

# Energy Efficient Protocols for Wireless Sensor Networks - A Review

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## ABSTRACT

Wireless sensor networks (WSNs) are becoming popular day by day due to its wide range of applications. But, sensors have battery constraints i.e. batteries are not rechargeable nor replaceable. Therefore, it becomes a significant issue to save the energy of sensor nodes, in such a way that the overall lifetime can be increased. Many clustering and tree-based protocols have been proposed so far to improve the network lifetime of WSNs. This paper has presented a detail review of some well-known energy efficient protocols for WSNs. It has been observed that the Game theory based energy balanced (GTEB) protocol is more efficient than other protocols in terms of network lifetime by balancing energy consumption in large network area using geographical routing protocols. It also compared some well-known protocols based upon certain features.

**Keywords:-** Wireless Sensor networks, Routing Protocols, Energy Balanced in WSN, GTEB

## I. INTRODUCTION

Wireless Sensor Networks are networks that hold sensors which are distributed in an ad-hoc manner. These sensors work with each other to sense some physical phenomenon and then the data collected is processed to have suitable outcomes [1]. Wireless sensor networks are the kind of a structureless wireless network where nodes are separate and auto-organize. Wireless sensor networks contain methods and algorithms with auto-organize capabilities. In lots of critical applications WSNs are very helpful such as military surveillance, environmental, traffic, temperature, pressure, vibration, monitoring and disaster areas.

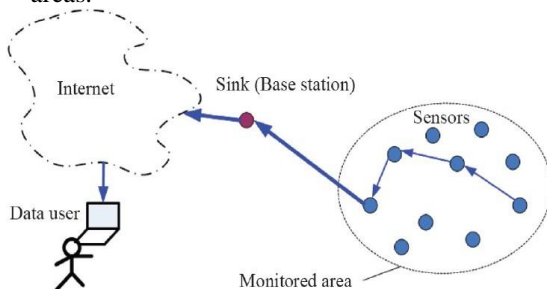


Fig 1: Wireless Sensor Network

Each sensor node processes information and broadcasts it to the Base Station (BS), also called a sink. In Wireless Sensor Networks, these sensor nodes are power-limited due to restricted battery sources [2]. Therefore, utilizing the battery in an effective way becomes a critical problem. A number of protocols perform an essential role to decrease useful energy consumption [2]. Firstly, direct communication and multi-hop data transmission are utilized. But due to restricted energy of sensor nodes, these techniques do not work efficiently.

Clustering is a method where nodes are arranged into clusters that use in achieving energy efficiency. All nodes belonging to exactly the same cluster deliver their information to the CH. Then the CH aggregates data and sends aggregated data to the BS where the end-user can access the information [3].

## II. ROUTING PROTOCOLS

A wide range of routing protocols has been proposed to resolve multi-hop routing problems. Generally speaking, the routing protocol algorithms can be categorized into two categories: topological routing protocols and geographical routing protocols.

**Topological Routing Protocols in WSNs:** Topological routing protocols (TRPs) were developed on the basis of routing algorithms that were manufactured for mobile ad hoc networks (MANETS). In the topological routing approach, a path is normally pre-defined among nodes and stored in a routing table before initiating a packet transmission, where every node has its own routing table. The key benefit of this process is that a route is readily available whenever a node needs to send a message to any other node. On the other hand, it is not convenient to have dynamic changes in the network and has a large network overhead because of the route discovery and route maintenance techniques, that have been very costly in the energy-constrained WSN networks.

**Geographical Routing Protocols in WSNs:** Geographical routing protocols (GRPs) take advantage of location knowledge of the sensor nodes to deliver data from any given node to the destination. This is performed without the necessity to develop a routing table. Hence, the sender does not require to check the route availability or damage as the

packets travel from the sender to the destination they may take different routes with respect to the network status. Furthermore, eliminating the dependence on topological information makes GRPs appropriate to handle dynamic situations that usually present in WSNs. This makes geographical routings a valuable option to develop decentralized and scalable routing protocols that may balance energy utilization in WSNs. Nevertheless, GRPs involve spot information. These facts could be offered via Global Positioning System (GPS) in outside deployments, and indicate energy and time of birth centered spot opinion methods in interior deployments.

### III. ENERGY BALANCED IN WSN

The key role of energy balance in WSNs is to extend network lifetime. Energy balance is generally accomplished through routing protocols by equally distributing traffic load among nodes to make sure that the average energy expenditure in every nodes is the same. In GRP, you will find two common energy balance routing methods: Route level energy balance and Region level energy balance

#### 3.1 ENERGY EFFICIENT ROUTING PROTOCOLS

##### A. Game Theoretic Energy Balanced Routing Protocol(GTEB)

It had been produced to supply energy balance to arbitrarily use multiple-hop Wireless Sensor Networks with M same type of nodes within communication range is r. Preliminary power of a node is E Joules. The nodes knew their places and the precise area of the location node (base station). In this system, any node could be a resource and may record functions occasionally or if they occur. The situation of reaching system large power stability is damaged on to the next two sub-issues:

- a) RLEB at sub-regions
- b) NLEB within the sub-region

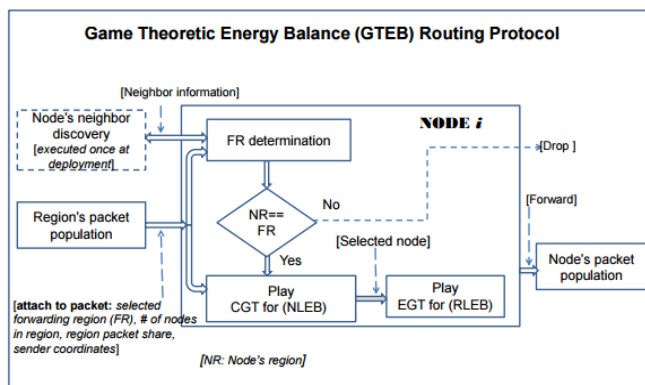


Fig 2: GTEB's functional diagram

Fig 2 depict procedural functioning plan of the spread choice creating techniques in GTEB protocol. The node friend finding purpose displayed in determines is achieved after at the implementation time of the system to be able to allow nodes to comprehend how many one jump neighbors. Different operates is going to be accomplished each time a single node gets a fresh box from certainly one of their neighbors. The node decreases a acquired box, when it is maybe not situated in the given transforming sub-region or if the box has been transfer before.

##### B. Low Energy Adaptive Clustering Hierarchy (LEACH)

LEACH [3] is the very first hierarchical cluster-based routing group of principles for wireless sensor network. In LEACH, the nodes sort themselves in to local clusters. Another node selected as cluster-head is trusted in making as well as influencing a TDMA (Time Time Division Multiple Access) approach as well as aggregating the information originating from distinct nodes and giving it to the BS. The technique of LEACH is separated in two parts. every circular includes 2 stages.

###### Set-up Phase

Every node in the selected region decide sepatately of another (or of different) nodes this will come out to become a CH in present round. Through the entire selecting period every node produces a arbitrary values between 0 and 1, and then examines the outcome with the under threshold.

###### Steady-state Phase

Each node might move down their radio till it contain the essential information. The family of nodes transfer their data to CH in their specified strategy desk shaped through the entire Set-up Phase. When it comes to CHs, they've to continue their transmission position up all the time to be able to take the whole information from their family nodes. Once the cluster head gets whole the information provide by it's nodes, this will acquire those data at first and then deliver the aggregating data packages to sink to be able to acquire power.

##### C. Hybrid Energy Efficient Distributed Protocol

HEED is just a multi-hop WSN clustering algorithm which actually supplies a energy-efficient clustering routing by using often especially anxiety of energy. Completely dissimilar from LEACH whilst in the methods with CH devotion, HEED wouldn't select nodes as CHs randomly. The way of in which of cluster manufacture is carried out based upon the hybrid grouping with couple of parameter. One of the parameters is dependent upon round the nodes remaining energy, and also one other parameter can function as intra-cluster interacting expenditure. Within HEED, chosen CHs have very high remaining power contrast to MNs. Furthermore, among the key ideal objectives with HEED is to receive really recent CHs

everywhere within the communities [9]. Furthermore, irrespective of the trend that two nodes, within each other's interacting selection, come out to be CHs collectively, however the chance of the trend is very little in HEED. Within HEED, CHs have common time periods chosen based on several essential parameters: continuing power and intra-cluster interacting charge in the choice nodes.

#### ***D. Distributed Weight-based Energy-efficient Hierarchical Protocol***

DWEHC would have been a spread clustering algorithm such as for HEED. The main element reason behind DWEHC is to improve HEED because they build balanced cluster size and optimize a intercluster topology by using posture understanding a node since they construct healthy group styles and enhance a intra-cluster topology by utilizing pose knowledge a nodes. Equally similarly DWEHC and HEED discuss numerous characteristics in addition to no presumptions in terms of multilevel dimension and interest, and applying below concern outstanding power in the strategy regarding CH selection. All nodes tools DWEHC by themselves combined with algorithm proves following much iteration which can be used in a distributed manner. Such as LEACH and HEED, DWEHC produces a multi-level business created for intra-cluster interaction and restrictions a parent node's level of child.

#### ***E. Power Efficient Gathering in Sensor Information System***

The main idea in PEGASIS is for every single node to get and transmit to close neighbors and take turns being the leader for transmission to the BS. This method can deliver the energy load consistently among the sensor nodes in the network [3]. We originally place the nodes arbitrarily in the play field, and therefore, the its node is at a arbitrary location.

#### ***F.Threshold Sensitive Energy Efficient Sensor Network Protocol:***

TEEN is a hierarchical clustering protocol [6], which groups different sensor nodes into clusters with each having a cluster-head( CH).The job of the sensors within a cluster is to send their sensed data to their respective CH. The CH now sends the aggregated data to higher level CH until the data reaches the sink. Thus, the sensor network architecture in TEEN is based on a hierarchical grouping where closer nodes form clusters and this process goes on the second level until the BS (sink) is reached.TEEN is a clustering communication protocol that targets a reactive network and enables CHs to impose a constraint on when the sensor should report their sensed data. After the clusters are formed, the CH broadcasts two thresholds to the nodes namely Hard threshold (HT), and Soft threshold (ST)

## **IV. RELATED WORK**

Qing, Li, et al. [1] proposed a novel distributed energy-efficient clustering system heterogeneous wireless sensor networks, that is called DEEC. In DEEC, the cluster-heads are selected by a probability on the basis of the ratio between residual energy of each node and the average energy of the network. Elbhiri, Brahim, et al. [3] proposed and examined a clustering technique called a Developed Distributed Energy-Efficient Clustering scheme for heterogeneous wireless sensor networks. This approach is dependant on changing dynamically and with an increase of efficient cluster head election probability. Saini, Parul et al. [4] proposed EDEEC for three kinds of nodes in prolonging the entire life and security of the network. Hence, it escalates the heterogeneity and degree of energy of the network. Simulation results reveal that EDEEC functions much better than SEP with more stability and effective messages. Jiujiu, Wu et al. [5] proposed a fresh protocol, Fixed Zone Clustering Protocol (FZCP), that is also based on clustering, but it is distinctive from above protocols. Within our protocol the areas of clusters are decided in advanced and cluster heads are selected based on residual energy and estimated energy cost. O. Younis et al. [6] suggested new vigor powerful process for bunching modems in unplanned alarm systems. Fixated with this specific technique, some form of typical meeting are shown, HEED (Hybrid Energy-Efficient Spread bunching), that often pick class minds in knowledge to half and 1 / 2 of their blend outstanding vigor moreover was extra parameter, such as for instance for instance regarding situation center place to their buddies or even center level. O. Younis et al. [7] discribed a fresh method, HEED (Hybrid Energy-Efficient Distributed clustering), which regularly every so often pick. Khan, M. Y, et al. [10] purposed Hybrid-DEEC (H-DEEC), a sequence and chaos centered (hybrid) spread system for effective power operation in WSNs. In H-DEEC, chose Group Minds (CHs) connect the Bottom Place (BS) through beta chose nodes, by utilizing multi-hopping. Javaid, Nadeem, et al.[11] present sink flexibility to boost the network entire life of hierarchal routing protocols. Two situations are mentioned to assess the activities of routing methods; in first situation fixed sink is implanted and in later one portable sink is employed. Abd, Mehmood et al. [16] proposed method is to create sensor nodes strain their power at around the same time frame, which is attained by approaching force stability issue at the area and node degrees. Abd, Mehmood et al. [17] addresses the issue of unbalanced power use in WSNs by developing traffic fill handling geographical redirecting protocols. To be able to offer power stability; two decentralized, scalable and secure redirecting practices are planned: Sport Theoretic Power Healthy (GTEB) redirecting method for WSNs and 3d (3D) Sport Theoretic Power Harmony (3D-GTEB) redirecting method for WSNs. Al Rubeaai, Sarab F, et al [18] novel 3D real-time geographical redirecting process (3DRTGP) for instant warning systems is shown in that paper. 3DRTGP regulates the amount of forwarding nodes in the system by decreasing forwarding to a distinctive package forwarding location (PFR). Attiah, Afraa, et al. [19] analyze this issue in routing and take an evolutionary

game theoretic approach to show how sensor nodes in a WSN an efficient and stable manner. could evolve their routing strategies to transmit data packets in

**Represents Comparison table of various protocols**

<b>Protocols</b>	<b>Network</b>	<b>Hop</b>	<b>Routing</b>	<b>Cluster Head choosing Criteria</b>	<b>Pros</b>	<b>Cons</b>
DEEC	Heterogeneous	Single Hop	Proactive	Threshold function and Residual energy	Enhanced network life time in wireless sensor networks	residual energy reduced and become in the range of the normal nodes
LEACH	Homogenous	Multi Hop	Proactive	Threshold Based Probability	Cluster head in network directly communicates with the base station in single hop.	requires high range of the transmission power in the network while transmission
HEED	Homogenous	Multi Hop	Reactive	Threshold Based Probability	Tree based protocol and provides mobile sink property	Compression is not considered
CAMP-TEEN	Homogenous	Single Hop	Reactive	Timer Based Probability	Tree based protocol and provides mobile sink property	Metaheuristic techniques has not been considered
DWEC	Heterogeneous	Multi Hop	Reactive	Threshold Based Probability	generates a multi-level business intended for intra-cluster communication	Parent Node volume has not been considered
EDEEC	Heterogeneous	Single Hop	Proactive	Threshold function and residual energy	Enhanced life network time in wireless sensor networks	residual energy reduced and become in the range of the normal nodes
GTEB	Hybrid	Multi Hop	Reactive	Tree based probability	Provides high throughput and having longer battery time	Average packet drop is slightly high with respect to time.
PEGASIS	Homogenous	Single Hop	Proactive	All nodes send data to neighbour	Tree based technique has low consumption of energy	Data fusion results into less transmission of data between sensor nodes and base station.



## V. GAPS IN LITERATURE

Mehmmood A. et al. [16] has examine the GTEB protocol which can be create sensor nodes that strain their energy at about the same time frame that can be accomplish by addressing the load balance issue at both the region as well as node levels. But it has been observed that the Global Energy Balance Protocol has utilized variety of probability function for picking best CH by using the residual energy. But Global energy balance protocol has ignored the exact space between base station and cluster. By conducting the literature survey it has been found that the each WSNs protocol has few problems is that no one is better in each case and many of the present literature has ignore one of the following:

- 1.The majority of the present researcher has not taken the usage of exact space between the SN and the BS while selecting the CH.
2. The maximum amount of CH in every cycle are not same in LEACH, Global energy balance protocol as well as in GLOBAL ENERGY BALANCE variants.

## VI. CONCLUSION

In this paper, a decentralized routing algorithm, named GTEB routing protocol is discussed. GTEB increase the network lifetime by balancing energy usage in a larger network area using geographical routing protocols. Many energy efficient routing protocols have been discussed in this paper. The key advantageous of the GTEB protocol is that the significant amount of clusters are formed in most of rounds. However, GTEB protocol has neglected the distance between base station and cluster. Therefore, to overcome these issues in near future we will propose optimized cluster head selection based Global energy balance protocol by utilizing the fuzzy logic based dynamic clustering technique.

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