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Self-Organized Routing Protocol for Wireless Sensor Networks

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Abstract: Wireless sensor networks (WSN) have a colossal number of sensor nodes that are utilized to amass and dispatch assorted kinds of data to a Base station (BS). Wireless sensor nodes are used randomly and densely in a target span, where the physical nature is so harsh that the sensor counterparts cannot be deployed. WSN consists of low-cost nodes alongside manipulated battery domination and substituting the battery is convoluted in thousands of nodes. To solve these issues, lots of protocols have been proposed. We propose a Self-Organized Routing Protocol (SORP), which gives a long-life work time and saves energy by balancing WSN load. The proposed way builds a routing tree employing a method whereas, for every single round, BS assigns a root node and forwards this choice to all sensor nodes. Eventually, each node selects its parent by thinking only about itself and its neighbor's information. Simulation aftermath displays that the proposed way performs larger than supplementary continuing ways in balancing power consumption, therefore spreading the lifetime of WSN.

Key words: Wireless Sensor Network · Balancing power consumption · Lifetime · Routing Protocol

INTRODUCTION

Wireless Sensor Networks (WSN) is composed of a hundreds or thousands of micro sensor nodes that are randomly used whichever inside the phenomenon or extremely close to it. The micro sensor nodes have skill of detecting, commencing wireless contact amid every single supplementary and acting computational and processing operations. The locale of sensor nodes demand not be engineered or fixed. This permits infrequent placement in inaccessible terrains or catastrophe relief procedures [1]. Sensor networks have an expansive collection of requests and arrangements alongside vastly fluctuating necessities and features. The sensor networks can be used in Disaster management, Military environment, Medical and health care, Habitat monitoring, Industrial fields, detecting chemical, Biological, Home networks.

In spite of the countless requests of WSNs, these networks have countless constrains, e.g., short power supply, bounded computing domination and restricted bandwidth of the wireless links relating sensor nodes. The main target of WSNs is to present data contact and to spread the lifetime of the network by employing power management approaches. The communication protocols have momentous impact on the overall power dissipation of these networks. Reliant on our findings that the established protocols of multi-hop routing, direct transmission, static clustering and minimum-transmission-energy, could not be optimal for sensor networks [2].Considering the manipulated battery manipulation skill of an individual sensor, a sensor node can able to sense negligible span, so a wireless sensor network has a remarkable number of sensor nodes coordinate in extremely elevated density that reasons for precise setbacks such as scalability, redundancy. Reducing the quantity of data communication by removing unnecessary sensed data and by means of the energy-saving link would save great amount of energy, therefore the lifetime of the WSNs gets increased [3].In general, WSN may produce large amount of data, so if data integration or data fusion could be used, the throughput could be reduced [4]. Fig.1 shows the general LEACH protocol architecture.

The bulk of the protocols present data fusion, but concerning all of them ponders that the length of the data sent by every single converse node be hypothetical to be steady [5]. PEGASIS [6], PEDAP [7] and TBC [8] are common protocols established on this thought and present larger than LEACH [4] and HEED [9] in this case.

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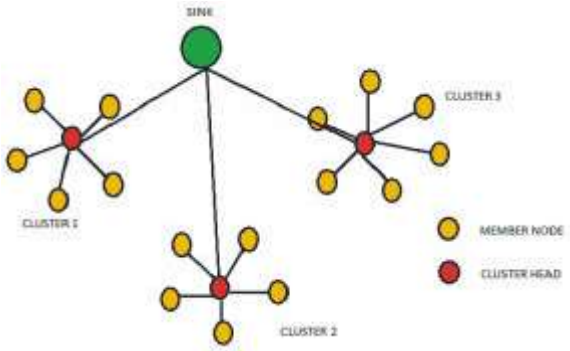

Fig. 1: LEACH protocol architecture

Hence, countless superior methods that cut power inefficiencies that should ponder the lifetime of the network are exceedingly important. Such constraints joined alongside a normal placement of huge number of sensor nodes produce countless trials to the design and association of WSNs and necessitate energy-awareness at all layers of the networking protocol stack. So this paper proposes an efficient energy balanced routing protocol to overcome the above mentioned issues in preceding studies.

Survey of Energy-Efficient

Techniques: Wireless sensor networks include many recent routing protocols [10] and their classification which are used for the various approaches. There are three main groups are discovered, they are data-centric, hierarchical and location-based routing protocols. Every single routing protocol is debated and delineated below the appropriate category. Moreover, protocols employing present methodologies such as network flow and quality of ability modeling are additionally explained. A routing protocol [11] is given to select the paths and to maximize the corresponding battery energy level of the nodes. After there is merely one power level, the setback is lowered to a maximum flow setback alongside node capacities and the algorithms encounter to the best solution. After there are several power levels next the attainable lifetime is close to the optimal (that is computed by linear programming) most of the time. In order to maximize the lifetime of WSN, the traffic ought to be routed such that the power consumption is balanced amid the nodes in proportion to their power store, instead of routing to minimize the finished consumed power.

An online-load balanced energy-aware routing protocol (Traffic Aware Energy Efficient Routing Protocol) [12] exploits traffic burden data in supplement to energy residue levels to optimize the burden allocation of the whole sensor networks and therefore accomplish longer network lifetime. The TAEE protocol can be adapted to contain a random gathering scheme that implements hierarchical routing to cut computation and routing overhead and to uphold power efficiency. The TAEE protocol gives larger presentation in words of network lifetime contrasted alongside the managing power-aware protocol. The design for self-organizing wireless sensor networks [13] links intensely actuators, embedded sensors and processors. This combination of wireless and data networking will consequence in a new form of computational paradigm that is extra contact centric than each computer network perceived before. Wireless sensor networks are portion of a producing collection of data knowledge constructs that are advancing away from the established desktop wired network design in the direction of an extra omnipresent and universal mode of data connectivity.

An energy-aware routing protocol [14] is used to reduce the energy consumption of wireless sensor networks using the combination of tree-based minimum transmission energy routing and cluster-based hierarchical routing. The highest energy node within h hops becomes a cluster-head. Therefore the area of every cluster is less than and/or equal to h hops. Every node can have distinct energy level the same as real environment and transmits its data to its cluster-head with short distance tree algorithm. Cluster head forwards data to the supplementary cluster-head or the sink alongside tree-based minimum transmission power algorithm due to the check of nodes' transmission range. COSEN (chain oriented sensor network) are utilized for accumulating data efficiently. It is a hierarchal chain-based protocol. COSEN is effectual in the methods that it ensures maximal utilization of network power, it makes the lifespan of the network longer, as well as it seizes far lower period to finish a round. The COSEN noticeably gives a good compromise amid power efficiency and latency [15]. Fig.2 shows the general COSEN architecture.

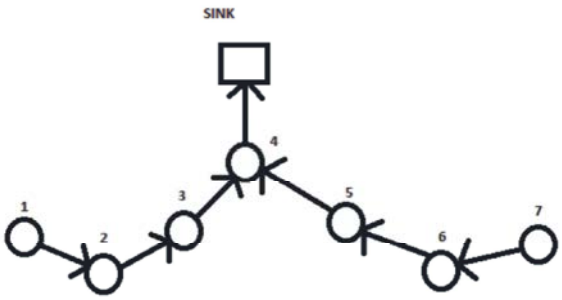

Fig. 2: COSEN Architecture

An enhanced logical tree based routing protocol (ELTRP) [17] is utilized to enhance the lifetime of the sensor networks. The ELTRP efficiently reduces and balances the power consumption amid the nodes and therefore considerably extends the network lifetime. The ELTRP method outperforms preceding method in words of power efficiency and network existence time. The finest routing protocol [17] is counseled established on Tree-on-DAG (ToD). It is a semi structured strategy that uses Vibrant Forwarding on a totally crafted construction encompass of several shortest trail trees to uphold network scalability. The key average at the back of ToD is adjacent nodes in a graph will have low down stretch in one of these trees in ToD, consequently following in main aggregation of packets.

A hierarchical cluster addressing scheme, a cluster-tree self-optimization period, a configurable top-down cluster and cluster-tree formation algorithm and a routing scheme are utilized in WSN [18]. The schemes retain features of clusters, cluster tree and routing to clarify the efficiency above existing methods. Fig. 3 shows the general architecture of cluster-based tree. The congestion-based scheduling algorithm [19] is utilized to cut delay of data communication. The sensor network is proficient correspond to arranging that is comparable to node-based scheduling. The scheduling algorithm presentation is established on the packets allocation at disparate levels of the routing tree. The congestion-based arranging algorithm provides the level-based arranging and evaluation to node-based arranging is larger for topologies that higher density of packets is at the elevated levels of the tree and comparable for topologies that have equal density of packets across the network or higher density of packets at low levels of the tree. Wireless Sensor Networks (WSNs) is a promising structure used to assist the condition of many military and industrial services. They have countless disparate limitations, such as storage capacity, computational energy, power supply etc and the vital subject is their power constraint. Many concerns hold back the efficacy of WSNs to support different applications, such as the finite battery power and the resource confines of sensor devices. A novel tree established routing protocol [20] is utilized to vanquish the setback and to enhance the presentation demand not merely to minimize finished power consumption but additionally to balance WSN load.

Self-Organized Routing Protocol: The main goal of the proposed way is to accomplish a longer network lifetime. In every single round, BS allots a root node and shows its ID to all sensor nodes. Then the sensor network decides the path either by transmitting the path information from BS to sensor nodes or by having the same tree structure being dynamically and individually built by each node. For both cases, the proposed arrangement can change the root and reconstruct the routing tree alongside short delay and low power consumption. In proposed approach, assume that the system model has the following properties:

- Sensor nodes are randomly distributed in the square earth and there is merely one BS used distant away from the area.
- Sensor nodes are stationary and power constrained. After positioned, they will retain working till their power is exhausted.
- Sensor nodes are location-aware. A sensor node can become its locale features across supplementary mechanisms such as GPS or locale algorithms.
- Each node has its own unique identifier (ID).

The proposed algorithm consists of two phases Building Phase and Cycle Phase.

Building Phase: In Building phase the network parameters are initialized and routing tree is built. Building phase consist of two operations.

Cluster Formation: The clusters are formed by using Power aware dynamic clustering algorithm. The main aim of this algorithm is to balance the load even when the nodes are in non uniform dispersion. It focuses on topology control and energy conservation. Each cluster head will dynamically adjust the size of cluster accordingly to the nodes density. It also provides multilevel transmission power to different cluster ranges. The process of assigning different cluster size based on node density is called dynamic clustering. It is assumed that the sensor node can adjust the transmission power in five levels. The cluster head is elected based on the cost computation. The cost computation depends on residual energy, intra cluster communication cost and mobility. The nodes with minimum cost have the high probability to be elected as cluster head. The non cluster heads join the cluster head when it receives a message from cluster head. Further it also records the minimum transmission power that is the strength to reach cluster head it joins.

Scheduling: The main aim of scheduling is energy conservation. There are two types of nodes cluster head

and non cluster head nodes. Non cluster head nodes are connected to a single cluster head. Cluster head can serve only limited number of nodes. This is to minimize the transmission energy and to operate the network for a longer lifetime. During the single phase clustering the cluster head pages the non cluster head nodes with maximum energy. Now every non cluster head node that receives the paging signal sends an acknowledgement back to the cluster head. Since the cluster head can serve only limited number of nodes, the node that receives only one paging signal is allocated channel. If few extra channels are available then non cluster head node that receives multiple paging signals is allocated channel depending upon the power level of the paging signal received from the cluster head.

Cycle Phase: In cycle phase the information is exchanged and the cluster head is re-elected for the next cycle.

Data Transmission: The data to be transmitted to the Base station is collected and fused. The data from every node is sent to the cluster head on the scheduled period through the allotted channels. The cluster head fuses the data to be transmitted. Data fusion is based on threshold. After fusion when threshold is exceeded the data is forwarded to the base station.

Re-Election: A node dies when the energy is depleted from frequent transmissions. Since lot of work is done by the cluster head it is more common for the cluster head to die quickly. To avoid network topology complications it is necessary to re-elect cluster head without degrading the quality of the network. In this phase cluster head with less energy changes itself to non cluster head after a period of time. When residual energy is below threshold it will start to broadcast the re-election message. The quality of network is not degraded by this re-election process.

RESULTS AND DISCUSSIONS

The simulator in our experiment is NS 2. In our experiment we simulated the number of clusters, energy consumption, load balancing, packet delivery ratio, delay and throughput on our SORP and LEACH protocol in comparison.

In figure 3 we compare the packet delivery ratio. It is the number of packets delivered to the base station with respect to the packets sent form all sensor nodes. It shows that the proposed approach outperforms LEACH. The quality and performance is proportional to the packet delivery ratio. The higher the packet delivery ratio the better is the performance of the network.

Figure 4 shows the comparison of delay involved in transferring the data from sensor nodes to the cluster head between SORP and LEACH protocol. Compared to LEACH our proposed protocol has much less delay. Performance of proposed protocol is higher than LEACH protocol even under mobile condition.

In figure 5 we have the number of nodes alive in the sensor network. According to illustration, we can clearly know that SORP can save more energy and extend the lifetime of the sensor network.

Fig. 3: Packet delivery ratio

Fig. 4: Delay in data transfer

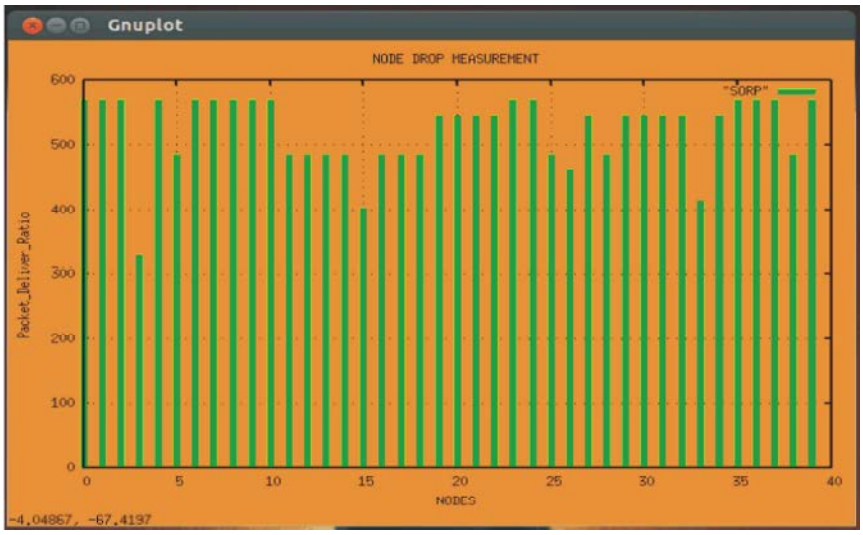

Fig. 5: Number of nodes alive

CONCLUSION

In general energy consumption plays an important role in wireless sensor network and routing protocol is used to conserve the energy and prolong the life time of the network.

In this paper, we present a self organized routing protocol by improving LEACH by adding several adaptive schemes: dynamic clustering, scheduling and cluster head re-election to prolong the lifetime of the network. Compared to LEACH our proposed protocol has higher performance for data transmission even under mobile environment. The major contribution of this paper is that the delay during data transmission is reduced by simultaneously considering dynamic cluster structure, scheduling and re-electing cluster head.

In the simulation, the experiment results show that SORP approach perform better for the above concerns. Moreover, SORP can be applied to static and mobile sensor nodes and as well as extend the lifetime of the network.

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