Volume 6, Issue 9, September 2016 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Self-Organizing Maps based Data Aggregation Algorithm in Wireless Sensor Networks

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Abstract- This paper introduced about the data aggregation in wireless sensor network. We have presented SOM Based Data Aggregation Algorithm in Neural Network based Multihop Wireless Sensor Network and AdWAS: Adaptive Weighted Aggregation Scheme for Single-hop and Multi-hop Wireless Sensor Network. Among the distributed detection in neural network gives better result than the other technique when the two are compared in terms of accuracy of detection.

Keywords- Review, Data Aggregation, ANN based DA, AdWAS, and Wireless Sensor Network

I. INTRODUCTION

In recent years an efficient design of a Wireless Sensor Network has turned into a main region of research. A Sensor is a device that responds and distinguishes some sort of commitment from both the physical or environmental conditions, for example, weight, warmth, light, etc. The output of the sensor is for the most part an electrical sign that is transmitted to a controller for further handling. Aggregation plan for tree network, the proposed Neural Network based wireless sensor network approach prompts a huge change in identification exactness without much vitality misfortunes because of correspondence and calculation overhead[1].

II. WIRELESS SENSOR NETWORKS (WSNS)

A Wireless sensor network can be characterized as a network of device that can communicate the data assembled from an observed field through wireless connections. The information is sent through numerous nodes, and with a gateway, the information is associated with different systems like wireless Ethernet.

2.1 Network Topologies (WSN)

For radio communication networks, the elements of a WSN includes different topologies like the ones given below.

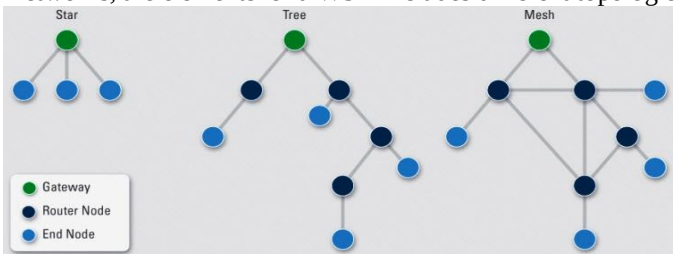


Fig.1.Network Topologies

2.2 Star Topologies

Star topology is a communication topology, where every node interface directly to a gateway. A single gateway can send or receive a information to various remote nodes. In star topologies, the nodes are not allowed to send messages to each other. This permits low-inactivity interchanges between the remote hub and the passage (base station).

Due to its dependency on a single node todeal with the system, the gateway must be inside the radio transmission scope of all the individual node . Although a number of the fact that various serial methodologies have been produced to decrease the time requirements, algorithms that could use conveyed figuring beats serial calculations for handling extensive datasets [2]. The advantage include the capacity to keep the remote hubs' energy utilization to a base and basically under control. The size of the system depend on the quantity of associations made to the center point.

2.3 Tree Topologies

Tree topology is additionally called as fell star topology. In tree topologies, every node associates with a node that is set higher in the tree, and after that to the gateway. The main advantages of the tree topology is that the development of a system can be effortlessly conceivable, furthermore blunder recognition turns out to be simple. The disadvantages with this network is that it depends intensely on the transport link; in the event that it breaks, all the system will crumple.

2.4 Mesh Topologies

The Mesh topologies permit transmission of information starting with one node then onto the next, which is inside its radio transmission range. if a node needs to make an impression on another node, which is out of radio correspondence range, it needs a middle of the road hub to forward the message to the desired hub.The advantage with this mesh topology includes easy isolation and detection of faults in the network. The impediment is that the system is vast and requires tremendous speculation.

2.5 Hybrid Topology

Some network topologies utilized for wireless sensor network applications utilize a combination of the past topologies, to make bigger network comprising of hundreds, even a huge number of nodes. A hybrid network comprises of a mix of star and mesh topologies. This blend comes about on a star- mesh network arrange that looks to exploit the low power and effortlessness of the star topology, and the broadened extent and self-healing nature of a cross section system topology. The rough worldwide requesting created by LSOM is joined with the neighborhood refinement Kernighan-Lin algorithm (LSOM-KL) to get the arrangement [3].In this case, nodes serve to sense, develop the scope of the system and give adaptation to internal failure. Since hubs can speak with different hubs, if a hub comes up short or if a radio connection goes down (e.g. because of obstructions or absence of battery), the system will reconfigure itself around the remaining nodes.

III. DATA AGGREGATION IN WIRELESS SENSOR NETWORK

With advance in technology, sensor systems made out of little and practical detecting device furnished with wireless radio handset for environment monitoring have gotten to be achievable. The key favorable position of utilizing these small device to screen the enviornment is that it doesn't require framework, for example, electric mains for force supply and wired lines for Internet associations with gather information, nor need human collaboration while conveying. These sensor nodes can monitoring the enviornment by gathering data from their environment, and work agreeably to send the information to a base station, or sink, for analysis. The fundamental objective of information aggregation algorithm is to assemble and total information in a vitality productive way so that system lifetime is improved. The algorithm utilizes a diagram structure to speak to information and can add or evacuate neurons to learn dynamic nonstationary design sets [4]. wireless sensor network (WSN) offer an inexorably appealing technique for information gathering in disseminated framework structures and element access by means of wireless connectivity.

3.1 Data Aggregation: An Overview

Data aggregation is a process of aggregating the sensor data using aggregation approaches. The general data aggregation algorithm works as shown in the below figure. The algorithm uses the sensor data from the sensor node and then aggregates the data by using some aggregation algorithms such as centralized approach, LEACH(low energy adaptive clustering hierarchy),TAG(Tiny Aggregation) etc. This aggregated data is transfer to the sink node by selecting the efficient path.

IV. NEURAL NETWORKS AND ENERGY CONSERVATION OF WSNS

These neurons are associated through weighted connection called synapses. Weight vectors (synapses) associate the network information layer to output layer. Undoubtedly, the information of NN is put away on weights of its associations and it doesn't have to any information storage. As such, Artificial Neural Networks are arithmetic algorithm which can learn mappings amongst info and yield as indicated by managed preparing or they can arrange information in an unsupervised way. One of the challenges with NNs is picking of suitable topology for the issue. This determination relies on upon properties of the issue, the most conceivable techniques for taking care of the issue furthermore the properties of NN. In addition there are distinctive sorts of preparing tenets which are roused from science which decide the way NNs learn. In the greater part of these systems, preparing depends on learning by example.A Growing (or Dynamic) Self Organizing Maps (GSOM) is a broadened rendition of the first SOM with versatile guide size and controllable spread [5].Thus, an arrangement of right info yield information are regularly given to the system and utilizing these cases, the system ought to change the weights values so that by inputting new information the system can return right replies as yield what we call "realizing". A standout amongst the most critical properties of NNs is capacity to perceive the information influenced by commotion or deliberate change and to expel those varieties in the wake of learning. There are diverse sorts of NN's topologies, each have distinctive capacities as indicated by the application required system's abilities rely on upon its structure, elements and preparing rules. The most vital utilizations of NN incorporate expectation, arrangement and recognizable proof. The most vital inquiry is in what capacity can Neural Networks help to energy preservation of Wireless Sensor Networks? In fact, Neural Networks are not energy protection strategies and can't independently monitor vitality however they can help vitality preservation techniques as astute apparatuses to work in more effective, alluring and less demanding way. So the vitality preservation strategies are the same past techniques which can utilize neural network as an apparatus to better way to deal with their objectives.

V. SELF ORGANIZING MAP

So far we have looked at network with regulated preparing techniques, in which there is an target output for every information design, and the network figures out how to deliver the required output. We now turn to unsupervised techniques, in which the systems figure out how to frame their own orders of the preparation information without outer

help. To do this we need to accept that class participation is extensively characterized by the information designs sharing normal components, and that the network will have the capacity to recognize those elements over the scope of info examples. The principle target of the field of system crime scene investigation comprises of social occasion confirmation of unlawful acts from a networking infrastructure [6]. One especially interesting class of unsupervised framework depends on aggressive learning, in which the yield neurons contend amongst themselves to be actuated, with the outcome that one and only is enacted at any one time. This initiated neuron is known as a victor takes all neuron or just the triumphant neuron. Such rivalry can be affected/actualized by having sidelong restraint connections (negative feedback path) between the neurons. The result is that the neurons are forced to organise themselves. For obvious reasons, such a network is called a Self Organizing Map (SOM).

5.1 Components of Self Organizing

The self-organization process involves four major components:

Initialization: All the connections weights are instated with small arbitrary qualities. Rivalry: For every information design, the neurons process their individual estimations of a discriminant capacity which gives the premise to rivalry. The specific neuron with the smallest value of the discriminant function is declared the winner.

Cooperation: The winning neuron decides the spatial area of a topological neighborhood of energized neurons, in this way giving the premise to participation among neighboring neurons.

Adaptation: The energized neurons decrease their individual estimations of the discriminant capacity in connection to the information design through reasonable alteration of the related association weights, to such an extent that the reaction of the energized neuron to the ensuing utilization of a comparative information example is improved.

VI. LITERATURE REVIEW

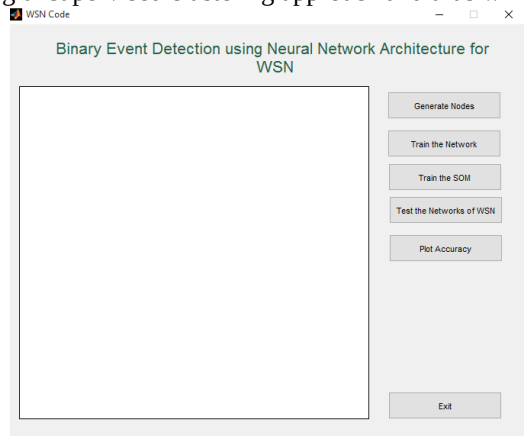
Name of Author(s)	Title of Paper	Summary
Raval et.al [1]	**Distributed Detection in Neural Network based Multihop Wireless Sensor Network**	A Neural Network based information collection way to deal with identify the binary events in a multi-hop Wireless Sensor Network has been proposed. They imagine each node in a system as a unit of neuron which gets prepared by utilizing the neural system based back propagation algorithm. When compared with the LMS based Adaptive Weighted Aggregation plan for tree organize, the proposed Neural Network based remote sensor system approach prompts a noteworthy change in identification precision without much vitality misfortunes because of correspondence and calculation overhead. They also compare the recognition precision of the proposed Neural Network based plan with that of the non-versatile Bayesian methodology which requires apriori learning of the sensor's execution records.
Ganegedara et.al [2]	**Redundancy reduction in self-organizing map merging for scalable data clustering**	The author proposed a redundant neuron reduction algorithm for self-organizing maps which enhances the effectiveness of the consolidating procedure. They showed that the proposed algorithm has quicker execution over the Parallel GSOM algorithm. Self-organizing map are generally utilized for exploratory data analysis. High preparing power necessity for substantial scale data clustring is a key issue with self-organizing map. In spite of the fact that various serial methodologies have been created to lessen the time requirement, algorithms that could use appropriated registering beats serial calculations for preparing substantial datasets. A viable disseminated methodology is to separate the dataset into allotments, prepare a self-sorting out guide on every segment and consolidation the maps to shape a solitary guide speaking to the entire information set. The as of late proposed Parallel GSOM algorithm has shown that parallel algorithm can essentially decrease preparing time for self-organizing maps. Be that as it may, if the genuine bunches in the dataset are dispersed over a few parcels, the individual prepared maps could contain repetitive neurons. Nearness of repetition builds the time prerequisite for the combining procedure. Diminishment of excess neurons would lessen the time utilization of the blending procedure along these lines enhancing the proficiency of the entire information grouping process.
Tan et.al [3]	**Mapping finite element grids onto parallel multicomputers using a self-organizing map**	LSOM (load-balancing self-organizing map), a neural network based of Kohonen's self-organizing map, is proposed for the issue of mapping finite element method (FEM) frameworks to dispersed memory parallel PCs with cross section interconnection systems. The unpleasant worldwide requesting delivered by LSOM is consolidated with the neighborhood refinement Kernighan-Lin algorithm (LSOM-KL) to get the arrangement. LSOM-KL accomplished a heap lopsidedness of under 0.1%, and a low number of hops,

		similar to comes about acquired with usually utilized recursive separation techniques..
Lang et.al [4]	**The plastic self organizing map**	A novel extension to Kohonen's self-organizing map, called the plastic self organizing map (PSOM), is displayed. PSOM is not at all like some other network since it just has one period of operation. The PSOM does not experience a preparation cycle before testing, similar to the SOM does and its variations. Every example is along these lines treated indistinguishably for record-breaking. The calculation utilizes a chart structure to speak to information and can add or expel neurons to learn dynamic nonstationary design sets. The network is tried on a true radar application and a simulated nonstationary issue.
Hsu et.al [5]	**Enhanced topology preservation of dynamic self-organising maps for data visualisation**	Unsupervised information disclosure utilizing Self Organizing Maps (SOM) has been effectively utilized as a part of unbiased and visualisable results. A Growing (or Dynamic) Self Organizing Maps (GSOM) is an expanded form of the first SOM with versatile guide size and controllable spread. In experiments a GSOM as a rule has impressively higher topographic mistake than SOM with comparative quantisation blunder. This can be undesirable in situations where, topology conservation is critical, in this way in this paper the creators proposed a algorithm to help the developing of the dynamic self-organizing map in accomplishing better topographic quality while keeping up or standing enhancing level of quantisation blunder. Comes about have demonstrated change of topographic mistake when contrasting with GSOM, and have preferable topology protection over non-topologically upgraded SOM with comparable guide size.
Palomo et.al [6]	**Visualisation of network forensics traffic data with a self-organizing map for qualitative features**	The self-organizing map has been connected to traffic data, for use as an tool in network criminology. Also, the proposed SOM considers the subjective elements that are available in the traffic data, in addition the quantitative components. The traffic data was clustring and imagined and the outcomes were then dissected. The outcomes exhibit that this strategy can be utilized to help in the cognizance of advanced crime scene investigation and to encourage the quest for bizarre conduct in the network environment.
Ren et.al [7]	**A Privacy Enhanced Data Aggregation Model**	This paper proposes an more advantageous privateness-retaining competencies aggregation scheme, which balances the laborious project of extracting low cost data worth and preserving capabilities privateness even with incomplete or malicious data presentence. They proposed an innovative encryption algorithm to keep knowledge privateness whilst it'll furnish comfortable knowledge evaluation between the encrypted knowledge. Moreover, they defined a effective and efficient aggregation operator to fuse the encrypted data with no decryption through at ease expertise assessment and density headquartered advantage mining. The proposed aggregation scheme can do away with each and every ordinarily malicious and redundant potential previous than aggregation so that it should furnish a strong aggregation have an effect on without scarifying know-how privateness. Moreover they mentioned the scheme performance in phrases of aggregation accuracy, distribution recuperation ability and aggregation effectivity. The test effect showcase that this scheme may give cheap aggregation values, get better the understanding distribution well even beneath 50% malicious readings, far more robust than the mainly used aggregation whilst it has just right aggregation effectivity with above 80% redundant information casting off.
Huang et.al [8]	**Combining voxel-based morphometry with artifical neural network theory in the application research of diagnosing alzheimer's**	The creators attempted to join voxel-based morphometry(VBM) with Artificial Neural Network(ANN) in diagnosing Alzheimer's disease(AD). Firstly, the elements were acquired by VBM strategy, and after that principal component analysis(PCA) was utilized for highlight dimensionality decrease to enhance its proficiency. At that point, a single three-layer, feed forward ANN with a back-propagation algorithm was utilized as a classifier. At last, the execution of the neural system was assessed by approval convention. By considering 20 highlights, which were acquired by VBM. The general prescient ability of Back-Propagation Neural Network in separating AD from ordinary controls achieved 100%. The system kept the exactness of

	disease	arrangement reliably. Likewise, the outcome will be somewhat better with the procedure of PCA. All in all, the consequences of this study affirmed that the strategy for blend VBM with ANN could be utilized as a part of the early finding of AD.
Kocyigit et.al [9]	**EMG pattern discrimination for patient-response control of FES in paraplegics for walker supported using artifical neural network (ANN)**	FES (functional electrical stimulation) envelops the utilization of electricity in working neural substrates. FES is utilized to reestablish lower appendage capacity to people deadened by spinal line damage. The framework decides a patient-responsive way utilizing above-sore surface EMG signs to actuate standing and strolling capacities. In this work, grouping of EMG examples which were utilized by FES to reestablish lower appendage capacity of walker-supported walking patients was finished by utilizing ANN.
Chen et.al [10]	**An Efficient Routing Algorithm to Optimize the Lifetime of Sensor Network Using Wireless Charging Vehicle**	This work proposes a geometric arrangement called the Dynamic Path Generation Scheme (DPG-Scheme) to mastermind the Wireless Charging Vehicle's (WCV's) voyaging way while minimizing a vehicle's vitality utilization and maximizing a sensor network's lifetime. The DPG-Scheme depends on the space-filling curve solution. In light of the properties of the space-filling bend, the DPG-Scheme utilizes space-filling bends as a space-filling bend heuristic for the NP-hard Euclidean voyaging sales representative issue. The DPG-Scheme can lessen computational time when figuring a wireless sensor network's (WSN's) voyaging way and another way is ascertained quickly amid sensor system topology changes.

VII. PROBLEM FORMULATION

In the presented paper [1], a neural network based concept for data aggregation is used to solve the problem of binary event detection. Although the presented paper has a very high accuracy compared to other algorithms like AdWAS, the presented method seems to be less accurate than “CV Rule” although CV rule requires apriori knowledge of the probability. We propose a solution wherein we will update the architecture of the ANN type. The paper is using simple tree based neural network architecture. By updating the architecture, we can implement an SOM based tree which learns using unsupervised clustering approach and thus will have a better accuracy index.



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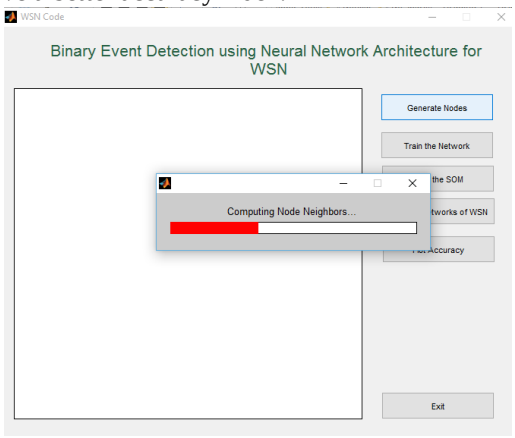

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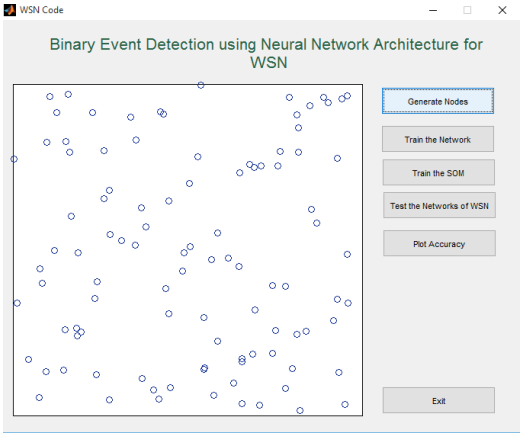

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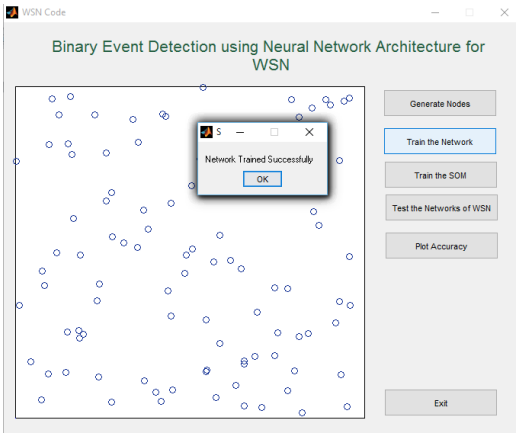

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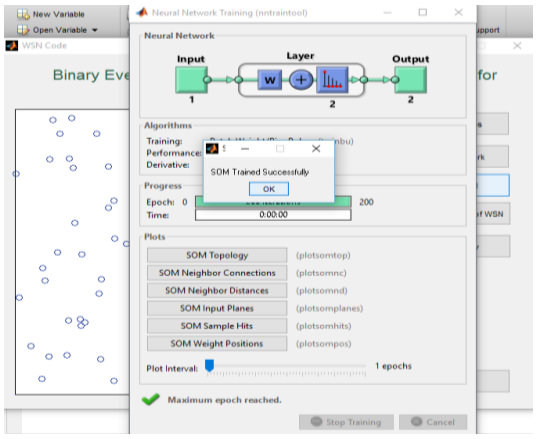

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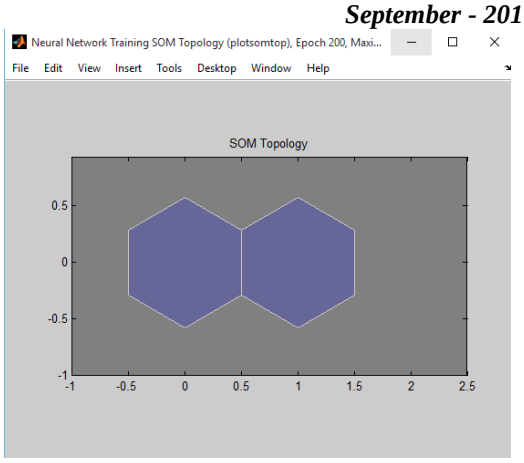

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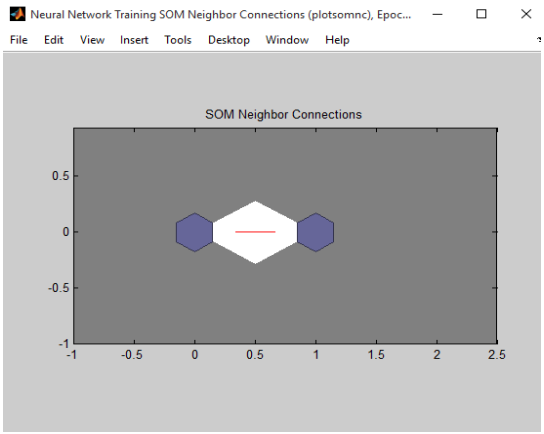

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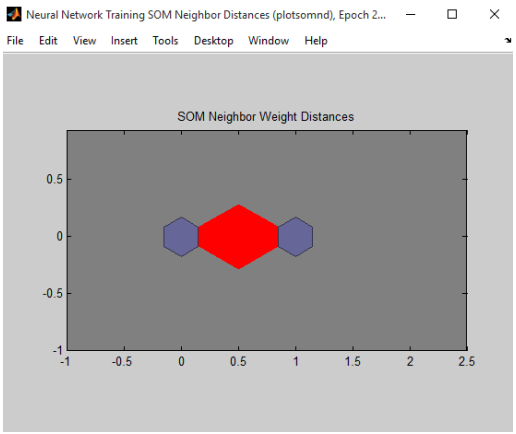

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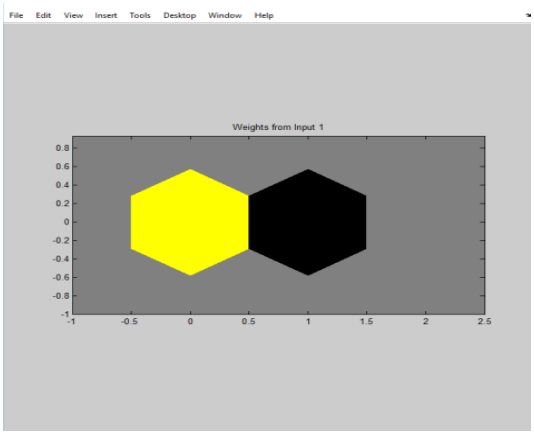

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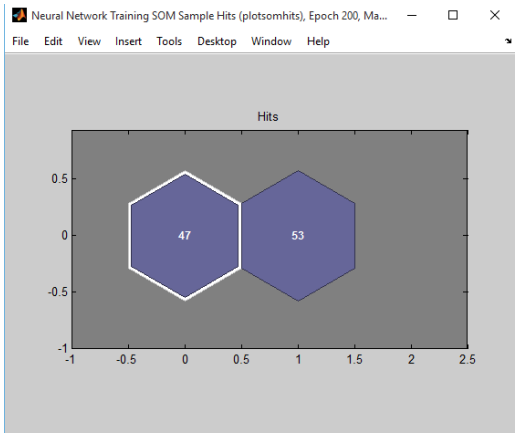

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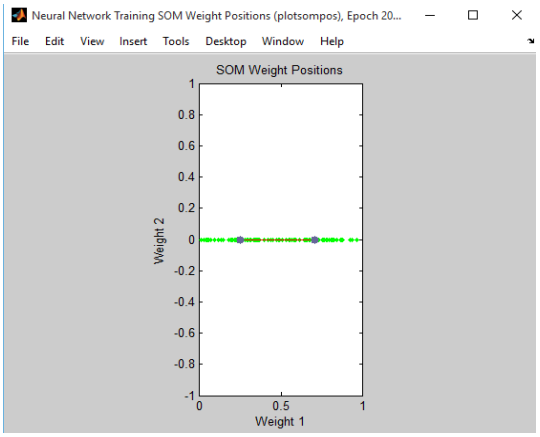

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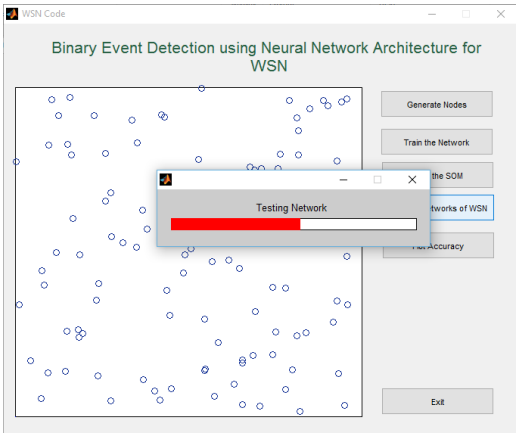

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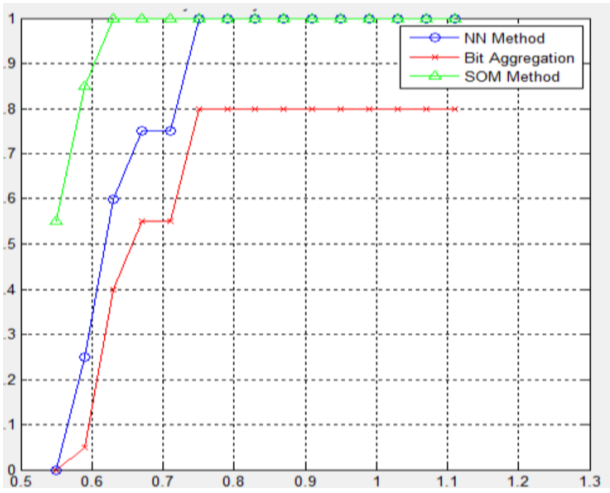

Fig.2.13

VIII. CONCLUSION

We considered the problem of efficient aggregation in wireless sensor network (WSN) for event detection application and the problem of binary event detection for an unbalanced tree topology based multi hop wireless sensor network was approached using the widely used Neural Network Backpropagation algorithm. A Least Mean Square (LMS) based Adaptive Weighted Aggregation Scheme (AdWAS) for WSN with star as well as tree topology. For star topology, the proposed AdWAS performance is very close to that of the CV rule which is the optimum decision fusion rule and give best result in terms of efficiency where as in case of Distributed Detection in Neural Network based Multihop Wireless Sensor Network the proposed scheme gives better results in terms of accuracy of detection as compared to the AdWAS scheme with relatively similar computation and communication cost.

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