GRADIENT DESCENT OPTIMIZATION FOR INTELLIGENT CORONARY DISEASE DIAGNOSIS USING FOG

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ABSTRACT: The leading cause of death in the modern world is heart disease. Early diagnosis of heart failure is crucial for improving the healthcare sector. Depending on preexisting information and statistics from comparable medical settings, the consistent and actual incidence of heart failure varies. Several solutions are capable of learning, adapting, and changing functional dependencies in response to new observations or due to changing interaction.There is gradient descent optimization in all of these abilities (GDO).People have incredible models that are easily generalised, entail little human interaction, and need just a little amount of computation during training. The cardiovascular disease prognosis, which has a significant impact on the lives of millions of people, is among the most significant prognoses constructed using algorithms for machine learning.Heart disease patients have a wide range of independent characteristics that can be utilised to diagnose them extremely successfully. The suggested model employs the gradient descent optimization approach to model variables using fog for security of data. The suggested SDCD-GDO system can take the place of costly medical tests because to its sophisticated detection of individuals who are likely to develop heart disease. Researchers from all across the world are now closely monitoring how medical databases are used. The suggested SDCD-GDO model is built using real data acquired from various sources, and during the validation phase, The recommended model's accuracy in detecting cardiovascular disease was 94.4 %.

INTRODUCTION

Cardiovascular disease is a term used to describe issues with the heart and blood vessels (CVD). Heart disease is the top cause of death for people of all sexes and age groups, according to (WHO) data. 17.3 million deaths worldwide in 2013 were caused by CVD. The illness is to account for 31.5% of deaths worldwide and 45% of all fatalities. For all communication, pregnancy, neonatal, and dietary issues combined, CVD has been responsible with twice quite so many mortality as cancer-related conditions worldwide (WHO,2016).

In the previous 20 years, the health service has made significant strides, and it is now capable of improving the way healthcare is delivered. Whereas healthcare systems improve patient workflow management by streamlining patient monitoring activities, their effectiveness in the clinical setting is still debatable.Reviewing the current condition maintenance programme and providing a thorough analysis of the results in the field of intelligent healthcare systems is the major goal (Selzer et.al.,2001).

Heart disease is becoming more common in wealthy countries. The disease, which is among the most common in humans, causes thousands of fatalities yearly and imposes tremendous socioeconomic costs, including those related to surgery and other medical care systems. The chances of people who have the condition in the long run may improve with early detection. Artificial neural networks (ANNs) are frequently employed to detect diseases. In this situation, ANN's parallel processing, parallel learning, and adaptability may be useful tools (Zebardast et al., 2014).

Obesity raises the likelihood of coronary disease and early mortality. Oedipus tissue releases a large number of bio-biotic mediators that affect homeostasis as well as body weight insulin resistance.Beginning to be known are the root reasons as well as the ways that nicotine damages cardiovascular health, increases dyslipidemia, and decreases physical activity. (1979; Kanel and others).

Contradictory findings have been found in the numerous research that have looked at the relationship between periodontal disease and cardiac issues. Meta-analyses were performed to investigate the relationship between periodontitis and cardiovascular disease. Studies published between 1989 and 2007 were stored in seven databases. The individuals have been identified as participants in reports of retrospective research and the association with both sporadic illness and cardiovascular disease has been assessed with verification of at least one of the following: death, unstable angina, acute myocardial infarction, or a coronary artery infarction used to diagnose coronary artery disease. Enough advice was followed in order to analyse the results of meta-observational studies. 47 of the 215 epidemiological studies produced findings, and 29 subjects could be covered by the meta-analysis method. Among 22 scenario and bridge experiments, the average arithmetic pool difficulty ratio was 2.35. (95 percent CI [1.87, 2.96], p 0.0001). Those with periodontal disease had a significantly increased chance (34%) of acquiring heart disease. (In healthy people, 0.0001).These clinical studies indicate that having periodontal disease increases both the difficulty and danger of developing cardiovascular disease, To lower the cardiovascular risk related with periodontitis treatment, however, more study is needed. (Blaizot,et.al.,2009).

Heart failure is one of the leading causes of mortality worldwide. Based on medical information that describes the client's present state of medical health, the complete article offers a clear method for forecasting heart disease. The main objective of the presented strategy is to locate suitable machine learning techniques that can accurately predict heart illness. Heterogeneous feature selection and relief are two different ways to feature selection that may be used to extract important properties from the dataset. People have contrasted four distinct methods to machine learning. Decision forest, assistance from a vector machine, decision tree classifier, and regression classifier logistics with chosen attributes and complete capabilities. To improve precision, cross-validation, hyper-parameter tinkering, and machine learning are employed. One of the key advantages of the suggested architecture is its capacity to manage Twitter data sources where patient data is adequately managed. The framework is created by integrating Apache Spark with Apache Kafka, which serves as the device infrastructure. The findings demonstrate that, when compared to other models, random forest classification got the greatest precision on model 84.9. (Nilashi et.al.,2020).

The most common cause of death in Sri Lanka, according to the 2010 Hospital Information System (SIRS) Report, is heart disease. The likelihood of death would be decreased with early identification and treatment of heart illness. Because of this, the method of Artificial Neural Networks (ANN) has been widely used and has a tolerable level of accuracy in the identification of heart illness. Additionally, there are drawbacks to adopting the ANN technique, including a protracted training time, the requirement to adjust several parameters, the potential for the results to get stuck in local optimums, and the requirement to distinguish between various device combinations (El Idriss et.al.,2020).

Literature Review: Software can be created by healthcare researchers that specialise in the diagnosis of cardiac disease. In this study, physio-deep learning neural networks, fuzzy rules, and expert diagnostic systems are combined to attempt to develop a system that can accurately identify heart problems. Based on previous patient data, we advise giving the level of uncertainty stated in the ambiguous regulations in the knowledge base for the cardiac condition field. The suggested approach helps medical professionals make the best decision when diagnosing heart disease.All physician choices can be updated in an information base that can significantly improve the consistency of the diagnosis of heart disease. Experimental results demonstrate that the suggested system is capable of identifying cardiac illness with high confidence in decision-making accuracy when compared to existing neural networks (Van Pham et.al.,2020).

Over the past 20 years, heart disease has affected a large number of people in wealthy countries. Patients who are diagnosed with these illnesses early on have a lower mortality risk and spend less money on care. The Fiji Logic Adaptive Genetic Algorithm (AGAFL) model tries to forecast heart illness, assisting medical specialists in early detection of heart disease. The model includes a fuzzy-based classification module and a modular set-based heart disease feature selection module. Vague categorization standards have been made stronger by the application of flawed genetic algorithms. Second, to some extent, theory selects the primary factors that lead to heart disease. The hybrid AGAFL classification is used in the second stage to forecast heart disease. Publicly available UCI heart disease datasets are used in this project. The present methodologies have been reinforced by our methodology, as shown by a thorough experimental assessment (Reddy,et.al.,2020).

Heart disease is one of the main causes of death worldwide and is considered a dangerous condition in middle and old age. The chance of death is particularly significant in common cardiac diseases like coronary artery disease. The most effective technique for identifying coronary artery disease is not necessarily angiography. On the other hand, it is associated with higher prices and more severe side effects. As a result, a lot of study has been done utilising machine learning and data mining to discover alternate methods. Here, a very accurate hybrid technique for identifying coronary artery disease is proposed. In fact, the suggested method can boost the neural network's effectiveness by up to 10% by increasing the initial weight using a genetic algorithm that suggests a better weight for the network. Using such an approach, the model's accuracy, sensitivity, and descriptive rates were respectively 93.85%, 97%, and 92% (Arabasadi et al., 2014).

Researchers have offered a wide range of tools and techniques to develop efficient systems to assist medical decisions over the years. New techniques and equipment are always emerging and reflecting one another. The diagnosis of heart disease is a serious concern, and numerous researchers have examined the development of sophisticated, smart aid systems for medical decision-making to raise the bar for doctors. The suggested approach offers a method for diagnosing cardiac disease using SAS software 9.1.3. The connection of a neural network is the key component of the suggested approach. These pair-based techniques integrate predictive values with later probabilities or numerous previous models as the system creates new models. As a result, more effective models may be created. We conducted tests with the suggested instrument. Our evaluation of the experiments using data from the Cleveland Cardiology Database was 89.01 percent. We also got sensitivity and descriptive values for the diagnosis of heart disease of 80.95 and 95.91 percent, respectively (Das,et.al.,2009).

Heart failure, the most rare cardiac ailment, is (CHD). Congenital heart disease, the most severe form of the condition that affects children, can be difficult to detect (CCHD). The introduction of CCHD testing using blood oxygen in clinical settings significantly raises detection rates. In Morocco, we are doing an experimental study on newborn heart disease screening. Innocent newborns who had been released between March 2019 and January 2020 were included in the study, which was done at the maternity section of the Mohammed VI University Hospital in Morocco. Of of 10,451 babies with no symptoms, 8013 (76.7%) received the treatment. In total, 7998 instances (99.82%) were found to have passed the test result, including one unremarkable inconclusive result that was repeated an hour earlier. Five CCHDs, five false positives, and five non-critical CHDs were among the fifteen babies (0.18 percent) that failed the screening test. One genuine incidence of rejection was discovered at the age of two months. By adding pulse oximetry into the standard treatment panel for newborn newborns, proposed findings allow us to improve CCHD screening (Slitine et al., 2020). (Siddiqui et.al.,2020).

Fog Computing (H.Sabireen et. al,2021) is a cloud computing platform extension archetype. Fog plays a role as an intermediary layer among cloud servers and edge devices. It is not a full-fledged cloud substitute; rather, it increases cloud capabilities. Fog works with edge devices, offering computing resources to them. Traditional IoT cloud systems suffer from scalability and reliability issues, which are addressed by fog computing . Data security, accuracy, latency rate and consistency is improved by fog nodes all of which are critical for applications like medical data, which operate at the edge and are more geographically dispersed. Furthermore, overall cloud bandwidth is lowered, which improves service quality.

Fuzzy systems, a type of computational intelligence approach (Hussain et al., 2019), (Fatima et.al.,2019). The three technologies are evolutionary computing, swarm intelligence, and artificial neural networks (Siddiqui, et al., 2020). (Khan,et.al.,2019) Like Island GA (Ali, et. al., 2016) and Genetic Algorithm 19 (Khan, et al., 2015), these systems are excellent candidates for use in smart cities, wireless communications, and other areas.

Proposed ID2S-COVID19-DLSystem: A factor analysis model in MATLAB was used to select a suitable machine learning approach. to assess the likelihood of getting cardiovascular illness or to monitor the presence of a large data source. The construction of a continuous glucose tracking device is then suggested using Lab-view software. The origins of data collecting, which are present as simple information, are in the data acquisition layer. The preprocessing layer is the next layer that receives the raw data after that. In the pre-processing layer, the raw data is handled, merged, and normalised. Figure 1 illustrates the usage of two additional layers, the prediction layer and performance assessment layer, in addition to the pre-processing layer and application layer, which were previously used to remove anomalies from the data.

The goal of the current study is to create a decision-support system for the early detection of heart disease using the finest data mining techniques currently available, combining naive Bayes, SVM, simple linear regression, random forest, and artificial neural networks (ANN). The risk of developing heart disease can be assessed using a variety of cardiovascular system characteristics. By a comparison of a few different algorithms using machine learning, it has been found which algorithm is the most successful at detecting and predicting cardiac disease.This algorithm uses the medical parameters as feedback and displays the chance of developing heart disease as an output.

The framework covers the architecture and layout of an Android web-based gadget that uses an efficient machine learning method to identify heart problems. For doctors, patients, and medical students, it may be a highly effective tool for detecting cardiac problems. This algorithm uses the medical parameters as feedback and displays the chance of developing heart disease as an output.

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The patient may check the risk profile of developing cardiovascular disease and input the meeting targets of cardiovascular disease from any location on the internet application utilising this application. Although there are some elements, such the kind of chest pain and activity angina, that must be regularly personality either by the physician and recorded manually on the internet programme, all variables that are not authentic will be attainable throughout the psychiatrist's diagnosis report. Any doctor who is able to register and is connected to heart illness may be located by entering his contact information in the search area. If the programme identifies a deadly condition, the patient can interact with any doctor through video call. The single hidden layer of a feed-forward neural network is being trained using gradient descent optimization.

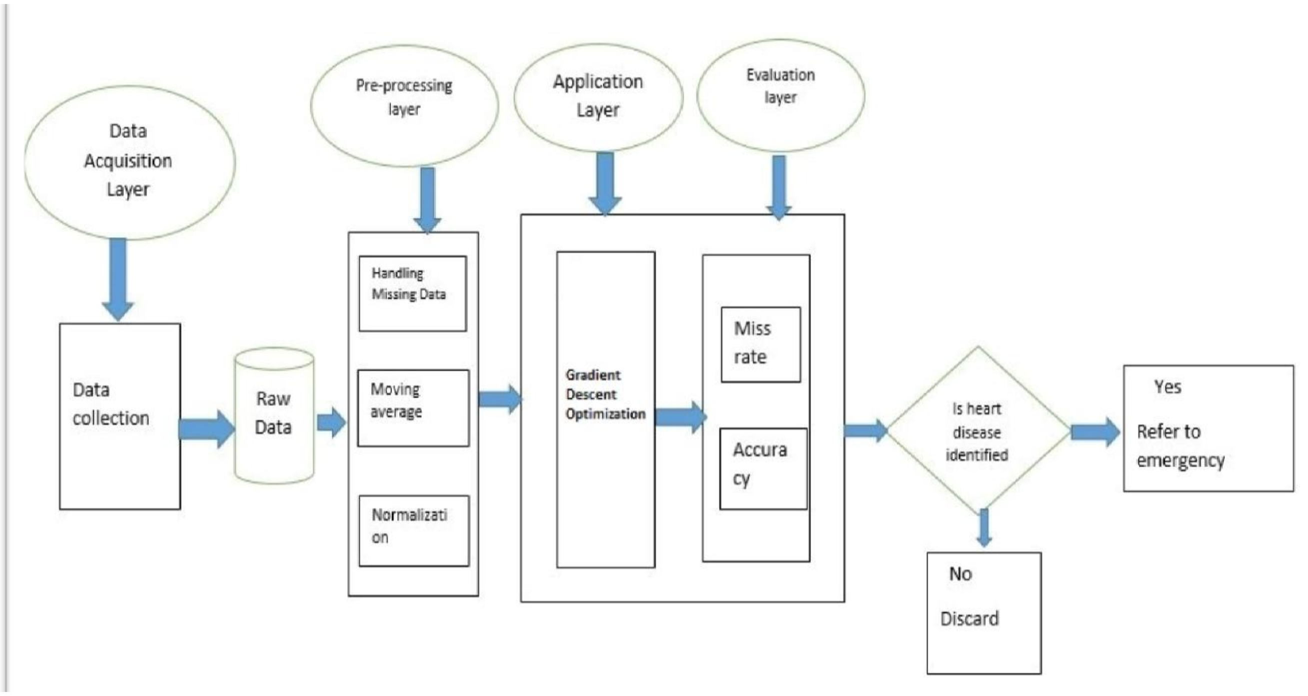

Figure 1:Proposed SDCD-GDOmodel

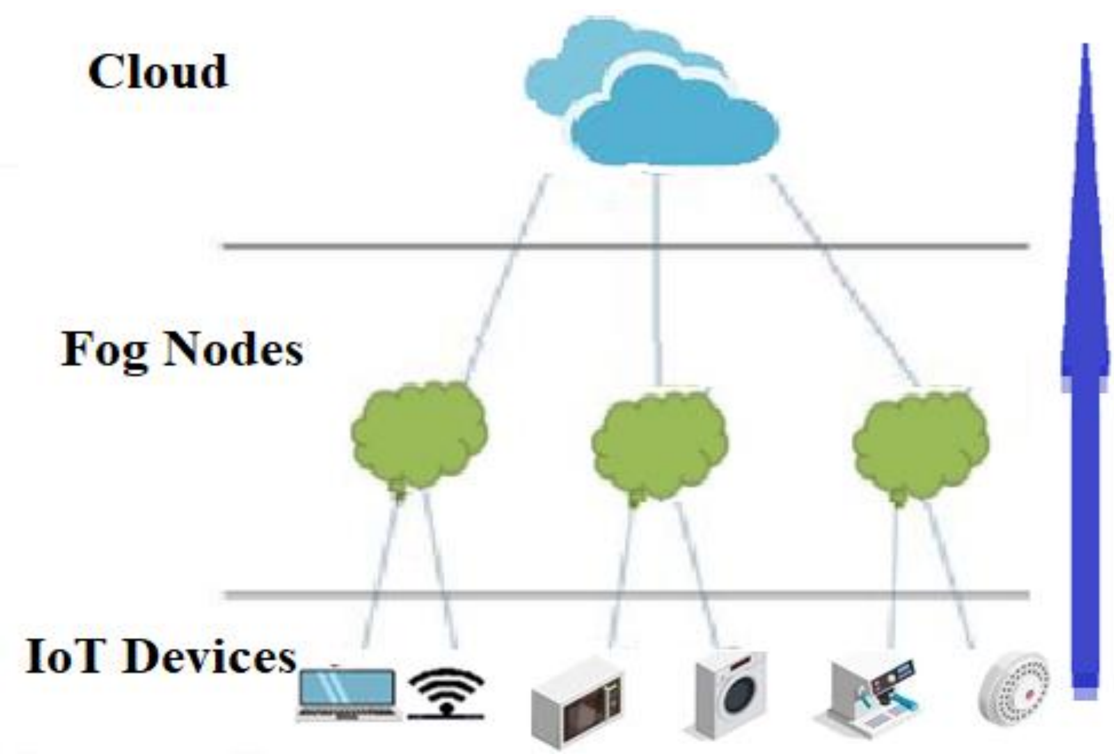

Figure 2:Security of data using fog

In contrast, the gradient descent optimizations automatically allowed for various learning strategies including back-propagation input weights. In iterative mode, GDO modifies the output weights while maintaining the constant input weights. GDO has a quick and effective learning rate. A number of hidden layers feed-forward machine learning tools, including Z records training dataset($¥_m, €_m$). For the mathematical GDO, Eq. (01) presents the input layer, and Eq. (02) represents the output of the first layer:

$$m_i = h_1 + \sum_{j=1}^{n} (\beta_{ji} * z_j) \quad (01)$$

$$\gamma_i = \frac{1}{1+e^{-m_i}}, \text{where } i = 1, 2, 3 \ldots, z. \quad (02)$$

The following is the feedforward propagation for the second layer to the output layer in Eq. (03):

$$m_{lk} = h^n + \sum_{i=1}^{m} (x_{ik} * \gamma_i) \quad (03)$$

The activation feature of the output layer is indicated in Eq. (04):

$$\gamma_{l^n} = \frac{1}{1+e^{-m_l^{n-1}}} \quad \text{where } l = 2,3 \ldots z, \quad (04)$$

$$m_l = h^n + \sum_{i=1}^{m} (x_{jk} * \gamma_i) \text{ Where } n = 1,2,3 \ldots \ldots k. \quad (05)$$

The error in backpropagation is written as follows in Eq. (06):

$$Er = \frac{1}{2}\sum_{l} (\text{expected}_l - \text{calculated}_l)^2, \quad (06)$$

The Mat-lab 2019 tool has the proposed model implemented. The dataset contains 303 samples that are classified through using GDO algorithm. Numerous statistical parameters with accuracy and miss rate are utilized to evaluate the model.These parameters can be expressed as:

$$Accuracy = \frac{truepositive + falsenegative}{totalinstances} \quad (07)$$

$$Missrate = \frac{truenegative + falsepositive}{totalinstances} \quad (08)$$

The results obtained using the SD-CVD-GDO technique are shown in tables 4.1 and 4.2. Table shows the training accuracy of the suggested GDOsystem with hidden layers during the simulation of CVD diagnosis. 4.1. As can be seen from the table, we use 70% of the data (303 samples) for training. Two projected yields—not detect (0) and detect—are included in the proposed model (1). Results of the Not detect (0) and Detect (1) tests indicated that the patient did not have CVD illness. Table 4.1 shows a total of 303 pieces of information, whereas 120 pieces of information were anticipated to be generated.

and130detect.Inthewakeofapplyingatrainingsample on 250 data samples, we get the result of 02 samples wrong detect and 128samples of correct detect. In the wake of contrasting and expected output and result thatgot after applying the proposed methodology, it tends to appear in Table 1. The results of our suggested methods during training are 95.20 percent accurate and 4.80 percent incorrect. While the typical output is 10 not detectable samples and 110 detectable samples, the proposed technique yields 120 not detectable samples.

Table 2 displays the proposed SD-CVD-accuracy GDOsystem's during the validation phase for the prediction of CVD diagnosis. As can be seen from the table, we use 53 samples, or 94.45% of the dataset, for validation. Two anticipatedresults do not detect (0) and detect (1). Not detect (0) results showed that the patient not hasCVD disease and detect (1) results showed the patient have CVD isease. Intable 2 it appearson 53 information tests, the proposed model has expected the output of 29 correctly detected samples and 01 wrongly predicted samples. The expected output of 23 correctly not detectedsamples are 21andwrongly predictedsamples are 02.

Table 1 Decision matrix of Proposed SD-CVD-GDOTraining phase.

Inputs (N = 250)		No. of Instances	Output	
Input	130	Positive	128	02
	120	Negative	10	110

Table 2 Decision matrix of Proposed SD-CVD-GDOvalidation phase

Inputs (N = 53)	No. of Instances		Output	
Input	30	Positive	29	01
	Negative	23	02	21

In this study, it was shown that the optimum values of GDO testing accuracy are greater than those of other system models, whether the maximum or the average. The figure 3 result, which depicts training accuracy and miss rate, is cloned using Mat-Lab devices, and validation is computed.

Data is store in cloud servers and edge devices interact through a layer called fog. It enhances cloud capabilities rather than serving as a full-fledged cloud replacement. By providing computational resources to edge devices, fog works with them. Fog computing addresses the scalability and reliability problems that plague traditional IoT cloud platforms. Fog nodes enhance data security, correctness, consistency, and latency rate.all of which are essential for edge-operating and geographically scattered applications like medical data.

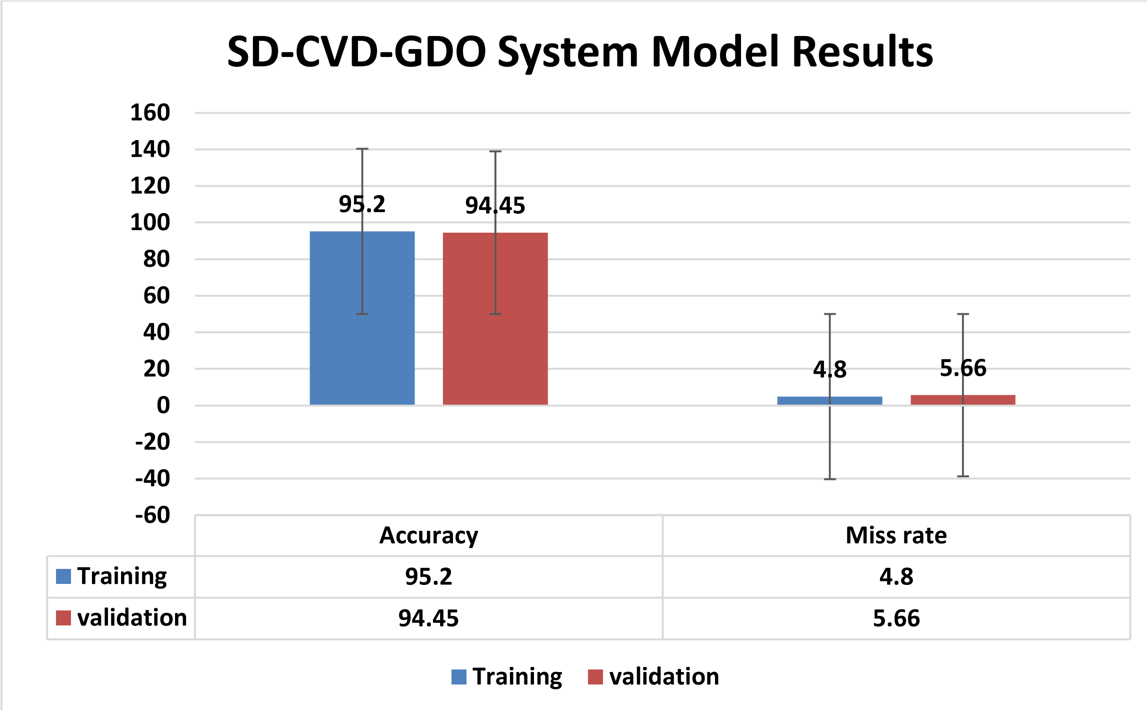

Figure 3: Proposed SD-CVD-GDOsystem model result

Table 3 shows that the proposed DD-CVD-GDO model achieved better accuracy in the validation phase in contrast with existing approaches.

Table 3: Comparison and Performance evaluation of proposed SD-CVD-GDO model

Approaches	Validation	
	Accuracy (%)	Miss rate (%)
Leven-berg-Marquardt	88.23	11.77
Bayesian Regularization	88.32	11.68
Scale Conjugated Gradient	89.40	10.60
Proposed ID2S-COVID19-DL	94.45	4.8

Conclusion: One of the most important applications of machine learning systems is in the identification of heart disease, which has a substantial impact on the lives of millions of people. Massive amounts of data are produced by the medical industry, yet practitioners are unable to efficiently comprehend and use it. GDO is exceptional at managing challenging medical tasks and making inferences from data. Gradient descent optimization has become a more dependable and efficient method in a number of medical circumstances, including as diagnosis, likelihood, and intervention. In the representation learning method known as gradient descent optimization, layers are utilised to modify the data to highlight hierarchical structures and linkages.

The advantages and drawbacks of employing GDO to treat cardiovascular disease, which are also generally relevant in medicine, while suggesting certain recommendations as the most practical for clinical application. In this study, heart disease is modelled using real-time information and the GDO. The suggested approach offers improved performance with effective precision when compared to existing Leven-berg Marquardt models, Bayesian regularisation, and scaled conjugate gradient algorithms. The suggested GDOmodel results show that this architecture is more accurate than existing methods in assessing heart disease, with training phase accuracy of 95.20% and validation phase accuracy of 94.45%.

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