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An Improved Leach Algorithm Based on Wireless Sensor Networks

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ABSTRACT: In our current generation, wireless sensor network is much in use and has become quintessential. With wide improvement of technology and the various ranges developed in communication and in other aspects, this document mainly focuses on the LEACH algorithm (Adaptive Low Energy Hierarchy) and the second most important methodology used is the SEP (stable election protocol). We have discovered improvements in energy efficiency by comparing our results with these two algorithms and the sensor mortality rate is reduced to a greater extent. This research proposes an improved computation algorithm method for the calculation of LEACH clustering, by considering the importance of the cluster heads and the sensor nodes present, T (n) is reorganisedrecommendinga procedure that focuses on reducing the energy consumption. The combined rate of information is found by allowing cluster heads to gather information before it is sent to base station. This improved computation algorithmwill be able to increase vital utilisation of networks and increase sensor life.

1. INTRODUCTION

Wireless sensor networks have arrived with advancing featuresinthemultifaceted web and many innovations, mainly the salient points of sensor nodes that include remote sensor systems (WSN), are

Present in different people. As we see that every sensor node that consists of many parameters within it has the ability to satisfy any external condition. With the daily improvement of wireless sensor networks, it can easily be seen that there has been a rapid change in increasing parameters, such as precision, greater spatial and temporal resolution, parameters such as size, cost and weight. They have decreased by many orders of size. These sensor networks are reaching real-world implementations every day for numerous endless applications.

WSN, one among the advances in the first generation, influenced a significant effect on human life. Many different conditions are seen through extensive collaboration between nodes, and therefore information is sent to clients from distributed systems even by numerous other changes. Sensors, viewers and discernment objects are the three WSN components, which nor-mally use remote correspondence to configure the correspondence interface.

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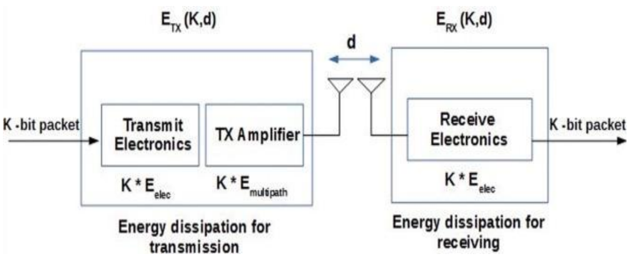
2. LITERATURE SURVEY

In WSN, to primarily improve the vitality of the node, these sensor nodes are limited by energy and work on data aggregation so that sensor nodes can use energy efficiently. Basically, two main parameters are needed for these sensor nodes to transmit information. One is the dis-tance among nodes and the second most important thing is the amount of bits that transmit the information. Now, considering the condition of vitality of a node, the cluster heads are chosen based on their energy consumption and also the mortality rate of these nodes is a more important parameter to consider when choosing a cluster head. The main adopted methods of the LEACH protocol are algorithms for distribution, cluster formation, adaptive cluster formation and cluster position change. Conglomerate formation distribution technique guarantees the self-organisation of most of the target nodes [1]. We can see that extensive work has been done in collaboration with the LEACH protocol and there are many variations found in this LEACH protocol that are currently accessible, from single-hop scenarios to multi-hop scenarios. The main concept of our research is to reduce the amount of energy consumed by the heads of the clusters chosen so that the number of dead nodes can be significantly reduced and the information can be transmitted efficiently. In the LEACH algorithm there are many more different protocols in which numerous algorithms have been presented to efficiently use energy and reduce the amount of energy con-sumption. Indicating the drawbacks of LEACH algorithm, where fixed grouping method was usedin selecting cluster heads based upon remaining energy of the nodes that improved energy efficiency [3].

Basing on energy consumption of single-hop communication between cluster head node and base station, Wang et al. [4] proposes minimum expansion algorithm of the Prim tree to con-struct the routing of tree network and cuts down the communication expense of the head node of the cluster to avoid an excessive consumption of energy of the cluster head and base station. To extend life of the network, Zhao [5] makes use of LEACH algorithm to obtain cluster heads that consume less energy and selects the cluster head node to optimize network life by making use of K-means clustering algorithm. In [6], he used the alternative K-medoids algorithm where the ran-domly selected cluster is processed and executed, that emphasises in decreasing energy consump-tion of all networks and improve the life cycle. In this the concept of data fusion rate is implemented, allowing cluster head nodes to transfer data to reduce energy consumption.

3. EXISTING SYSTEM

In the existing system, the emphasis was mainly on the design, development and implementation of a network algorithm of high energy efficiency wireless sensors that form groups containing nodes driven by energy. There is a wide variety of differentiated nodes as homogeneous and het-erogenous sensors capable of collecting accurate information in all types of environments, distant or dangerous. Basically, these sensor nodes work with a DC source that has a low capacity or can be set so that you can't see the replacement of your power source. In general, nodes are implemented ad hoc. The energy required for the transmitter, the receiver can be defined as follows basing on the first order radio transmission energy model:



Where,

$$E_{transmitting} = (E_{elec} * k) + \left(E_{amp} * k * d^2\right) \ldots\ldots\ldots\ldots\ldots (1)$$

$$E_{receiving} = E_{elec} * k \ldots\ldots\ldots\ldots\ldots. (2)$$

Eelec = energy dissipated to operate the transmitter
Eamp = power dissipation of the transmission amplifier
K = length of the message bit
d = distance between transmitter and receiver

The direct transmission between the transmitter and the receiver presented in the previous equa-tion is the useful energy for the transmitter amplifier circuit equal to the equation shown below.

$$E_{transmitting} = (E_{elec} * k) + (E_{amp} * k * \left(\frac{d}{2}\right)^2\Big) \ldots\ldots (3)$$

The energy required to transmit data from source node to destination node in multiple hop will be half of the direct transmission.As all normal nodes in a cluster send their information to the head nodes, in order to save energy and this is accomplished by the absence of floods, multiple paths or routing circuits. Clustering makes resource allocation efficient to better design power control and also further any change in the way the node behaves within a cluster effects that particular cluster but not over that complete network, becoming robust for these changes.

There are several disadvantages of existing clustering schemes, such as the cell combination clustering algorithm, localisation clustering, the energy efficient zoning clustering algorithm, the highest connectivity clustering algorithm in WSN, as for example in selection of cluster heads, some algorithms select cluster heads only based on the identification number or the residual energy of sensor nodes.

Since complete data in the sensor network is sent to base station, the traffic near base station is more. Therefore,sensor nodes in these areas will run out sooner. The base station will be isolated consequently, the energy stored in the other nodes of the sensor foes wasted. The SEP also used in our research to compare our results also known with heterogeneous protocols and all nodes in the field do not have same amount of initial energy. By prolonging this stable region, SEP seeks to preserve the limitation of sufficiently balanced energy consumption.

4. PROPOSED SYSTEM

In this proposed system, in view of the choice of the leading groups, based on the existing features and defects of LEACH algorithm, it suggests that the head groups of the LEACH algo-rithm be improved. A new grouping method is used to get uniform grouping and also, the speed of data fusion is adopted to cut down energy loss in the data transmission process. In the investi-gation of the LEACH algorithm, we are comparing our results with the LEACH protocol and the SEP algorithm in which the number of active nodes and number of dead nodes are compared and shown with our improved result. In the existing code, the interval is 100, also static, so we are comparing the results with the dynamic range and we are extending the results up to 1500 in the existing code and then obtained results are compared with the previous static data set, but we can implement the existing method also to show the difference between the proposed method and the existing one. With this we can see that the number of dead nodes is reduced to a greater extent and the residual energy is also increased to a greater extent in these nodes.

5. INTRODUCTION TO THE ALGORITHMS

5.1 LEACH ALGORITHM AND IT'S PROTOCOL

LEACH is programmed in such a way that there is a random rotation of high-energy cluster head between other nodes of sensor, so that drainage of battery of any sensor in the network can be largely avoided. Therefore, the energy load of the cluster head is distributed among the other sensor nodes evenly. LEACH creates a TDMA program to avoid cluster collisions between adjacent clusters. There are two phases followed by LEACH. One is the set-up phase and the second is the steady state phase. The set-up phase is that in which the clusters are organized and the steady state phase does this work of transferring various forms of data from the nodes to head clusters and finally to base station.

In the beginning of the set-up phase, clusters are grouped and the heads of the groups are selected and therefore each node selects a random number between 0 and 1 and this value is compared with the threshold value T (n) shown below. . If the number obtained is less than the threshold number, that particular node is the head of the cluster.

$$T(n) = \frac{P}{1 - P^*(r \; mod \; \frac{1}{P})} \; if n \in, G, 0 \; otherwise$$

Where,
p = required percentage of group leaders,
r = current round,
G = set of nodes that did not become head clusters in the last rounds 1 / p

The grouping includes the construction and regulation phase. As indicated in the table data, the node collects information and therefore, after the information has been combined, this in-formation is transmitted to the base station. After a while another series of cluster head races will begin. At each round, the heads of the selected clusters transmit an advertising message to nodes present in the respective networks, informing them of their new current status. After receiving the message issued, each of the nodes that are not a group leader has the ability to determine which group they belong to based on the intensity of the received signal. Subsequently, depending on the number of nodes in a cluster, the cluster header generates a multiple access time per time di-vision and transmits a transmission time window to its CHs.

In the steady state phase, nodes belonging to every group begin hearing information and trans-mit the information collected to their cluster head during the distributed transmission time. The cluster node directs aggregation and data compression and then the information gathered is trans-ferred to base station. Because base station is generally at a greater distance from the ground, communication with the base station will swallow a lot of energy from the cluster heads. At the end of the set transmission time, the stable state phase is completed and the network returns to the configuration phase and then starts with an alternative round, starting from the choice of another round of head cluster.

5.2 SEP ROUTING ALGORITHM

SEP is a protocol with heterogeneous detection that extends the time interval before the death of first node, also known as stability period, is very important in applications where feedback from the sensor network must be reliable. The SEP is generally based on the weighted probabilities of choosing each node to become the head of cluster group based on remaining amount energy pre-sent in each node. This protocol is basically used to increase stability and gradually reduce energy consumption; it is the main technique behind this idea of this stable election protocol.

Nodes with the lowest energy are assigned a weighted probability of choice. The Stable Choice Protocol (SEP) could be a network protocol of hierarchical sensors. The SEP rule was applied with different sensor nodes within the network with higher energy levels [7]. Basically in algorithm used here consists of nodes that are in 2 variations. First, the normal node and the other is the advanced node. In LEACH algorithm if the values are less below the threshold value, that particular node takes the place as head of cluster. The threshold values are different for normal and advanced nodes, since SEP mainly deals with heterogeneous networks. The threshold value for normal nodes is as follows:

$$T(S_{nrm}) = \begin{cases} \dfrac{P_{nrm}}{1 - pnrm * (r \bmod \frac{1}{pnrm}} & if\ S_{nrm} \in G' \\ 0 & otherwise \end{cases}$$

Where,
r = on-going round,
G = nodes that did not become head clusters inlast rounds of 1 /pnrm,
T (Snrm) = threshold applied to a population of N nodes,
Pnrm = probability that normal nodes become cluster head, given by

$$Pnrm = \frac{Popt}{1 + a * m}$$

Where,
m = percentage of the total of advanced nodes,
α = percentage of extra energy supplied to the advanced nodes and Popt is
for

$$Popt = \frac{k_{opt}}{N}$$

Where,
N = overall nodes in the network
kopt = optimal number of cluster heads.
The threshold value for advanced nodes is as follows:

$$T(S_{adv}) = \begin{cases} \dfrac{P_{adv}}{1 - P_{adv} * (r \bmod \frac{1}{P_{adv}})} & if\ S_{adv} \in G' \\ 0 & otherwise \end{cases}$$

Where,
r = on-going round,
G '' = set of nodes that did not become the Cluster Head in the last 1 round / Padv,
T (Sadv) = threshold set on a population of N ∗m knots,
Padv = probability that the advanced nodes become Cluster Heads and is the following

$$P_{adv} = \frac{P_{opt}}{1 + a * m} * (1 + a)$$

The threshold value as whole for both normal and advanced nodes given respectively as follows:

$$T(n) = \begin{cases} \dfrac{P_{bnrm} * (u\left(\frac{E_{current}}{E_{start}}\right) + v\left(\frac{d_{current}}{d_{max}}\right))}{1 - P_{nrm} * (rmod\ \left(\frac{1}{P_{nm}}\right))} \\ 0, \end{cases}$$

Here , we see that the cluster heads are established according to the type of nodes they are i.e, normal node or the advanced node where P = b ∗Pnrm is the weight of Pnrm, Pbadv = b ∗Padv denotes weight of Padv and b denotes weighted proportional parameter, based on size of the net-works to assign b different values. Their interval here is (0, 1), Ecurrent, Estart, dcurrent and dmax, respectively, are the residual energy of the nodes and initial energy of nodes and the dis-tance of the node from sink node and lastly a huge distance between the node from the sink node. u, v denote the ratio coefficient, its interval is $0 < u < 1$, $0 < v < 1$ eu $+ v = 1$. Above equations show improvements emphasising percentage of energy consumption of the small and large distance ratio of nodes designingmuch reasonable grouping method so that node and energy distribution is uniform across all networks.

6. RESULTS

6.1 Simulation parameters deployed

In this document, compared to the SEP algorithm, based on the configuration of the parameters in [8], the simulation parameters are implemented as follows: the node number of all networks is 200, the interval is 1500 m and the energy is initial of the nodes is 0.5 J. Furthermore, the energy consumed by the node to send and receive data is ETX = ERX = 50 nJ/bit, Efs = 10 pJ/bit/m2, Emp = 0.0013 pJ/bit/m4, and EDA = 5 pJ/bit/signal.

6.2 comparison of simulation results

Now we compare our results with the LEACH and SEP algorithms and we can see that a lot of energy consumption of the nodes is reduced and also death rate is decreased to much extent. The energy assignment for all the nodes are done as we can see in our improved algorithm and then the percentage of alive nodes is increased to much extent in our algorithm when compared to LEACH and SEP algorithm. After the information that is sent to the base station we can see that after the energy dissipation in our improved LEACH there is a lot of energy that is saved and that is present as the remaining energy when seen with the other two algorithms.

The results are shown below where we see that in figure 1 there is this initial clustered network wherein the clusters are formed from the nodes that are indexed pink in colour and the green round indicates that the cluster heads are being initiated in each group of nodes that are present within the network. Figure 2 indicates the red coloured nodes represent normal nodes and the blue coloured nodes being advanced nodes and the base station is indicated with the pink coloured node that is above on the top. Figure 3 tells us about the alive nodes in each stage and our improved LEACH has shown much improvement and there is a greater number in the number of nodes that are alive after the energy dissipation of all those nodes. Figure 4 shows the number of dead nodes in each of the respective algorithms. Figure 6 shows the energy remaining percentage in each node in the respective algorithm and there has been a larger improvement done in our improved LEACH algorithm by changing the static values to the dynamic values. Figure 7 and 8 shows the number of packets that is the amount of information sent to the cluster head and then to the sink by each of the respective algorithm used. In figure 9, the energy consumption of each round is also reduced to a large amount in our improved LEACH. The death rate is also reduced to a larger extent when seen in our improved algorithm in figure 10.

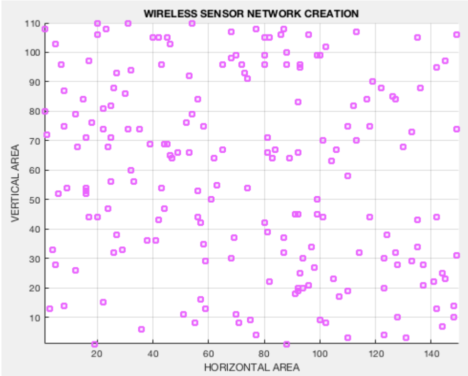


Fig 1. Wireless sensor network creation

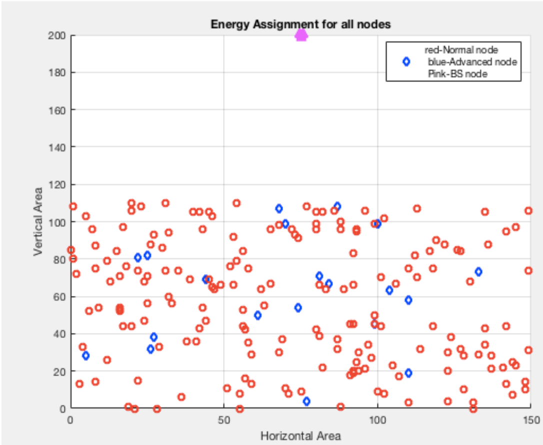


Fig 2. Energy assignment for all nodes

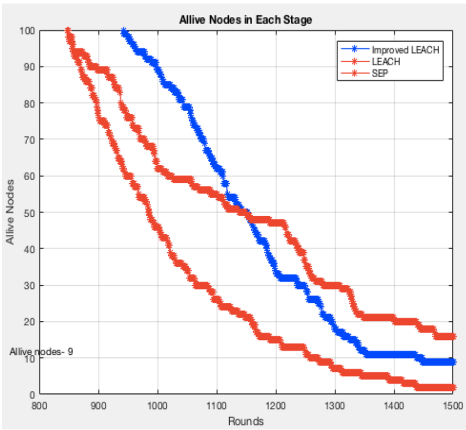


Fig 3. Alive nodes in each stage

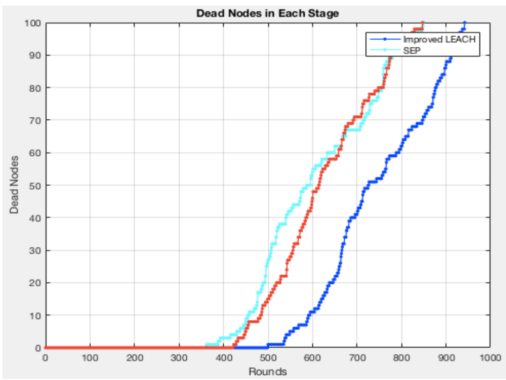


Fig 4. Dead node in each stage

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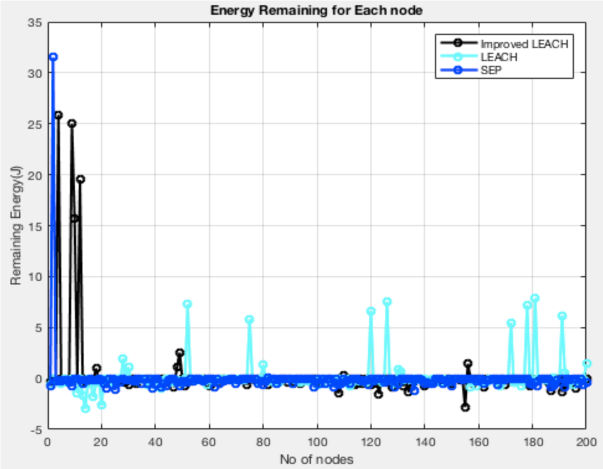

Fig 5. Energy remaining for each node

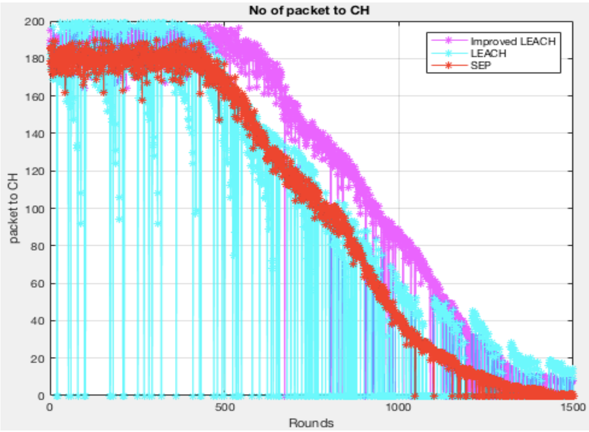

Fig 6. No of packet to CH

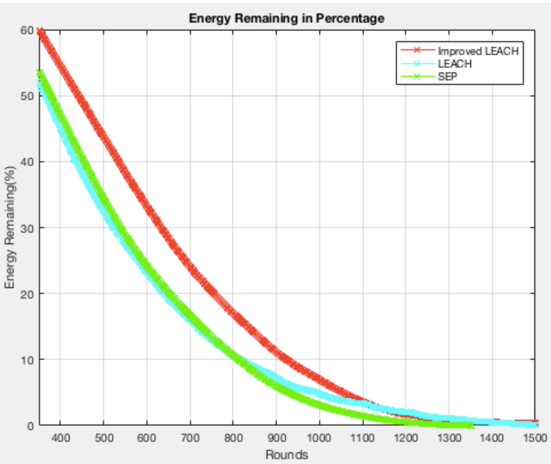

Fig 7. Energy remaining in percentage

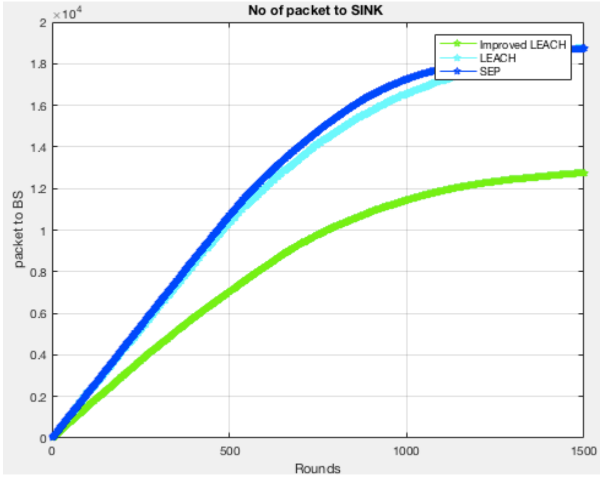

Fig 8. No of packet to SINK

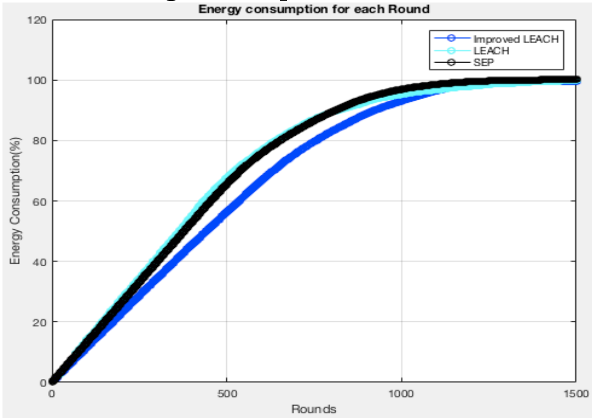

Fig 9. Energy consumption for each round

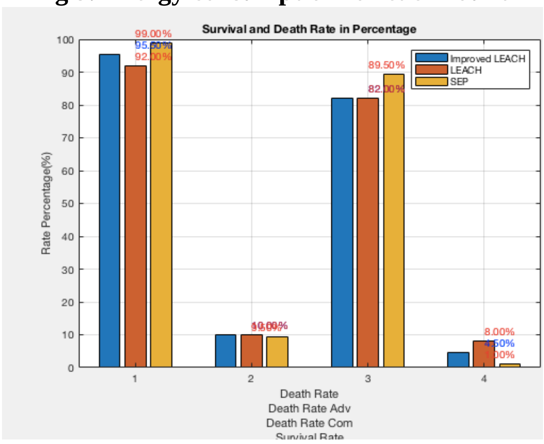

Fig 10. Survival and Death rate in percentage

7. CONCLUSION AND FUTURE WORK:

In this paper, we make improvements in the cluster heads and the energy consumption of each node is reduced to much extent and also when compared to LEACH and SEP algorithms, our improved algorithms shows dynamic results that are not available in the former algorithms, however there are still some shortcomings. Considering the security issue of the hub area and gathering information in the correspondence of remote sensor systems is important. The development of nodes causes the difference in the structure of the systems, which is not considered in the management procedures plan.

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