Pneumonia Detection Using Machine Learning via Gemini API

A Research Paper

Abstract

Pneumonia is a critical respiratory infection that causes inflammation of the air sacs in one or both lungs, potentially leading to severe health complications if not detected and treated promptly.

This study presents an effective pneumonia detection system utilizing the Gemini API, which integrates machine learning techniques to classify chest X-ray images as normal or pneumonia-affected.

The objective of this research is to provide an efficient, accurate, and user-friendly diagnostic tool to assist healthcare professionals in early diagnosis. The system offers high accuracy, precision, and recall rates, demonstrating its potential as a reliable tool for pneumonia detection.

Introduction

Pneumonia is a life-threatening lung infection that predominantly affects children, elderly individuals, and immunocompromised patients. It remains a major cause of mortality worldwide, particularly in developing countries with limited access to advanced medical facilities.

Conventional methods of pneumonia diagnosis involve clinical examination, radiological assessments, and laboratory tests, which can be time-consuming and costly.

The proposed system leverages the Gemini API, a robust deep-learning-powered tool, to detect pneumonia from chest X-ray images. This paper aims to evaluate the system's performance in terms of accuracy, precision, recall, and usability.

Problem Statement

The traditional process of pneumonia diagnosis requires extensive medical expertise and time-consuming laboratory tests.

Misdiagnosis or delayed diagnosis can have fatal consequences. Therefore, there is a need for a fast, accurate, and accessible diagnostic tool that can assist healthcare providers in making timely decisions.

Objective

1. To develop a web-based pneumonia detection system using the Gemini API for image classification.
2. To achieve high accuracy, precision, and recall rates in pneumonia detection.
3. To provide a user-friendly interface for easy image uploading and result viewing.
4. To compare the proposed system's performance with existing models and techniques.
5. To store and retrieve user results for future reference.

Scope of Study

The study focuses on building a reliable pneumonia detection system using machine learning techniques.

It includes the development of a web interface, testing with datasets, integration with the Gemini API, and comparison with traditional models.

Methodology

1. Data Collection: Collected 5,863 chest X-ray images (Normal: 1,583, Pneumonia: 4,280).
2. Data Preprocessing: Image resizing, normalization, and augmentation applied.
3. System Design: Web application with user authentication and image uploading features.
4. API Integration: Processing of images via Gemini API.
5. Evaluation: Performance measurement using accuracy, precision, recall, and F1-score.

System Overview

The system comprises three main components:

1. Frontend Interface - User interface for image uploading and result display.
2. Backend Processing - Handling API requests, results, and data storage.
3. Gemini API - Processing chest X-ray images for pneumonia detection.

Working Structure / Flow

1. User logs in or registers through the web interface.
2. User uploads a chest X-ray image.
3. The image is sent to the Gemini API for processing.
4. Results are returned and displayed to the user.
5. Results are stored in the database for future reference.

Advantages

1. High accuracy in detecting pneumonia.
2. Fast processing and real-time results.
3. User-friendly interface for easy operation.
4. Reduced workload for medical professionals.
5. Scalable and easily integrable with other systems.

Disadvantages

1. Dependency on third-party API performance.
2. Possible privacy concerns during image uploading.
3. Limited customization options due to external API dependency.

Conclusion

The proposed pneumonia detection system using the Gemini API offers a reliable method for detecting pneumonia from chest X-ray images.

Future work will focus on improving the model's accuracy, enhancing data privacy, and integrating additional APIs for better performance.

References

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