RADemics

AI and IoT-Based Cardiology Systems for Heart Disease Prediction and Monitoring

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Abstract

Cardiovascular diseases continue to represent a major global health challenge, creating an urgent demand for intelligent technologies capable of enabling early diagnosis and continuous monitoring. Integration of Artificial Intelligence (AI) with the Internet of Things (IoT) has introduced a transformative approach for developing smart cardiology systems that support predictive healthcare and real-time patient monitoring. Advanced wearable sensors and interconnected medical devices enable continuous acquisition of physiological signals such as electrocardiogram patterns, heart rate, blood pressure, and oxygen saturation. AI-driven analytical models process large volumes of sensor-generated data to identify hidden patterns associated with cardiovascular abnormalities and potential cardiac events. Intelligent alert mechanisms and remote monitoring platforms strengthen clinical decision support and enable timely medical intervention. The presented chapter explores recent advancements in AI–IoT integrated architectures, wearable sensing technologies, predictive analytics, and intelligent monitoring frameworks for heart disease prediction and management within digital healthcare ecosystems.

Keywords: Artificial Intelligence, Internet of Things, Heart Disease Prediction, Smart Cardiology Systems, Wearable Sensors, Digital Healthcare.

Introduction

Cardiovascular diseases represent one of the most significant global health challenges, contributing to a substantial proportion of mortality and long-term disability across both developed and developing regions [1]. Rapid urbanization, sedentary lifestyles, unhealthy dietary habits, and increasing levels of stress have intensified the prevalence of cardiac disorders such as coronary artery disease, arrhythmia, heart failure, and hypertension. Aging populations and growing exposure to cardiovascular risk factors continue to increase the burden on healthcare systems worldwide [2]. Early detection of cardiac abnormalities plays a crucial role in reducing mortality rates and improving patient survival. Conventional diagnostic approaches primarily rely on clinical examinations, electrocardiography, imaging techniques, and laboratory investigations conducted during hospital visits. Periodic clinical assessments often fail to capture transient or intermittent cardiac irregularities that occur outside medical facilities [3]. Absence of continuous monitoring restricts the ability of healthcare professionals to detect early physiological changes associated with cardiovascular dysfunction. Technological advancements in biomedical engineering and

digital healthcare have created new opportunities to enhance cardiovascular disease management through intelligent monitoring systems and automated diagnostic support [4]. Emerging computational technologies support large-scale analysis of medical data generated through electronic health records, wearable monitoring devices, and medical imaging systems. Such developments highlight the growing importance of integrating digital technologies with cardiology practices in order to enable timely detection, improved risk assessment, and proactive healthcare interventions for cardiovascular disease prevention and management [5].

Digital transformation within healthcare has introduced advanced technological frameworks capable of capturing and analyzing physiological information in real time [6]. Development of connected health devices and biomedical sensors enables continuous monitoring of cardiac parameters beyond traditional hospital environments [7]. Wearable technologies equipped with electrocardiogram sensors, photoplethysmography modules, blood pressure monitors, and activity tracking units generate large volumes of physiological data reflecting cardiovascular activity during everyday life. Wireless communication networks enable seamless transmission of this data to remote processing platforms designed for storage, analysis, and clinical interpretation [8]. Continuous monitoring of cardiac signals provides valuable insight into physiological variations that remain undetected during routine clinical examinations. Integration of digital health platforms with patient monitoring devices contributes to a more responsive healthcare environment capable of detecting subtle changes in cardiovascular activity. Digital cardiology represents an emerging field that combines medical knowledge with computational technologies to enhance diagnosis, monitoring, and treatment of heart diseases [9]. Data generated through wearable devices and medical sensors contributes to large-scale cardiovascular datasets that support research and development of intelligent diagnostic systems. Continuous digital monitoring also strengthens preventive healthcare strategies by enabling early recognition of abnormal cardiac patterns associated with potential disease progression [10]. Expansion of digital healthcare infrastructures therefore plays a vital role in transforming cardiovascular care into a more proactive and patient-centered discipline.