Design Energy Efficient Routing Scheme for WSN

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Abstract:Wireless Sensor Networks have an extensive range of applications but they are conquered with many challenging problems and complications that need to be addressed. The energy consumption of the nodes and the extension of the network lifetime are the core challenges and the most significant features of the routing protocol in order to make it suitable, effective and efficient for WSNs. As the sensor nodes are basically battery powered devices, so the top concern is always to how to reduce the energy utilization to extend its lifetime. In the past few years WSNs has gained a considerable amount of attention from both the research community and the real users. The researchers also proposed many different energy efficient routing protocols to achieve the desired network operations. In this paper there is an attempt to give a wide comparison of the routing protocols in WSNs focusing on the hierarchical or clustering based routing protocols. Moreover, extracting the strengths and weaknesses of each protocol, providing a comparison among them, including some metrics like scalability, mobility, power usage, robustness etc. to make it understandable and simple to select the most suitable one as per the requirement of the network.

Keywords: Energy Efficiency, Network Lifetime WSN, Fuzzy Clustering Mechanism

1. INTRODUCTION

Wireless Sensor Networks (WSNs) brought a dramatic variation in bringing advancement in technologies and also providing opportunities for effective usage of resources in critical environments [2]. WSNs are basically the collection of wireless nodes having limited energy capabilities, are deployed randomly over a dynamically changing atmosphere, may be mobile or stationary, for observing physical phenomena like humidity, temperature, health monitoring, vibrations, seismic events etc. [4][5]. Selecting a routing strategy is the core issue for gathering and delivering the efficient packets of useful information to the specified destination. So the routing strategy should guarantee the least energy consumption resulting in maximizing the network's lifetime [6].

The WSNs may be used in the variety of everyday life activities or services. For example its common use is for monitoring like in Military to detect enemy intrusion or monitoring the air pollution or to be used for forest fire detection to control when a fire has started. In addition, an important area of use is the healthcare sector. Moreover, the use of WSNs on agriculture may benefit the industry frees the farmer from the maintenance and wiring in a difficult environment [5].

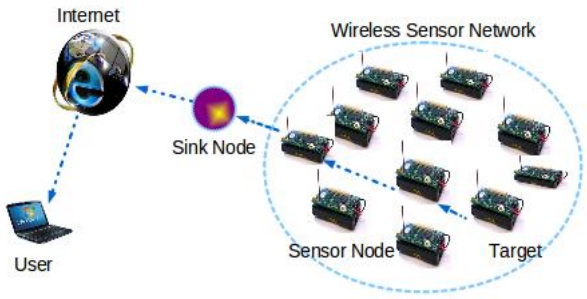

Fig 1: Wireless Sensor Network

A sensor node is typically an ultra-small limited power device that consists of four basic components. First is the sensing part for data acquisition, then the control system for the local data processing and memory operations (storage), then a communication subsystem for transmission and reception of data from other linked devices and finally a power source that supplies the required energy for performing the desired tasks [1][3]. This power source usually comprises of a battery with limited energy so if a critical node stops working then it's a big and serious protocol failure. The main thing is that it could be impossible to recharge the battery because the nodes are deployed and spread randomly in a hostile environment or any other area of interest such as unapproachable areas or the disaster locations for getting the required information. So to fulfill the scenario requirements the sensor nodes should have enough and prolonged life time, even in some cases up to several months or years can be required. So the question arises that "how to elongate the lifetime of the node for such a long duration" [2][3].

It is also possible to use the energy from the external environment e.g. using the solar cells as a power source [7]. But usually a non- continuous behavior is usually observed from the external power sources so some energy buffer is also needed. Whatever is the situation; energy is a serious resource and should be used very carefully. So what clear from it is that energy is a main issue for the systems grounded on WSNs.

2. INTRODUCTION TO ENERGY EFFICIENCY:

Much of the discussion has already shown that energy is a precious resource in wireless sensor networks and that energy efficiency should therefore make an evident optimization goal. It is Clear that with an arbitrary amount of energy, most of the QoS metrics defined above can be increased almost at will (approximation and tracking accuracy are notable exceptions as they also depend on the density of the network). Hence, putting the delivered QoS and the energy required to do so into perspective should give a first, reasonable understanding of the term energy efficiency. The term "energy efficiency" is, in fact, rather an umbrella term for many different aspects of a system, which should be carefully distinguished to form actual, measurable figures of merit.

2.1 Energy-efficient Routing Algorithms

Energy efficient routing algorithm can be categorized as follows: data centric routing algorithm, location based routing algorithm and hierarchical routing algorithm. Data centric routing algorithm uses Meta data to find the route from source to destination before any actual data transmission to eliminate redundant data transmission Location based routing algorithm requires actual location information for every sensor node. Hierarchical routing algorithm divides the network into clusters. Cluster head (CH) is elected in each cluster. CH collects data from its members, aggregates the data and sends to sink.

2.2.1 Data centric

Data centric protocols are query based and they depend on the naming of the desired data, thus it eliminates much redundant transmissions. The BS sends queries to a certain area for information and waits for reply from the nodes of that particular region. Since data is requested through queries, attribute based naming is required to specify the properties of the data. Depending on the query, sensors collect a particular data from the area of interest and this particular information is only required to transmit to the BS and thus reducing the number of transmissions. E.g. SPIN was the first data centric protocol.

2.2.2 Hierarchical

Hierarchical routing is used to perform energy efficient routing, i.e., higher energy nodes can be used to process and send the information; low energy nodes are used to perform the sensing in the area of interest. E.g. LEACH, TEEN, APTEEN.

2.2.3 Location Based

Location based routing protocols need some location information of the sensor nodes. Location information can be obtained from GPS (Global Positioning System) signals, received radio signal strength, etc. Using location information, an optimal path can be formed without using ooding techniques. E.g. Geographic and Energy-Aware Routing (GEAR).

3. RELATED WORK

In [8] thispaper introduces Robust Formally Analyzed Protocol for Wireless Sensor Networks Deployment with Load Balancing (RAEED-LB). This protocol takes the decision of selecting the next node on the basis of load balancing. The performance of RAEED-LB and RAEED is compared through formal verification. The formal verification results show that RAEED-LB achieves network lifetime gain in the range of 10% to 35% overRAEED.

In [9]this paper is intended to introduce energy efficient routing protocol, known as Position Responsive Routing Protocol (PRRP) to enhance energy efficiency of WSN. Position responsive routing protocol differs in several ways than other existing routing techniques. Position response routing protocol approach allows fair distribution of gateway\cluster head selection, maximum possible distance minimization among nodes and gateways\cluster heads to utilize less energy. Position responsive routing protocol shows significant improvement of 45% in energy efficiency of wireless sensor network life time as a whole by increasing battery life of individual nodes. Furthermore PRRP shows drastic increases for data throughput and provide better solution to routing energy hole due to it fair distributed approach of gateway selection.

In [10]the objective of this paper is to propose fundamental modeling of topology control algorithm to conserve individual WSN node's energy, and at the same time preserving the graph connectivity. The proposed topology control algorithm consists of three phases: 1. Identifying connecting nodes at maximum transmission, 2. pairing nodes with shortest algorithm /minimum energy level, 3. Calculating/setting minimum power transmission per-node for energy conservation. The algorithm works-out locally and dispenses full graph connectivity, and theoretically would be able to reduce WSN control overhead.

In [11] Wireless connection suffer from some weaknesses chiefly fault detection and energy efficiency which stay again the main problems in (WSN).Both was under the scope of research communities and industry engineers. We are interested to the IEEE 802.15.4 standard with beacon enabled mode. IEEE802.15.4 is a protocol designed to Physical (PHY) layer and Medium Access Control (MAC) for WSN. We intervene in the Super fame Duration (SD) which present the main private characteristic of the MAC frame in IEEE 802.15.4 in order to minimize the energy consumption when the energy level in a battery reach a critical level.

In [12] This paper propose a user-oriented load balancing scheme for an energy-efficient load balancing in wireless networks which is based on allocate load on wireless sensor nodes proportionally to each of the agent's capacity and user-oriented

approach. This proposed scheme is combined dynamic provisioning algorithm based on greedy graph and user oriented load balancing scheme for maintain of the performance and stability of distributed system in wireless sensor networks. We address the key functions for our proposed scheme and simulate the efficiency of our proposed scheme using mathematical analyze.

In [13] the proposed work introduces a technique named as Honey Bee Optimization that aims to reduce the energy Consumption by finding an optimal route with low cost. The proposed approach is to extend the lifetime of a network and throughput and it delivers better performance than existing method in terms of the energy efficiency, link quality, and scalability. Hence, we build the energy clusters by the biologically inspired efficient searching features of the artificial bee colony approach.

In [14] this paper introduce a combination of cluster and chain based data delivery approach to reduce data redundancy and energy consumption of a static wsn. Also consider nodes with dual radio that are capable of transmitting at two energy levels.

4. PROPOSED WORK

Energy Efficiency and Network lifetime are key features for multi-hop routing in WSN. Routing protocols provides energy efficiency and increases the lifetime of network. So, using our proposed method we will work on dynamic thresholding with Fuzzy logic for improve efficiency of existing system.

4.1 Proposed System

We have made a survey on different techniques for improve energy efficiency and which approach suits the best. From that, we have realized that we will work on dynamic thresholding using fuzzy logic which can be more efficient.
The source node starts for searching the destination node. If it gets any node then going to next step otherwise return to initial state. Then after getting a node apply over there fuzzy clustering mechanism (base on neighbor, selected node energy, cluster head with location).After that calculate nearest neighbor nodes for routing. And create a group base on (Threshold and Hop-count).And at last reach to the destination node and give the appropriate output.

Flow Diagram of proposed system

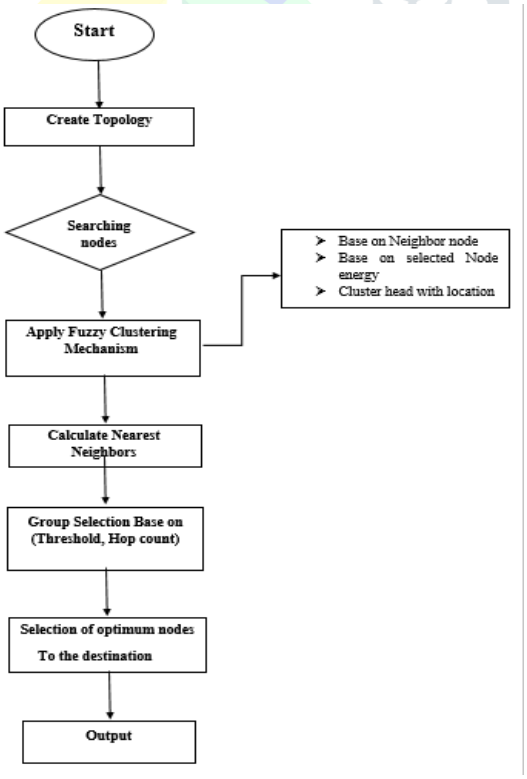

Fig. 2. Flow Diagram of Proposed System

4.2 Algorithm

Step 1: Create topology
Step 2: Searching for nodes
If get
Go to Step 3
Else
Return to initial state
Step 3: Apply fuzzy clustering mechanism
Step 4: Calculate the nearest neighbor nodes
Step 5: Create group base on (Threshold, Trust, and Hop-Count)
Steps 6: Select Optimum node as destination node
Step 7: Output
Step 8: End

5. EXPERIMENTAL EVALUATION

Experiment of proposed method is executed on computer having Intel (R) Core (TM) i3-5200U CPU@2.20GHz with 4GB RAM having Windows 10 (64 bit) operating system and MATLAB 2017R .Simulation and carried out implementation taking into consideration a network scenario consisting of 200 sensor nodes and creating the working environment of wireless sensor network of 100X100m area. The experimental parameters used in simulation of the system are listed below:

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Table 1:Simulation parameter

Parameters	Values
Simulation Area	100 X 100
No. of Nodes	200
Initial Energy	0.5 J
No. of rounds(iterations)	300
Sink X	1.5*XM
Sink. Y	0.5*YM
Energy for transmission	50*0.000000001 J
Energy for receiving data	50*0.000000001 J
Emp	0.0013*0.000000000001 J
Efs	10*0.000000000001 J
EDA	5*0.000000001 J

After implementing the System the result derived is been shown in below figures. The simulation result shown below gives the comparison of energy with previously proposed algorithm which shows significant improvement in the energy efficiency which indeed increases the sensor nodes lifetime.

Table 2: Energy of live nodes of existing and proposed system

No of nodes	Energy(J) of nodes in existing System	Energy(J) of nodes in Proposed System
50	0.571	0.571
80	0.58	0.555
100	0.581	0.541
130	1.1	0.525
140	1.3	0.522
180	1.4	0.49
200	1.5	0.485

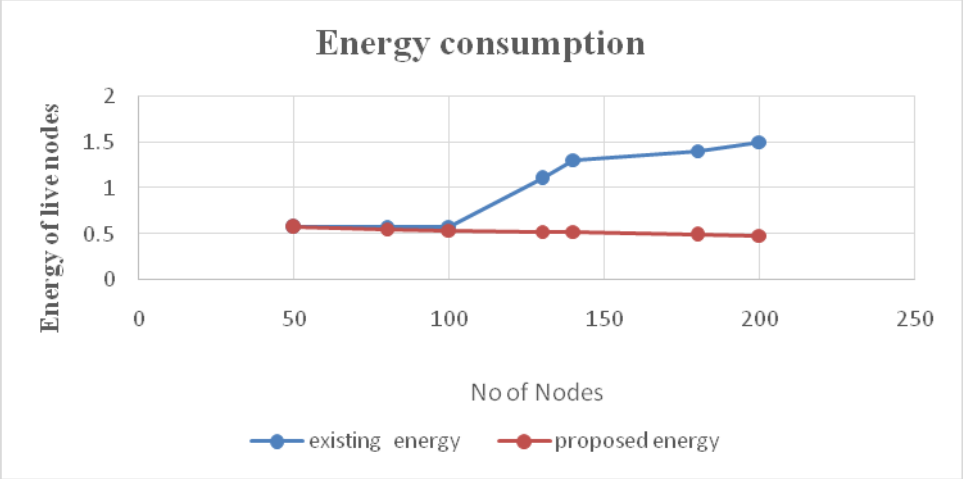

Fig 3:Energy consumption of live nodes

Table 3: Energy of nodes Vs. Time

Energy of nodes	Time in Sec
0.571	177.558
0.555	179.029
0.541	178.02
0.525	178.512
0.522	178.782
0.49	180.853
0.485	195.098

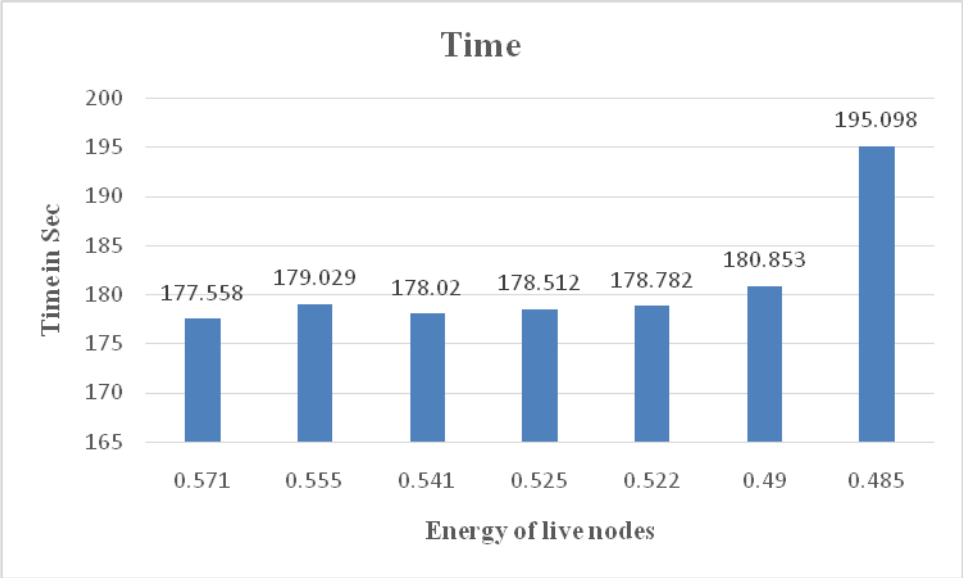

Fig 4: Energy vs. Time

6. CONCLUSION

A WSN system incorporates a gateway that provides wireless connectivity back to the wired world and distributed nodes. So for transmission of information between nodes required routing mechanism for data transmission.so using analysis we found certain routing techniques for effectively routing mechanism but still faces and found some certain limitation related to node energy, load balancing and low PDR. Using proposed system design FUZZY base efficient routingmechanism for WSN. Also analysis result with different parameters like Energy and Time.

7. REFERENCES

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