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ENERGY BASED LOCATION OPTIMIZATION IN WIRELESS SENSOR NETWORKS

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Abstract : The Health of the systems are monitored to determine their status such operations are performed by the Structural Health Monitoring (SHM) systems. The advancements of the SHM systems are adopted in Wireless Sensor Networks (WSN) to operate on huge volume of data that deals with the placement computation. Though the study of civil or structural engineering the wireless sensors are placed at certain locations to determine the status of the systems. The occurrences of the faults are minimized through the widely used approach Fault toleration in SHM. The clustering is applied distributively to find the points to repair by placing the backup sensors that satisfy the requirements, which produces the constraint on the energy to increase the lifetime of the nodes of the wireless sensor.

Index terms-*wireless sensor networks, structural health monitoring, fault-toleration.*

1. Introduction

Wireless sensor networks are involved in the enhancements of the environments that include the climatic conditions and so on. To study about such systems the SHM are used. SHM is not only study about the environment; it has a huge application like civil structures, military enhancements and biological factors.

The SHM systems are primarily used on wired systems. Those systems were developed on the basis of public safety [3]. The main problem that exists on the wired systems is the bottleneck. The central server wire used to transfer the data. Compared to wired systems, the WSN are efficiently used to place the sensors. Also, the wired system due to limitations in the power scarifies its lifetime. Therefore, the WSN is involved in monitoring the unusual activities over a long period of time.

The challenge to place the sensors enhances the feature of location optimization in which the sensors are to be placed efficiently. This requires more detailed knowledge about the complexity of SHM systems.

To provide a general approach to WSN, the relay nodes can be used to increase the lifetime under connectivity. When N sensors are placed, their location information is collected to determine their health is done through SHM.

In the earlier stage, a wired network tends to have high reliability and stability. But there were severe constraints with the delivery of the data. To overcome the faults, SHM are used. The SHM system primarily focuses on providing the structures with integrity. The existing SHM provides the raw data at high frequency with the deployment of multiple sensors. As an energy-constrained approach, the damage indicator is used to detect the damage on the structures. The detection is a light-weight process that is handled over a cluster.

For the purpose of the location optimization, EFI (Effective Independence) is used to determine the quality of the location. It deals with the efficient placement of the sensors at the strategic locations.

The augmentation is as follows:

- To have a detailed knowledge in order to deploy the backup sensors.
- In the determination of the fault Backup Sensor Placement (BSP) algorithm and its sub-algorithms are used.
- To provide an energy-constrained approach to WSN, the decentralized SHM is used.
- The comparison is made with the existing methods to determine the efficiency.

2. Related work

The problem with the deployment of the sensors is considered. The framework is provided for the distributed network to detect the damage and the decision is made finally at the Base Station [1]. Many deployment methods for the sensors are provided for the wired systems. The systems are verified with the redundancy with the gathered information. The most cost effective mechanisms are selected, which is a part of the optimization. Such systems are different in the determination of the constraints in WSN.

SPEM is the most effective way used in wired systems for the deployment of the sensors. In this method, the sensor locations are adjusted which satisfies the engineering requirements. The problem arises is that; there may be a loss in the optimized locations, which lead to the inefficiency in

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SHM systems. Also, the quality is not achieved due to the centralized approach. This causes the loss in the data transmission. This operation fails due to usage of relays.

The observation of any event is not a straight forward method. The effectiveness in SHM is not achieved through the generic WSN. Christo Ananth et al. [4] discussed about a system, In this proposal, a neural network approach is proposed for energy conservation routing in a wireless sensor network. Our designed neural network system has been successfully applied to our scheme of energy conservation. Neural network is applied to predict Most Significant Node and selecting the Group Head amongst the association of sensor nodes in the network. After having a precise prediction about Most Significant Node, we would like to expand our approach in future to different WSN power management techniques and observe the results. In this proposal, we used arbitrary data for our experiment purpose; it is also expected to generate a real time data for the experiment in future and also by using adhoc networks the energy level of the node can be maximized. The selection of Group Head is proposed using neural network with feed forward learning method. And the neural network found able to select a node amongst competing nodes as Group Head.

To overcome the difficulties in SHM the mechanism of fault-toleration is used. The mode shape is analyzed for connectivity, cost effectiveness and the detection of the faults, which helps to increase the lifetime in WSN.

3. Overview

In order to deploy the sensors, the mode shape analysis is done. Thereby, we end up with the procedures to place the backup sensors.

3.1 Analysis of the mode shapes:

Definition 1[Ø: mode shape]

Each and every mechanical structure has a specified number of vibration patterns at certain frequencies, which are referred as mode shapes.

Definition 2[mode]

Mode is the mechanism of numbering the number of half waves under the conditions of ambient or forced which describes the pattern of vibration.

Definition 3[Reference mode shape]

It is a measurement of the set of vibrations to determine the health status is normal or damaged.

The optimization of the sensorized location deals with the placement of the number of sensor which is limited is done through the analysis of the modes. These modes shapes are very appropriate to determine the dynamic changes of the system. The mode shape analysis is done comparit to determine the exact location of the damage. The analysis is done with the help of the following method.

$$[Ø1,Ø2,\ldots Øp]=[Ø11\ldots Ø1p \\ Ø21\ldots Ø2p \\ Øm1\ldots Ømp]$$

Where m determines number of sensor and p determines the mode shapes.

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3.2 Methods for sensor deployment

The most efficient method used for the placement of the sensors is the Effective Independence. For the optimization purpose, the EFI values are calculated. These values are calculated through the fisher Information matrix referred as FIM. It helps to determine the quality in the placement of the sensors. In order to locate the sensors, the iterative algorithm is used. It is used to return the exact location of the sensors.

3.3 Limitations of the sensor deployment:

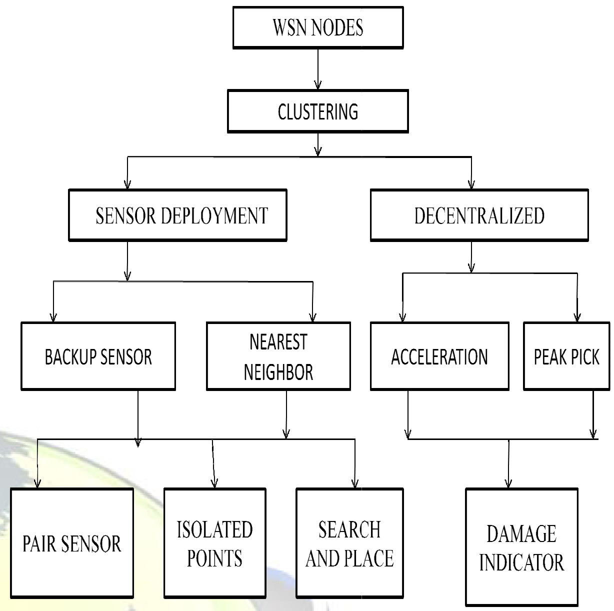
The situations that cause the faults in the sensors are listed as follows:

- Constraints with structures: it deals with the inefficiency of transferring the data over the base station.
- Due to the loss in connectivity, the communication is not efficient.
- The degradation of the performance of the sensors.
- The depletion of the energy causes the inefficiency to transmit the data.

3.4 Deployment of the number of sensors:

The main purpose of the placement of the sensors is to utilize the limited number of the sensors and minimize the occurrence of the faults. There are two approaches to place the sensors. One approach is to use set of sensors for primary and set of sensor as backup sensors separately. Another approach is to use set of sensors for primary and backup.

4. Proposed scheme



The above figure represents the system architecture to deploy the backup sensors. First, the numbers of nodes are determined. The numbers of nodes are determined depending on the network. It may vary from network to network. When all the nodes are defined along with the base station, the clustering is performed.

Clustering:

The clusters helps in placing up the Backup sensors. Each cluster analysis the node on the basis of the vibration. The model based cluster analysis is performed which defines the structural dynamic vibration pattern. In the existing system, the C-SHM is used to perform clustering which is based on the centralized approach. Hence it is inefficient for processing.

Deployment of the backup sensors:

The backup sensors are placed through location optimization. The placement is done by estimating the repairing points is helpful in finding the damage and hence overcome through the placement of the

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backup sensors. The repairing points are performed by three points namely, separable points, isolated points and critical middle points. The isolated points is the point which falls in constraint to overcome the fail or fail the network. The critical point is the poor transmission rate. Hence they are failure points. The maximum data rate is achieved in the BSP points.

The nearest neighbor is the fundamental process to identify the failure nodes. Depending on the acknowledgement received from the neighbor, a node can estimated as good or failure node.

The search and place algorithm is used to determine whether there is an availability of placing of the sensors.

Damage Indicators:

The efficiency of the SHM is determined through the damage indicator. It is a light-weighted technique to determine the damage. It is performed after clustering. The energy is consumed by concentrating on the failure nodes.

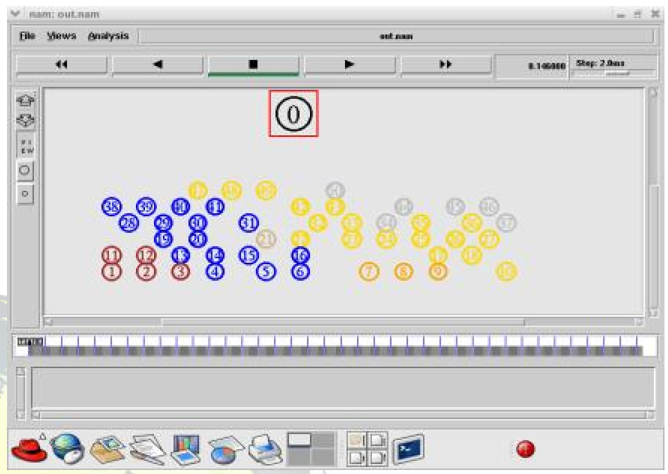
The peak-picking process is used to determine the damage. The peak value is determined through the acknowledgement from the neighbors. Depending on the value, the node can be identified as good or not. Thereby the backup sensors are placed.

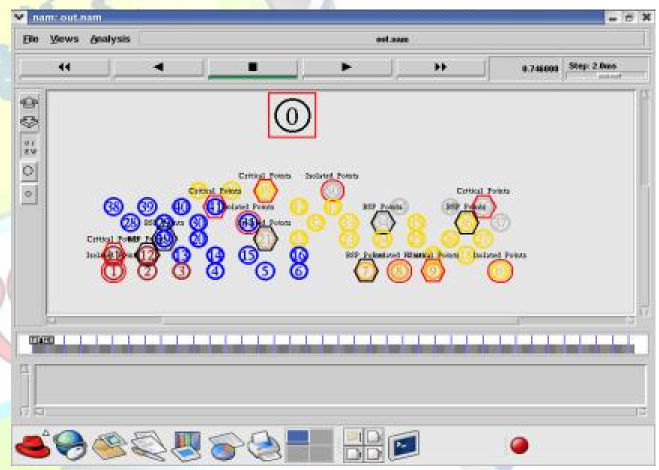
5. Performance Evaluation

The performance evaluation provides the simulated environments and screen shots which is shown below.

5.1 Simulation:

The simulation is based on the ns-2 Environment. In our simulation AOMDV is used as an underlying routing algorithm.





In the dynamic environment, the BSP points are taken. With the consideration of the BSP points, the isolated points and the critical points are taken. Here the BSP points have the highest value and hence no damage exists on the nodes. The critical points have the lowest value and they determine the damage. But the isolated points exists between the values of BSP and critical points. Thereby, the peak value is determined to verify the node is damaged or not. The peak value is the weight, which is calculated on the basis of the

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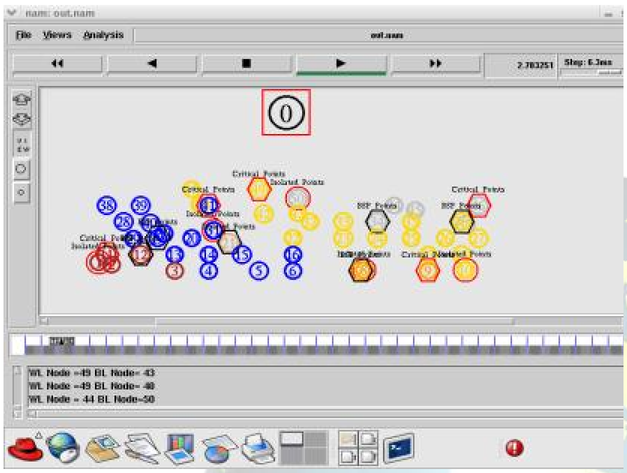
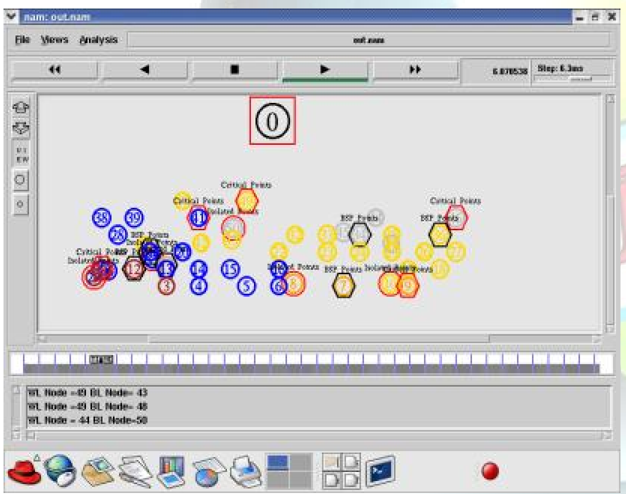
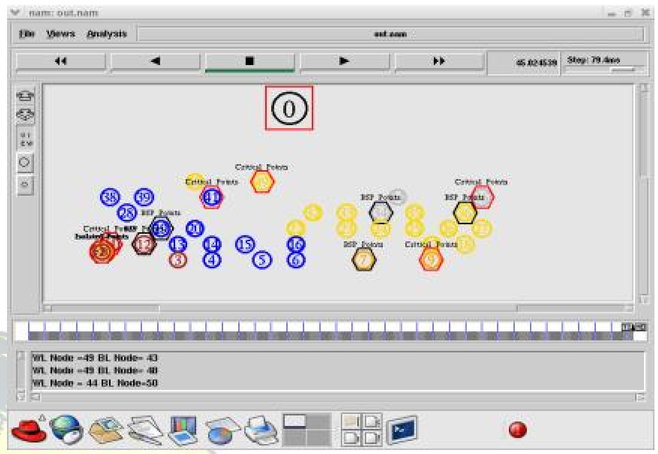
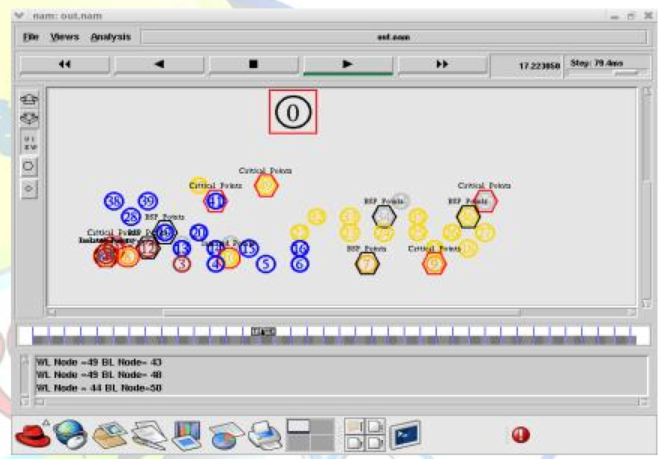
acknowledgement received from their respective neighbors. If the peak value is low then the node is said to be damaged. If the peak value is not low, then the node is not damaged. Hence the node is determined as good to transfer the data.





To achieve the best estimates to transfer the data, then it is necessary to determine the failure nodes. Therefore, the peak value is determined to know the appropriate value. So all the isolated points are moved to a particular location. Now the peak value is determined. If the node has an growth in its value, then the node is assumed to be good. Hence the node is relocated in its original position. The other nodes are not considered for transfer of data.





There are about 50 nodes taken to estimate the damage. As it is a dynamic environment, the BSP points, isolated and critical points changes accordingly. Similarly, for large number of nodes, the best estimation can be done through the analysis of the peak value.

5.2 Graph Model:

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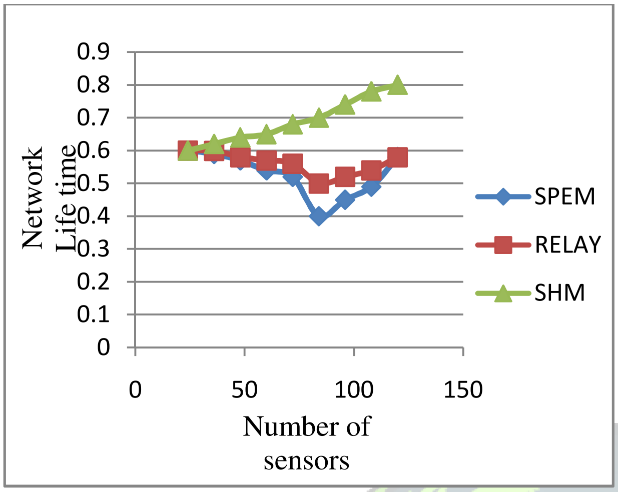

6. Conclusion

In this paper the health status of the node is determined. Thereby, the efficient transmission of the data is achieved. The three points namely BSP points, critical points and isolated points are used to verify the health status by calculating the peak value. The decentralization mechanism helps to achieve the dynamic change in the environments. Since all the defects of the nodes are identified and repaired by placing the backup sensors. Simulation results show the proposed schemes are widely used to detect the faults and efficient techniques to repair the faults.

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