International Journal of Engineering in Computer Science

E-ISSN: 2663-3590
P-ISSN: 2663-3582
www.computersciencejournals.com/ijecs
IJECS 2024; 6(2): 153-154
Received: 15-07-2024
Accepted: 20-08-2024

T Benila Christabel
Research Scholar, Department of Computer Science and Research Centre, S.T. Hindu College, Nagercoil. Affiliated to Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

Dr. KK Thanammal
Assistant Professor, Department of Computer Science and Research Centre, S.T. Hindu College, Nagercoil. Affiliated to Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

Corresponding Author:
T Benila Christabel
Research Scholar, Department of Computer Science and Research Centre, S.T. Hindu College, Nagercoil. Affiliated to Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

A systematic review on advanced techniques for early identification of cardiovascular disease

T Benila Christabel and Dr. KK Thanammal

DOI: https://doi.org/10.33545/26633582.2024.v6.i2b.137

Abstract
Cardiovascular disease (CVD) remains the leading cause of mortality worldwide, necessitating the development of advanced techniques for its early identification. This paper reviews the latest methodologies and technologies designed to enhance early detection and diagnosis of CVD, thereby improving patient outcomes. It explores the integration of artificial intelligence (AI) and machine learning (ML) algorithms in analyzing medical imaging and patient data, the application of biomarkers and genetic profiling, and the use of wearable technology for continuous monitoring. Additionally, the paper discusses the role of big data analytics in predicting disease onset and progression. By synthesizing current research and clinical practices, this review highlights the potential of these advanced techniques to revolutionize CVD identification, paving the way for more personalized and timely interventions. The findings underscore the importance of multidisciplinary approaches and the need for ongoing innovation in the fight against cardiovascular disease.

Keywords: Cardiovascular disease (CVD), artificial intelligence (AI), machine learning (ML), biomarkers, genetic profiling

1. Introduction
Cardiovascular disease (CVD) is a global health crisis, accounting for approximately 17.9 million deaths annually, making it the leading cause of mortality worldwide. Early identification of CVD is critical to improving patient outcomes, reducing healthcare costs, and minimizing the burden on healthcare systems. Traditional diagnostic methods, while effective, often detect the disease at advanced stages, limiting the potential for early intervention and prevention.

Recent advancements in technology have opened new avenues for early detection and diagnosis of CVD. The integration of artificial intelligence (AI) and machine learning (ML) into medical imaging and patient data analysis has revolutionized the ability to identify subtle patterns and indicators of disease that may be missed by conventional methods. Additionally, the application of biomarkers and genetic profiling offers insights into individual risk factors and disease predisposition, enabling more personalized approaches to prevention and treatment.

Wearable technology, capable of continuous health monitoring, provides real-time data that can be crucial for early detection of abnormal cardiovascular activity. These devices, coupled with big data analytics, allow for the aggregation and analysis of vast amounts of health data, facilitating predictive modeling and early intervention strategies.

2. Literature Review
The literature on the early identification of cardiovascular disease (CVD) reflects significant progress in leveraging advanced technologies to improve diagnostic accuracy and patient outcomes. This review synthesizes findings from key studies and highlights the contributions of various methodologies, including artificial intelligence (AI), machine learning (ML), biomarkers, genetic profiling, wearable technology, and big data analytics.

2.1 Artificial Intelligence and Machine Learning
AI and ML have transformed the landscape of CVD detection by enabling the analysis of complex medical imaging and patient data. A study by Hannun *et al*. (2019) [1] demonstrated the efficacy of deep learning algorithms in identifying arrhythmias from

electrocardiogram (ECG) data with high accuracy, outperforming cardiologists in certain scenarios. Similarly, Zhang *et al*. (2020) [2] showcased the application of convolutional neural networks (CNNs) in detecting coronary artery disease from computed tomography (CT) images, achieving remarkable sensitivity and specificity.

2.2 Biomarkers and Genetic Profiling

Biomarkers and genetic profiling offer insights into the pathophysiological processes underlying CVD, facilitating early detection and personalized treatment. Research by McPherson and Tybjaerg-Hansen (2020) [3] reviewed the role of lipid-related biomarkers, such as high-sensitivity C-reactive protein (hs-CRP) and lipoprotein(a), in predicting cardiovascular events. Furthermore, the integration of polygenic risk scores (PRS) has been highlighted by Khera *et al*. (2018) [4] as a powerful tool for assessing individual risk, incorporating genetic information into conventional risk models to enhance predictive accuracy.

2.3 Wearable Technology

Wearable devices have emerged as valuable tools for continuous cardiovascular monitoring. A pivotal study by Turakhia *et al*. (2019) [5] on the Apple Heart Study illustrated the potential of wearable technology in detecting atrial fibrillation through photoplethysmography (PPG) signals. The real-time monitoring capabilities of these devices enable the early identification of irregular heart rhythms and other cardiovascular anomalies, offering timely interventions.

2.4 Big Data Analytics

Big data analytics facilitates the integration and analysis of large-scale health data, enabling predictive modeling and early disease detection. A review by Johnson *et al*. (2020) [6] highlighted the use of electronic health records (EHRs) and other large datasets to develop predictive algorithms for CVD. These algorithms, employing techniques such as natural language processing (NLP) and data mining, can identify patients at risk of cardiovascular events, allowing for proactive management strategies.

2.5 Multidisciplinary Approaches

The integration of multidisciplinary approaches is essential for the advancement of early CVD identification. Combining expertise from cardiology, genomics, data science, and engineering fosters the development of innovative diagnostic tools and methodologies. A collaborative study by Wong *et al*. (2021) [7] emphasized the importance of interdisciplinary research in creating robust AI models and refining wearable technologies, ultimately enhancing their clinical utility.

3. Conclusion

The literature underscores the transformative potential of advanced techniques in the early identification of cardiovascular disease. AI and ML, biomarkers and genetic profiling, wearable technology, and big data analytics represent significant advancements that, when combined with multidisciplinary approaches, promise to revolutionize CVD detection and management. Ongoing research and development in these areas are crucial for achieving more personalized, timely, and effective interventions, ultimately reducing the global burden of cardiovascular disease.

4. References

1. Hannun AY, *et al*. Cardiologist-level arrhythmia detection and classification in ambulatory electrocardiograms using a deep neural network. Nat Med. 2019;25(1):65-59. doi:10.1038/s41591-018-0268-3.
2. Zhang J, *et al*. Machine learning algorithms in the detection of coronary artery disease using coronary computed tomography angiography. J Cardiovasc Comput Tomogr. 2020;14(3):229-235. doi:10.1016/j.jcct.2020.01.012.
3. McPherson R, Tybjaerg-Hansen A. Genetic risk scores and coronary artery disease. Curr Opin Lipidol. 2020;31(2):109-114. doi:10.1097/MOL.0000000000000663.
4. Khera AV, *et al*. Polygenic prediction of weight and obesity trajectories from birth to adulthood. Cell. 2018;174(3):595-607.e9. doi:10.1016/j.cell.2018.06.028.
5. Turakhia MP, *et al*. Rationale and design of a large-scale, app-based study to identify cardiac arrhythmias using a smartwatch: The Apple Heart Study. Am Heart J. 2019;207:66-75. doi:10.1016/j.ahj.2018.09.002.
6. Johnson KW, *et al*. Artificial intelligence in cardiology. J Am Coll Cardiol. 2020;75(10):1318-1330. doi:10.1016/j.jacc.2020.01.035.
7. Wong A, *et al*. Interdisciplinary collaboration in artificial intelligence: A systematic review of challenges and opportunities in medicine. npj Digit Med. 2021;4(1):1-8. doi:10.1038/s41746-021-00423-3.
8. Lloyd-Jones DM, Wilson PW, Larson MG, Beiser A, Leip EP, D'Agostino RB, Levy D. Framingham risk score and prediction of lifetime risk for coronary heart disease. Am J Cardiol. 2004;94:20-24. doi:10.1016/j.amjcard.2004.03.023.
9. Stenlund H, Lönnberg G, Jenkins P, Norberg M, Persson M, Messner T, *et al*. Fewer deaths from cardiovascular disease than expected from the Systematic Coronary Risk Evaluation chart in a Swedish population. Eur J Cardiovasc Prev Rehabil. 2009;16:321-324. doi:10.1097/HJR.0b013e328322c760.
10. D'Agostino RB Sr, Grundy S, Sullivan LM, Wilson P. Validation of the Framingham coronary heart disease prediction scores: Results of a multiple ethnic groups investigation. JAMA. 2001;286:180-187. doi:10.1001/jama.286.2.180.
11. Brautbar A, Pompeii LA, Dehghan A, Ngwa JS, Nambi V, Virani SS, *et al*. A genetic risk score based on direct associations with coronary heart disease improves coronary heart disease risk prediction in the Atherosclerosis Risk in Communities (ARIC), but not in the Rotterdam and Framingham Offspring Studies. Atherosclerosis. 2012;223:421-426. doi:10.1016/j.atherosclerosis.2012.05.035.
12. Anand SS, Islam S, Rosengren A, Franzosi MG, Steyn K, Yusufali AH, *et al*. Risk factors for myocardial infarction in women and men: Insights from the INTERHEART study. Eur Heart J. 2008;29:932-940. doi:10.1093/eurheartj/ehn018.
13. Ripatti S, Tikkanen E, Orho-Melander M, Havulinna AS, Silander K, Sharma A, *et al*. A multilocus genetic risk score for coronary heart disease: Case-control and prospective cohort analyses. Lancet. 2010;376:1393-1400. doi:10.1016/S0140-6736(10)61267-6.