PROJECT SUMMARY

Early Disease Detection Using AI- A Deep Learning Approach to Predicting Cancer and Neurological Disorders

Introduction

This project focuses on the early diagnosis of cancer and neurological disorders by automating the analysis of medical images (CT, MRI, histopathology) and EEG signals using deep learning. Traditional diagnostic practices are manual, slow, and error-prone, especially where expert availability is limited. AI advances enable faster, reliable detection through automated multimodal data interpretation.

Objectives

- Develop a Multi-Level Classification system to validate medical data type and reject invalid inputs.
- Classify diseases into cancer (lung, breast, colon) or neurological disorders (Alzheimer's, epilepsy, multiple sclerosis).
- Use optimized CNN and CNN-LSTM models for subtype prediction.
- Provide a secure, user-friendly interface for doctors to upload data, view reports, and track history.
- Design for scalability and integration into existing hospital workflows.

System Architecture

- **Frontend:** React.js application for user management, data upload, and dashboard visualization.
- **Backend:** Node.js/Express API managing preprocessing, AI inference, and database communication.
- **AI Models:** CNN-based and CNN-LSTM architectures built with PyTorch.
- **Database:** MongoDB for secure storage of user data and results.
- Multi-Level Classification funnels data from modality validation to disease subtype detection.

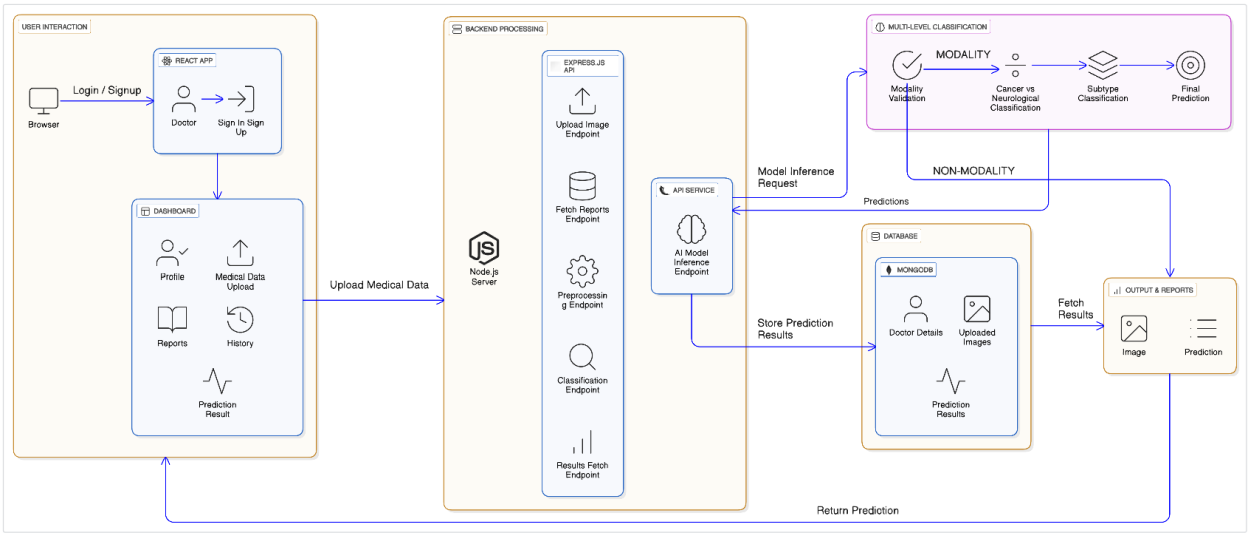

Fig-1: Architecture Diagram

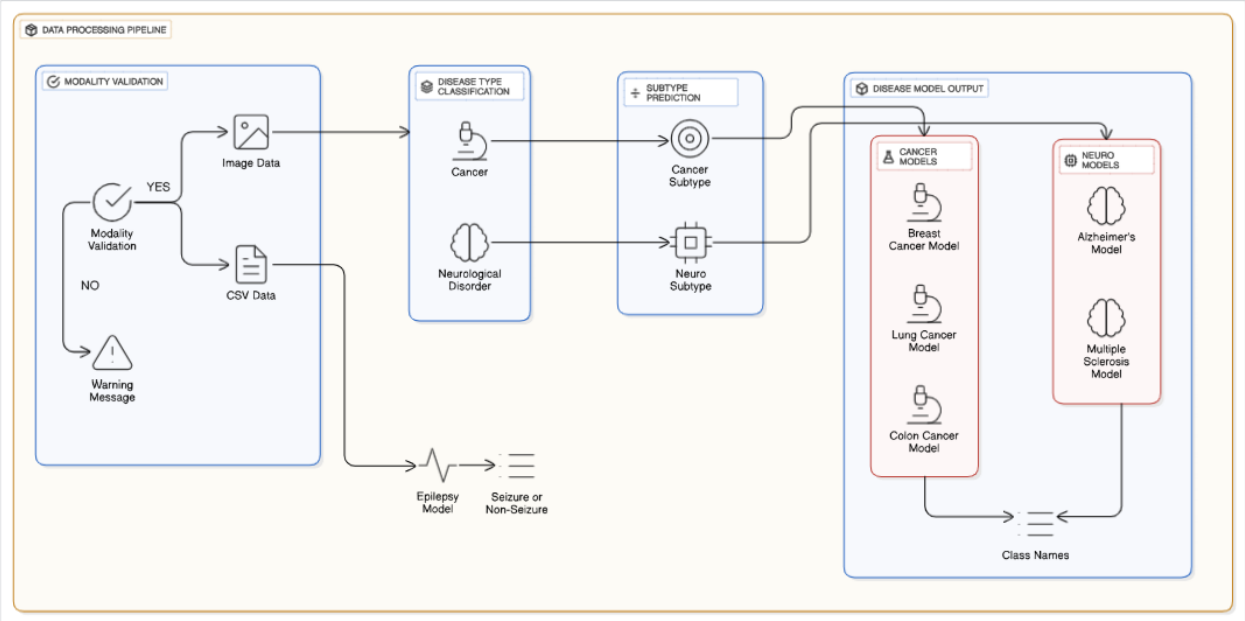

Fig-2: Multi-Level Classification Architecture

Multi-Level Classification Workflow

The multimodal AI pipeline begins with modality validation using a custom CNN that distinguishes whether uploaded data is an MRI, CT, EEG signal, or histopathology image. If the input is valid, it is routed into disease-specific branches: cancer or neurological disorder. For cancer detection, EfficientNet is applied to lung CT images while ResNet-18 is used for breast and colon classification using histopathology and CT scans respectively. For neurological classification, the workflow employs a hybrid CNN-LSTM network for epilepsy detection from EEG signals, EfficientNet-B3 for Alzheimer's MRI scans, and ConvNeXt Tiny for multiple sclerosis.

Each model operates with data augmentation and transfer learning, resulting in up to 96% accuracy, confirmed by precision, recall, F1, and ROC-AUC metrics. Doctors interact with this platform by uploading JPEG/PNG images or EEG CSV files. The backend validates file modality, predicts disease type and subtype, and securely stores outputs in MongoDB. Results, recent activity, and error feedback are displayed on the dashboard, ensuring both reliability and smooth clinician experience.

Results and Impact

High accuracy and robust metrics indicate effective disease classification across modalities. The system's user-friendly design supports streamlined clinical workflow and aids timely diagnosis.

Future Scope

- Incorporate Mixture of Experts models for improved accuracy.
- Enable federated learning for collaborative, privacy-preserving training.
- Develop explainable AI for transparency and clinician trust.
- Expand to personalized medicine and real-time monitoring.