

AI-Based Disease Prediction from Medical Images

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ABSTRACT

Disease prediction using medical images is a crucial aspect of modern healthcare, as early and accurate diagnosis plays a significant role in improving patient treatment and recovery outcomes. Traditional diagnostic methods rely on manual examination by medical experts, which can be time-consuming, costly, and sometimes inaccurate, especially during the early stages of diseases. To address these challenges, this mini project presents an intelligent disease prediction system that utilizes deep learning and artificial intelligence for automated medical image analysis. The proposed system employs Convolutional Neural Networks (CNNs) along with transfer learning models such as ResNet and Efficient Net to analyze medical images, including X-rays, MRI scans, and retinal images. It is designed to detect diseases such as pneumonia, brain tumors, and diabetic retinopathy with high accuracy. Image preprocessing techniques are applied to enhance image quality and improve model performance across different datasets. To improve interpretability, the system incorporates Gradient-weighted Class Activation Mapping (Grad-CAM), which highlights the important regions in medical images that influence predictions. The backend is implemented using Python with the Django framework and a MySQL database to securely store patient details, medical images, and diagnostic results. A web-based application developed using HTML, CSS, and JavaScript enables users to access predictions in real time. By integrating deep learning models, explainable AI, image processing techniques, and web technologies, the proposed system provides faster diagnosis, improved accuracy, reduced dependence on continuous expert involvement, and scalability for larger healthcare systems. This project demonstrates the potential of artificial intelligence in supporting early disease detection, telemedicine, and enhanced healthcare services.

1.INTRODUCTION

1.1 INTRODUCTION OF THE PROJECT

Artificial Intelligence (AI)-based disease prediction from medical images is an advanced healthcare system that utilizes machine learning and deep learning techniques to analyze medical imaging data such as X-rays, CT scans, MRI scans, and ultrasound images. The primary objective of this system is to assist healthcare professionals in diagnosing diseases accurately, efficiently, and at an early stage. The system combines image processing, feature extraction, classification, and predictive modeling to generate reliable outputs.

The process begins with data collection, which involves acquiring medical images from publicly available datasets or hospital databases. These datasets may include labeled images for specific diseases such as cancer, pneumonia, brain tumors, or cardiovascular conditions. The quality and diversity of the dataset play a crucial role in determining the accuracy of the model. A well-balanced dataset ensures that the system performs effectively across different patient demographics.

The next step is data preprocessing, which is essential for improving the quality of input images. Preprocessing techniques include resizing, normalization, noise removal, contrast enhancement, and image augmentation. These steps help standardize the data and improve the robustness of the model. Image augmentation techniques such as rotation, flipping, and scaling are used to increase the dataset size and prevent overfitting.

Following preprocessing, feature extraction is performed using deep learning models such as Convolutional Neural Networks (CNNs). CNNs automatically learn hierarchical features from images, including edges, textures, and complex patterns, which are critical for disease detection. Unlike traditional methods, CNNs do not require manual feature engineering, making them highly effective for medical image analysis.

The model is then trained using labeled data. During training, the system learns to map input images to corresponding disease labels. Various architectures such as ResNet, VGG, and Inception can be used depending on the complexity of the problem. Transfer learning is often employed to improve performance, especially when the dataset is limited. This involves using pre-trained

models and fine-tuning them for specific medical tasks .

After training, the model is evaluated using performance metrics such as accuracy, precision, recall, F1-score, and area under the curve (AUC). These metrics help assess the effectiveness of the model in predicting diseases. Validation techniques such as cross-validation are used to ensure the model generalizes well to unseen data.

The prediction phase involves feeding new medical images into the trained model. The system processes the input image, extracts features, and classifies it into disease categories. The output may include probability scores indicating the likelihood of different diseases. In some cases, the system also highlights affected regions in the image using techniques such as heatmaps or saliency maps.

The system can be integrated into clinical workflows through user-friendly interfaces. Healthcare professionals can upload patient images and receive diagnostic insights in real time. This reduces the workload of radiologists and speeds up the diagnostic process. AI systems have been shown to achieve diagnostic accuracy comparable to human experts in certain scenarios .

Security and privacy are critical aspects of the system. Patient data must be handled securely, and compliance with healthcare regulations such as HIPAA or GDPR is necessary. Data anonymization techniques are used to protect patient identity.

In conclusion, AI-based disease prediction systems offer significant advantages in terms of accuracy, speed, and scalability. By leveraging advanced deep learning techniques, these systems have the potential to transform healthcare and improve patient outcomes.

2. LITERATURE SURVEY

The application of artificial intelligence in medical imaging has been extensively studied by researchers across the world. Numerous studies have demonstrated the effectiveness of machine learning and deep learning techniques in disease prediction and diagnosis.

Salehi et al. (2023) conducted a comprehensive study on the use of CNNs and transfer learning in medical imaging. They highlighted that CNN-based models significantly improve diagnostic accuracy and reduce computational effort. Their work emphasized the importance of transfer

learning in handling limited datasets and improving model efficiency .

Mienye et al. (2025) provided an in-depth review of deep convolutional neural networks in medical image analysis. They discussed how CNNs have become the state-of-the-art approach for tasks such as disease detection, segmentation, and classification. Their study covered applications across multiple medical domains, including oncology, cardiology, and neurology .

Aggarwal et al. (2021) conducted a systematic review and meta-analysis to evaluate the diagnostic accuracy of deep learning in medical imaging. Their findings indicated that AI systems can achieve performance comparable to healthcare professionals, highlighting their potential as decision-support tools .

Ghaffar Nia et al. (2023) explored various AI techniques used in disease diagnosis and prediction. They emphasized that AI reduces human error, improves efficiency, and enhances clinical decision-making. Their study also discussed challenges such as data quality and model interpretability .

Deshmukh (2024) examined the role of deep learning in medical imaging applications. The study highlighted the use of CNNs for

automated disease detection, image segmentation, and predictive modeling. It also discussed the impact of AI on personalized medicine and healthcare workflows .

Zhou et al. (2020) reviewed deep learning techniques in medical imaging, focusing on technological advancements and future trends. They discussed challenges such as limited annotated data, interpretability issues, and the need for robust models. Their work provided insights into the integration of AI with clinical practice.

Singh et al. (2020) explored the use of 3D deep learning models for medical image analysis. Their study highlighted the advantages of 3D CNNs in capturing spatial information and improving diagnostic accuracy for volumetric data such as MRI and CT scans.

Kazi et al. (2019) introduced a graph convolutional network for disease prediction. Their approach integrated imaging and non-imaging data, demonstrating the potential of multimodal learning in healthcare applications.

Yang and Mohammed (2020) focused on AI-based prediction of Alzheimer's disease using medical imaging. Their study

reviewed various deep learning techniques, including CNNs, RNNs, and auto encoders, and discussed their effectiveness in early disease detection.

Recent advancements have also explored hybrid models combining CNNs with other architectures such as LSTM networks. These models improve performance by capturing both spatial and temporal information, making them suitable for dynamic medical data.

Overall, the literature indicates a growing trend toward the use of AI in medical imaging. Researchers have demonstrated significant improvements in disease prediction accuracy, efficiency, and scalability. However, challenges such as data scarcity, bias, and interpretability remain areas of ongoing research.

3.METHODOLOGY

The methodology for AI-based disease prediction from medical images involves several key stages. The first stage is data acquisition, where medical images are collected from reliable sources such as hospitals or public datasets. These images are labeled according to disease categories.

The preprocessing stage includes image resizing, normalization, and noise removal.

Data augmentation techniques are applied to increase dataset diversity and improve model generalization. This step ensures that the model can handle variations in image quality and conditions.

The next stage is feature extraction using convolutional neural networks. CNNs automatically learn relevant features from images, eliminating the need for manual feature engineering. Transfer learning is often used to enhance performance, especially when dealing with limited data.

The classification stage involves training a model to predict disease categories based on extracted features. Various architectures such as ResNet or VGG can be used depending on the complexity of the dataset. The model is trained using supervised learning techniques.

Evaluation is performed using metrics such as accuracy, precision, recall, and F1-score. Cross-validation is used to ensure the reliability of the model. The system is then deployed in a user-friendly interface for real-time predictions.

4.EXISTING METHODS

Existing methods for disease prediction from medical images include traditional image processing techniques and basic machine

learning models. Early approaches relied on manual feature extraction, where experts identified specific patterns in images. These features were then used to train classifiers such as support vector machines (SVMs) and decision trees.

These methods were limited by their dependence on handcrafted features, which required domain expertise and were not scalable. They also struggled with complex image patterns and variations in medical data.

Another approach involved rule-based systems, where predefined rules were used to detect abnormalities. These systems lacked flexibility and were unable to adapt to new data.

Machine learning models such as k-nearest neighbors (KNN) and logistic regression were also used for classification. While these methods provided moderate accuracy, they were not suitable for large-scale image analysis.

Overall, existing methods are limited in terms of accuracy, scalability, and automation. They cannot match the performance of modern deep learning techniques.

5. PROPOSED SYSTEM

The proposed system utilizes advanced deep learning techniques to improve disease prediction from medical images. It employs convolutional neural networks for feature extraction and classification, ensuring high accuracy and automation.

The system integrates transfer learning to enhance performance with limited data. Pre-trained models are fine-tuned for specific medical applications, reducing training time and improving efficiency.

A key feature of the proposed system is the use of explainable AI techniques. These techniques provide visual explanations of model predictions, helping healthcare professionals understand the reasoning behind decisions.

The system also incorporates multimodal learning by combining imaging data with patient information. This improves prediction accuracy and enables personalized diagnosis.

A user-friendly interface allows healthcare professionals to upload images and receive real-time predictions. The system is designed to be scalable and adaptable to different medical domains.

Compared to existing methods, the proposed system offers higher accuracy, better scalability, and improved interpretability. It addresses the limitations of traditional approaches and provides a comprehensive solution for modern healthcare applications.

6. OUTPUT SCREENS

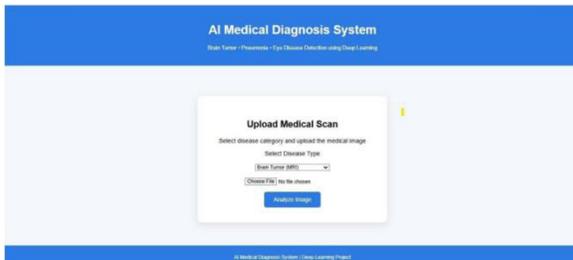


Fig 6.1: home page

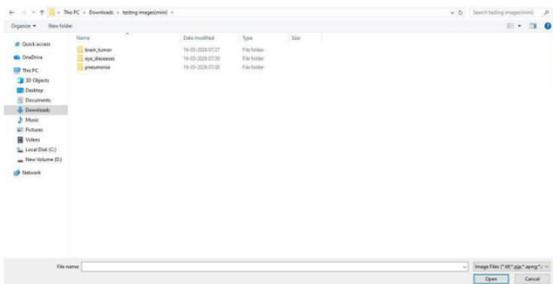


Fig 6.2 Choosing a file

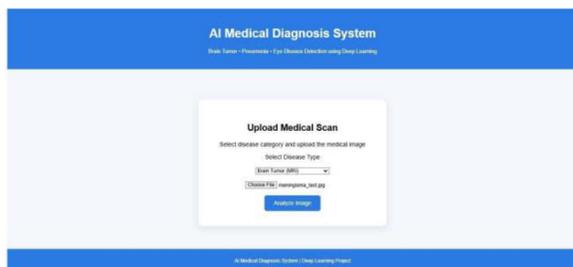


Fig 6.3: Uploading the file

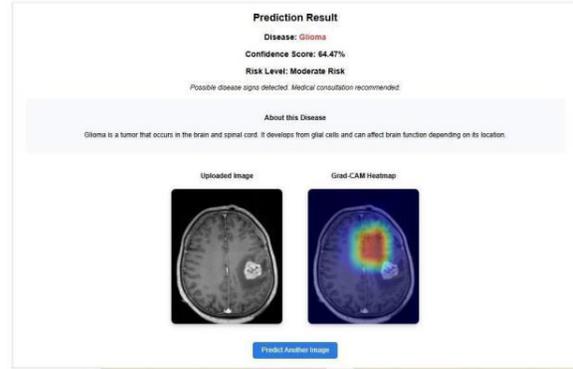


Fig 6.4: Disease Prediction for Glioma

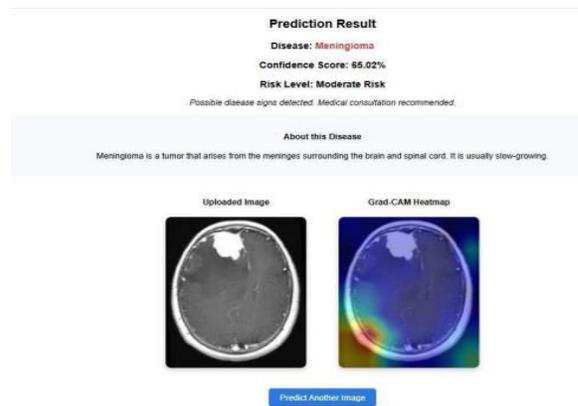


Fig 6.5: Disease Prediction for Meningioma



Fig 6.6: Disease Prediction for Tumor

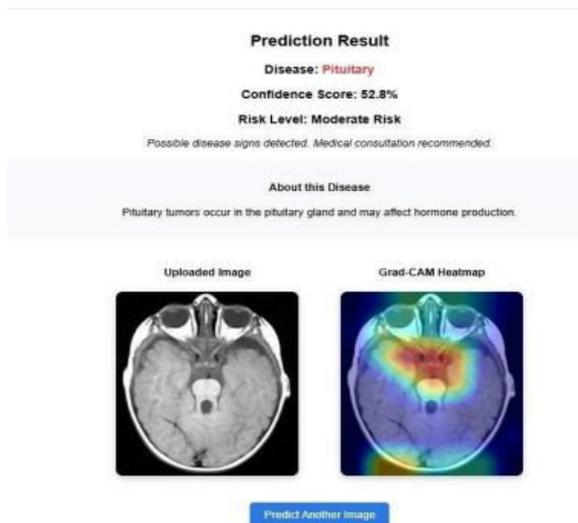


Fig 6.7: Disease Prediction for Pituitary

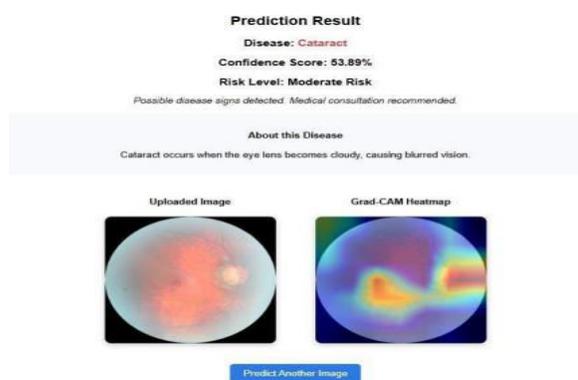


Fig 6.10 Disease Prediction for Cataract

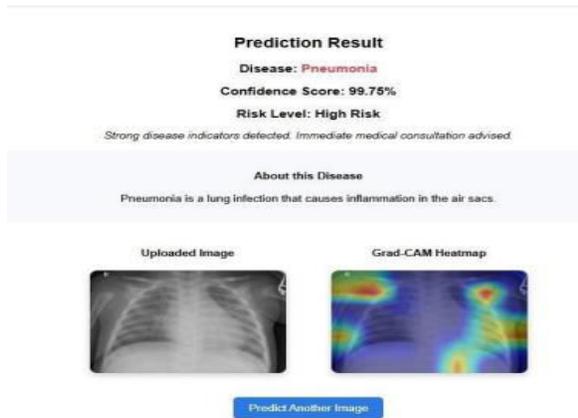


Fig 6.8: Disease Prediction for Pneumonia

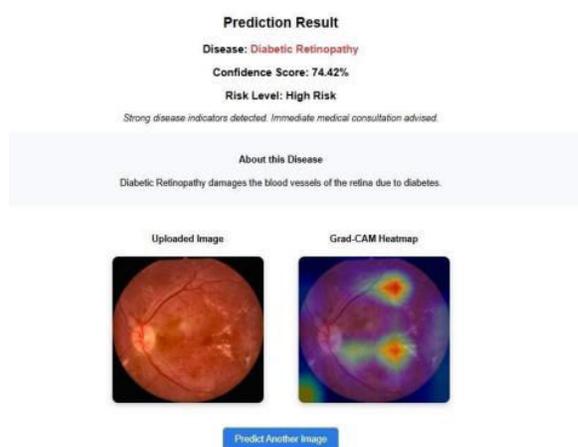


Fig 6.11 Disease Prediction for Diabetic Retinopathy

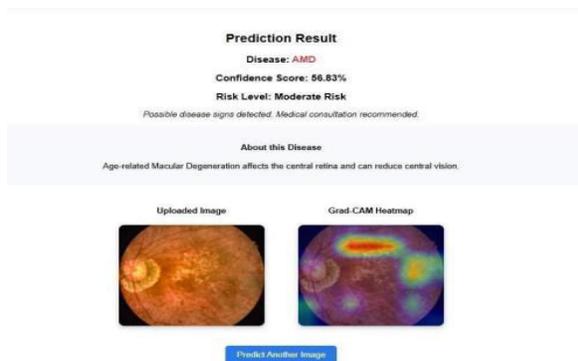


Fig 6.9: Disease Prediction for AMD



Fig 6.12 Disease Prediction for Glaucoma

7. CONCLUSION

The AI-Based Disease Prediction System successfully overcomes the limitations of existing systems by enabling multi-disease prediction using advanced deep learning models instead of basic CNNs. The integration of Grad-CAM enhances explainability and trust, making the system suitable for real-world medical applications. This project demonstrates the powerful role of artificial intelligence in improving healthcare diagnostics.

8. FUTURE SCOPE

The future of AI-based disease prediction from medical images is highly promising, with continuous advancements expected to revolutionize healthcare systems. One major direction is the integration of 3D imaging and digital twins, where patient-specific anatomical models can be generated for precise diagnosis and surgical planning. AI is already enabling the creation of 3D models from imaging data, improving treatment accuracy and outcomes .

Another important area is the adoption of federated learning, which allows multiple hospitals to collaboratively train models without sharing sensitive patient data,

thereby addressing privacy concerns and improving model generalization.

Additionally, explainable AI and uncertainty estimation techniques will enhance trust and reliability by providing confidence levels and interpretable predictions for clinicians .

The integration of multimodal data, including imaging, genomic, and clinical records, will further improve disease prediction accuracy and enable personalized medicine. AI systems are also expected to support early detection and prognosis, shifting healthcare from reactive to preventive care .

Moreover, advancements in real-time AI diagnostics and cloud-based deployment will make these systems accessible even in remote and resource-limited areas. Overall, AI in medical imaging is expected to significantly enhance diagnostic efficiency, accuracy, and global healthcare accessibility

9. REFERENCE

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