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INTRODUCTION OF ESC/DSC-HTN PROTOCOLS FOR ENHANCING WIRELESS SENSOR NETWORK LIFETIME

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ABSTRACT
The main problem with LEACH protocol lies in the random selection of cluster heads. There exists a probability that the cluster heads formed are unbalanced and may remain in one part of the network making some part of the network unreachable. In this proposed work we are trying to improve the network life by designingtwonewalgorithmsandwillcomparetheirlifetimewiththehelpofgraphswiththeearlierdesignleachprotocol.
Ourfirstprotocolistakingdistanceforelectionascriterionimproving energy consumption by taking different transmission energy levels for communication between base station and cluster heads and in intra cluster communication. It will also have heterogeneous nodes with different energy in battery. Our second protocol will conduct cluster head election on the basis of energy in cluster with taking different energy amplification for transmission energy in
Intra-cluster communication and cluster head to base station.

Keywords: LEACH, Wireless sensor network, ESC-HTN protocol, DSC-HTN protocol.

1. INTRODUCTION

Wireless sensor networks (WSNs) [1,2] are composed of a large number of radio-equipped sensor devices that autonomously form networks through which sensor data is transported. The sensor networks can be used in Military situation, Disaster management, Habitat observing, Medical and health care, Industrial fields, Home networks, Spotting chemical, Biological, radiological, Nuclear, and Explosive material etc[3]. Most sensor nodes use batteries for power supply in wireless sensor networks. So battery power is a significant resource for sensor devices. The sensor nodes can be installed in an extensive geographical space to observe physical phenomenon with adequate precision and dependability. Once installed, the minor sensor nodes are usually unapproachable to the operator. Therefore, conservation of energy and energy efficient routing must be taken into account to realize a dynamic and adaptive networking concept for wireless sensor networks. Thus, how to design an energy efficient routing protocol that decreases the energy consumption of data transmissions and prolongs network lifetime is an important issue.

W.R.Heinzelman[4], introduced a hierarchical clustering algorithm for sensor networks, called Low Energy Adaptive Cluster Hierarchy – based protocol (LEACH). Paper[5] and paper[6] introduce LEACH protocol in detail. LEACH protocol is a grade routing protocol. It can extend the network life-cycle but it also has shortcomings. Paper[7] proposed the work on “Improving LEACH Protocol of Wireless Sensor Networks Using Fuzzy Logic and Paper[8] proposed a general formula for lifetime of WSNs. In this paper, to

improve the network life, two new improved protocols: ESC-HTN protocol and DSC-HTN protocol are introduced. We conducted this study to determine whether the improved LEACH protocol could be better than the traditional one.

2. NEW IMPROVED PROTOCOLS

2.1 ESC-HTN PROTOCOL

There are 3 phases of ESC-HTN protocol: START

1. Number of nodes (heterogeneous with normal and advanced nodes) with fixed processing and energy are deployed.

2. Starting of first round, first is advertisement, A) cluster head election is performed on the basis of energy of node taken as criteria and. Also energy used for intra cluster communication and transmission is one tenth of the normal transmission energy used from cluster head to base station B) status of being a cluster head is advertised to the nearby nodes using one tenth transmission energy level

C) non cluster nodes listen to the medium to decide their cluster membership on the basis of signal strength.

3. SECOND IS SETUP PHASE,

A) nodes broadcast their membership status B) cluster listen to medium and create a time division multiple access based dynamic time slots for them.

4. DATA TRANSMISSION IS THIRD STEP OF PHASE A) nodes sleep until its TDMA slot and transmit during its slot

B) cluster head collect data aggregates and compresses and pass it to sink with energy normal transmission level.

5. Completion of single iteration

6. Phase works until completion of number of rounds.

END

2.1.1 ALGORITHM DETAILS

In this algorithm we are taking heterogeneous nodes with total number of nodes equal to a temporary variable temp. Temp is checked for temp>=m*NoofNodes+1 condition to get normal nodes of energy Eo else if temp<m*NoofNodes+1 then Energy Eo*(1+a). Various phase of algorithm are:

2.1.1.1 ADVERTISEMENT PHASE

Initially when clusters are started forming the decision whether a node become cluster head for the present round is dependent on the percentage of cluster heads for the network and how many times the node had been used for the same purpose. This decision is done on following criteria:

$$p_{normal} = \frac{p_{simple}}{1+ma}$$

$$p_{advance} = \frac{p_{simple}}{1+ma}(1+a)$$

Terminology

p_{normal} probability of normal node of becoming cluster head

$P_{advance}$ probability of advanced node of becoming cluster head

m is fraction of nodes

a is additional energy factor

p_{simple} probability of node of becoming cluster head as per leach protocol (taking energy at place of distance for election)

Each node that has elected itself a cluster-head for the current round broadcasts an advertisement message to the rest of the nodes. For this "cluster-head-advertisement" phase, the cluster-heads use a CSMA MAC protocol, and all cluster-heads transmit their advertisement using the same transmit energy. The non-cluster-head nodes must keep their receivers on during this phase of set-up to hear the advertisements of all the cluster-head nodes. After this phase is complete, each non-cluster-head node decides the cluster to which it will belong for this round. This decision is based on the received signal strength of the advertisement. Assuming symmetric propagation channels, the cluster-head advertisement heard with the largest signal strength is the cluster-head to whom the minimum amount of transmitted energy is needed for communication. In the case of ties, a random cluster-head is chosen.

2.1.1.2 CLUSTER SET UP PHASE

As soon as decision is done by the nodes that which cluster they belong the cluster head must have to be informed about the membership in the group.

Information is send back to the cluster head using a CSMA MAC protocol by the node. Also, the receivers of cluster heads must be on to receive their signals.

2.1.1.3 SCHEDULE CREATION

The cluster head after getting the messages of request from the nodes that want to get included in the cluster, it creates a TDMA schedule which will decide and tell each node that when they can transmit their data. This schedule is broadcasted over the cluster by the cluster head to the nodes.

2.1.1.4 DATA TRANSMISSION

As the clusters get created the schedule of time i.e. TDMA get fixed and data transmission can be started. Let us take an assumption with nodes having always data to transmit; it will be send to the cluster head only during the time which is allocated as per the TDMA schedule. It uses least amount of energy based on strength of cluster-head advertisement. So as per our proposed methodology the energy for intra cluster communication is:

Forwarding_energy1= Forwarding_energy/10;

Energy1=Energy /10;

Amplification energy when do>=do1 or do=<do1.

The radio of nodes remains off during the time of non transmission and thereby saving a lot of energy dissipated from these cluster members. But the cluster head's radio remains all time on to receive all the data from various sensor nodes of the cluster. As soon as the data from all the clusters get received the processing is done basis of signal function which compress the data into single signal. For example, if the data are audio or seismic signals, the cluster-head node can beam form the individual signals to generate a composite signal. This signal is sent to the sink which is composite in nature. After a definite time, which is decided a priori, the next round starts with every node deciding if it should be a cluster-head in the present or upcoming round.

2.2 DSC-HTN PROTOCOL

2.2.1 PSUEDOCODE

There are 3 phases in each iteration of DSC-HTN PROTOCOL:

START

1. Number of nodes (heterogeneous with normal and advanced nodes) with fixed processing and energy are deployed.

2. STARTING OF FIRST ROUND, FIRST IS ADVERTISEMENT,

A) cluster head election is performed on the basis of DITANCE of node taken as criteria and. Also energy used for intra cluster communication and transmission is one tenth of the normal transmission energy used from cluster head to base station

B) status of being a cluster head is advertised to the nearby nodes using one tenth transmission energy level

C) non cluster nodes listen to the medium to decide their cluster membership on the basis of signal strength.

3. SECOND IS SETUP PHASE,

A) nodes broadcast their membership status

B) cluster listen to medium and create a time division multiple access based dynamic time slots for them.

4. DATA TRANSMISSION IS THIRD STEP OF PHASE

A) nodes sleep until its TDMA slot and transmit during its slot

B) cluster head collect data aggregates and compresses and pass it to sink with energy normal transmission level.

5. Completion of single iteration

6. Phase works until completion of number of rounds.

END

2.2.2 ALGORITHM DETAILS

In this algorithm we are taking heterogeneous nodes with total number of nodes equal to a temporary variable temp. Temp is checked for temp>=m*NoofNodes+1 condition to get normal nodes of energy Eo else if temp<m*NoofNodes+1 then Energy Eo*(1+a). Various phase of algorithm are:

2.2.2.1 ADVERTISEMENT PHASE

Initially when clusters are started forming the decision whether a node become cluster head for the present round is dependent on the percentage of cluster heads for the network and how many times the node had been used for the same purpose. This decision is done on following criteria:

$$p_{normal} = \frac{p_{simple}}{1+ma}$$

$$p_{advance} = \frac{p_{simple}}{1+ma}(1+a)$$

Terminology

p $_{normal}$ probability of normal node of becoming cluster head

P $_{advance}$ probability of advanced node of becoming cluster head

m is fraction of nodes

a is additional energy factor

p $_{simple}$ probability of node of becoming cluster head as per leach protocol (DISTANCE)

Each node that has elected itself a cluster-head for the current round broadcasts an advertisement message to the rest of the nodes. For this "cluster-head-advertisement" phase, the cluster-heads use a CSMA MAC protocol, and all cluster-heads transmit their advertisement using the same transmit energy. The non-cluster-head nodes must keep their receivers on during this phase of set-up to hear the advertisements of all the cluster-head nodes. After this phase is complete, each non-cluster-head node decides the cluster to which it will belong for this round. This decision is based on the received signal strength of the advertisement. Assuming symmetric propagation channels, the cluster-head advertisement heard with the largest signal strength is the cluster-head to whom the minimum amount of transmitted energy is needed for communication. In the case of ties, a random cluster-head is chosen.

2.2.2.2 CLUSTER SET UP PHASE

As soon as decision is done by the nodes that which cluster they belong the cluster head must have to be informed about the membership in the group. Information is send back to the cluster head using a CSMA MAC protocol by the node. Also, the receivers of cluster heads must be on to receive their signals.

2.2.2.3 SCHEDULE CREATION

The cluster head after getting the messages of request from the nodes that want to get included in the cluster, it creates a TDMA schedule which will decide and tell each node that when they can transmit their data. This schedule is broadcasted over the cluster by the cluster head to the nodes.

2.2.2.4 DATA TRANSMISSION

As the clusters get created the schedule of time i.e. TDMA get fixed and data transmission can be started. Let us take an assumption with nodes having always data to transmit; it will be send to the cluster head only during the time which is allocated as per the TDMA schedule. It uses least amount of energy based on strength of cluster-head advertisement. So as per our proposed methodology the energy for intra cluster communication is:

Forwarding_energy1= Forwarding_energy/10;

Energy1=Energy /10;

Amplification energy when do>=do1 or do=<do1.

In this way multiple transmission levels are used for intra cluster and base station communication by the cluster head. The radio of nodes remains off during the time of non transmission and thereby saving a lot of energy dissipated from these cluster members. But the cluster head's radio remains all time on to receive all the data from various sensor nodes of the cluster. As soon as the data from all the clusters get received the processing is done basis of signal function which compress the data into single signal. For example, if the data are audio or seismic signals, the cluster-head node can beam form the individual signals to generate a composite signal. This signal is sent to the sink which is composite in nature. After a definite time, which is decided a priori, the next round starts with every node deciding if it should be a cluster-head in the present or upcoming round.

3. RESULT AND ANALYSIS

MATLAB software, here, is used to simulate the result. MATLAB (matrix laboratory) is a numerical computing environment and fourth-generation programming language. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and FORTRAN. The life time of network basically depends on no. of alive nodes. If there is less number of alive nodes then life of network is ended. The simulation parameters which are used to increase life time of network are dead nodes, alive nodes and packet transmission rate.

3.1 SIMULATION RESULT

The result refers to the measurement of life time. Figures will show the output of ESC-HTN (Energy Selected Cluster Head in Heterogeneous transmission Network) protocol. Life time of network related to no. of alive nodes, no. of dead nodes, and rate of packet transmission and how long time cluster of nodes is formed in network. System which is proposed here gives good output in all three parameters. We have take all these values and find that there are less dead nodes and more alive nodes in proposed system. Also rate of packet transmission is enhanced and due to more alive nodes cluster formation process is ensue for a long time which tends o increase life time of wireless sensor network. Modified system output shows improvement in four areas: There is less number of dead nodes; Number of alive nodes is enhanced; Packet transmission to base station occurs frequently; Even in last round clustering process is going take place. Here we are taking three scenarios as follow:

1. LEACH V/S ESC-HTN (Energy Selected Cluster Head in Heterogeneous transmission Network)
2. LEACH V/S DSC-HTN (Distance Selected Cluster Head in Heterogeneous transmission Network)
3. DSC-HN V/S ESC-HN

3.1.1 SCENARIO ONE

Parameters which are used for simulation in scenario one:

LEACH

n= 150
P= 0.1;
Eo= 0.5;
ETX= 50*0.000000001;
ERX= 50*0.000000001;
Efs= 10*0.000000000001;
Emp= 0.0013*0.000000000001;
EDA= 5*0.000000001;
EDA=5*0.000000001;
rmax= 5000;
do= sqrt(Efs/Emp);

ESC-HTN

n= 150
P= 0.1;
Eo= 0.5;
ETX= 50*0.000000001;
ERX= 50*0.000000001;
Efs= 10*0.000000000001;
Emp= 0.0013*0.000000000001;
EDA= 5*0.000000001;
rmax= 5000;
Efs1=efs/10;
Emp1=emp/10;
do= sqrt(Efs/Emp);
do= sqrt(Efs1/Emp1);

These are the basic parameter taken for simulation of results in WSN. Here n is number of nodes, p is the probability factor, Eo is the thresh hold energy value, rmax is the no. of maximum rounds. In this scenario we are taking n=150 i.e no. of nodes in network is 150. The probability factor p and thresh hold value Eo and number of rounds rmax will be taken constant for all the three scenarios. Depending on these parameters we will get different graphs which consist of output of **ESC-HTN** and **LEACH** protocol. The comaprisions graphs are given below:

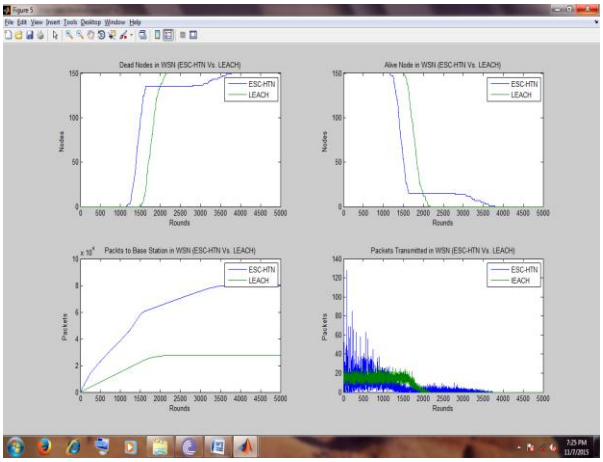

Figure 3.1.1.1 LEACH V/S ESC-HTN

The graph is showing whether our protocol is better or not and if it is better then up to which size of network it will work better.

3.1.2 SCENARIO TWO

In this scenario we are taking n= 150 i.e no. of nodes in network is 150. The probability factor p and thresh hold value Eo and number of rounds rmax will be

taken constant for all the three scenarios. Depending on these parameters we will get different graphs which consist of output of **DSC-HTN** and **LEACH** protocol. The graph will show whether our protocol is better or not and if it is better then up to which size of network it will work better. The graphs are given below:

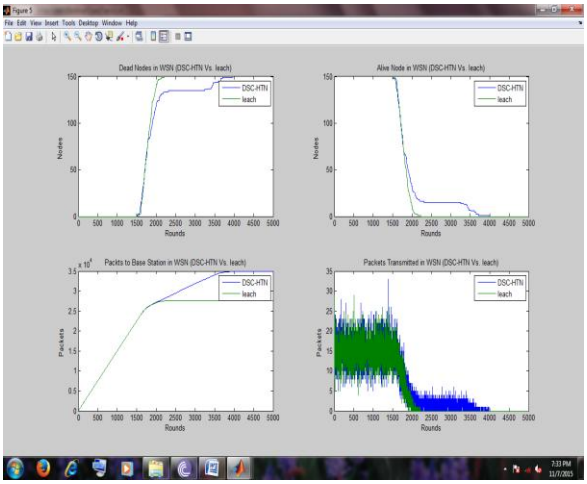

Figure 3.1.2.1 LEACH V/S DSC-HTN

3.1.3 SCENARIO THREE

In this scenario we are taking n= 150 i.e no. of nodes in network is 150. The probability factor p and thresh hold value Eo and number of rounds rmax will be taken constant for all the three scenarios. Depending on these parameters we will get different graphs which consist of output of ESC-HTN and DSC-HTN protocol. The graph will show whether our protocol is better or not and if it is better then up to which size of network it will work better. The graphs are given below:

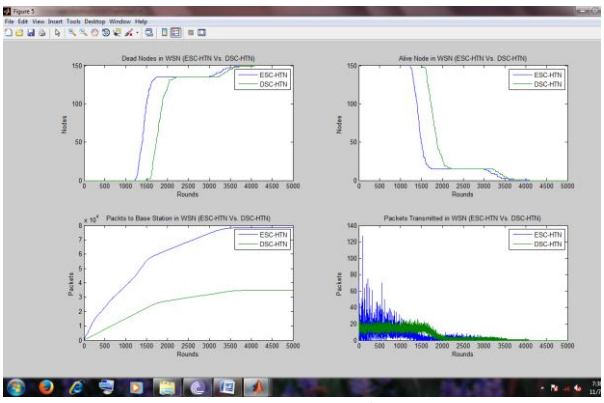

Figure 3.1.3.1 ESC-HTN V/S **DSC-HTN**

3.2ANALYSIS OF WORK

From the first analysis it is found that taking scenario one i.e. LEACH V/S ESC-HTN that leach protocol persist for nearby 2100 no of rounds or iteration whereas our protocol ESC-HTN persist till 3600 rounds hence 70% better than the former. From the second analysis it is found that while taking the scenario two i.e. LEACH V/S DSC-HTN that leach protocol persist for nearby 2100 no of rounds or iteration whereas our protocol DSC-HTN persist till 3750 rounds hence 75% (approximately) better than the former. From the third analysis it is found that while taking the scenario three i.e. ESC-HTN V/S DSC-HTN that ESC-HTN protocol persist for nearby 3600 no of rounds or iteration whereas our protocol DSC-HTN persist till 3750 rounds hence 5% (approximately) more better than the former.

4. CONCLUSION

WSN is a network that consists of microelectronics system nodes having limited power and processing capability which record and report various physical variables related to the environment in which they are deployed. We designed two new algorithms and compared their life time with the help of graphs with the earlier designed leach protocol. The main problem with LEACH protocol lies in the random selection of cluster heads. In this proposed work we tried to improve the network life. In our work we analysed the new protocol designed with leach and also with one another based on parameters like number of alive and dead nodes etc. And proved that the new designed protocols provides better network lifetime.

5.FUTURE WORK

Various directions in which further research work can be carried out are following: We change the parameters on which election of the heterogeneous nodes network is carried out for example, as in some other protocol like ISEP a combination of average and residual energy is taken. Also, we can extend the heterogeneity of nodes by having three levels like normal node, intermediate node and advanced for deployment in our multi-level energy transmission. We can change direction of our study to GPS EQUIPPED sensor nodes which are capable of

location based sensing and apply our concept to that specific domain. Multi sinks can be taken for the same idea in case application area in which network is to be deployed is having such possibility. Multi-hop concept between cluster head nodes away from sink can be paired with multiple transmission level and heterogeneous network.

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