Journal of Critical Reviews

ISSN- 2394-5125 Vol 7, Issue 15, 2020

IMPROVE SCHEDULING AND ENERGY EFFICIENCY OF WSN USING OPTIMAL CLUSTER SCHEME

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Received: 24.04.2020 ***Revised: 23.05.2020*** ***Accepted: 25.06.2020***

Abstract
Cluster heads nearby base station (BS) reduce their energy very rapidly in Multihop method, due to the large inter-cluster relay load, which causes the problem of the hot spot. Therefore, both energy capable with liability accepting be required for a clustering protocol. This paper provides an unpredictable and fault tolerant clustering with a TDMA process system known as PSO-UFC-TDMA dependent particle swarm optimization (PSO). Here, the network connection is restored in PSO-UFC protocol via the sudden failure of the MCH by selecting an additional CH called Surrogate Cluster Head. TDMA allocates timescales to save energy when transmitting data. The results of the simulation show that the PSO-UFC-TDMA approach extends the lifespan of the network against protocols like PSO-UFC, EBUC, PSO-C and LEACH-C.

Key words: Particle swarm optimization, unequal clustering, fault tolerance, MAC protocol, TDMA, packet delivery ratio, network lifetime, PSO-UFC-TDMA.

 DOI: http://dx.doi.org/10.22159/jcr.06.06.24

Introduction

Wireless sensor networks have emerged as one of the most recent developments over the next few years [1-2]. Initial work on WSN focused mainly on monitoring applications, while widespread use of WSNs in various conditions and for different purposes, for example, Healthcare, Military Surveillance, Smart Grid and Industrial Automation, was the result of immense growth in micro-electro-mechanical (MEMS). These provide automatic sensing, incorporation also, remote correspondence into little inserted gadgets known as sensor nodes. Because of its confined and non-battery-powered battery source, each sensor node is restricted to energy supply. However, the onboard processing power and storage capacities of their processors are minimal. For long term WSNs, these constraints include the sensor node's energy resources [4]. Clustering for the energy efficiency of WSNs has recently been researched extensively. The process divides the system into clusters where the node with a cluster head (CH) is present for each cluster. The inter- and intra-cluster communication between the nodes can be classified in as far as it is divided into clusters. Non CH nodes transmit data to CH, then CH directly or by multi-hop routing transfer the aggregated data to the database (BS) station. [3]. [4]. [4]. [4]. However, CHs close to the BS are filled with intercluster and their resources are very easy to deplete compared with other CH nodes in Multihop routing. This subject is generally accepted as the high point in the literature [6]. In addition, sensor nodes are vulnerable to failure because their energy is quickly drained or hardware components fail. If a CH node fails, the communication between network members as well as neighboring CHs will not only be stopped [7]. This paper therefore deals jointly with the issues at the heat of the case, imbalanced grouping and adaptation to internal failure.
Please note that CH selection is a hard-optimizing NDP, since the choice of m ideal CHs among n sensor nodes gives n m C prospects. A number of these NP problems have been successfully resolved by swarm intelligence approaches. Particle swarm optimization (PSO) [8] is an optimisation technique focusing on swarm intelligence and based on the social actions of bird- and fish schools. This optimizes a problem by conducting a number of iterations to refine the answer for the candidate to the defined application standard. Because of its simple hardware and software deployment and the capacity to meet quickly into an optimized solution, an optimized CH range can be a better choice. Therefore, the simpler the network performance algorithm, as the clustering is a repetitive operation. It is another reason for the large number of PSOs used by many clustering protocols to optimize the CH electoral cycle.

In the EBU Clustering Protocol (EBUC) [9] PSO BS Algorithm has been used to address the problem of the hot spot. The protocol creates uneven clusters that accommodate a high traffic intercluster load in fewer nodes close to the BS. EBUC does not take into account the grade and residual energy of CHs in clusters which can help to scatter the power between CHs unequally. Therefore, the question of fault tolerance for the EBUC protocol is not considered. We are proposing a new optimisation of the particulate swarm based on an unappropriated and fault-tolerant clustering protocol to mitigate clustering and faulty tolerance problems under this EBuc Protocol.
Here, we performed a TDMA convention for grouped Wireless Sensor Networks (ECTDMA) that means to give a new intra-cluster communication TDMA schedule mechanism. EC-TDMA adjusts the length of TDMA frames by number of sensor nodes with traffic charge of the sensor node in a cluster dynamically, decreases idle listening, and increases the channel efficiency and thus extends the life of networks.

Related work

This section addresses many of the current WSN clustering protocols.

A. LEACH-C

LEACH-C [10] be a central clustering protocol that ensures that BS is responsible for optimizing network life during the democratic cycle of CH. To pick the maximum number of CHs in the network, BS uses simulated impression techniques. LEACH-C's main downside is a one-stop routing for cluster communication which can result in an unequaled energy supply, particularly if the BS has been positioned far away by a large number of CHs. So, during the contact with BS, the CHs use high energy also expire easily.

B. PSO-C

The PSO-C (PSO-C) [11] is an energy-conscious protocol of clustering, where BS manages the entire power grid cycle and the cluster mechanism to boost the network life. The BS considers the intrusion distance between nodes and current energy in order to optimally collect ch nodes. If the CHs directly attach to the BS, the distance from the BS, which raises energy consumption, is not required.

C. EBUC

The PSO BS algorithm is an uneven, centralized clustering protocol that resolves the hot spot problem. The Protocol creates unmatched clusters that put CHs closer to smaller cluster sizes of BS in order to maintain their battery power for large intercluster relay load. EBUC also uses clever multi-hop routing algorithms for the inter-cluster. In clustering, the EBUC takes into account the nodal score and residual energy of the CHs, which can produce a different energy distribution between the CHs. Furthermore, the issue of fault tolerance is not considered to prevent the rapid failure of excessive CHs.

D. IPSO

To extend the life of the network [12], the latest EBUC Protocol [9] implements the improved version of the Particle Swarm (IPSO). By expanding the quest particles scan field, IPSO overcomes typical PSO issues. This is achieved by actively adding disturbances to the best and brightest in the world. However, problems still appear to be addressed in the EBUC protocol.

E. PSO-ECHS

In PSO-ECHS [13], the BS operates PSO to optimize both CH elections as well as cluster formation. Closer algorithm is energy-efficient. A new fitness function is introduced, which minimizes the linear combination of intracluster distance function, BS separation and the remaining vitality sensor node. Unclustered head nodes are connected toward the CH's, according to different parameters, such as scale, power and CH nodes, to make up the symmetry cluster. However, when the BS location changes center to corner, its network output still worsens.

PSO-UFC [14] is an efficient mechanism, the PSO-based clustering method for solving the WSN Hot Spots problem. Costs for a dynamic process of clustering Intra-cluster and intercluster energy consumption set. Build a multi-hop MCH communication routing tree. Choosing cluster heads in every cluster to solve the issue of fault tolerance. The rounds consist of the establishment and continuous process, each round is rounded. The BS splits the network into uniform clusters throughout the deployment, with each cluster providing an MCH and SCH, and manufactures a various jump directing tree between the chose MCHs. Intra-group and between group correspondences transmits sensor nodes to the BS during the steady stage process. Just in the event that one SCH takes the undertaking of its MCH so as to limit vitality utilization and processing time during the execution stage does the PSO-UFC Protocol adopt that step, otherwise it would use existing MCHs at the following round.

The EC-TDMA is split into rounds. A process of cluster setup and stabilization are part of every cycle. During the setup process, clusters are formed and data is moved in a steady stage to the head of the cluster. The EC-TDMA is divided into n frames in a steady stage. Because not all data must be sent to each source node, every frame is not set for a fixed length. A time line and time period are included in each period. The TDMA cycle for intranet communication without collisions is generated for each cycle. The cluster head allocates similar space for the cluster members into first cycle, per round. The head of the cluster assigns other source nodes for the other time span. The longer data is split into slots equivalent toward amount of source nodes into a cluster. — The source node moves your intended traffic information to the cluster head with loads from a frame and stops your radio. Throughout information transmission cycle, entirely non-source nodes has their radios off. For instance, information can also be sent towards cluster head by source node. While length of TDMA network can be modified dynamically by the amount of sensor nodes with loading of the sensor node. The next structure starts with a strategy to replicate the same loop until the frame has been completed. The cluster head gathers the information and passes it to the base station from all the source nodes. The computer starts the next cycle and after a predefined time the whole cycle is repeated.

Protocol Definition: The process of the EC-TDMA is divided into circles, similar to the LEACH and BMA protocols. A process of cluster setup and stabilization are part of every cycle. The EC-TDMA system structure is shown in Figure 1. During the setup process, clusters are formed and data is moved in a steady stage to the head of the cluster. The stable EC-TDMA process is divided into n frames compared to LEACH and BMA. Since not every source node has to be transmitted with all data, not each frame has to have a fixed length. A time line and time period are included in each period. A TDMA framework was developed without collisions for each time of intra-cluster communication. For the members of the cluster in their first cycle, the cluster head assigns the same slot. The head of the cluster assigns to other source nodes the other time span. Section 3.2 explains the duration of the time slot.

Proposed framework

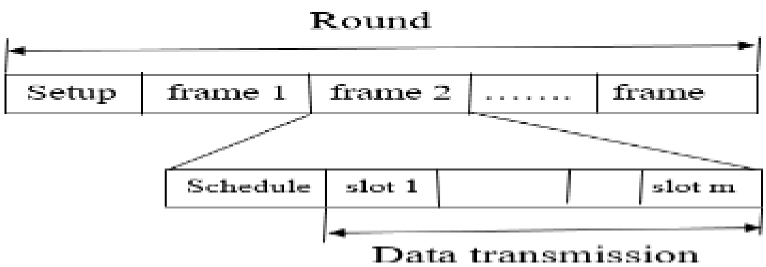

Fig. 1. Structure diagram EC- TDMA frame work

The quantity of source nodes in a cluster is divided into slots during data transmission. —The source node sends over its transmission time its information with predictable traffic from the following figure toward head of the cluster and stops its radio at every supplementary period. During the time of data transmission, all non-source nodes have their radios off. Source node could also provide cluster header data, for example, to leave the post. The length of the TDMA network can therefore be adjusted dynamically by the amount of the sensor nodes and by loading sensor node. When a frame is done, a technique to repeat the process starts with the next frame. The head of the cluster gathers and sends data from all source nodes to the base station. The computer then begins the next loop and completes the whole cycle after a predefined time.

Size of time slot: The EC-TDMA Procedure is aimed at making wireless sensor network intra- cluster communication mechanisms more adaptable. The time slot can be determined by network topology and traffic load of the cluster member. The time slot in a frame can be seen as: Ith Source Node

$$\mathrm{ti} = \min\{\frac{\mathrm{li}}{\mathrm{CCi}}, \frac{\mathrm{li}}{\sum_{j=1}^{m}\mathrm{lj}}(\mathrm{Tnframe} - \mathrm{Tnschedule})\} \quad (1)$$

Where li indicates the traffic from the next frame in the expected source node, m is the number of knots from the source into a cluster, CC_i be a filter volume, the T_i schedule be extreme extent of the loop. The cluster head must assign time to Eq source nodes for the duration of this cycle.

Results and discussion

The PSO-UFC-TDMA scheme, is implemented using the NS-2 network simulator have proposed in this paper. We suppose arbitrary dispersal of 21 sensor nodes over region of 1000x1000m2. In this paper that there is no difference in the field of detection, and in its abilities static sensors are the same. In the meantime, it has been decided that the base station is located in the top-left corner and its coordinates (250 m, 250 m). The base station received data from MCH and SCH. Table 1 displays device parameters used in our simulations and the simulation time required for 1200 ms.

Table 1. system parameters

Parameter	Value
Application Traffic	CBR
Transmission rate	512 bytes/0.5sec
Radio range	250m
Simulation time	1200ms
Number of nodes	21
Area	1000 x 1000
Routing protocol	AODV

A. Performance of proposed system

In the set distribution association and end-to-end inactivity, total energy consumption, the reliability of the PSO-UFC protocol is measured. Life of system be defined as amount of first node deaths (FND) contact rounds or the percentage of nodes to die. In sparsely distributed WSNs, the FND metric is commonly used. However, the death of a single node in densely distributed WSN has no impact on system connectivity with detecting. But the output of the densely distributing WSN is drastically reduced when half a number of nodes die.

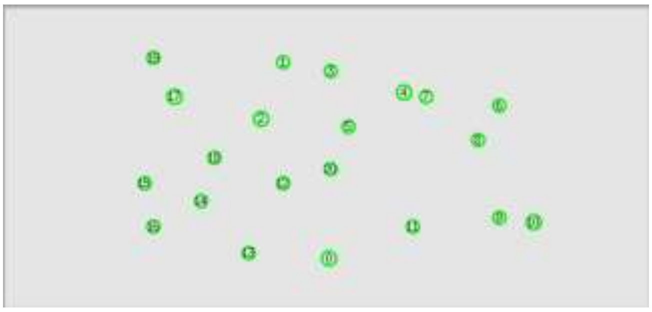

Fig. 2. Network Deployment

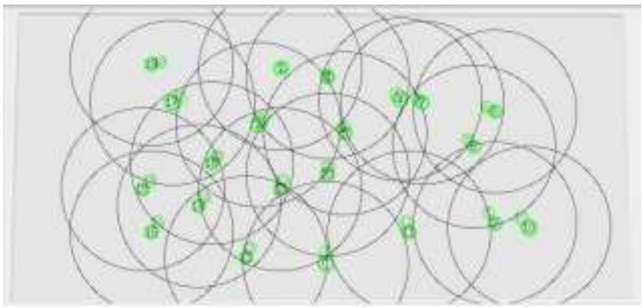

Fig. 3. Broadcasting process in network

Fig. 4. Cluster formation and selection of MCH and SCH

Fig. 5. Data process between cluster heads and BS

```
Cluster - 1 : 14 15 16
Cluster - 2 : 12 13
Cluster - 3 : 0 11 20
Cluster - 4 : 9 10
Cluster - 5 : 17 18 19
Cluster - 6 : 1 2
Cluster - 7 : 3 4 5 7
Cluster - 8 : 6 8

^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^

#######    MCH   ##########

========================================================= 14  15  16
 0.000000  0.136015  0.125300  14  15  16
 0.136015  0.000000  0.101980  14  15  16
 0.125300  0.101980  0.000000

Master Cluster Head(MCH) is node : 14
=========================================================

========================================================= 12  13
 0.000000  0.178885  12  13
 0.178885  0.000000

Master Cluster Head(MCH) is node : 12
=========================================================
```

Fig. 6. Cluster file

```
index :15  dest :15 source :16 nexthop :15 prevhop :16
index :14  dest :15 source :16 nexthop :15 prevhop :16
index :18  dest :15 source :16 nexthop :15 prevhop :16
index :13  dest :15 source :16 nexthop :15 prevhop :16
index :6  dest :6 source :8 nexthop :6 prevhop :8
index :7  dest :6 source :8 nexthop :6 prevhop :8
index :9  dest :6 source :8 nexthop :6 prevhop :8
index :4  dest :6 source :8 nexthop :6 prevhop :8
index :10  dest :6 source :8 nexthop :6 prevhop :8
index :10  dest :10 source :9 nexthop :10 prevhop :9
index :8  dest :10 source :9 nexthop :10 prevhop :9
index :11  dest :10 source :9 nexthop :10 prevhop :9
index :15  dest :15 source :16 nexthop :15 prevhop :16
index :14  dest :15 source :16 nexthop :15 prevhop :16
index :18  dest :15 source :16 nexthop :15 prevhop :16
```

Fig. 7. HOP table

```
Node 2 forwards the packet to 1 at 2.520409
Node 2 forwards the packet to 1 at 2.520409
Node 12 forwards the packet to 13 at 2.592410
Node 12 forwards the packet to 13 at 2.592410
Node 16 forwards the packet to 15 at 2.736409
Node 16 forwards the packet to 15 at 2.736409
Node 16 forwards the packet to 15 at 2.852400
Node 2 forwards the packet to 1 at 2.899165
Node 9 forwards the packet to 10 at 2.970409
Node 9 forwards the packet to 10 at 2.970409
Node 9 forwards the packet to 10 at 2.977404
Node 12 forwards the packet to 13 at 2.993065
Node 8 forwards the packet to 6 at 3.078409
Node 8 forwards the packet to 6 at 3.078409
Node 8 forwards the packet to 6 at 3.134773
```

Fig. 8. Transmission Table

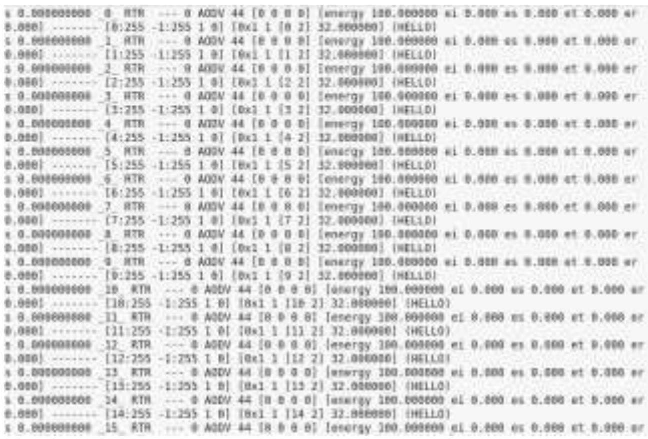

Fig. 9. Trace file

In above fig 2, shows all nodes placed in the network; deployment of the nodes in the network. Here every node displayed on the basis of topology values; all properties of NAM window it should be mentioned. In this fig 3, broadcasting occur throughout network. Here broadcasting occur for the purpose of communication. Every node should involve in this process. In fig 4, cluster formation started based on network area. In this cluster members should transmit the data to cluster head (MCH or SCH). The selection of cluster head based on distance parameter. In fig 5, cluster head to base station data communication, this data should be reached to cluster head properly. Here we use CBR protocol as traffic purpose and how many byte of data sent and when it sending is shown in figure 5. In fig 6, it shows the cluster formation file. In this file cluster division and cluster selection based on parameters. Figure 7 shows and represent the hop table. In tis hop table, source, destination, index, previous hop, and next hop node details shows. Figure 8 represent the Transmission table. Here each source node to destination process updated as per simulation time. In fig 9, shows and represent the trace file of the network, it shows all the attributes, variables, energy levels for individual nodes and data transmission process.

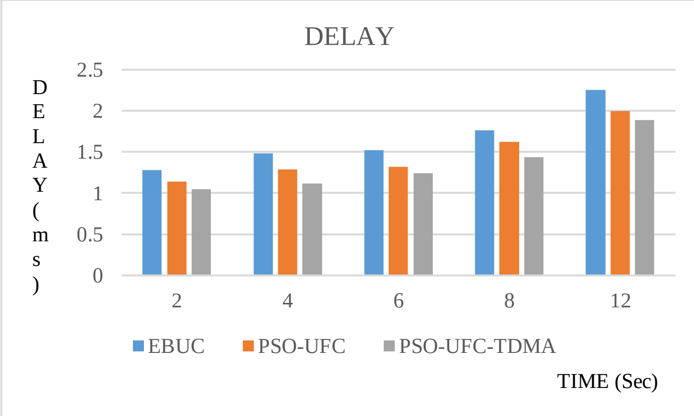

Fig. 10. Figure performance on delay

In figure 10 it shows the delay of the network. If the delay is low in the network them it is proved that method performed well. So here proposed method PSO-UFC-TDMA gave low delay than the existing methods like PSO-UFC, EBUC.

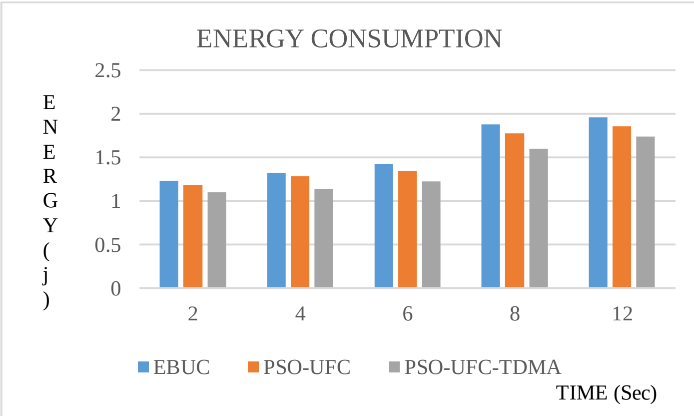

Fig. 11. Energy Consumption

In figure 11 it shows the energy consumption (EC) of the network. If the energy consumption is low in the network them it is proved that method performed well. So here proposed method PSO-UFC-TDMA gave low energy consumption than the existing methods like PSO-UFC, EBUC.

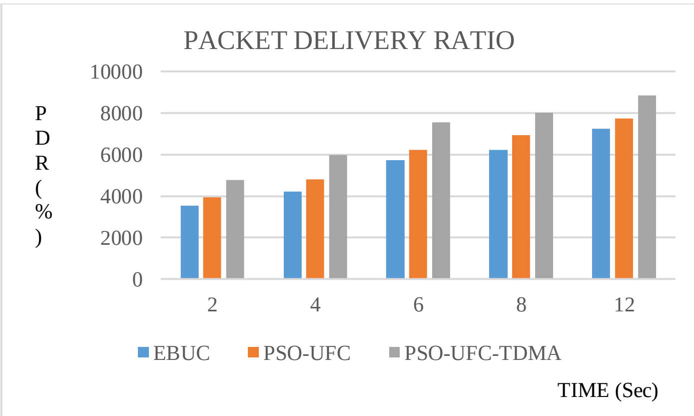

Fig. 12. Packet Delivery Ratio

In figure 12 it shows the packet delivery ratio (PDR) of the network. If the packet delivery ratio values is high them it is proved that method performed well in the network. So here proposed method PSO-UFC-TDMA gave high packet delivery ratio than the existing methods like PSO-UFC, EBUC.

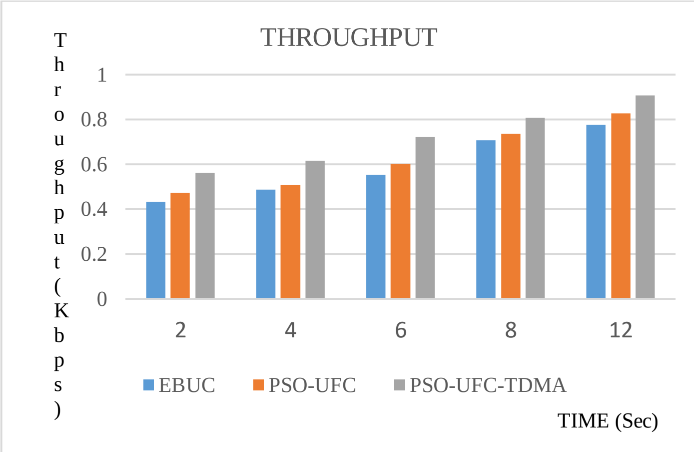

Fig. 13. Throughput

In figure 13 it shows the throughput of the network. If the throughput values is high them it is proved that method performed well in the network. So here proposed method PSO-UFC-TDMA gave high throughput than the existing methods like PSO-UFC, EBUC.

Conclusion

Aim of this paper was to resolve the question of hot spot issues, unbalanced clustering, fault tolerance, and time-slot problems. They suggest the standard, fault tolerance cluster with TDMA approach for the wireless sensor networks known as PSO-UFC-TDMA. The PSO-UFC-TDMA method aims at selecting additional MCHs near the base station to solve temperature problems. TDMA allocates timescales to save energy when transmitting data. Based on the existing traffic and network topology, our proposed solution dynamically adjusts the duration of the TDMA system, raising energy savings times. The results of the simulation are compared to the existing methods PSO-UFC and EBUC. We showed, as far as system life, section transmission amount, delay and throughput, that the PSO-UFC-TD Method can provide larger energy efficiency comparative results.

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