AORA-A Novel Optimized Intrusion Detection System for Identification of the Black Hole Attacks in Wireless Sensor Networks

S. Sridevi, R. Anandan

Abstract: ***The application of Wireless Sensor Networks finds its function in all the application areas like Health care, Automation, Agriculture and others. Along with the IoT (Internet of Things), WSN plays a very important role in data collection which is used for the monitoring and control. Even though WSN plays a more noteworthy role in the collection, monitoring and control, WSN suffers a serious setback in the form of different attacks which manipulates the data or even the nodes. To overcome this setback, IDS (Intrusion detection System) has been placed to guarantee the stability and security of the Wireless Sensor Networks. Several IDS has been implemented, but challenges increases day by day.As first step towards intelligent IDS, this paper proposes the new algorithm AORA (Advanced Optimizer for Reliable Allocation) which mechanism on the powerful BAT optimizer integrated with Cognitive learning machines (CLM). The proposed algorithm has been tested with the two scenarios such as AODV and LEACH environment and accuracy of detection is determined for several test cases. The proposed algorithm has been compared by implementing the other optimization algorithms method such as different PSO and GA in which the proposed optimizer outperforms and other algorithms in terms of accuracy of detection (AID), and throughput.***

Keywords: ***AORA, BAT, PSO, GA Cognitive Learning Machines (CLM), AODV, LEACH.***

I. INTRODUCTION

In the recent times the Wireless Sensor Networks finds its highest potential in the various procedures in the different applications. By utilizing Internet of things (IOT), WSN plays a pivotal role in terms of data collection, promotes to the main gateways which is then used for monitoring and control. Wireless Sensor Networks consist of the sensor, microcontrollers and transceivers.Wireless Sensor Networks consist of the sensor, microcontrollers and transceivers as shown in Fig 1

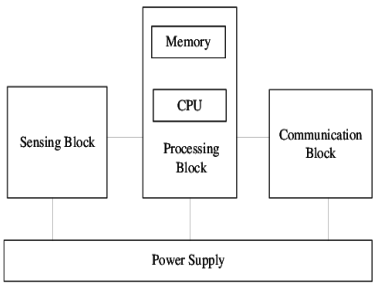

Fig 1: Illustrates General Block Diagram for the Wireless Sensor Node with its Transceiver

The WSN data Transmission is purely depends on the type of environmental routing protocols. Hence protecting Wireless Sensor Networks from the different network attacks plays an important role for several researchers. Unfortunately, it becomes more challenging among the researches. Also the nature of open distribution and limited resources, WSN are easily susceptible to the different attacks.

Wireless Sensor Networks (WSN) broadcasts the data frequently and placed randomly, attacks can be easily done on the WSN by manipulating the data packets and even changing the data scheduling. Hence placing the IDS (Intrusion Detection System) in Wireless Sensor Networks plays a major role for attacks detection and moreover there is need of intelligent System in IDS to find different attacks, for these the system has been designed for the detection of the black hole attacks.

The Intelligent AORA has been proposed for the detection of the attacks in which the powerful BAT algorithm has been integrated for the most accurate detection ofBlack hole attacks in frequently used AODV and LEACH environment. The different datasets have been formulated based on the RSSI, Residual Energy, distance, Cluster head and so on. Hence the data sets formulated are called AORA-DS which is then used for the detection of the black hole attacks. This paper is well thought-out as follows: Section –I deals with the related works and literature Survey. Section-II completely deals with the proposed methodology. Section-III gives the collection of datasets with testing environment. Finally, Section –IV deals with the Simulation results. Finally, Conclusion along with future enhancement has been explained in Section –V.

II. SECTION-I

Background Work and Related Works

Barnali Sahu's novel explains the concept of feature selection methodology which is applied in the characterization of high dimensional malignant growth microarray information, which utilizes filtering system. For example it converts a signal to noise ratio and optimization strategy as Particle swarm Optimization (PSO). The proposed technique is isolated into two phases.

In the initial stage the informational collection is clustered by utilizing k-means grouping. SNR score is utilized to rank every quality in each cluster. The best scored qualities from each group are accumulated and other subset element is created.

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In the second stage the new element subset is utilized as contribution to the PSO and upgraded highlight subset is being delivered. K- The nearest neighbor, support vector machine, and Probabilistic Neural Network are utilized as evaluators and allow one cross approval approach is utilized to approval. It has been exhibited that the proposed methodology utilizing PSO gives preferred outcome over others methodologies [1] Pallavi Dixit proposes edge-based feature elimination methodologyfor SVMs and show both enhanced edge and enhanced speculation, contrasted and RFE. In addition, for the instance of a nonlinear kernel, the work demonstrates RFE accept the squared weight vector 2-standard is entirely diminishing as highlights are killed. the proposed system shows this isn't valid for the Gaussian part and, thusly, RFE may give poor outcomes for this situation. The proposed outcomes demonstrate that MFE for nonlinear parts gives better edge and speculation. they likewise present an expansion which accomplishes further edge gains, by improving just two degrees of opportunity – the hyperplane's capture and its squared 2-standard – with the weight vector introduction settled. In test utilize two dataset one is picture divided information and second is iris dataset. In test utilize distinctive emphasis of GWO and ascertain exactness, review, precision[2]. SEDIGHEH KHAJOUEI NEJAD proposed a hybrid system with three levels.The first level extracted features Accelerated PSO. Inthe second level, the generated data-sets are fed intodecision tree classifiers, k-nearest neighbor and neuralnetwork. Then, median results were obtained. Finally,in the third level, a classifier carried out the classification based on AdaBoost algorithm. Theproposed hybrid approach was evaluated with respectto accuracy, recall, precision and F value. Comparedto other approaches, the proposed approach shows ahigher performance [3] Rajagopal examined BFO (Bacterial foraging Optimization) methodology and it is adapted forcluster head selection so that multiple objectives like reduced packet delivery ratio, improved cluster formation, improvednetwork life time and reduced end to end delay are achieved. Also a novel Hybrid algorithm using Bacterial foragingOptimization (BFO) , (BSO)Bee swarm Optimization is attempted for the analysis and the number of clustered formed, delay between the ends, packet drop ratio and lifetime. To maximize the network lifetime, optimal CH selection is important. Selections of CH are Non deterministicPolynomial (NP) hard. Recently a swarm algorithm is inspired such as PSO, ACO in this domain and gives the results effectively. Naresh Mallenahalli projected a novel approach named tunable swarm measure which deals with reconfiguration of the particles in a standard PSO for the real time application by using standard data sets. It is commonly known as wrapper based methodology, which is used to classify the Alternating Decision Tree to utilize for recognizing influential element subset, which is additionally assessed by another target. Later the work incorporates the Classification Accuracy with an adjusted F-Score to obtain effective classification accuracy over differing populace sizes. Experimental results on the bench mark data and statistical Wilcoxon test have demonstrated to determine algorithm proficiency in distinguishing ideal element subsets that enhance accuracy in the classification with base classifiers in contrast to its independent form [5]. Yu Xue received a self-versatile differential advancement algorithm to manage choice issues for IDS. The versatile instrument and four powerful CSGSs are utilized in SaDE. Through this technique, a fitting CSGS can be chosen adaptively to create new people during developmental process. In addition, the proposed system enhanced the control parameters of the SaDE. The K-Nearest Neighbor (KNN) is utilized for execution evaluation for highlight choice. Investigations utilized KDDCUP99 dataset, and exploratory outcomes show that SaDE is more encouraging than the calculations its comparison [6]Amandeep Kaur proposed an implementation based on Genetic algorithm as well as PSO method in order to design more efficient and practical black holes, also comparison between GA and PSO has been done. Related to security in Black-hole assault has been looked into. At that point an Intrusion Detection System (IDS) particularly for black-hole attack is implemented using Genetic Algorithm/ PSO algorithm. It is presumed that black-hole assault aversion is accomplished at more noteworthy rate when PSO has been used w.r.t. GA only [7]. Manizheh Ghaemi has endeavored to utilize Forest Optimization Algorithm for solution of feature selection issue. As FOA is accounted for to be appropriate for nonstop search space issues, so the proposed system have the balanced phases of FOA for discrete search space of highlight determination issue and proposed FSFOA calculation. So as to explore the execution of FSFOA, the proposed system have chosen some notable datasets from the UCI archive and contrasted the consequences of FSFOA and different techniques. Among the elected techniques for correlation, there is GA, ACO and PSO based calculations. The aftereffects of the analyses demonstrated the prevalence of the proposed technique is the greater part of the chose datasets. The proposed framework utilized J48, KNN, SVM classifiers of WEKA programming to assess the effectiveness of every potential arrangement and order exactness is considered as proposed system fitness function [8]. Ahmed Ibrahem Hafez's method discusses a sine cosine calculation (SCA) to highlight determination to choose an insignificant number. The highlights given for the dataset can deliver a better and tantamount grouping precision by using every highlights of the given dataset. This examination demonstrates the SCA, a productive pursuit calculation. The process happens when connected to the element choice issue. The utilized wellness work is intended to improve the arrangement exactness and decrease the chose highlights set size, so as to acquire the arrangement of a base, the chosen highlights set with a greatest grouping precision. SCA is conveyed in the component determination area for assessment, and the outcomes are analyzed against two of the notable element choice strategies are genetic algorithm and molecule swarm optimization which generally demonstrates a development in characterization execution utilizing a proper arrangement of machine learning datasets. The SCA shows a variation expansion with PSO and GA grouping precision in both sizes [9]

Shih-Wei Lin introduced a particle swarm enhancement-based methodology, fit for searching of the ideal parameter esteems for SVM to acquire a subset of helpful highlights. This ideal subset of highlights is then embraced in both preparing and testing to acquire the ideal results in grouping. Examination of the acquired outcomes with those of different methodologies shows that the new PSO combined with SVM approach has a superior classification accuracy than others tried. experiment utilizes the feature selection in the test, the PSO combined with SVM approach is connected to dispose of pointless or irrelevant feature elements, and successfully decide the parameter esteems, thus enhancing the general results for the classification. outcomes of this examination were acquired with a kernel fucntion RBF. Notwithstanding, other parameters OF kernel can likewise be streamlined utilizing a similar methodology [10]LucijaBrezocnik proposed a technique for the issue of handling information with high-dimension. When one has a great many attributes (qualities) in a dataset, it is difficult to accomplish a proficient selection of attirbute. To adapt with this issue, the proposed system utilizes double particle swarm enhancement calculation joined with the C4.5 as a classifier in the fitness function for the determination of educational characteristics. The outcomes acquired on 11 datasets were examined factually and uncover that the proposed technique, called BPSO combined with C4.5, beats known classifiers, such as SVM, C4.5, Naive Bayes [11]. Marwa Sharawi presented a new framework called attribute selection which applies the whale optimization algorithm. This is a late presented meta-heuristic advancement algorithm that imitates the common conduct of the humpback whales. The proposed model applies the wrapper-based strategy to achieve the ideal subset of highlights. This system was connected to locate the best component subset that amplifies the precision of the characterization while protecting the base number of highlights. The proposed model is contrasted with the PSO and GA algorithm utilizing various evaluation markers on 16 unique informational collections from UCI information archive. The outcomes show the upside of the acquainted calculation contrasted and alternate analyzers [12]

Long Zhang proposed a foundation dependent on shared data, and the model can not just gauge the connection between two highlights chosen by a firefly yet additionally decide the emendation of highlights among the accomplished element subset. The proposed methodology is contrasted and differential advancement, genetic algorithm, and two adaptations of particle swarm optimization on a few benchmark datasets. The outcomes exhibit that the proposed DbFAFS is proficient and aggressive in both grouping exactness and computational execution [13]

III. SECTION-II

AORA- Proposed Methodology

The proposed AORA algorithm has consist of the three different phases such as Data Sets Collection, BAT optimizer and Cognitive Learning machines which is shown in Fig.2

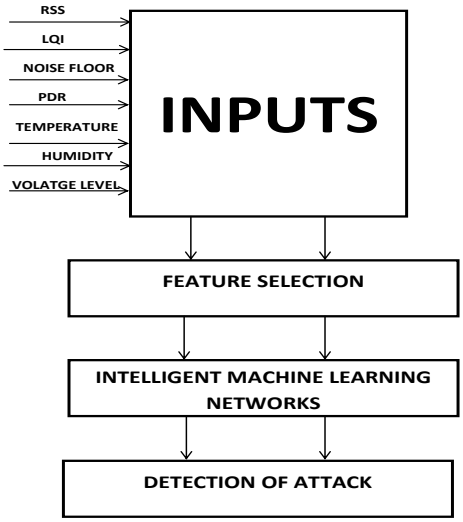

Fig 2: Block diagram of AORA

Dataset Collection

In Wireless Sensor networks datasets are most important for the detection of the black hole attacks. The datasets which are used for the detection is illustrated in table I

Important parameters which are used for the analysis are RSSI, Residual Energy, Cluster Head details, Distance which are calculated as follows

RSSI and Distance Measurement

The RSSI and Distance can be measured by the following expression which is then given as follows

$d = 10[(P_0 – F_m – P_r – 10\log10 (f) + 30n - 32.44) / 10n]$ (1)

Where,

d - distance between the Transmitter(Sink) and Receiver(Monitoring Nodes)

n - Path-Loss Exponent

P_0–Energy or power of the signal (dBm) in the zero distance (at Static Place)

P_r–Energy or Signal power (dBm) in the distance d (Distance is taken from the Monitoring nodes and Sink)

f - Signal frequency in MHz

Fm - Fade margin(rssi FORMULA HAS TO BE ADDED)

Energy Measurement

After calculation of the distance, energy is calculated by using the expression given below and it sends to the sink in the above mentioned for the frame format.

$$E_{TNx}(n,d)=E_{Ele}*n+E_{amp}*n*d^2 \quad (2)$$

Where, E_{TNx} (n,d)Energy of the CPU (E_{Ele}) + Energy of radio (E_{amp}* n*d^2) to transmit ‘n’ bytes at a distance ‘d’

Bat Algorithm

The standard bat algorithm generally depends on the microbats bio - sonar attributes or echolocation. In light of the echo cancellations algorithms, bat algorithms have been developed with the accompanying three important rules:

1. All bats utilize echolocation method is used to detect separation, and they additionally 'know' the contrast between sustenance/prey and foundation boundaries in some mystical way

2. Bats fly arbitrarily with speed vi at position xi with a recurrence fmin, fluctuating wavelength _ and uproar A0 to look for prey. They can naturally modify the wavelength of their discharged heartbeats and modify the rate of heartbeat emission r 2 [0, 1], contingent upon the closeness of their objective;

3. Despite the fact that the din can change from numerous points of view, we expect that the uproar fluctuates from an extensive (positive) A0 to a base consistent esteem Amin.

Each bat Motion is related with the speed vit and starting separation x_i^s with the 'n' number of cycles in a dimensional space or inquiry space. Among every one of the bats , best bat must be picked relies upon the three standards which are expressed previously. The refreshed speed v_i^s and beginning separation x_i^s utilizing the three guidelines are given underneath

$$fi = f_l + (f_h - fl)\,\beta \qquad (3)$$

$$x_i^s = x_i^{s-1} + v_i^s \qquad (4)$$

where $\beta \in (0,1)$ fl is the most minimal recurrence =0 and fh is the simple high recurrence which at first relies upon the issue articulation. every bat is at first assigned for the recurrence between the f_l and f_h. Consequently, bat calculation can be considered as a frequency tuning calculation to give a fair blend of investigation and exploitation. The commotion and heartbeat emanation rates basically give a component to programmed control and auto zooming into the locale with promising arrangements.

To get ideal arrangements, it is fundamental for the variety of the uproar and the beat emanation. Since the commotion as a rule diminishes once a bat has discovered its prey, while the rate of heartbeat discharge expands, the loudness can be picked as any estimation of comfort, among A_l and A_h, expecting A = 0 implies that a bat has recently discovered the prey and briefly quit producing any stable.

Cognitive Vector Machines

AORA, the Cognitive Learning machine as the next phase for the classification of the black hole attacks. Support vector Machines methodology are used for the classification of the black hole attacks.

Right off the bat working with neural systems for managed and unsubstantiated learning demonstrates the great outcomes while the utilized is used for such learning applications. MLP's is used for feed forward and repetitive systems. Multilayer perceptron properties incorporate inclusive estimate of constant nonlinear capacities and incorporate learning with information yield designs and furthermore include propelled organize structures with numerous sources of info and yields [10].

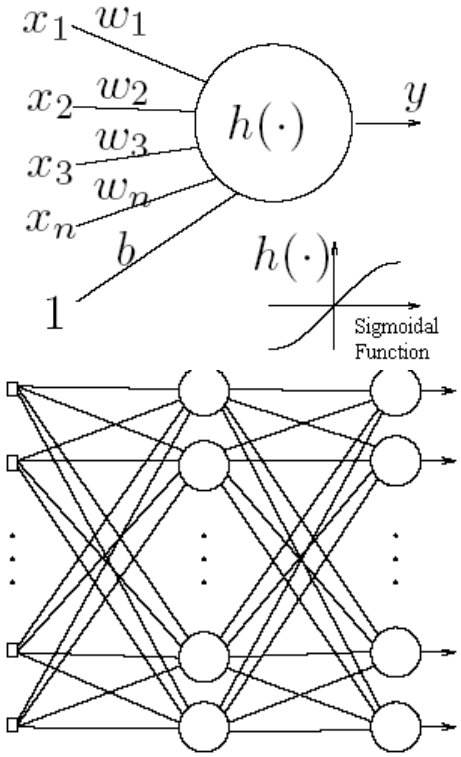

Figure 2: a] Simple Neural Network b] Multi-layer Perceptron. [10][11].

These are the general structures for a general study on how the neural network works.

There can be a few issues taken in to account. Some of them are having numerous nearby minima and furthermore discovering what number of neurons may be required for an errand is another issue which decides if optimality of that NN is come to. Something else to note is that regardless of whether the neural system arrangements utilized will in general merge, this may not result in a one of a kind arrangement [11]. Presently given us a chance to take a gander at other model where we plot the information and endeavor to characterize it and we find that there are numerous hyper planes which can order it.

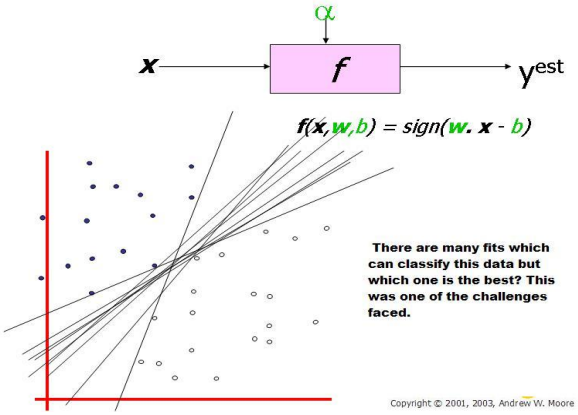

Figure 3: Here we identify that there are numerous hyper planes which can be fit in to characterize the information however which one is the best privilege or right arrangement.

The requirement for SVM emerges. Note the legend isn't portrayed as they are test plotting to make comprehend the ideas included.

From above representation, more numerous direct classifiers (hyper planes) has found and that is different the information. Anyway, just a single of these accomplishes greatest partition. The reason we require it is in such a case that we utilize a hyper plane to arrange, it may wind up more like one arrangement of datasets contrasted with others and the proposes system does not need to occur and hence we identify that the idea of the most extreme edge classifier or hyper plane as a clear arrangement. The following delineation gives the most extreme edge classifier model which gives an answer for the previously mentioned issue [8].

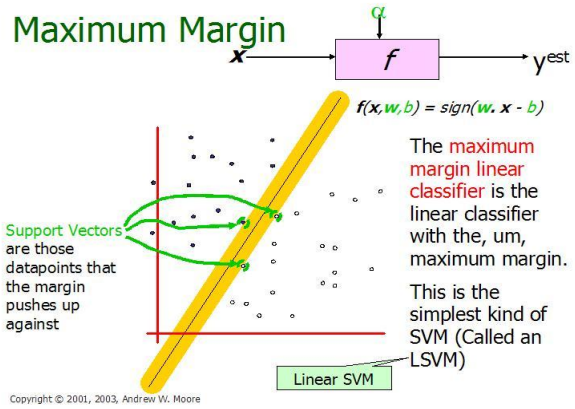

Figure 4: Illustration of Linear SVM. (Taken from Andrew W. Moore slides 2003) [2]. Note the legend is not described as they are sample plotting to make understand the concepts involved.

Expression for Maximum margin is given as [4][8]

$$\text{margin} \equiv \arg\min_{\mathbf{x}\in D} d(\mathbf{x}) = \arg\min_{\mathbf{x}\in D} \frac{|\mathbf{x}\cdot\mathbf{w}+b|}{\sqrt{\sum_{i=1}^{d} w_i^2}}$$

The above outline is the most linear classifier in the greatest range. The setting is a case of a basic linear SVM classifier. The fascinating inquiry is the most extreme edge. The other reason is regardless because a little mistake has occurred in the area of the limit that gives us a minimum shot of causing a misclassification. The other selected standpoint would be away from neighborhood minima to attain a better arrangement. The result reveals the SVM scientifically. The instructional exercise attempts to show a straight SVM.The objectives of SVM is isolating the information with hyper plane and stretch out to non-straight limits utilizing piece trap [8] [11]. To identify the objective of SVM by computing, every information should be in order to obtain an effective result. The scientific formulae are

[a] If Y_i= +1;

[b] If Y_i= -1; $wx_i + b \leq 1$

[c] For all i; $y_i (w_i + b) \geq 1$

In this condition x is a vector point and w is weight and is likewise a vector. So to isolate the information [a] ought to dependably be more noteworthy than zero. Among all conceivable hyper planes, SVM chooses the one where the separation of hyper plane is as extensive as could be allowed. On the off chance that the preparation information is great and each test vector is situated in range r from preparing vector. Presently the picked hyper plane is situated at the most distant conceivable from the information [12]. This coveted hyper plane which augments the edge additionally separates the lines between nearest focuses on arched body of the two datasets. Along these lines we have [a], [b] and [c].

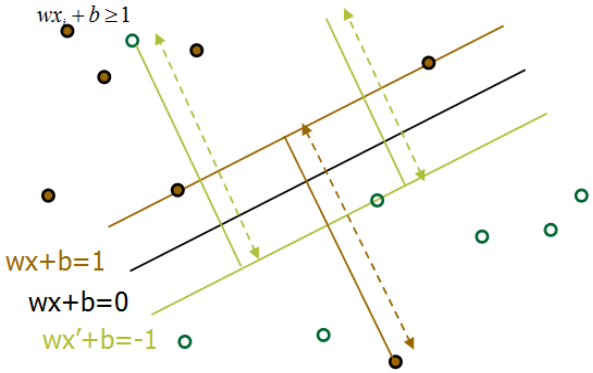

Figure 5: Hyper planes portrayal. [9]

The Separation of the nearest point on hyper plane to its birthplace can be found by amplifying the x as x. additionally we have a comparable situation on the opposite side focus. In this way we comprehending and subtracting the two separations as a result, we get the summed separation from the isolating hyperplane to closest focuses.

Maximum Margin = M = 2 / ||w||

Currently augmenting edge is same as least [8]. Presently we have a quadratic streamlining issue and we have to increase w and b. To illuminate, we have to streamline the quadratic capacity with direct requirements. The arrangement includes a double building issue and where the Langlier's multiplier αi is related. We have to discover w and b to such an extent thattΦ (w) =½ |w'||w| is minimized;

And for all {(x_i, y_i)}: y_i (w * x_i+ b) ≥ 1.

By solving: we derive that w=Σα_i *x_i; b= y_k- w *x_k for any x_k such that $\alpha k \neq 0$

The classifying function as in the following form: $f(x) = \Sigma \alpha_i y_i x_i * x + b$

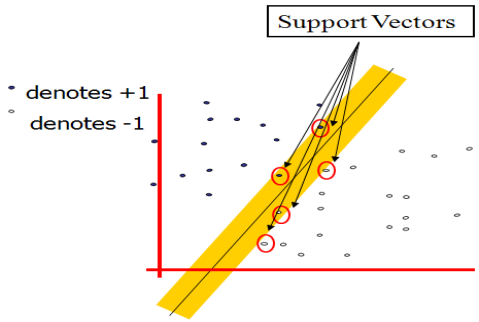

Figure 6: Support Vectors Representation

Support Vector Representation

The QP formulation for SVM classification is defined in a simple representation. [4][8][12][13].

SV classification:

$$\min_{f,\xi_i} \|f\|_K^2 + C\sum_{i=1}^{l} y_i f(x_i) \geq 1 - \xi_i, \text{ for all } i$$

$\xi_i \geq 0$

SVM classification in Dual formulation:

$$\min_{\alpha_i} \sum_{i=1}^{l} \alpha_i - \frac{1}{2} \sum_{i=1}^{l} \sum_{j=1}^{l} \alpha_i \alpha_j y_i y_j K(x_i, x_j)$$

$0 \le \alpha_i \le C$, for all i;

$$\sum_{i=1}^{l} \alpha_i y_i = 0$$

Variables ξ_i are called slack variables and it is used to measure the error made at the point (x_i, y_i). When the number of training points is large, the Training SVM becomes a quite challenging. A number of methods for fast SVM training have been proposed for further studies.

IV. SECTION III

AORA Implementation Mechanism

As explained on top of, AORA consist of powerful BAT optimizer which optimizes the WSN Inputs from the different nodes in which the n applied to theCognitive vector Machines for the classification and Prediction of the Attacks.

Table 1: Sample Dataset

NODE ID	CH_WHO	RSSI(CH TO NODE)	DISTANCE BETWEEN CH_NODE	LINK QUALITY INDICATOR	ENERGY RECEIVED	ATTACK OR NOT
1	7	15.2202	0.000194532	5.1282	1.000000076	0
2	7	-2.674	0.001526511	22.1782	1.000000466	0
3	7	-11.0249	0.003992501	29.9151	1.00003188	0
4	7	37.5736	1.48361E-05	-1.6546	1	0
5	7	-23.7123	0.017203428	0.207	1.00059 1916	0
6	7	-11.7983	0.004364304	25.213	1.00003 8094	0
7	7	-55.4916	0.667697884	21.308	1.89164 0929	1
8	7	-73.8577	5.53203603	-51.9545	62.2068 4528	0
9	7	2.0344	0.000887728	2.8554	1.00000 1576	0
10	7	-11.5054	0.004219588	41.9823	1.00003 561	0
11	11	15.2202	0.000194532	5.1282	1.000000076	1
12	11	-2.674	0.001526511	22.1782	1.000000466	0
13	11	-11.0249	0.003992501	29.9151	1.00003188	0
14	11	37.5736	1.48361E-05	-1.6546	1	0
15	11	-23.7123	0.017203428	0.207	1.00059 1916	0
16	11	-11.7983	0.004364304	25.213	1.00003 8094	0
17	11	-55.4916	0.667697884	21.308	1.89164 0929	0
18	11	-73.8577	5.53203603	-51.9545	62.2068 4528	0
19	11	2.0344	0.000887728	2.8554	1.00000 1576	0
20	11	-11.5054	0.004219588	41.9823	1.00003 561	0
21	21	15.2202	0.000194532	5.1282	1.000000076	1
22	21	-2.674	0.001526511	22.1782	1.000000466	0
23	21	-11.0249	0.003992501	29.9151	1.00003188	0
24	21	37.5736	1.48361E-05	-1.6546	1	0
25	21	-23.7123	0.017203428	0.207	1.00059 1916	0

The above datasets are used for the AORA which are obtained from simulating in the LEACH protocol which is given by []. The powerful BAT optimizes the above attributes which is then feed to the Cognitive Vector Machines which are illustrated below.

Specifications Used for the AORA using BAT and CVM:

SL.NO	PARAMETERS TAKEN	Specifications	Descriptions
01	No of BATS	04	RSSI, Distance, Energy, CH_ID were Ouputs from BATS
02	No of Populations	100	No of Inputs Taken
03	Initial Velocity	20%	All The Specifications used for the Simulations in AORA
04	No of Iterations	40	
05	Initial Loudness	0.9	
06	Initial Pulse rate	0.9	
07	Minimum Frequency	0 KHZ	
08	Maximum Frequency	20 KHZ	

V. SECTION-IV

Performance Evaluation

The performance of the AORA has been evaluated on the based accuracy of detection (Sensitivity) in which 70 % of datasets were taken as training and 30% were used for the testing . The accuracy of detection of attacks are calculated as follows

Accuracy in detection: (No of True Values)/ (Total No of Iterations) x100

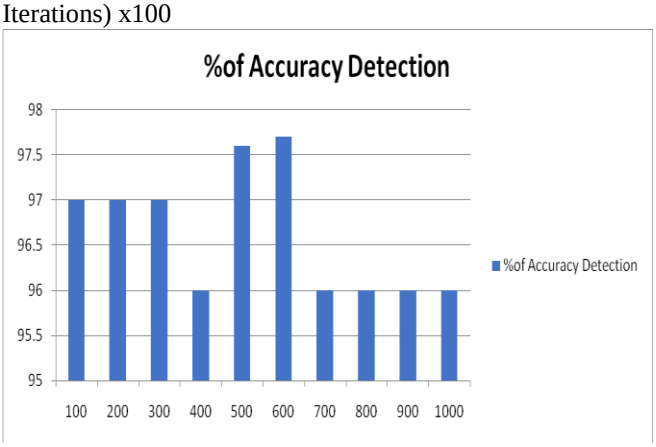

Fig 7: Shows Accuracy of Detection in Black Hole Attacks using AORA Mechanism(LEACH)

Fig 7 shows the AORA 'detection of blackhole attacks is maintained from 98% to 97% as the rounds in LEACH protocol is increased. Also the AORA has been tested with the AODV protocol which is then given as follows

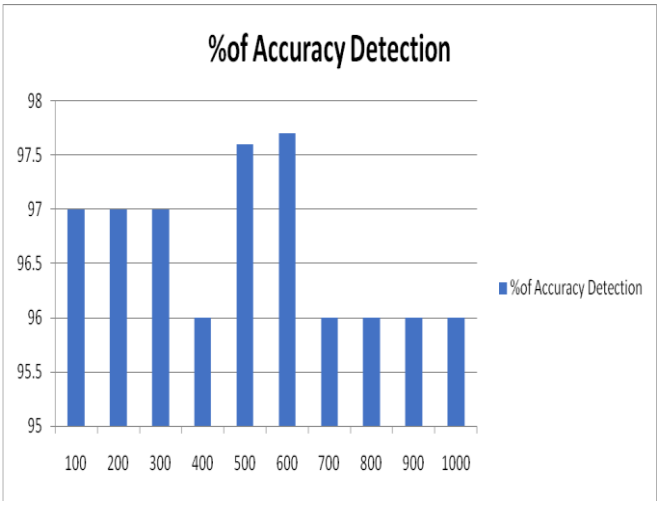

Fig 8: Shows Accuracy of Detection in Black Hole Attacks using AORA Mechanism.(AODV)

Fig 8:shows the AORA ' detection of black hole attacks is maintained from 97% to 96% as the rounds in AODV protocol is increased. Again the AORA 's performance has been compared with the existing optimization algorithms such as PSO(Particle Swarm Optimization), Genetic Algorithms (GA) along with Support Vector machines as classifier an predictor which is used same as in AORA .

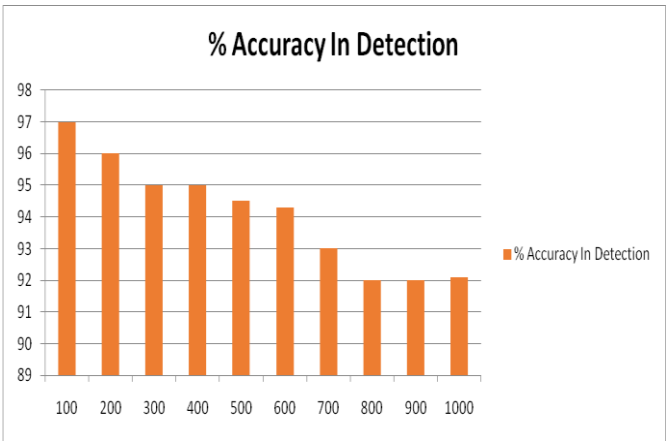

Fig 9: Shows Accuracy of Detection in Black Hole Attacks using GA Mechanism(LEACH)

Fig 9: shows the GA ' detection of blackhole attacks is decreased from 95% to 92% as the rounds in LEACH protocol is increased. Also the GA has been tested with the AODV protocol which is then given as follows

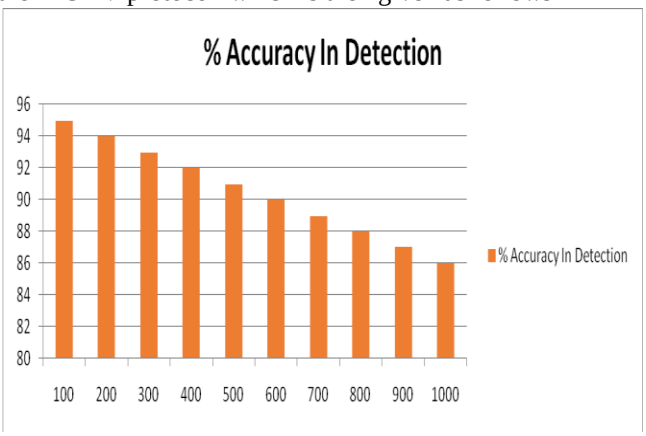

Fig 10: Shows the Accuracy of Detection of Black Hole attacks Using GA Mechanism(AODV)

From the above Fig ,10 it clearly understood that AORA mechanism outperforms both the PSO and GA for the detection of the Black Hole attacks. The powerful BAT in AORA has highest performance , even though the rounds of iterations increases. As the number of rounds increases, the accuracy of detection naturally decreases when it is used with PSO and GA Algorithms. With this Proposed AORA will have the high through put when compared with the existing algorithms.

Throughput Analysis

The throughput has been analyzed for the proposed algorithm AORA and compared with the PSO and GA based black hole attacks.

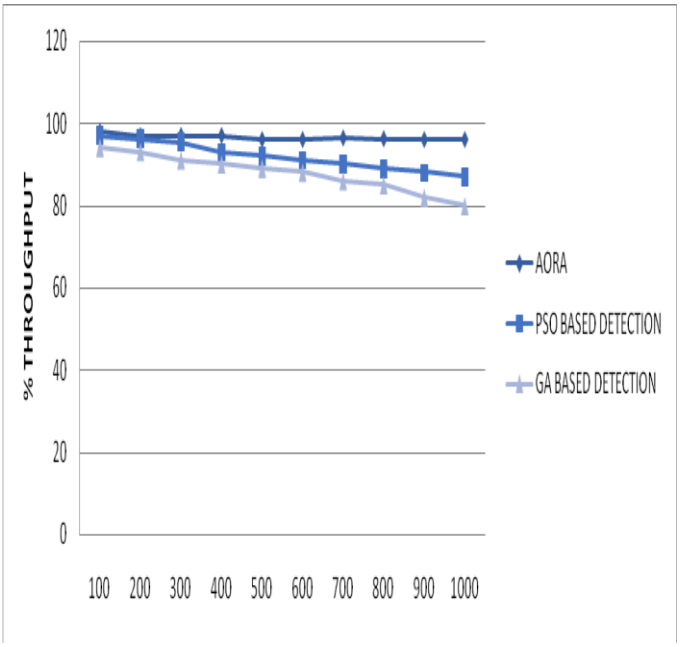

Fig 11: Throughput Analysis for the different detection systems of the Black Hole attacks

From the above fig 11 , it clearly shows the throughput for the proposed algorithm is 98% to 97 % as the rounds of testing increases, but the PSO and GA based detection system decreases from 95 % to 89 %, 96 % to 88% for the different rounds of iterations. The throughput is maintained high for the proposed algorithm in which the other algorithm degrades as the number of rounds increases.

VI. SECTION-V

Conclusion

The proposed AORA mechanism was successfully tested in LEACH and AODV protocol, in which the competence is maintained from 98% to 97% , even though the number of iterations increases. Further AORA can be improvised by testing with the different machine learning algorithms to detect the different attacks. Also AORA needs a real time test with the real time datasets , which is then applied for any Internet of things(IoT) based Wireless Sensor Networks implementation, where the security breaches are real night mare for the mankind.

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