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An Efficient Energy Conservation using Diffusion Update Algorithm in Wireless Sensor Networks

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ABSTRACT

In wireless network communication, the energy efficiency is obtained from throughput of data transmission. During the network traffic and failure of data transmission, the energy efficiency and lifetime of network can be reduced in Wireless Sensor Networks (WSN). For this problem, we propose a duty cycling preservation scheme with Enhanced Interior Gateway Routing Protocol (EIGRP). EIGRP is used to preserve energy by reducing the network traffic in which the routing decisions are managed on network automatically. It reduces the workload on amount of data needs to be transferred, so the throughput is accomplished by EIGRP for WSN. The EIGRP based on diffused update algorithm to find the shortest path to goal of network. The duty cycling is commonly used for preserving energy effectively. In this process, the cluster heads play a major function in WSN. The aim of this paper is to extend a network lifetime and to preserve the energy by using EIGRP.

Keywords: EIGRP, Lifetime of network, Duty cycling preservation scheme, Cluster head, WSN, energy efficiency.

I. INTRODUCTION

The Wireless Sensor Network (WSN) [1] is also called Wireless Sensor and Actor Network (WSAN) in distributed autonomous sensors. WSN verifies the physical or environmental conditions, such as sound, pressure, weather condition, temperature, etc. WSN is a made of nodes from some to several hundreds or even thousands in which each node is associated with one sensor or several sensors. Homogeneous or heterogeneous sensor nodes are used in WSN as shown in Fig. 1. Computations are limited in sensor networks; some examples of computations are node power, strength of signal and buffer size. WSN has many applications that are Area monitoring, Healthcare monitoring, Environmental or earth sensing, and Industrial monitoring computers on the back end, thus significantly speeding up the application for the user, which just pays for the used services.

Low Energy Adaptive Clustered Hierarchy (LEACH) is the one method of energy preservation to lower the energy consumption for extension of network lifetime in WSN. LEACH is not suitable for longest network. To overcome this problem, we propose a duty cycling preservation scheme with Enhanced Interior Gateway Routing Protocol (EIGRP). In WSN, the sensing nodes are available, where every sensing node is handled in idle and sleep modes. Most of the transceiver can working in idle mode have an energy expenditure which is equal to the energy consumed in receive mode. If nodes are in inactive mode, the energy can be saved.

The following steps are used to save energy in communication of WSN

- Based on the states, the sensing nodes will be scheduled.
- In sensing nodes, the ranges of transmission are varied

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- Methods of data collecting and routing are used in effective manner
- Unwanted data are avoided to save lifetime of network

In this paper, the EIGRP protocol is used with duty cycling method to save energy for energy efficiency and lifetime of network in WSN

LITERATURE SURVEY

Genetic Algorithm Application in Optimization of WSN [3, 4] demands progress of the particular parameters and current available protocol. In every application, certain eminent parameters are energy expenditure and network lifetime for routing which plays some key role. Fault node recovery algorithm enhances the lifetime of a WSN shut down the some nodes have to be to enhance the lifetime of a wireless sensor network. Fault node recovery algorithm is based on the algorithm of grade diffusion combined with the genetic algorithm. This algorithm uses some replacements of sensor nodes and more reused routing paths [5].

In efficient routing protocols in WSN [18] to design routing protocol, sensor node has limited energy and communication ability. Network lifetime of WSN can be increased by using routing protocol. This paper contains various existing routing protocol techniques. The sensing data are transmitted effectively in WSN. Enhancing Network Lifetime in WSN [6] shows that the sensor networks do not have a continuous power supply at their disposal.

Trends and Technologies used for mitigating energy efficiency issues in Wireless Sensor Network [9] are used either as a sub-network or as a complete domain. One of the most irreversible resources is battery power. Since year 2000 a project called ìAMS in Massachusetts Institute of Technology (MIT), where Wendi Heizelman has introduced a communication protocol called LEACH. In energy saving in WSN using Attribute Based Dynamic Routing [22], the sensor nodes are deployed in various environments. It checks the physical or environmental conditions, such as sound, pressure, weather condition, temperature, etc.

In an efficient multipath routing protocol for WSN [10] a Fault Node Recovery (FNR) algorithm is used to enhance the lifetime of a WSN when some of the sensor nodes shut down, because either they no longer have battery energy or they have reached their operational threshold. Sensor nodes will be burdened with increased transmission processing; to overcome these limitations is prospective, but quite challenging.

Fault routing node detection using Diffusing Update Algorithm (DUAL) in WSN uses DUAL for improving existence of wireless sensor networks of sensor nodes is failed. In beacon routing algorithm in WSN with mobile gateway [7, 8], a mechanism of optimization, a reverse sector mechanism can supply benefits of prodigious energy conservation. In a distributed algorithm for energy efficient and fault tolerant routing in wireless sensor networks [13], energy conservation and fault tolerance are the most two important challenging issues for the development of large scale WSNs.

Planning of energy-efficient protocols [19] is critical for WSNs because of the constraints on the energy of sensor node and during transmission to the sink node. Recent advances in WSN [12] have commanded many new protocols specifically designed for sensor networks where energy awareness is an important concern. Two major controversial metrics [11] that determine the stability period of a WSN are accuracy and durability. WSNs are ubiquitous and pervasive [14], and therefore; highly susceptible to a number of security attacks.

Advancement in WSN [20] over the past two decades has foreseen an increased interest in the potential use in applications like combat field, security surveillance, border protection, disaster management and exploration. To reduce the transmissions among sensor nodes [16] and prolong the lifecycle of the wireless sensor network, the immune theory and any cast technique were brought into the mobile agent routing mechanism, and an immune-based MA any cast routing algorithm was put forward.

This paper aim is to improve energy performance of Dynamic Source Routing (DSR) protocol [21] in mobile ad hoc networks. This routing protocol looks for shortest paths which jointly improve packet latency and network life time. Continuous-Monitoring (CM) of natural phenomenon [15] is one of the major streams of applications in WSNs, where aggregation and clustering techniques are beneficial as correlation dominates in both spatial and temporal aspects of sensed phenomenon. Conversely, in Event Driven Reporting (EDR), the efficient transmission of sensitive data related to some predefined alarm cases is of major significance.

Some of the major challenges confronting WSN [2] are usually associated with scarcity of energy and limitations of resource. In [5], an implementation for the directed diffusion paradigm aids in studying this paradigm's operations and evaluates its behavior according to this execution.

The study of WSNs and its routing protocols becomes challenging because from an extremely large variety of disciplines it requires an extremely large breadth of knowledge. In [17], the big data emerged as a hot topic because of the tremendous growth of the information and technology communication.

METHODOLOGY

(A) EIGRP Algorithm

Enhanced Interior Gateway Routing Protocol (EIGRP) to prevent routing loops via a continuous route computation for diffused update algorithm is routing protocol to reduce the energy consumption in routing topology and dynamic change of routing. The EIGRP is focused on route to tracking the optimal path and to add the path for the frequent topology change in the routing table for efficiency and durability. For an unreachable destination causing data packets to energy back in the loops must be prevented because they slow down the performance of the whole network. Looped packets may have to be retransmitted to ensure that transmission is not due to overflow or other delivery failure. In diffused update algorithm having following steps:

Step 1. Find the sensor readings b0js of neighbors of vi

Step 2. Calculate U1U0+U1 at each node vi

Step 3. Segregate the n nodes into three groups R1,R2 and R3 vi2 R1 if U1U0+U1>_1vi 2 R2 if_2 <U1U0+U1_ _1vi 2 R3

Step 4. If jR1j 6=0, then H = 1 (i.e., an event) find out that vi is an event node if (vi 2 R1) or (vi 2 R2, vj2 R1, vj2 N(vi))If jR1j =0, then H = 0 (i.e., no-event)

Step 5. Update substance, Sii and Sij

The correct route to a destination is known as a successor route and is established in the routing table. The lowest subsidiary distance will be selected as a successor route to a destination. If multiple successors have the same feasible distance they will be placed in the routing table and equal cost load balancing will occur over the links, again by default. For the load balancing behavior in EIGRP can be modified with the deviation for command. By replacing a failed successor route, routes provide a loop free path to a destination. In order for a route to become a FS it must meet the variance condition. Routes that do not meet the variance condition will not be used to avoid routing loops.

The subsidiary condition is traditional when condition is true, no loops can occur, but the traditional condition under some status for total routes to a destination is loop-free. Therefore no feasible route to a destination is possible, DUAL algorithm invokes diffusing computation to ensure that all traces of the difficult route are eliminated from the network. Successor is a neighboring router that has the minimum path of all possible paths to reach a destination network, to select the better path to reach a network is selected, EIGRP inserts the destination network, for a particular interface to reach the next-hop router, measure to reach the network and the IP address of the next-hop router into the IP routing table. For EIGRP topology table the path has multiple equal-cost nodes to a destination; all successors for the destination will be inserted into the routing table. Subsidiary Successor is a neighboring router that does not provide the least-cost path but provides a route of backup.

The path through the feasible successor must be loop-free. Feasible successors and successors are selected at the same time during the measure for a particular node. In the topology table, the Subsidiary successor routes are maintained, as well as in the routing table when unequal-cost load balancing is enabled with the variance router subcommand.

(B) Selection of Cluster Head

The cluster heads gather and compress the data and forward to the sink. In Fig. 2 shows that selection of cluster head in WSN.

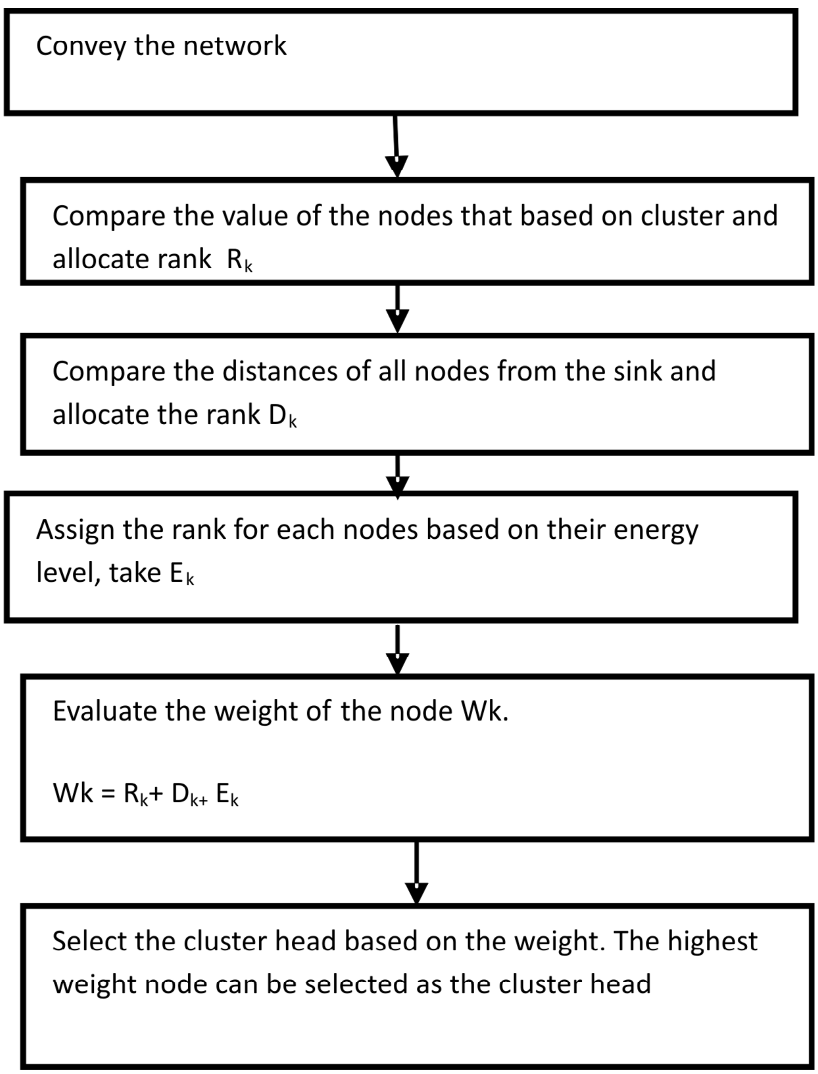

Figure 2: Dataflow diagram of selection of CH

The initial energy is an important parameter to select the cluster head. The energy is initiated when any algorithm is started. After completion of some of the rounds, the selection of cluster head should be based on the energy remaining in the sensors. For each node the average energy is used as the reference energy. The ideal energy of each node should own in current round to keep the network alive.

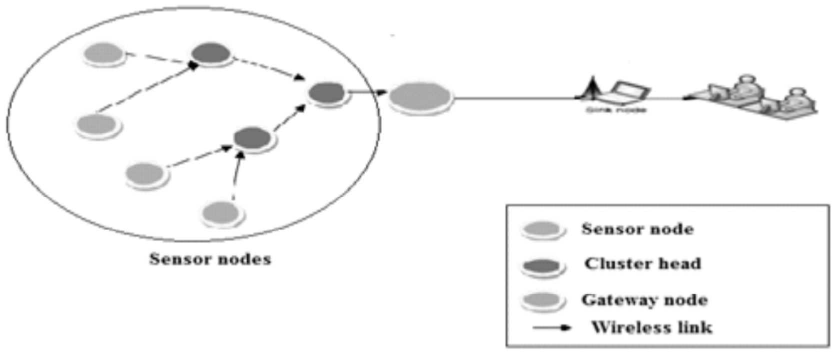

Figure 3: WSN with Cluster Head

In Fig. 3 shows that clustering we will discuss the CH and BS for the communication purpose of sensor networks. Connectivity of cluster head to base station: Cluster heads send the aggregated data to the base station directly or indirectly with the help of other nodes of cluster head. It means there exist a direct link or a multi-hop link.

RESULT AND DISCUSSION

(A) Lifetime of Network

The threshold parameter consists of the Hard Threshold (HT) and Soft Threshold (ST). HT is a particular value of an attribute beyond which a node can be triggered to transfer the data. Software Threshold a little varies in the value of an attribute which can trigger a node to transmit data again.

Table 1
Parameters of Network for Measurement of Protocols

Parameters	*Value*
Protocols	HEED, LEACH,WCA, EIGRP
Size of Network	150*150m
Sensor Nodes	120
Distance of Threshold, d_0	60m
Initial Energy, E_0	1.5J
Sink location	60,225m
Packet size	2500bits
Range of transmission	55m

The lifetime of network can be calculated through the parameters that are shown in the above table 1. Energy efficiency of each protocol is evaluated by throughput of transmission in (WSN). The EIGRP can provide more lifetimes for WSN compared to another protocol because it decide the efficient route automatically on the network. The EIGRP uses the diffused update algorithm to find the best path for data transmission.

Table 2
Network Lifetime of Protocols

Percentage of node dead	*Number of Rounds*			
	HEED	*LEACH*	*WCA*	*EIGRP*
10%	450	670	850	875
50%	470	670	870	890
100%	600	800	900	950

In table 2 shows that the network lifetime of protocols based on their number nodes dead. Lifetime of network protocol can be measured by calculating the time when 10%, 50%, 100% nodes expired in the network. If energy becomes less than zero, then a node is said to be expired. The EIGRP on an ordinary accomplishes the 45% and 40% longer lifetime than the HEED, Weighted Clustering Algorithm (WCA) and LEACH respectively. All protocols are measured using same network parameters as defined in table 1. In the evaluation of protocols using the same parameters, the result shows that the EIGRP has more efficiency than the remaining three protocols. Compared to WCA, HEED and LEACH, the EIGRP efficiently allocate the best route and cluster head. EIGRP reduces the network traffic and also reduces the cluster head selection overhead.

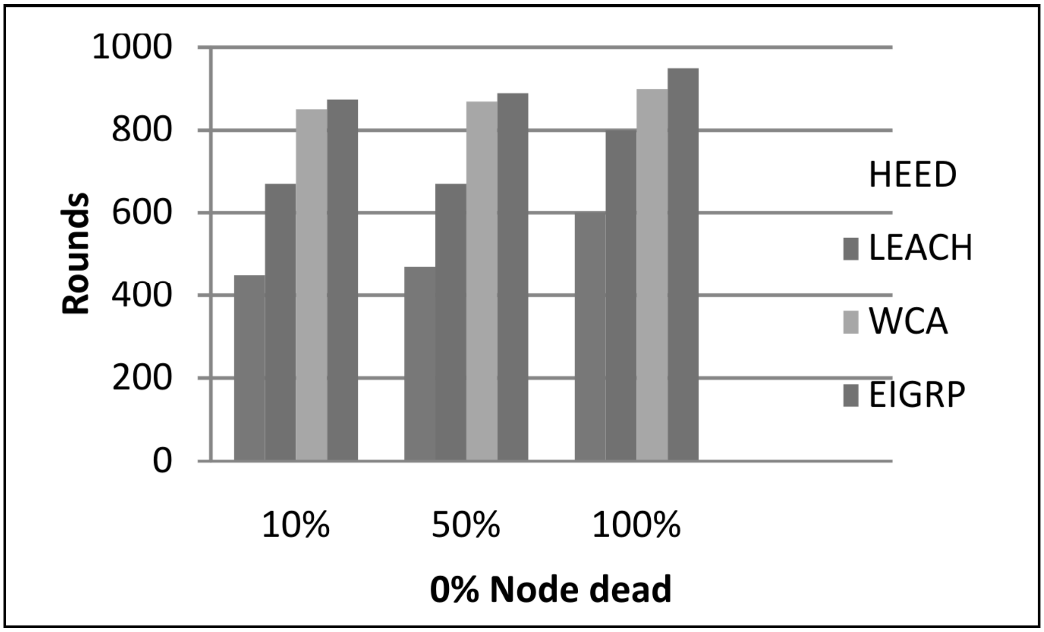

Figure 4: Network Lifetime

The Fig. 4 shows the network lifetime of all protocols. The range of node expired in all protocols. The initial energy is an important parameter to select the cluster head. For each node, the average energy is used as the reference energy; it is the ideal energy that each node should own in current round to keep the network alive. After completion of some of the rounds, the selection of cluster head should be based on the energy remaining in the sensors. The EIGRP saves energy by choosing a dynamic, shortest route for data transmission. The Duty Cycling is mainly used for conserve energy in effective way in a WSN.

(B) Energy Efficiency

The energy efficiency is based on the total energy consumed by the all nodes in the WSN.

$$Energy = \sum_{i=1}^{N} E_i \tag{1}$$

Where Ei is the energy consumed by each node in network in Eq. 1. EI GRP reduces the consumption of energy of the network significantly as contrasted to HEED, WCA, and LEACH. The cluster head role is allocated dynamically. In the cluster, the traffic load can be contributed evenly among all the nodes. The data transfer can be done through the multiple paths using the duty cycling scheme, hence energy consumption of nodes will be reduced. Thus a fair approach is designed that balances well between inter-cluster and intra-cluster approach. Each node needs an amount of energy to perform certain task like send, receive, idle, sleep wakeup etc. The remaining energy of each node after one function round can be calculated as Eq. 2.

$$E_{cene}=E_{cene}-\lfloor E_{TX}+E_{RX}+E_{idle}+E_{sleep}+E_{wakup}+E_{listen}\rfloor \quad (2)$$

Where, $E_{cene}\rightarrow$ is Current Energy, $E_{TX}\rightarrow$ is Transmission Energy, $E_{RX}\rightarrow$ is Receiving Energy, $E_{idle}\rightarrow$ is Idle Energy, $E_{sleep}\rightarrow$ is Sleep Energy, $W_{alkup}\rightarrow$ is Wakeup Energy, $E_{listen}\rightarrow$ is Listen Energy.

Table 3
Energy Consumption

Protocols	*Energy Consumption in Joules*
LEACH	21.45
HEED	27.95
EIGRP	19.0
WCA	20.5

In Table. 3 have the energy consumption comparison of some network protocols. In that table, the EIGRP has the low energy consumption compared with other protocols that are mentioned in the above table, so the EIGRP protocol can give a better performance more than the existing protocols. During the network traffic, the energy consumption can be increased in wireless sensor networks, but the EIGRP can manage the network traffic because it automatically allocate the route for data transmission, so it consumes low energy during the network traffic. The LEACH 21.45J, HEED 27.95J, EIGRP 19J, WCA 20.5J in energy consumption range that are shown in the table 3.

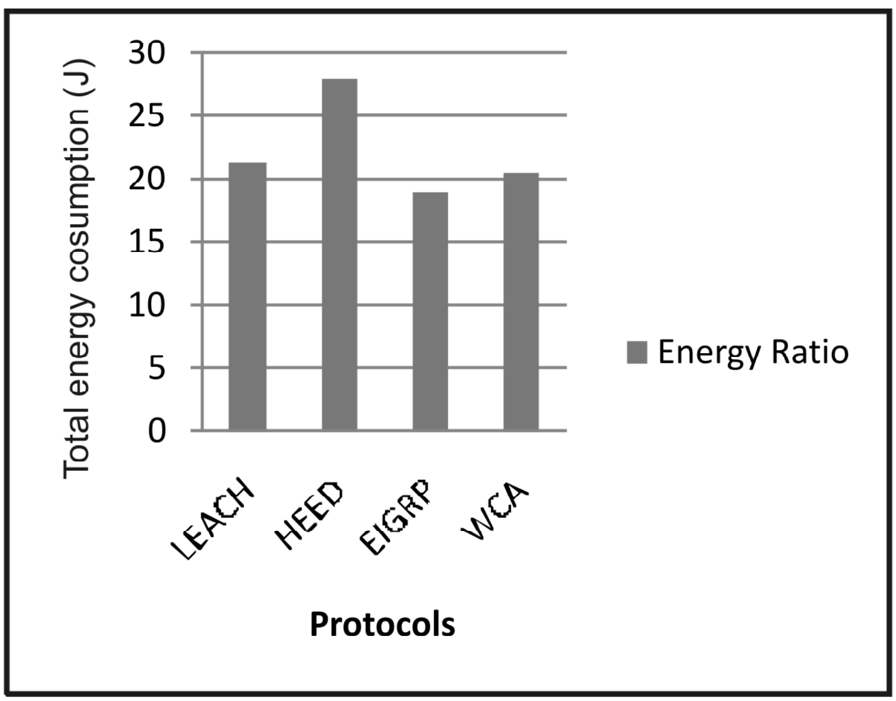

Figure 5: Energy Consumption

In Fig. 5 shows the energy consumption of protocols. The energy consumption of each protocol can be measured in Joules. The application sends a counter through the network and it consumes specific Joules in 60 seconds. The energy consumption of HEED, WCA, LEACH and EIGRP takes 27.95J, 20.5J, 21.45J and 19J. Compared to HEED, WCA and LEACH, the EIGPR takes less energy consumption in Joules. Energy is conserved by reducing the energy consumption. Therefore the EIGRP conserves energy for data transmission in WSNs. The network lifetime can be increased through energy conservation.

CONCLUSION

In this paper, an attempt has been made to reduce the network traffic for maintaining a lifetime and energy efficiency. These will be accomplished by EIGRP with the help of duty cycling preservation scheme. Clustering is used for grouping the data and finding wireless sensor networks gateway and cluster heads. The process of EIGRP is to minimize the network traffic for reducing workload of data transmission. So throughput can be achieved by this process. EIGRP can react with the critical routing decisions in router, in which the routing decisions are created automatically. So the network traffic can be reduced and energy consumption also minimized. EIGRP with duty cycling method avoids energy expenditure and increase the throughput of data transmission. Due to the process, the energy can be saved. The lifetime of network in WSN can be extended by energy efficiency. Our future enhancement is security of data transmission with energy conservation protocol in WSN.

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