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DEVELOPING A NOVEL MEDICAL IMAGING TECHNIQUE FOR DIAGNOSING CARDIOVASCULAR DISEASES

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ABSTRACT
Technical advancements that have significantly increased the sensitivity and spatial resolution of imaging modalities over the last ten years have made medical imaging much more widespread. The remarkable developments in medical imaging have led to the creation of clinical imaging technology, which can significantly contribute in the development of customized patient care. Swine animal models are very helpful for studying coronary flow and for generating predictive tools for the development and progression of disease.The coronary flow in humans and pigs has not yet been shown to be equal, despite the fact that myocardial hemodynamics is crucial to these processes. The study made use of a variety of flow and structural characteristics obtained using intravascular ultrasound and coronary computed tomography angiography. In addition to providing comprehensive diagnostic data, some technologies may also predict the outcomes of therapies, enabling more customized intervention planning. The primary focus of this research issue is the instruments that improve medical imaging's capacity to precisely measure cardiovascular disease.
Keywords: Cardiovascular Disease, detailed quantification, pathophysiology urges

1. INTRODUCTION

Data are currently dispersed through forms, reports, statistics, and other means. They serve as inputs for several types of methods. Numerous approaches have been developed as a result of the current technological boom, and efforts are ongoing to eliminate the problems that arise in every industry [2]. The technique has proved quite useful for detecting flaws in a certain industry and is very helpful for quickly fixing problems [1]. This rapidly developing technology is mostly used in the medical field. In terms of producing the outcome in the real-time scenario, this has greatly helped. In spite of this, several investigations and research projects have been carried out in various domains, with the medical profession primarily expanding the use of technology for official data access and result estimation that might be shown globally [11]. According to a World Health Organization (WHO) report, heart disease, or cardiovascular disease, is a leading cause of the high death rate worldwide. One of the body's components, the heart is essential to every area of the body because it pumps and circulates blood to every portion of the body, including the brain [4].In the event that the heart stops pumping blood to the brain and other body nerves, the nerve system will die, meaning that all of the tissues and nerves in the various body parts will stop functioning and death will occur [3]. Consequently, a living being's life is entirely dependent on its heart [6].

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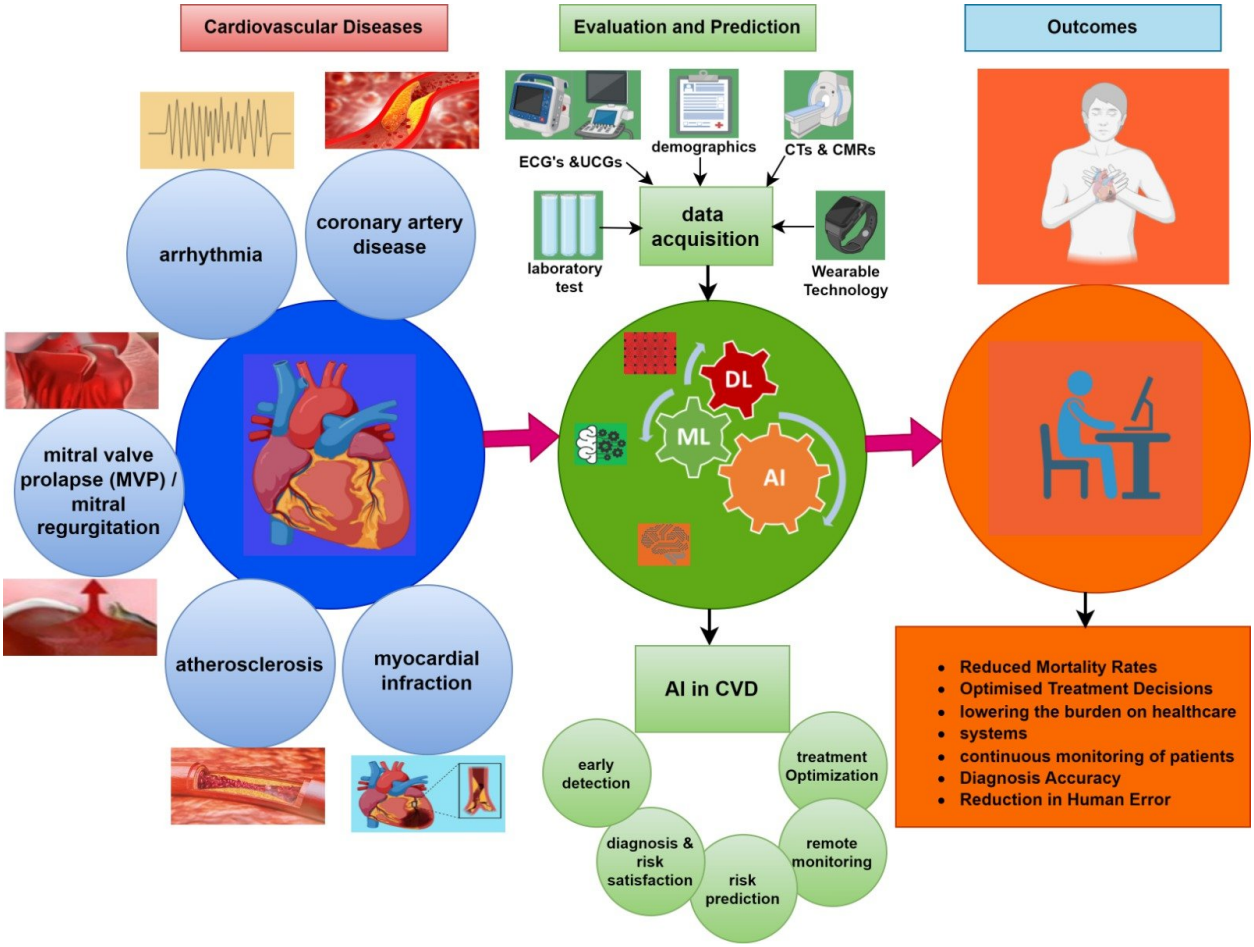

Figure 1:Analysis of Cardiovascular Disease(source: web)

Therefore, for each person to have a healthy life, their heart must operate properly. Reducing the mortality rate requires early disease detection in order to administer the right medication at the right time [16]. Furthermore, the main issue in the current scenario is the prediction of cardiac disease.

2. LITERATURE REVIEW

Over the past 20 years, medical imaging has experienced tremendous advancements and a huge increase in usage. Interest in patient-specific image-based cardiovascular in silico modeling has increased due to the devastation caused by cardiovascular illnesses and the increased emphasis on personalized healthcare [8]. These models are starting to help physicians choose individualized and effective treatments, and they have helped researchers obtain a more thorough and profound understanding of cardiovascular illnesses [5]. The integration of fluid dynamics and electrophysiological modeling for long-term patient-specific projections is one of the primary challenges facing cardiovascular modeling in the future [10]. The ultimate goal of a personalized cardiovascular model that integrates fluid dynamics, circulatory mechanics, individualized genomes, tissue shape, and cellular behavior should be envisioned by academics and medical professionals as the technology advances [12]. We hope that the information provided here will be instructive and thought-provoking for our readers as we work to improve the treatment of cardiovascular disease [13].

High-resolution CT scans of each patient's coronary anatomy are used in contemporary CFD estimates of coronary flow; however, as inlet boundary conditions, allosteric scaling and flow rates based on population statistics are used [7]. The authors illustrated the significance of patient-specific characteristics in the assessment of coronary disease by showing that this method. Current diagnostic imaging modalities have been expanded upon in a number of studies. created a methodology that uses compressed sensing image reconstruction and respiratory motion

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correction in accelerated 4D flow MRI to quantify coronary flow [14]. The existing 2D flow MRI approach, which has limited clinical relevance, is improved by the presented framework. According to 2D flow MRI, the suggested framework enables the diastolic measurement of left coronary flow. The diagnosis of intermediate coronary stenosis cannot be made with the current intravascular ultrasonography (IVUS) criteria. established the possibility of accurately diagnosing intermediate coronary stenosis using IVUS characteristics by combining them with lesion length

3. METHODOLOGY

Improvedthe temporal and spatial resolution of flow data by developing a data assimilation technique based on voxels derived from biomedical imaging modalities.Another study looked into how aortic shape and hemodynamics relate to the development of type B aortic dissection (TBAD). This study proved that 4D flow MRI is clinically feasible for TBAD patients and that it is crucial for determining the hemodynamic imprint of the illness..

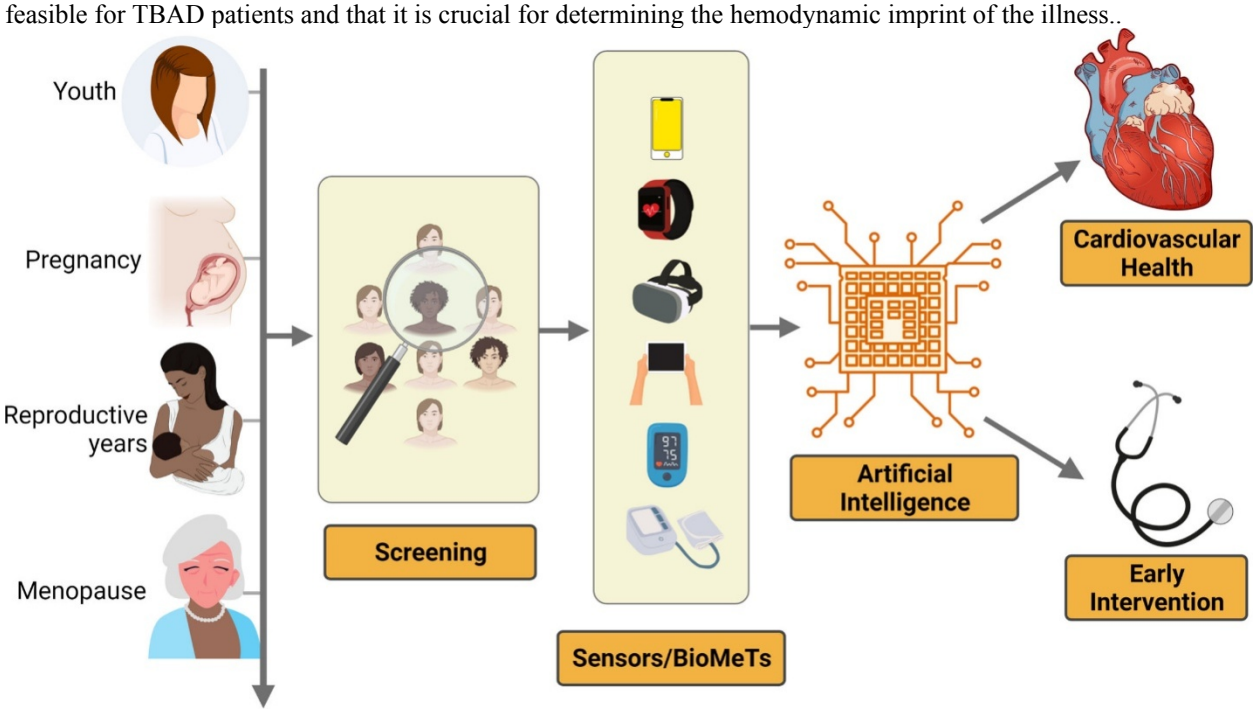

Figure 2: sample model (source: web)

investigated how aerobic training affected peripheral vascular and cardiopulmonary function and cardiac and peripheral arterial capacity in comparison to resistance training. In inactive and obese people, a number of measures were examined, including strain-based variables, brachial artery flow-mediated dilatation, peak VO2, and peak O2 pulse [8]. The findings of this study may help choose the best exercise modality to use in order to meet particular clinical goals. The cranium contains an essential part of the circulatory system that provides enough oxygen to the brain. When given inflow-outflow boundary conditions, image-based CFD analysis yields accurate cerebral flow predictions.However, it is challenging to create precise patient-specific boundary conditions using only anatomical pictures due to the circle of Willis' redundancy of flow routes. This problem was resolved by using arterial spin labeling MRI to model brain hemodynamics in a way that is unique to each patient with cerebrovascular stenoses.

4. RESULTS & DISCUSSION

Medical imaging of myocardial fibrosis, which is associated with alterations in electrophysiology, increased stiffness, and decreased contractility, has gained attention in recent years.

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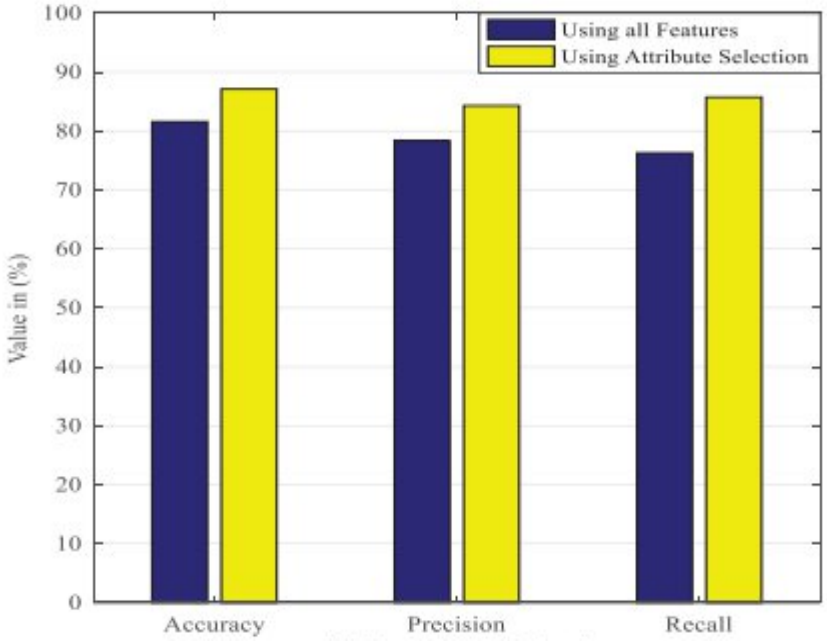

Figure 3: **Simulation results of ML model**

To assess myocardial strain and ascertain which technique is a more reliable indicator of myocardial fibrosis in heart transplant recipients, a study combining 2-D and 3-D STE was conducted [15].

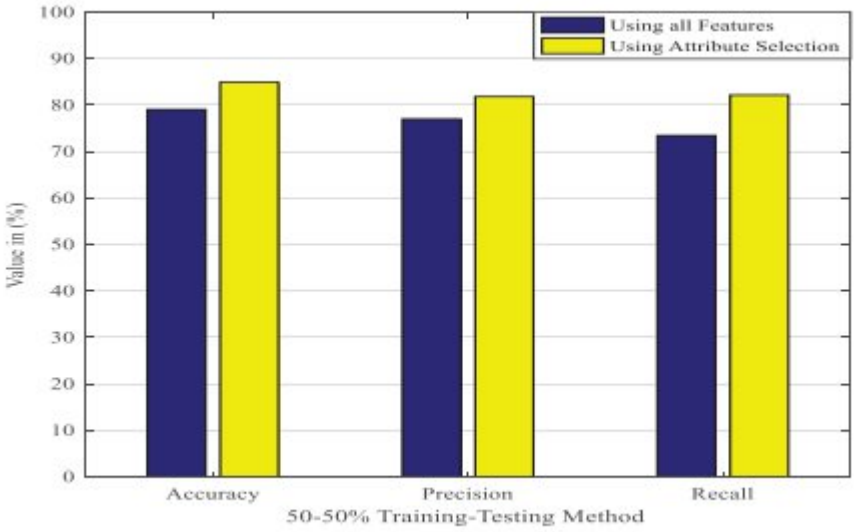

Figure 4: Simulation results of 50-50% training testing

The method for lowering the number of input variables in training data is known as the dimensionality reduction methodology. By projecting the data to a lower dimensional subspace, it is automatically helpful for lowering the dimensionality of the data when dealing with high dimensional range data and captures the core of the data. Lastly, performance indicators like accuracy rate, F1 score, and others are used to evaluate the prediction of heart disease or heart failure detection. Accuracy rate is the primary performance parameter that this study focuses on.

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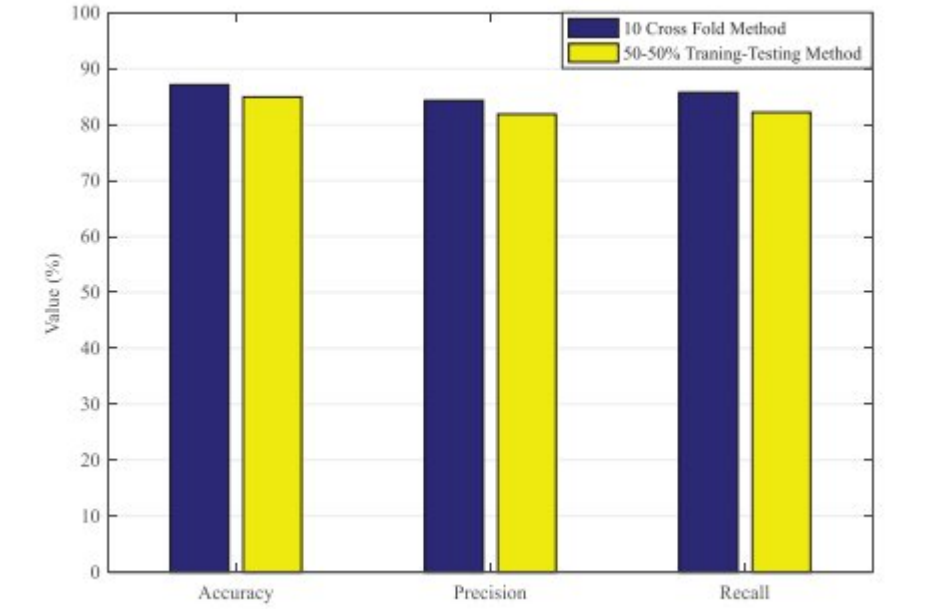

Figure 5: Comparison of simulation results of 50-50% training testing

It has been shown that genetic testing significantly affects cardiomyopathy.This was achieved by measuring myocardial strain using the previously described techniques and assessing myocardial fibrosis by CMR extracellular volume fraction.

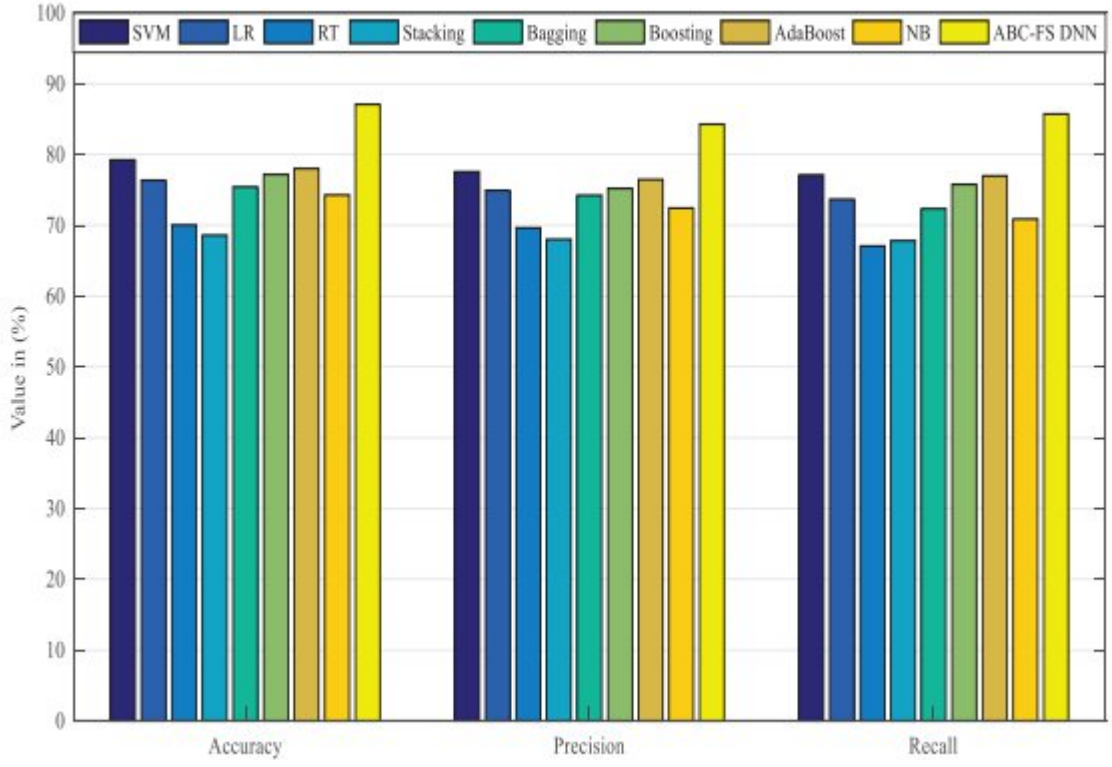

Figure 6 Simulation results various ML models

Finding patients favorable genotype is crucial, especially considering the psychological and social challenges related to genetic testing.Compared to conventional techniques, the algorithm employed in this study is more accurate in predicting positive genotypes in individuals with cardiomyopathy.

5. CONCLUSION

The efforts and observation to manage the gaps in the model have to pave the way for finding a disease prediction technique and to implement it with the real-field of various domains. The cardiovascular disease has increased the mortality rate as per the released reports recently. The motivation of this study comes from the fact that the people are trying to diagnose on their known by using their existing knowledge. This way of treating themselves with the existing knowledge is not the correct way and it has to be taken into the consideration. This will inevitably raise the disease's risk and severity. Heart and cardiovascular disorders are categorized into different sorts of diseases that require early prediction. This is one of the newly emerging diseases that is contributing to the high global mortality rate. This sickness has claimed the lives of the majority of people. There are numerous risk factors for this condition that must be avoided, and if a patient already has cardiac disease, precautions must be taken.The patients who are affected by the heart disease or cardiovascular diseases should follow the safety measures and the precaution must be taken as per the doctor’s advice in order to reduce the infection rate of the heart disease.

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