ArthoAid–Smart Arthritis Detection System

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Introduction

Project Overview :
ArthoAid is a system that detects and classifies Rheumatoid Arthritis (RA) and Osteoarthritis (OA) using patient data, and assesses OA severity through knee X-ray analysis with deep learning.

Purpose :
ArthoAid uses ML to detect RA and OA from patient data and X-rays, helping diagnose faster and more accurately, especially in low-resource areas.

Target Audience :
Doctors, clinics, patients with joint pain, and healthcare researchers.

Problem Statement

- Arthritis diagnosis is slow and prone to errors.
- Rural areas lack experts and proper tools.
- Patients often don’t understand disease severity.
- Need Fast, reliable AI to detect arthritis and severity from data and X-rays.

Objectives

Patient Classification :
Use Machine Learning to classify individuals as Healthy, RA, or OA patients.

OA Severity Grading :
Apply Deep Learning (CNN) to assess the severity of Osteoarthritis from knee X-rays.

Accessible Healthcare Tool :
Develop a low-cost, user-friendly support tool for arthritis that helps reduce misdiagnosis and improve patient care.

Technology Stack

MySQL

Manages user login and authentication

Random Forest

Classifies patients as Healthy, RA, or OA from clinical data

HTML, CSS

Create the user interface

CNN

Analyzes knee X-rays to determine OA severity

TensorFlow

Framework used to train and run the CNN model

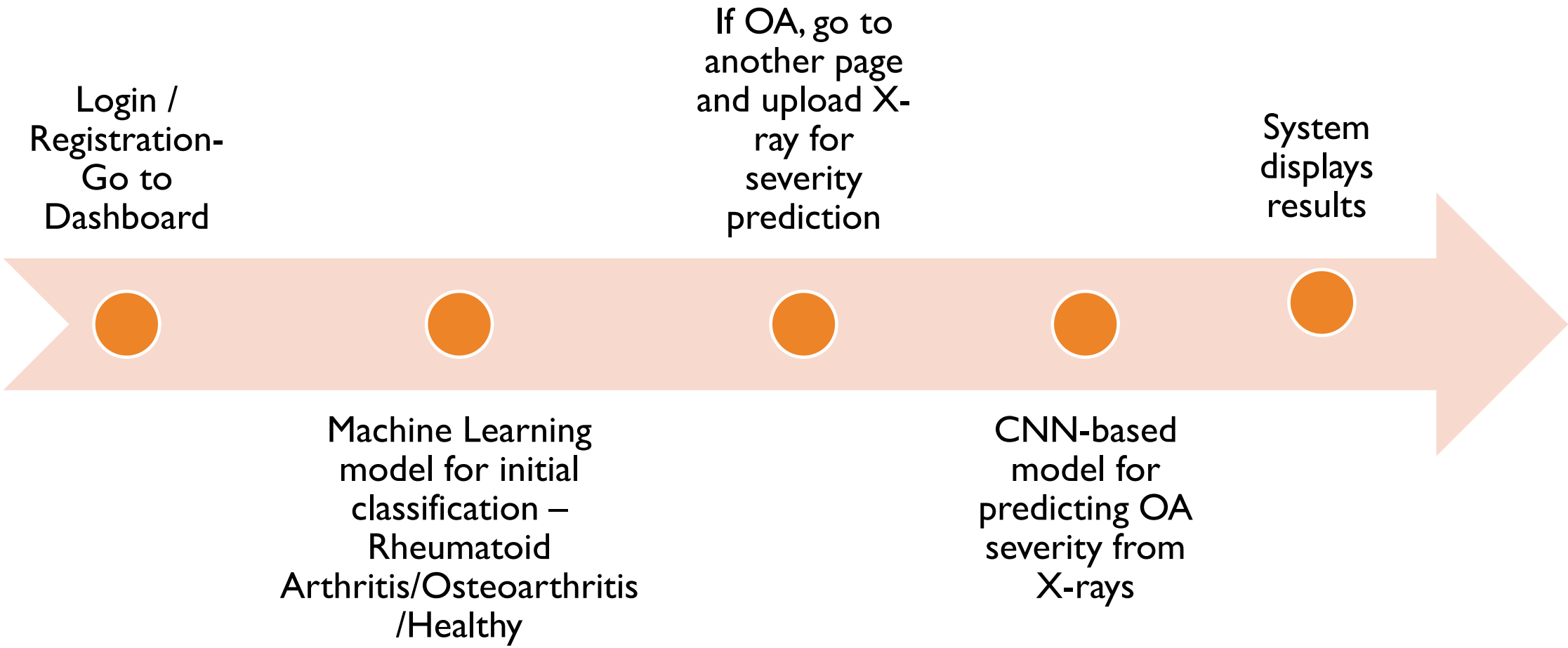
Scikit-learn

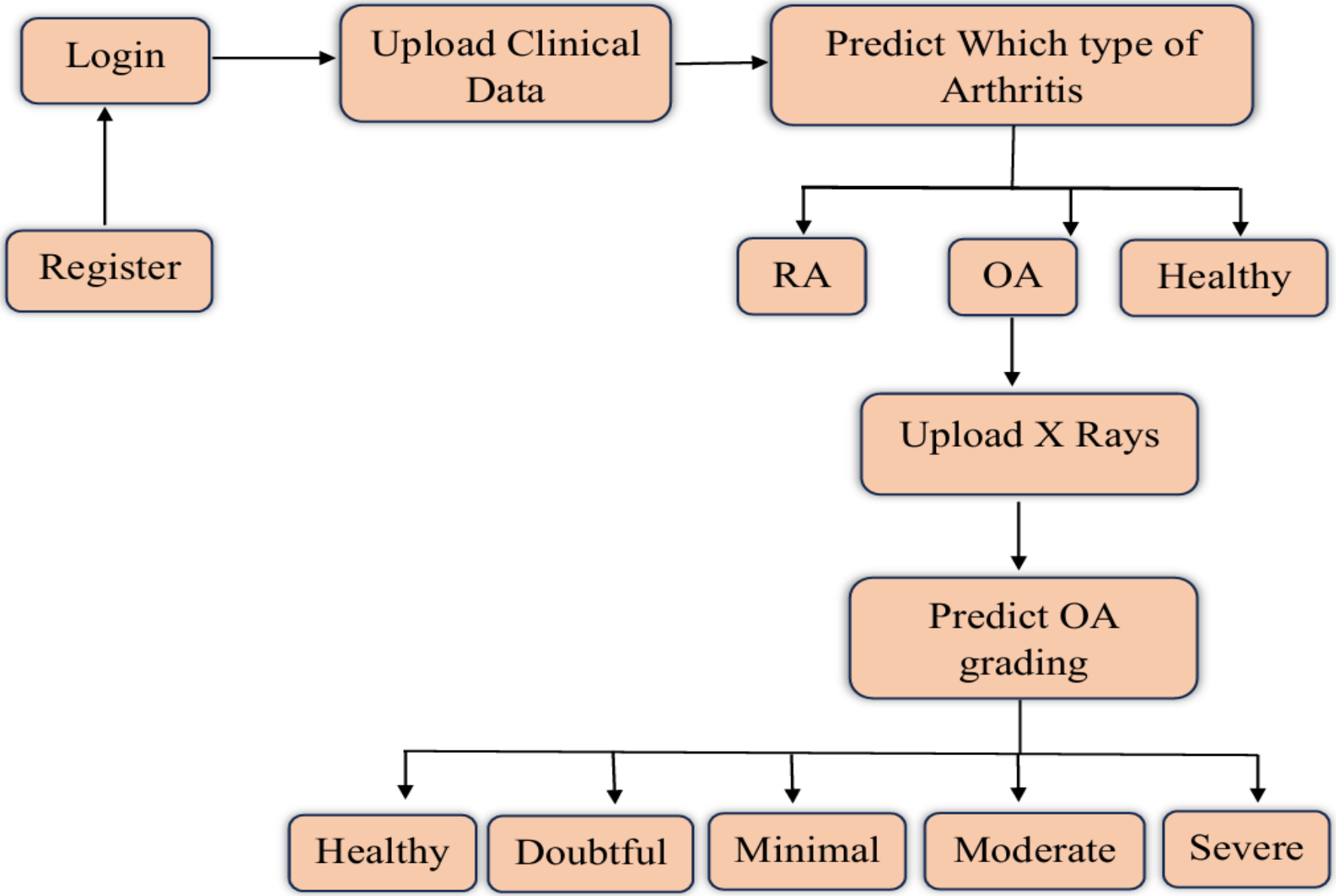
Machine learning library for various algorithms

Python Flask

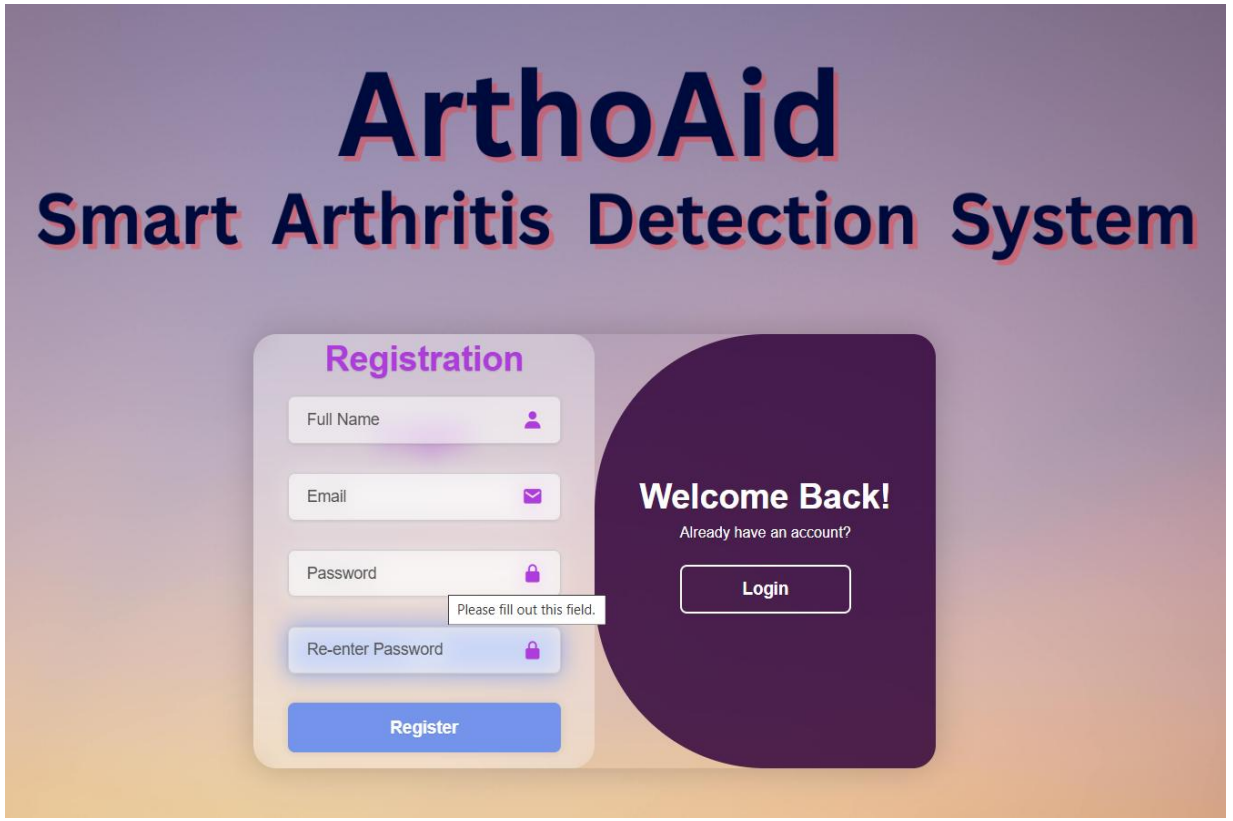
Web framework for the application

Work-flow

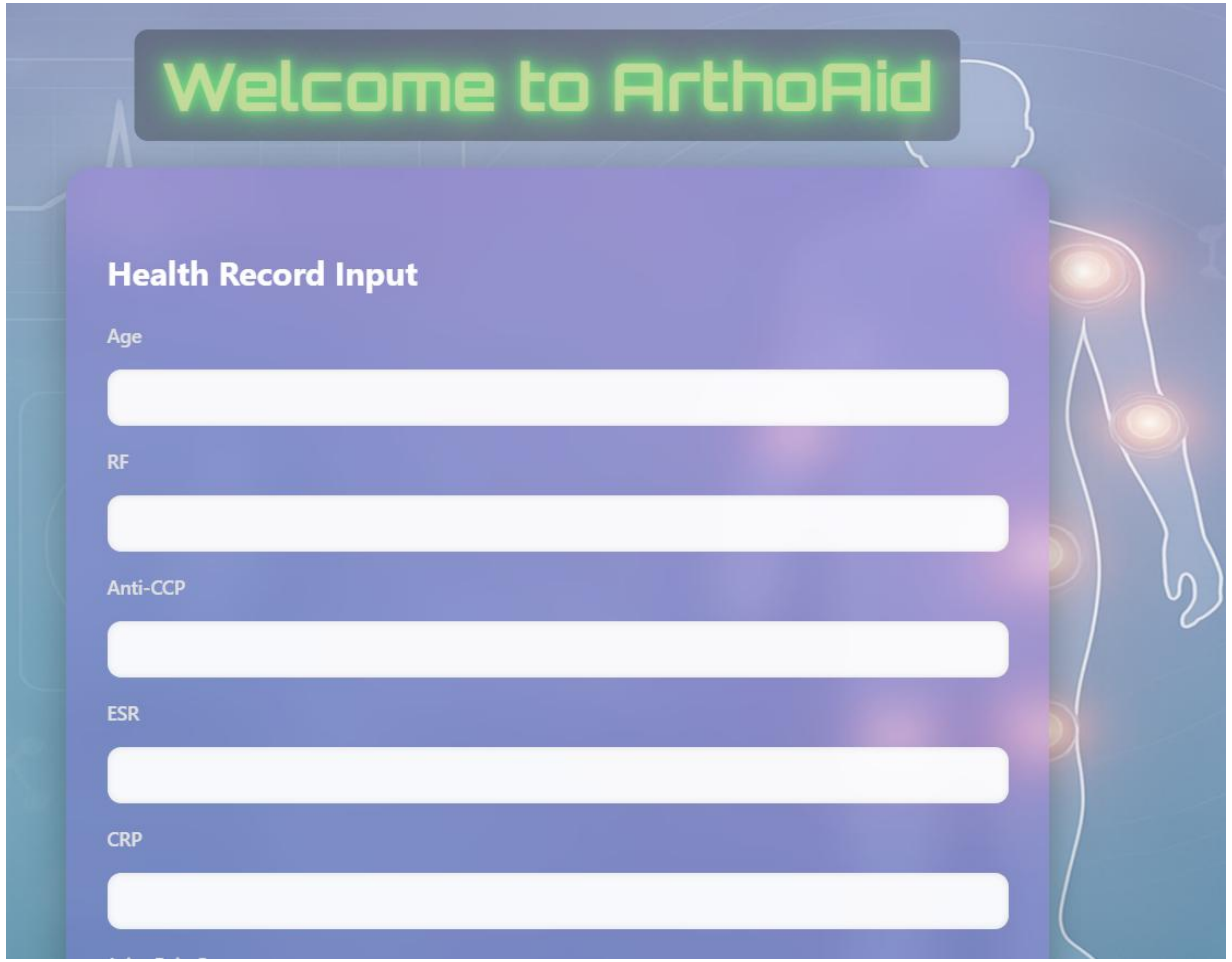

Login / Registration- Go to Dashboard
Machine Learning model for initial classification – Rheumatoid Arthritis/Osteoarthritis /Healthy
If OA, go to another page and upload X-ray for severity prediction
CNN-based model for predicting OA severity from X-rays
System displays results

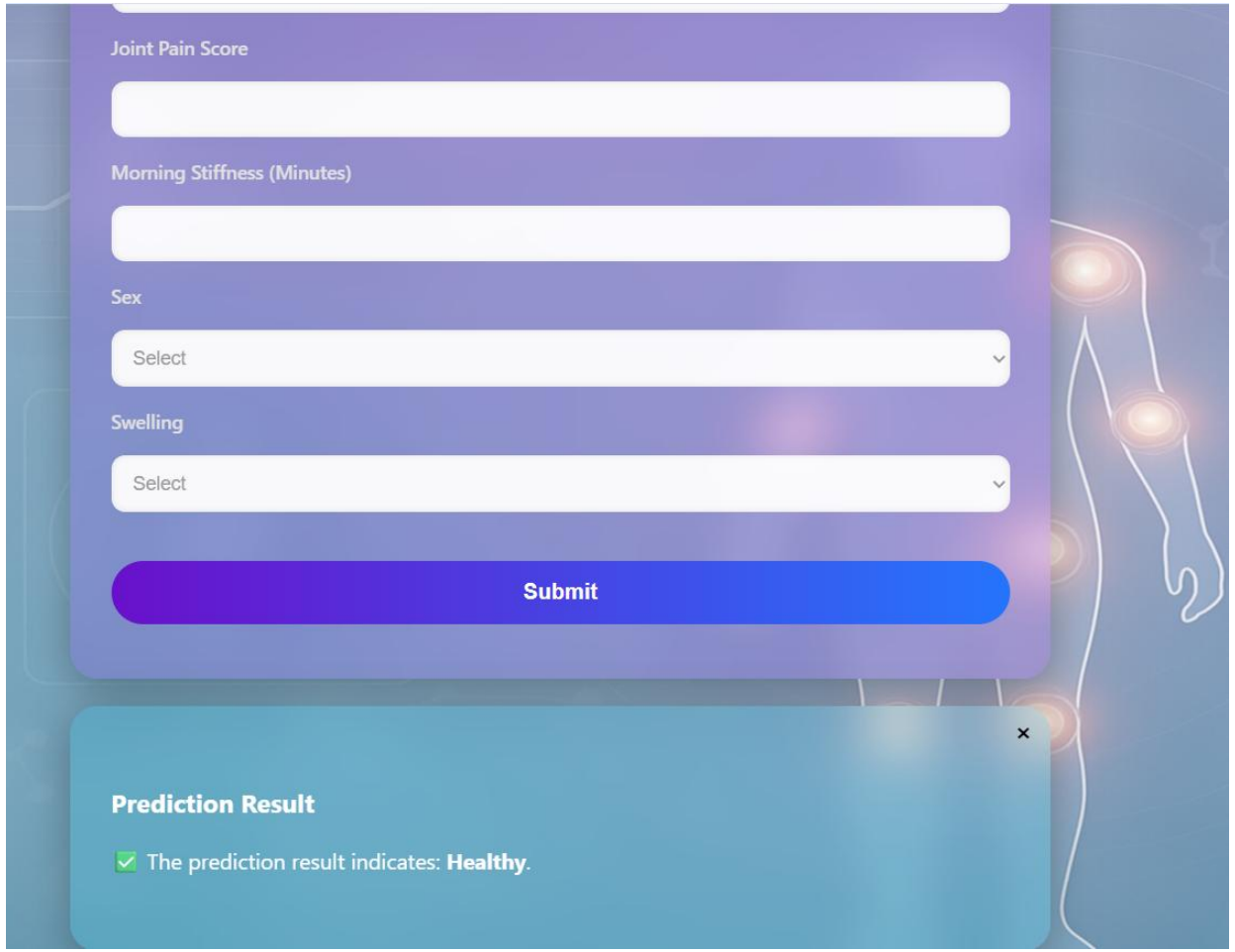

Login
Upload Clinical Data
Predict Which type of Arthritis
Register
RA
OA
Healthy
Upload X Rays
Predict OA grading
Healthy
Doubtful
Minimal
Moderate
Severe

User Experience & Interface

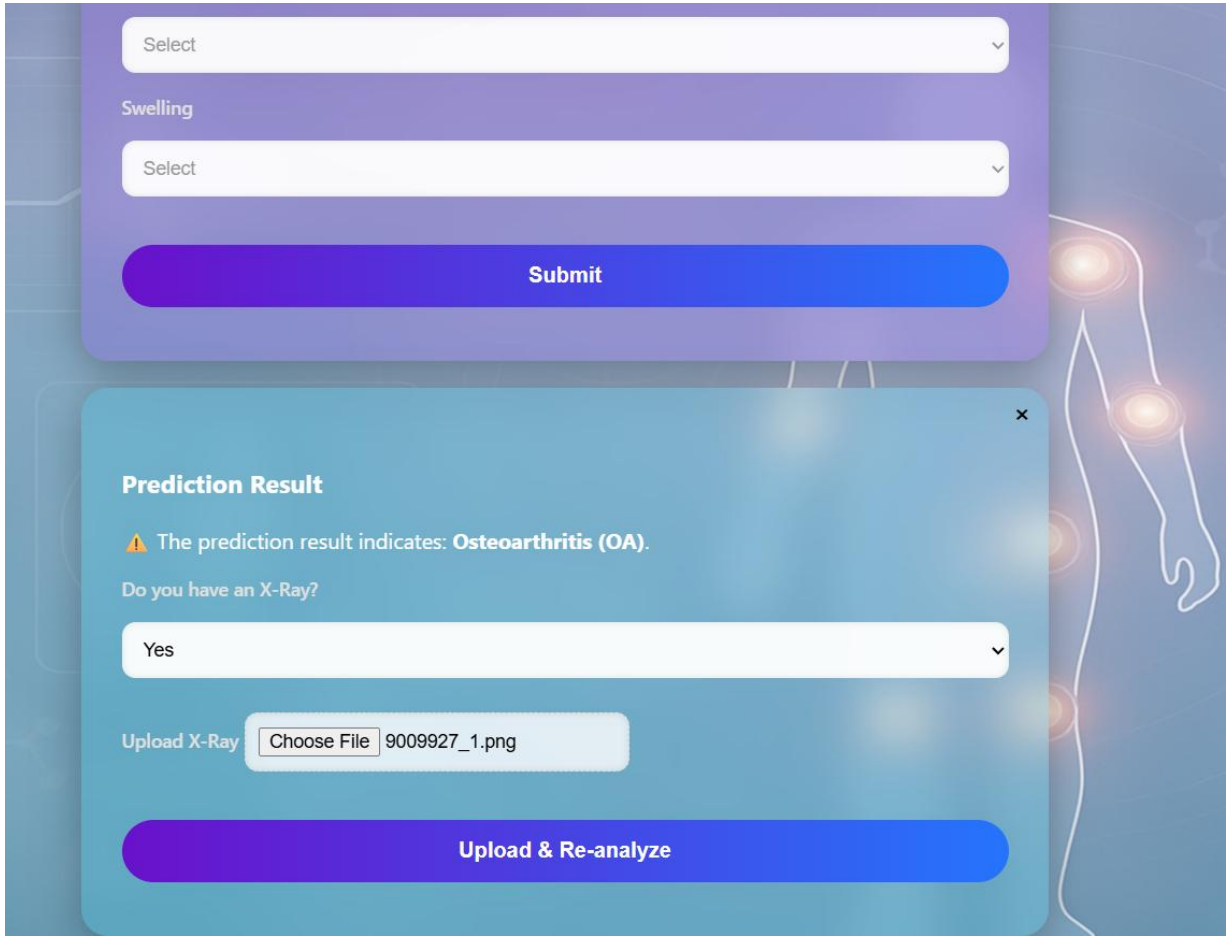


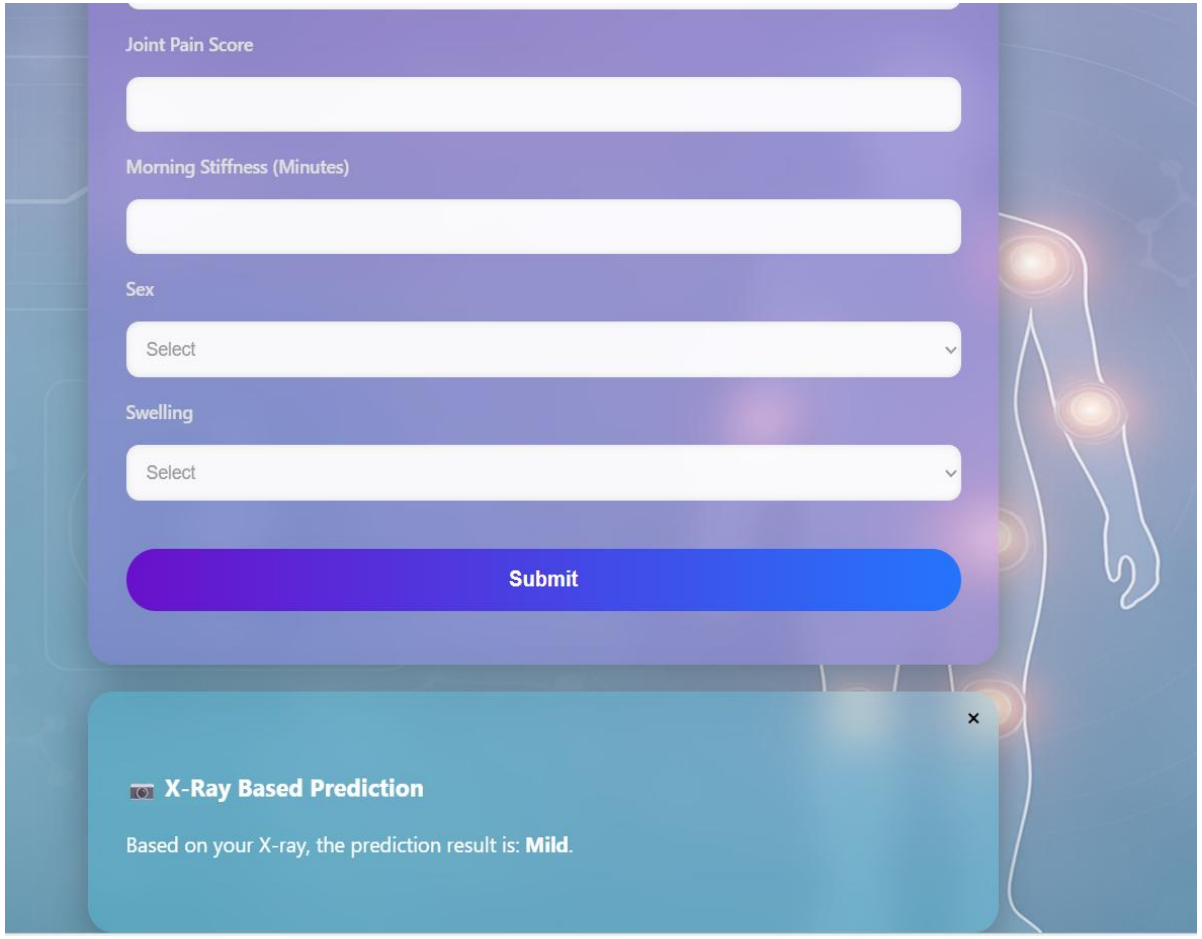
User Experience & Interface





User Experience & Interface





Performance Measures

Confusion Matrix -1

- **ML (Random Forest) based arthritis classification**

Class	Healthy	OA	RA
Healthy	55	3	3
OA	1	71	0
RA	3	2	62

Classification Report:

Class	Precision	Recall	F1-Score	support
Healthy	0.93	0.90	0.92	61
OA	0.93	0.99	0.96	72
RA	0.95	0.93	0.94	67
Accuracy	-	-	0.94	200
Macro avg	0.94	0.94	0.94	200
Weighted avg	0.94	0.94	0.94	200

$$\text{Accuracy} = \frac{\text{sum of diagonal elements}}{\text{total samples}}$$

Accuracy = 188/200

= 0.94

Confusion Matrix -2

- **CNN-based OA severity detection**

Actual

Predicted

Class	Class 0	Class 1	Class 2	Class 3	Class 4
Class 0	89	5	4	0	2
Class 1	12	80	1	4	3
Class 2	2	6	90	2	0
Class 3	0	3	0	89	8
Class 4	2	0	2	4	92

$$\text{Accuracy} = \frac{\text{sum of diagonal elements}}{\text{total samples}}$$

Accuracy = 440/500

= 0.88

Weighted Precision ≈ 0.880

Weighted Recall ≈ 0.880

Weighted F1-Score ≈ 0.880

Future Plan

1

User Feedback

Allow users to give feedback on prediction accuracy.

2

Mobile Support

Make the system mobile-friendly or develop a mobile app.

3

Doctor Recommendation

Recommend nearby arthritis specialists based on diagnosis.

4

Dataset Expansion

Add more RA X-rays to enable RA severity prediction.

Conclusion

AI-Powered Early Diagnosis

Provides an effective, AI-based tool to support early detection and management of arthritis.

Technological Integration

Combines Machine Learning, Deep Learning, and software engineering efficiently.

Cost-Effective & Scalable

Designed for affordable deployment in clinics, including rural healthcare centers.

Ready for Future Clinical Use

With enhancements, the system holds strong potential for real-world medical adoption.

References

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[2] A. Courties, J. Sellam, F. Berenbaum, Metabolic syndrome-associated osteoarthritis, Curr. Opin. Rheumatol. 29 (2) (2017) 214–222.

[3] F. Cabitza, A. Locoro, G. Banfi, Machine learning in orthopedics: a literature review, Frontiers Bioengin. Biotechn. (2018) 6.

[4] A.C. Staugaard, Robotics and AI: an Introduction to Applied Machine Intelligence, Prentice-Hall Englewood Cliffs, 1987.

Dataset 1 – Kaggle (https://www.kaggle.com/datasets/michaelkevin001/arthritis-clinical-dataset-using-blood-report)
Dataset 2 – Kaggle (https://www.kaggle.com/datasets/shashwatwork/knee-osteoarthritis-dataset-with-severity)

THANK YOU