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ENERGY AWARE STRATEGIES AND DISTANCE ANLYSIS OF NODE DEPLOYMENT FOR WIRELESS SENSOR NETORK

[1]Sanjay M. Asutkar, [2] Dr. RavindraC.Thool,

[1]. Associate Professor, M. I.E.T Gondio (India), [2.] Professor & Head, 5.G.G.S. Nanded (India),
Email ID:asutkarsanjay@yahoo.com

Abstract

The paper presents energy aware node deplo)ment strategies and distance analysis for Wireless sensor network system used to monitor and control the air quality in Nagpur City, India, Environmental air pollution monitoring system that measures, RSP/91 (Respirable Suspended Particulate Matter), NOx, end 502 are proposed. The traditional air quality monitoring system, controlled by the Pollution Control Deparentent, is extremely expensive. Analytical measuring equipment is costly, lime and power consuming, and can seldom be used for air quality reporting in real time. Wireless Sensor Network_sare a new and ticry challenging research field for embedded system design automation, as their design must enforce stringent constraints in terms or power and cost. Wireless Sensor Network is a fast evolving technology having a number of potential applications. In various dumnins of daily-life, such as structural and en v run menial monitoring, medicine. military surveillance, condition based maintenance etc. A WSN is composed of A large number of sensor nodes that are deployed either inside a region of interest or very dose in it. The proposed system makes use of an Air Quality Index (AQI') is presently in use. Several sensor nodes, measures pollutants information, were unifotiot) deployed in the networks lo create sensing phenomena. The simulation results cnnsist of the scenario generated and a and y co- ordinates of the nodes from the gateway by using Network Simulator (NS-2.33). For better power management we used low power strategies and hierarchical muting protocol in wireless air pollution system and caused the mates to sleep during idletime.

Keywords - Sensor Network. Power Consumption. Energy Saving Strategy.

I. INTRODUCTION

Air pollution has been aggravated by developments that typically occur as countries become industrialized: growing cities, increasing traffic, rapid economic development and industrialization. and higher levels of energy consumption. The high influx of population to urban areas, increase in Consumption patterns and unplanned urban and industrial development has led to the problem of air pollution. One of the main design issues for wireless sensor networks is the sensor placement problem. We formulate a constrained multivariable nonlinear programming problem to determine both the locations of the sensor nodes and data transmission pattern. Our two objectives are to maximize the
network lifetime and to minimize the application-specific total cost, given a fixed number of sensor nodes in a region with a certain coverage requirement. We first study a linear network, and find optimal placement strategies numerically. Through numerical results, we show that the optimal node placement strategies provide significant benefit over a commonly used uniform placement scheme. Furthermore, we also present a performance bound as a benchmark. Lastly, we extend the results to a more sophisticated planar network, and use numerical results to evaluate the performance of the proposed strategies.

Wireless Sensor Network

A sensor network is a group of specialized transducers with a communications infrastructure intended to monitor and record conditions at diverse locations. A sensor network consists of multiple detection stations called sensor nodes, each of which is small, lightweight and portable, Every sensor node comprises of a transducer, microcomputer, battery, transceiver and power source. The transducer generates electrical signals based on sensed physical effects and phenomena. The microcomputer processes and stores the sensor output, The transceiver, which can be hard-wired or wireless, receives commands from a central computer and transmits data to that computer. When such thousands of nodes are brought together that communicate through wireless channels for information sharing and cooperative processing makes Wireless Sensor Network. Although each node in the WSN is very

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limited in energy. communications ability and computing and storage ability. the WSN has very obvious advantages:-

I) They can store a limited source of energy.

2) They have no hassle of cables and havemobility.

3) It can work efficiently under the harsh conditions, and it has deployment up tolarge.

4) It can be accessed through a centralizedmonitor

5) Communications networks are self-organized with network topology adaptive to various environments.

The Wireless Sensor Networks are being used in many ways. Traditionally, it has been used in the high- end application such as radiation and nuclear-threat detection system's, weapons sensors For 'ships, biomedical applications,, habitat sensing and seismic monitoring. Recently, Wireless Sensor Networks are focusing on national security applications and consumer applications suchas:-

I. MilitaryApplications

- Monitoring, tracking and surveillance ofborders
- Nuclear. biological and chemical attackdetection
- Battle damageassessment

2. EnvironmentalApplications

- Flood and oceansdetection
- Forest firedetection
- Precisionagriculture

3. HealthApplications

- Drugadministration
- Remote monitoring of physiologicaldata
- Tracking and monitoring doctors and patients inside ahospital

4. HomeApplications

- Automated meterreading
- Homeautomation
- Instrumentedenvironment

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II.DISTANCE VECTORALGORITHM

Wireless Sensor Network (WSN) is the collection of power-efficient sensor nodes that work together to form a network for monitoring the target region (II. The no. of nodes in the wireless sensor network has a common tendency to send the data with itself to transmit it to the nearby nodes so as to send the data to the gateway. The nodes utilize their energy for data sensing, data processing, and data transmission/reception, amongst which, the energy consumed for communication is the most critical. In Wireless Air Pollution Monitoring System a packet consists of two pads: the data, which is the reading collected by the source node, and an id, which identifies the node uniquely in the network such as a network address. The cluster head collects readings from every node and stores them in a list. As lig I shows the processes carried out to produce a performance output before the WSN model can analyze. Three major process involved in analyzing the performance of WSN are, creating a scenario model, simulating and analysis. All these processes were done by the Network Simulator (NS). We can also speed up or slow down the speed of the simulation to clearly observe and analyze the network scenario. Once the simulation has been done, the graphical metrics results collected during simulation of a network scenario. The performance of WSN models, which are created and simulated. Several sensor nodes can be uniformly deployed in the networks to create sensing phenomena. The simulation results recorded are the amount of data packets sent and received by each node. The throughput and the delay can be noticed. All these graphical simulation resuits from several WSN models can be compared and analyzed separately. The coordinate of each node and the distance between each sensor node to the sink node for both WSN modelcreated.

The locution of each sensor node are determined and defined in terms of coordinate (Xn. Yn). The distance (0) between each sensor node Irom sink node had been determined:-

D

= (I) Where, Xn — difference between coordinate X of the sensor nodes and the sink node Yn — difference between coordinate Y of the sensor nodes and the sink node

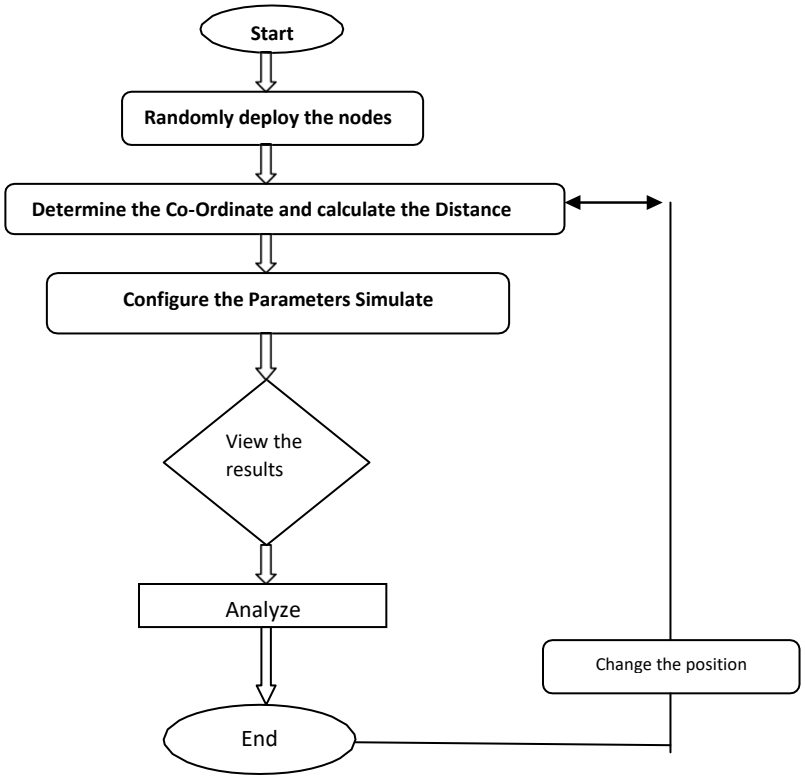

Fig 1.- Flowchart of the algorithm to analyze the performance of WSN

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The strategy to deploy the WSN for our system is as follows:-

1) First partition the region of interest into several smaller areas for better management of huge amount of data that will be collected from the system and for better coordination of the various components involved.

2) Deploy one cluster head in each area these will form cluster with the nodes in their resp-ective areas, collect data from them, perform aggregation and send these back to thesink.

3) Then, randomly deploy the sensor nodes in the different areas. These will sense the data; send them to the cluster head in their respectivearea.

4) We will use multiple sinks that will collect aggregated data 171 from the cluster heads and transmit them to the gateway. Each sink will be allocated a set of clusterheads.

5) The gateway will collect results from the sinks and relay them to thedatabase.

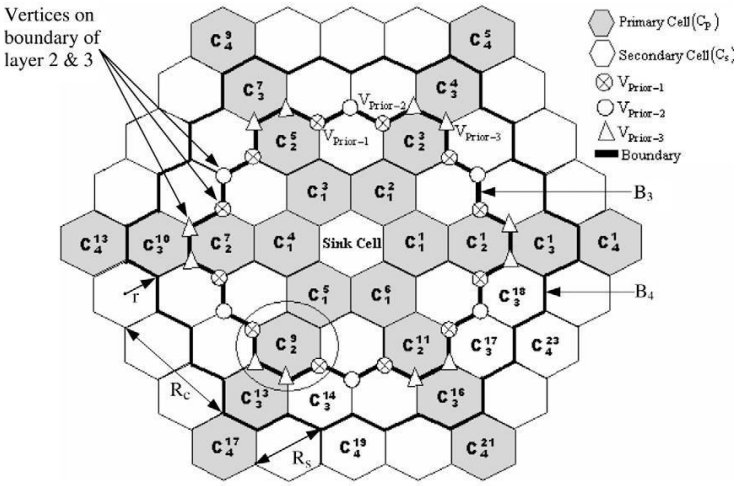

Fig 2:- Node Deployment Strategy

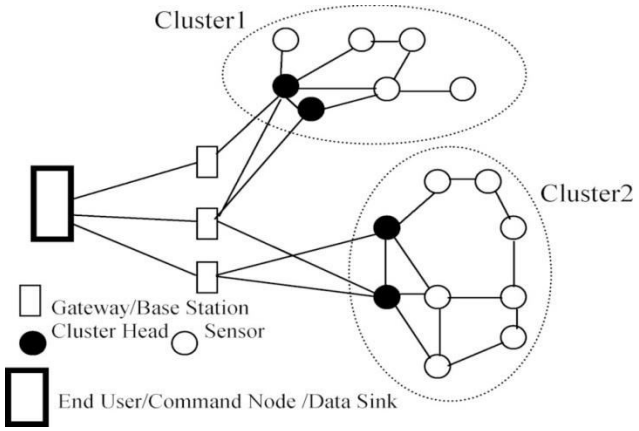

Fig 3:- Diagram of the flow of data from Nodes to the Gateway

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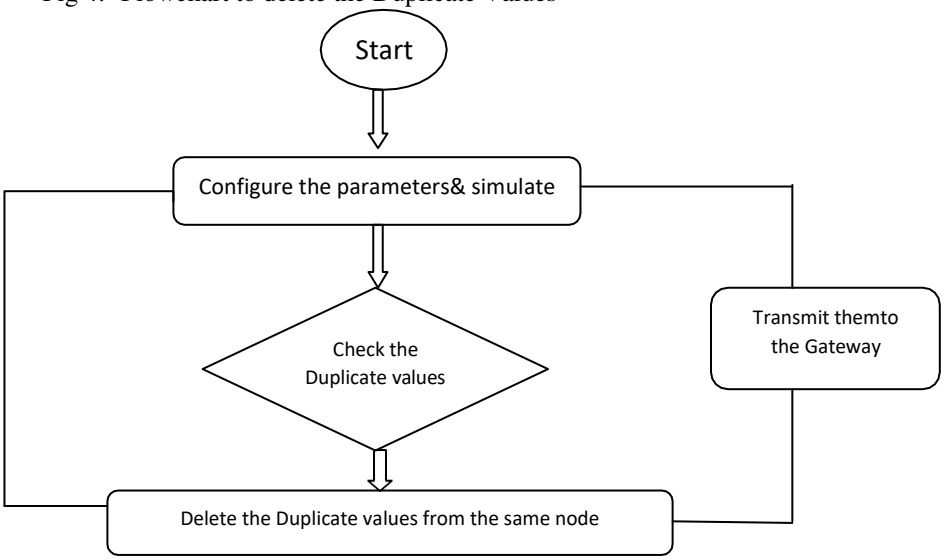
As, the above figure 3 shows the data from the nodes which are deployed and set into one network transmits the data to the available nearby nodes and then further this reading reaches the cluster head and then to the Gateway. There are psix nodes and the data transmitted from every node is denoted by a particular colour as shown inTable.
Table I: Colour codes for the miles

Node id	Colour
1	Green
2	Blue
3	Red
4	Black
5	Purple
6	Cyan

As shown in figure 4, the parameters are configured so as to simulate the network and observe the output. During this type of data transmission the duplicate values. The same values from the farthest nodes arc transmitted many times to the cluster head and the power of the node is wasted. Therefore, by using the Data duplication Technique as shown in the flowchart checks tbr the duplicate values from the same node id. I it recognizes the duplicate values then deletes the value thereby saving the power else transmit it to the cluster head.

Fig 4:- Flowchart to delete the Duplicate Values



The figure 5 below is of area in Nagpur, which can be divided into smaller areas. Every small area will have number of nodes which will collect the data and send it to the cluster head where the duplicate packets will be deleted and then it is further send to the. gateway and from gateway to the database

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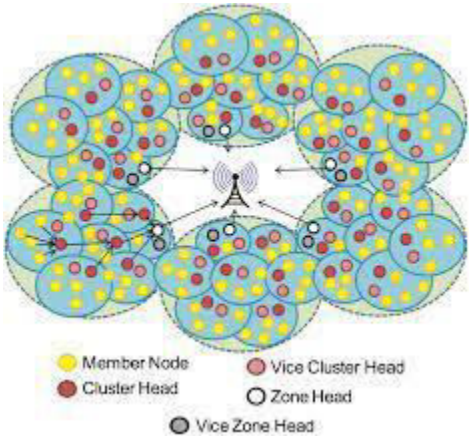

Fig 5 - Area is divided Smaller parts

III. TOOLS

A methodology is a collection or methods. Techniques, was and doeurneniation aids which help the system developers analyze, design and implement a software system. This section. describes the methods used to conduct the research and the fact finding techniques. Various research techniques can be used to gather data and analyze WSN routing protocols. NS2 has emerged from the VI NT project. It is written and developed in C++ and TCL. It is widely used network simulator. It provides extensive support for simulating TCP/IP, routing and multi protocols over wired and wireless network. Its object lob oriented design, mix or C-0-4- and 'FM, increases the complex it; of the software,

IV. RESULTS

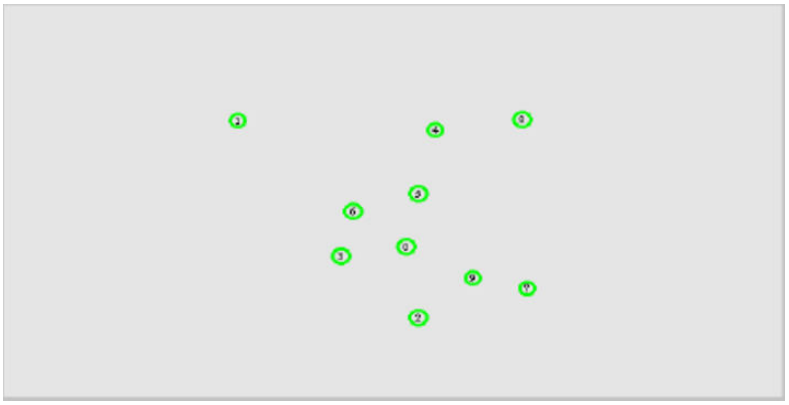

Fig 7:- Field Topography

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Effect or Distance on Nodes from the Cluster Head

The average energy utilized (joules) and the average distance of the nodes from the cluster head (meters) for number of experiments carried out in which the considerations of total area and all other simulation parameters were kept constant. The placements of the nodes from the gateway were changed for every experiment.

As shows for the readings for the energy goes on increasing as the distance between the nodes and the cluster head goes on decreasing. As we can observe that for experiment number 5 the distance is very less and the energy utilized is also very less but the placement of nodes such closer to the head covers very less area for monitoring which is not desirable . Thus, we have choosen experiment no 2 where we can cover desirable area of monitoring and the energy utilized is also desirable.

Results for elimination or duplicaie readings

(i) The figure 8 below consist of the unique node id and the data which is transmitted from these nodes to the cluster head.The simulation time which was set for this simulation is 80 sec. The data which is choose is random data(i.e.) this data can be considered as the readings tbr air pollution system. While considering, some of readings are duplicate values Le with same node id and the data.

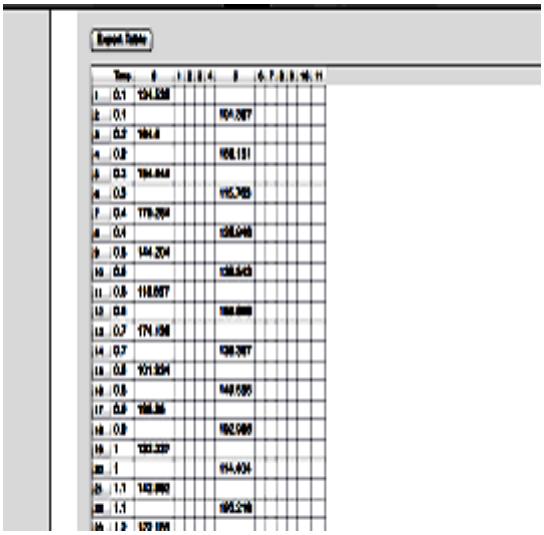

Fig 9.- The Data after the removal of Duplicate values with same id Effect of Event Time:

Nodes in a WSN sense the environment and forward the gathered data after a given time interval (Event time). Event time in this case denotes the time which elapses before a node sends signals from the sensor field to base station. Higher event time will lead to fewer packets within sensor network and consequently less congestion which reduces delay. The event time, however should not be reduced to an extent that it compromises the quality of data gathered from the sensor field. Data dissemination from a node should he event driven whereby it should be triggered by the occurrence of an event in the sensor field. This ensures that onl). useful signals are transmitted in WSN. Throughput Figure 10 shows the throughput of the receiving node in our scenario. Throughput of a node is deiined as the average rate of successful message delivery over a communicationchannel.

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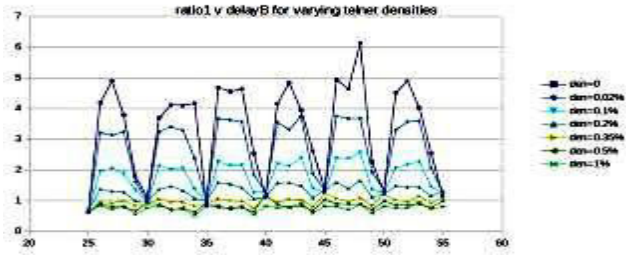

Fig 10:- Graph for throughput

Packet loss occurs when one or more packets of data travelling across a computer network fail to reach their destination. Packet loss is distinguished as one of the three main error types encountered in digital communications; the other two being bit error and spurious packets caused due to noise. When caused by network problems. lost or dropped packets can result in highly noticeable performance issues or jitter with streaming technologies, voice over 1P, online gaming and videoconferencing, and will affect all other network applications to adegree.

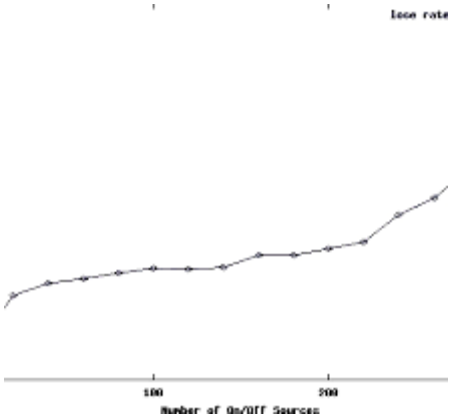

Fig 11 - Loss of Packets

However. it is important to note that packet loss does not always indicate a problem. If the latency and the packet loss at the destination hop are acceptable then the hops prior to that one don't matter. Some network transport protocols such as TCP provide for reliable delivery of packets. In the event of packet loss, the receiver asks for retransmission or the sender automatically resends any segments that have not been acknowledged. Although TCP can recover from packet loss, retransmitting missing packets causes the throughput of the connection to decrease.

V. CONCLUSION

The research study on energy consumption estimates the lifetime of a node. A node's lifetime expresses how long a node has been active before it halts due to lack of battery capacity. The lifetime of nodes directly affects the lifetime of the network. Network life time is defined as the time taken for first of the

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nodes in the network runs out of energy. Through this project, following are the important issues contributing to the performance of WSNs.The location of the sensors affects on power consumptions, sensing capability, operating environment and connectivity itli the cluster head,For example. from the simulation, we can see that a lot nodes which cause to failure in the sensor to associate with cluster head of the network due to the distance between the gateway and the nodes. Therefore, longer distance will cause node to drop the data packets during the trans m ission.

■ Other factors to be considered are the fact that if the transmitted packets were to arrived at the same time at server node, it would create congestion at server node and may cause lower server throughput and longer delay in transmissiontime.

• As the readings collected are considered of Air pollution, thus the readings are monitored after sometime from every area. This in return will result in less energy consumption andcongestion.

This project uses a novel technique to do data elimination in order to tackle the challenge of power consumption minimization in WSN. This highly reduces the amount of data to be transmitted to the sink, thus reducing the transmission energy required and at the same time representing the original values accurately.

• The Data Elimination Technique and the placements of the nodes in the scenario increase the throughput of the network and reduce the dataloss.

VI, FUTURE SCOPE• This project only focuses on performance of Wireless Sensor Network in Network Simulator software. Therefore, for the future development. the real Building Automation System can be integrated with the Wireless Sensor Network to control and improve indoor building condition and both installation and maintenance costs significantly reduced. • This project can be continued for other Sensor Network application such as battle field monitoring by utilizing moving sensornodes.

• For further minimization of data to be transmitted from the nodes to the gateway, the use of appropriate Data aggregation method can bedone.

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