

A Survey on Hybrid Particle Swarm Optimization and Neural Network for Heart Disease

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Abstract— Cardiac disease is a major global health problem in modern medicine. The twenty-first-century adage consummate proliferation in life expectancy and a significant transference in the causes of heart disease bereavement throughout the world. The criticality of cardiac diseases are more crucial and can even lead to vulnerable consequences if it is not detected at an earlier stage. The techniques such as electronic health records, body area networks are emerged to continuously monitor and diagnose patient's health conditions through the projection of medical sensors and wearable devices across human bodies. Since the data generated from the body area networks are continuous and tremendous in volume, the machine learning techniques are used for efficient health data classification processes. However, health data classification is the most challenging process as it needs to be executed accurately with an earlier prediction of heart diseases.

Keywords- Particle swarm optimization, Neural Network, Classification, Heart Disease

I. INTRODUCTION

Cardiac disease is a major global health problem in modern medicine. The twenty-first-century is adage consummate proliferation in life expectancy and a significant transference in the causes of heart disease bereavement throughout the world. Today it is interpreted for approximately thirty percent decrease across the globe including approximately 40 percent in the high-income country and twenty-eight percent in low and middle-income countries. Compelled by economic development, suburbanization and associated with circadian life changes this constant transition is arising around the world among all races, ethnic groups, and nations at an even faster rate than the last century [1]. A recent development of modern life style exponentially increases the heart failure rates.

Recent study showed that the evidence of heart failure is tripled in the last twenty-five years. Recent study states that Chronic noninfectious disease like cardiac disease is one of the prominent reasons of demise around the world. Global rise in cardiac disease effects from a dramatic transferral in the health status of individuals around the world [2].

The cardiac disease became the absolute daily basis of death worldwide. The global rise in cardiac disease effects from a dramatic transferral in the health status of individuals around the world. Heart diseases are ominously increasing day by day over the past two decades, and it has become one of the principal reasons for bereavement in most of the countries across the globe. Recent cardiac health-oriented survey convinced that

almost 1.2 billion people perish every year because of heart diseases. There is no single solution to the rising burden of heart disease, given the massive changes in societal, ethnic, and economic environs. Traditionally heart failure prognosis is highly a thought-provoking task in the eve of high-cost ratios [3].

The variety of modern imaging, clinical methodology for diagnosis of heart disease cost is too high. Primary symptoms associated with the cardiac disease include chest discomfort, dyspnoea, fatigue, edema, palpations, and syncope, cough, haemoptysis, and cyanosis are additional examples. Heart disease death rate structure of the year 2017 is showed on Fig 1.

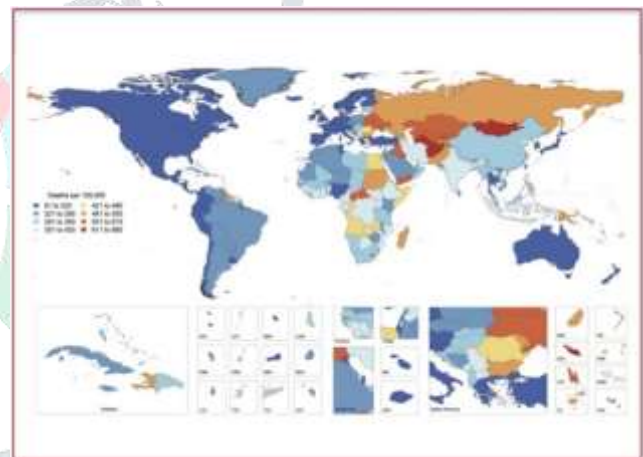


Fig. 1: Global Map Standardized Death Rate of CVD in 2017

II. LITERATURE REVIEW

Amin Khatami et al. [1], recognizes a classifier model of sending highlight incorporation joined with back-disposal of different data sets specifically Arrhythmia, and coronary illness datasets and ECG datasets. Experiential outcomes focus on that the element choices improved order procedures precisely and downsized the amount of admissions. In this paper the given arrhythmia dataset gives the upgraded presentation of 78 rate with condensed conspicuously decreased from highlights of nineteen. The following data set gives the upgraded exhibition of 85 rate and the amount of highlights cut back to four. The above Investigation exhibits that reduct highlights upgrade the classifier execution.

Zhang, Shuai et al. [2], shows a helpful neural organization troupe (CNNEs) to prepare the individual neural organizations in a gathering model. This model utilizes a valuable way to deal with improve the exactness measures to decide the concealed hubs in an individual neural organization. Each neural organization in a multi-layered model is prepared independently in a steady way

utilizing the negative connection ideas. The utilization of hurtful relationship learning strategies keeps up the property of variety over various layers of the neural organizations. This technique is widely tried across different AI issues, for example, malignancy identification, diabetes, coronary illness forecast, and letter acknowledgment datasets. The outcomes show it furnishes a helpful neural organization model with a further extent of speculation capacity.

Zhiyong Wang et al. [3], this framework is uncommonly intended to manage UCI apparatus heart data sets. This framework utilizes the choice tree based calculation to recognize the fundamental ascribes that help viable determination and meds. The yield information determined in fluffy guideline base. Fluffy estimate is utilized for yield deduction. Molecule swarm improvement calculation enhances the created fluffy master framework to yield a higher precision of 93.27%. The noteworthy favorable position of the framework is that the yield models delivered by the fluffy master frameworks are effectively deciphered in contrast with the other order draws near.

Ashwini Shetty et al. [4], extended a model of a precise expectation framework use of firefly-based calculation alongside harsh sets. The blend of fluffy and harshest hypothesis ideas lessens the difficulties of vulnerabilities and high-dimensional components of coronary illness datasets. The harshest based fluffy learning model aids simpler ID of ideal arrangements with lesser calculation measures. The outcomes are higher when contrasted and the help vector machine and ANN for coronary illness forecast and the prescription cycle.

Aydin, S. et al. [5], built up a way to deal with anticipate ventricular arrhythmia. This work presents an entirely incorporated electrocardiogram signal processor to anticipate distress. An unmistakable ECG include set is utilized to anticipate the presence of ventricular arrhythmia across people. It identifies and checks out the ECG waves (PQRST) to investigate and remove the fiducial focuses. This cycle is utilized ongoing and versatile methods. The act of this methods handles the varieties in ECG signals in a viable way and gives high affectability and exactness measures. The framework execution is assessed utilizing cardiovascular signs recorded from the information base from american heart affiliation. The reenactment results give nearly higher exactness measures than the current strategies. The reenactment is performed utilizing application indicated coordinated circuit (ASIC). It is astounding that this strategy is the main ASIC usage to anticipate ventricular arrhythmia utilizing ESP in a prior way.

Bayasi, N. et al. [6], extended a methodology which distinguishes the danger of cardiovascular infections in grown-ups utilizing credulous Bayes classifier. To begin with, it examinations the clinical records and distinguishes the likelihood of coronary illness. This work chiefly centers around progress of affectability, exactness and particularity proportions of the coronary illness order and expectation measure. It centers around essential elements of coronary illness, for example, diabetes, blood lipid levels, the working of kidney and courses for prior identification of the danger factors. It orders the danger levels into three classes, for example, level-1,2,3. The trial results express that this work predicts coronary illness more viably than different methodologies (over 80%). It is likewise distinguished from the perception that levels the patients, cardiologists, and clinical experts express this

work predicts coronary illness all the more precisely and deliberately.

Berikol, B. et al. [7], it utilizes AI procedures with quick Fourier change strategies to anticipate heart maladies and give clinical suggestions to the patients. The recurrence of the info information is assembled through the time arrangement decay utilizing quick Fourier change techniques. The patient wellbeing subtleties are anticipated before, and proposals are given ahead of time utilizing troupe learning strategies. This sort of approach utilizes ongoing coronary illness dataset gathered from heart patients. The outcomes express that this methodology furnishes better forecast precision with diminished calculation works to the patients. It further gives a valuable instrument to ideal investigation and drug suggestions to heart patients.

Chebbi, A. et al. [8], underscored a way to deal with coronary illness determination utilizing credulous Bayes arrangement. This work features the effects of coronary illness in this day and age. It gives a combinational methodology of measurable strategies with Nave Bayes classifier to perform proficient forecast and determination of heart sicknesses. It utilizes information pre-preparing strategies to viably manage the enormous and complex arrangement of clinical information. A discretization calculation is utilized to plan different heart infections into its comparing classifications. The discretization strategy utilized here is managed discretization with equivalent frequencies. The trial is directed utilizing coronary illness datasets from detail log heart information base. The outcomes express that it gives preferable exactness measures over existing strategies.

Cheng-Hsiung et al. [9], elucidated the direct SVM classifier model. This discriminative classifier that isolates a hyperplane of any given dataset with named preparing tests, it yields an ideal hyperplane. The hyperplane is a line that isolates the given hyperplane into two sections in a two-dimensional space. Each class dwells at either side of the parcels. In straightforward terms, SVM plays out the detachment of classes.

Ghadge et al. [10], clarified the straight combinational model to distinguish right hyperplane. It distinguishes proper hyperplane to order the objective classes. The hyperplane ought to be chosen so that it effectively group the objective class. The determination of hyperplane changes starting with one situation then onto the next. On the off chance that there exist three hyperplanes and all the three precisely isolates the objective classes. In such a case, the idea of separation edge is utilized. It empowers simpler recognizable proof of proper hyperplane. Additionally, the edge separation measures are changed by situations to improve results. Maximal edge classifier and delicate edge classifier are a portion of the SVM order procedures that work from edge separation measures. Through which it plays out a proficient characterization measure.

Lafta, R. et al. [11], included a profound learning based straight SVM arrangement. It replaces the delicate max layer in profound convolutional networks with direct combinational machine. This methodology lessens the edge based misfortune as a choice to cross-entropy misfortune. There exist writing that substitutes various layers of the profound convolutional network with the SVM. This work replaces the SVM with the second layer of the profound convolution organization. The key

utilization of this work incorporates human face acknowledgment frameworks.

Liu, Wang et al. [12], clarified the SVM based way to deal with recognize coronary conduit illness. This work applies a help vector machine with head segment investigation (PCA) for valuable forecast and determination of coronary conduit infections. The dataset utilized for the trial cycle incorporates 480 patients with 23 credits for each patient. The profundity of the properties in the trial dataset is decreased with head segment investigation to give improved execution measures. With the decrease of qualities, an ideal SVM model is distinguished for each diminished measurement. The exploratory outcomes exhibit that this methodology gives decreased preparing blunder lesser preparing and test time.

Long, Nguyen Cong et al. [13], the essential target of the work is to perceive coronary illness and to help clinical experts in prior analysis and medicines. So as to give improved clinical direction, this work utilizes SVM classifier to dissect patients information, for example, age, sex, hazard factors. The presentation proportion of the framework is dissected with research center and clinical information of around 228 patients. Four unique philosophies tried on the equivalent dataset. SVM classifier gives the more noteworthy forecast of coronary illness finding. Among the tried examples of 228 patients, 99 are found of expectation. This work obviously expresses that the utilization of AI procedures across medical services frameworks significantly helps the clinical experts to clarify and solid choice and determination.

G. Purusothaman et al. [14], talk about the difficulties and procedures for of clinical choice emotionally supportive network for coronary illness forecast and finding. This work essentially centers around cardiovascular infections in the Iranian people group. A blend of help vector machine and twofold molecule swarm enhancement is used for the forecast and arrangement measure. Here SVM assumes the prevailing job, and it has totally identified with the information characterization measure, and the double molecule swarm improvement procedure aids the component choice cycle. The framework execution measures are assessed utilizing the Isfahan Healthy Heart Program (IHHP) dataset, and it gives improved precision, affectability and particularity measures in contrast with the regularly embraced classifiers for coronary illness expectation. Backing vector machines are the best strategy for characterization method broadly utilized over a few areas. It likewise has a few applications identifying with coronary illness expectation and the executives measures. This technique is a lot of compelling across high dimensional spaces and functions admirably with the exact edge of partition. Likewise, it performs well with the higher number of measurements than tests. Further, this methodology is computationally serious and memory productive. The exhibition gauges here and there debase with the boisterous and indistinct information.

III. TYPES OF CARDIAC DISEASE

There are several categories of heart diseases. Figure 2 shows the various types of heart disease based on clinical conditions. These categories are broadly classified as myocardial infarction, heart failure, heart arrhythmia, angina pectoris, cardiomyopathy, atrial fibrillation based on their clinical evidence. Heart disease has many

features, which affect the function or structure of the heart [8].

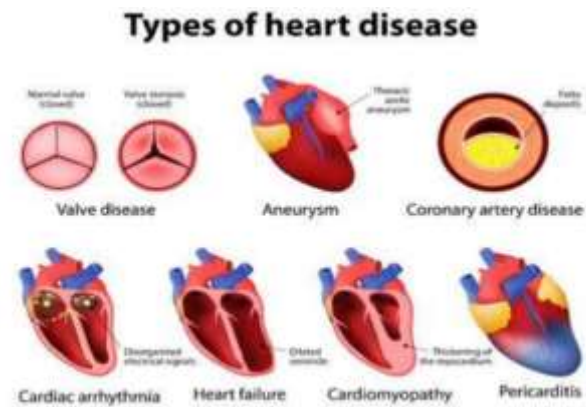


Fig. 2: Types of Cardiac Disease

Coronary Artery Disease

The coronary artery disease is discomfort induce by depleted circulation of blood. The depletion supply in arteries will damage the vein and produce the discomfort to the regular systolic and diastolic function of the heart [9].

Acute myocardial infarction

Clinical name for a cardiac arrest is acute myocardial infarction. A cardiac arrest is a condition that fatty substances present in the blood value affect the rate of flow which results tissue damage on arteries. The blockage arteries may not be able to supply the oxygenated blood supply to the body which will result in the dysfunction to other organs. Figure 3 explains a type of heart arrest caused by intense pressure [10].



Fig. 3: Acute Myocardial Infarction

Chest Pain (Angina)

Clinical name of chest pressure is Angina. It is predominant medical attention need emergency treatment for the patients. Patients has to treated with ventilators immediately if we experience this type of discomfort. Due to the poor supply of blood flow will cause the pressure on the blood walls and affect the blood vessels. Which will creates pressure on the blood vessals results chest pain. Figure 4 shows typical angina caused in the coronary vessel. Stable angina is the condition causes in peritoriam. Irregular blood flow between the peritoris walls. The main reasons of unstable angina are lifestyle modification, behavioural habits. Figure 5 shows typical unstable angina caused in the coronary vessel [11].

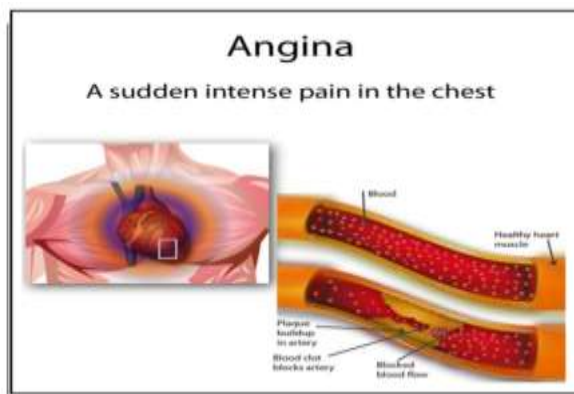


Fig. 4: Angina

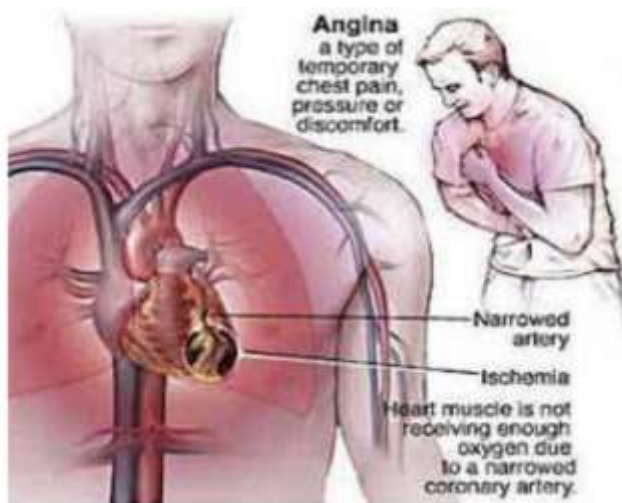


Fig. 5: Unstable Angina

IV. METHODS

1. Particle Swarm Optimization:-The notation is used in Particle swarm optimization are as follows:

- Xid :Component in dimension d of the ith particle of swarm
- Vid :The particle velocity of particle I in dimension d
- PBi : the best position achieved so far by particle i
- GB : The best global best position
- C1,C2 : Constant weight factors
- W: The inertia weight
- r1,r2: Random factors in [0,1] interval
- Vmin : The minimum velocity value of particle
- Vmax: The maximum velocity value of particle
- yi : The fitness value of particle i

PSO is a population base stochastic optimization technique inspired by the social behavior of swarm, such as bird flocking or fish schooling, to obtain a promising position to achieve certain objectives. The PSO algorithm works by having a population (called a swarm) of candidate solution (called particles). Each particle in a population has a fitness value computed from a fitness function and each particle has a position, and move based on an updated velocity according to few simple formula. The movements of the particles are guided by their own best known position in the search space as well as the entire swarm's best known position. The particle movements are directed by the position vector and velocity vector of each particle. In the n-dimensional space, the vector and velocity vector of the ith particle position are represented as $X_i=[x_{i1},x_{i2},x_{i3},x_{i4},\dots,x_{in}]$ and $V_i=[v_{i1},v_{i2},\dots,v_{in}]$ respectively, where xid is a binary bit, $i=1,2,\dots,m$ (m is the number of particles). The record of the position of the previous best performance of the neighborhood is $GB_i=[g_{bi1}, g_{bi2},\dots,g_{bin}]$. The

particle velocity and position is updated and based on Eqs. (A1) and (A2), respectively.

$$Vid_{new} = w \times vidold + c1r1(pbidold -xidold) + c2r2(gbdold -xidold), d=1,2 \dots D \quad (A1)$$

$$Xid_{new} = xidold + vid_{new}, d=1,2,\dots,elyN \quad (A2)$$

Where c1 and c2 are the positive constant values between 0 and 4, indication the cognitive and the social learning factors, respectively. The inertia weight (w has a value between 0.4 and 0.9 and r1 and r2 are uniformly distributed with the numbers between 0 and 1. The values of the velocities are between v_{min} and v_{max}, N is the size of the swarms.

2. Feed Forward Back propagation Neural Network

Neural networks are predictive model that have ability to learn, analyses, organize the data and predict test results accordingly. Among several kinds of neural networks, feed forward neural network is usually employed in medical diagnosis applications and others. These networks are trained by a set of patterns called training set, whose outcome is already known. In our study Feed Forward NN consists of input, hidden and an output layer, and the data operates in forward direction, and the error is back propagated to update the weights at every epoch in order to reduce errors.

V. CONCLUSION

This thesis provides the need for machine learning techniques in health data mining and management processes. In particular, the dissertation provides special attention to heart disease prediction and diagnosis measures. This due to the reason that heart diseases are one of the major concern across several countries and can even lead to death if not treated at an earlier stage. The major thesis objectives are achieved successfully and specifically we have accomplished three tasks:

- First, we formulate the problems and difficulties of machine learning classification models across healthcare applications.
- We solve the issues across healthcare systems, we formulated algorithms that deal with those issues in an effective manner.
- We evaluated the proposed approach with real-time datas.

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