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AI Powered Monkeypox Detection Using Deep Learning

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ABSTRACT: Monkeypox is a viral disease that has become a global public health concern. The disease spreads through close physical contact and is marked by fever, swollen lymph nodes, and visible skin lesions. Early detection is crucial for preventing transmission and ensuring timely treatment. Traditional lab-based diagnosis may not be easily available in remote areas. An automated detection system using machine learning can aid in early screening. In this paper, we propose an image-based monkeypox detection system that uses convolutional neural networks (CNN). The model analyzes images of skin lesions and classifies them as infected or non-infected. Experimental results show that our method achieves good accuracy and can help in preliminary diagnosis. This approach may boost awareness and early responses during outbreaks.

KEYWORDS: Monkeypox; Machine Learning; Convolutional Neural Network; Image Processing; Disease Detection

I. INTRODUCTION

Monkeypox is caused by the monkeypox virus, which belongs to the Orthopoxvirus genus [1]. The disease was first identified in humans in 1970, and it has re-emerged in several countries [2]. Symptoms include fever, headache, swollen lymph nodes, and skin rashes that develop into lesions. Global travel and reduced immunity to smallpox have led to a significant rise in monkeypox cases in recent years [2]. Early detection is essential to isolate infected individuals and prevent further spread. However, laboratory tests like PCR require proper medical facilities and trained personnel. With the growth of artificial intelligence, machine learning techniques have shown promising results in classifying medical images. Deep learning models like convolutional neural networks (CNN) have been successfully used to detect diseases such as skin cancer and COVID-19 [3][4]. This paper proposes a machine learning-based approach to detect monkeypox from skin lesion images. Monkeypox is a zoonotic viral disease caused by the monkeypox virus, part of the Orthopoxvirus genus in the Poxviridae family [1]. It was first identified in laboratory monkeys in 1958, and the first human case occurred in 1970 in the Democratic Republic of Congo. For many years, monkeypox cases were mainly found in Central and West Africa. However, recent outbreaks in several non-endemic countries have raised global concern and captured the attention of healthcare authorities worldwide [2].



Fig. 1. Clinical Appearance of Monkeypox Skin Lesions



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II. RELATED WORK

Several studies have examined AI-based disease detection systems. Esteva and others showed that deep neural networks can achieve accuracy in skin cancer classification that matches that of dermatologists [3]. Similar image-based techniques have been applied to detect infectious diseases from radiographic and dermatological images [4]. Recent research also targets the automated detection of viral diseases using deep learning. For instance, CNN models were extensively used during the COVID-19 pandemic to classify chest X-ray images [4]. Some researchers have started looking into monkeypox detection using transfer learning and pre-trained models, achieving promising accuracy [5]. However, research in this area is still developing due to a lack of publicly available datasets for monkeypox. This paper aims to contribute by creating a simple but effective classification model. The use of artificial intelligence in medical diagnosis has expanded significantly in recent years. Deep learning techniques, especially Convolutional Neural Networks (CNN), have shown strong results in medical image classification tasks. Esteva et al. proved that CNN models could classify skin cancer images with accuracy similar to that of dermatologists, highlighting AI's potential in dermatological analysis [3]. Their research laid the groundwork for applying deep learning to skin diseases. After that, several researchers explored AI-based systems for identifying infectious and viral diseases. During the COVID-19 pandemic, deep learning models were widely used to classify chest X-ray and CT scan images for quick screening [4]. These studies showcased that machine learning models can assist healthcare professionals in early detection and lessen the burden on healthcare systems.

III. PROPOSED ALGORITHM

3.1 System Overview

The proposed system consists of the following stages:

- Image Collection
- Image Preprocessing
- Feature Extraction
- Model Training
- Classification Output

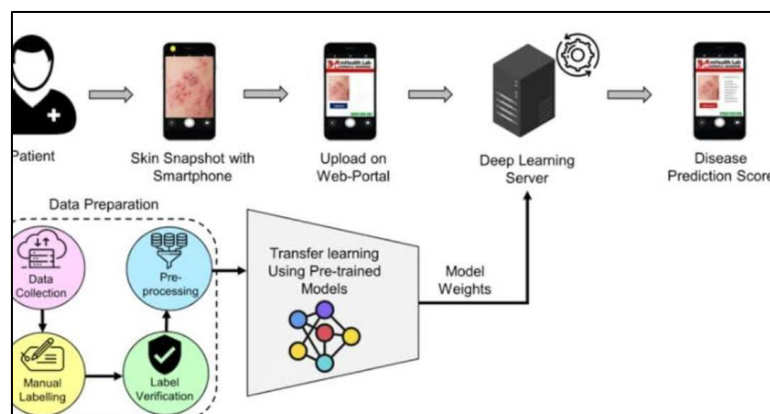


Fig 2. Proposed System Architecture

3.2 Image Preprocessing

Input images are resized to a fixed dimension and normalized for consistency. Noise removal techniques are applied to improve clarity. Data augmentation methods such as rotation and flipping help expand the dataset size and reduce overfitting.

3.3 Feature Extraction and Classification

A Convolutional Neural Network (CNN) model is employed for classification. The CNN automatically extracts important features like texture patterns and lesion structures from images. The final layer uses a softmax activation function to classify images into two categories: - Monkeypox Positive - Monkeypox Negative .



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3.4 Performance Metrics

The system's performance is evaluated using: -

Accuracy

Precision

Recall

F1-Score

Accuracy is calculated as:

$$\text{Accuracy} = (\text{Correct Predictions} / \text{Total Predictions}) \times 100$$

IV. RESULTS AND ANALYSIS

The dataset was split into training and testing sets. The model was trained over multiple epochs to optimize its performance. Experimental results reveal that the CNN model achieved good accuracy in identifying monkeypox cases. The confusion matrix shows that most infected cases were correctly classified. The results imply that image-based machine learning models can serve as an effective preliminary screening tool. To assess the proposed monkeypox detection system's performance, the dataset was divided into training and testing sets. About 80% of the images were used for training, while the remaining 20% were set aside for testing and validation. The CNN model was trained for multiple epochs until the loss function showed convergence.



Fig3. Sample Dataset Images (Infected vs Non-Infected)

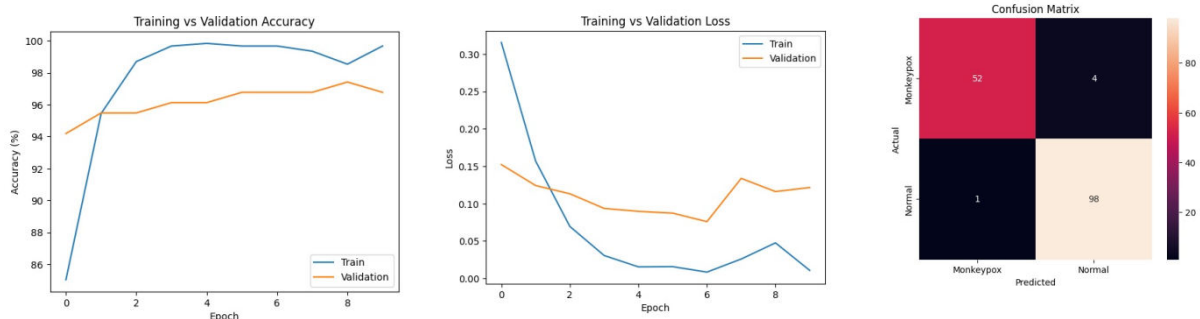


Fig.4. Accuracy, Loss Graph And Confusion Matrix

V. CONCLUSION AND FUTURE WORK

This paper presented a machine learning-based approach for the early detection of monkeypox using images of skin lesions. The proposed CNN model showed satisfactory classification performance. The system can aid in preliminary screening and enhance awareness during outbreaks. Future improvements may include:



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Using larger and more varied datasets

Applying transfer learning with modern architectures

Developing a mobile-based detection application

Integrating cloud-based medical reporting systems

While the proposed system yields promising results, it should act as a support tool rather than replace medical diagnoses.

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