



# 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.

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# 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

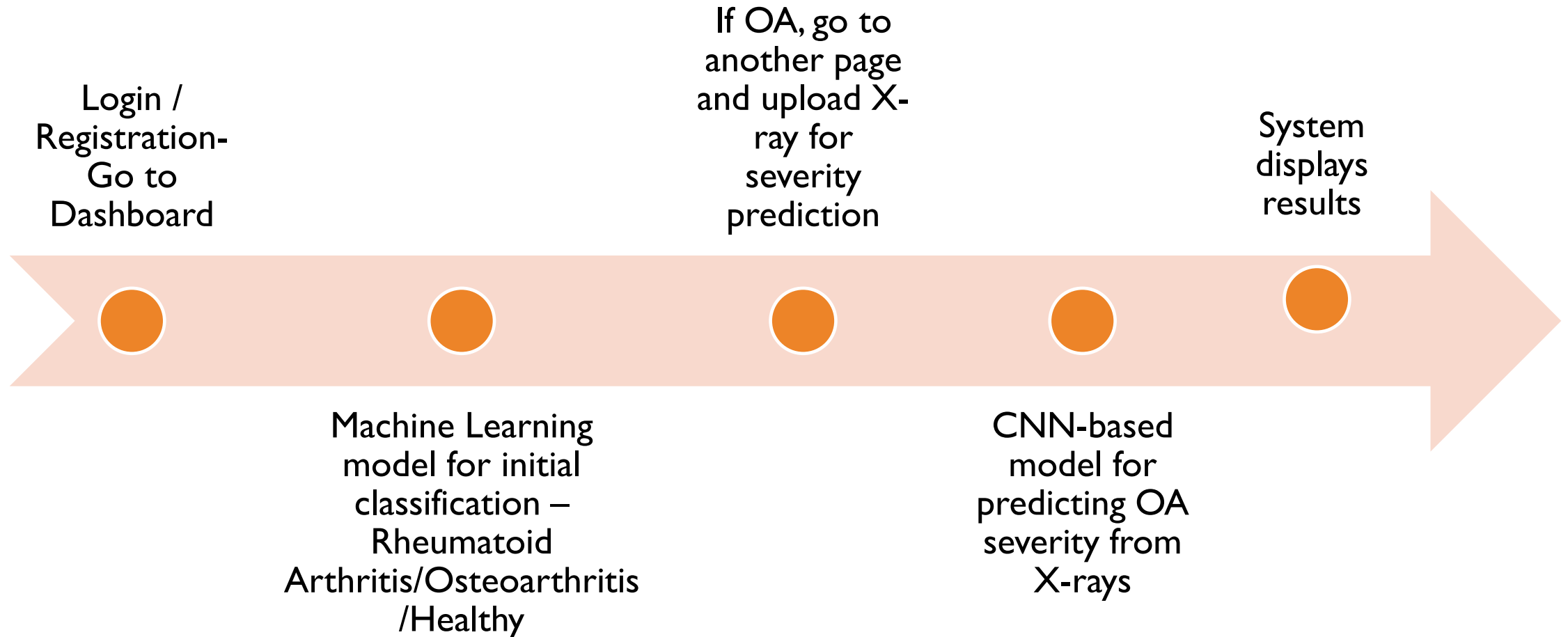
Machine learning library for various algorithms

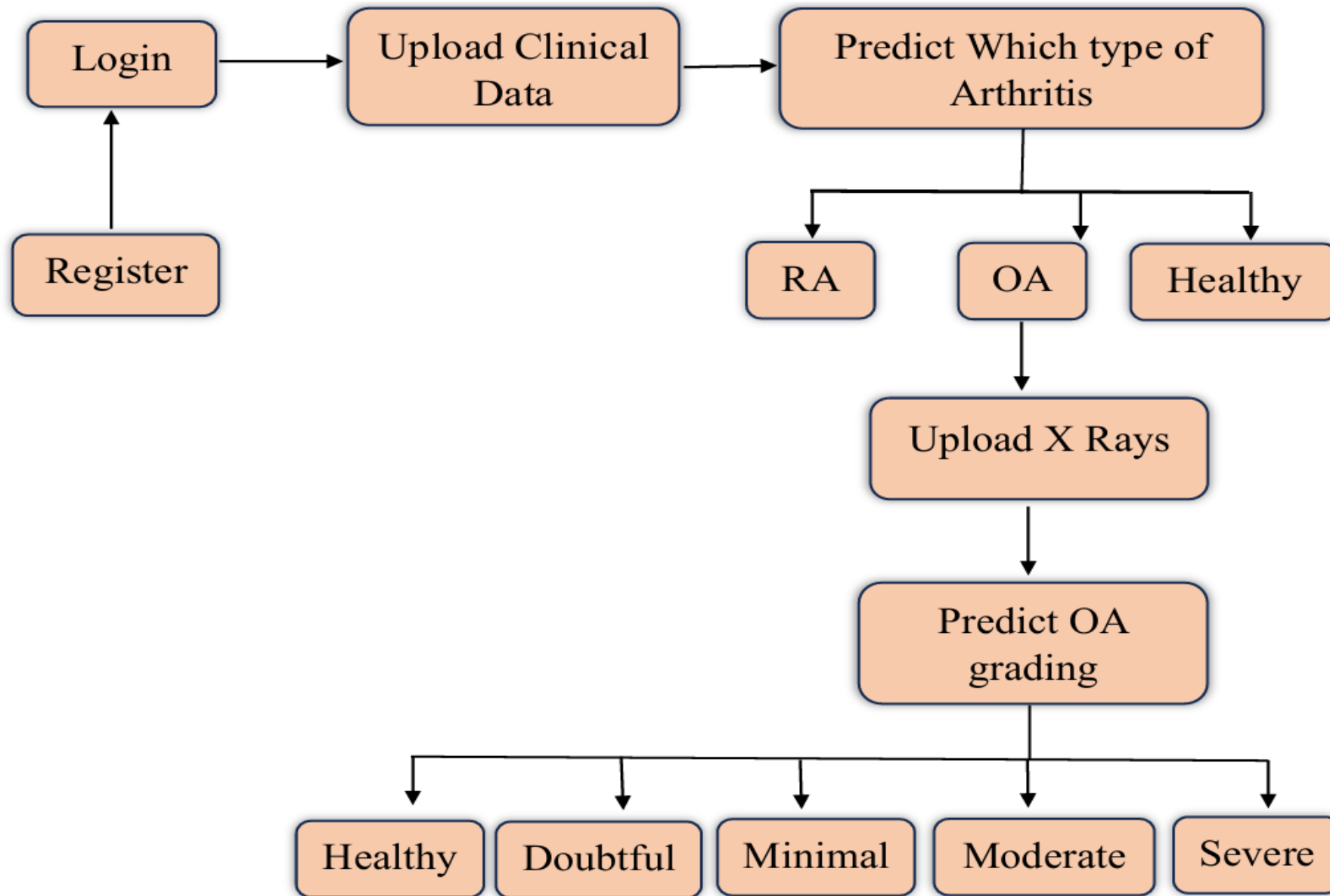
## Python Flask



Web framework for the application

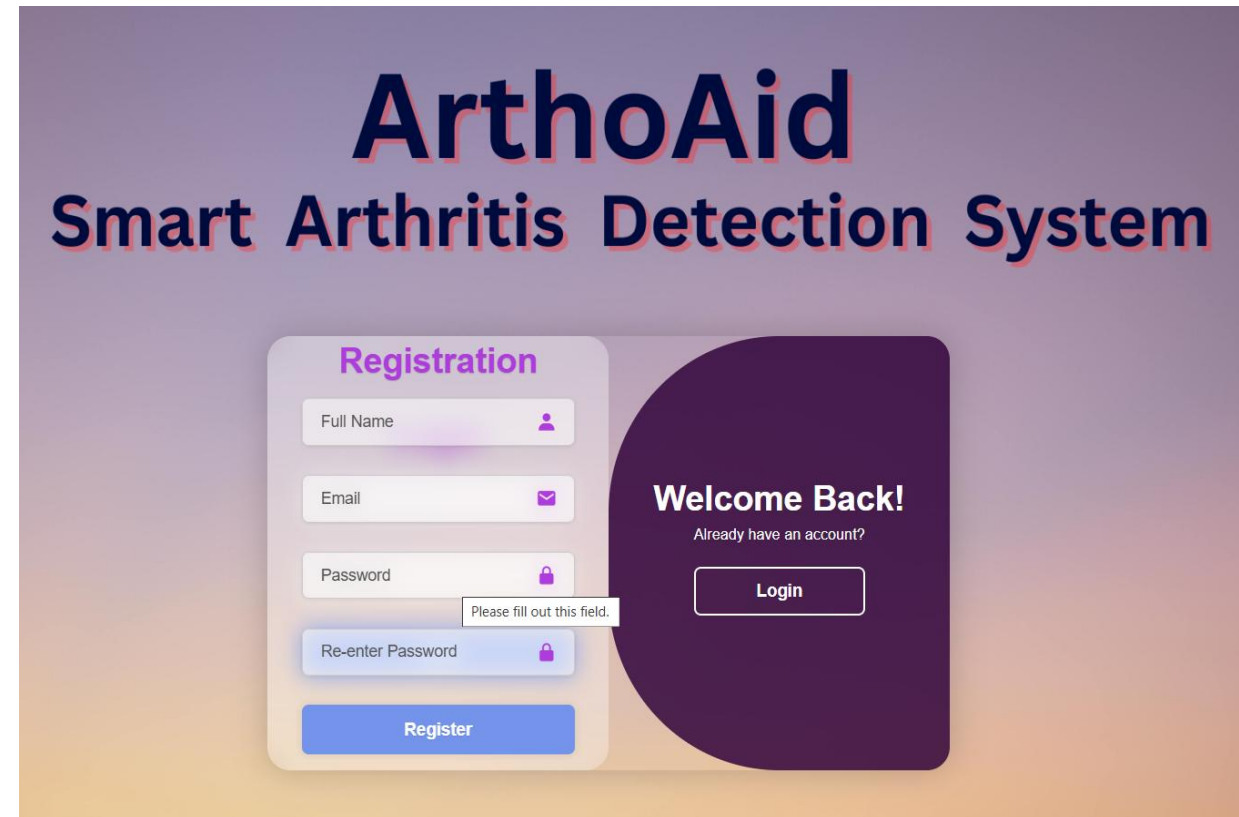
# Work-flow



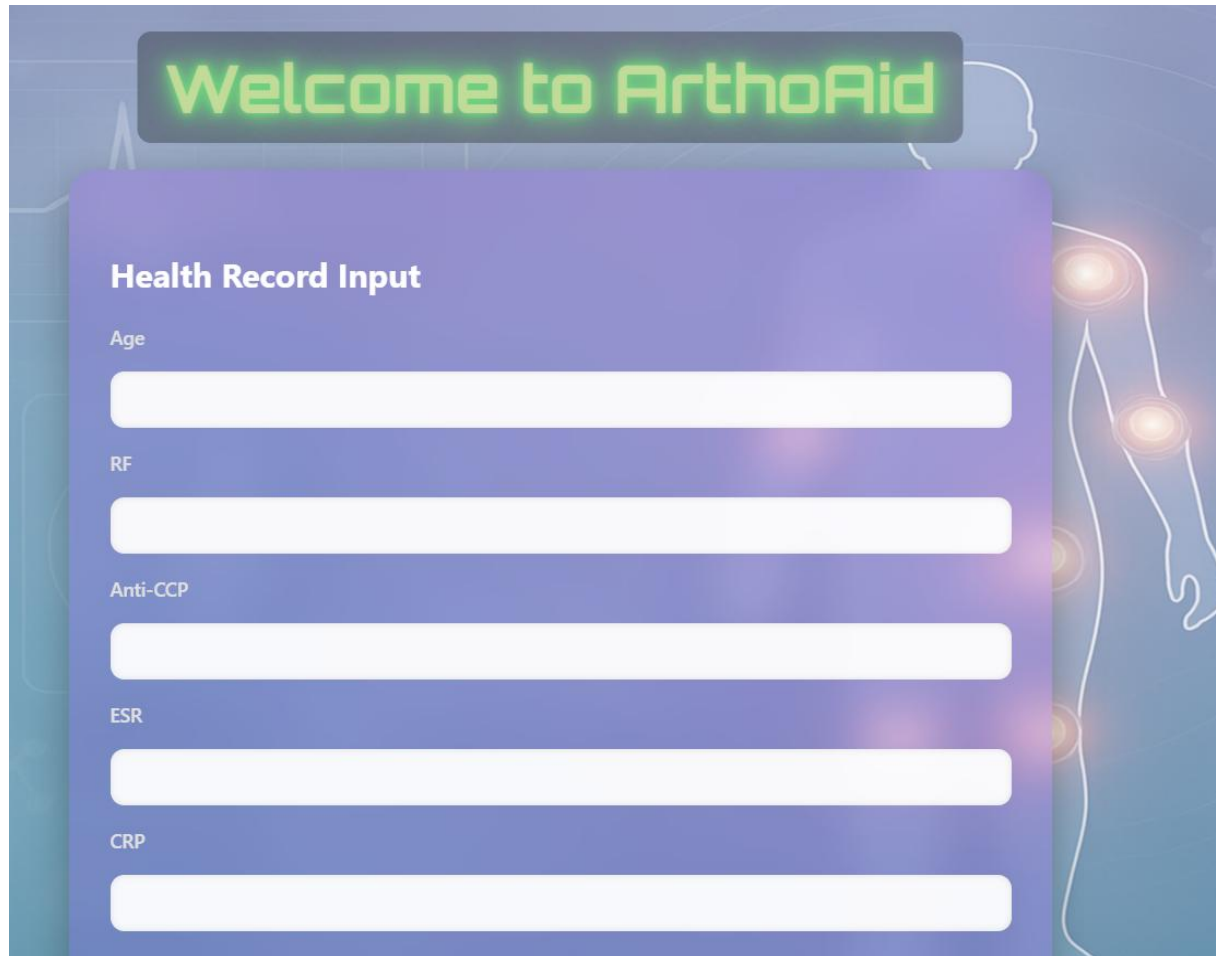




# User Experience & Interface



# User Experience & Interface



The image shows the 'Welcome to ArthoAid' screen. At the top, a green speech bubble contains the text 'Welcome to ArthoAid'. Below this is a purple rectangular form titled 'Health Record Input'. The form contains five input fields, each with a label to its left: 'Age', 'RF', 'Anti-CCP', 'ESR', and 'CRP'. The background of the screen is a light blue grid with a faint illustration of a human arm and hand, with glowing orange circles at the joints (shoulder, elbow, wrist, and hand).

Welcome to ArthoAid

### Health Record Input

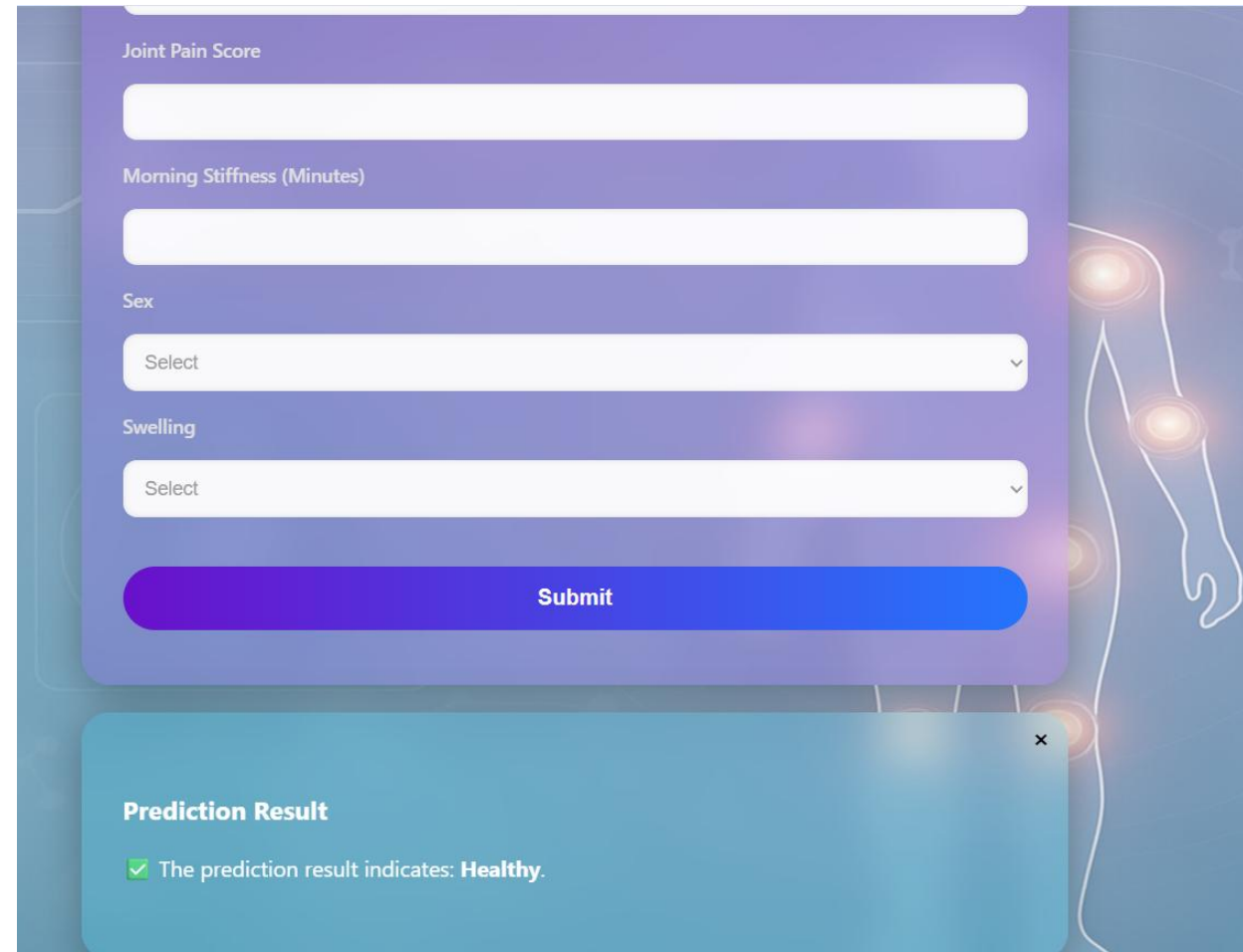
Age

RF

Anti-CCP

ESR

CRP



The image shows the continuation of the ArthoAid interface. It features a purple rectangular form with four input fields: 'Joint Pain Score', 'Morning Stiffness (Minutes)', 'Sex', and 'Swelling'. The 'Sex' and 'Swelling' fields are dropdown menus. Below these fields is a large blue button labeled 'Submit'. At the bottom of the screen, there is a light blue rectangular box titled 'Prediction Result' which contains a green checkmark icon and the text 'The prediction result indicates: Healthy.'.

Joint Pain Score

Morning Stiffness (Minutes)

Sex

Select

Swelling

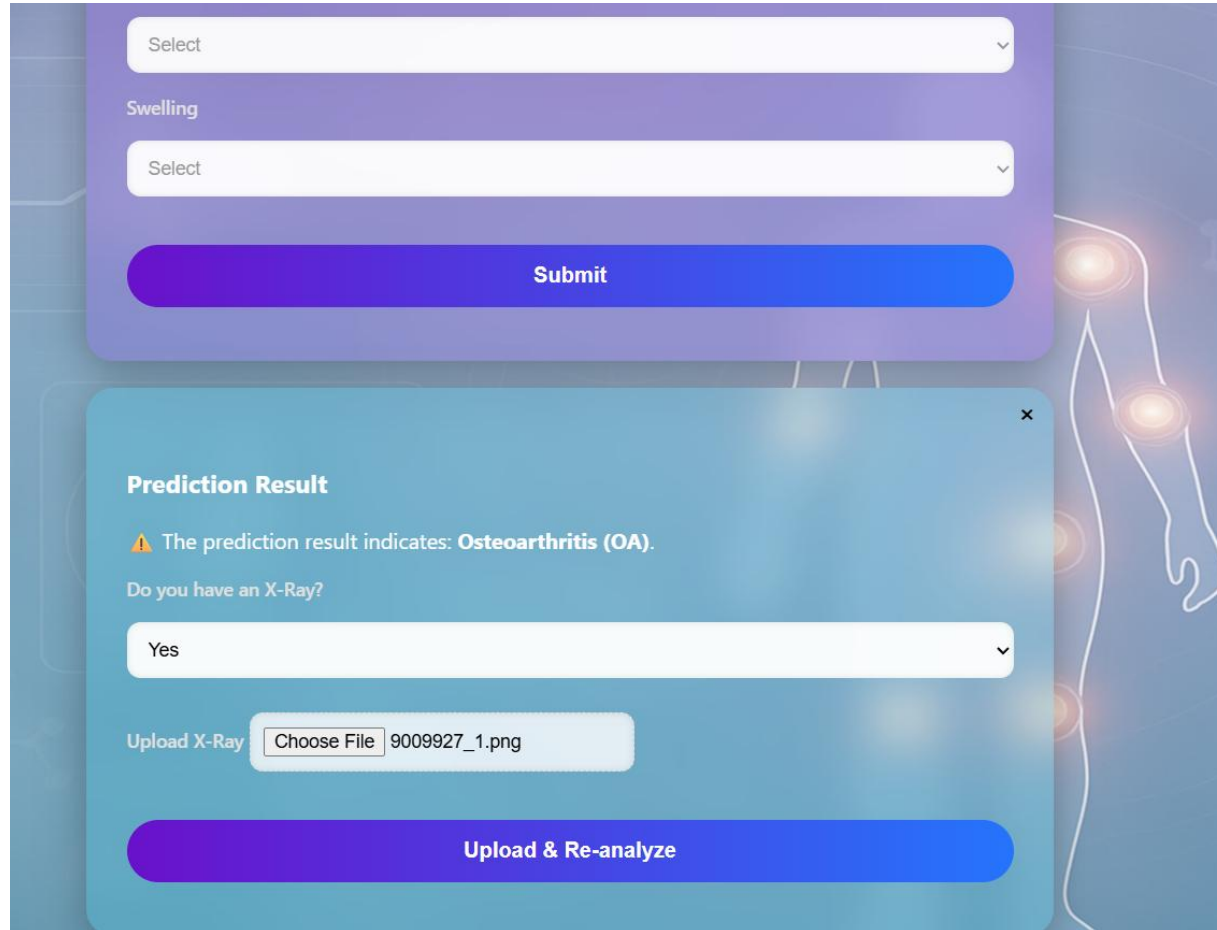
Select

Submit

### Prediction Result

✓ The prediction result indicates: **Healthy.**

# User Experience & Interface



The interface features a purple header bar with three colored segments: dark blue, orange, and grey. Below this, a light purple form contains two dropdown menus labeled 'Select' and 'Swelling'. A blue 'Submit' button is positioned below the form. To the right of the form is a faint illustration of a human arm with glowing joints. Below the form, a light blue modal window titled 'Prediction Result' is displayed. It contains a warning icon and text stating 'The prediction result indicates: Osteoarthritis (OA)'. Below this, a question 'Do you have an X-Ray?' is followed by a 'Yes' dropdown menu. At the bottom of the modal, there is an 'Upload X-Ray' section with a 'Choose File' button and the filename '9009927\_1.png'. A large blue 'Upload & Re-analyze' button is at the bottom of the modal.

Select

Swelling

Select

Submit

**Prediction Result**

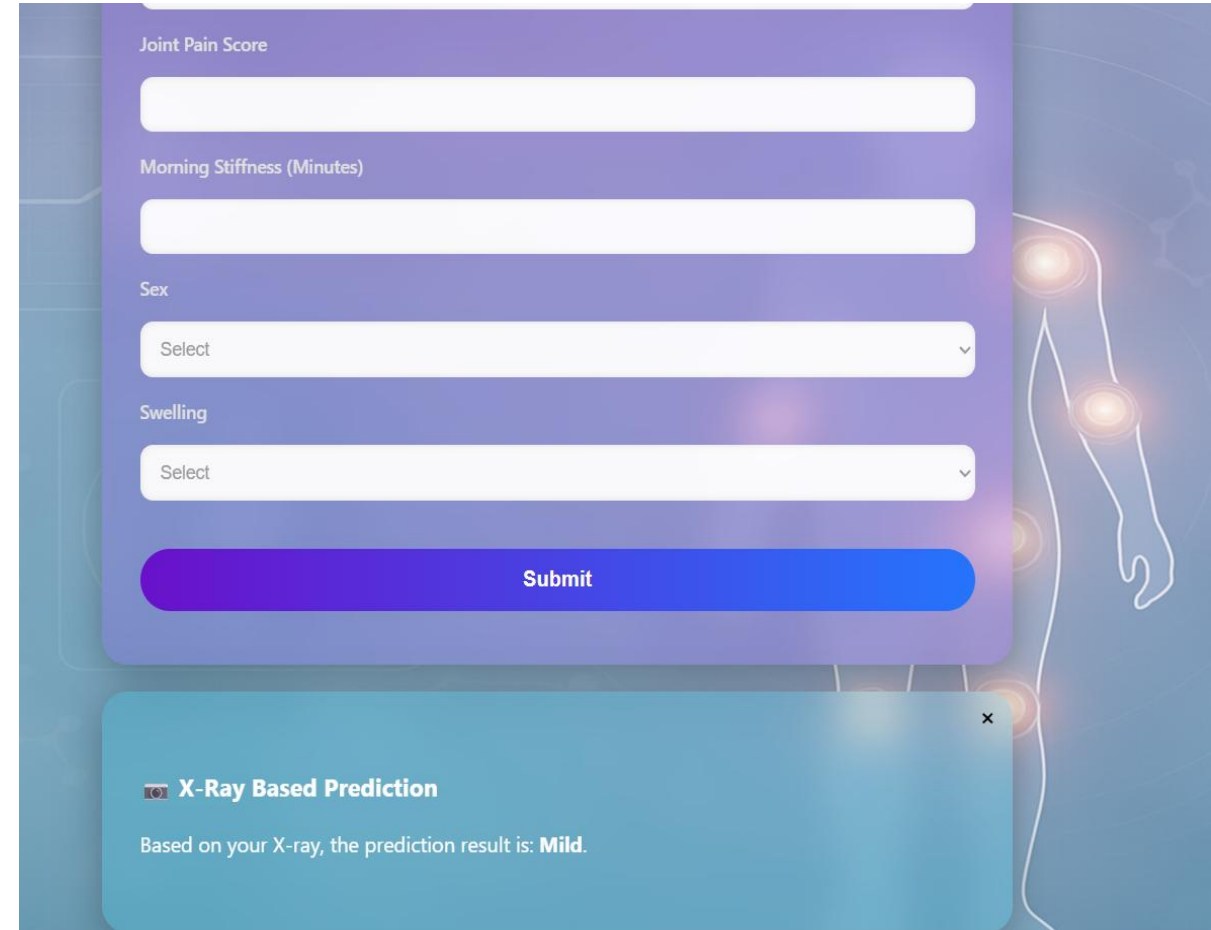
⚠ The prediction result indicates: **Osteoarthritis (OA)**.

Do you have an X-Ray?

Yes

Upload X-Ray Choose File 9009927\_1.png

Upload & Re-analyze



This interface is similar to the first one but includes additional input fields. The purple form contains 'Joint Pain Score' and 'Morning Stiffness (Minutes)' text inputs, followed by 'Sex' and 'Swelling' dropdown menus. A blue 'Submit' button is at the bottom. To the right is the same faint arm illustration. Below the form, a light blue modal window titled 'X-Ray Based Prediction' is shown. It contains the text 'Based on your X-ray, the prediction result is: Mild.'.

Joint Pain Score

Morning Stiffness (Minutes)

Sex

Select

Swelling

Select

Submit

**X-Ray Based Prediction**

Based on your X-ray, the prediction result is: **Mild**.

# 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

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

$$\text{Accuracy} = 188/200$$

$$= 0.94$$

**Confusion Matrix -2**

➤ **CNN-based OA severity detection**

Predicted	Actual					
	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

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

$$\text{Accuracy} = 440/500$$

$$= 0.88$$

$$\text{Weighted Precision} \approx 0.880$$

$$\text{Weighted Recall} \approx 0.880$$

$$\text{Weighted F1-Score} \approx 0.880$$

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# Future Plan

**1**

## **User Feedback**

Allow users to give feedback on prediction accuracy.

**3**

## **Doctor Recommendation**

Recommend nearby arthritis specialists based on diagnosis.

**2**

## **Mobile Support**

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

**4**

## **Dataset Expansion**

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

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# 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

- [1] M.J. Lespasio, et al., Knee osteoarthritis: a primer, Perm. J. (2017) 21.
- [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**