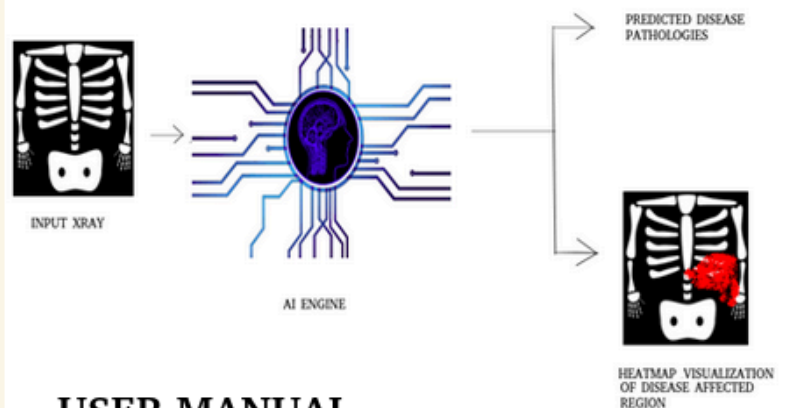## X-RAYCAD

A
CHEST X-RAY
COMPUTER AIDED
DIAGNOSIS
TOOL

AN ARTIFICIAL INTELLIGENCE ENGINE FOR COMPUTER AIDED DIAGNOSIS

An Artificial Intelligence Web Application Solution

INPUT XRAY

AI ENGINE

PREDICTED DISEASE PATHOLOGIES

HEATMAP VISUALIZATION OF DISEASE AFFECTED REGION

USER MANUAL

X-RAYCAD
SUPPORTING DOCTORS

CONTENTS

Getting Started

The CHEST X-RAY Computer Aided Diagnosis Software Solution by Centre for Development of Advanced Computing(C-DAC), Chennai is a Web Application Portal for assisting doctors in Chest X-Ray Diagnosis. This Solution is an Artificial Intelligence Engine that can help in Chest X-Ray Computer Aided Diagnosis. The functionality includes:

a) Chest X-Ray Disease Classification
b) Visualization of disease affected region
c) Indian Patients Chest X-Ray Dataset Collection and Annotation

About XRAYCAD

This Section briefly describes the functionalities of XRAYCAD Artificial Intelligence Software Solution:

a) Chest X-Ray Disease Classification:

The Software solutions identifies 14 disease pathologies associated with Chest X-Ray. The disease pathologies are following:
1) Atelectasis
2) Cardiomegaly
3) Nodule
4) Pneumothorax
5) Lung Opacity (Infiltration, Consolidation, Pneumonia and Mass)
6) Edema
7) Emphysema
8) Fibrosis
9) Effusion/Thickening (Pleural_Thickening, Effusion)
10) Hernia

If the Chest X-Ray is not diagnosed with above pathologies, the Software will say the X-Ray has '**No findings**'. Multiple pathologies associated with a single X-Ray Image will also be predicted by the Software Artificial Intelligence Engine.

The accuracy of the proposed system is 0.9290 AUROC(Area Under Receiver Operating Characteristics). This tool is a beta version for testing and should not be used for Medical Diagnosis at this stage.

The scope of Computer Aided Diagnosis is for postero-anterior(PA) and AP Chest X-Rays and does not include Lateral Chest X-Ray.

1. **Visualization of disease affected region**

The tools also portray the disease affected region in Chest X-Ray. 'Fig 1' is the showing red marking curve generated for a patient with Cardiomegaly. Cardiomegaly is a state in which the heart size is enlarged greater than 50% of the Chest X-Ray width. The Heart Region is shown as affected using Red Curve.
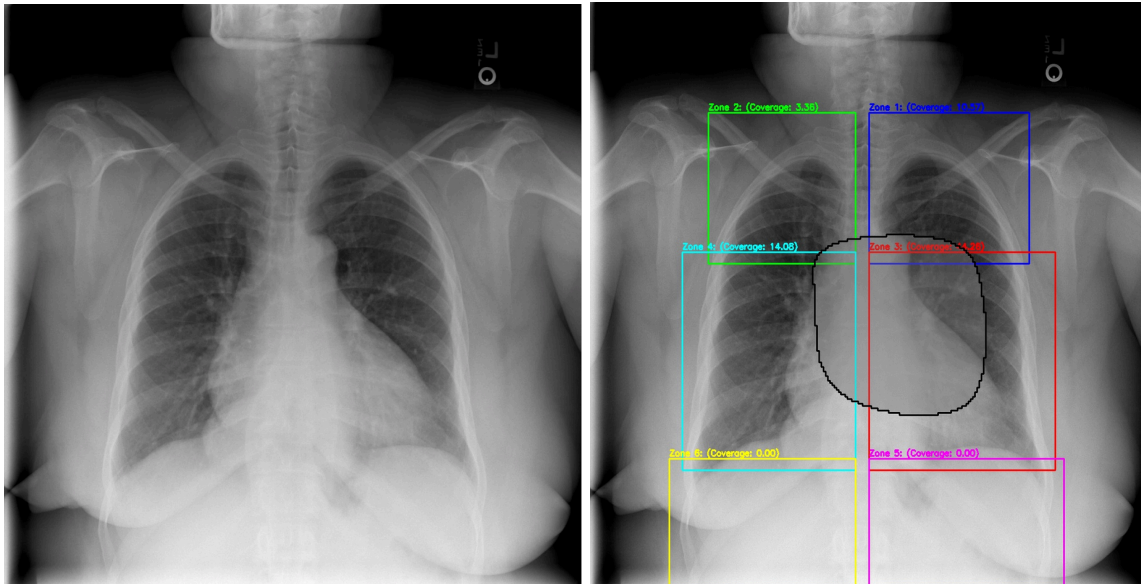
Fig 1: Cardiomegaly
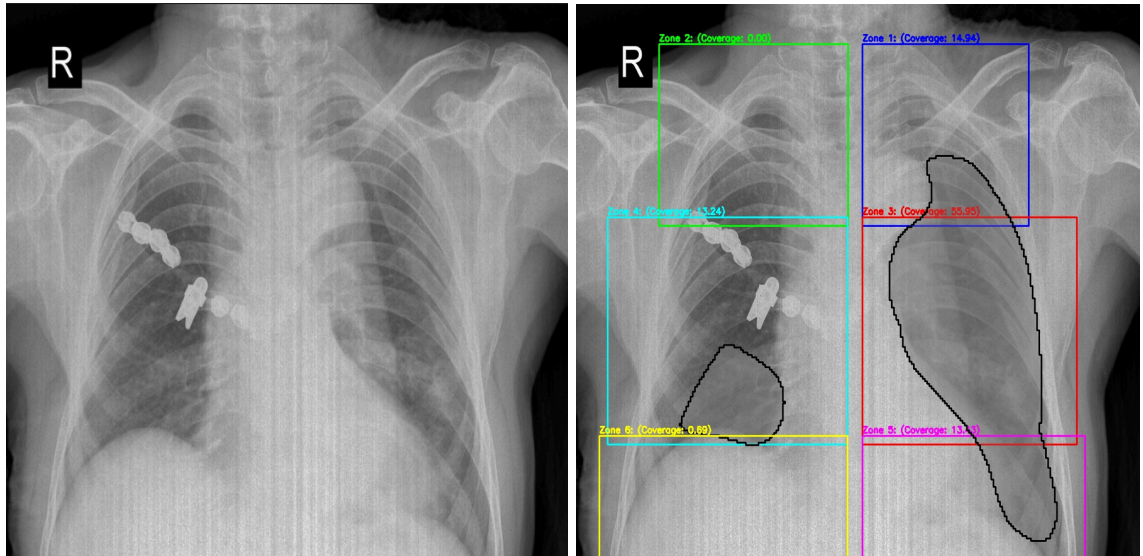
Fig:2 Infiltration

2. Indian Patients Chest X-Ray Dataset Collection and Annotation

The Chest X-Ray image uploaded will be used for both Diagnosis and Data Collection. The Chest X-Ray data will be saved in the C-DAC Chennai server. Hospitals are requested to get permission from the medical ethics board for sharing data with C-DAC, Chennai, if required.

The data will be used by C-DAC Chennai for improving the accuracy of the underlying software solution. The doctors are requested to use the checkbox "Untick for Correction" to correct the wrongly predicted 'Chest X-Ray Pathology' by the Software Tool. This will allow the doctor to input correct findings. The correct findings will be used to enhance the software in the next version.

System Requirements

The tool is intended to be used by the target audience: Doctors. Following are the minimum facilities required for using software:

   a) Input   : X-Ray images in digital format (-*.jpg,*.png,*.dcm,*.bmp)
   b) PC/Laptop with Operating System : Windows/Linux
   c) Browser   : Google Chrome/Mozilla Firefox
   d) Internet Connection

Using XRAYCAD

XRAYCAD version 1.0 has been designed to be an extremely simple and easy-to-use AI diagnosis support system that requires minimal effort from the user. Users must know how to use a browser and access a website to start using XRAYCAD.

Userflow

Using XRAYCAD is a simple 4 step process to get the consultation you need.
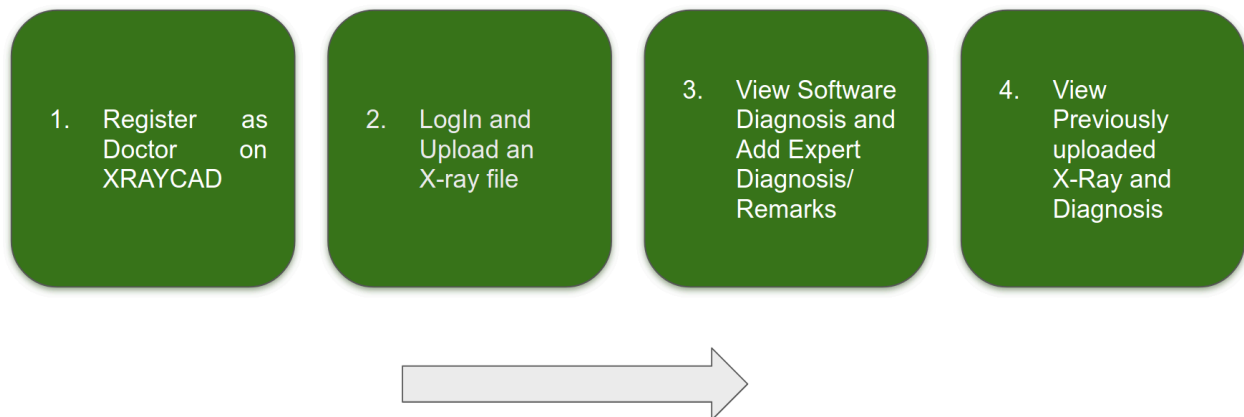
Apart from above functionalities XRAYCAD also provides option for view past uploaded x-ray images and diagnosis, similar x-ray images

Homepage
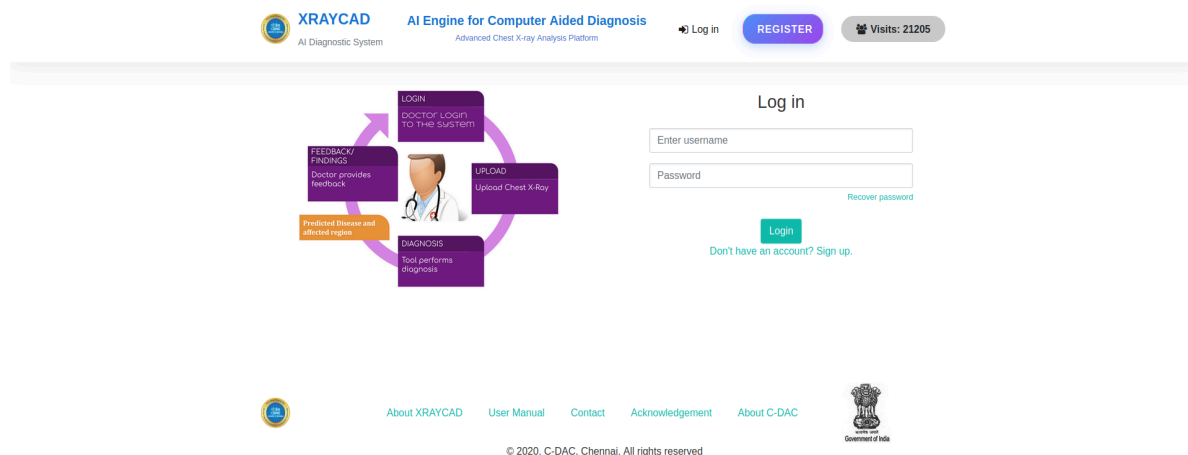
Step 1: Registering with XRAYCAD for the first time

All new users must register on the XRAYCAD website before logging in and trying to use the facility. Refer to the following steps to Signup with XRAYCAD:

1. Visit https://xraycad.bosschn.in/
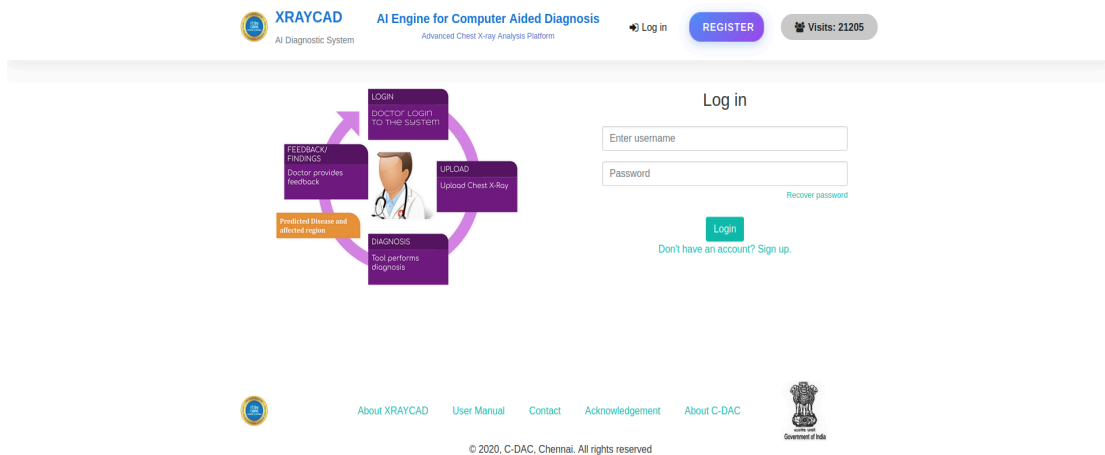
2. Click the SignUp link on the homepage. User can also click on Register link at the top for registration
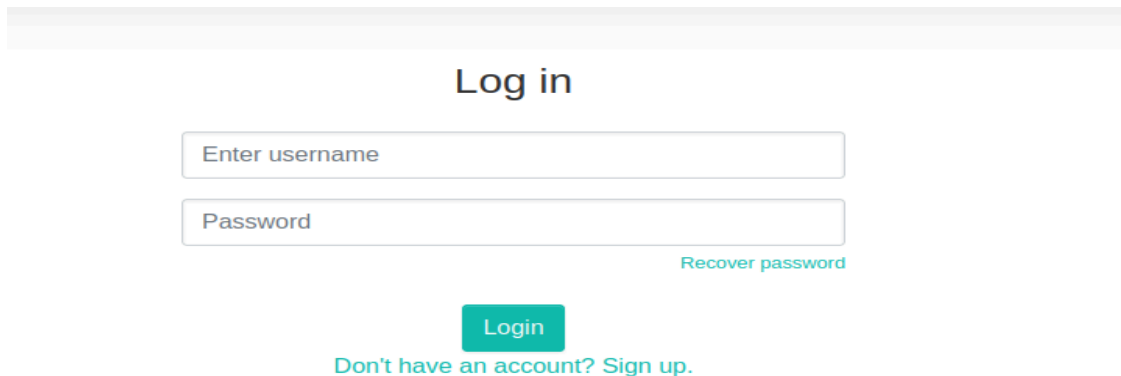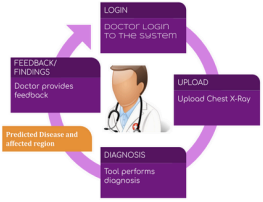
3. Type in Name, username, email, password, phone number and specialization
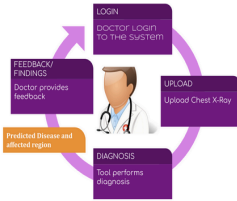
4. Click on the register button to complete the registration process.

Step 2: Logging in to XRAYCAD

1. Enter your username and password in the textbox, then click the login button.
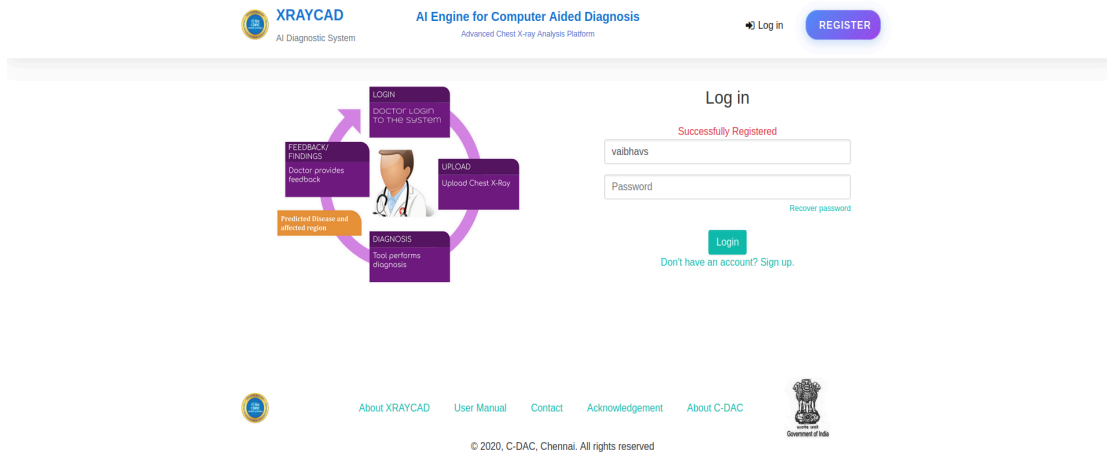
2. Click on the 'Upload New XRAY' button to upload an X-Ray file. To view previously uploaded files, click on the 'View Uploaded XRAY' button.
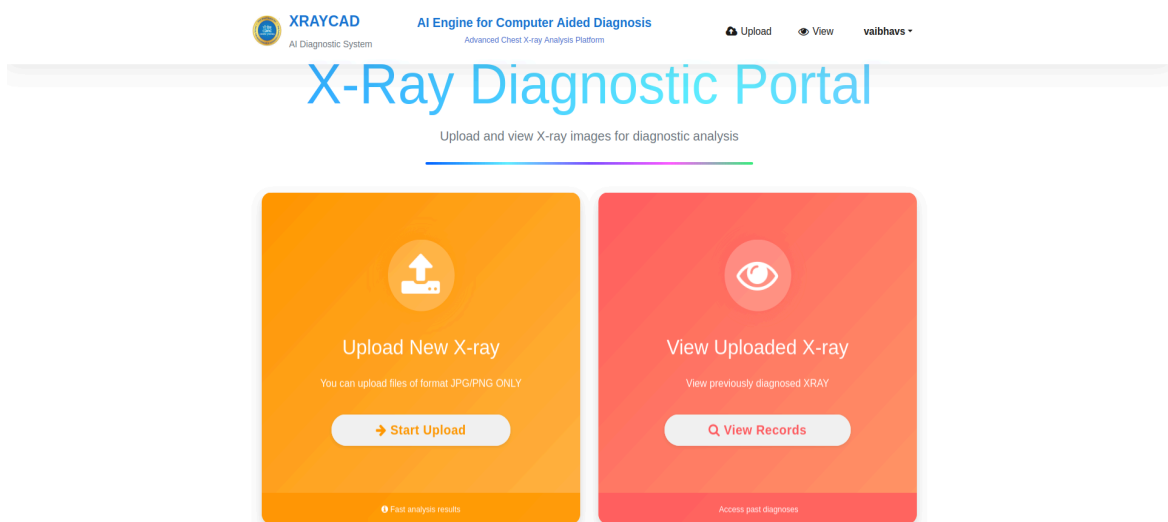
Step 3: Uploading a new image into XRAYCAD

1. You can upload Single file/Multiple files associated with a patient. You can also upload a directory containing X-Ray images to the portal. Choose radio buttons:

2. For single patient, following steps can be followed
    a. Enter patientfile No, patient name, age and gender. These details are optional entries.
    b. You can make 'tick to make visible to others' checkboxes ticked, if you are comfortable with sharing the information with other login users.
    c. Use 'Choose File' Button to upload a new XRAY image from your computer.
    d. Click the 'Upload' button to upload an image. The uploaded image will be saved in database

3. For multiple patients, you need to select multiple files or Browse the directory. Choose appropriate radio buttons.

4. Multiple file selection is shown below.
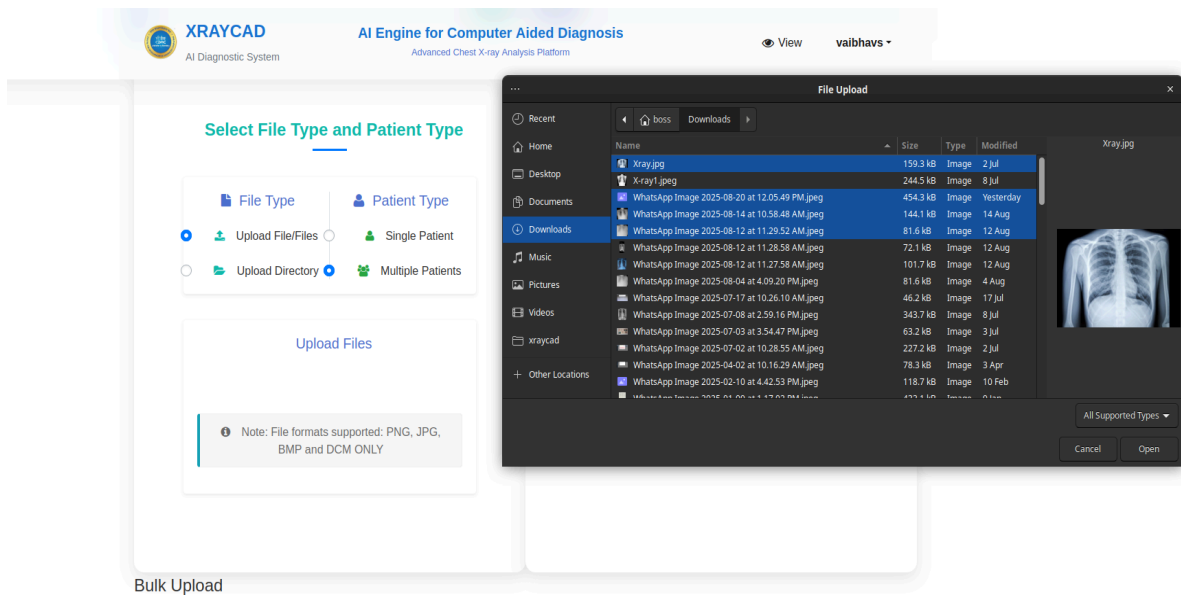
Bulk Upload

- Upload multiple patient X-Rays
  - Browse the folder containing X-Rays
  - X-ray iles inside the selected folder should be .jpg, .png and .dcm types.

5. You can upload a directory of maximum 2 GB size to the XRAYCAD.
   A large directory will have waiting time. It is requested that the upload page should not be refreshed during the process. Directory upload process is shown below.

Bulk Upload

- Upload multiple patient X-Rays
  - Browse the folder containing X-Rays
  - X-ray iles inside the selected folder should be .jpg, .png and .dcm types.
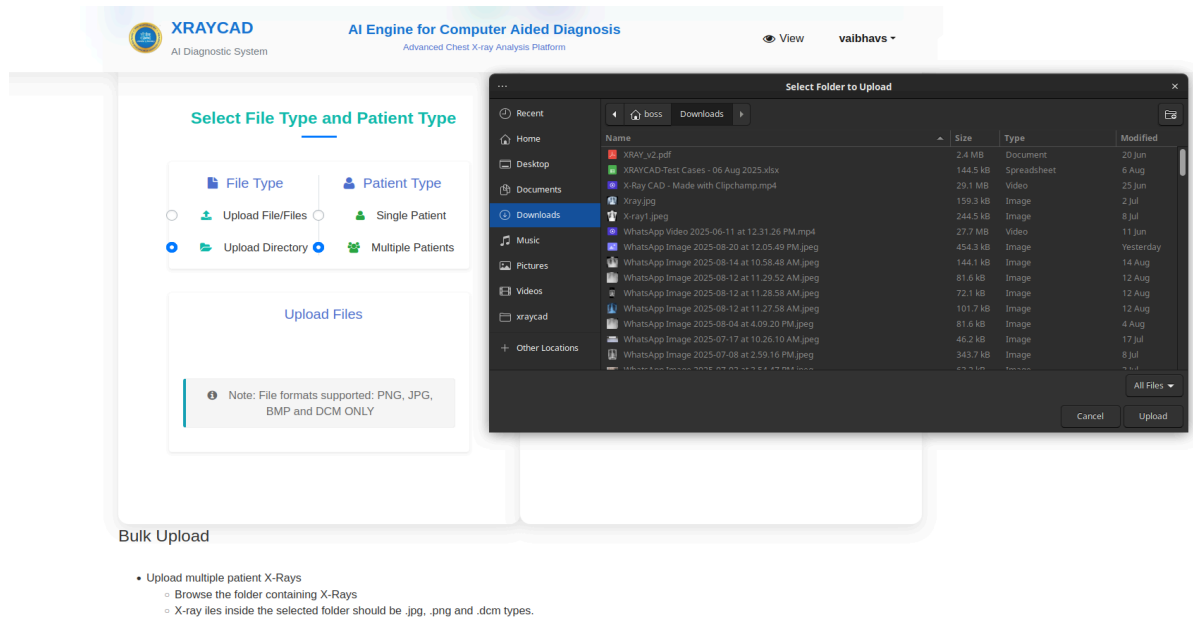
6. The upload process will show the x-ray image, Image verification info. The images which software feels are not an x-ray due to markings or wrong images are shown in GUI with a warning message and with an unticked checkbox. Users can forcefully upload that x-ray image by ticking the associated checkbox, if required.
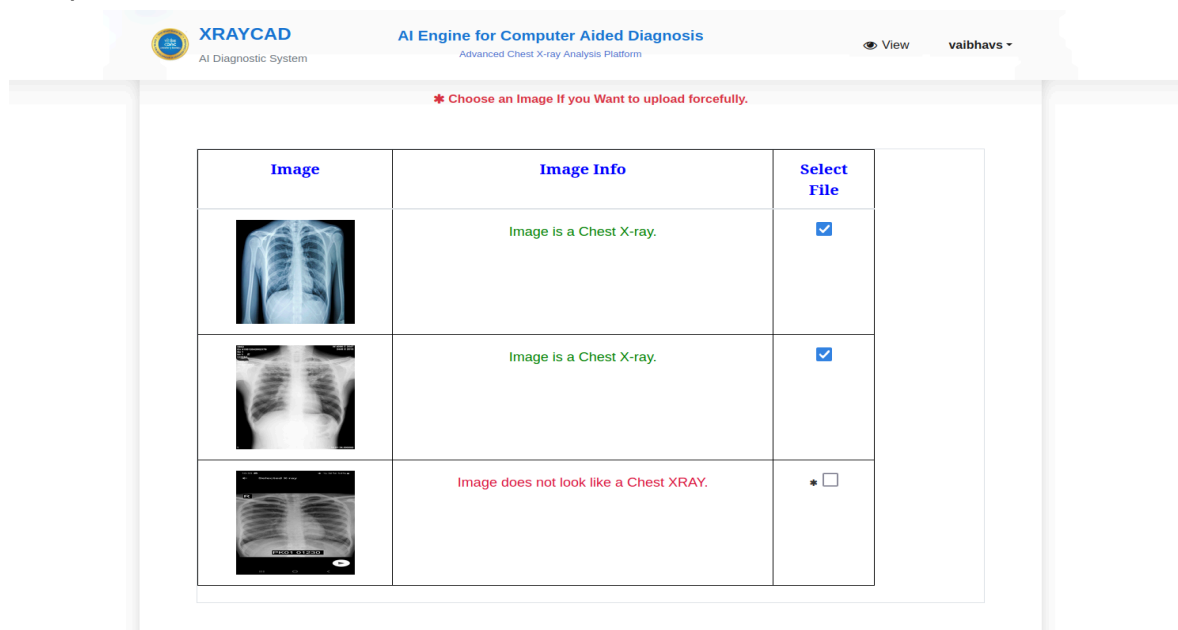
7. Click the upload button in the above screenshot to complete the upload process.

8. You can view the uploaded files and software proposed diagnosis as shown below.
You can use the Diagnosis Icon associated with x-ray to add Expert Diagnosis.
Total number of Normal(No findings) x-ray is also shown for folder/ multiple files uploads.
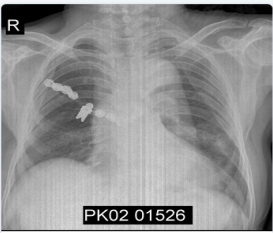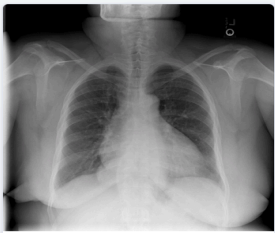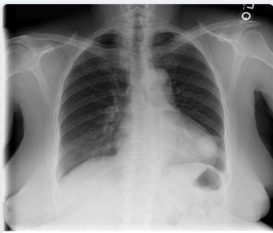
Step 4: Algorithm Diagnosis and Expert Diagnosis

1. You can see the 'Input X-Ray Image' and 'Proposed Algorithm Diagnosis' on the page. If the doctor/user agrees with the proposed diagnosis, he/she can click the submit button with default "I agree for Proposed Diagnosis" Button clicked.

2. If the doctor/user wants to suggest some diagnosis other than the proposed diagnosis, he/she can click on "I do not agree for Proposed Diagnosis" radiobutton. This allows the doctor/user to select a new set of correct findings. Users can also fill in the remarks column for future reference.

3. Users can click on the proposed diagnosis image to view the enlarged image with red curve markings.
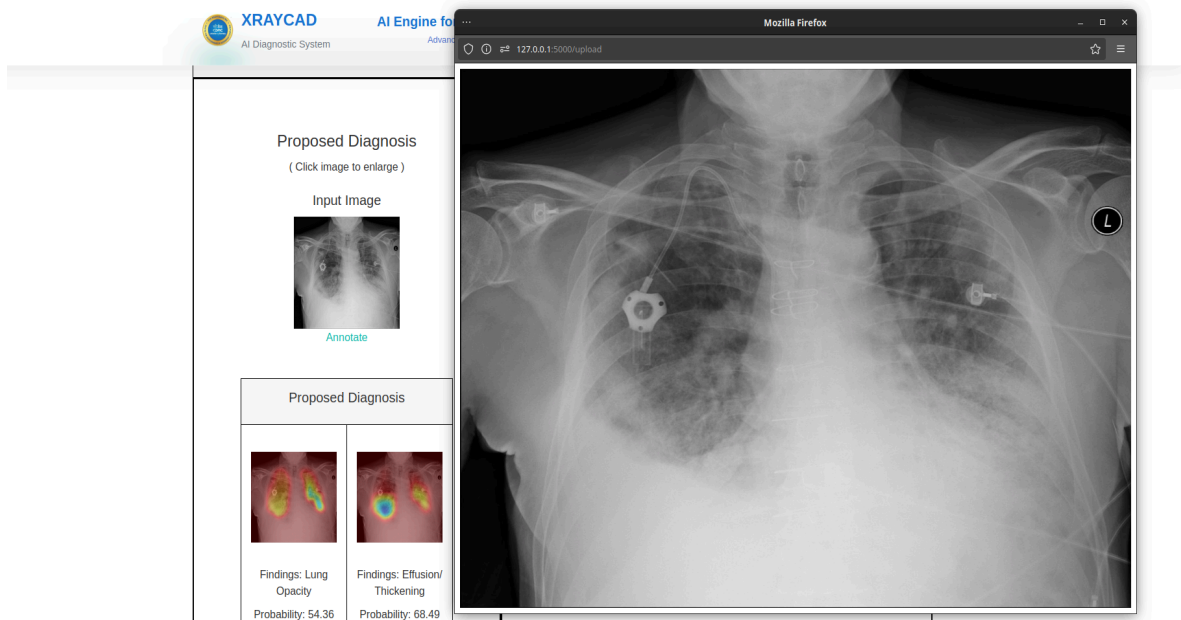
4. Users can click on the Similar Image link to view x-rays diagnosed with the same set of diseases.
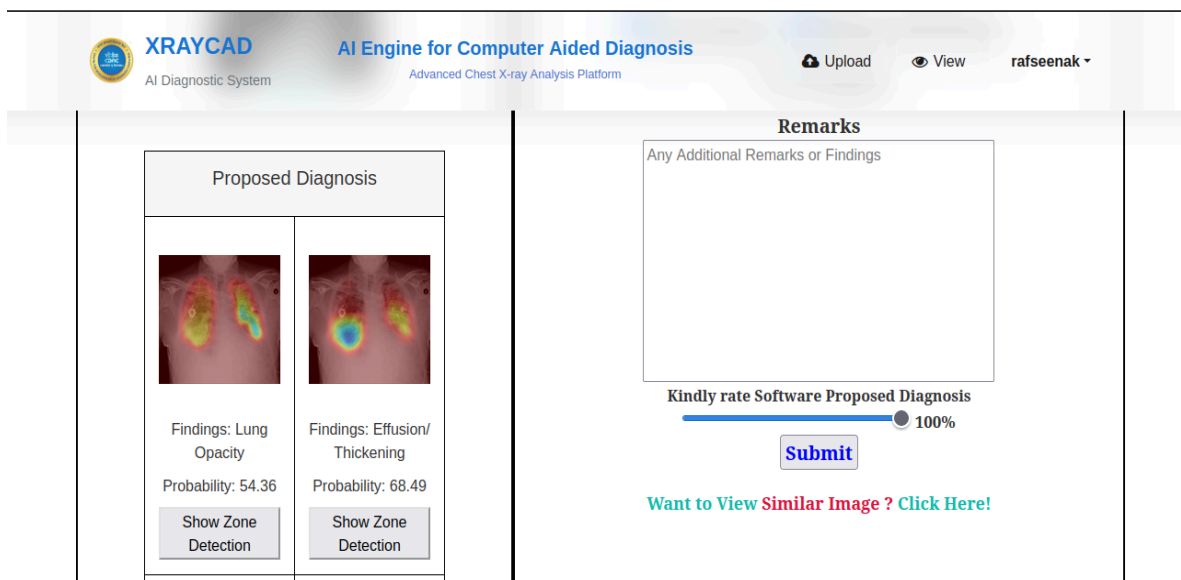
5. Users can click on the proposed diagnosis x-ray to view x-rays diagnosed with the same disease.

Viewing previously uploaded X-Ray images and diagnosis

1. You can see the 'Input X-Ray Image' , 'Proposed Algorithm Diagnosis', Expert Diagnosis, Uploaded Date, Corrected Date on this page.
2. Doctors can view an enlarged X-Ray image by clicking on Image.
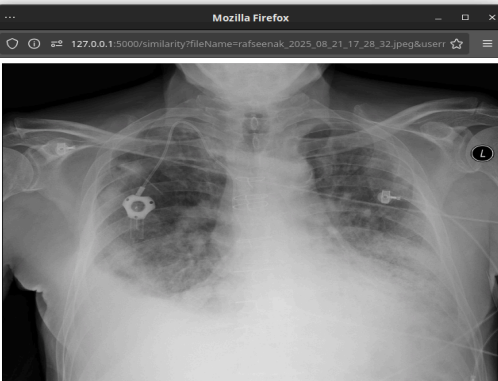
3. Doctors can perform Re-diagnosis for an X-Ray by clicking on Edit ICON. The updated diagnosis will be saved on the database.
4. Doctors can click on view similar X-RAY Images with similar diagnosis by clicking on Record Book ICON.

Support, questions, comments and feedback

If you face any problems while using XRAYCAD or if you have any suggestions, questions, comments or feedback, please visit the contact page at https://xraycad.bosschn.in

Suggestions & queries may be directed to the XRAYCAD team at:

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