Equitable Distribution Energy Consumption of WSNs

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ABSTRACT

Power consumption is the main challenge for expanding the wireless sensor network, since the active nodes are more vulnerable to energy consumption. How to save energy and extend the lifetime of wireless sensor networks imposes a great challenge addressed by this paper. This paper introduces the tasks of scheduling and distribution of roles dormant cells of wireless sensor network (TSDRDC) to curb excessive consumption of energy consumed in duplication and unhelpful tasks. Duplicate Dropping and Roles-Dormant Cells are proposed to achieve equitable distribution of energy consumption for all nodes on the network. Integrating the advantage of protocol existing LEACH with TSDRDC approach led to improve the formation of more homogenous clusters, better performance, and increased lifetimes of wireless sensor networks.

Categories and Subject Descriptors

C.2.0 [**Computer Communication Networks**]: Energy Conservation method and protocols.

General Terms: Algorithms

Keywords

Energy Consumption; Clustering; Sensor Networks, Tasks Distribution, Duplicate Dropping.

1. INTRODUCTION

Sensor networks consist of hundreds or thousands of sensor nodes, low power devices equipped with one or more sensors. In many emerging application scenarios (e.g. Battlefield surveillance, large-area, and perimeter monitoring in agriculture and autonomous ocean scientific sampling), a large number of such simple immobile nodes are deployed in a vast geographical area to monitor activities or environmental conditions.

When a sensor detects activities or unusual behaviors, it generates report messages and delivers them to the interested user. The user thus receives its information from multiple sensing sources. These users usually lose a lot of energy in dealing with such data or in re-broadcasting to higher levels or other users. To reduce the high-energy consumption we proposed the scheduling system functions to facilitate the process of sending reports from terminal nodes to the interested users or re-broadcasting them to a higher level of the network. In this paper, the user can be the cluster head, neighbor node or sink.

The challenge to build a wireless sensor network in the geographically remote and rugged area is related to the energy consumption. In earlier years some literature works were published related to this challenge [1],[2]. In the past few years, the problem of energy attracted the attention of many researchers in the field of wireless sensor networks. A few scenarios and protocols were proposed to reduce the problem of energy consumption [3],[4],[5],[6],[7]. Tan and Korpeoglu [8] proposed PEDAP depending on spanning tree-based protocol with minimum cost, the improvement of PEDAP-PA proposed by Younis et al., [9], adopted cluster-based network architectures to enhance network scalability.

Heinzelman and Chandrakasan [4] propose a typical cluster-based network protocol, low-energy adaptive clustering hierarchy (LEACH) to optimize communication energy. In LEACH, sensor nodes choose themselves as cluster heads to route data and these cluster heads change every round to balance energy consumption through networks. Some improvements of LEACH have been presented. Threshold sensitive energy-efficient sensor network protocol (TEEN) and adaptive periodic threshold-sensitive energy-efficient sensor network protocol (APTEEN) are based on LEACH, both designed for time critical applications [10]. Some researchers propose a new chain-based protocol based on LEACH. It is called power-efficient gathering in sensor information systems (PEGASIS), which minimizes the energy consumption at each sensor node [11].

However, little effort has been made for the optimal cluster head distribution, which is an important factor for communication energy efficiency. Thus, a distributed cluster heads selection approach should be exploited to form reasonable clusters so that the cluster heads can perform more energy-efficient forwarding tasks. Through this feature our proposal is a practical and important addition to the LEACH protocol.

Xue Wang and Jun-Jie Ma's, [12] latest proposal was very closely related to our work, they presented a dynamic energy management mechanism based on dynamic adaptive clustering with intra-cluster optimal routing (DACIOR).

The rest of this paper addressed the problems of wastage of energy in wireless sensor networks resulting from:

a. Duplication of tasks and functions for nodes in the same area coverage.
b. Re-send duplicate messages.

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c. Energy wasted when certain part of the network are exploited where half of the nodes die, which in turn leads to the suspension of the entire network.

2. Tasks Scheduling and Distribution of Roles Dormant Cells

2.1 Preliminaries

During target tracking, wireless sensor nodes have the functions of data acquisition, processing and reporting. The related sensing, computation and communication operations will lead to energy depletion. Out of all the energy consumption sources in WSNs, wireless communication is the largest portion. Thereby, it is the main one taken into account here. As radio signal attenuation in the air is related to propagation distance, we adopt the free space propagation model [13], which is expressed as:

$$L_p = \left(\frac{\lambda_s}{4\pi d_{i,j}} \right)^2 \tag{1}$$

Where L_p is the path loss, λs is the wavelength of signal, and di,j is the propagation distance. If radio signal propagates between wireless sensor node i and j, which are located at (xi,yi) and (xj,yj), the corresponding propagation distance can be calculated as:

$$d_{i,j} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \tag{2}$$

Accordingly, a model of wireless communication is assumed to analyze energy consumption of communication. Here, the power consumption of data transmission between wireless sensor node i and j is calculated as [15]:

$$\psi = \alpha_1 r_d + \alpha_2 d_{i,j}^2 r_d \tag{3}$$

Where r_d denotes the data rate, α_1 denotes the electronic energy expended in transmitting one bit of data, $\alpha_2>0$ is a constant related to the radio energy. Given the transmission tasks through the network, the energy consumption feature of WSNs can be obtained. The total energy consumed is calculated as:

$$\omega_i = \gamma \psi_i \qquad 0 < i < k \tag{4}$$

Where γ is power consumption of sensor node component and k is the number of nodes on the cluster.

2.2 Cluster configuration

The structure of each cluster on the network has two parts, cluster head (CH) and cluster nodes. First, every sensor broadcasts their IDs on a specific time shift before embedded into the targeted area, then it listens to its neighbors, adds their IDs in its routing table, and calculates the number of messages it receives to find the number of neighbors (NBR) it can reach, these connected neighbors build their own group or cluster.

To determine the cluster head, sensors broadcast their *IDs* and *NBR*s. Every sensor keeps a list of all its neighbors' NBRs. A sensor becomes a cluster head if it has the highest NBR. We chose this approach because cluster heads receive more messages than other nodes. The cluster head with its connected neighbors form the cluster or the group. We call the cluster head's neighbors its children. Hence, the cluster head and its children have a parent-child relationship in the tree-based network.

LEACH is proposed to reduce and balance the energy consumption of sensor nodes. In LEACH, cluster heads are chosen in each round based on a percentage NBR of total sensor node number. Cluster heads send their announcement with the same power, and then each sensor node can join the cluster with the closest cluster head according to the received signal strength.

The amendment, which will have to add it to the LEACH selecting CH (cluster head), is started from the second round according to round Ri and sensor node remaining energy Ei as the following:

In the First round, cluster head will be selected according to LEACH process because the first deploying sensor should have the same energy E1=E2…, En-1= En. In the first round, the sensor, queued according to NBR value of queue is called RDC-queue (Roles dormant cells). For the second round, we will stop the ordinary LEACH select cluster head, where we select the head according to RDC-queue order, where equation (4) is the base on the new changes of the queue order.

This process can be addressing through the following two steps:

Step1: First cluster perform and cluster head selection,

1. *Q=empty; NBRi=0; Ψ is very low and interrupt factor=Ei/2;*
2. *Start with LEACH procedure to configure the clusters; suppose that all nodes have the same E in the beginning.*
3. *For(i=0; i<=l;i++) where l is cluster nodes;*
4. *Q(i)=Ni_{+1};*
5. *end loop, Q(0) will be the cluster head*

After a period of time slot or if the energy level of the current cluster head falls below the level of the interrupt factor, then the queue is rearranged though the intervention of *RDC* (*roles dormant cells*) process to arrange the queue again according to the energy consumed by each node. So that the arrangement is downward queue where the higher consumed energy will be the tail of the queue. At this stage, we will stop using LEACH process for selecting the next round head and switch to *RDC* process to select the next round head and this will be the second step that will repeat for rest step until the networks die, as shown in the following:

Step2:

1. *Push the current cluster head to the end of queue and change the state to sleep mode*
2. *For (i=0,i<l;i++)*
3. $\rho_i = \rho_i - \omega_i$ (5)
4. $$Q(i) = \begin{cases} Q(i) & NBR_{NI} = Max; \ and \ p_{i+1} \\ Q(i+1) & if \ \ p_i < p_{i+1} \end{cases} \quad (6)$$
5. *End loop, Q(0) will be the cluster head*
6. *Re-order the queue content according to the equation (5)*
7. *Change the lowest energy node to change to the sleep state for this round.*

Therefore, we repeat *RDC* procedure for future round until most of the nodes reach the dead state, which is the then energy of the node, a very low energy state. The end of this process when will show that the last node in the queue should have the lowest energy that will be assigned to the interrupt factor.

The purpose of using tow factors (*Time factor and Interrupt factor*) is the unfair distribution of tasks (*some rounds in the network lifetime are more active than other rounds*). Since that period , considerable pressure on cluster head from the neighboring nodes lead to loss of much of its energy and access to a death state in a short time ; this certainly means that the network has lost this node function that is not be used again for the next round.

Nevertheless, adding interrupt factor to the protocol, simulations, showed that the nodes have the same opportunities to work within the network and 80% to 90% of the nodes arrived to the dead state during same period.

This increases the efficiency and performance of the network effectively, contrary to the way which is currently used, where half of the nodes die in a short time, leading to the shutdown of the whole network.

2.3 Distribution Tasks for cluster Head

Based on the above and in order to understand the implementation of the distribution of tasks between the various nodes in the same cluster. Figure 1 and table I show this process clearly, where figure (*1/a/b*) shows the first step of cluster performed and cluster head selected according to the *NBR* factor where the *E* is the same for all the nodes in the beginning as we assumed. Figure (*1/c*) and table I show the next round of cluster head selection, where the *RDC-Queue* applied.

Table I showed that round one and round two will be normal and there is no change for queue order except that the cluster head of the first round will be the tail of the queue with sleep mode; the round three showed that *{N4}* will be the cluster head because it has highest energy in this round. It does not matter if it has the less *NBR* than the other and this is one of the advantages of our algorithm where rest node, which *{N4}* has no contact with, will change to the sleep mode for this round. Unusually round four showed that *{N4}* did not change to the sleep node, this is because of the $E_{\{N4\}}$ still bigger than interrupt factor, which means that the cluster change on round four happened because the period is finished, not because of the interrupt factor.

Table I showed the following results:

No requirement that the node that has the highest NBR, has the highest order within the queue

Restructuring queue and cluster on the basis of time and the interrupt factor

Distributive justice, in the case of the restructuring of the cluster because of the end of the specified period of the current session and the current session in which the network is inactive, could choose the same cluster head for the continuation of current tasks for the next session if it owns more energy from the rest node. This leads to fairness in the distribution of functions of all nodes according to the energy remaining in each node.

When the node has less NBR, the procedure forces the node, which is not in the CH range to change to sleep mode for this session and those entire nodes wake up when the end of this session is reached.

The queue size depends on the cluster weight.

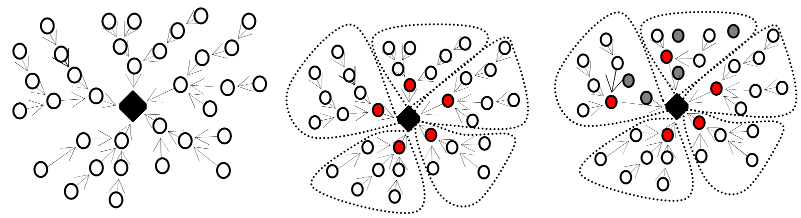
This process continues until most of the nodes in the queue reach the minimum energy which can not be used for transmit or receive any more signal, at which time the network is going down..

2.4 Distribution of roles-dormant cells

This section will address how to reduce the excessive consumption of energy and how to reduce duplicate reporting through negligence in sending the same information, through the imposition of compulsory *dormant cells*. This algorithm is implemented through the initial composition of the clusters. Each cluster consists of a group of nodes that are contiguous and have direct contact with each other in the same area.

This feature will enable us to distribute roles where nodes that serve the same purpose as other neighboring nodes shift to *dormant cells* for a period of time depending on the time and energy consumed by the active node.

The distributions of functions and tasks during the first phase of the deployment of the network, which can be defined as the objective of this network, expand the network, dividing it into subgroups called cluster Figure (1/b).

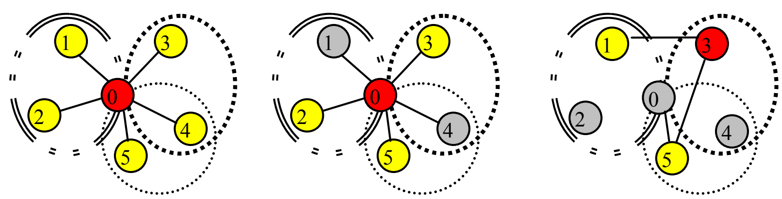


(a) (b) (c)

Figure 1. Cluster Structure of WSNs

○ Sensor Node ● Cluster Head ⬣ Sink ◉ Sleep Node

Figure 1 illustrates how the composition of clusters: figure (1/a) represents beginning of the formation cluster group, which consists of several node contiguous communicate with each other. Figure (1/b) shows the method of selecting the head of the cluster, which has the largest number of NBR and while Figure (1/c) shows the second phase of the formation and selection cluster head of the group, in addition to applied RDC-Queue to the cluster.



(a) (b) (c)

Figure 2. Dormant Nodes

○ Sensor Node ● Cluster Head ◉ Sleep Node

Figure 2 illustrates the process of exchange of roles within the cluster and applied the RDC-Queue method to the cluster to define which nodes are going to the sleep mode and that continue in the active mode.

Table I. The Queue System After 4 Round

N1 is a cluster head round 1							
NBR	5	6	5	4	6	7	7
Node	N7	N6	N5	N4	N3	N2	N1
N2 is a cluster head fo round 2							
NBR	7	5	6	5	4	6	7
Node	N1	N7	N6	N5	N4	N3	N2
N4 is cluster head for round 3							
NBR	7	7	5	6	5	6	4
Node	N2	N1	N7	N6	N5	N3	N4
N5 is cluster head for round 4							
NBR	7	7	5	6	4	6	5
Node	N2	N1	N7	N6	N4	N3	N5

Table I shows a queuing-system process after 4 rounds, where in each round is measured amount of energy remaining for each node and the number of NBR owned, which will schedule nodes in a queue for the next round basis of NBR and energy remained. At this stage to identify which node will go to the sleep mode, those which have the least amount of energy as in the case of sleep continue to reach all the nodes with the same amount of energy or less in order to change their activation

In this case, it is very possible that a large proportion of nodes are performing the same function and this process will cost much energy to send the same information to the same cluster head. Figure (*2/a*) showed that node {*N1*} has the same range of node {*N2*}, node {*N3*} has the same range of node {*N4*} and node {*N4*} has the same range of node {*N5*}. So it is possible that each of these nodes sends the same information at the same time to node {*N0*} (*cluster head*). This is the crux of the problem for which we are about to develop appropriate solutions to reduce energy consumption because of boundary neighboring nodes performing the same tasks. Two proposals suggested to limit excessive consumption of energy, are called *Duplicate dropping and Roles-dormant cells.*

2.4.1 Duplicate dropping:

The neglect of duplicate packages seems a complex and difficult process of application, especially in wireless sensor networks. Since each package must be compared with other packages, this leads to the loss of much energy; a result of these comparisons on the basis of which of the duplicate sets of packages must be disregarded and which must be sent to the highest level, the advantage of the networks in restricts terms of sensitive storage and processing.

Hence for a message coming from any node to be compared with messages Id stored in a table, if found to have been receiving a similar message id from the same group to which it belongs, the node will send a message in the current duplicate time, and the new message will be ignored.

Table II. List of repetition node based on figure 2

Row	Neighbor nodes with same tasks		
R1	N1	N2	….
R2	N3	N4	….
R3	N4	N5	….

Table II based on equation (2) and figure 2 put the first image to solve this dilemma, as it will compare each package received by CH. Equation (2), gives the propagation distance of each node that allows the system to classify the node tasks according to each area coverage.

Table II shows that {*N1*(*x1,y1*) and *N2*(*x2,y2*)} are in the same row meaning {S1≈S2} where is *S1* and *S2* are the area space coverage by *N1* and *N2* if any message received from *N1*and *N2* in *duplicate time*($\Delta\tau$) which is the maximum waiting time before forwarding the messages received. Therefore, the recent messages received will be canceled.

$$f(d) = \begin{cases} D_1 & if \quad \Delta\tau 1 > \Delta\tau 2 \qquad else \quad D2 \\ \\ D_1 & if \quad \Delta\tau 1 > \Delta\tau \qquad Non - duplicate \end{cases} \quad (7)$$

The approach in a nutshell:

- Each cluster is held in a specific location and a specific id
- Examination of the primary beams received identifies and resolves duplicate reports involving and stored in the list of repetition.
- Any future package which comes from the same group in the list of redundancies and the same transmission time is neglected.
- This algorithm will preserve much of the energy that is currently wasted in sending duplicate messages.
- Each node only propagates optimal information to its neighbors, and discards all redundant or non-optimal messages.
- The approach establishes the minimum cost field with only one message broadcast at each node.

We tried to put perception here where first troubleshooting the problem of energy consumed by sending duplicate messages. Nevertheless, this algorithm suffers many problems that make it not the best solution to curb excessive consumption of energy, those problems can be classified as following:

a. *The proposal addresses the problem of energy consumption of forwarding duplicate messages in the cluster head and does not deal with the lost energy of the ordinary node.*
b. *Facing a big problem when there are a large number of nodes in the cluster.*
c. *Need to use part of the memory for scheduling neighbor nodes and messages.*

Because of these problems of this algorithm, the following proposal is offered as the best solution to the problem of energy and also deals with the previous three points.

It is noted that it would come to the reader's mind, that if this algorithm is not the optimal solution, why is it proposed here? The answer is yes, it is not the optimal solution, but part of the solution is that the algorithm does not depend on complex equations to calculate the cost of energy consumed but depends on technically very simple scheduling of neighboring nodes in the cluster based on the number of nodes within the cluster.

2.4.2 Roles-dormant cells (LEACH Expanded)

The difficulty we have encountered in the previous proposal, as it has been part of the energy at the stage of the comparisons, as well as the need for part of memory, would suggest the following algorithm.

2.4.2.1 Algorithm Assumption

- When one sensor node transmits, other nodes in its coverage area can receive the transmitted data.
- Sensing operation consumes a fixed amount of energy during each data gathering round.
- The energy consumed to receive r bits is

$$Erx(r) = Ee \times r \quad (8)$$

Where *Ee* (in Joules/bit) is the energy consumed in the electronic circuits of the transceiver when receiving or transmitting one bit [14].

$$Etx(r, d) = Ee \times r + Ea \times d\alpha \times r \quad (9)$$

Where *d* (in meters) is the transmission distance and $2 \leq \alpha \leq 4$ is the channel path-loss exponent. For short distances, the free-space path-loss model, $\alpha = 2$, can be used, while for longer distances, a multi-path model, α = 3, 4, is more appropriate. *Ea* (in Joules/bit/m*α*) is the energy consumed in the power amplifier to transmit one bit of information over a distance of one meter. *Ea* depends on the receiver sensitivity and it can range from10 pJ/bit/m2 to 100 pJ/bit/m2 for the free-space path-loss model [15].

2.4.2.2 Algorithm Descriptions

We introduce our approach by considering a very simple cluster based wireless sensor network depicted in Figure (*2/a*) where is composed of two sensor nodes, {*N1*} and {*N2*}, and the cluster head {*N0*}, which gathers data collected by {*N1*} and {*N2*} and routes them toward the central station {*Sink*}. We assume that all nodes transmit using Omni-directional antennas. If the distance between {*N1*} and {*N0*} is not less than that between {*N1*} and {*N2*}, then when {*N1*} transmits to {*N0*}, its transmission can also be received by {*N2*}. If *N1* transmits a message with *n* bit to {*N0*} and {*N2*} receives the {*N1*} message and after period {*N2*} transmit the same message to {*N0*} and {*N1*} receives the {*N2*} message because {*N1*} and {*N2*} in the same range having the same sensing area as we assumed . Therefore, using equation (8) and (9), the energy consumed to transmit r_{Ni} bits to $\{N_0\}$ are:

$$E_{Ni} = E_e * r_{Ni} + E_a * d^2 NiN0 * r_{Ni} \quad i = 1,2 \qquad (10)$$

Therefore, the energy consumption to transmit $\{r_{N1}/r_{N2}\}$ to {*N0*} is $\{E_{N1}+E_{N2}\}$ .This will lead to the failure of the network because of the presence of a significant number of nodes that perform the same purpose, and send the same messages if they have the same sensing range.

The queuing system proposed in this paper is the optimal solution to save much energy consumption and keep the network performance active as much as possible.

2.4.2.3 Queuing System

This theory is based on queuing node within the queue as the sensing range of each node within the cluster they belong. In addition, because the network is usually large and wide, the queue will be in the sink and each cluster with have its own queue. Arrangement of nodes within the queue according to signal strength equation (2), where nodes that have the same sensing range will be entered in order to the *DCR-Queue*, and are all in the category of sleep mode except the node with order zero which is active for the current period.

Each round has two factors to change the node state, they are period and max-active, where max-active is the maximum energy that each node consumes when its in active mode. Therefore, the queue order will change every round when the time is out for this round or when the cluster head consumed energy equal or bigger than max-active factor for each cluster.

Figure (*2/a*), shows the stage of two round of LEACH protocol with queuing system, where the figure 2/b shows the first configuration of the cluster, which consists of six nodes and node zero was selected to be the cluster head according to aforementioned *NBR* factor. The nodes that possess the same sensing range and play the same purpose are showed in Figure 2/b, the cluster has three sensing areas *A1, A2* and *A3* where *A1*=[*N1* and *N2*], *A2*=[*N3* and *N4*] and *A3*=[*N4* and *N5*]. So the queue order will be *A1A2A3={N1,N2,N3,N4,N5}*. The queue order will change each round according to energy consumption and sensing range. Table III showed that when a round is finished because of period or max-active factor, the order inside the queue would change according to following equation:

$$E_{Ni} = E_{Ni} - Ee * r + Ea * da * r \qquad (11)$$

The node that still possesses the largest energy has priority to be the first order in the queue. Even if it is active in the case in the previous round, for some rounds the network is inactive where cluster head does not lose, much energy therefore the current cluster head can continue to act as a cluster head for one or more consecutive rounds, the same method applied for the rest of the clusters *B,C,…*etc.

2.4.2.4 Algorithm Theory

The algorithm classified cases of node within the queue to four classifications as follows:

Case S_0: All the components of sensor node are active. Data acquisition, reception, and transmission are enabled. Sensor nodes can accomplish target detection and message forwarding tasks in this state. Using (8) and (9) to calculate the total energy consumed to receive or send *r* message of S_0 is:

$$Es_0 = \sum_{i=0}^{n} E_{rx}(r_i) + \sum_{j=0}^{m} E_{tx}(r_j) \qquad (12)$$

Where *n,m* are the number of receiving or transmitting message per round.

Case S_1 in this case data transmission is disabled, the sensor node can only receive order from sink node. The total energy consumed of S_1 is :

$$Es_1 = \sum_{i=0}^{n} E_{rx}(r_i) \qquad (13)$$

Case S_2 : In this state, only the sensing component is active. The total energy consumed of S_2 is :

$$Es_2 = Ee \qquad (14)$$

Case S_3 : This is the deepest sleep case, which consumes the lowest energy, the sensing, processing, memory and communication components are inactive. Its own timer can only a waken sensor nodes in this case.

Table III. Node Active / Sleep in Queuing System

A	S	A	S	A	H	4	3	2	1	6	5	4	3	2	1
5	4	3	2	1	0										
Cluster A						Cluster B				Cluster C					
Round 1															
S	S	A	S	A	H	4	3	2	1	6	5	4	3	2	1
0	4	5	2	1	3										
Cluster A						Cluster B				Cluster C					
Round 2															

Where symbols A,S,H are Active, Sleep mode and Cluster Head respectively.

3. Simulation Results and Discussions

Different sensing field WSN were assumed: 300 m x 300 m , 400 m x 400 m , 500 m x 500 and 600 m x 600 m, in which there are 200,350,400 and 450 sensor nodes for each sensing field respectively are deployed randomly. The sink node is located at (150 m, 150 m, 200 m, 200 m, 250 m, 250 m and 300 m, 300 m) respectively. Each sensor node has a detection radius of 30 m. In the energy consumption model, parameters are:

α_1 = 50 nJ/b , $2\alpha_2$ =100 pJ/(b×m) .

Cluster head period T is set as 2000s and the execution time of task is set as = 0.005 s. The data packet size is 2 KB and the parameter r =105. Simulations are performed using OMNET++ [16], which is a simulation platform for a distribution communication system. Network models are established based on the LEACH mechanism. We Assume the energy consumption of each sensor node is as follows: Ea =100 pJ/bit/m2, Ee = 50 nJ/bit and Ec = 5 nJ/bit. Each sensor needs to send a packet of length *R* = 400 bits to the cluster head on random time.

Many scenarios have been implemented to obtain accurate effective results and through which we can evaluate the proposed algorithm accurately. Many of the tests show that there are significant developments in the performance of the network. The simulation result showed in Figure 3 ran with 200,350 and 450 nodes deployed in the area of square 300 x 300, 500 x 500 and 600 x 600 meter. The result showed that the most of sensor nodes will die after 10 rounds when the protocol The LEACH protocol used on the simulation scenario causes network breakdown because of the protocol structure which whole network will stop when a half of nodes die. On the contrary, we note that when the simulation ran with LEACHE scenario most of nodes were still working until round 22 with same scenario parameters as used for LEACH protocol. Impressive results achieved for wireless sensor network on LEACHE with use double energy than LEACH of total network energy available showed in figure 4, which, means the total power used by LEACH protocol is 45% to 60% of the total power of wireless sensor network, where LEACHE used around 70 to 90% for different scenarios. Figure 5 showed the stages of energy consumption in each round, the nodes being divided into different ratios of energy consumed for each round during the network lifetime. It is noted that in the first round all node have 100% of energy and the second round nodes consume around 10% of their energy.

For wireless sensor network with LEACH protocol Scenario dead at round 16, figure (5/a) illustrates that {40, 10, 50} nodes own {30%, 15% and died} sequentially. Whereas the figure (5/b) show that the network still work until round 20 with {85, 15} nodes own {30% and 15%} of energy sequentially. Wireless sensor networks using LEACHE break down in round 21 where 85% of nodes die. Figure 6 shows the sensors lifetime and the network performance for each round where the network still work until round 21 with LEACHE whereas they die in round 15 when using the former LEACH.

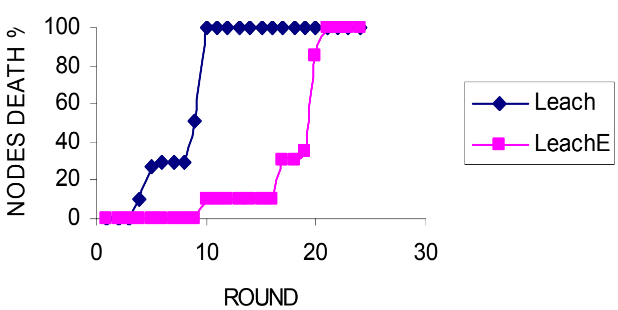


Figure 3. Number Nodes Die vs. Round

Simulation ran with the maximum network lifetime=30 rounds on square area[300x300,600,600], the energy consumption of each sensor node is as follows: Ea =100 pJ/bit/m2, Ee = 50 nJ/bit and Ec = 5 nJ/bit consumed for transmitting , receiving and listening respectively. Each sensor needs to send a packet of length R = 400 bits to the cluster head on random time. Cluster head period T is set as 2000s and the execution time of task is set as = 0.005 s. The data packet size is 2 KB and the parameter r =105, and the sensing range to 64 meters.

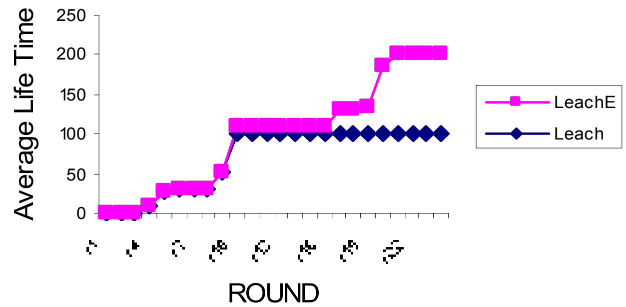
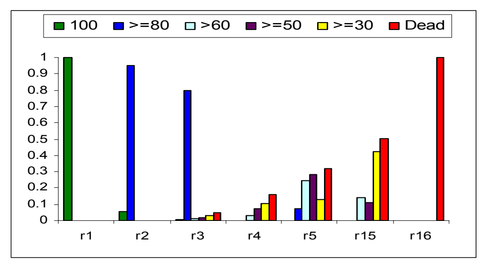
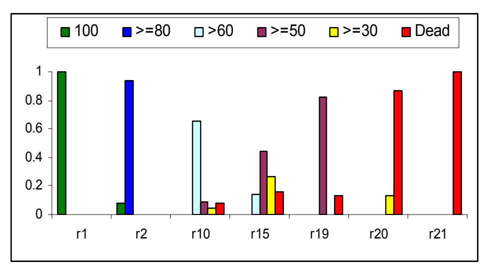


Figure 4. Total Energy Consumption of Network

Simulation ran with the maximum network lifetime=30 rounds on square area [300x300, 600,600], the energy consumption of each sensor node is as follows: Ea =100 pJ/bit/m2, Ee = 50 nJ/bit and Ec = 5 nJ/bit consumed for transmitting, receiving and listening respectively. Each sensor needs to send a packet of length R = 400 bits to the cluster head on random time. Cluster head period T is set as 2000s and the execution time of task is set as = 0.005 s. The data packet size is 2 KB and the parameter r =105 and the sensing range to 64 meters.



a) LEACH with 100 nodes



b) LEACHE with 100 nodes

Figure 5. Classification of Node Consumption

Simulation ran with the maximum network lifetime called round (ri, i=1,… network life time). Each round classified the networks nodes energy level according to the energy consumed for the previous round, the energy consumption of each sensor node is as follows: Ea =100 pJ/bit/m2, Ee = 50 nJ/bit and Ec = 5 nJ/bit consumed for transmitting , receiving and listening respectively. Each sensor needs to send a packet of length R = 400 bits to the cluster head on random time. Cluster head period T is set as 2000s and the execution time of task is set as = 0.005 s. The data packet size is 2 KB and the parameter r =105, and the sensing range is 64 meters.

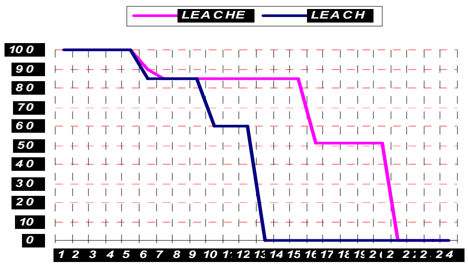


Figure 6. Network Life Time

Simulation ran with the maximum network lifetime=30 rounds on square area [300x300, 600,600], the energy consumption of each sensor node is as follows: Ea =100 pJ/bit/m2, Ee = 50 nJ/bit and Ec = 5 nJ/bit consumed for transmitting, receiving and listening respectively. Each sensor needs to send a packet of length R = 400 bits to the cluster head on random time. Cluster head period T is set as 2000s and the execution time of task is set as = 0.005 s. The data packet size is 2 KB and the parameter r =105 and the sensing range to 64 meters.

4. Conclusion

The tasks scheduling and distribution are based on the identification of the following:

1. *Definitions of neighboring nodes, which are approximate, have the same range and cover the same region. It must commit a series of this decade to be forced to sleep for a certain, period.*
2. *Verifying the nodes which have the same purpose.*
3. *Define the NBR for each node, which will be nodes queued in this first round according to node NBR, and the highest NBR node will be elected as the cluster head, assuming that all nodes in this first round have the same energy when deployed.*

Through the above-mentioned points, the algorithm organizes the distribution of roles and tasks of nodes. This algorithm control and reduce excessive consumption of energy; therefore, the wireless networks can be more efficient and perform better. Different simulation scenario applied *TSDRDC* algorithm and proved that the wireless sensor network could use 80 to 90 percent of the total method devoted to this network. All the nodes die almost at same time at this mean. Interrupt factor addition was good and important, as that makes all nodes which lose energy equal to or less than this factor to be forced to sleep and add it to the end of the queue. Thus continues the distribution of functions within the cluster and work again until most nodes of the network die. Unlike what is currently used, the node dies quickly because of the excessive use of energy and this leads to the death of half of the network. This affects the rest of the nodes and breakdown of the network occurs in a short time, despite the existence of some nodes with enough energy to accomplish many tasks and here lies the difference of by using the proposed algorithm for improved network performance and the fair distribution of functions.

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