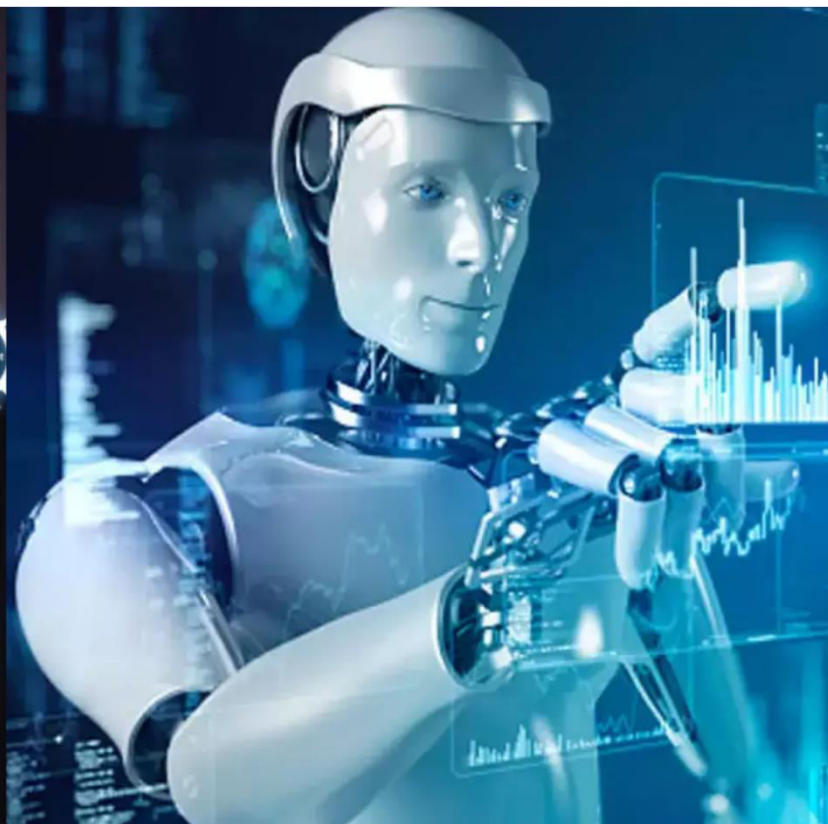




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A Deep Learning Approach to Brain, Skin & Kidney Anomalies

Prof. Poral Nagaraj¹, Ningaraju N², Sadashiva N M³, Yuvaraj B⁴

Assistant Professor, Dept. of CS & E, SJMIT, Chitradurga, Karnataka, India¹

UG Student Dept. of CS & E, SJMIT, Chitradurga, Karnataka, India²⁻⁴

ABSTRACT: The rapid advancement of artificial intelligence (AI) and deep learning has revolutionized medical diagnostics by enabling automated, accurate, and efficient disease detection. This project, “A Deep Learning Approach to Brain, Skin, and Kidney Anomalies,” presents an intelligent diagnostic system designed to identify medical abnormalities in multiple organ systems using deep learning techniques. Separate Convolutional Neural Network (CNN) models were developed and trained on domain-specific datasets—MRI for brain, dermoscopic images for skin, and ultrasound/CT scans for kidneys—to classify anomalies such as tumors, lesions, and cysts.

The system integrates advanced image preprocessing, model training, and evaluation using metrics like accuracy, precision, recall, and F1-score to ensure reliable performance. Implemented through a Streamlit-based web interface, it allows users to upload medical images, view real-time predictions with confidence scores, and generate detailed AI-driven diagnostic reports using the Gemini API for natural language explanation.

KEYWORDS: Deep Learning, Convolutional Neural Network (CNN), Medical Image Analysis, Brain Tumor Detection, Skin Lesion Classification, Kidney Anomaly Detection, Artificial Intelligence in Healthcare, Medical Diagnostics, Image Preprocessing, Gemini API, Streamlit, Automated Disease Detection, Multi-Organ Classification, Computer Vision, AI-based Medical System.

I. INTRODUCTION

The field of medical diagnostics has undergone a remarkable transformation with the integration of artificial intelligence (AI), especially deep learning technologies. Medical imaging techniques—such as MRI, CT scans, dermoscopy, and ultrasound—are essential tools in detecting diseases and monitoring organ health. However, manual interpretation of these images can be time-consuming, prone to error, and dependent on the expertise of medical professionals. To address these challenges, this project introduces a deep learning-based framework designed to detect anomalies in three critical organ systems: the brain, skin, and kidneys.

The integration of artificial intelligence (AI) and medical imaging has led to revolutionary changes in the field of healthcare diagnostics. Among these advancements, deep learning—a subset of machine learning inspired by the human brain's neural networks—has shown exceptional promise in detecting and classifying anomalies in various organs. In particular, the detection of brain, skin, and kidney anomalies has garnered significant research interest due to the high prevalence, complexity, and clinical importance of diseases affecting these organs.

Deep learning, particularly convolutional neural networks (CNNs), has shown outstanding performance in image classification, segmentation, and pattern recognition tasks. These models can learn and extract features from large volumes of annotated medical images without manual programming. Once trained, they can identify complex patterns that may be missed by human observers. The use of deep learning models not only automates the detection process but also improves diagnostic consistency and accuracy.

In this project, separate deep learning models are trained on high-quality datasets for each organ system. The models are designed to classify images into normal or abnormal categories and, in some cases, even identify the specific type of anomaly (e.g., tumor type, skin lesion class, or kidney abnormality). By implementing and comparing different architectures such as ResNet, VGG, or U-Net, the most effective model for each organ is selected.

II. LITERATURE SURVEY

Several research studies have explored the use of deep learning, particularly Convolution Neural Networks (CNNs), in detecting medical anomalies from image data. Below is a summary of notable related works in the areas of brain, skin, and kidney anomaly detection:

[1] Paper Title: Brain Tumor Classification Using Convolutional Neural Network, Nyoman Abiwinanda, Muhammad Hanif, S. Tafwida Hesaputra, Astri Handayani, and Tati Rajab Mengko, 2023. In this paper, they have introduced CNN to automatically classify the three most common types of brain tumor, i.e. the Glioma, Meningioma, and Pituitary; without requiring region-based pre-processing steps. We identified an optimal CNN architecture consisting of 2 layers of convolution, activation (ReLU), and maxpool, followed by one hidden layer of 64 neurons. [2] Classification of Brain Tumors from MRI Images Using a Convolutional Neural Network, Milica M. Badža and Marko C. Barjaktarovic, 2020 [3] A Deep Learning Approach for Kidney Disease Recognition and Prediction through Image Processing, Kailash Kumar, M. Pradeepa, Miroslav Mahdal, Shikha Verma, M. V. L. N. Raja Rao and Janjhyam Venkata Naga Ramesh, 2023. [4] AI Techniques of Dermoscopy Image Analysis for the Early Detection of Skin Lesions Based on Combined CNN Features, Fekry Olayah, Ebrahim Mohammed Senan, Ibrahim Abdulrab Ahmed and Bakri Awaji, 2023, [5] Artificial Intelligence for Skin Cancer Detection, Abdulrahman Takiddin, 2021,

III. SYSTEM MODEL AND ASSUMPTIONS

The proposed system model for “A Deep Learning Approach to Brain, Skin, and Kidney Anomalies” is designed as an intelligent diagnostic framework that integrates deep learning models with an interactive web interface. The system takes medical images such as brain MRI scans, dermoscopic skin images, and kidney ultrasound or CT scans as input. These images are preprocessed through resizing, normalization, noise removal, and augmentation to ensure consistency and enhance image quality. After preprocessing, the images are passed into Convolutional Neural Network (CNN) models such as ResNet, VGG16, or MobileNet, which are specifically trained for each organ type. These models automatically extract features and classify the images into normal or abnormal categories, identifying conditions such as brain tumors, skin lesions, or kidney cysts and stones. The classification results are then processed in the decision layer, where the system provides prediction outputs along with confidence scores and visualizations such as charts or heatmaps for interpretability. An additional AI layer, powered by the Gemini API, generates medical explanations and patient-friendly reports, which can be downloaded in PDF format. The entire process is executed through a Streamlit-based web interface, allowing users to easily upload images, view results, and access reports.

The system operates under several assumptions to ensure reliable performance. It assumes that the uploaded medical images are clear, well-focused, and belong to one of the three organ categories (brain, skin, or kidney). The datasets used for training and testing are assumed to be accurately labeled and medically validated. Users interacting with the system, such as doctors or technicians, are expected to have basic computer knowledge and access to a stable internet connection for model inference and AI explanations. The system is designed to run on hardware with at least 8 GB RAM, an Intel i5 or higher processor, and GPU support for faster processing. It also assumes that the system functions as a decision-support tool rather than a replacement for medical professionals, providing diagnostic assistance and reducing human error while maintaining clinical oversight.

IV. IMPLEMENTATION

TECHNOLOGY STACK

The implementation of the Table 1 explains represents the combination of programming languages, frameworks, tools, and services used in building the deep learning-based medical diagnostic system. Each layer of this stack plays a vital role in ensuring accurate anomaly detection, smooth user interaction, and efficient integration of AI-driven explanations.

Table 1 Technology Stack Overview

Layer	Technology / Tool	Purpose / Description
Programming Language	Python 3.8+	Core language for AI model development, data handling, and integration.
Deep Learning Framework	TensorFlow / Keras	Building, training, and evaluating CNN (MobileNetV2) models for anomaly detection.
Machine Learning Libraries	NumPy, Pandas, Scikit-learn	Data preprocessing, manipulation, and performance evaluation.
Image Processing	OpenCV, Pillow (PIL)	Image resizing, normalization, augmentation, and enhancement.
Visualization	Matplotlib, Plotly, Seaborn	Displaying graphs, charts, and confidence levels for model predictions.
Web Framework	Streamlit	Creating an interactive, web-based interface for uploading images and viewing results.
Natural Language AI	Google Gemini API	Generating medical explanations and patient-friendly diagnostic summaries.
Report Generation	ReportLab	Producing structured and downloadable PDF reports containing diagnostic results.
Version Control	Git / GitHub	Source code management and collaboration.
Development Environment	Jupyter Notebook / VS Code / PyCharm	Code writing, testing, and debugging environments.
Deployment Environment	Localhost / Streamlit Cloud / Google Colab	Model training and deployment of the application.

DATAFLOW

A Data Flow Diagram (DFD) illustrates how data moves through the system — from input (image upload) to output (diagnosis results). It also shows interactions between external entities, processes, and data stores.

DFD – Level 0 (Context Level)

External Entities:

- **User** – Uploads medical image and receives diagnostic output.
- **Database** – Stores input images, results, and model data.

Process:

- The core system that performs image preprocessing, analysis, and prediction using deep learning.

DFD – Level 1 (Detailed Breakdown)

1. Image Input

- The user uploads an image (e.g., Brain MRI).
- The system verifies and stores it temporarily.

2. Preprocessing

- Resize, normalize, clean.
- Augment data (rotation, flipping).

3. Deep Learning Processing

- CNN extracts features.
- Classifies the image (e.g., Tumor/Normal).

4. Prediction & Evaluation

- The system generates output with probability/confidence.

- Optional: Grad-CAM visualization.
5. **Storage**
- Final results are stored.
 - Patient or clinician can access the diagnosis.

V. ARCHITECTURE OF THE PROPOSED SYSTEM

Streamlit WebPages

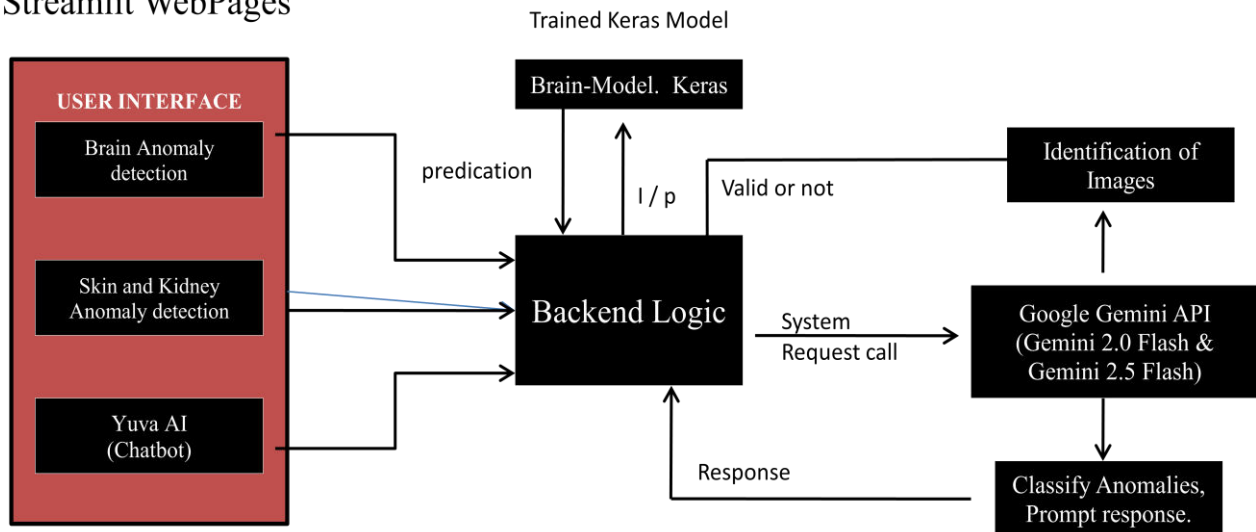


Fig 1. ARCHITECTURE OF THE PROPOSED SYSTEM

The proposed system is designed to automatically detect anomalies in brain, skin, and kidney images using deep learning models. The architecture follows a modular pipeline approach from data input to final diagnosis.

1. Data Acquisition Layer

- **Source:** Medical image datasets (MRI, dermoscopy, ultrasound)
- **Format:** .jpg, .png, or converted from .dcm, .nii
- Images are uploaded by clinicians or collected from open-source medical datasets.

2. Data Preprocessing Layer

- Standardizes and cleans image data:
 - Resize, normalize, and augment
 - Remove noise and irrelevant background
- Labels are encoded for classification (e.g., Tumor = 1, Normal = 0)

3. Deep Learning Model Layer

- Uses CNN-based architecture such as **ResNet50**, **VGG16**, or **MobileNet**.
- Performs **feature extraction** and **classification**.
- Separate model paths may be used for each organ type (brain, skin, kidney).

4. Decision Layer

- The model's softmax output is analyzed:
 - Predicts classes (e.g., Benign/Malignant)
 - Provides confidence scores (e.g., 95% likelihood of tumor)

5. Storage Layer

- Stores:
 - Processed images
 - Diagnostic results
 - Patient history (if applicable)
- Format: SQL/NoSQL database

6. Output and Visualization Layer

- Provides a diagnosis to the user (clinician or patient)
- Displays result with:
 - Class label
 - Probability/confidence
 - Visual aids like **Grad-CAM** heatmaps for model transparency

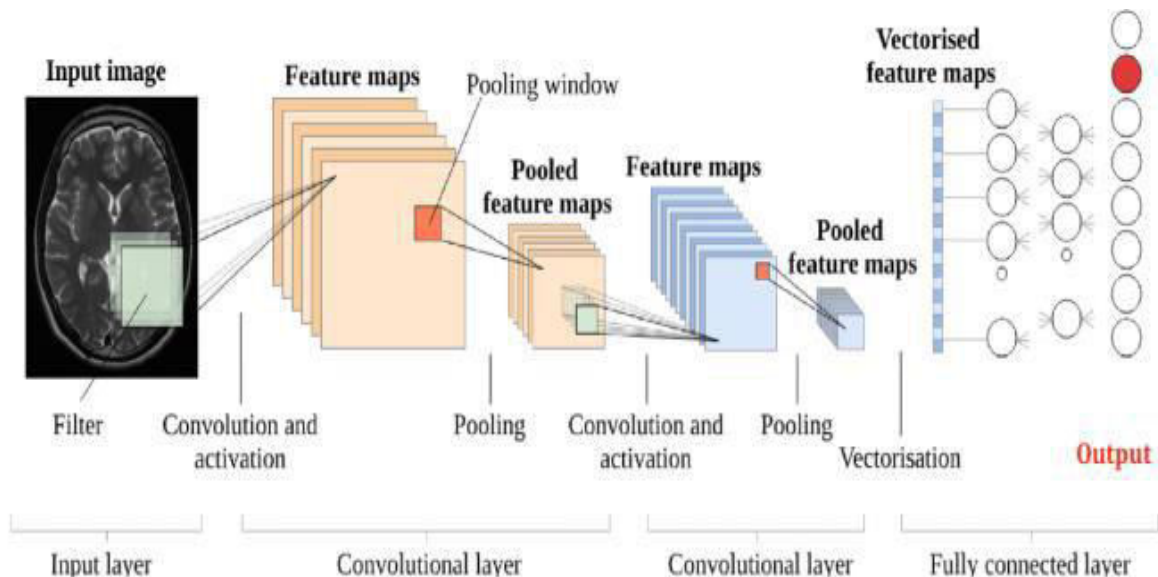


Fig 2. CNN Architecture Diagram

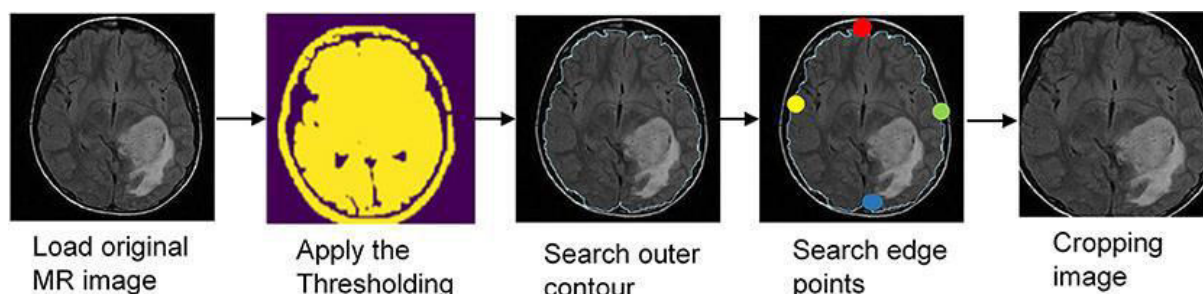


Fig.3 Preprocessing steps

VI. SOFTWARE TESTING

Software testing is an essential phase in the software development life cycle (SDLC) that ensures the developed system functions as intended and meets user requirements. It involves evaluating the system for accuracy, reliability, performance, and usability. For this project, “A Deep Learning Approach to Brain, Kidney, and Skin Anomalies,” software testing verifies that the integrated modules—such as **data preprocessing, deep learning model prediction,**

Gemini-based explanation, and Streamlit interface—work seamlessly to deliver accurate and consistent diagnostic results.

OBJECTIVES OF TESTING

The main objectives of software testing in this project are:

- To verify that the system correctly detects anomalies in medical images.
- To validate the accuracy and performance of CNN-based models.
- To ensure all modules (uploading, preprocessing, prediction, and report generation) operate without errors.
- To confirm that the user interface is intuitive, stable, and responsive.
- To guarantee that outputs such as confidence scores and AI explanations are accurate and reliable.

VII. RESULT AND DISCUSSION

Result of Brain Anomalies:

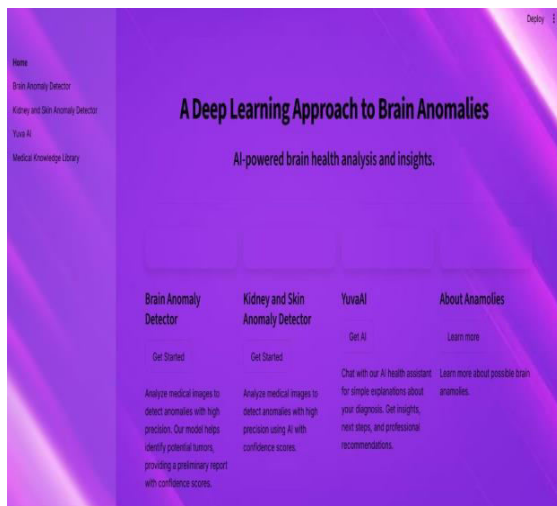


Fig 4. Home Page

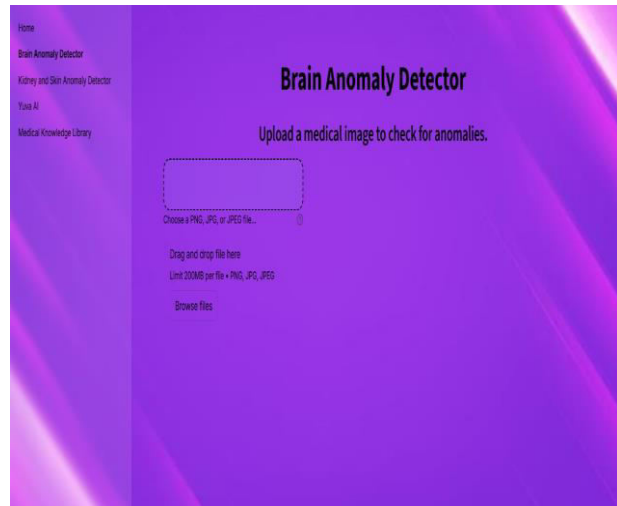


Fig 5. Uploading image page

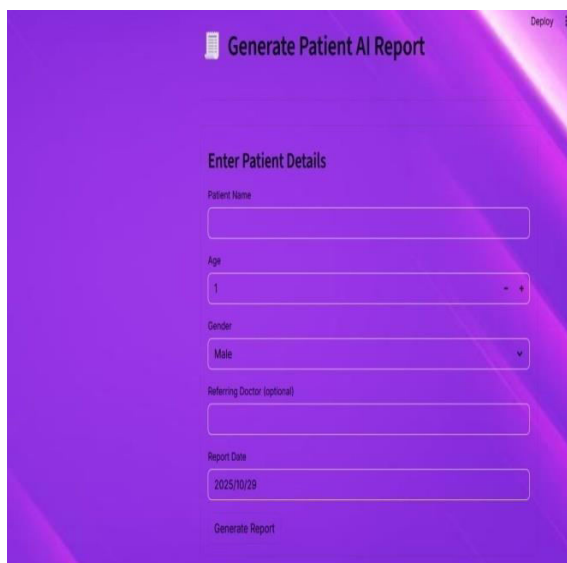


Fig 6. Generate patient Report

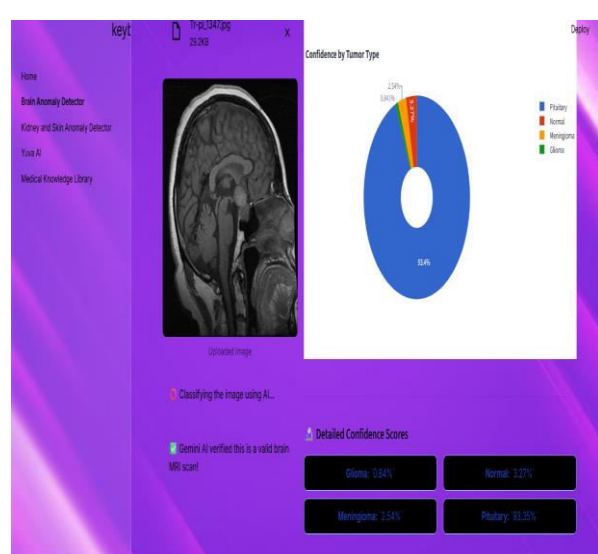


Fig 7. Analyzing the result

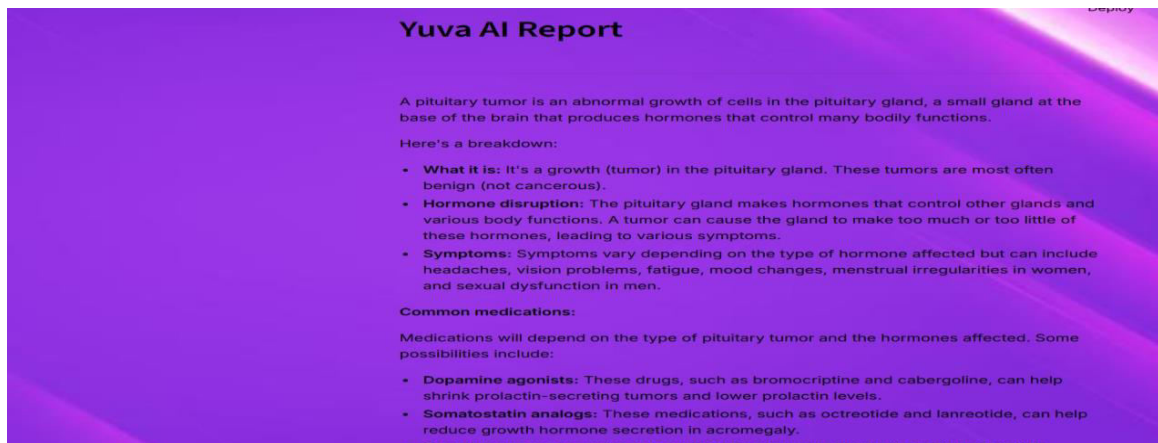


Fig 8. Final Report on brain anomalies

The image displays the **Yuva AI Report** section of a medical AI platform, providing an explanation about a **pituitary tumor**.

Result of kidney and skin Anomalies:

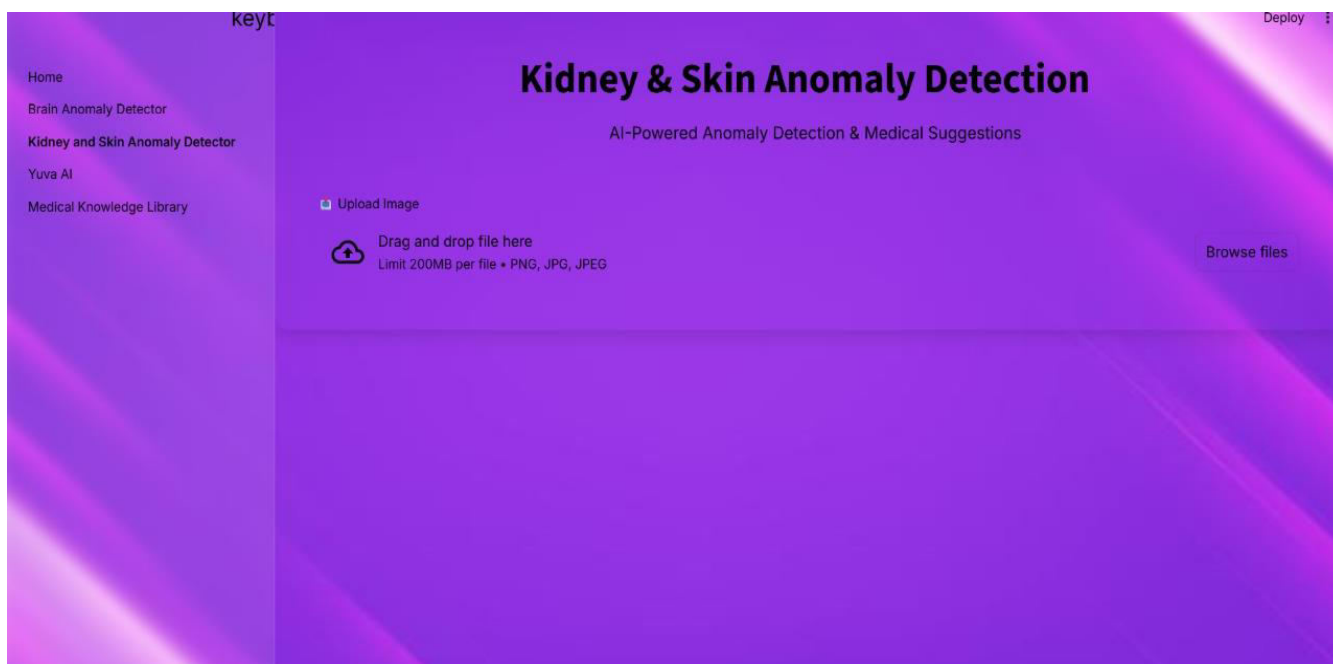


Fig 9. uploading images

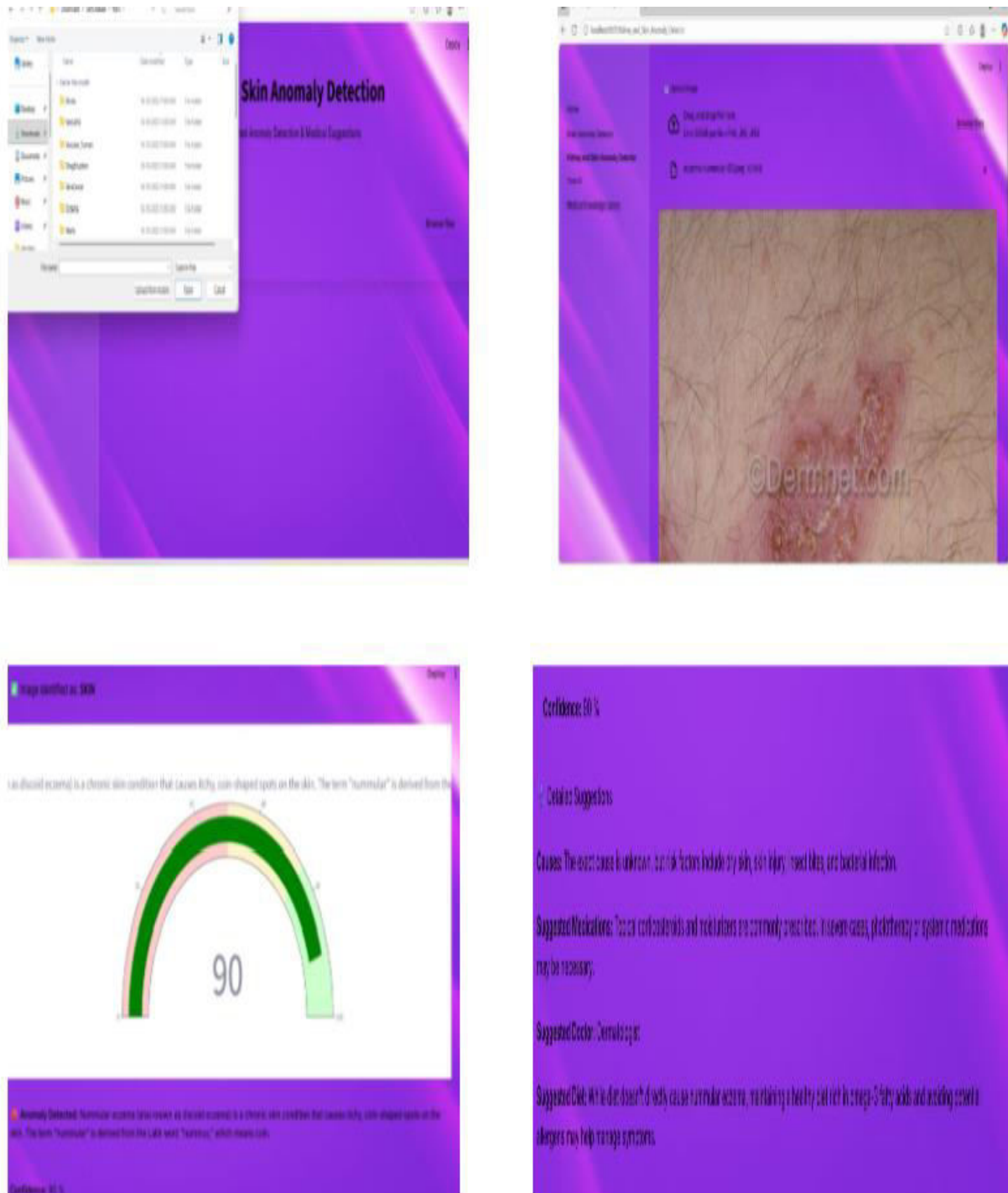


Fig 10. Final Report on skin anomalies

kidney anomaly detection

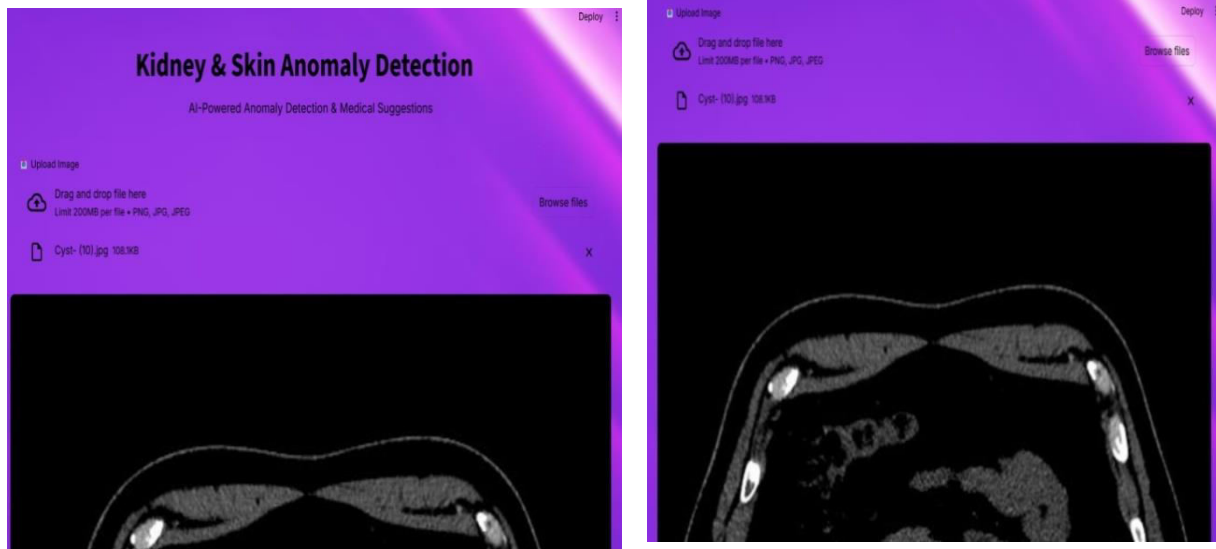


Fig 11. Uploading images to detect kidney stone

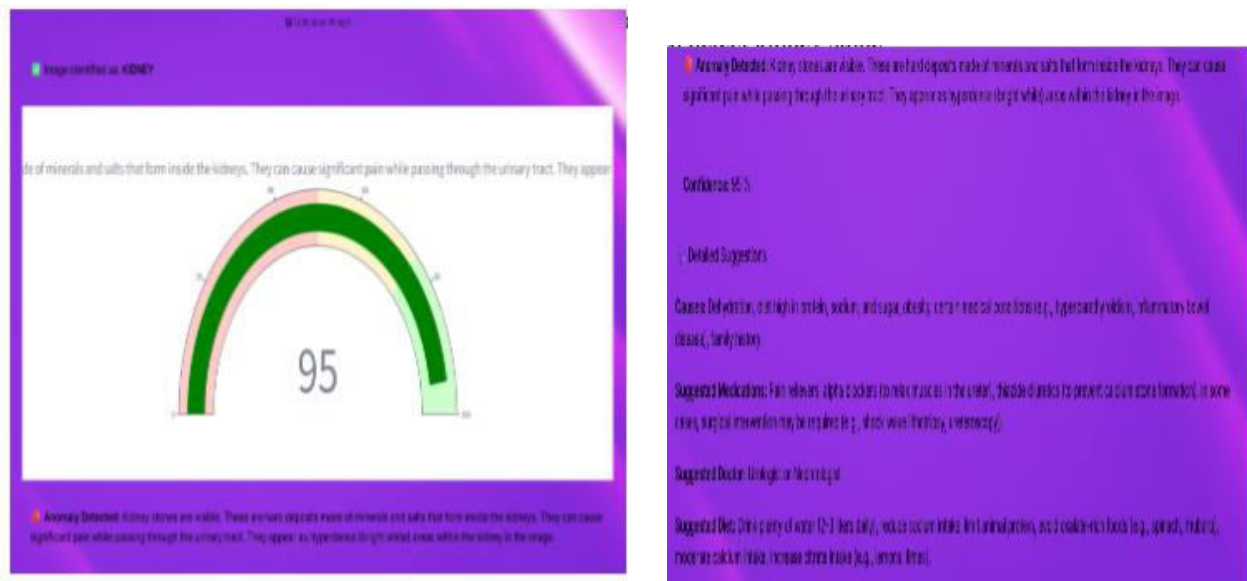


Fig 12. Final Report on kidney anomalies

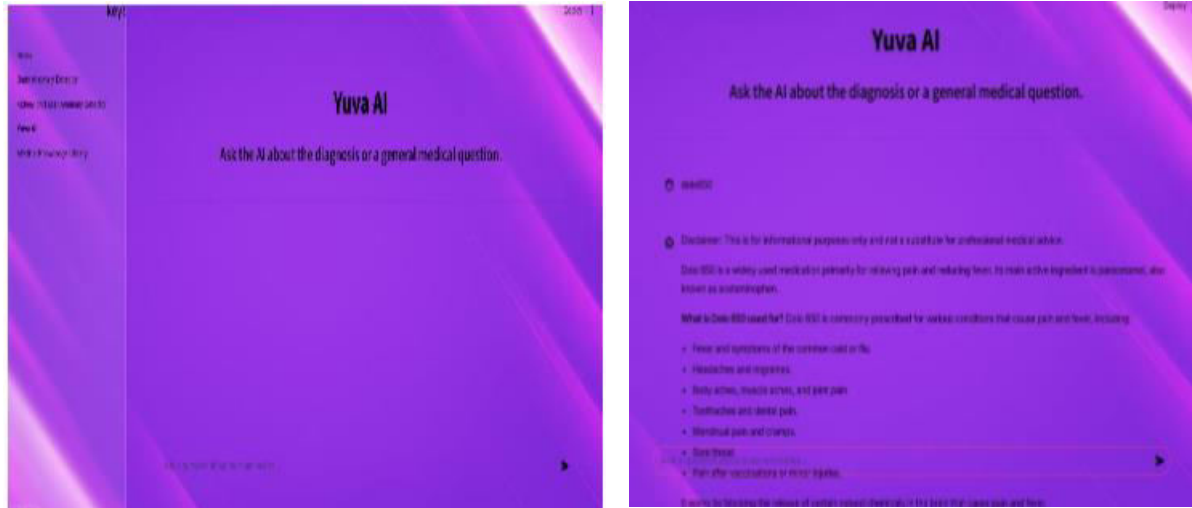


Fig 13. Chabot image

VIII. CONCLUSION

The project “A Deep Learning Approach to Brain, Kidney, and Skin Anomalies” demonstrates the effective use of artificial intelligence in the field of medical diagnostics. By integrating **Convolutional Neural Networks (CNNs)** and **Generative AI (Gemini API)**, the system provides accurate, automated, and interpretable medical image analysis. The implemented model efficiently detects anomalies such as **brain tumors, skin lesions, and kidney cysts or stones** using MRI, dermoscopic, and ultrasound/CT images. Through the **Streamlit-based interface**, users can easily upload medical images, obtain diagnostic predictions, visualize results, and generate downloadable medical reports.

This project successfully bridges the gap between **AI technology and clinical usability** by offering a unified diagnostic platform that enhances the speed and reliability of medical decision-making. It also highlights how AI can assist doctors in reducing diagnostic errors, supporting early disease detection, and improving accessibility in areas with limited specialist availability.

Overall, the project achieves its objectives by creating a **scalable, explainable, and user-friendly AI-based diagnostic tool**, contributing to advancements in smart healthcare systems.

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