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Name of the Course: AI in Healthcare(H)	**Name of the Instructor:** Ms. Jayasri K
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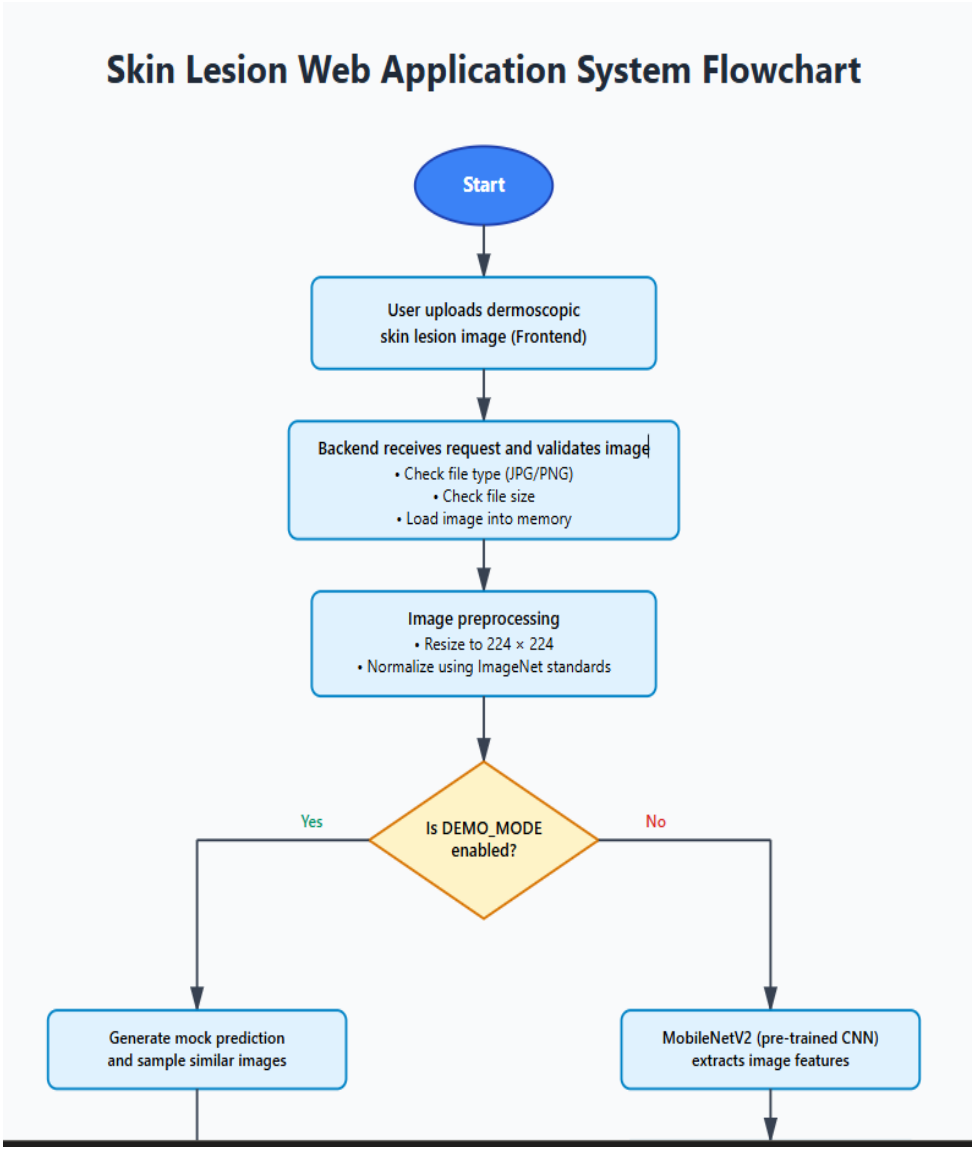
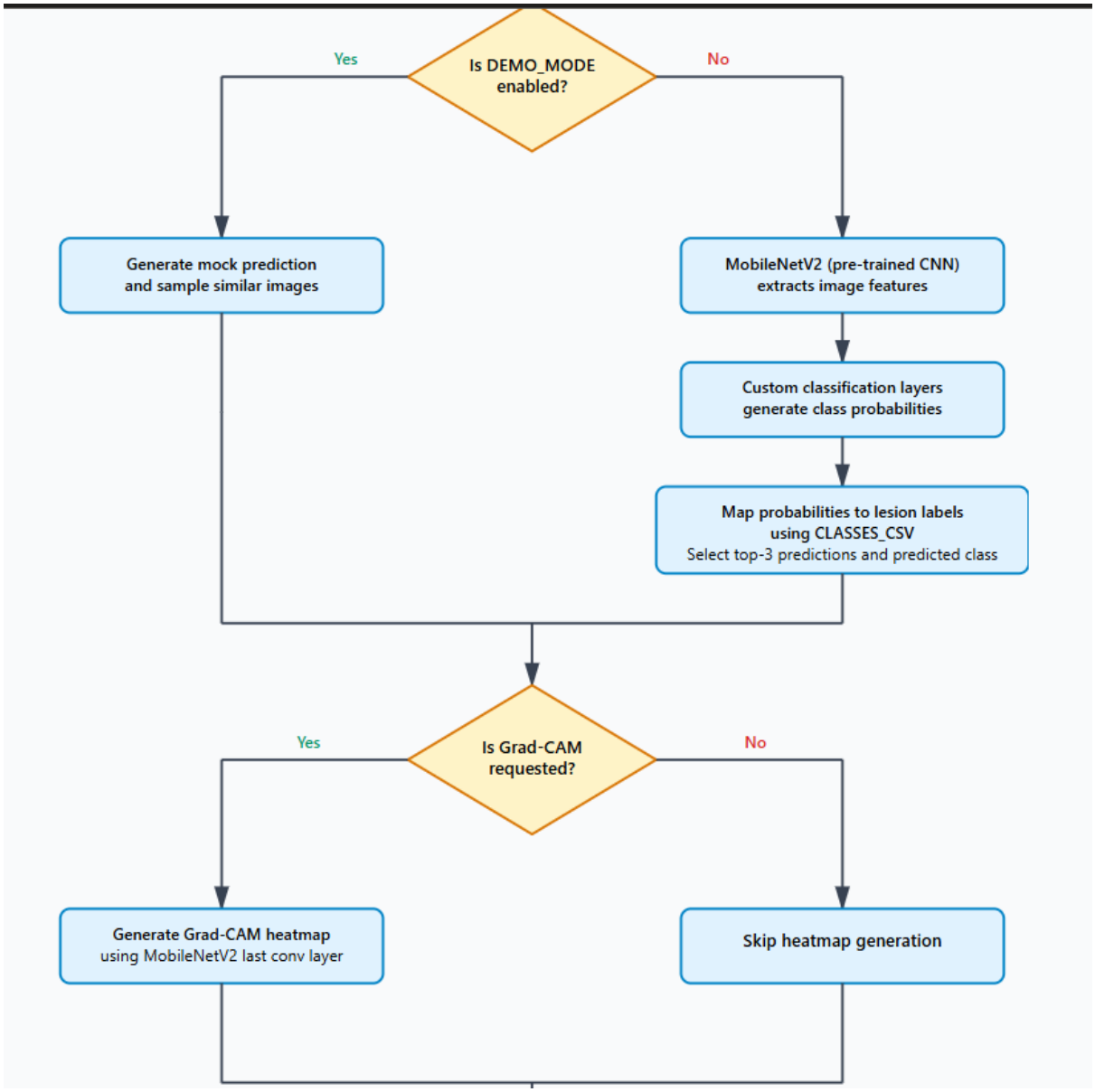
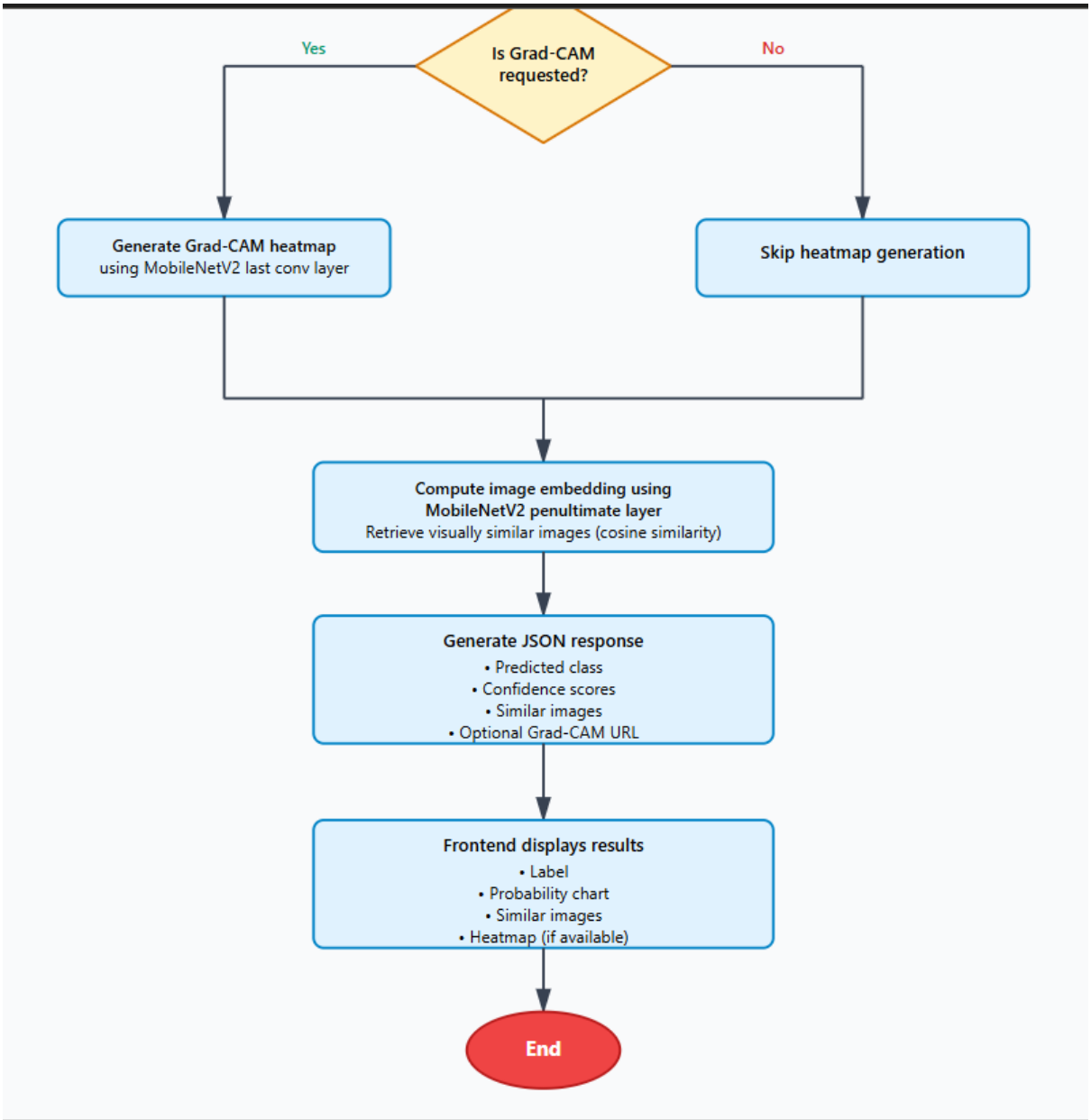
Skin Lesion Web Application System Flowchart




Is DEMO_MODE enabled?
Yes
No
Generate mock prediction and sample similar images
MobileNetV2 (pre-trained CNN) extracts image features
Custom classification layers generate class probabilities
Map probabilities to lesion labels using CLASSES_CSV
Select top-3 predictions and predicted class
Is Grad-CAM requested?
Yes
No
Generate Grad-CAM heatmap using MobileNetV2 last conv layer
Skip heatmap generation



Introduction - The Skin Lesion Classification Web Application is an AI-based system designed to assist in the early detection and classification of skin lesions using deep learning techniques. The system follows a well-defined workflow starting from image upload by the user to final prediction and visualization of results. The flowchart represents the end-to-end processing pipeline, integrating frontend interaction, backend processing, deep learning inference using MobileNetV2, and result presentation.

Image Upload and Request Handling - The workflow begins at the frontend, where the user uploads a dermoscopic image of a skin lesion through a web interface. Once the image is submitted, it is sent to the backend through a secure API endpoint. The backend validates the uploaded file to ensure that it meets predefined requirements such as supported image formats (JPG/PNG) and acceptable file size limits. After validation, the image is safely loaded into memory for further processing.

Image Preprocessing - Before the image can be analyzed by the deep learning model, preprocessing is performed to standardize the input. The image is resized to **224 × 224 pixels**, which is the required input size for the MobileNetV2 model. Pixel values are then normalized using ImageNet-based preprocessing standards. This step ensures consistency between training and inference data, improving model accuracy and reliability.

Mode Selection (Demo Mode vs Real Mode) -

At this stage, the system checks whether **DEMO_MODE** is enabled.

- **Demo Mode Enabled:** The system skips actual model inference and generates predefined mock predictions along with sample similar images. This mode is useful for demonstrations and testing without heavy computation.
- **Real Mode Enabled:** The system proceeds with actual deep learning inference using the trained model.

Feature Extraction Using MobileNetV2 –

In real mode, the preprocessed image is passed through **MobileNetV2**, a lightweight convolutional neural network pre-trained on the ImageNet dataset. MobileNetV2 acts as the backbone of the system by extracting meaningful and high-level visual features from the skin

lesion image. Its efficiency and low computational cost make it suitable for real-time web applications.

Classification and Prediction –

The features extracted by MobileNetV2 are fed into custom classification layers trained specifically for skin lesion detection. The model produces probability scores for each lesion class. These outputs are mapped to their corresponding class labels using the predefined **CLASSES_CSV** file. The class with the highest probability is selected as the predicted lesion type, and the top-three predictions are logged to the backend console for verification and debugging.

Grad-CAM Visualization (Optional) –

If the user requests explainability, the system generates a **Grad-CAM heatmap** using the last convolutional layer of MobileNetV2. This heatmap highlights the important regions of the image that influenced the model's decision, improving transparency and trust in the AI system. If not requested, this step is skipped.

Similar Image Retrieval –

To enhance interpretability, the system computes an image embedding using the penultimate layer of MobileNetV2. This embedding is compared with stored embeddings using cosine similarity to retrieve visually similar images from the dataset. These similar cases help users understand how the prediction relates to previously seen examples.

Response Generation and Result Display –

Finally, the backend generates a JSON response containing the predicted class, confidence scores, similar images, and an optional Grad-CAM URL. This response is sent back to the

frontend, where the results are displayed in an intuitive manner, including the prediction label, probability chart, similar image gallery, and heatmap visualization.

Conclusion –

The flowchart clearly illustrates a structured and efficient pipeline for skin lesion classification. By integrating MobileNetV2 for feature extraction, optional explainability through Grad-CAM, and similar image retrieval, the system ensures accuracy, transparency, and user-friendly interaction, making it suitable for real-world medical decision support applications.