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HealthBot +

AI-Powered Web App for Skin Disease Diagnosis and
Management

*In21-S5-CS3501 Data Science and Engineering Project
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1. Executive Summary:

HealthBot+ is an AI-powered web application aimed at the early detection and management of skin diseases, including cancer. By leveraging pre-trained models and transfer learning, HealthBot+ accurately identifies skin conditions using image analysis and text-based inputs. The application incorporates explainable AI techniques to ensure transparency in its decision-making process. Key features include a user-friendly interface, an oncology-trained chatbot, automated medical reports, and secure data management.

2. Problem Statement:

This project aims to develop a web-based application using advanced machine learning to accurately detect various skin diseases, including skin cancer. It addresses the challenge of limited access to dermatological specialists by providing a reliable tool for early diagnosis and treatment. This initiative seeks to improve patient outcomes by enhancing diagnostic accuracy and facilitating timely dermatological care.

3. Data Description:

1) SIIM-ISIC Melanoma Classification dataset

i) Data Source:

<https://www.kaggle.com/competitions/siim-isic-melanoma-classification/data>

ii) Data size: 116.16GB

iii) Data Format: DICOM / JPEG / TFRecord (Images), CSV (Meta data)

iv) Data fields:

image_name - unique identifier, points to filename of related DICOM image

patient_id - unique patient identifier

sex - the sex of the patient (when unknown, will be blank)

age_approx - approximate patient age at time of imaging

anatom_site_general_challenge - location of imaged site

diagnosis - detailed diagnosis information (train only)

benign_malignant - indicator of malignancy of imaged lesion

target - binarized version of the target variable

v) Data collection process:

The dataset was generated by the International Skin Imaging Collaboration (ISIC) and images are from the following sources: Hospital Clínic de Barcelona, Medical University of Vienna, Memorial Sloan Kettering Cancer Center, Melanoma Institute Australia, The University of Queensland, and the University of Athens Medical School.

vi) Data Use and Access:

<https://creativecommons.org/licenses/by-nc/4.0/legalcode.txt>

2) Skin Disease Classification [Image Dataset]

i) Data Source:

<https://www.kaggle.com/datasets/riyaelizashaju/skin-disease-classification-image-dataset/data>

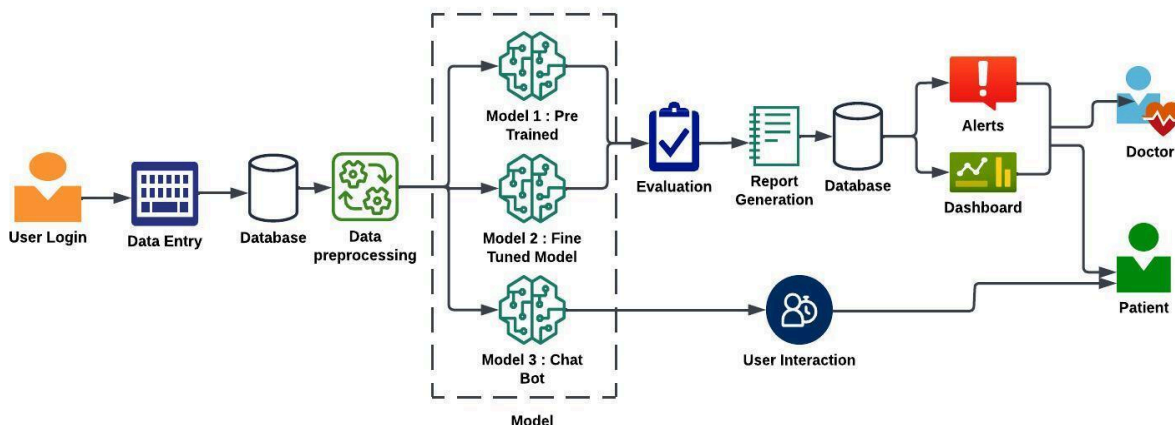
ii) Data Size: 177.73 MB

iii) Data Format: JPG

iv) Data Fields:

Actinic keratosis, Atopic Dermatitis, Benign keratosis, Dermatofibroma, Melanocytic nevus, Melanoma, Squamous cell carcinoma, Tinea Ringworm, Candidiasis, Vascular lesion

4. Methods:



- **Explainable AI (XAI)**

Explainable AI (XAI) techniques such as LIME and Grad-CAM (Gradient-weighted Class Activation Mapping) are utilized in HealthBot+ to provide transparent insights into the reasoning behind diagnostic outcomes. By highlighting the most influential factors in model predictions, XAI enhances trust and understanding for healthcare professionals and users. These explanations are integrated into medical reports and the doctor dashboard, ensuring informed decision-making and improving overall system reliability.

- **Model Fine Tuning**

In HealthBot+, fine-tuning involves adapting pre-trained models using transfer learning techniques. Specifically, models trained on large-scale datasets like the SIIM-ISIC Melanoma Dataset are adjusted to detect specific skin diseases beyond melanoma, such as Actinic Keratosis, Atopic Dermatitis, Benign Keratosis, and Dermatofibroma. This process optimizes the models to recognize nuanced patterns and characteristics unique to each condition, thereby enhancing the accuracy and reliability of diagnostic outcomes in diverse clinical scenarios.

5. Expected Outcomes and Success Criteria:

- **Expected Outcomes**

HealthBot+ aims to deliver several key outcomes:

1. **Accurate Detection of Skin Cancer:** By leveraging advanced image analysis and pre-trained models, HealthBot+ will effectively identify probable skin cancers, enabling early intervention and treatment.
2. **Comprehensive Skin Disease Prediction:** The system will predict various skin diseases with high accuracy, utilizing both image inputs and patient data.
3. **Patient Assistance Chatbot:** An oncology-trained chatbot will provide detailed information, medical advice, and support to patients, enhancing their understanding and management of skin conditions.
4. **Data Privacy and Security:** Ensuring secure storage and management of patient data, maintaining user history, and complying with data privacy regulations.

- **Success Criteria**

To ensure the success of HealthBot+, the following criteria will be met:

1. Clean and Accurate Datasets: Utilizing high-quality, well-curated datasets for training and fine-tuning the model.
2. Well-Fine-Tuned Model: Ensuring the model is fine-tuned to achieve high accuracy and reliability in diagnosing skin diseases.
3. Robust Software Engineering: Implementing a secure, scalable, and user-friendly web application that maintains data privacy and manages user history efficiently.
4. User and Doctor Feedback: Continuous feedback from users and healthcare professionals to refine and improve the system.

- **Achieving Goals**

HealthBot+ will achieve its goals through:

1. User and Doctor Engagement: Collecting and analyzing feedback from users and doctors to assess the accuracy and usability of the application.
2. Performance Metrics: Monitoring diagnostic accuracy, user satisfaction, and engagement metrics to ensure the system meets its objectives.
3. Iterative Improvements: Regular updates and improvements based on feedback and performance analysis, ensuring the application remains effective and user-friendly.

By delivering accurate diagnoses, providing valuable patient assistance, and ensuring robust data privacy, HealthBot+ aims to significantly enhance the early detection and management of skin diseases.

6. Preliminary Bibliography:

<https://www.ibm.com/topics/explainable-ai#:~:text=What%20is%20explainable%20AI%3F,expected%20impact%20and%20potential%20biases>.

(What Is Explainable AI (XAI)? | IBM, n.d.)

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<https://medium.com/@amanatulla1606/fine-tuning-the-model-what-why-and-how-e7fa52bc8ddf>