PREDICTION OF HEART DISEASE USING ARTIFICIAL NEURAL NETWORK

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1. Introduction:

The heart is the central organ of the human body, and its proper functioning is essential for survival. If the heart fails to work correctly, it can lead to severe complications throughout the body, often resulting in death. Between 1990 and 2013, the prevalence of cardiovascular diseases increased by 41% globally, posing a significant health challenge. The heart regulates critical bodily functions, including blood pressure, body temperature, and oxygen levels in the blood, making it vital for overall health.

Several factors contribute to heart disease, including genetic predispositions passed down through generations, high blood pressure, high cholesterol, age (particularly in individuals over 30), sex, poor diet, elevated calcium levels, overstretched blood vessels, and lack of physical exercise. Heart disease has become a global concern, with its prevalence rising significantly. According to the Institute for Health Metrics and Evaluation (IHME), the death rate from cardiovascular diseases increased by 41% from 1990 to 2013, followed by an additional 9.83% increase in 2014. A World Health Organization (WHO) survey reported 17 million deaths globally due to heart disease, highlighting the urgent need for effective prevention and treatment strategies.

Early detection of diseases, including heart conditions, is crucial for timely intervention and improved outcomes. Predicting heart disease in its early stages allows for the application of appropriate treatments before the condition becomes severe. Such prediction problems, often related to medical diagnoses, fall under the domain of bioinformatics—a branch of computer science.

In bioinformatics, historical data from patients is utilized alongside pattern-matching algorithms, which are trained on this data to generate predictions. Clinics and health centers collect vast amounts of data daily, such as medical reports, which can be leveraged to extract valuable insights. This collected data can serve as a foundation for developing predictive models, aiding in early diagnosis and effective management of heart disease

Methodology:

This study follows the Knowledge Discovery in Databases (KDD) model, which includes the collection of datasets, preprocessing of data, and the development of a pattern-matching classifier model using Artificial Neural Networks (ANN). Once the models are trained, they are ensembled to improve decision-making and predictive accuracy. The Weka tool has been utilized for the implementation of this methodology, as illustrated in the "Implementation Design" (refer to Figure 5).

In the first step, the data is preprocessed for training using the Principal Component Analysis (PCA) algorithm. The preprocessed data is then fed into the ANN for further processing and classification.

Conclusion:

To provide a clear understanding of the results, the prediction rates for each algorithm are summarized in tabular and graphical formats. The best prediction rate achieved through various techniques and methodologies is identified by studying, analyzing, and implementing an ensemble-based approach.

Different variations of Artificial Neural Networks (ANN) yield varying accuracy rates. A comparison of results before and after applying the Principal Component Analysis (PCA) algorithm reveals a significant improvement in accuracy—from 94.7% before PCA to 97.7% after PCA. This notable difference highlights the impact of preprocessing on the model's performance, demonstrating that heart disease prediction is achievable with high accuracy.

Further improvements in prediction accuracy are possible by optimizing the algorithm settings and tailoring them to the specific characteristics of the data. This opens avenues for enhanced methodologies to ensure even better outcomes in future studies.