Chimp Optimization Algorithm based Recurrent Neural Network for Smart Health Care System in Edge computing based IoMT

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Abstract – The Internet of Medical Things (IoMT) and Artificial Intelligence (AI) have changed the traditional healthcare scheme to an intelligent system. The data are produced continuously by millions of devices and sensors, exchanging important messages through supporting network devices that monitor and control the smart-world infrastructures. While compared with cloud computing, the data storage or computation are migrated to the network (near end users) by edge computing. Therefore, edge computing is highly required to satisfy intelligent healthcare systems' requirements. However, the confluence of IoMT and AI opens up new potential in the healthcare sector. The main objective of this paper is to create a disease detection model for heart disease utilizing AI approaches. The given model includes many phases, including data gathering, preprocessing for detection of outliers, classification of disease, and weight parameter adjustment. Initially, the Correlation Based Feature Selector (CFS) approach is used in this study to exclude outliers. Then, the research work employs a Chimp Optimization Algorithm (ChOA)-based Recurrent Neural Network (RNN) model for illness diagnosis. ChOA is to fine-tune the 'weights' parameters of the RNN model to categorize medical data better. During the testing, the given ChOA -RNN model achieved extreme accuracies of 96.16 percent in identifying heart disease. As a result, the suggested model may be used as a suitable illness analysis tool for intelligent healthcare systems.

Keywords – Artificial Intelligence, Chimp Optimization Algorithm, Correlation Based Feature Selector, Health Care System, Internet of Medical Things, Recurrent Neural Network.

I. INTRODUCTION

The healthcare industry has been using IT to develop innovative apps and improve diagnosis and treatment in recent years. The principal entity generating enormous volumes of digital data [1] are advanced techniques and scientific ideas. Advanced clinical applications follow the information technology which has recently been established. Advanced medical treatment is also considered simpler, more elegant, and task-able [2]. This amendment included an expansion of clinical models (from illnesses to patient care), changes in computerization development, an increase in clinical management, and variations in anticipation and treatment (shift from disease treatment to prevention) [3]. Therefore, the following amendments concentrate on fulfilling the individual's fundamental needs to improve the competence of healthcare, which will increase the knowledge of the health services and imply the future use of intelligent medicine [4-5].

The aim is to build a new idea, termed the Internet of Medical Things (IoMT)[6], by extensive distribution and deployment of efficiently integrated hardware and sophisticated medical sensors in unparalleled health care. It changes the healthcare process and sum of medical devices using IoMT in the future[7]. The data, gathered by mobile, ingestible, and included sensors and usage patterns of devices, can follow user habits[8] by the researcher. Furthermore, machine learning (ML) and deep learning approaches can reveal their medical status [9]. This is possible in particular.

DL is seen as an artificial intelligence branch. Since medical data are digitized, DL plays a vital part in diagnosing numerous diseases such as cancer. Researchers in the past decade has studied multiple approaches to machine learning in the medical system. These techniques act as (a) a segmentation and (b) a malignant classification of the segmented abnormality[10]. Both phased processes can thus be seen as supervised classification, first by classifying each voxel or pixel by identifying it as suspicious or not, secondly by allowing the detected/segmented abnormalities to be further analyzed or quantified and ultimately classified as hazardous or not. Thus, the IoMT is a whole network of networks enabled by innovation. Furthermore, since IoMT brings everything related to the web, this related group offers new chances to progress assembly, agriculture, economics, and therapeutic management across the board [11-13].

A new concept for intelligent healthcare systems for AI and IoMT-based illness diagnostics is presented in the current research. The goal is to construct an AI- and IoMT-convergence diagnostic model for diagnosing cardiac disease. The model includes some steps, such as the collection, preprocessing, classification, and adjustment of parameters. Data acquisition procedure is performed on IoMT devices such as wearables and sensors, while AI approaches procedure this data to diagnose the ailment. The RNN model is employed as the final prediction classifier, where ChOA is used to optimize the RNN weights.

This is the rest of the paper: Section 2 displays its disadvantages to the workings of the existing methodologies. Section 3 describes the methods presented. Section 4 defines validations of the suggested technique concerning various parameters in various scenarios. Finally, Section 5 will conclude the research effort's conclusion with its future work.

II. RELATED WORKS

Additional sensors for motion tracking were also used in the study previously conducted [14] to investigate the use of the movement forecast by using two classifiers as SVM and RF. The examination of ML-edge techniques simulates some of the models recently created for conducting biological data analyses in transportable sensors. However, the abnormalities of physical variables in terms of the scheming structure of borders are problems. There are problems. The study included the distribution of HTM. The model was applied at edge nodes and used for the deduction.

In the context of daily surveillance and illness prevention, in [15] suggested a ViSiBiD prediction model for evaluating patients' vital signs. For the learning of the cloud platform, the machine learning technique and specific map reduction implementation have been employed. They analyzed the publicly accessible patient data collection of 4893 and noticed that six bio-signals diverged from typical and various data observation aspects. In intervals 1-2 hours, data events are collected. Their results demonstrate that random forests are equally accurate as other techniques at 95.85 percent.

The Coronary Artery Disease approach (CAD) presented by [16] is based on K-means risk factor detection algorithms. They used different learning techniques such as MLP, Fuzzy Unordered Induction Algorithm for Rules, MLR, and C4.5 for data extraction. Data are acquired from Indira Gandhi Medical College, Cardiology Department, Shimla, India. There are 26 characteristics and 335 instances in this dataset. The findings from experiments suggest that MLR attained 88.4 percent of best accuracy.

The [17] projected a drop forecast solution based on the edge approach LSTM RNN. A case training on EEG data defined the performance of the Multi-Access Edge Computing approach. The developers expected the main tasks to be performed from the edge side, and the application requirements could be met. Current classification methods such as RF, NB, kNN, and classifying or regressing trees were compared to the accuracy of the results.

In [18] have established a novel cancer forecast system based on statistical learning. The technique can be used in binary and multi-class situations. In high dimensional space, the SVM technology develops a big hyperplane, maximizing the distortion among data facts, and supporting vectors are employed to generate hyperplane. The SVM delivers greater precision but is time-consuming.

III. PROPOSED SYSTEM

The approach provided is successful about previous wireless communications, and users in external movement consume low power and high freedom of action. Furthermore, this strategy uses small and lightweight IoMT devices that are easy to operate. Smartphones, wristbands, smartwatches, and so on are such IoMT devices. The implanted sensors can be used to guess and distinguish between normal and abnormal heart rates using sophisticated calculations. Intelligent devices such as cellphones, which may also be transported anywhere in pockets, are included in the themes. These data can also be used to identify the results of their everyday lifestyle. When Bluetooth communications receive data, smartphones treat data and classify it as healthy or unhealthy. Diabetes prognosis and efficient heart rate are carried out on the android platform. Initially, IoMT devices collect and process patients' data in a suitable format before processing them. Pre-processing consists of a few phases, including data processing, conversions of formats, and class labeling. In the case of patient data, the CFS technology is used to remove outliers. The ChOA-RNN ideal categorizes the data into the disease's existence and nonexistence.

Correlation Based Feature Selector (CFS)

The quality of the functional subsets is evaluated according to statistical measurements as assessment criteria through a filtering process. In DL, one of the selecting functions can be accomplished based on the correlation between the functions, and such a technique of selecting features can be effective for standard DL procedures. A characteristic is advantageous if it conforms to anticipates that class [19]. A distinguishing feature (X_i) is detected to be relevant if and y such that $P(X_i = x_i) > 0$ as in Equ. (1)

$$P(\gamma = y|X_i = x_i) \neq P(\gamma = y) \quad (1)$$

Experimental evidence from the literature for feature selection shows that extraneous features must be deleted in addition to inconsequential characteristics. If it is highly connected with one or more other features, one feature is considered as redundant. **Fig 1** shows the system model developed in this research study.

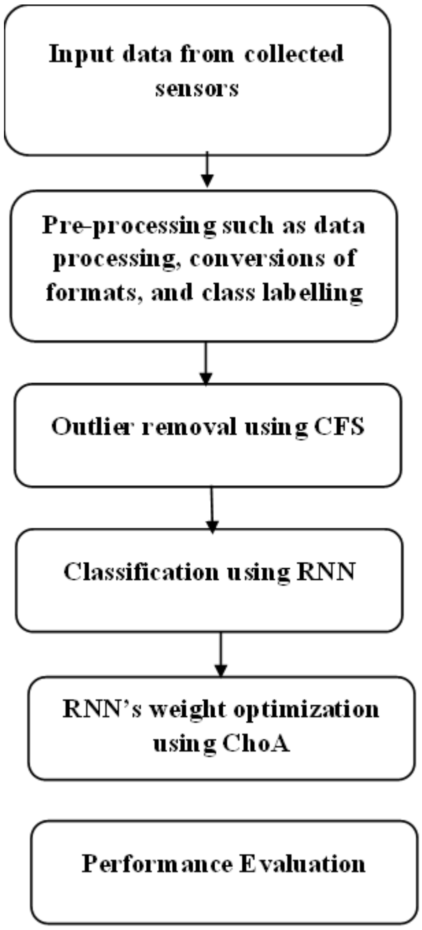

Fig 1. Proposed System Model.

If the association between each characteristic and an external variable is recognized and the interaction between each other pair of the characteristics is given, then an equation may be defined as an link among the difficult test consisting of entire characteristics and the extrinsic variable (2),

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})}{\sqrt{\sum_{i=1}^{n}(x_i-\bar{x})^2 \sqrt{\sum_{i=1}^{n}(y_i-\bar{y})^2}}} \quad (2)$$

The equation above defines the coefficient of Pearson. Where xi and x define the perceived and regular values of the functions taken into account. The average values of the data set class observed and yi are defined. If you've chosen a group of n characteristics, you can use the correlation coefficient to examine the link between the group and the class, including the interrelation of the characteristics. With the link between features and classes, the importance of the functional group increases. It also decreases with an increasing interrelationship. The literature on decision-making and overall estimates has investigated these thoughts [20]. Defining coefficient between the features and output variables correlation as $r_{ny} = p(X_n, Y)$ and the aggregate among varying features as $r_{nn} = p(X_n, X_n)$.

$$J(X_n, Y) = \frac{nr_{ny}}{\sqrt{n+(n-1)r_{nn}}} \quad (3)$$

This illustrates that the combination of a set and an exterior feature represents the entire sum of characteristics of the separate group. The equation got from [21] is derived by normalizing all variables from the Pearson correlation coefficient. The algorithm for selecting correlations was used so that only one character could be added or deleted simultaneously [22].

The following results are predicted for the functional importance based on correlation-based filtering:

- The lesser the interrelation between the individual and the extrinsic variable, the lesser the correlation between the grouping variable and the extrinsic.
- It is clear to eliminate the superfluous features from the dataset for an efficient prediction. If another feature controls an existing prediction capability, it can be safely deleted.

In addition, the decreased feature-set achieved is fed into the following prediction process to enhance the system's forecasting performance.

Formulation of RNN

Here, RNN is used to predict the disease, and the weighting parameter of RNN is optimized by using ChOA, which is described as follows. **Fig 2** displays the architecture of the RNN model.

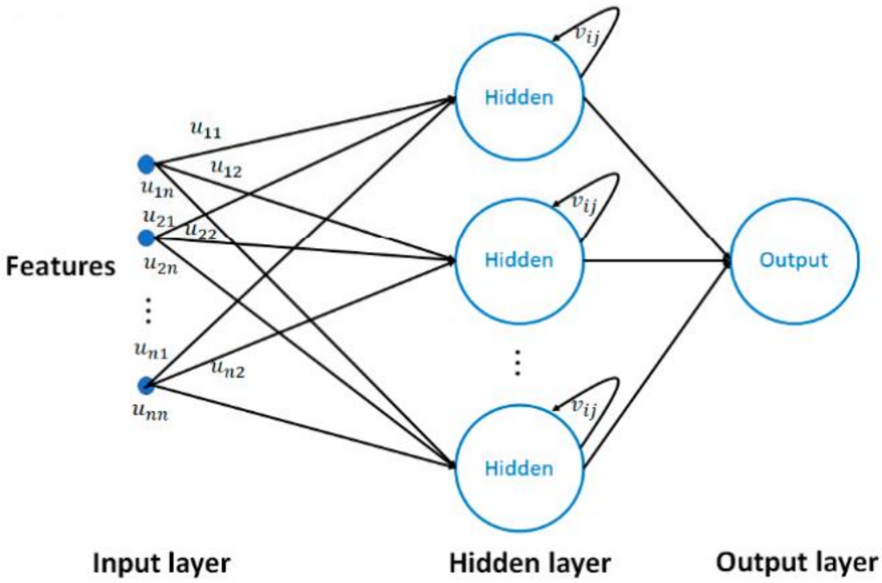

Fig 2. Architecture of the RNN.

To generate information output for the current time, RNN Architecture relies on prior information (t-1). A conventional Elman network with three layers is used. The input is transmitted with learning to the buried level. The prior facts of the remote unit is retained in the context unit. The wording is provided:

$$h_t = \varphi_h(\mathcal{U}_{in}x_t + V_h h_{t-1} + b_h) \tag{4}$$

$$y_t = \varphi_y(W_{out}h_t + b_y) \tag{5}$$

When in former times and present times, h_{t-1} and h_t are the vectors for the hidden layer; φ_h and φ_y are the hidden layer and output layer activation functions, respectively; $\mathcal{U}_{in}$ is an input/hidden layer matrix; V_{in} is an input/hidden layer weight matrix; b h and b (y) are vector for biases in the hidden and output layers.

The vectors h (t-1) and h t for the previous and current hidden layer are; ·¨h and¨y are indicated for both the hidden and the output layers. The matrix of weight between the entrance and the hidden layers is marked U_{in}whereas V_{in}in is marked as the matrixt between the hidden layers. In both the hidden and the output layers b_h and b_y are bias vectors.

The slow-convergence rate may be affected by traditional functions such as sigmoid, tanh, and rectified linear (ReL U) and other nonlinear functions, such as power-sigmoid and bipolar-sigmoid activation functions for RNN implementation. Therefore, the wording is defined as:

The Activation Function of Power-Sigmoid

$$\varphi(x) = \begin{cases} \frac{(1-e^{-\varepsilon x})(1-e^{-\varepsilon})}{(1-e^{-\varepsilon})(1+e^{-\varepsilon x})} & |x| < 1 \\ x^a & |x| \geq 1 \end{cases} \tag{6}$$

Where $\varepsilon > 2$ and $a \geq 3$.

The Activation Function of Bipolar-Sigmoid

$$\varphi(x) = \frac{(1-e^{-\varepsilon x})}{(1+e^{-\varepsilon x})} \tag{7}$$

Where $\varepsilon > 2$, $\mathcal{U}_{in}$ Is the weight matrix is optimized with the aid of proposed optimization.

An Algorithm with The Purpose of Maximizing Overall The Chimpanzees

Despite the fact that the chimpanzee colony is a civilization that combines components of both fission and fusion, both processes are present in the colony. The members of this kind of civilization wander around in the environment, and the grouping or size of the colony shifts throughout the course of time. This sort of civilization comes from the ancient world. One of the traits that sets this form of civilization apart from others is the presence of this kind of civilization. Those chimpanzees that reside in fusion colonies are subject to a dynamic process that determines the individuals who are a part of their groups. The distribution of members among their groups is the responsibility of this process. The autonomous group concept is offered in light of these problems. Each chimp group tries to find the search space separately using this technique. Chimpanzees are not identical to each group for skill and intelligence, but they all do their obligations as colony members. In a particular situation, the ability of any person can be valuable.

Four types of chimpanzees are called drivers, barriers, chasers, and attackers in a chimpanzee colony. All have different skills, yet for successful pursuits, these diversities are essential. Drivers pursue the beast without trying to catch it. Barriers are placed in a tree to construct a dam through the prey's path. Chasers chance to catch up quickly after the prey. Finally, the assailants forecast the prey breaking out into the lower canopy or into the path to inflict it (the prey). Attackers are considered to need considerably more cognitive efforts to predict the following movement of the prey, which is why they get compensated for successful cassation with more flesh. This key job (attack) is strongly correlated with age, intelligence, and physical skill. In addition, during the same hunt, chimpanzees can shift roles or do their identical duties throughout the entire process.

It has been demonstrated that chimpanzees are searching for meat that may be traded for socially valued items, such as support for coalitions, sex, or toiletries. Chimpanzees are also known to forage for food. The findings of the research have demonstrated this. The conclusion that can be drawn from this is that intelligence has the ability to have an effect on hunting that was not something that was anticipated. The reason for this is the explanation that was provided previously in the sentence. To be more specific, this is due to the fact that intelligence makes it possible to establish a new field of privilege possibilities. This is the reason why situations are the way they are. Because chimpanzees were the only species for whom it was hypothesized that this "social incentive" existed, the only species for which it was hypothesized that it occurred was chimpanzees. No other species was considered. This particular species was the only one for which it was theorized that it existed, that is, according to the knowledge that we have right now. During the course of the research, conjecture concerning the existence of chimpanzees was another issue that was the subject of the investigation. When this is taken into consideration, the chimpanzee and other social predators would be seen to be a fundamental differentiation, and the cognitive capacity of the individual would be the decisive factor in this regard. The decision on this fundamental distinction would be made by the chimpanzee, which would be the one responsible for making the ultimate choice. The situation would be like that. When chimpanzees are approaching close to the finish of the hunting process, they begin engaging in a behavior that might be defined as chaotic. This activity is characterized by aggressive conduct. One of the characteristics of this activity is that it is not consistent. In contrast to other activities, this one is distinguished by the manner in which the chimpanzees behave. It is carried out in this manner with the objective of pushing all of the Chimpanzees to forget their particular responsibilities and instead get preoccupied with the process of collecting meat. When hunting chimpanzees, there are typically two primary periods that are separate from one another. These phases are distinct from one another. In this context, the stages that are being implemented are referred to as the approach. The assault on the prey is the focus of these phases, which are referred to as "exploration" and "exploitation," respectively. These activities are collectively referred to as "exploration." The mathematical expressions of each and every one of these ChOA principles are presented in the following section of the article.

Both The Algorithm and The Ideal Number are Important Concepts in The Realm of Mathematics

The mathematical prototypes of self-determining groups, driving, blocking, chasing, and attacking are presented in this section of the article. Every single one of these is an example of a mathematical operation. After that, the ChOA algorithm that corresponds to the one that came before it is described. This comes after the previous one.

1) An approach to hunting that entails pursuing and pursuing the animal in order to capture it

In accordance with what was mentioned earlier in the sentence, the process of hunting the prey is carried out throughout the many stages of the process of exploitation. All the way through the procedure, this is something that happens. In order to offer equations (8) and (9), which will be used to model the activity mentioned above, the purpose of this article is to provide equations that will be used to statistically model the process of driving and pursuing the prey.

$$d = |c.X_{prey}(t) - m.X_{chimp}(t)| \tag{8}$$

$$X_{chimp}(t+1) = X_{chimp}(t) - a.d \quad (9)$$

Where t designates the sum of present iteration, $a, m,$ and c are the constant vectors, X_{prey} is represented as the vector of prey location and X_{chimp} is represented as the position vector of a chimp. **a**, **m**, and **c** vectors are considered by the Eq.s (10), (11), and (12), respectively

$$a = 2.f.r_1 - f \quad (10)$$

$$c = 2.r_2 \quad (11)$$

$$m = Chaotic\_value \quad (12)$$

Because of the iteration process, this is decreased in a nonlinear way from 2.5 to 0. Consequently, this is the outcome of the reduction. The random vectors of r1 and r2 are contained inside the range of intervals that is denoted by the notation [0,1]. This range of intervals contains the random vectors.

To add insult to injury, m is a chaotic vector that is derived from a separate chaotic map. This is the final point, but it is certainly not the least important. This vector, which captures the effect, takes into consideration the impact that the sexual urge of chimpanzees has on the process of hunting. It does so by capturing the effect. Every particle has a comparable action in both local and global research when it comes to the standard population-based optimization technique. All of these actions are carried out simultaneously. Within the confines of the methodology, this is the situation that exists. It is because of this that it is possible to view personalities as a separate category that adheres to a similar search policy. On the other hand, in theory, it is possible to use a number of distinct independent groups that all have the same objective in order to achieve a straight and random search outcome in each population-based optimization method at the same time. This is something that is doable. This is actually something that can be accomplished. An example of a mathematical modeling of autonomous chimpanzee groups is presented in the following graphic. This modeling takes use of a variety of different updating processes. It is possible to create alterations to the independent groupings by utilizing each and every one of the continuous functions that are given. In order to bring the value of f down to a more manageable level, it is essential to select these functions at each and every iteration.

These four distinct groups are conducting their search for the issue region, and each of them is applying their own distinctive patterns, both locally and globally. Additionally, there are two distinct varieties of ChOA, which are referred to as ChOA1 and ChOA2, and each of these variants includes their own unique set of liberated groups. These versions were selected from a broad variety of strategies that were investigated in order to reach the best possible results and maximize the benchmark. All of these strategies were investigated in order to achieve the best possible outcomes.

2) This is the Exploitation Phase, which is the Attacking Methodification.

Both of these methods are intended to correctly imitate the behavior of chimpanzees, and they are as follows: The capacity to examine and encircle their target is a skill that chimpanzees possess. They can do this by driving, obstructing, and chasing after their prey. The process of hunting often entails the utilization of chimpanzees as a mode of transportation through the forest. A sport that is occasionally played by drivers, barriers, and chasers is hunting. Hunting is a sport that is played occasionally. One of the most disappointing aspects of an abstract search area (prey) is that it does not include any information about the best possible location. It is hoped that the first assailant or assailants, the driver, the barrier, and the chaser will have a better grasp of the approximate location of possible prey in order to statistically replicate the behavior of the chimpanzee. This will allow for the simulation of the behavior of the chimpanzee on a statistical level. Furthermore, the other chimpanzees are urged to enhance their position to that of the best chimpanzees. As a consequence of this, four of the most remarkable solutions that are currently available are kept. In order to solve equations (13), (14), and the connection, there is an expression (15) that can be used.

$$\begin{gathered} d_{attacker} = |c_1 X_{attacker} - m_1 X|, d_{Barrier} = |c_2 X_{Barrier} - m_2 X| \\ d_{chaser} = |c_3 X_{chaser} - m_3 X|, d_{driver} = |c_4 X_{driver} - m_4 X|, \end{gathered} \quad (13)$$

$$\begin{gathered} X_1 = X_{Attacker} - a_1(d_{attacker}), X_2 = X_{Barrier} - a_2(d_{Barrier}) \\ X_3 = X_{chaser} - a_3(d_{chaser}), X_4 = X_{driver} - a_4(d_{driver}) \end{gathered} \quad (14)$$

$$X(t+1) = \frac{X_1 + X_2 + X_3 + X_4}{4} \quad (15)$$

The final location is a circle that is randomly set within the circle, and the position of the assailant, the obstruction, the chaser, and the driver all combined to decide this location is what determines the ultimate location. Observation is possible at this site. To put it another way, the four groups that are able to make the most accurate predictions are the ones that are able to detect the location of the prey. Additionally, the chimps will occasionally modify their positions dependent on how close they are to the prey.

3) Invading the Prey (Application of Utilization)

At the very end of the process, the chimpanzees launch an attack on the animal, which results in the conclusion of the hunt when the prey stops moving. As was mentioned earlier, etc. In order to provide a more true representation of the process of attacking, it is suggested that the value of f be decreased. I would like to bring to your attention the fact that the range of feasible permutations of an is likewise limited by f. To put it another way, the value of an is a random variable that falls between the range of [-2f,2f], however in the iterations, in f, the value decreases from 2.5 to 0; this is due to the fact that the random values of a chimpanzee lie within the range of [-1,1].

The ChOA provides chimpanzees with the opportunity to update their positions based on the position of the assailant, barrier, chaser, and driving chimpanzees. Additionally, it provides them with the ability to attack the prey in accordance with those who have already been shown to them. The fact that ChOAs may still be at risk of getting trapped in local minimum conditions does not change the fact that it is vital for other operators to take precautions in order to prevent this problem from occurring. It is necessary for ChOA to have extra operators in order to place an emphasis on exploration, despite the fact that the proposed mechanism of drive, blocking, and pursue displays a process of exploration in some form.

4) During the course of the search, looking for Pray is being done

As was said before, chimpanzees are considered to be the principal subject of inquiry due to the fact that they play the function of an attacker, barrier, chaser, and chimpanzee. In contrast to when you contribute to the assault on the beast, you are a different person while you are looking for the beast. Utilizing the vector with a random value that is either more than 1 or less than -1 is done so with the intention of statistically describing the behavior of variety. It is done in this manner in order to guarantee that research agents are driven to diverge and differentiate themselves from projections. This protocol not only demonstrates the method for scanning, but it also makes it possible for the ChOA to perform scans on a global scale.

The value of the variable c is yet another aspect of the ChOA that has an effect on the investigation phase of the process. In a manner analogous to that of Equation (11) the c vector elements are represented by a random variable set to [0,2]. In Equation 16, the random weights that are provided by this component are utilized in the evaluation of distance. The objective of this evaluation is to either increase (c>1) or decrease (c<1) the distance (12). In addition to this, over the course of the optimization phase, ChOA is able to enhance its stochastic behavior, which, in turn, reduces the possibility that local trapping would take place. Not just in the early iterations but also in the final iterations, c is required continuously for the purpose of generating random values and carrying out the exploration process. This requirements are in place throughout the duration of the exploration process. This particular component is advantageous, particularly in the final iterations of the process, because it helps to avoid local limitations. You might alternatively view the C vector as the influence of impediments on the manner that chimpanzees approach their prey. This is another possible interpretation of the C vector.

5) Social Incentive

As previously mentioned, acquiring social incentives (sex and care) in the third step leads chimps to relieve their hunting obligations. They, therefore, try to get meat that is chaotic forcibly. Primate species are able to mitigate the difficulties that are connected with sluggish convergence and the trapping of two local optimal solutions together by utilizing this chaotic behavior in the last phase of the process.

We assume that 50 percent is likely to select either a regular update location mechanism or a chaotic model to appraise the chimpanzee position during optimization to design this simultaneous behavior. Eq. (16) expresses the mathematical model.

$$X_{chip}(t+1) = \begin{cases} X_{prey}(t) - a.d & if\ \mu < 0.5 \\ Chatic_{value} & if\ \mu > 0.5 \end{cases} \tag{16}$$

Where μ is a random number in [0,1].

The first step is to give the stakeholders the privileges to use the health care system in hospitals, application industries, or medical firms. Healthcare information is susceptible; consequently, user privacy will be safeguarded at this level with the help of the healthcare security layer.

The safety layer of healthcare plays a crucial function in invalidating the exact use of pre-determined regulations for admissions. An IoMT broker can either allow or refuse access to cloud system data. The following layer will be mapped with registered and authenticated requests. Anomaly detection and data protection ensure data security and privacy [28]. However, wearable gadgets' IoMT information is exposed to multiple threats. Therefore, a privacy safeguard mechanism must be used to deal with these threats and avoid alteration or deletion of data. This document does not take these mechanisms into account. The proposed framing includes security of physical connections, communication protection, protection of information fluxes, cryptographic protection, authentication, security of healthcare devices, monitoring of healthcare devices, and threat analysis modules to stop malicious attacks, viruses, and any other matters that could affect user confidence.

The safety module of the healthcare device guarantees the integrity of the wearable device by confirming the necessary settings. These settings regulate distinct device security policies and update the known vulnerabilities structure as required.

The module for monitoring health care devices maintains continuous monitoring of wearable IoMT devices. The monitoring process consists of integrity controls, denial of service operations, and the detection of malicious use. The management of the security of the physical connection module is the responsibility of attacks that occur within the physical connection layer. The Communication Protection Module encrypts the data that is transported between the devices, fog nodes, and the cloud system. This is accomplished through the employment of defined protocols and technology that is designed to safeguard borders. The cryptographic defense module is responsible for continuously monitoring any and all modifications made to the modules that came before it. It is also accountable for the administration of security regulations for all communication lines, which includes the setup of firewalls and the settings for communication that are protected by passwords. In addition, it is responsible for security laws. As a final step, but certainly not the least important, the Threat Analysis Module is responsible for conducting investigations into improper activity by looking for potentially dangerous patterns that could lead to system crashes. Following the observation of normal behavior, the system will next develop a rule-based collection that will contain particular examples of abnormal behavior. This will determine whether or not the system has detected any unusual behavior.

IV. RESULTS AND DISCUSSION

The model given here was built in a PC with the following specifications: Processor - i5-8600k, 16GB RAM, and 1TB HDD. The experiments were conducted to appraise the projected model's performance using different measures, deliberated in the following subsection.

Performance Measures

To evaluate the proposed methodology, performance is an analysis by using sensitivity, specificity, and accuracy. Below **Table 1** shows the performance analysis of the proposed method with a comparison of different sigmoid Activation based RNN techniques, such as Normal bipolar-sigmoid Activation based RNN, Normal power-sigmoid Activation based RNN, Weighted bipolar-sigmoid Activation based RNN, and weighted power-sigmoid Activation based RNN. By these different function, performance are measured at different instance. **Fig 3** shows graphical representation of different sigmoid activation function based rnn with number of instances in terms of sensitivity and **Fig 4** shows graphical representation of different sigmoid activation function based rnn with number of instances in terms of specificity. **Fig 5** shows graphical representation of different sigmoid activation function based rnn with number of instances in terms of accuracy.

Table 1. Comparison of Different Sigmoid Activation Function Based RNN Performance

Sensitivity (%)				
Number of Instance	**Normal bipolar-sigmoid Activation based RNN**	**Normal power-sigmoid Activation based RNN**	**Weighted bipolar-sigmoid Activation based RNN**	**Weighted power-sigmoid Activation based RNN**
100	87.90	92.60	93.30	94.80
200	84.60	88.40	92.30	95.20
300	86.40	93.20	93.60	96.30
400	88.60	92.40	96.90	97.60
500	89.10	93.60	96.00	98.00
Specificity (%)				
100	83.40	84.20	92.60	94.70
200	83.60	86.10	91.20	96.80
300	86.90	87.30	92.40	95.00
400	82.10	88.30	88.60	91.20
500	86.40	89.30	90.40	93.80
Accuracy (%)				
100	76.80	89.40	91.60	95.10
200	78.60	91.30	92.40	95.90
300	77.80	87.60	90.40	95.30
400	80.10	86.40	93.20	97.10
500	82.40	86.30	92.80	97.40

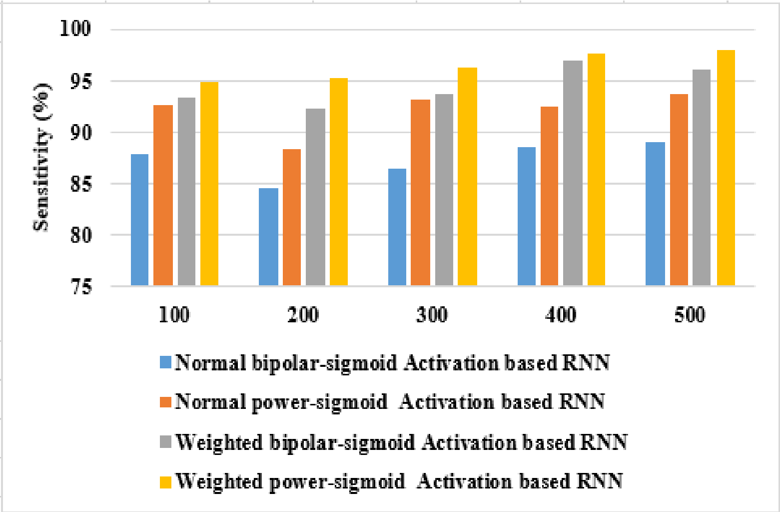

Fig 3. Graphical Representation of Different Sigmoid Activation Function Based RNN With Number of Instances in Terms of Sensitivity.

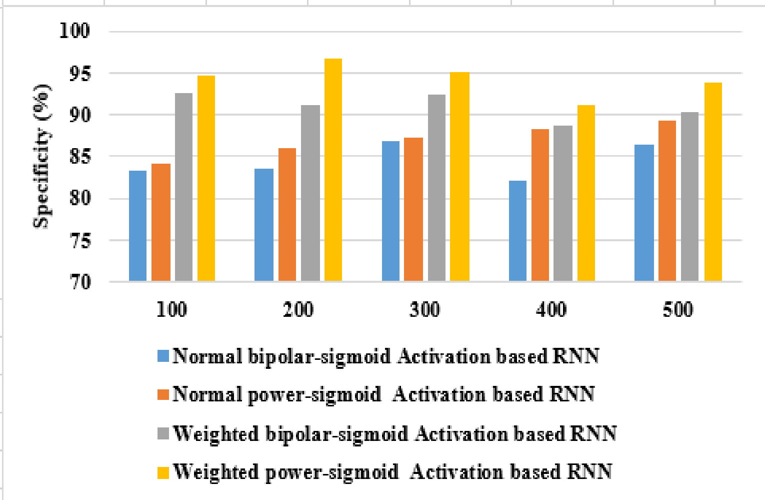

Fig 4. Graphical Representation of Different Sigmoid Activation Function Based RNN With Number of Instances in Terms of Specificity.

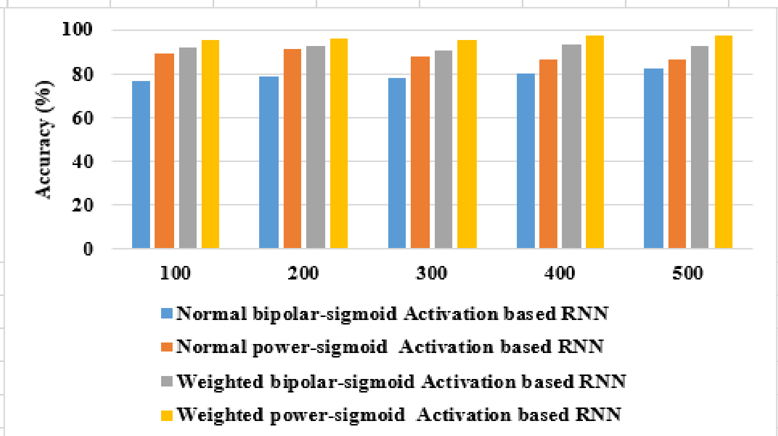

Fig 5. Graphical Representation of Different Sigmoid Activation Function Based RNN with Number of Instances in Terms of Accuracy.

Table 2 and **Fig 6** represent the performance of the projected model with average performance measures of three metrics as Sensitivity, specificity, and Accuracy.

Table 2. Average Performance Analysis of Different Sigmoid Activation Function

Measurements	Normal bipolar-sigmoid Activation based RNN	Normal power-sigmoid Activation based RNN	Weighted bipolar-sigmoid Activation based RNN	Weighted power-sigmoid Activation based RNN
Sensitivity (%)	92.04	92.04	94.42	96.38
Specificity (%)	87.04	87.04	91.04	94.30
Accuracy (%)	88.80	88.80	92.08	96.16

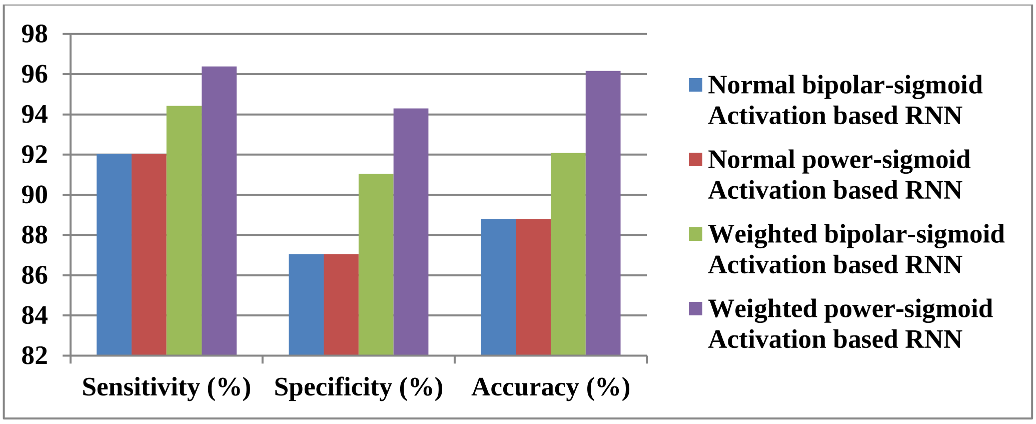

Fig 6. Graphical Representation of Different Sigmoid Activation Function Based RNN Performance.

In Normal bipolar-sigmoid Activation based RNN scheme achieved the sensitivity of 92.04%, specificity of 87.04%, and accuracy of 88.80%. However, Normal power-sigmoid Activation based RNN achieved the same performance as Normal bipolar-sigmoid Activation based RNN. As a result, weighted bipolar-sigmoid Activation-based RNN achieved an accuracy of 92.08% and a sensitivity of 94.42%. Finally, the Weighted power-sigmoid Activation based RNN achieved the specificity of 94.30%, sensitivity of 96.38%, and accuracy of 96.16%, respectively.

V. CONCLUSION

In information technology, intelligent and connected healthcare, the IoMT has made it possible to operate numerous applications. By analyzing past data to predict future problems using prescription analytics. This will enable us to shift from reactive to visionary by quickly identifying patterns and making approvals on behalf of the actual supplier of medical services. A powerful AI and IoMT merging diagnosis ideal for intelligent healthcare systems have been established in recent studies. The model described covers many stages, including data collecting, preprocessing, classification, and tweaking for weight parameters. Data collected by IoMT devices, such as wearables and sensors, are used by AI approaches to diagnose disease. Afterward, the CFS technique is used to remove outliers in the patient information. The ChOA-RNN model is then used to classify the data whether or not the sickness occurs. Furthermore, ChOA is used to optimize the RNN model's weight parameter. Thus, the use of ChOA helps improve the diagnostic result of the RNN model. ChOA-RNN model performance with healthcare data was validated. The ChOA-RNN model achieved a maximum precision of 96.16% and 96.38% in the diagnostic test, respectively, of the sensitivity of heart disease. This determines the efficiency of the model offered. In the future, the achievement can be improved by adopting strategies for feature selection that lower the dimensionality and computer complexity curse. In addition, many forms of disease data such as Parkinson's, diabetes, breast cancer etc., can be used to test the suggested model.

CRediT Author Statement

The authors confirm contribution to the paper as follows:

Conceptualization: Yejnakshari Meghana K, Yellina Sri Bhargav, Radhika N, Uma Jothi, Radhika G and Mahaveerakannan R; **Methodology:** Yejnakshari Meghana K, Yellina Sri Bhargav; **Software:** Yejnakshari Meghana K, Yellina Sri Bhargav; **Writing- Original Draft Preparation:** Yejnakshari Meghana K, Yellina Sri Bhargav, Radhika N, Uma Jothi, Radhika G and Mahaveerakannan R; **Visualization:** Uma Jothi, Radhika G and Mahaveerakannan R; **Validation:** Yejnakshari Meghana K, Yellina Sri Bhargav, Radhika N, Uma Jothi, Radhika G and Mahaveerakannan R; All authors reviewed the results and approved the final version of the manuscript.

Data Availability
No data was used to support this study.

Conflicts of Interests
The author(s) declare(s) that they have no conflicts of interest.

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Competing Interests
There are no competing interests

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