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NETWORK LIFETIME ENHANCEMENT USING MODIFIED STABLE ELECTION PROTOCOL FOR WSN

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ABSTRACT

In Wireless Sensor Networks data packets are used to be transmitted from node to base station. Out of these nodes, some nodes become cluster heads, compiling the details of their group members and transferring them to the sink. We suppose that the sensor node population has additional energy sources based on heterogeneity that may be due to initial setup or network performance changing. We also consider that the sensors are transmitted randomly (similarly) and are incompatible. In this research work, a different method is adopted for selection of normal nodes and advanced nodes based on a fixed criterion. Also, In a single round, there are multiple nodes which are working as cluster heads (include normal nodes and advanced node). So, a team of cluster core members is working in each round to transfer the information to the base station. Finally, the efficiency of proposed WSN increases by making the transmission of packets through this core team. In each round, energy dissipated and average energy retains by each node is calculated. Also, number of dead nodes after each round is calculated. Both the values i.e., dead nodes after every cycle and average power retain by every node will be treated as output parameters. Also, Number of cluster heads per cycle, Number of Packets to the Base station and number of Packets to the head of Cluster are calculated and plotted. These parameters are compared from that of existing SEP, EAMMH and LEACH. MATLAB R2013a is used as an implementation platform using generalized toolbox and wireless sensor network toolbox.

Keywords: Wireless Sensor Network, Stable Election Protocol, Cluster Leader, Sensor Node, Energy, Base Station.

INTRODUCTION

The network of sensor is stated as the formation of [4] a great number of low-cost and low-power nodes with multiple functional sensors [7] scattered widely within the system or very near to it [4].

WSNs are a group of sensor nodes that feel the environment and transfer the information to operators [2]. Wireless Sensor Networks (WSNs) predict widespread use and increased deployment soon [3].

The development of protocols and uses for such networks must have the capacity to extend the life of the network because embedded batteries replacement is a tough process once these nodes are used [1]. The main requirements for a WSN are to extend the life of the network and efficiency of energy [6] [5].

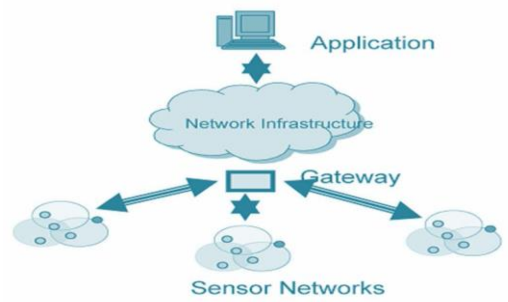

Figure 1 Basic Architecture of Wireless Sensor Network [8]

PERFORMANCE MEASURES

The number of measures can be used to check the performance of WSN protocols.

Stability Time: The time from the onset of network performance till the decease of the first sensor node. That period is also called the "stable region."

Instability time: The time from the death of the first node till the death of the last sensor node. That time period is also called the "unstable region."

Network life time: The time period from the onset of network performance till the last live node dies.

Number of cluster head per cycle: This quick quote shows the number of nodes that could transfer direct to the sink the information gathered to their cluster members.

Number of alive nodes (complete, advanced and normal) cycle: This quick rate shows the total number of nodes and those types that have not yet used all of their power.

Input: It is the total rate of data sent by the network, the average of the data sent from the cluster heads to the sink and the average of the data sent from the nodes to the heads of their cluster [1].

PROPOSED METHODOLOGY

Stable Election Protocol (SEP) for WSN are considered in this research work. In the proposed system, a completely different area is considered, i.e., the effect of the heterogeneity of the sensor node, according to their Energy, on the WSN categorized. Some of sensor nodes become group leaders in these networks, compile data for their group members, and send it to the base channel. It is thought that some parts of the total sensor nodes are adjusted by additional energy sources. It is also considered that sensor nodes are equally scattered and motionless. First, all sensor nodes are classified as normal and advanced sensor Nodes. Thereafter the Advanced sensor nodes are further divided into Alive Advanced sensor nodes and Dead Advanced node nodes. The cluster leader is selected from the advanced sensor nodes only. Cluster leader collects data from member sensor nodes, assembles them, and transfers them to the base channel. Choosing a cluster leader is one of the most important tasks for WSN. After the selection of the cluster leader, the cluster leader sends an announcement message to the sensor nodes. Sensor nodes receive news and agree with a specific group leader; will go to the current cycle. The proposed protocol is developed in the active field with a diameter of 100 × 100 m, and 100 sensor nodes are located in specific locations according to their potential. Some input parameters are as follows**:**

Input Parameters	values
Number of cycles	900
Base station location	150,50
Alpha (α)	0.2
Initial energy (Eo)	0.5 J
Initial energy of advance nodes	Eo(1+α)
Energy for the data aggregation (EDA)	5 nJ/bit/signal
Number of nodes	100
Transmitting and receiving energy (Eelec)	5 nJ/bit
Amplification energy for short distance (Efs)	10 Pj/bit/m2
Amplification energy for long distance (Eamp)	0.013 pJ/bit/m4
Probability (Popt)	0.1
Filed dimension	100 x 100 square meters

STABLE ELECTION PROTOCOL (SEP)

The authors in SEP [3] authors were very first to explain the effect of the energy distribution of sensors on categorized WSNs. Their approach was to provide weighted opportunities for every sensor based on its power level as the network evolved. Another great feature of this algorithm is that it rotates the cluster leader to align election opportunities to match the complex settings. The authors have used LEACH skills to create a flexible and well-distributed model to provide more power embedded in the system, which is a cause of solidarity. Under the advancement of the SEP model, two different types of sensors with separate power levels were used, formed a two-level WSN in a single-hop sequence. It is also assumed that sensors are incompatible and are evenly scattered in the sensor region. The development of LEACH was the first to increase the sensor network time. The cycle is the time for all sensors to transfer data to their cluster leaders; cluster leaders collect data and sent it to the sink node; this kind of set of cycles forms Epoch. If the sensors are compatible, with the correct percentage of 'p_{opt}' of sensor nodes 'n' can be cluster leader in each cycle, LEACH ensures that each sensor will be a cluster leader at once around '1 / popt' (epoch). But this view ceases to grip when the LEACH is used where there are differences. Once the first sensor is dead, the system instability becomes very large and the process of clustering becomes uncertain. This is because of p_{op}, 'pop' is only effective when we find the network value constant and equal to the initial value 'n'. For solving the instability problem, SEP authors redefined the new era of the sensor network. They are using two types of sensors: normal sensors (α) and advanced sensors (m). Advanced sensors have more value of α factor power than conventional sensors. Advanced sensors take the position of cluster leader over common areas during the same period according to the model rating of SEP. The proposed new time equals 1 / popt (1 + mα). The SEP utilized selection options depends on the original strength of each sensor to select cluster leaders by providing a weight equivalent to the original strength of every sensor divided by the initial strength of the normal sensors. The weighted opportunities for normal and advanced areas in the SEP were elected to reflect the additional capabilities embedded in the network. The probabilities and the total original energy are assumed below as:

$$Pnrm=Popt/(1+m\alpha) \quad (1)$$

$$Padv=(Popt)(1+\alpha)/(1+m\alpha) \quad (2)$$

$$Etotal=nEo(1+m\alpha) \quad (3)$$

P_{nrm} = weighted probability for the normal sensor. P_{adv} = weighted probability for the advanced sensor nodes

m = amount of the advanced nodes with α time more Energy than the normal sensor nodes.

E_{Total} = total original Energy of the network [1].

In this work, the author studied, analyzed and discovered some new energy-efficient algorithms such as LEACH, ESEP, SEP, TSEP, and TEEN.

The SEP [2] algorithm stands as an extension & improvement of the LEACH protocol that usages a clustering directing approach based on the device sensor node's connection heterogeneity. Some sensor nodes have high power in this protocol and technique, what they're called are the advanced nodes & the probability of advanced nodes being CHs is higher than that of regular nodes, and normal nodes in the network have lower energy than advanced nodes. In WSNs, to choose a CH, the SEP method employs a distributed method. When compares with the other nodes in WS, the initial energy of the node is weighted in the heterogeneity protocol and CH collection nodes probabilities. Basically, the SEP protocol is established on two-node heterogeneity levels, such as advanced -nodes and regular-nodes. Suppose, m is the part of the total number of n-nodes organized with alpha times extra energy as compared to the other nodes. These strong nodes are like advanced nodes. The leftover nodes (1 − m) are like regular nodes. The CH probability of normal nodes is found as

$$P_{nor} = \frac{Popt}{1+m.\propto}$$

Probability of advanced nodes to convert CHs is found as

$$P_{adv} = \frac{Popt}{1+m.\propto}(1+\propto)$$

P_{opt} is the optimum likelihood of each node in the network being CH. In the SEP strategy, based on probability, CH selection is performed at random for each node. Data is constantly sensed and relaying of the data to the sink or base station to their related CH and CH (BS) is done by sensor nodes. It is possible to further develop this scheme by increasing the value of m or P_{adv}. The SEP approach provides a long stable time cycle, long network longevity, and a high throughput due to advanced nodes with two degrees of node heterogeneity.

Advantage of SEP:

- Any type of global knowledge or identification of sensor node power is not mandatory for SEP strategies for every cluster leader election cycle.

Limitations of SEP:

- The choice of cluster leader (CH) between sensor nodes does not change, resulting in the farthest and most powerful areas dying first.

ESEP (Enhanced Stable Election Protocol)

ESEP develops & enhances the SEP process. Three types of sensor nodes are taken into consideration in the ESEP technique, as advance, normal and intermediate sensors based on their power levels. The main purpose of ESEP is to create a WSN that improves network-life and stability time.

MATLAB R2013 has been used as an application platform. In this research work, exiting SEP and proposed Advanced SEP has been implemented and matched their assessment factors. Their factors are:

1. The Number of Dead sensor nodes according to increasing Number of cycles.
2. The Number of alive sensor nodes according to increasing Number of cycles.
3. Number of Packets moved to the base station according to increasing Number of cycles.

Here, all the implementation steps:

Declare input parameters like Dimensions of Field - x and y as maximum (in meters), X and y are the Coordinates of the Base station, Nodes Quantity in field, Probability of Optimal Election of a node to develop cluster head, Model of Energy (all values in Joules), Initial Energy, types of Transmit Amplifier, Energy of Data Aggregation, Values for Heterogeneity, Percentage of advanced nodes, Alpha, Maximum number of cycles, Calculation of distance between transmitter and receiver. Create the random Sensor Network, initially there are only nodes, Random selection of Normal Nodes, Random Election of Advanced Nodes. Display the sink or base station in the field & Declare counter for total cluster heads. Declare counter for cluster heads per round & flag for first death.

Commence First Iteration

Declare a loop as per the maxim um number of round & Calculate Election Probability for Normal Nodes as well as for Advanced Nodes. Operate heterogeneous epoch & sub-epochs. Declare counter for Number of dead nodes & for Number of dead Advanced Nodes. Also declare counter for Number of dead Normal Nodes & for bit transfer to Base Station and to Cluster Heads & for bit transfer to Base Station and to Cluster Heads Per cycle. Declare a loop as per the quantity of nodes & Check if there is a dead node. If yes than increase the dead node Counter by one Also than check for the advanced and normal node. If no than mark that node as normal node Also check for advanced and normal node & Rise flag for 1st death when the first node dies & Check if there is an alive node. Elect Cluster Heads from standard nodes & update counter of cluster head & counter packs for base-level channels. Assign a specific node as the head & Calculate the median distance between the Member of cluster and head of cluster & Calculate the scatter power when Eelec = (ETX + EDA) is the power distributed individually using a transmitter or receiver circuit & Cluster Heads Selection -node advanced & Update counter of cluster head & counter packs for base channels. Assign a specific node as the head of cluster & Calculate the normal distance between the cluster Member and its cluster head. Calculate Energy spent where Eelec = (ETX + EDA) is amount of energy used per bit to start the Transmitter or the receiver circuit & Elect Associated Cluster Head for Normal Node & Announce the loop according to the number of nodes. See if there is a normal and active node and if there is more than one collection number. Calculate the normal distance between a cluster member and a live node & Start loop according to the total number of clusters. Calculate the median distance between the cluster head and the alive node and compare the normal distance between the cluster member and the alive node and also calculate the terminal power where ETX is the energy dissipated each time using a Transmitter or Receiver or Energy removed by the corresponding Cluster Head. Calculate the power scattered by the head of the collection at a short distance and refresh the collector head of the selector around. Calculate total energy dissipation & average energy dissipation. Plot the bounded cells of the Voronoi diagram for the various cluster Heads.

Plot average energy of every node for all the rounds, quantity of dead nodes for all the rounds, Quantity of heads of cluster per, Number of Packets to the Base, Number of Packets to the Cluster Head.

EXPERIMENTAL RESULTS

An efficient protocol for the WSN is implemented and designed using advanced Stable Election Protocol to transmit the information packets to the base station via efficient cluster leaders. **In this research work, a different method is adopted for the selection of normal nodes and advanced nodes based on a fixed criterion. Also, there are multiple nodes working as cluster heads (including normal nodes and advanced nodes). So, a team of cluster core members works in each round to transfer the information packets to the base station.** Firstly, all of the sensor nodes are classified in Normal and Advanced Sensor Nodes. Then Advanced Sensor Nodes are again classified as Alive Advanced Sensor Nodes and Dead Advanced Sensor Nodes. Cluster leaders are elected amongst advanced and normal sensor nodes. Cluster leaders accumulate data bits from the member sensor nodes, combined & forward them towards the base station.

Election of Cluster leader is very significant, and when the heads of cluster are selected, the heads of cluster broadcast message across nodes. The nodes accept the message and determine which cluster head will fall in the current cycle. That stage is known as the phase of cluster formation. Depending on the strength of the signal obtained, the nodes answer to the head of the cluster and become the leader of the cluster. The head of the cluster then provides a TDMA schedule for sensor nodes, during which time those sensors can transmit information to the cluster leader. After the cluster is formed, the whole sensor node transmits the information to the cluster leader in its own time. The leader of the cluster then collected the information and transmitted to a base station. That stage is called the transfer phase. MATLAB R2014 is used as an application platform. In this research work, exiting SEP and Advanced SEP (proposed) is executed and compared them by their performance parameters. Their performance parameters are explained as:

1. Number of Dead nodes according with increasing number of rounds.
2. Average energy of each node for all the rounds
3. Number of cluster leader formation per round
4. Number of Packets delivered to the Base station
5. Number of Packets to the Cluster Head

We have taken the snapshots of MATLAB figure window as we have plotted the graph of above-mentioned parameters in the same. Figure 2 is the snapshot of complete wireless sensor field showing normal nodes, advanced nodes, cluster heads, base station and dead nodes. Figure 3 is the snapshot of Average energy of each node for all the rounds. Figure 4 is the snapshot of Number of Dead nodes according with increasing number of cycles. Figure 5 is the snapshot of Number of cluster heads per round from 800 – 900 rounds. Figure 6 is the snapshot of Number of Packets to the Base station from 800 – 900 rounds. Figure 7 is the snapshot of Number of Packets delivered to the head of Cluster 800 – 900 rounds. Figure 8 is the snapshot of Number of command window showing round number of 1st node death.

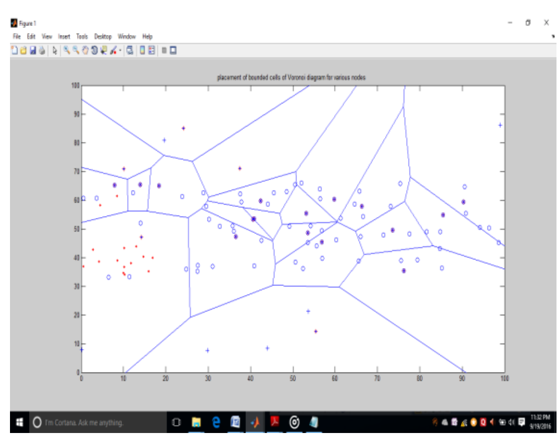

Figure 2 snapshot of complete wireless sensor field showing normal nodes, advanced nodes, cluster heads, base station and dead nodes

Figure 3 snapshot of Average energy of each node for all the rounds

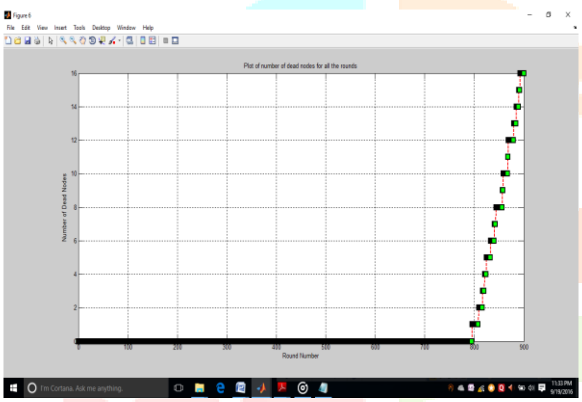

Figure 4 snapshots of Number of Dead nodes according with increasing number of cycles

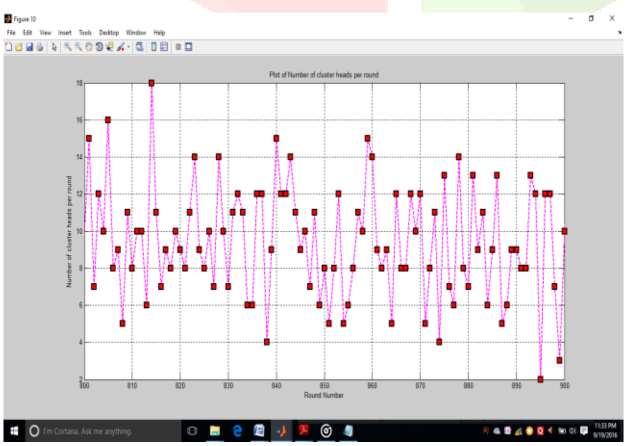

Figure 5 snapshot of Number of cluster heads per round from 800 – 900 rounds

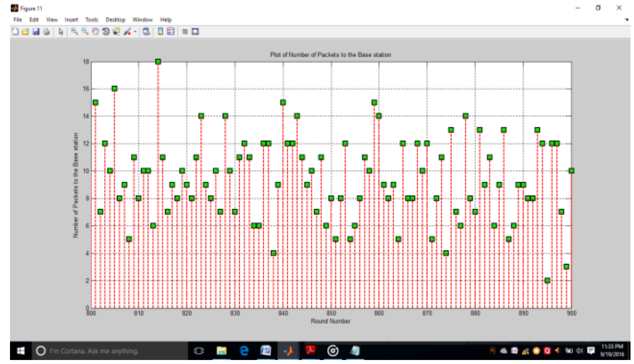

Figure 6 snapshot of Quantity of Packets to the Base station from 800 – 900 rounds

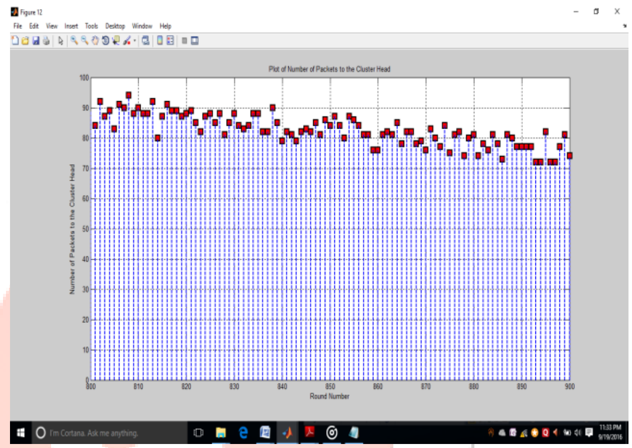

Figure 7 snapshot of Quantity of Packets to the head of Cluster 800 – 900 rounds

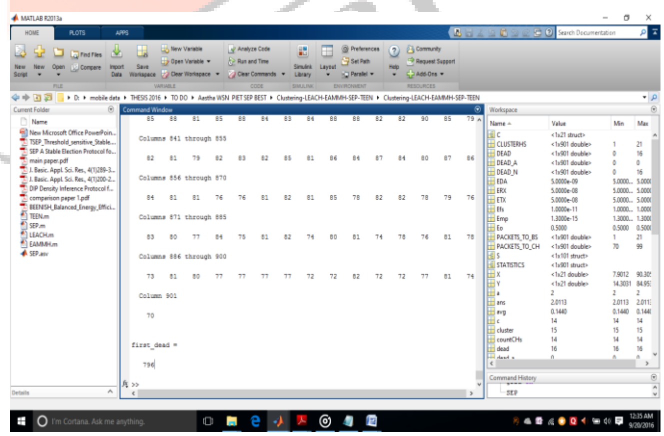

Figure 8 snapshot of Number of command window showing round number of 1st node death

CONCLUSION

The Modified Stable Election Protocol for the Wireless Sensor Network is proposed in this research work. This protocol is bit dissimilar as compared to existing SEP because; a different method is used for selection of the normal nodes and the advanced nodes based on a fixed condition. Also, In a single round, there are multiple nodes which are working as cluster heads (include normal nodes and advanced node). So, a team of cluster core members is working in each round to transfer the information to the base station. Finally, the efficiency of proposed WSN increases by making the transmission of packets through this core team. If we compare the results of proposed method with that of existing SEP, EAMMH and LEACH, it can be concluded that proposed method is working with very much efficiency as compared to existing methods. The major proof of above statements is:

1. Average energy is falling from 0.6 J to 0.15 J only whereas its falling from 0.1 J to 0.01 J in case of LEACH and EMMAH
2. First node dies after 80% of completion of rounds whereas it dies after 10% rounds completion in case of LEACH and 17% rounds completion in case of EMMAH.
3. Total number of deaths at completion of all the rounds is 16 whereas in case of LEACH it is 67 and in case of EMMAH it is 62.

So, all the comparison proves that the proposed method is much efficient as compared to existing methods.

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