Medical-Health Early Diagnosis System

Dipti Pipaliya (P2848179@my365.dmu.ac.u)
Supervisor: Shengxiang Yang
De Montfort University, Leicester, UK

BACKGROUND:

In order to improve healthcare delivery and patient outcomes through sophisticated computational techniques, this review examines the transformative potential of machine learning in dermatology. It does this by assessing state-of-the-art algorithms like k-nearest neighbor, support vector machines, convolutional neural networks, recurrent neural networks, generative adversarial networks, and attention mechanisms for their capacity to transform the diagnosis and treatment of skin diseases.

INTRODUCTION:

The goal of the "Human Skin Disease Detection Using AI-Based Mobile Application" project is to develop a highly accurate and user-friendly tool that utilizes artificial intelligence to detect and diagnose various skin conditions through a mobile platform. By integrating advanced AI algorithms, this application aims to offer users quick and reliable skin health assessments, enabling early detection, timely treatment, and better management of dermatological issues. The overarching objective is to empower individuals to take a proactive approach to their skin health and seek medical attention when necessary. While several similar applications exist in the market, their accuracy rates typically range between 80% and 90%. This project seeks to surpass these limitations by enhancing diagnostic precision, ensuring a more dependable solution for users.

PROPOSED WORK:

Advancements in machine learning for dermatology go beyond traditional methods like k-nearest neighbor and convolutional neural networks, incorporating more sophisticated techniques. These include transfer learning, which utilizes pre-trained models for improved efficiency, and ensemble methods that enhance predictive accuracy. Multi-modal learning integrates diverse data sources, while explainable AI ensures transparency in decision-making. Active learning optimizes data annotation, and data augmentation increases dataset diversity for more robust training. Additionally, real-time decision support systems assist clinicians, privacy-preserving methods safeguard patient data, and longitudinal analysis enables continuous disease tracking. **The primary objective is to enhance diagnostic accuracy, optimize treatment strategies, and improve overall healthcare delivery in dermatology through advanced computational methodologies.** Moreover, integrating machine learning with electronic health records further strengthens data-driven insights, supporting more effective and personalized patient care.

RESEARCH QUESTIONS:

1. How can transfer learning enhance the accuracy and efficiency of AI-based skin disease diagnosis?

2. What role does explainable AI play in improving trust and transparency in dermatological diagnostics?
3. How can multi-modal learning improve diagnostic precision by integrating various dermatological data sources?
4. What privacy-preserving techniques can be implemented to ensure secure AI-driven dermatology solutions?
5. How can AI-powered real-time decision support systems assist dermatologists in improving treatment outcomes?

PROJECT REQUIREMENTS:

- **Dataset Collection** – Large, diverse, and high-resolution dermatological images from sources like **ISIC, DermNet, and HAM10000** or clinical collaborations.
- **Data Preprocessing** – Techniques like contrast enhancement, noise reduction, and background removal to improve image quality.
- **Data Augmentation** – Methods such as rotation, flipping, zooming, and synthetic image generation (GANs) to enhance model generalization.
- **Annotation & Metadata** – Expert-labeled images with additional metadata (age, gender, symptoms) for improved learning and accuracy.
- **Data Security & Privacy** – Compliance with **GDPR and HIPAA**, anonymization of patient data, and encrypted cloud storage for protection.

PROJECT RISKS:

1. **Data Privacy and Confidentiality**:
    - User data, including sensitive medical information and skin images, must be kept confidential. A breach in privacy can lead to exposure of personal health information, which could have serious legal and ethical consequences.
2. **Data Security**:
    - Insufficient data security measures can expose sensitive information to hacking or unauthorized access. It is essential to implement strong encryption, secure data storage, and protection against cyber threats to prevent data theft or corruption.
3. **Bias in Data**:
    - If the training dataset lacks diversity (e.g., missing various skin tones, ethnicities, or types of diseases), the AI model may not perform equally well across all populations. This can lead to inaccurate diagnoses, especially for underrepresented groups.
4. **Data Quality and Accuracy**:
    - Poor-quality or incorrectly labeled images can significantly affect the accuracy of the AI model. If images are blurry, poorly lit, or incorrectly tagged, the model may fail to detect or misdiagnose skin conditions.
5. **Regulatory Compliance**:
    - Data collection and processing must comply with healthcare regulations, such as HIPAA (in the U.S.) or GDPR (in the EU). Failure to meet these legal standards can lead to severe fines, legal challenges, and loss of user trust.

PROJECT SCHEDULE:

- **Phase 1 – Review paper**
  - The project begins with a detailed study and review of existing research on human skin disease detection using AI and mobile applications. This phase involves gathering relevant papers, analyzing different methodologies, algorithms, and applications, and synthesizing key findings to identify research gaps and challenges in the field. The goal is to summarize the state of the art, highlight trends, and offer insights into areas for further improvement. This culminates in the creation of a review paper that provides an overview of the current landscape of skin disease detection technologies.

- **Phase 2 – Research paper**
  - The project transitions into original research based on the insights gained from the review paper. This phase includes defining a research problem, selecting appropriate AI models and methodologies, and collecting and preparing data for experimentation. AI models are then developed, trained, and tested for skin disease detection, and the results are evaluated using various performance metrics. The findings are written up in a research paper that discusses the methodology, results, and conclusions, which is then finalized for submission after incorporating feedback and revisions.

REFERENCES:

- TT, Zhou Y., Zheng H., Cheung NM. and Koh D., 2014. Early melanoma diagnosis with mobile imaging. In *2014 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 6752-6757. IEEE.
- Aleem M., Hameed N. and Anjum A., 2017. m-Skin doctor: a mobile enabled system for early melanoma skin cancer detection using support vector machine. *Vol. 2*, 468-475.
- Barata C., Marques JS. and Rozeira J., 2013. The role of key point sampling on the classification of melanomas in dermoscopy images using bag-of-features. In *Iberian Conference on Pattern Recognition and Image Analysis*, LNCS, vol. 7887, 715-723.
- Ashraf R., Afzal S., Rehman AU., Gul S., Baber J., Bakhtyar M., Mehmood I., Song OY. and Maqsood M., 2020. Region-of-Interest based transfer learning assisted framework for skin cancer detection. *IEEE Access*, 8, 147858-147871.
- Vayadande K., 2024. Automated multiclass skin disease diagnosis using deep learning. *International Journal of Intelligent Systems and Applications Engineering*, 12(11s), 327-336.