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Enhancing Cardiovascular Disease Prediction with EML-IoT Integration

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***Abstract*— CardioVascular Disease (CVD) remains a foremost reason of morbidity and mortality worldwide, requiring advanced methods for initial finding and prevention of heart diseases. In recent years, the combination of Ensemble Machine Learning (EML) techniques with the Internet of Medical Things (IoMT) has developed as a capable possibility for improving CVD prediction. This research article provides a comprehensive review and analysis of the state-of-the-art techniques that are based on EML and IoMT for CVD prediction. The epidemiology and significance of CVD, followed by an overview of IoMT technologies and their potential in healthcare is presented. Subsequently, principles and methodologies of EML, including bagging, voting, and stacking techniques, highlighting their advantages in handling complex and heterogeneous healthcare data, are presented. Through a critical analysis of the literature, key trends, gaps, and future research directions in leveraging EML and IoMT for enhancing CVD prediction accuracy and clinical decision-making are identified.**

Keywords— Cardiovascular Disease, Ensemble Machine Learning, Internet of Medical Things, Predictive Analytics, Healthcare, Data Science

I. INTRODUCTION

Heart attacks have become common disease in recent days. The main goal in dealing with heart problems is to look at lots of data, understand it, and use it to predict, manage, and treat diseases like heart attacks. Tools like data mining, visualization, and Hadoop help handle big amounts of data [1]. The main reason for a heart attack is minimal flow of blood and oxygen to heart muscles, due to blockages in blood vessels. This can happen because of a buildup of a hard substance called plaque made of cells and fat in the arteries. When the heart muscles do not get enough oxygen, they can stop working, leading to a heart attack and, sadly, sometimes death. Cardiovascular diseases affect people of all ages and backgrounds. According to the World Health Organization (WHO), CVDs are accountable for around 17.9 million deaths annually, representing nearly one-third of all deaths globally [2]. Moreover, the prevalence of CVDs is rising, fueled by factors such as aging populations, unhealthy lifestyles, and increasing degrees of stoutness and diabetes. Several risk factors contribute to the development of cardiovascular diseases, including smoking, high blood pressure, high cholesterol, diabetes, physical inactivity, unhealthy diet, and excessive alcohol consumption. Additionally, genetic predisposition and socioeconomic factors can also influence an individual's susceptibility to CVDs.

AI algorithms are employed to analyze large-scale datasets, including electronic health records, medical imaging data, and genomic information, to extract valuable insights related to CVD risk factors, disease progression, and treatment outcomes. Machine learning techniques such as deep learning can identify patterns, correlations, and predictive biomarkers that contribute to our understanding of CVD. AI-driven approaches are accelerating the discovery of novel therapeutic targets and drug candidates for the treatment of CVD [3]. Machine learning algorithms analyze biological data to identify disease mechanisms, predict drug efficacy and safety profiles, and optimize drug design, leading to the development of more effective treatments for CVD. AI-based decision support systems provide clinicians with personalized treatment recommendations based on individual patient characteristics, medical history, and clinical guidelines. These systems assist in risk stratification, treatment selection, and monitoring of patients with CVD, ultimately improving clinical outcomes and patient care.

AI algorithms analyze cardiac imaging data such as echocardiograms, MRIs, and CT scans to detect and quantify abnormalities associated with CVD. These algorithms can identify subtle changes in cardiac structure and function, aiding in early diagnosis and risk stratification. AI-driven approaches accelerate the discovery of novel therapeutic targets and drug candidates for the treatment of CVD. Machine learning algorithms

performance. To determine the value of various features, and their traits, chi square test was used and the metrics were accessed and evaluated. To increase the precision, recall and f1 score, ensemble approaches are used along with feature selection.

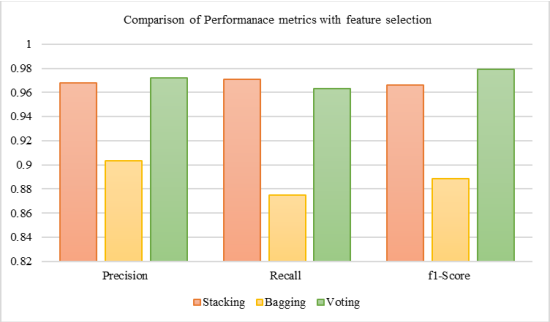

Fig. 4. Comparison of Performance metrics using ensemble approaches and with feature selection

The ensemble classifiers such as stacking, bagging and voting approaches are used to predict the risk of heart disease with higher accuracy. Out of three approaches, voting classifier provides a higher accuracy and the heart disease can be accurately predicted using the ensemble machine learning approaches.

V. CONCLUSIONS

This research showcases the efficacy of Ensemble Machine Learning (EML) techniques, including stacking, bagging, and voting, in predicting CardioVascular Disease (CVD) risk. Through comprehensive experimentation and analysis, significant improvements are observed in classification accuracy, precision, recall, and f1 score when employing ensemble methods, especially when coupled with feature selection techniques. The proposed hybrid recommender system for CVD integrates diverse data sources, such as medical records, patient demographics, lifestyle factors, genetic information, and environmental data. By leveraging this multifaceted approach and the capabilities of the Internet of Things (IoT), this work aims to provide more accurate and personalized recommendations for cardiovascular health management. By harnessing the power of ensemble machine learning and IoT technologies, we can advance proactive healthcare strategies, reduce healthcare costs, and ultimately enhance patient outcomes in the domain of cardiovascular health. Moving forward, further refinement is envisioned to validate the proposed methodology through collaboration with healthcare professionals. Innovations in cardiovascular health monitoring, diagnosis, and treatment that lead to improved quality of life will lead to reduced mortality rate.

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