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Department of Information Technology-2025

"Optimized Hybrid CNN-BiLSTM Approach for Accurate and Efficient Heart Disease Prediction"

First Review-1-(20-03-2025)

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AGENDA

- Domain Introduction
- Current Issues
- Issues planning to address
- Tools Required
- Literature Review
- Research Gaps
- Proposed Idea
- Tools Introduction

DOMAIN INTRODUCTION

- Deep Learning is a subset of Machine Learning that uses artificial neural networks to process data.
- It enables computers to learn from large datasets without explicit programming.
- Deep Learning models use multiple layers of neurons to extract complex patterns and features.
- It is widely used in healthcare, image recognition, speech processing, and autonomous systems.

DOMAIN INTRODUCTION

- Deep Learning improves accuracy in heart disease prediction by identifying hidden patterns in medical data.
- Deep Learning excels in handling large, high-dimensional medical datasets and improving prediction accuracy.
- Popular architectures include CNN (Convolutional Neural Networks), RNN (Recurrent Neural Networks), and LSTMs (Long Short-Term Memory) BiLSTM (Bidirectional Long Short-Term Memory).

CURRENT ISSUES IN HEART DISEASE PREDICTION

- Late Diagnosis & High Mortality Rate.
- Class Imbalance in Dataset.
- Feature Selection Complexity.
- Overfitting on Training Data.
- Lack of Explainability in AI Models.
- High Computational Cost.

ISSUES PLANNING TO ADDRESS

Issue in Heart Disease Prediction	Challenges Faced	Techniques Used in Your Project	How It Solves the Problem
Late Diagnosis & High Mortality Rate	Many patients are diagnosed at an advanced stage, reducing treatment effectiveness.	CNN-BiLSTM Model	Predicts heart disease early by learning deep patterns in medical data.
Class Imbalance in Dataset	More non-disease cases than disease cases, leading to biased predictions.	SMOTE (Synthetic Minority Over-sampling Technique)	Balances the dataset by oversampling minority cases, improving prediction fairness.
Feature Selection Complexity	Not all medical attributes contribute equally to prediction accuracy.	SelectKBest & PCA (Principal Component Analysis)	Selects the most important features, reducing noise and improving model efficiency.

ISSUES PLANNING TO ADDRESS

Issue in Heart Disease Prediction	Challenges Faced	Techniques Used in Your Project	How It Solves the Problem
Overfitting on Training Data	The model performs well on training data but struggles with new patient data.	Dropout & Batch Normalization	Prevents overfitting by regularizing the model and stabilizing training.
Lack of Explainability in AI Models	Doctors find it difficult to understand AI-driven decisions.	SHAP (SHapley Additive Explanations) & Attention Mechanism	Provides model interpretability by highlighting important features influencing predictions.
High Computational Cost	Deep learning models require significant resources, making real-time deployment	Model Optimization (Pruning & Quantization)	Reduces the model's size and computation, making it deployable on edge devices.

TOOLS REQUIRED

Programming Language:

- Python – Used for data preprocessing, model building, and evaluation.

Deep Learning Framework:

- TensorFlow/Keras – Implementing CNN and BiLSTM models.

Data Handling:

- Pandas & NumPy – For dataset manipulation and numerical computations.

Feature Selection & Dimensionality Reduction:

- Scikit-learn – Used for SelectKBest, PCA, and data preprocessing.

TOOLS REQUIRED

Class Imbalance Handling:

- Imbalanced-learn (SMOTE) – To balance the dataset and improve prediction accuracy.

Data Visualization:

- Matplotlib & Seaborn – To plot accuracy, loss, and feature distributions.

Model Training & Optimization:

- Adam Optimizer – Used to improve model performance and stability.

TOOLS INTRODUCTION

- **Python:** A versatile programming language widely used in AI, machine learning, and deep learning applications.

- **TensorFlow & Keras:** Deep learning frameworks that provide powerful tools for building and training neural networks..

- **Pandas & NumPy:** Libraries for efficient data manipulation, preprocessing, and numerical computations.

- **Scikit-learn:** A machine learning library used for feature selection (SelectKBest), dimensionality reduction (PCA), and data preprocessing.

TOOLS INTRODUCTION

- **Imbalanced-learn (SMOTE):** A tool for handling class imbalance by generating synthetic samples for underrepresented classes.

- **Matplotlib & Seaborn:** Visualization libraries for analyzing data patterns, model accuracy, and loss trends.

- **Adam Optimizer:** An advanced optimization algorithm that helps in stable and efficient model training.

LITERATURE SURVEY

Title	Year	Authors	Techniques Used	Pros	Cons
A Novel Early Detection and Prevention of Coronary Heart Disease Framework Using Hybrid Deep Learning Model and Neural Fuzzy Inference System	2024	Kanumuri Vinay Varma et al.	Hybrid Deep Learning + Neural Fuzzy Inference System (NFIS)	Improved accuracy, early CHD detection	High computational complexity, limited scalability
Heart Disease Prediction Using Deep Learning	2024	Kanumuri Vinay Varma et al.	Deep Neural Networks (DNNs), SVM, Naïve Bayes, Random Forest	Good predictive accuracy (85%)	Lacks detailed explanation of CNN-BiLSTM, moderate accuracy

LITERATURE SURVEY

Title	Year	Authors	Techniques Used	Pros	Cons
Ensemble Learning Based on Hybrid Deep Learning Model for Heart Disease Early Prediction	2023	S. Kumar et al.	CNN + LSTM + Random Forest	High accuracy with ensemble learning	High memory consumption, slow training process
Crow Intelligence Optimization-Based Deep Learning Model for Cardiovascular Disease Detection	2023	P. Gupta et al.	Crow Search Optimization + Deep Neural Networks (DNN)	Good feature selection	High complexity, requires manual tuning

LITERATURE SURVEY

Title	Year	Authors	Techniques Used	Pros	Cons
A Clinical Decision Support System for Heart Disease Prediction Using Deep Learning	2022	A. Bharathi et al.	CNN + RNN with Decision Support System (CDSS)	Real-time decision-making for doctors	Requires extensive training data, difficult to interpret

RESEARCH GAP

- Limited Real-World Deployment.
- High Computational Cost.
- Lack of Multimodal Data Integration.
- Black-Box Nature of Deep Learning.
- Class Imbalance and Minority Class Bias

EXISTING SYSTEM

- Traditional machine learning models (e.g., Decision Trees, SVM, Naïve Bayes) are used for heart disease prediction.
- Limited accuracy due to inadequate feature extraction and handling of sequential dependencies in data.
- Difficulty in processing high-dimensional medical data, leading to inefficiencies in prediction.
- Lack of deep learning integration, reducing the ability to capture complex patterns in ECG or other medical data.
- Performance metrics (accuracy, precision, recall) are suboptimal, making real-time clinical applications challenging.

PROPOSED IDEA

- A hybrid **CNN-BiLSTM** model for improved heart disease detection by leveraging deep learning.
- CNN extracts spatial features, while BiLSTM captures sequential dependencies, improving classification accuracy.
- Optimized feature extraction and selection techniques reduce redundant information and enhance model performance.
- Real-time processing capability, ensuring efficient and accurate diagnosis with minimal computational delay.
- Higher accuracy and reliability, making it suitable for clinical implementation and assisting healthcare professionals

Thank you!!