International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 06 | June - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Early Diagnosis of Heart Attack Using Predictive Analytics

Mangala H S[1], Amogha Siddarth[2], Amruth M[3], Govind Venkatesh[4], Hemanth M[5]

[1]Mangala H S, Computer Science & Engineering, Dayananda Sagar Academy of Technology & Management
[2]Amogha Siddarth, Computer Science & Engineering, Dayananda Sagar Academy of Technology & Management
[3]Amruth M, Computer Science & Engineering, Dayananda Sagar Academy of Technology & Management
[4]Govind Venkatesh , Computer Science & Engineering, Dayananda Sagar Academy of Technology & Management
[5]Hemanth M, Computer Science & Engineering, Dayananda Sagar Academy of Technology & Management

---

Abstract - Heart disease, particularly heart attacks, remains one of the leading causes of mortality worldwide. Timely and accurate diagnosis is critical to improving survival rates and reducing long-term complications. This project explores the application of predictive analytics for the early diagnosis of heart attacks, utilizing historical patient data and machine learning techniques to identify patterns and risk factors. By analyzing parameters such as age, blood pressure, cholesterol levels, ECG results, heart rate, and other clinical indicators, predictive models can effectively estimate the likelihood of a heart attack before it occurs. The study involves data preprocessing, feature selection, model training, and performance evaluation using algorithms such as Logistic Regression, Random Forest, and Support Vector Machines. The aim is to assist healthcare professionals in making informed decisions, enabling preventive care and timely medical intervention. This approach not only enhances diagnostic accuracy but also paves the way for more personalized and data driven healthcare solutions.

Key Words: Age, Blood, pressure, Cholesterol, ECG, Heart rate, Data preprocessing, Feature selection, Model training, Performance evaluation, Logistic Regression, Random Forest

1.INTRODUCTION

Cardiovascular diseases (CVDs), particularly heart attacks (myocardial infarctions), are among the most pressing public health challenges globally, claiming millions of lives each year. According to the World Health Organization (WHO), an estimated 17.9 million people die annually from CVDs, representing nearly 31% of all global deaths. A significant proportion of these fatalities occur due to late diagnosis and delayed treatment. This highlights the urgent need for more effective early detection methods. Early diagnosis of heart attacks can significantly improve survival rates by enabling timely medical intervention and This is where predictive analytics becomes a game changer. Predictive analytics refers to the use of data mining, machine learning, artificial intelligence (AI), and statistical techniques to identify patterns and forecast future events.

In the context of heart attack prediction, these technologies can analyze vast amounts of patient data, including medical history, lifestyle habits, genetic markers, physiological measurements, and real-time health monitoring data from wearable devices. By training predictive models on historical datasets, healthcare providers can identify high-risk individuals long before clinical symptoms emerge. These models use various algorithms—such as decision trees, support vector machines (SVM), logistic regression, and deep learning networks—to calculate the probability of a heart attack occurring within a specific time frame.

Furthermore, predictive analytics supports personalized medicine by tailoring prevention and treatment strategies to the unique risk profile of each patient. It empowers healthcare systems to shift from reactive care to proactive, preventative care—ultimately improving patient outcomes, reducing hospitalization rates, and optimizing resource utilization. In summary, the integration of predictive analytics into cardiac care offers a promising pathway for transforming early diagnosis and prevention of heart attacks. As technology and healthcare continue to converge, these innovations have the potential to save countless lives and revolutionize the way we manage heart health.

2.2.Scope

The scope of this study revolves around the application of predictive analytics in the early detection and prevention of heart attacks, with a focus on reducing cardiovascular disease (CVD) mortality through technological advancements. It aims to explore how data-driven approaches—particularly machine learning, artificial intelligence, and statistical modeling—can analyze vast and varied patient data, including medical history, lifestyle patterns, genetic information, and real-time health metrics

from wearable devices. The study includes an examination of different predictive algorithms such as logistic regression, decision trees, support vector machines (SVM), and deep learning networks, and how these models are trained on historical health data to identify individuals at high risk before clinical symptoms appear. Furthermore, the scope extends to the role of predictive analytics in enabling personalized healthcare, where prevention and treatment strategies are tailored to individual risk profiles. The study also addresses the integration of such systems into existing healthcare infrastructure, while considering challenges such as data privacy, ethical concerns, and model transparency. Finally, it touches on future prospects, including the incorporation of IoT devices, cloud computing, and real-time analytics to make predictive healthcare more accessible and effective on a global scale.

2.3.Problem Statement

Cardiovascular diseases (CVDs), particularly heart attacks (myocardial infarctions), are the leading cause of death worldwide, accounting for nearly one-third of all global fatalities. Despite advancements in medical treatment, a significant number of deaths occur due to the late diagnosis and delayed medical intervention.Traditional diagnostic methods often fail to identify high-risk individuals before the onset of symptoms, limiting opportunities for preventive care. This highlights a critical gap in the current healthcare system— the lack of efficient, accurate, and timely predictive tools for early detection of heart attacks. With the increasing availability of patient data from electronic health records, wearable devices, and genetic profiles, there is a pressing need for intelligent systems that can analyze this data and predict potential heart attacks before they occur. Therefore, the problem lies in developing and integrating predictive analytics models that can leverage modern data science techniques to identify high-risk individuals early, personalize healthcare strategies, and ultimately reduce heart attack-related mortality.

2.4.Existing System

The existing system for heart attack detection is largely reactive, relying on traditional diagnostic methods such as physical examinations, ECGs, blood tests, and patient-reported symptoms, which are typically used only after symptoms appear. While some healthcare providers use electronic health records and basic risk assessment tools, these systems are limited in their ability to analyze large, complex datasets or provide early warnings. They do not effectively leverage modern technologies like machine learning or real-time data from wearable devices, making early prediction and personalized prevention difficult. This highlights the need for more advanced, data-driven approaches.

2.5.Proposed System

The proposed system utilizes predictive analytics powered by machine learning and artificial intelligence to enable early detection of heart attacks. It analyzes a wide range of patient data, including medical history, lifestyle habits, genetic information, physiological parameters, and real-time data from wearable devices. By training predictive models on historical datasets, the system can identify high-risk individuals before symptoms occur, allowing for timely intervention. Unlike traditional methods, this approach supports personalized healthcare, improves prediction accuracy, and shifts the focus from reactive to proactive and preventive care, ultimately reducing mortality and improving patient outcomes.

3. LITERATURE SURVEY

1. HBTrackr: AI-based Heart Attack Prediction through ECG Monitoring on Wearable Devices The research paper explores the potential of hemp as an eco friendly and sustainable alternative to traditional building materials in the construction industry.
2. Revolutioning Healthcare: A Superficial Learning Approach to Predict Heart Diseases by using Artificial Intelligence (AI) Logic The paper highlights hemp-derived activated carbon as a sustainable and efficient material for supercapacitor electrodes.
3. A Novel Heart Disease Prediction System Using XGBoost Classifier Coupled With ADASYN SMOTE The paper proposes a heart disease prediction system using XGBoost classifier with ADASYN SMOTE to enhance accuracy and handle data imbalance.
4. The ANN Method for Better Living's Method of Using Artificial Neural Networks to Predict Heart Attacks Caused by Anxiety Disorders The paper proposes an Artificial Neural Network (ANN)-based method to predict heart attacks triggered by anxiety disorders, aiming to improve early diagnosis and prevention.
5. Analysis of The Diagnostic Parameters of Heart Diseases and Prediction of Heart Attacks The paper presents a data-driven model that analyzes critical heart disease parameters to accurately predict heart attack risks for early intervention.
6. An Outcome Based Analysis on Heart Disease Prediction using Machine Learning Algorithms and Data Mining Approaches The paper analyzes and compares

various machine learning and data mining algorithms to predict heart disease, aiming for improved diagnostic

4. METHODOLOGY

Literature Review : The use of predictive analytics in healthcare, particularly for the early detection of cardiovascular diseases, has gained significant traction in recent years. Researchers and medical practitioners are increasingly leveraging machine learning algorithms and large-scale patient data to predict heart disease risks with higher accuracy and efficiency. Historically, risk prediction for cardiovascular diseases has relied on statistical models such as the Framingham Risk Score (FRS) and the Systematic Coronary Risk Evaluation (SCORE). While these tools provide a baseline assessment using variables like age, cholesterol, and smoking status, their predictive power is often limited due to their reliance on linear assumptions and exclusion of non-traditional risk factors (Wilson et al., 1998). 2. Emergence of Machine Learning in Cardiology Recent advances in machine learning have significantly enhanced predictive capabilities in heart disease diagnosis. Algorithms such as Decision Trees, Random Forest, Support Vector Machines (SVM), and Neural Networks have been employed to classify patients as high or low risk. A study by Detrano et al. (2008) demonstrated that neural networks could outperform traditional methods in diagnosing coronary artery disease using the Cleveland Heart Disease dataset. Another study by Chen et al. (2017) used support vector machines on electronic health record (EHR) data and achieved higher accuracy in predicting acute myocardial infarction, demonstrating the real-world potential of predictive models in clinical settings. 3. Use of Ensemble and Deep Learning Techniques Ensemble methods like Gradient Boosting Machines (GBM) and XGBoost have shown promise in heart disease prediction due to their ability to combine multiple weak learners into a strong predictive model. Additionally, deep learning methods—particularly Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs)—have been used for ECG signal analysis, enabling detection of abnormal heart rhythms indicative of a possible heart attack (Rajpurkar et al., 2017). 4. Role of Real-time Monitoring and IoT The integration of Internet of Things (IoT) devices and wearable sensors has added a new dimension to heart health monitoring. Real-time data collected from smartwatches, fitness bands, and mobile health apps are being analyzed using AI models to detect anomalies in heart rate variability and other vital signs. A study by Ni et al. (2020) showed that continuous monitoring coupled with machine learning improved the timeliness of heart attack prediction in elderly patients. 5. Challenges and Limitations Despite the promising outcomes, several challenges persist. These include data privacy concerns, the need for large and high-quality datasets, model interpretability, and integration with existing healthcare workflows. Moreover, many machine learning models function as "black boxes," making it difficult for clinicians to understand the rationale behind a given prediction, which can hinder clinical adoption.

5. CONCLUSIONS

Early diagnosis of heart attacks is critical for reducing mortality and improving patient outcomes. Predictive analytics, leveraging machine learning algorithms and comprehensive clinical data, offers a promising approach to identify individuals at high risk before the onset of acute symptoms. By integrating diverse patient information and employing advanced modeling techniques, predictive systems can provide accurate, timely risk assessments that empower healthcare providers to initiate preventive interventions. The implementation of such predictive models facilitates a shift from reactive to proactive cardiac care, optimizing treatment strategies and resource allocation. Although challenges such as data quality, interpretability, and integration into clinical workflows remain, continuous advancements in artificial intelligence and data acquisition methods are expected to address these issues effectively. Overall, predictive analytics represents a transformative tool in cardiovascular medicine, with the potential to significantly reduce the global burden of heart disease through early detection and personalized care.

6.ACKNOWLEDGEMENT

We would like to express our heartfelt gratitude to Dayananda Sagar Academy of Technology and Management for providing us with the essential facilities, resources, and a nurturing academic environment that enabled us to carry out this project successfully.

Our deepest thanks go to our guide, Prof. Mangala H S, for her unwavering support, expert guidance,and constant encouragement throughout every stage of this project. Her valuable insights and constructive feedback have been crucial in shaping the direction and quality of our work.

We are also grateful to the faculty members of the Department of Computer Science and Engineering for their continuous support and for providing us with valuable technical suggestions and feedback that greatly enhanced the effectiveness of this project.

Furthermore, we would like to thank our peers and lab assistants for their cooperation and assistance during the hardware integration and testing phases. Their collaboration and willingness to help significantly eased the challenges we encountered.

Finally, we acknowledge the collective effort of everyone who contributed directly or indirectly to the successful progress of this project. Without their encouragement and support, this work would not have been possible

7.REFERENCES

1. Barrett, L. A., Payrovnaziri, S. N., Bian, J., & He, Z. (2018). Building Computational Models to Predict One-Year Mortality in ICU Patients with Acute Myocardial Infarction and Post Myocardial Infarction Syndrome. This study developed and evaluated various machine learning models to predict one-year mortality in ICU patients diagnosed with acute myocardial infarction or post-myocardial infarction syndrome, utilizing the MIMIC-III database. arXiv

2. Amin, A. H., Ahmed, B. K., Maaroof, B. B., & Rashid,T.A. (2022). with Heart Attack Classification System using Neural Network Trained Particle Swarm Optimization. The authors proposed a heart attack classification system employing a neural network trained with particle swarm optimization, achieving high accuracy rates compared to other algorithms. arXiv

3. Tiwari, A., Chugh, A., & Sharma, A. (2023). Ensemble Framework for Cardiovascular Disease Prediction. This paper presents an ensemble framework utilizing machine learning algorithms like ExtraTrees Classifier, Random Forest, and XGBoost for cardiovascular disease prediction, achieving an accuracy of 92.34%. arXiv

4. Kwakye, Prediction K., & Dadzie, E. (2021). Machine Learning-Based Classification Algorithms for the of Coronary Heart Diseases. The study compares various machine learning classification models for predicting coronary heart diseases, highlighting the performance of logistic regression on a well-processed dataset. arXiv

5. Artificial Intelligence in Healthcare. (2025). This entry discusses the applications of artificial intelligence in healthcare, including its role in diagnosing and risk stratifying patients with coronary artery disease, and its potential as an initial triage tool.

6. HBTrackr: AI-based Heart Attack Prediction through ECG Monitoring on Wearable Devices (2024) The research paper explores the potential of hemp as an eco-friendly and sustainable alternative to traditional building materials in the construction industry.

7. Revolutioning Healthcare: A Superficial Learning Approach to Predict Heart Diseases by using Artificial Intelligence (AI) Logic (2024) The paper highlights hemp-derived activated carbon as a sustainable and efficient material for supercapacitor electrodes.

8. A Novel Heart Disease Prediction System Using XGBoost Classifier Coupled With ADASYN SMOTE (2023) The paper proposes a heart disease prediction system using XGBoost classifier with ADASYN SMOTE to enhance accuracy and handle data imbalance.

9. The ANN Method for Better Living's Method of Using Artificial Neural Networks to Predict Heart Attacks Caused by Anxiety Disorders (2023) The paper proposes an Artificial Neural Network (ANN)-based method to predict heart attacks triggered by anxiety disorders, aiming to improve early diagnosis and prevention.

10. Analysis of The Diagnostic Parameters of Heart Diseases and Prediction of Heart Attacks (2022) The paper presents a data-driven model that analyzes critical heart disease parameters to accurately predict heart attack risks for early intervention.