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Multiple Event Detection In Wireless Sensor Networks Using Compressed Sensing: Health Monitoring Perspective

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***Abstract*—** Wireless Sensor Network (WSN) has tremendous growth due to low cost sensors and well planned techniques. Remote sensor systems are considered as expansive systems made of countless hubs with energy to detect the earth and discuss it with administrator. Event detection in remote systems is a method for handling inspected information specifically on the sensor hubs, accordingly, decreasing the requirement for multi-bounce correspondence with the b ase station of the system. This research has studied the existing work of event detection as well as health monitoring using WSN. We have studied various algorithms for route discovery like trust model and GA (Genetic Algorithm). Also studied about the impacts of health monitoring is done by ANN (Artificial Neural System). The assessment depends on QoS parameters, to be specific, Throughput, Energy Consumption, PDR (Packet Delivery Ratio).

***Keywords*—** WSN, WSN applications, Multiple Event detection, Multiple Event detection in Health Monitoring, Compressed Sensing, Genetic Algorithm, ANN

I. INTRODUCTION

A wireless sensor network is the smallest unit of a network that has unique features, such as it supports large scale deployment , mobility, reliability, etc. WSN gathered several low power multi-functional nodes, where all nodes are connected by radio frequency, or other medium without any wire connection. By using these medium and technology it allows direct communication between any two nodes. Sensor data measure a physical data to be monitored. Sensor is small in size. These sensor node can sense and gather information, and transmit the data to the user. The data collected by nodes traverses among the nodes in wireless medium.[1],[2],[3],[4] Now a days, wireless sensor Network are used to access the health conditions of human body to make human life more comfortable.

Wireless Sensor Networks are used in various applications like- health monitoring[12], environmental parameter like forest fire detection, air quality monitoring , air pollution monitoring and various event detections etc. [5],[6],[7],[8]

An event can be defined as an exceptional change in the real world phenomenon . Event is of two types. Atomic event and composite Event. Atomic event consists single attribute. Multiple event is combination of some atomic events. A sensor nodes consist some smaller nodes. These nodes can sense and monitor environment conditions, temperature, noise and smoke etc.

An event detection typically consists of a type specification and number of parameters, where each parameter has a name, a type, and a value. Detection of multiple events – sets of events that fulfill certain constraints on their types and parameters . A multiple event is detected whenever a certain pattern of events occurs in the subscribe system. This means that subscribers can subscribe directly to complex event patterns, and tries to match them with actual event detection. Whenever a match is detected, the system generates a new event detection representing the composite event. [9],[10],[11], [12]

This paper is organized as follows:
Section I describe the introduction of wireless Networks and event detection in wireless Sensor Networks and its applications. Section II presents the literature Survey and Multiple Event Detection using WSN and health monitoring is present in section III Section IV presents proposed techniques that we have used and V presents results of our research work . Section VI concluded the research paper.

II. RELATED WORK

GA (Genetic algorithm) is stimulated from the biological evolutions that are effective for searching domain independent methods. These methods can help the user for solving the problems in varied number of application domains. Firstly, GA generates some number, known as population size from the first generation of strings. Next, for evaluating the solution for the first generation, payoff function is used. Good solution has maximum payoffs.

Neural network consists of a simple composition components operating in parallel. Stimulation of these components is through the biological neural system. By its nature, the many components are connected between the main network and defines a specific function.

Rana Ejaz Ahmed[13] Author proposed a common approach to recognize and localize the source of failures or doubtful nodes in WSNs that is Centralized approach . In this approach all the power is in the hand of central nodes. Most of these methods have been used for any kind of fault. The complex messaging and management can be transferred to the central node which can extend the network life cycle. Usually active central node detection mode was used to recover the performance and status of each node . This method has several advantages like- good detection accuracy resulting from the global knowledge available at the base station.[**14**]

Yu Liu [15] has proposed used CS (compressive sensing) multi-event detection program. Similar problems with CS, CS effective recovery algorithm can be used to reconstruct the original signal containing multiple real-time events. Simulation results show that the use of CS multi-event detection with higher than traditional Bayesian event region detection probability of detection technology. The authors also discussed the relevance of time event detection problem.

M. Mathiesen [16] introduced wireless ad-hoc networks and their applications in industrial automation. Author has also made the difference between open-loop and closed-loop applications, and presented some example scenarios. Due to the fact that open-loop applications send data that is less process-critical, these scenarios have already started to appear in industry.

P. Suri [17] concluded that efficient energy consumption plays an significant role in the wireless sensor network (WSN). The protocols like LEACH, SEP etc divide the network into cluster and then select a (cluster head) CH between that nodes having maximum energy amongst all other nodes but a lot of energy is exhausted in broadcasting decreasing the efficiency of the network. Wastage of energy also takes place in making the clusters of the nodes which do not have any data to transmit and results in reduction of efficiency of the network.

Q. Liang and L. Wang, [18] introduced Event detection for WSN , author proposed a fuzzy logic with double sliding window for event detection. Fuzzy logic is used to combine personal and neighbors' observations for an event detection. Limitations of this paper is that it don't study the effect of fuzzy logic approach. This approach does not use any temporal semantics and do not analyze then umber of false alarms.

M. Marin Perianu and P. Havinga [19] proposed a framework for detecting both simple and composite events with distributed collaboration of sensor nodes. Each protocol works in two phases: (i) initialization phase, and (ii) collection phase. Drawbacks of this paper is that sending data periodically from sensors to the subscriber incurs communication overhead which causes large energy consumption.

L. A. Zadeh [20] proposed composite event detection in WSN. The proposed protocol divides the set of sensors into a number of non-disjoint subsets called detection sets .Each detection set defines a tree, constructed using the Breadth First Search (BFS) algorithm starting from a gateway and data is then collected along this tree. Disadvantages of this paper is that sending sensed data from sensors to the gateway node incurs high communication overhead which causes large energy consumption. .

C. T. Vu, R. A. Beyah, and Y. Li [21] proposed an compressed Sensing approach . CS achieves this task by exploiting the sparsely of the signal. By the reduced amount of data samples, CS may help reduce the energy consumption and storage costs associated with Structural health monitoring systems. Structural Health Monitoring having issue of the cost associated with data transfer and storage.

M. Marta, Y. Yang, and M. Cardei [22] proposed an human health monitoring approach . Author disscuessed about CS technique that do help to reduce the global traffic and to decrease data correlation . Thus WSN which apply in CS technique should require low power. Major drawback is in health monitoring is that WSN is dealing with Security attacks.

Deepapriya [23] describes health-related applications of WSN and increase the performance of the nodes by taking into account security and privacy as important metrics. Author has also discussed principally uses different types of sensors to detect all the diseases applications like chronic diseases, fall detections, monitoring vital signs, infant monitoring and wellness monitoring. While lots of issues overcome in the development of all existing applications, the most significant ones are security and privacy.

Liu Xiang, Jun Luo,Athanasios V. Vasilakos[24] discussed about compressed Sensing and event detection approach. Compressed sensing technique is used by some existing schemas in wireless sensor network to detection of any event .. So main goal of existing schema is to purpose a distributed approach based in CS to localized and addressed the unsolved challenges.

Norman Dziengel [25] Author discussed about event detection in WSN . How WSN comes in different forms for

event detection. Advantages of this paper is Reliability, Save energy. Robustness and simplicity ' etc. Some drawbacks of this paper is Unable to detect complex event.

JiaMeng [26] has focused on solving detects the problem as wireless sensor networks with compressed sensing (CS) issues in the sparse event. In this article, the first contribution is to develop questions for the compressed sensing sparse event detection in wireless sensor networks. Number (wake-up) sensors can greatly reduce the number of events similar to the sparse level, which is far less than the number of sources. Second, the authors have believed that the event has a binary nature, and Bayesian detection method uses a priori information. Finally, the author has analysed the Gaussian noise performance compression algorithm perception.

III. METHODOLOGY

1) MULTIPLE EVENT DETECTION USING WSN :HEALTH MONITORING

Health monitoring systems are particularly[24] important when an addressing potential injuries of default.

The main tasks of the medical sensors are to collect physiological signals and send them to the personal server.[26]

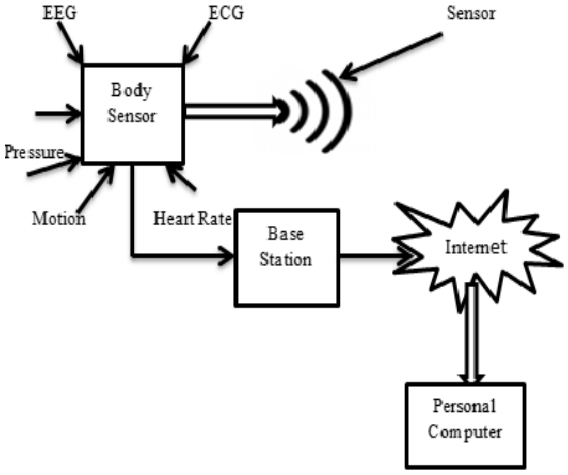

Figure 1: Hardware Architecture

Event detection [27] is the important part, because any sudden change in body gives terrible results. It is also difficult to monitor the health of a patient for a long time. These network system not only monitoring the health but also give the best changes result.

The above figure shows that sensors are attached to the patient through the jelly so that they remains stable and does not give any electrical shock to the patient. Biometric sensors are the transducers that converts the biometric values like temperature, pressure etc. taken from the patient into electrical signal. Now, these signals are reached at the base station through internet. It convert these analog signals into digital signals and then the information is transmitted from the base station in the form of electromagnetic waves. These signals received by the PC and stored in the memory for future use.

2) PROPOSED TECHNIQUE

WSN space for independently distributed network of sensors monitors the environment. The main disadvantage is the cost of energy and energy efficient processing in WSN. One of the major cost of energy is depleted with the WSN communication between nodes in energy, and when the sensor is an event of interest, sometimes only transmits data to the gateway node. Sensors may only be opened in the event of communication, save communication costs. In the dynamic environment, large amounts of data collected may not be interested in saving even more difficult. To overcome this problem, define a constraint to be relaxed event, usually modeled as a set of thresholds or probability[28]. Event detection is divided into three main categories: threshold-based, supervised and unsupervised. Wireless Sensor Networks are a spatially distributed network of autonomous sensors. These sensors are deployed to collect data from multiple data points at a given time then that collected data is to be aggregated at any node and some method is to be used for threshold based event *detection* to measure the change in the data. To solve these issues we used genetic algorithm

Step 1: Design and develop a network area for the simulation of proposed work in WSN with the help of height and width of network.
Step 2: Describe N number of nodes in the network area for simulation work.
Step 3: Define the source and destination node from the N nodes.
Step 4: Initialize coverage area of each nodes including source and destination.
Step 5: Genetic algorithm is used to develop route between source and destination then transfer data and also check for event occurs in the network.
Step 6: If fitness function is satisfied then ANN (Artificial neural network) is applied to identify the event. ANN will block that event and starts transferring the data between nodes. Else the data transferring will be stopped.
Step 7: To check the accuracy and efficiency of the proposed simulation work, we will calculate the QOS parameters like Throughput, Error Rate.

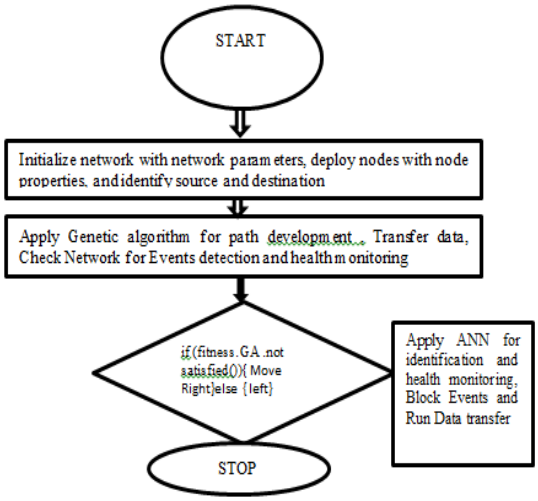

Figure 2 : Flow Chart of Proposed Work

IV. RESULTS AND DISCUSSION

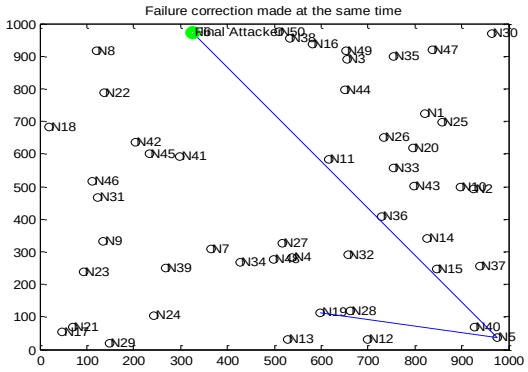

Figure 3: Network area of the proposed network

The network area of the proposed work consists of area 1000× 1000 having 50 numbers of nodes to run the network. The network runs for five times that means five iterations have been applied to run the network so that best results can be obtained.

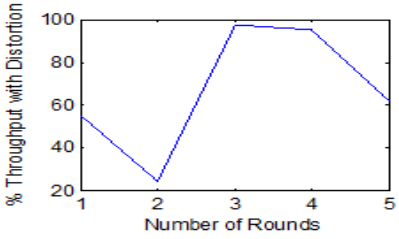

Figure 4: Graphical depiction of throughput with distortion

As depicted in the figure above, system is being run for five times. At first iteration, approximate value of throughput in %age is obtained as 58%, for the second iteration, throughput value is 25 %.For 3rd, 4ty and 5th iteration the values of throughput obtained are 99%, 96% and 60 % respectively. If we calculate the average value of throughput with distortion then it is 57%

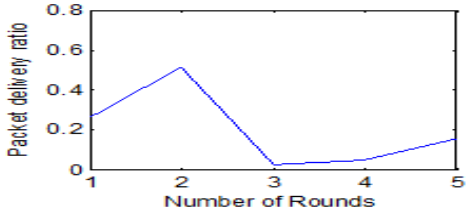

Figure 5 : Graphical representation of Packet delivery ratio with distortion

The above figure depicts the packet delivery ratio obtained for distortion network with five iterations. The average value of PDR (Packet delivery ratio) obtained for the simulated network is approximately 0.23. As we know that Packet Delivery Ratio is the ratio of the packet received and the packet transmitted. So, the value obtained is very less, which depicts that the number of packet received are less as compared to the number of packet transmitted

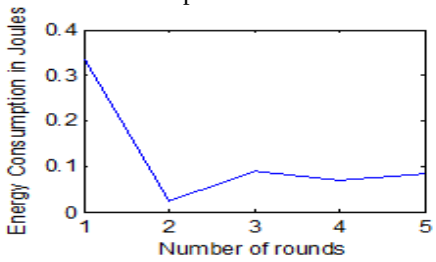

Figure 6: Graphical representation of Energy consumed with distortion

The above figure is depicting the energy consumption for distortion network.

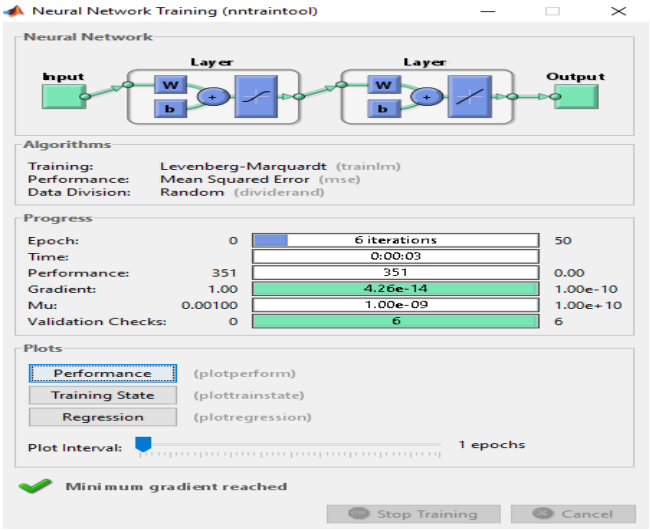

Figure 7 : Neural network training

ANN training architecture is being shown in figure 7. As shown in the figure, NN has three layers.

i. **Input layer:** The trained data is provided on this layer.
ii. **Hidden Layer:** Processing of the trained data is done in this layer.
iii. **Output Layer:** Classified results are taken from this layer.

The system is not essential to run for all the iterations provided. Training of the Feed Forward Network will only be completed if any of the stopping criteria like Epoch, Time, Performance, Gradient and Validation Checks will meet. After completing its task, Back Propagation Neural Network will cross check it

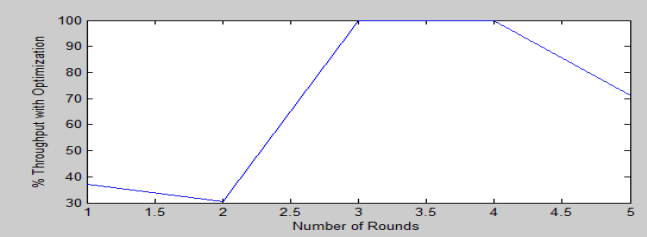

Figure 8: Throughput with optimization

Throughput means the number of outcomes that are passing through the source node towards the destination nodes or it can be said that it is the total number of packets delivered over the total simulation time. Graphical representation of the through put values obtained with optimization is shown in figure 8 . Here, optimization is done using Genetic algorithm for finding the exact path and the packet for reaching at exact destination. The process is repeated five times to achieve accurate results.

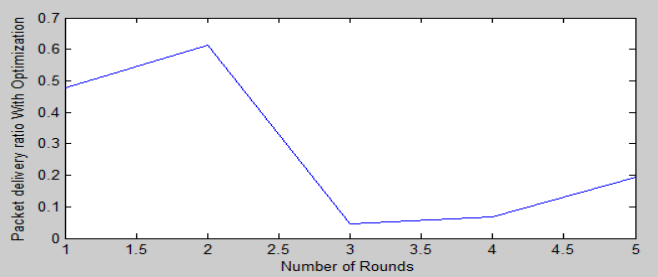

Figure 9: PDR with Optimization

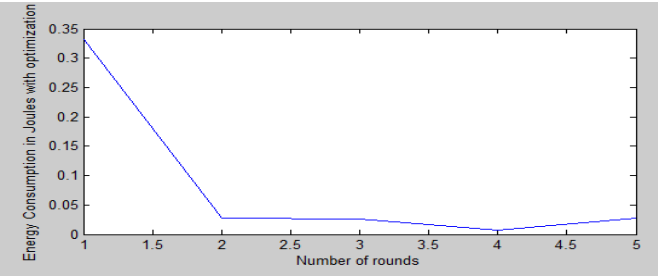

Figure 10 : Energy consumption with optimization

Above graph is after the optimization with genetic algorithm. The average value obtained for energy consumed by the network is .1 J which is very small value

V. CONCLUSION

Use of wireless sensor network (WSN) in medical field is increasing day by day. By using WSN, one can transmit information collected from the patient using wireless network. In such a scenario, it is quite difficult to identify any event in the network and to mitigate the effects of the event. The proposed Generic Algorithm not only solves the problem of finding alternative path in case of an wrong event occurred in the network but also identifies the faulty node and takes it back to the base station for recovery. The network performance has been evaluated with the parameters like Throughput, Packet delivery ratio and energy consumption. By considering Energy Consumption as a major parameter for optimization we can find alternative path. Alternative path have been evaluated using Generic algorithm and the mitigation and identification has been done using Neural Network.

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