InnoDB	utf8mb4_general_ci	144.0 KiB	0 B

# View Samples

	<input type="button" value="←"/> <input type="button" value="→"/>	<input type="button" value="▼"/>	UserID	Password	EmailAddress	F_name	M_name	L_name
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	1111 11a_11	Aa11@gmail.com	amal	mohamed	omar
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	1112 11a12_2	Aa12@gmail.com	hassan	salem	alzahrani
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	1113 11c1_3	Aa13@gmail.com	khalid	saad	alqahtani
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	1114 11_a14	Aa14@gmail.com	rana	yasser	khan
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	1115 11a15	Aa15@hotmail.com	rasha	abdul aziz	Juffali
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	1234 \$2y\$10\$IVfqqEJhZUtH5jxWljwb2OMWOAKEie89FQIP4OxNh7K	ahmed@gmail.com	AHMED	Omar	basha

	<input type="button" value="←"/> <input type="button" value="→"/>	<input type="button" value="▼"/>	EvaluationID	ErrorsDetected	Suggestions	Classification	RadioID
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	1	positioning error placing the receptor in the same horizontal plane ...	Not diagnosable	2
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	2	receptor orientation error The receptor must be placed straight or perpendicu...	Not diagnosable	4
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	3	positioning error placing the receptor in the same horizontal plane ...	diagnosable	1
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	4	scanning errors the central ray must pass through the proximal sur...	Not diagnosable	3
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Copy"/>	<input type="button" value="Delete"/>	5	receptor orientation error Proximal overlap in the outer half of the enamel.	Diagnostic with errors	5

# System Testing

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## Objectives



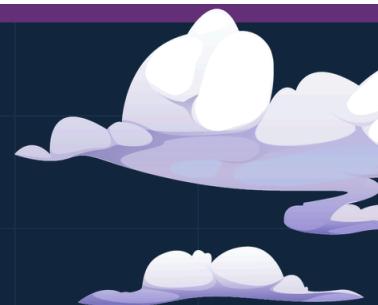
Ensure system meets all functional and non-functional requirements



Detect and resolve logic, semantic, and computational errors



Confirm alignment with system design, features, and performance specs



# Types of Software Testing



1

## Unit Testing

- Tested individual modules like AI, image input, and data handling.
- Verified correct function in isolation.

2

## Usability Testing

- Focused on ease of use by dental professionals
- Tested interface clarity and result readability



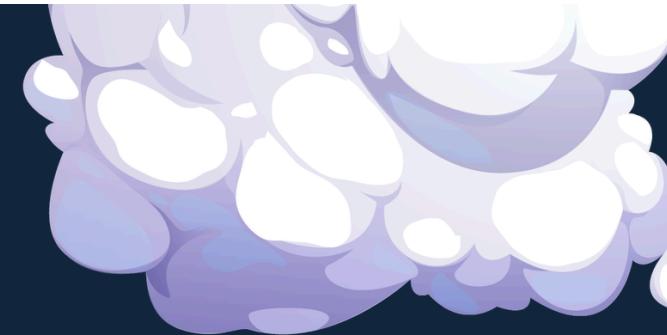
# System Testing Results

Test Name	End-User Input	Expected Output	Actual
Sign Up	ID, name, email, password	Show login page	
Log In	Email or ID, password	Show dashboard	
Add Patient	Patient info, upload file	Display success message	
Edit Patient	Patient ID, name, gender, age, phone number, medical file upload	Show success and update table	
Delete Patient	Confirm deletion	Remove and confirm	
Upload Radiograph	Drag/drop or browse	Show preview and Next	
Select Patient	Choose or Add New	Display selected info	
Technical Settings	Input exposure, kVp, mA	Save and continue to AI	
AI Analysis	Wait for system	Show results, errors, suggestions	
Generate Report	Click Generate	Downloadable PDF	
Search Patient	Type keyword in Search bar	Filtered patient list	

As Expected



# AI-models Testing



This testing procedure verified  
the models' ability to:

- Process both image and tabular data inputs
- Learn multimodal feature representations
- Make accurate predictions on unseen test data

# AI-models Testing



Model	Learning rate	Precision	Recall	F1 Score
MobileNetV3 Small	97.26%	97.28%	97.26%	97.21%
EfficientNetB0	98.63%	98.83%	98.63%	98.63%
Vision Transformer (ViT)	84.93%	92.67%	84.93%	87.09%
EfficientNet +ViT Hybrid	82.19%	67.55%	82.19%	74.16%
MobileNetV3 +ViT Hybrid	82.19%	67.55%	82.19%	74.16%
Custom ViT-style	89.04%	93.07%	89.04%	90.09%

The EfficientNetB0 model emerged as the most accurate solution, while MobileNetV3 provided the best balance between efficiency and accuracy. The results also showed that transformer-based models require careful adaptation to outperform traditional CNNs in this particular multimodal task.

# Back-end Testing:

Test name	Expected output	Actual
Sign up	Successfully adding a new user	As Expected
Log in	Successfully log in for an authorized account	
Add patient	Successfully adding and storing new patients into the database	
Edit patient	Successfully modifying patients from the back-end database	
Delete patient	Successfully deleting patients from the back-end database	
Uploading images	Successfully uploading image in the website to the AI model	
Select Patient	Selecting patient from whom already exists in the database	
Enter Technical Settings	Successfully setting the technical settings in the back-end database	
AI Analysis	Store the AI Analysis result for each image	
Generate Report	Storing patient's report	
View patient	easy reviewing patients	

Table 6.2: Usability Testing Tasks For the Back-end of OralOptix System.

# Object Measure Analysis

Task	Expected Clicks	Expected Duration
1	2	1 minute
2	1	30 seconds
3	3	2 minutes
4	3	1 minute
5	3	30 seconds
6	2	1 minutes
7	2	30 seconds
8	1	1 minute
9	3	30 seconds
10	1	15 seconds
11	2	1 minute

Table 6.3: Expected Measures for the Compilation of Each Task

# Subjective Measure Analysis

Question	Answer	
	Yes	No
# Are all website functions clear to you?	2	
# Does this website save time in determining the diagnosability of radiograph images?	2	
Question (1-5)	1	2
# What do you think of the website in general?		1
# How often would you use it?		1
# How much the website solves the diagnosability problem?		2

Table 6.6: Post-Test Summary

# Future Work

More

participants in the usability testing

Enhance

the AI model

Writting

the conclusion and the future work



# Challenges and Difficulties



# Challenges and Difficulties



## Dataset Challenges

There was a delay in obtaining enough labeled images, and some types of errors were rare, which affected model training and required the use of data augmentation techniques to improve performance.



## AI Model Development Challenges

Selecting the best model was challenging, as Vision Transformers needed more tuning than CNNs, and the small dataset caused overfitting, which was addressed with regularization, data augmentation, and validation.



## Integration of Components

Integrating the AI model with the web system and ensuring real-time analysis and smooth display required careful coordination between the back-end and front-end to maintain system stability.



## Unexpected Technical Issues

Unexpected technical issues, like data preprocessing errors, model performance changes, and integration bugs, caused delays and required adjusting the plan and redistributing resources to keep the project on track.



## Time Management Challenges

There was a delay in obtaining enough labeled images, and some types of errors were rare, which affected model training and required the use of data augmentation techniques to improve performance.





# Thanks

Do you have any questions ?