EMPLOYABILITY OF SUPPORT VECTOR MACHINES WITH GRAY WOLF OPTIMISATION (SVM-GWO) ALGORITHM TO OPTIMISE DATA CLASSIFICATION FROM IOT ENABLED DEVICES TO DEVELOP AN EFFICACIOUS SMALL HEALTHCARE SYSTEM

Saumya Gupta

ABSTRACT

Nowadays, medical services using cloud services with IoT, which offers a huge number of highlights and constant administrations. They offer a genuine phase for billions of clients to get standard data identified with health and a better way of life. The consumption of IoT related devices in the therapeutic area incredibly assists with executing differing qualities of these applications. The huge volume of information made by the IoT gadgets in the therapeutic field is researched on the Cloud as opposed to essentially relies upon accessible memory and preparing assets of handheld gadgets. Remembering this thought right now, attempt to devise an IoT and cloud-based savvy human services framework to analyze the patient. The IoT gadgets attached to the patient's body and attached the required sensors and push away the data on the Cloud. At this stage, we apply an ideal Support Vector Machine with Gray Wolf Optimization (SVM-GWO) algorithm to characterize the exactness of infection utilizing the gained information. For experimentation, we utilize a benchmark coronary illness dataset and a lot of measures used to dissect the achieved outcomes. The proposed SVM-GWO accomplishes a final classifier output with the exactness of 84.07%, accuracy, review, and F-score of 84.10% separately. An ideal Support Vector Machine with Gray Wolf Optimization (SVMGWO) calculation is utilized to group the exactness of sickness utilizing the gained information. The exploratory result guarantees the advancement of the displayed model over the thought about techniques under various assessment parameters.

1. INTRODUCTION

IoT characterizes the method for demonstrating and connecting gadgets utilizing the Internet. IoT shows that a couple of incredible handling gadgets like PCs, tablets, and telephones are noteworthy to have many low amazing gadgets. The most often utilizing articles like deodorizer and vehicle are mentally modified by preparing gadgets with help from sensors and produces the output. Along these lines, the connected gadgets or articles can process and convey the prerequisites of basic gadgets to interconnect building utilizing system correspondence. They associate structures, too, through system correspondence. IoT and distributed computing are similarly valuable when they are coordinated together. The perception model planned by the incorporation of these advancements for watching the patient information proficiently, even in remote zones, finds accommodating specialists. The IoT advances are upheld by the Cloud for upgrading the outcomes dependent on more asset use, memory, power, and computation ability. Incapacity, distributed computing enjoys favor from IoT advancements for improving the degree for dealing with the present world and to disseminate different novel administrations in an energetic and scattered manner. Despite the fact that IoT based cloud model is upgraded to grow new administrations and applications in the acute conditions. The coordination of Cloud and IoT based online applications works well than conventional cloud-put together applications based with respect to effectiveness. The rising applications like therapeutic, safeguard, and banking applications make use of these combinations. Especially, the Cloud-based IoT strategy utilize offering successful administrations to the therapeutic applications to screen just as access records from remote zones. IoT driven Healthcare application is utilized to assemble the required information like regularly changes in social insurance variable on schedule and it refreshes the meticulousness of the therapeutic factors under default time length. In addition, IoT segments and therapeutic factors identified with sensor esteem can be utilized adequately to analyze the illnesses decisively at the prior stage. AI algorithm has an essential impact on the basic leadership process while overseeing a large amount of data. The way toward applying information examination strategies to specific areas like the neural system, arrangement bunching, and utilizes productive methods is utilized. The information can be made from various sources with specific information types and is basic to create techniques that can take care of information attributes. Right now, a huge amount of different sorts of information has been accumulated by the utilization of IoT gadgets which are utilized as information. They are spared in the Cloud and recovered for different purposes. Here, we utilize an AI way to deal with continues the learning method that maps the information under two classes in particular Normal and irregular. Right now, attempt to devise an IoT and cloud-based savvy social insurance framework to analyze the illness. The IoT gadgets appended to the patient's body accumulates the required information and puts away in the Cloud. At that point, we present an ideal Support Vector Machine with Gray Wolf Optimization (SVM-GWO) calculation to order the nearness of ailment utilizing the procured information. For experimentation, we utilize a benchmark coronary illness dataset, and a lot of measures are utilized to investigate the accomplished outcomes. The exploratory result guarantees the advancement of the exhibited model over the thought about strategies under various assessment parameters. The up and coming areas of the paper are organized as follows: Section 2 shows the proposed model, and Section 3 approves the introduced model. section 4 exhibits a conclusion.

2. PROPOSED MODEL

The presented IoT and cloud-based smart healthcare system first gather the needed data from IoT devices, UCI repository, and medical data. Then, the data is saved on the Cloud. Finally, the data will be investigated by the SVM-GWO classifier for the identification of the diseases. The overall process is given in Figure 1.

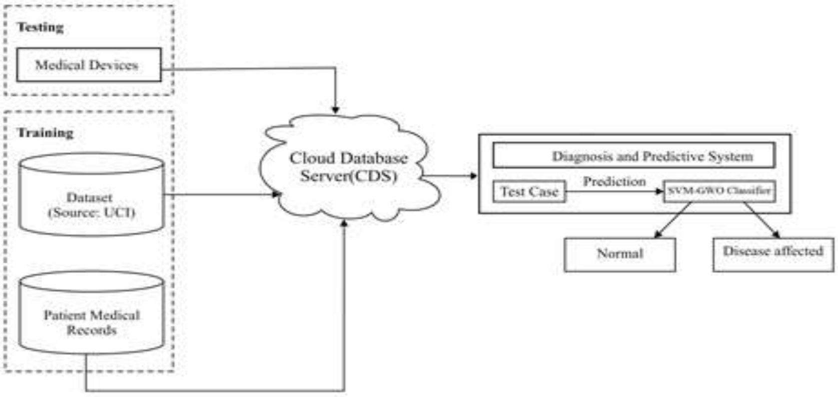


Figure 1. The overall process of the proposed model.

2.1 Data Collection

The presented model contains three diverse types of data. It has the authority to gather patient data through the use of wearable IoT devices that operates on sensors. They are placed on the human body to collect specific patient data or data seamlessly at regular time intervals. In general, these devices ensure that every patient's healthcare data falls at a reasonable level. When the observed patient data crosses the average value, it raises an alarm and sends an alert to the doctor. In addition, the data stored in the Cloud will be investigated by the SVM-GWO classifiers.

2.2 Disease Diagnosis Model

SVM is a well-known and effective classifier developed. It can be employed to detect the abnormalities in the healthcare data acquired by the IoT devices. Here, the structure of SVM is based on the following factors: Initially, the regularization variable C controls the trade-off among maximizing margin and number of misclassifications. Next, kernel functions of nonlinear SVM are employed to map the training data from an input space to high dimensional feature space. Every kernel function of linear, polynomial, radial basis function and sigmoid has few variables known as called hyperparameters. Presently, the kernel mainly employed in Brain-Computer Interface research is Radial Basis Function (RBF) kernel with width σ:

$$fitness(w,t) = \sum_{k=1}^{N} \frac{acc_{w,t,k}}{N}$$

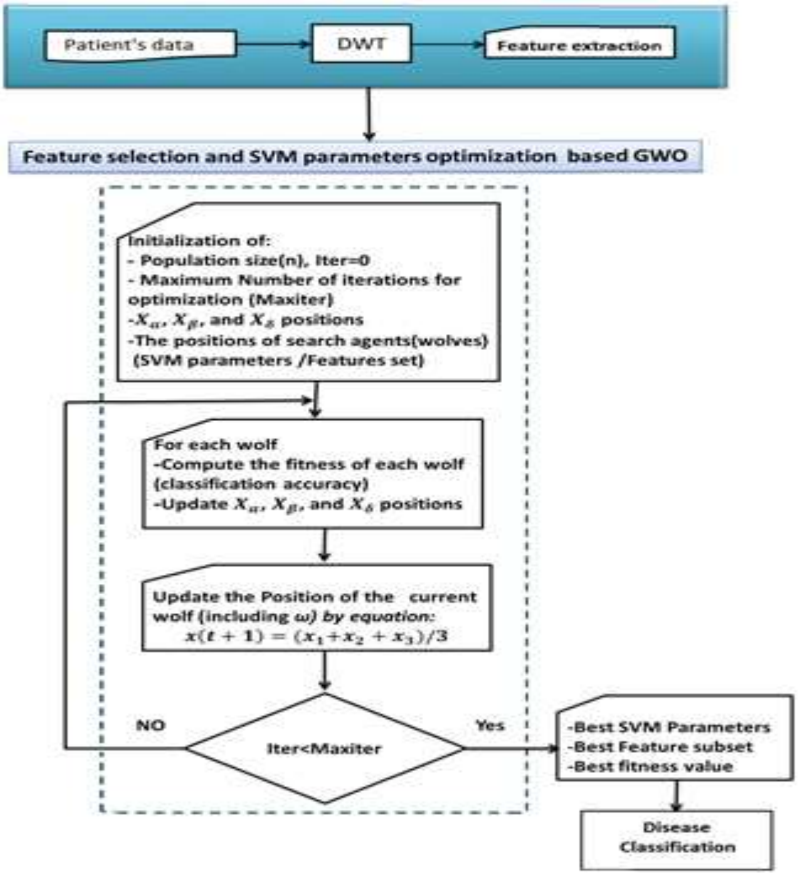


Figure 2. Process involved in SVM-GWO.

Where, K(x,y) is the kernel function defined by the multiplication of two invariants x and y. appropriate trade-off and kernel parameters C and σ are needed for training the SVM classifier and generally attained using K-fold cross-validation approach. Here, we employed the standard 10-fold cross-validation for effective results. Here, we present an SVM-GWO method to classify the patient data for disease diagnosis. GWO algorithm is developed based on the nature of wolves. This method intends to optimize the classifier results of SVM the automatic estimation of optimum feature subset and optimum values of the SVM variables of the SVM model. The presented SVM-GWO model has various sub-processes, which are shown in Figure 2.

2.2.1 Pre-processing and Feature Extraction using DWT

Initially, with the aim to achieve effective performance in feature extraction, wavelet decomposition is employed to pre-process the medical data for extracting the attributes present in the instance.

2.2.2 Features Selection and Parameters Optimization using GWO

Effective classification can be attained by the removal of unwanted and repetitive data with the maintenance of the discriminating power of the data by feature selection. GWO has the capability of generating optimum feature subset as well as SVM variables concurrently. The parameter settings of the SVM show significant results on its classifier performance. The unsuitable parameter settings will result in worse classifier performance. The parameters that need to be optimized are C and σ.

2.2.3 Fitness Function

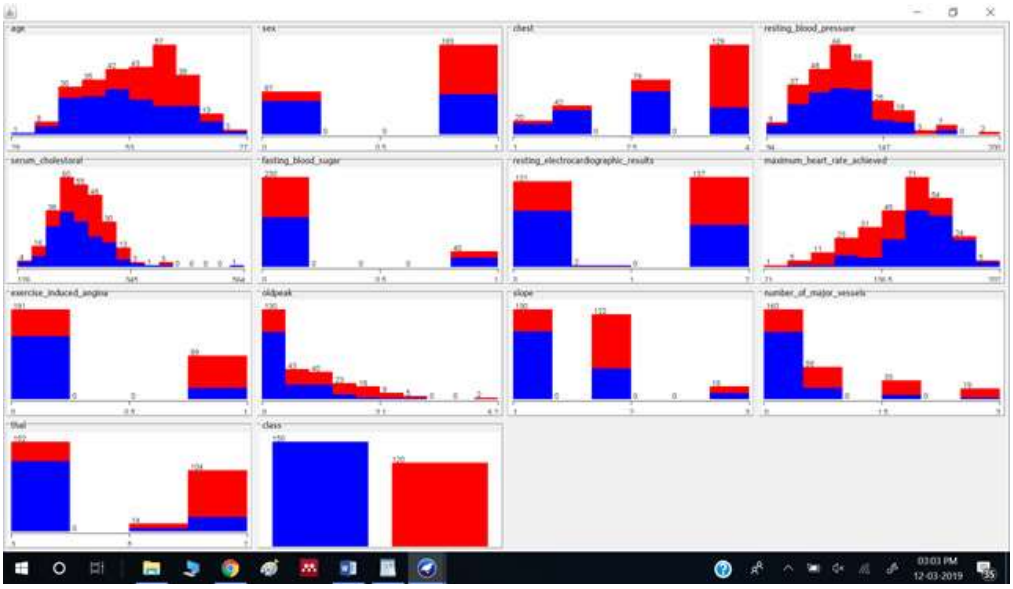
The classification accuracy is selected as the solution qualifier in the searching procedure. The classifier accuracy ranges between [0, 1], where each wolf Search Agent reflects a number of accuracies based on the applied cross-validation mechanism. In addition, every wolf shows ten accuracy values for every fold and every accuracy value are averaged to produce a fitness value to the search algorithm and is represented as:

Where fitness (w, t) is the fitness value of wolf w in iteration t, N is the number of folds chosen for cross-validation and accw,t,k is the resultant accuracy.

3. PERFORMANCE VALIDATION

3.1 Dataset used

For ensuring the results of the applied SVM-GWO, a set of experimentation takes place on the applied Heart disease dataset15. The information related to the applied dataset is available in Table 1. Generally, the dataset is downloaded from UCI repository. It has a total of 270 instances with 13 attributes. Among the 270 instances, 150 instances denote the absence of heart disease and the remaining 120 instances implies the presence of heart disease. The total number of 13 attribute distribution of the used dataset is shown in Figure 3. From the figure, it can be clearly shown the name of the attribute and the corresponding distribution.



3.2 Results Analysis

In this section, the obtained results of the proposed SVMGWO is provided in terms of different measures such as False Positive Rate (FPR), True Positive Rate (TPR), precision, recall, accuracy, F-score, ROC and kappa values. The minimum values of FPR, at the same time, maximum values of TPR, precision, recall, accuracy, F-score, ROC, and Kappa values imply effective classification performance. Figure 4 shows the values obtained by the presented SVM-GWO and compared methods in terms of FPR, TPR, precision, and recall. Likewise, Figure 5 depicts the comparative results attained by SVM-GWO and other methods in terms of accuracy, F-score, ROC, and kappa value. To compare the results of SVM-GWO, a set of well-known classifiers namely RF, MLP, and DT are used. From Table 2, it is apparent that the SVMGWO attains a minimum FPR of 16.60. The DT and MLP classifiers depict ineffective results with a maximum FPR of 24 and 21.80 respectively. The RF classifier tries to manage to produce effective results with a FPR of 19.60, but not better than SVM-GWO. Similarly, in terms of TPR, the maximum value of 84.10 is attained by the SVM-GWO implying effective classifier results. And, the MLP and DT offer the lowest TPR of 78.10 and 76.70 respectively. At the same time, the RF exhibits somewhat better results with a high TPR of 81.50.

However, it fails to outperform SVM-GWO. In terms of precision and recall, the DT shows worse results with minimum values of 76.60 and 76.70 respectively. And, the MLP is somehow better than DT with the precision and recall values of 78.40 and 78.10 respectively. But, the proposed SVM-GWO shows excellent results with maximum identical precision and recall values of 84.10 respectively. Based on F-score, the maximum value of 84.10 is obtained by SVM-GWO and minimum values of 81.40, 78.20 and 76.70 are achieved by RF, MLP, and DT respectively. In addition, on measuring the classifier performance in terms of ROC, the lowest value of 74.40 attained by DT indicates its efficiency on the applied dataset. Next, the RF shows superior ROC with a higher value of 89.80 compared to MLP and SVM-GWO. The SVM-GWO shows competitive results with ROC value of 89.30.

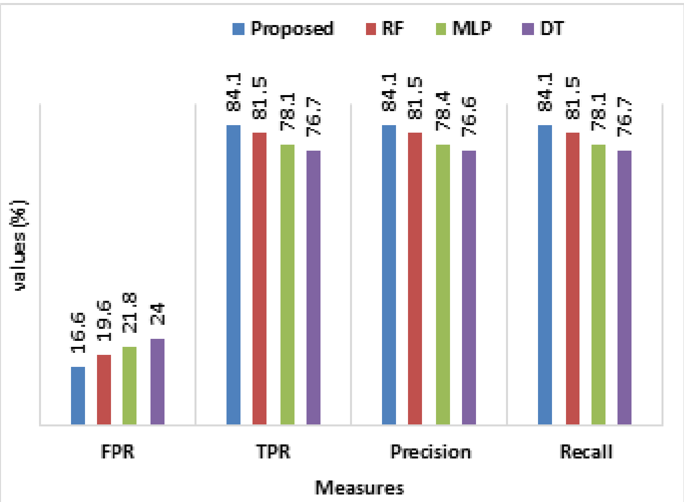


Figure 4. Analysis of various classifiers in terms of FPR, TPR, precision and recall.

Finally, the classifier results of the presented SVMGWO are analyzed in terms of kappa value. It is shown that the lowest kappa value of 52.70 is obtained by DT. And, MLP achieves a kappa value of 56 which is higher than DT, but not higher than RF and SVM-GWO. Likewise, the RF attains a kappa value of 62 which is higher than MLP and DT, but not higher than SVM-GWO. The presented SVM-GWO exhibits maximum results with the highest kappa value of 67.67. The above table and figures reported the superiority of the presented SVM-GWO over the compared methods with a maximum TPR of 84.10, precision of 84.10, recall of 84.10, accuracy of 84.07, F-score of 84.10, ROC of 89.30 and kappa value of 67.67 respectively. These values indicate that the SVM-GWO is found to be an effective model to diagnose diseases in IoT and Cloud-based smart healthcare systems.

Classifier	FPR	TPR	Precision	Recall	Accuracy	F-score	ROC	Kappa
Proposed	16.60	84.10	84.10	84.10	84.07	84.10	89.30	67.67
RF	19.60	81.50	81.50	81.50	81.48	81.40	89.80	62.00
MLP	21.80	78.10	78.40	78.10	78.15	78.20	83.90	56.00
DT	24.00	76.70	76.60	76.70	76.66	76.70	74.40	52.70

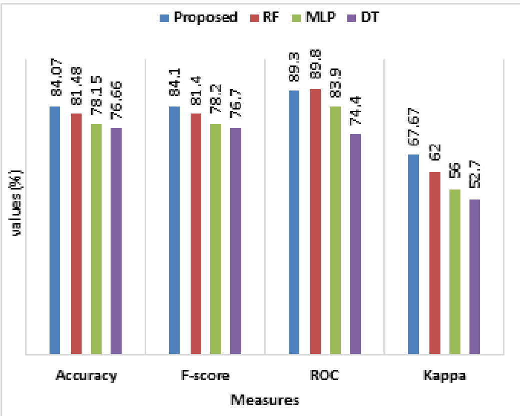


Figure 5. Analysis of various classifiers in terms of accuracy, F-score, ROC and Kappa.

4. CONCLUSION

In our research IoT and cloud-based brilliant medicinal services framework to analyze coronary illness is created. The IoT gadgets appended to the patient's body assembles the required information and it is put away in the Cloud. When all is said in done, these gadgets guarantee each patient social insurance information fall at a typical level. At the point when the watched patient information crosses the typical worth, it raises a caution and sends an alarm to the specialist. Also, the information put away in the Cloud will be examined by the SVM-GWO classifiers. At that point, an ideal Support Vector Machine with Gray Wolf Optimization (SVM-GWO) calculation is utilized to arrange the nearness of illness utilizing the procured information. For experimentation, benchmark coronary illness dataset is utilized and a lot of measures are utilized to break down the accomplished outcomes. The displayed SVM-GWO accomplishes the greatest classifier results with the exactness of 84.07%, accuracy, review, and F-score of 84.10% separately. The exploratory result guarantees the improvement of the introduced model over the looked at techniques under changed assessment parameters.

5. REFERENCES

1) Balamurugan S, Ayyasamy A, Suresh Joseph K. A review on privacy and security challenges in the Internet of Things (IoT) to protect the device and communication networks. International Journal of Computer Science and Information Security. 2018; 16(6):57–62.
2) Balamurugan S, Ayyasamy A, Suresh Joseph K. Investigation of performance analysis of QoS in the Internet of Things (IoT). International Journal of Science, Engineering and Technology. 2018; 5(3):32–7.
3) Islam SMR, Kwak D, Kabir H. The Internet of Things for health care: A comprehensive survey. IEEE Access. 2015; 3:678–708. https://doi.org/10.1109/ACCESS.2015.2437951
4) Gope P, Hwang T. BSN-care: A secure IoT-based modern health care system using body sensor network. IEEE Sensors Journal. 2016; 16(5):1368–76. https://doi.org/10.1109/JSEN.2015.2502401
5) Varatharajan R, Manogaran G, Priyan MK, Sundarasekar R. Wearable sensor devices for early detection of Alzheimer disease using dynamic time warping algorithm. Cluster Computing. 2018; 21(1):681–90. https://doi.org/10.1007/ s10586-017-0977-2
6) Verma P, Sood SK. Cloud-centric IoT based disease diagnosis health care framework. Journal of Parallel and Distributed Computing. 2018; 116:27–38. https://doi.org/10.1016/ j.jpdc.2017.11.018
7) Christos S, Kostas EP, Byung GK, Brij G. Secure integration of IoT and cloud computing. Future Generation Computing Systems. 2018; 78:964–75. https://doi.org/10.1016/ j.future.2016.11.031
8) Chinmaya Kumar D, Prasan Kumar S. Design and implementation of a novel service management framework for IoT devices in cloud. Journal of Systems and Software. 2016; 119:149–61. https://doi.org/10.1016/j.jss.2016.06.059
9) Dazhong W, Connor J, Janis T, Soundar K. Cloud-based machine learning for predictive analytics: Tool wear prediction in milling. IEEE International Conference on Big Data, Big Data; 2016. p. 2062–9.9
10) Gelogo YE, Hwang HJ, Kim H. Internet of Things (IoT) framework for health care system. International Journal of Smart Home. 2015; 9:323–30. https://doi.org/10.14257/ ijsh.2015.9.11.31
11) Gubbi J, Buyya R, Marusic S, Palaniswami M. Internet of Things (IoT): A vision, architectural elements and future directions. Future Generation Computing Systems. 2015; 2(7):1645–60. https://doi.org/10.1016/j.future.2013.01.010
12) Cortes C, Vapnik V. Support vector networks. Machine Learning. 1995; 20(3):273–97. https://doi.org/10.1007/ BF00994018
13) An introduction to Support Vector Machines and other kernel-based learning methods. 2000.399,https://www.cambridge.org/core/books/an-introduction-to-supportvector-

(IJIEST) 2016, Vol. No. 2, Jan-Dec **e-ISSN: 2454-9584; p-ISSN: 2454-8111**

machines-and-other-kernelbased-learningmethods/
A6A6F4084056A4B23F88648DDBFDD6FC

14) Mirjalili S, Mirjalili SM, Lewis A. Grey wolf optimizer. Advances in Engineering Software. 2014; 69:46–61. https:// doi.org/10.1016/j.advengsoft.2013.12.007
15) Statlog (Heart) Data Set. 2019. http://archive.ics.uci.edu/ ml/datasets/statlog+(heart)