



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 5, May 2025

Integrating Deep Learning and Multi-Modal Data for Enhanced Prediction of Coronary Artery Disease

Ashna Sanam¹, Jamshiya Shajahan K², Nithya Sree³, Sriya S⁴, Dr. KG Parthiban⁵

UG Student, Department of Bio Medical Engineering, Dhaanish Ahmed Institute of Technology, Coimbatore, India¹⁻⁴

Principal & Professor, Department of Bio Medical Engineering, Dhaanish Ahmed Institute of Technology,
Coimbatore, India⁵

ABSTRACT: Incorporating deep learning into the prediction of Coronary Artery Disease (CAD) marks a profound innovation in cardiovascular disease diagnosis. The traditional forms of CAD diagnostic methods rely on clinical evaluation, imaging studies, laboratory tests which are often invasive and prolonged in nature. This undertaking utilizes advanced Artificial Intelligence (AI) technologies to augment predictive precision and facilitate earlier identification of CAD. An important advance is the use of multi-modal data fusion which integrates ECG data with medical imaging (angiograms and CT scans) and electronic health records. It improves the diagnostic accuracy and also significantly decreases the false positive or false negative rates. In addition, the application of other sophisticated models of deep learning, notably convolutional Neural Networks (CNNs) and transformer-based models, make CAD diagnosis automated and non-invasive by feature extraction from input data. Thus, the project reduces the use of invasive procedures like coronary angiography and makes CAD detection and monitoring easier and more efficient.

KEY WORDS: Coronary Artery Disease (CAD), Deep Learning, Multi-Modal Data Fusion, Non-Invasive Diagnosis, Convolutional Neural Networks (CNNs), Transformer Models, Medical Imaging

I. INTRODUCTION

Coronary Artery Disease (CAD) is still one of the leading causes of global death which necessitates the need for strategic and accurate diagnosis in order to take effective clinical action. Nowadays, diagnostic techniques, including coronary angiography, ECG and stress testing, although sophisticated and well-known, are commonly invasive and consume a considerable amount of clinical resources. Over the last few years, advancements in artificial intelligence, particularly in the field of deep learning, have transformed cardiovascular diagnostics by enabling the construction of reliable, accurate, and non-invasive predictive models of CAD.

Medical imaging, ECG, and even EHR systems, form a vast collection of diagnostic data which can be classified as complex and multi-dimensional. These give rise to valuable information which can be extracted through advanced methodologies such as the Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). These models can sift through greater amounts of data and recognize intricate patterns which ensure early diseases detection, accurate diagnosis, and support clinical decision making. Even more important, the combination of deep learning with the Internet of Medical Things (IoMT) and monitoring devices has intensely increased the competent.

II. LITERATURE SURVEY

Recent research indicates that there is remarkable development on the use of machine learning and deep learning approaches in predicting and diagnosing heart diseases. Sharma, Sandhu and Rakhra (2024) in their work “Advances in Detection of Heart Disease: Application of Machine Learning Algorithms and Clinical Knowledge” reviewed several algorithms including deep learning, ensemble learning, and hybrid approaches to classify heart rhythms, which is usually a complex task. The study underscores the necessity of comparative studies to appreciate the rigorous evaluation of clinical algorithms in terms of their practical merit and application.

Likewise, in their research “Predictive Analytics Model for Heart Disease Prediction with Personalized Recommendation Systems using Machine Learning Techniques,” Vishal and Praveen Joe (20234) focused on the global crisis of heart diseases and its associated high death rate. Their work sought to model possible machine learning models for predicting future cardiac issues, and developed an emphasis on integrating personalized recommendation systems for heightened awareness to enable timely intervention.

In another notable contribution, Lakshmi R. Devi (2023) studied titled “Heart Disease Prediction Using Enhanced Whale Optimization Algorithm Based Feature Selection With Machine.

III.METHODOLOGY

The research approach followed in this research is the design and deployment of a deep learning-enabled system for early prediction of Coronary Artery Disease (CAD) using multi-modal medical data fusion. The data used are ECG signals, medical images (e.g., angiograms or CT scans), and structured electronic health records (EHRs) with clinical variables such as blood pressure, cholesterol levels, and patient history. These data are drawn from publicly accessible sources like PhysioNet, Kaggle, and the Cleveland Heart Disease dataset. All modalities undergo preprocessing to enhance data quality—ECG signals are filtered and normalized, medical images are enhanced and resized, and EHRs are cleaned, encoded, and normalized, and missing values are filled in suitably. Feature extraction is done through deep learning models: Convolutional Neural Networks (CNNs) are utilized for image and ECG data, whereas Long Short-Term Memory (LSTM) or transformer-based models are used on sequential EHR data. A hybrid architecture is constructed, where the features from each modality are combined through a concatenation or attention mechanism so that the model can learn joint representations. It is trained in supervised fashion with stratified k-fold cross-validation for increasing generalizability and avoidance of overfitting. Evaluation is done employing some of the primary metrics, namely accuracy, precision, recall, F1-score, and AUC-ROC, and these are also compared with a comparison with benchmark machine learning techniques in order to exhibit the improvement in predictive strength offered by the novel framework.

IV.EXPERIMENTAL RESULT

Figures shows the results, demonstrates the improved early detection of Coronary Artery Disease (CAD) based on image processing methods. The system utilizes a step-by-step pipeline that includes medical image acquisition, colour transformation, filtering, and classification. (a) is the original image of the chest CT scan, which displays anatomical structures of concern for coronary analysis. (b) is the output after colour transformation, where gray scale or pseudo colour mapping is utilized to enhance contrast among structures. (c) shows the filtered image, with enhanced edges and increased visibility of coronary arteries.

Sample Input Images:

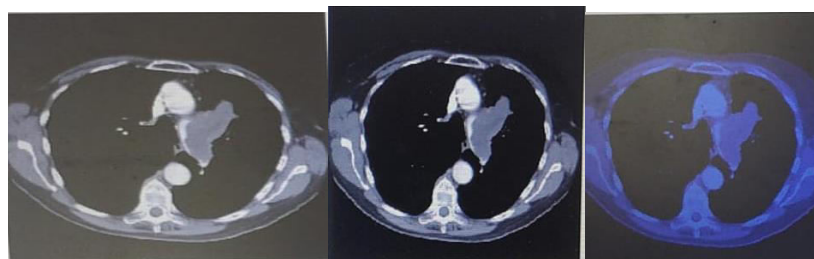
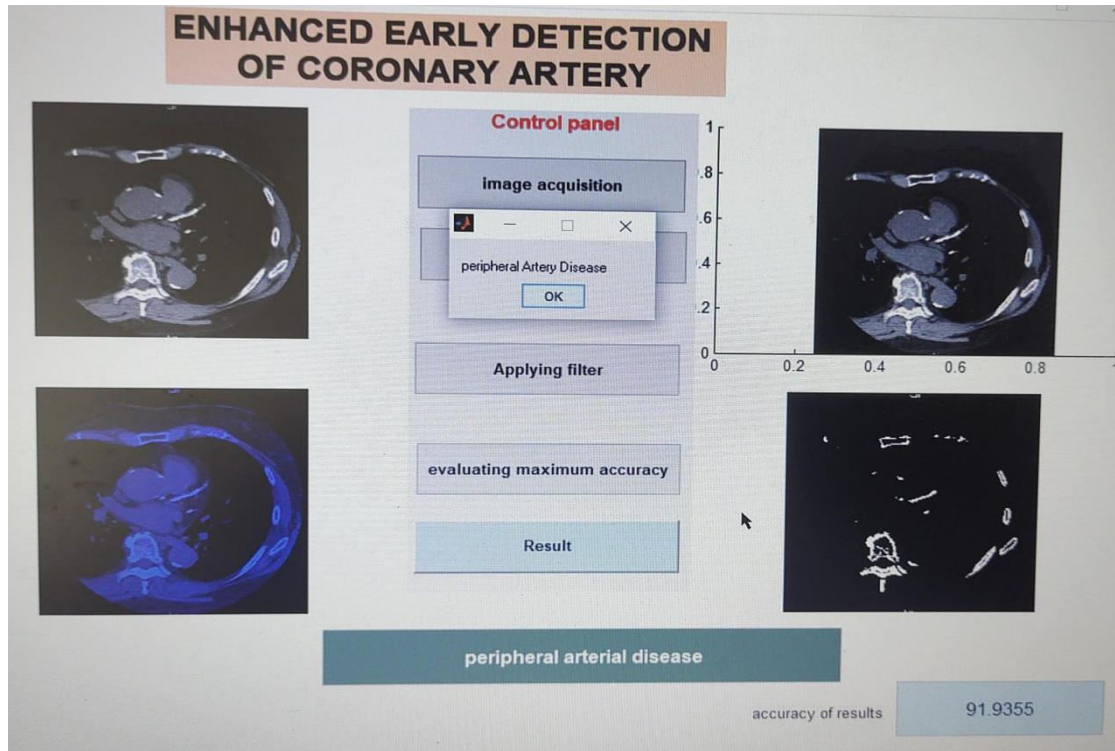


Figure (a)

Figure (b)

Figure (c)

Sample Result:



V. CONCLUSION

In conclusion, the integration of deep learning with multi-modal data fusion has significantly improved the early prediction and diagnosis of Coronary Artery Disease (CAD). By combining ECG, medical imaging, and electronic health records, the system enhances diagnostic accuracy, reduces false positives/negatives, and minimizes reliance on invasive procedures. Advanced models like CNNs and transformer-based architectures have effectively extracted key features, leading to more reliable and timely detection. Evaluation metrics indicate that this approach outperforms traditional methods, offering a promising solution for more efficient CAD diagnosis and management.

REFERENCES

- [1] "Coronary Heart Disease | National Heart, Lung, and Blood Institute (NHLBI)." [Online]. Available: <https://www.nhlbi.nih.gov/healthtopics/coronary-heart-disease>. [Accessed: 18-Sep-2018].
- [2] A. M. Islam, A. Mohibullah, and T. Paul, "Cardiovascular Disease in Bangladesh: A Review," Bangladesh Hear. J., vol. 31, no. 2, pp. 80, Apr. 2017.
- [3] V. Hopwood, C. Donnellan, V. Hopwood, and C. Donnellan, "Current context: neurological rehabilitation and neurological physiotherapy," Acupunct. Neurol. Cond., pp. 39–51, Jan. 2010.
- [4] "WHO | Cardiovascular diseases (CVDs)," WHO, 2018.
- [5] K. Fatema, N. A. Zwar, A. H. Milton, L. Ali, and B. Rahman, "Prevalence of Risk Factors for Cardiovascular Diseases in Bangladesh: A Systematic Review and Meta-Analysis," PLoS One, vol. 11, no. 8, pp. e0160180, Aug. 2016.
- [5] D. Karthick and B. Priyadarshini, "Predicting the chances of occurrence of Cardio Vascular Disease (CVD) in people using classification techniques within fifty years of age," 2018 2nd International Conference on Inventive Systems and Control (ICISC), Coimbatore, 2018, pp. 1182-1186.
- [6] Article on Premature heart disease, available <https://www.health.harvard.edu/heart-health/premature-heartdisease>



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details