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INCREASING LIFETIME AND REDUCING ENERGY CONSUMPTION OF A WIRELESS SENSOR NETWORK USING A NEW APPROACH CTT (COOPERATIVE THRESHOLD TRANSITION)

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Abstract — **Wireless Sensor networks are dense wireless networks of small sensors, which collect and disseminate environmental data. The collected data or information is processed, interpreted and accordingly actions are performed. Wireless sensor networks facilitate monitoring and controlling of physical environments from remote locations with better accuracy. One of the major issues in wireless sensor network is to maximize the lifetime of the network by minimizing the energy consumption by the node. In this paper we have proposed a technique CTT (cooperative threshold transition) this process take care of energy consumption into the network and because of this power management can be utilize in an efficient manner so that life time of a network is increases. Due to this technique transition time between various cycles like sleep, idle and active get reduced and consumed energy can be saved.**

Keywords- MAC (Medium Acess Control), Wireless Sensor Networks, Power Management, NW Sleep & Life time.

1. Introduction

Sensor network is formed with group of nodes. Few sensors data are required by the user, which are called the source node. These sensors share a common channel. Generally the end node where data is processed is far away from the sources and due to lack of any fixed infrastructure, sources transmit data through the intermediate nodes. A sensor participates in two types of operations, sensing and data forwarding of the data coming from other nodes. It is as a network which consists of equally distributed autonomous devices using sensors capable of monitoring the physical or environmental conditions such as temperature, sound, vibration, pressure, motion or pollutants, at various different locations especially for buildings in campus. The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created [1]. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth[2]. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network.

2. Sensor Nodes

A sensor node, also known as a mote is a node in a wireless sensor network that is capable of performing some processing, gathering sensory data and communicating with other connected nodes in the network. A mote is a node but a node is not always a mote. Node deployment in WSNs is application dependent and affects the performance of the routing protocol. The deployment can be either deterministic or randomized. In deterministic deployment, the sensors are manually placed and data is routed through pre-determined paths. However ,in random node deployment, the sensor nodes are scattered randomly creating an infrastructure in an ad-hoc manner .if the resultant distribution of nodes is not uniform, optimal clustering becomes necessary to allow connectivity and enable energy efficient network operation. Sensor nodes often make use of ISM band which gives free radio, spectrum allocation and global availability. The possible choices of wireless transmission media are Radio frequency (RF), and Infrared. Lasers require less energy, but need line-of-sight for communication and are sensitive to atmospheric conditions. [2, 3, 4] Infrared, like lasers, needs no antenna but it is limited in its broadcasting capacity. Sensor nodes can use up their limited supply of energy performing computations and transmitting information in a wireless environment. As such, energy conserving forms of communication and computation are essential [4, 5]. Sensor life time shows a strong dependence on the battery lifetime. In a multihop WSN, each node plays a dual role as a data sender and data router. The malfunctioning of some sensor nodes due to power failure can cause significant topological changes and might require rerouting of packets and reorganization of the network Most transceivers operating in idle mode have a power consumption almost equal to the power consumed in receive mode[1,2]. Thus, it is better to completely shut down the significant amount of power is consumed when switching from sleep mode to transmit mode in order to transmit a packet.

Figure 1.wireless sensor network architecture

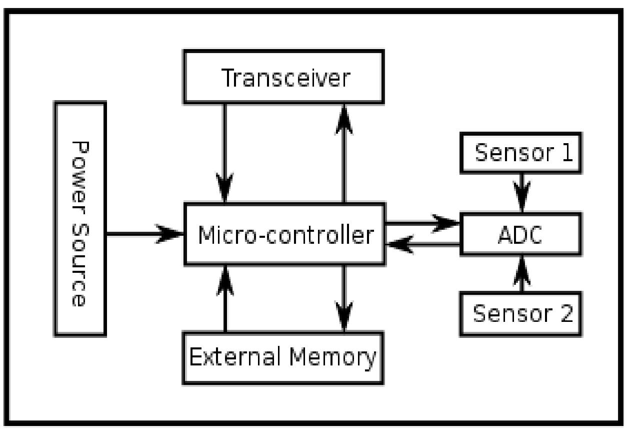

Figure 2.Internal Structure of sensor node.

3. Related Work

A work cannot be completed without referring to the prior work, papers and books written on the subject there are so many researches going on in the field, and also there is much scope for feature research work in the area of energy consumption reduction in Wireless Sensor networks. The idea of energy consumption in WSN referenced from [1, 2, 7, 8, and 9]. These References give the elaboration about implementing concept of CTT (cooperative threshold technique) for efficient utilization of energy for wireless sensor network. Wireless Sensors are small devices with limited energy without energy backup; they are more of one-time-use sensor. Therefore, an energy-efficient routing mechanism would mean longer sensor lifetime and higher network efficiency. Research is ongoing in this particular field many of approaches have been defined. In reference paper [1] RPM algorithm have been defined that exploits additional energy saving opportunities introduced with the new generation of faster platform transmitter and receivers. This approach optimizes radio sleep capabilities by introducing an intermediate power level state. Another approach in reference [11] has been implemented this approach shows that in sensor network energy consumption can be optimized by dynamic power management in this digital system has been adopted for wireless sensor network for this DPM protocol is implemented into the network. In wireless sensor network each sensor is battery driven, which are charged before deployment. Thus they keep losing the charge. Thus over activity leads to battery drain up which leads the node to die or become permanently inactive before it is recharged. Therefore the prime objective is to use a system which minimizes the energy consumption of these nodes. For this particular approach we have presented here CTT technique.

4. Proposed technique

As it has been mentioned earlier that in wireless sensor network energy consumption reduction is the key issue there are three states in wireless sensor network these are sleep state, idle state and active state according to conventional theory a sensor network must consumed least energy in sleep state while it consumed a significant amount of energy in active state [13, 14]. Another important aspect with regarding to energy is energy using for transition between these states so in our approach we are presenting a technique that is called CTT (cooperative threshold transition) that is not only take care of energy consumption during transition between these states but also introduced a threshold level. That threshold level defines a proper demarcation between sleep and active state during this approach an average value is get set and all the nodes above this value will be in active state and below this will be in sleep mode threshold value is defined on the basis of nodes in that process all the nodes have attempts to source of energy basis on these attempts average of all nodes get calculated now this average of nodes become threshold level value so all the nodes having value greater than or equal to threshold will change their state to active from sleep while other will remain in sleep mode once all the node have transmitted or received during their active state they will again switch to sleep state than again average is taken out for all other nodes so this process repeats itself unless remaining nodes have approached during processing.

5. Performance Parameter

NW life & sleep time

Network life time is defined as active session of network in which transmission and reception takes place. While sleep time is defined as inactive or passive time in this time energy consumed must be least.

6. Simulation Scenario

6.1 Software

Simulation has been carried out in NS-2(network simulator version 2) .This is a type of discrete event network simulator. Ns provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks. It has proved useful in studying the dynamic nature of communication networks. Simulation of wired as well as wireless network functions and protocols can be done using NS2.in general,NS2 provides users with a way of specifying such network protocols and simulating their corresponding behaviors.NS2 consists of two key languages; C++ and object oriented tool command language (OTcl).After simulation NS2 outputs can be categorized either text based or animation based .to interpret these results graphically and interactively tools such as NAM (Network Animator) and Graph are used. To analyze a particular behavior of the network users can extract a relevant subset of text based data and transform it to a more conceivable presentation.

6.2 Performance script

In ns 2 when we run the program two types of file created they are NAM file and TR file .The first one is Network Animator file which is use to visualize the simulation.TR file stands for Trace Root file this file contains all the important information with regarding to which information is useful to calculate various parameter so that analysis of network can be done in a efficient manner. Gawk files are used to calculate various parameters these parameters are calculated by using TR file using this file we can calculate no. of sent packets, no. of received packets, throughput, and packet delivery ratio and network sleep and network life time.

6.3 simulation parameter

In our simulation, we used 1200m x 1200m environment size we have fixed node density that is 25 nodes with Mac802.15.4 Here we are using two tcl scenarios and making comparison between them the network parameters we have used for simulation purpose shown in table.

Table1. Network parameters

Statics	Value
Channel type	Wireless
Radio propagation model	Two way ground
MAC type	802.15.4
Antenna	omnidirectional
Source type	UDP
Environment Area(m, m)	1200,1200
Number of mobile nodes	25
Traffic type	CBR
Initial energy(joule)	0.75
Routing protocol	AODV

7. Result Analyses

In our simulation we have categorized our result in two parts.

1. NAM windows: Here this window provides a Network animation which visualizes the simulation that we have done in NS2. This is the most important aspect of results because we can visualize and analyze that what we have simulated. Apart from visualizing we can get the information about the nodes those have been deployed by just clicking the node it tells about energy, bandwidth and etc about the particular node.

2. Xgraph: This is the important tool in simulation it provides graphical visualization of the simulation it is 2D graph between X and Y axis. When we simulated the particular environment than trace root file is generated by using that trace root file this tool provides graph between various parameters like PDR, Throughput, delay and etc.

7.2 NAM windows:

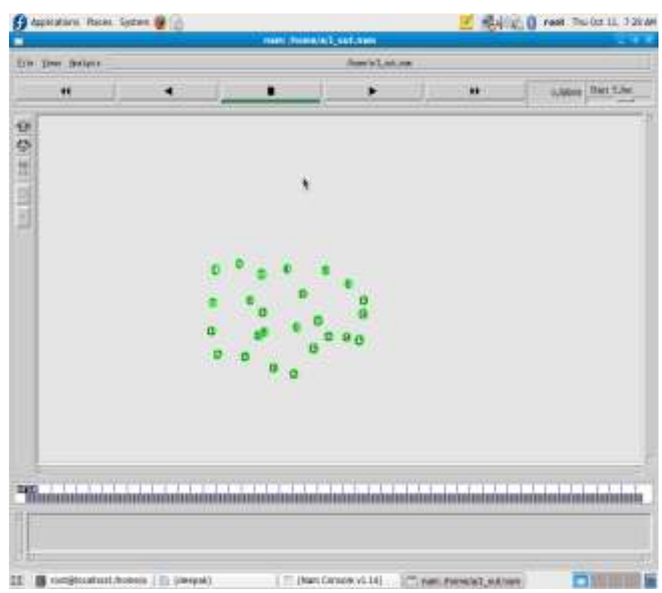

FIGURE2. Deployment of the mobile nodes in WSN environment

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Before applying CTT

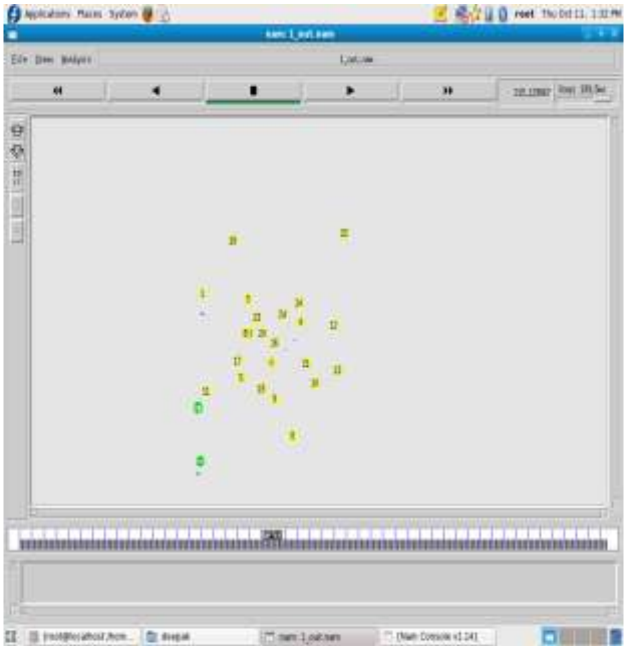


Figure3. All nodes getting transition from sleep to active

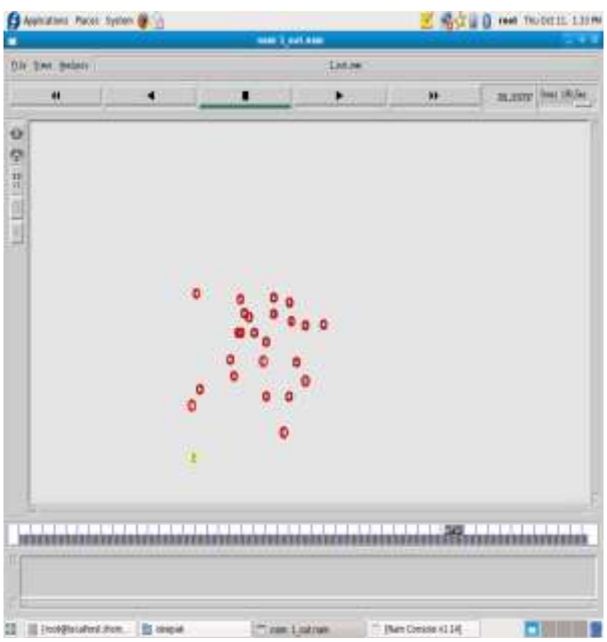


Figure4. Shows no. of energy depleted nodes

After applying CTT

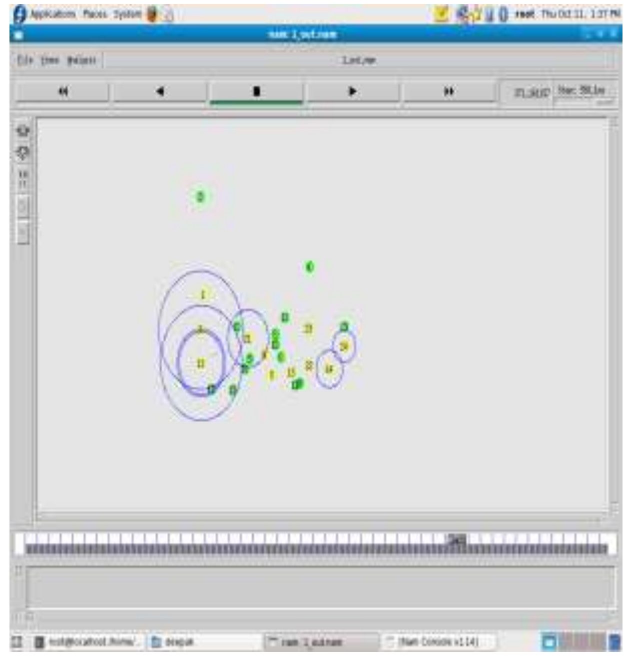


Figure5. Nodes about threshold value trying to transition from sleep to active.

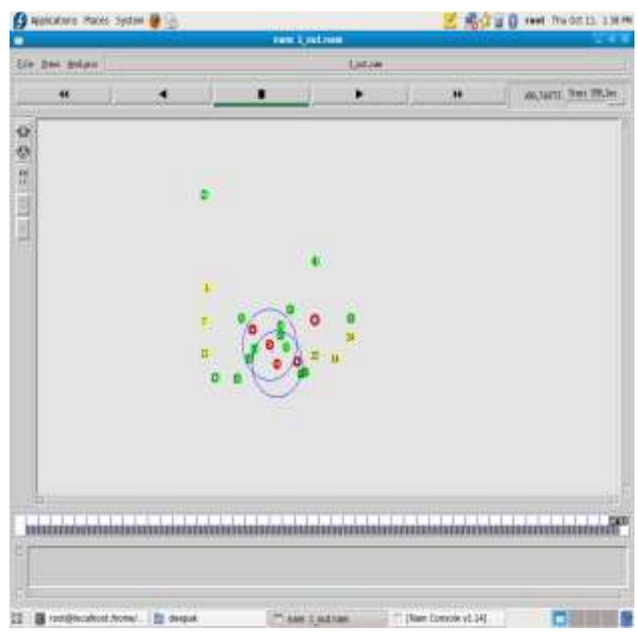
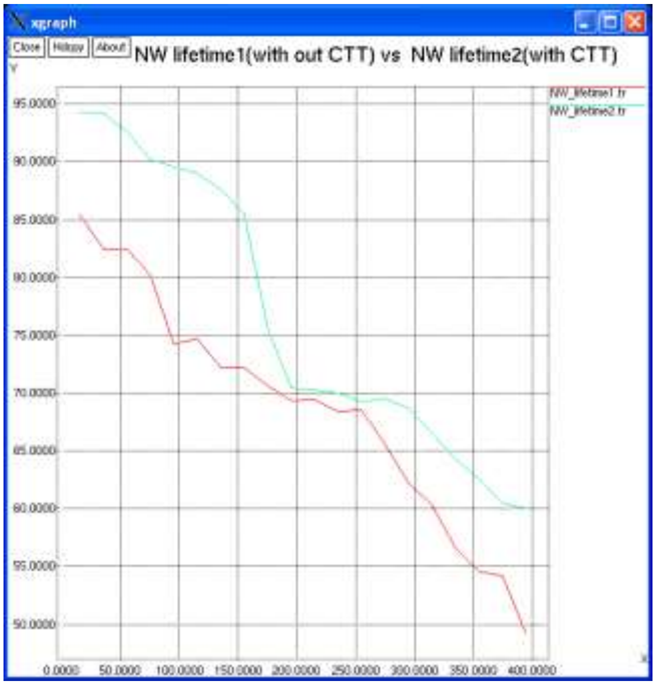
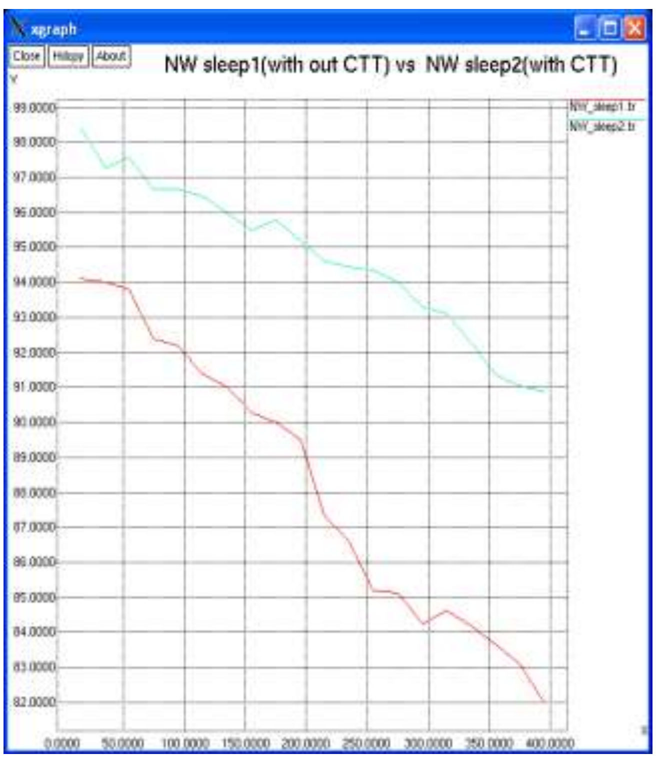


Figure6. Shows only few nodes are energy depleted

7.3 Simulated Graphs



Graph1.Shows comparison between lifetime of both scenario wsn1 (without CTT) and wsn2 (with CTT)



Graph2.Shows comparison between sleep time of both scenarios wsn1 (without CTT) and wsn2 (with CTT)

7.4 comments

NAM Windows simulation: Animation of our simulation has been presented here. There are many nodes those are reflecting different color here color resembles to energy level of the nodes. Green node resembles to high energy level while yellow for medium and red for least energy. so when we compare these scenario with and without our proposed technique we come to conclusion that by using this approach lifetime of a network can be improved as we can see in windows that because of this approach only nodes those have value more than threshold will change their state while others are remain in sleep moreover of it energy consuming during transition also get reduced so this also contributes in network lifetime .at the last of both scenarios we can see that there are numbers of red nodes in first environment that's show least energy node and more energy consumption while in our proposed scenario there are few red nodes and in that scenario consumed energy is less in comparison of previous environment.

X graph simulation: After simulation another important aspect is the analyses of graph here we have shown two graphs these two graphs provide some useful information about the network. The graph is drawn between life time and sleep time of both scenarios. In graph 1 it shows comparison between life time of network with and without applying CTT. Red line is for without CTT while Green line is on graph after applying CTT .One thing is pretty much clear with this graph that green line is reflecting improved life time while red one shows a degrading scenario. In the same way we can conclude about the next graph that is reflecting comparison between sleep times of both scenario and by analyzing this graph it can be declare that transition state is a critical phase in wireless sensor network by reducing energy during this particular phase a life time of a network can also be improved and while node is in sleep mode it should have at least energy as possible.

So we have simulated network here in two scenarios in one environment we have not used CTT approach while in another we used this approach so we can come to a result that by using this approach a performance of a network has been increased to a manifold and because of this consumption of energy in a wireless sensor network can be decreased and by following this lifetime itself increased of a network. Threshold level plays a significant role here for this energy consumption reduction because all nodes are evaluated by this threshold level and nodes those are having essential amount can transient their self for change of state sleep to active or active to sleep depending upon the nature and this transition can be experienced by visualizing the network and calculation of parameter can be done by using trace root file and than a graph can be plot between these parameters.

8. Conclusion

Sensor Networks hold a lot of promise in applications where gathering sensing information in remote locations is required. It is an evolving field, which offers scope for a lot of research. Their energy-constrained nature necessitates us to look at more energy efficient design and operation.

This paper presents a new technique for wireless sensor network by applying this technique performance and lifetime of the network can be improved to manifold this approach is called CTT (cooperative threshold transition) by implying this we have seen various results these results proved significance of proposed approach more precisely here we proposed a technique that reduces energy require for transition between various states and allow nodes to change their states only when they have value according to predefined threshold value so all nodes don't get change their state so only few nodes those are required for processing change their state while others are remain in sleep state so in this way consumed energy can be saved and can be utilize further for increasing the lifetime of a network. Future works includes scaling studies and different more parameter analysis more test will be done with different number of nodes and system complexity and with different area.

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