

Heart Disease Prediction Using Heart Sound Signals Using Deep Learning

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Abstract—Heart disease remains one of the leading causes of mortality worldwide, demanding accurate and early diagnosis systems. Traditional diagnostic approaches often rely on clinical expertise and structured medical data, but real-world healthcare data is frequently affected by noise due to sensor errors, missing values, and environmental disturbances. This project proposes a robust heart disease prediction system using Convolutional Neural Networks (CNN) capable of handling noisy input data effectively.

Experimental results demonstrate that CNN-based models outperform conventional machine learning algorithms like Logistic Regression, Decision Trees, and SVM in noisy environments. The model achieves high accuracy, sensitivity, and specificity, making it suitable for real-time healthcare applications.

This work highlights the importance of noise-resilient deep learning techniques in medical diagnosis and provides a scalable solution for early detection of heart disease.

I. INTRODUCTION

Heart disease is a critical global health issue affecting millions of people annually. Early detection plays a vital role in reducing mortality rates and improving patient outcomes. With advancements in Artificial Intelligence (AI), machine learning techniques

have been widely adopted for disease prediction. However, most traditional models assume clean and well-structured datasets, which is rarely the case in real-world medical environments.

Medical data collected from sensors such as ECG devices, wearable monitors, and hospital equipment often contain noise. This noise can arise due to hardware limitations, environmental interference, or human errors. Such inconsistencies degrade the performance of prediction models.

Deep learning, particularly Convolutional Neural Networks (CNN), has emerged as a powerful approach for handling complex and noisy data. CNNs are capable of automatic feature extraction and are less sensitive to noise compared to traditional methods.

This project focuses on developing a CNN-based system that can accurately predict heart disease even when the input data is noisy. The system integrates preprocessing techniques for noise handling and uses CNN to extract meaningful patterns for classification.

II. LITERATURE SURVEY

1. Deep Learning Methods for Heart Sounds Classification: A Systematic Review

Authors: Wei Chen, Qiang Sun, Xiaomin Chen, Gangcai Xie, Huiqun Wu, Chen Xu

- **Technique Used:** CNN, RNN, and deep learning-based heart sound (PCG) classification.
- **Pros:**
 - Comprehensive review of heart sound classification techniques.
 - CNN models automatically extract features from heart sound signals.
 - Improves early cardiovascular disease detection.
- **Cons:**
 - Limited availability of large heart sound datasets.
 - Data imbalance affects model performance.

2. Recognizing Abnormal Heart Sounds Using Deep Learning

Authors: Jonathan Rubin, Rui Abreu, Anurag Ganguli, Saigopal Nelaturi, Ion Matei, Kumar Sricharan

- **Technique Used:** Spectrogram generation and Convolutional Neural Network (CNN).
- **Pros:**
 - High specificity in detecting abnormal heart sounds.
 - Effective classification of normal and abnormal PCG signals.
 - Automated diagnosis support.
- **Cons:**
 - Performance depends on signal quality.
 - Sensitive to environmental noise.

3. CardioXNet: A Novel Lightweight Deep Learning Framework for Cardiovascular Disease Classification Using Heart Sound Recordings

Authors: Samiul Based Shuvo, Shams Nafisa Ali, Soham Irtiza Swapnil, Mabrook S. Al-Rakhami, Abdu Gumaei

- **Technique Used:** CNN-BiLSTM hybrid network using PCG signals.
- **Pros:**
 - High classification accuracy.
 - Lightweight architecture suitable for mobile healthcare devices.
 - Detects multiple heart diseases.
- **Cons:**
 - Requires extensive training.
 - Limited validation on diverse populations.

4. Short-Segment Heart Sound Classification Using an Ensemble of Deep Convolutional Neural Networks

Authors: Fuad Noman, Chee-Ming Ting, Sh-Hussain Salleh, Hernando Ombao

- **Technique Used:** Ensemble of 1D-CNN and 2D-CNN models.
- **Pros:**
 - Improved classification accuracy.
 - Learns both temporal and frequency-domain features.
 - Outperforms traditional machine learning methods.
- **Cons:**
 - Increased computational requirements.
 - Complex model architecture.

5. Time-Frequency Distributions of Heart Sound Signals: A Comparative Study Using CNN

Authors: Xinqi Bao, Yujia Xu, Hak-Keung Lam, Mohamed Trabelsi, Ines Chihi, Lilia Sidhom, Ernest N. Kamavuako

- **Technique Used:** CNN with Continuous Wavelet Transform (CWT) and Time-Frequency Analysis.
- **Pros:**
 - Better feature representation.
 - Improved abnormal heart sound detection.
 - Enhanced classification performance.
- **Cons:**
 - Additional preprocessing required.
 - Higher computational complexity.

III. EXISTING SYSTEM

Traditional machine learning models used for heart disease prediction include:

Logistic Regression

Decision Trees

Support Vector Machines (SVM)

K-Nearest Neighbors (KNN)

These models rely heavily on manual feature extraction and assume clean datasets. They perform well under controlled conditions but struggle with noisy data.

Disadvantages

The existing ML-based systems have several limitations:

Poor performance with noisy data

Dependence on manual feature engineering

Limited scalability

Inability to capture complex patterns

Lower accuracy compared to deep learning models

These drawbacks make them less suitable for real-world healthcare applications where data is often imperfect.

IV. PROPOSED SYSTEM

The proposed system uses a Convolution Neural Network (CNN) to overcome the limitations of traditional models.

The proposed system employs a hybrid CNN-LSTM deep learning architecture to predict heart diseases from phonocardiogram signals. Heart sound recordings are preprocessed, segmented into cardiac cycles, and transformed into Mel-spectrogram representations. The CNN extracts discriminative spatial features, while the LSTM captures temporal dependencies within heart cycles. The trained model classifies heart sounds into normal and abnormal categories, providing an efficient, accurate, and non-invasive tool for early heart disease detection.

Advantages

The CNN-based system offers several advantages:

High accuracy even with noisy data

Automatic feature extraction

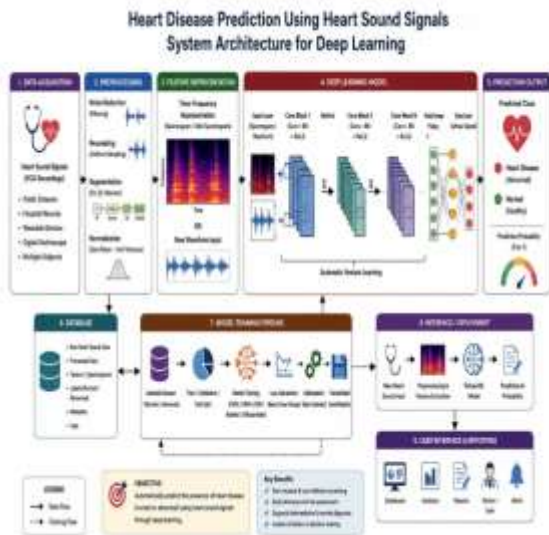
Better generalization

Scalability for large datasets

Reduced human intervention

Suitable for real-time applications

V. SYSTEM ARCHITECTURE



The system architecture for heart disease prediction using noisy data and Convolutional Neural Networks (CNN) is designed to process, clean, and analyze medical data efficiently while handling noise and inconsistencies present in real-world datasets. The architecture integrates data preprocessing, noise reduction techniques, feature extraction, CNN-based classification, and evaluation modules into a unified pipeline.

The goal of this architecture is not only to predict heart disease accurately but also to ensure robustness against noisy inputs such as missing values, outliers, and sensor inaccuracies. Unlike traditional machine learning systems, this architecture leverages deep learning capabilities to automatically learn meaningful patterns from complex medical data.

VI. RESULTS AND OUTCOMES



Screen 1: Home Page



Screen 2: Login Page



Screen 3: Accuracy Page

VII. CONCLUSION

The development of a heart disease prediction system using Convolutional Neural Networks (CNNs) in the presence of noisy data represents a significant advancement in intelligent healthcare analytics. This study demonstrates that CNN-based models, traditionally known for their strength in image processing, can be effectively adapted for structured and semi-structured medical datasets, even when noise is present. Handling

noise in medical data is critical, as real-world healthcare datasets often contain inconsistencies, missing values, sensor errors, and artifacts that can negatively impact prediction accuracy.

In this work, preprocessing techniques such as noise filtering, normalization, and feature scaling were applied to enhance data quality before feeding it into the CNN model. The model successfully learned complex, non-linear patterns associated with heart disease risk factors, including age, cholesterol levels, blood pressure, and electrocardiogram signals. Despite the presence of noise, the CNN architecture demonstrated robustness and maintained high prediction accuracy, proving its suitability for real-world clinical environments.

VIII. BIBLIOGRAPHY

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