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A power efficient routing scheme: Wireless sensor network for implementation of Green Network by clustering

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ABSTRACT

Faced with increasing energy prices, financial crisis, and environmental problems, the sector of increation and communications technologies initiates the third industrial revolution. This revolution aims to intelligently allocate and distribute energy. The study, development, and implementation of intelligent energy managers for computer networks are called Green Networking. The proposed project aims to develop and test an energy-aware solution. In this, an energy-efficient topology control algorithm named EALSP. The algorithm first tries to preserve the minimum-energy paths. However, when a node searches its requirement a large transmission power to cover some of its neighbors, it capitalizes two-hop paths to reach them instead of using single hop. Simulation results show that EALSP can effectively decrease the transmission power and reduce the energy dissipation when transmitting. This paper presents an energy efficient routing scheme for wireless sensor network to apply GREENNET work protocol by clustering. This is based on the PSO algorithm, which is designed so that it automatically selects the desired nodes. This protocol looks after both the energy efficiency as well as transmission distance. In this paper, we compare different parameters varying selected parameters and observed the simulated result.

Keywords— *EALSP, WSN, Clustering, LEACH, Network, PSO*

1. INTRODUCTION

A wireless sensor network is systems which have different types of sensor for collecting in creation from a different source and transmit to a target base station to enhance the life and reduce the data traffic and power dissipation and its emission. The WSN touched all the part of human life in all area. In this network system, each node a sensor or a router has a limitation in its storage, computation etc. Sometimes the nodes are affected by environmental or physical damage also which have to replace but it is difficult and costly. It also affects the network in some area. To get rid of these problems there are always or more alternative this is the requirement of the present scenario. There were different protocols used earlier but LEACH protocol is of the best protocol and well known WSN clustering protocol, which target a cluster head based on a probability moving the CH's energy and the choose of CH is in a random manner. So a node having the lowest energy may be chosen as the CH. Then the LEACH protocol is used that need the transmission between the CHs and the BS connected by a single hop network, which requires a huge amount of energy due to the larger distance between CHs and the BS.

The above problem of dissipation of more energy can be managed through adjusting the network topology and varying the nodes and its transmission power levels in the routing protocol which can be achieved by clustering technique with GREEN NET [3]. This paper focuses on energy efficiency routing protocols for WSNs.With the aim of prolong network longevity. A wireless sensor network designed for ultra-low Power operation, energy harvesting and secured IP-based communication. GREENNET aims at contributing to the emergence of the Internet of Things (IoT) that proposes the vision of rich interactions with the physical world through the interconnection of objects having advanced processing, communication, sensing and actuating capabilities. While many physical (PHY) and medium access control (MAC) protocols, as well as applications for sensor networks, exist, there is only one language spoken by all machines all around the world, the IP protocol at the networking layer. IP-enabled sensors allow any host or connected device to communicate with any other sensor via the Internet without the need for proprietary gateways or network address translators. Given the resource-constrained nature of wireless sensor nodes (very small memory, low processing speed, limited battery), IP connectivity comes at a price of an increased resource dissipation and for this reason, a designed and prototyped, a new generation of sensor nodes with ultra-low energy dissipation enabled by three major advances:

1) An energy efficient radio transceiver; 2) photovoltaic energy harvesting; and 3) the integration of the IEEE 802.15.4 beacon-enabled mode with lightweight IP routing. The goal of this paper is to present the design and implementation of an operational low footprint system with energy harvesting. We discuss the constraints and trade-offs of the considered sensor board along with the details of the protocol stack and we report on its measured performance and energy efficiency [4]. The work is technically oriented to end up with an operational prototype. However, we also report on some novel mechanisms that enhance an existing protocol stack and provide the research community with our experience in developing and integrating a complex highly constrained system. Even if the MAC and network layers have much in common with existing standards, their successful integration also required significant adaptations and enhancement.

A GREENTNET mote is a microcontroller of 32 bit, a802.15.4 2.4 GHz radio receiver a power controller management system and some MEMs. This has a cortex embedded in it of M3 used at 12 MHz frequency with 32 kB RAM and 256kB flash for consuming energy this mote has a photovoltaic cell with an area of 4x4 cm^2 and a rechargeable battery with a capacity of 20 mAh**.** It aims is supporting a required stage of security. It is totally based on the concept of object security which relates security with the application layer. The above method is used only to focus on the uniform and lower valve of energy dissipation of the nodes for further prolong network lifetime, some location-aware protocols and proposed to decrease the transmission cost and provide better security level to the WSN.

In this paper, we try to explain the design and implementation of the proposed mechanism and an improvement made to existing protocols we also check the workability and dissipation of energy of GREENNET. The main contributions of this paper are as follows. To study the protocols used in WSN routing. Propose a new clustering protocol using an improved particle swarm optimization algorithm to achieve the optimum solution LEACH protocol is used in WSN. Overview of the methods and techniques to save energy. An overview of IP routing and discuss its advantage. Proposed a scheme that enhances the process of connecting the network Explain how GREENNET works and provide security with the minimum use of energy to reduce the radiation level.

2. PROPOSED WORK

A. Under the constraints of limited energy and computation capabilities, a lot of routing protocols are designed to increase the efficiency. The LEACH protocol selects a CH based on a predetermined probability of moving the CH role among the sensor nodes so the as to avoid fast depletion of the CH's energy [10]. Which select, a node with lower energy is as the CH. And the LEACH protocol requires that the transmission between the CHs and the BS be fulfilled through a single hop, which uses a large amount of energy and disturb the energy balance between nodes if the CHs have located far away from the BS. The LEACH-centralized (LEACH-C) protocol is utilized as an improvement over LEACH, which uses a centralized clustering algorithm to form different clusters. LEACH-C improves the network performance by creating better clusters network. The huge amount of works has been done to minimize the inefficient power dissipation in the sensor network field. This is a basic protocol for all protocols concerned with clustering. A concise introduction is given below. LEACH uses the special methodology to select the cluster head and to transfer data. This uses the hierarchal protocol in WSN.

This uses two-phase to implement the protocol in each round as below:

1. Set-up Phase
2. Steady-state Phase

The setup phase is responsible for the creation of clusters. In this, a random number is selected between zero and one by the nodes of the sensor network [2]. Leach uses a distributed approach in the cluster creation, in this each and every node makes decisions on the basis of non-centralized support. At the beginning of every round, all nodes declared itself cluster head using the probability criterion of P (i) with a number of K CH in the present round. While the steady-state plays a vital role in transmitting data from non-header nodes to header nodes and finally from header nodes to the BS.

$$P(i) = \begin{cases} -K \div (N - K * (r\frac{modN}{K}, & C(i) = 1 \\ 0 \qquad , & C(i) = 0 \end{cases}$$

This random generator function generates a value between 0 and 1 and that is compared to the threshold value T (n), in the case when the value of P(i) is less than T (n), then that node elected as CH. Threshold value calculated as :

$$T(n) = \begin{cases} P/(1 - P * \left(r \, mod \frac{i}{P}\right)), & n \in G \\ 0 & ,otherwise \end{cases}$$

Here r represents current round, P represents probability to be CH, and G represents to those nodes which are not elected as CH in1/P rounds. The main quality of LEACH protocol is distributive in nature and the also this not requires any type of the knowledge about the network. Another modification in the LEACH known as CHEF in CH selection method using fuzzy logic [2], [6], [7].This elect node as CH on the basis of two fuzzy inputs (Proximity distance and Energy concept). This distance is proposed as the addition of distances linking the CH and nodes inside r radius distance. Where r is denoting the average radius of the cluster and calculated by the following equation.

$$r = \sqrt{(area|\pi \cdot n \cdot P)}$$

Here the number of total nodes are denoted by" n" in the WSN, While P represents the power level of the battery or cell. This selection method provides a node that is of higher energy level and optimizes to the node locally for choosing as CH. The increation on the residual energy of the nodes is taken into account in the probability formula, so the nodes with higher energy are more likely to be selected as the CHs. However, LEACH and LEACH-C are unable to use intelligently the CH selection methods and the distribution of CHs are random, which result in overloaded energy dissipation. As a result, BCDCP [11] is proposed to form more balanced clusters. In BCDCP, each CH servers an approximately equal number of member nodes so as to avoid CH overload, and the CHs utilize CH-to-CH routing to transfer data to the BS. These protocols focus on uniform energy dissipation of the nodes. To further prolong the network lifetime, some location-aware protocols (HEED protocol) [16]. Are proposed to reduce the transmission costs among the nodes. In the HEED protocol, CHs are selected based on the nodes residual energy plus a secondary parameter, such as the nodes' proximity to its neighbors. The CHs send data to the BS through the multi-hop path. HEED ensures that only one CH within a certain distance can achieve the uniform CH distribution across the network. Therefore, the head nodes dissipate a huge power in the HEED protocol, results in their faster depletion of energy. The EECS protocol [10], [12] leads to a fair distribution for CHs, in which CHs are selected based on the residual energy and location of nodes. The Hausdorff clustering method introduces an algorithm to select CHs based on the location, communication efficiency, and network connectivity. Therefore the residual energy of the nodes consumes quickly when the clusters are organized inefficiently at the first time. In, an LECP-CP protocol is proposed, in this the core of which includes an ideal cluster head selection algorithm and an inter-cluster communication routing tree construction algorithm, both based on the predicted energy dissipation ratio of nodes. What's more, the protocol also provides a more accurate and realistic cluster radius to minimize the energy dissipation of the entire network. In most applications, the BS is far from the sensor network, and thus the CHs have to consume much more energy than the other nodes. Thus, task allocation can be done in such a way that the sensor nodes play a significant role in improving energy efficiency. For example, relay nodes can be used to balance the heavy dissipation of the CHs. In SEECH [7] some nodes with higher residual energy are selected as the relay nodes, and the CH chooses the closest relay node as its next hop. Thus, the CH collects and aggregates data from all the cluster members, and then transfers the data to the relay node, which relays the data to the BS. In this way, the relay node can share the CH's data transmission, and thus helps offload the CH's energy dissipation. However, two or more CHs may choose the same relay nodes, which will expedite the energy depletion of the selected relay nodes. In addition, extra energy dissipation is required when a CH chooses its relay node. Moreover, the location of nodes is not taken into consideration in the selection of relay nodes.

2. Contributions although the mentioned protocols are able to prolong network lifetime to some extent, there is no guarantee that the selected node is best fit as a cluster head. There are two main reasons. Firstly, some nodes with lower energy are probabilistically determined as the CHs, which will exacerbate the energy dissipation of these nodes. Secondly, some nodes are not suitable to be at the center of a cluster because of their location. If a node near the boundary of the network is selected as a CH, energy dissipation will increase because the CH is far from the BS. In our previous work, we have used a non-linear optimization method in the algorithm to select CHs. In this paper, we propose a new clustering protocol using an improved particle swarm optimization (PSO) algorithm [1]. Firstly, we use relay nodes to offload the energy dissipation of the CHs. Different from these protocols, in our paper, every CH has a corresponding relay node in our protocol, which has two benefits the: 1) the CHs do not need to consume additional energy to choose their next-hop node; 2) channel contention which arises when choosing ing relay nodes by the CHs can be avoided. In addition, the selection, n of the relay nodes is based on not only the residual energy but also the distance to the corresponding CH and the BS. Then, two fitness functions are generated which determine whether a node is selected as a CH or a relay node, in consideration of both their location and residual energy. The selection of the CHs and relay nodes as is formulated an NP hard problem. And an improved PSO an algorithm is proposed to achieve the optimum solution.

Reduction of power dissipation in networks can be achieved through different methods. Like the use of green hardware for networking devices. At the physical level, the energy-efficient circuit design can be used while at the functional level, dynamic frequency and voltage scaling can be applied. Similarly, to achieve energy efficiency through next-generation green networking protocols. Green protocols can allow, like, proxies to take over the functionality of network devices that will be put into sleep mode in an autonomic manner. Such an approach has been illustrated in [12] where a router can transparently transfer all the virtual links from one line card to another so that the former can be put to sleep. The other method is the use of green network management paradigms, such as ETE, where traffic demands are routed appropriately in order to promote either link rate adaptation and/or link sleeping by taking into account the energy dissipation characteristics of links and line cards. Future energy savings based on the exploitation of different possible energy dissipation profiles of links have also been investigated in [10].The principle of ETE was first introduced in and there has been a comprehensive introduction and analysis of existing ETE solutions in and. ETE schemes can be classified into offline and online solutions. Offline ETE mainly refers to the computation of static network configurations (e.g. planned node/link sleeping) based on forecasting traffic behavioral patterns. On the other hand, online ETE can be used as a complementary approach in order to deal with short timescale traffic dynamics with on-the-fly network reconfigurations. Taking link/node sleeping reconfiguration as an example, most offline ETE paradigms aim to compute reduced network topologies based on one single traffic matrix (TM) for energy-saving purposes. However, due to the dynamics of traffic patterns in operational networks, existing offline ETE paradigms may exhibit inefficiency due to inaccurate traffic forecasting, as has always been the case in conventional offline TE approaches. In order to circumvent this limitation, complementary online ETE solutions have been designed to allow fast local network reconfigurations to handle rapid changes in traffic demands but the high complexity in realizing these approaches has made them less attractive in practical deployments. The majority of ETE solutions in the literature use an offline optimization strategy because of its simpler implementation compared to online energy saving methods. Furthermore, offline ETE solutions can make use of global optimization methods because of their long timescale and this will result in more predictable network behavior compared to the case where local optimization methods are used by online ETE solutions Early work in sensor networks suggested that the constrained and application-specific nature of sensor networks required networking to be based on non-IP concepts. This resulted in a body of work on clean-slate communication architectures for wireless sensor networks. Although such systems could achieve very low power dissipation and reasonable performance they incurred a significant complexity because of cross-layer interactions and non-modular designs. Recently, there has been a movement toward IP-based sensor networking platforms seeing that layered IP-based sensor network systems could be made as efficient as those based on monolithic designs. Sensor networks have traditionally consisted of isolated and homogeneous networks of sensors that periodically report their data to a sink. A decade of research in the sensor network community has resulted in algorithms, mechanisms, and protocols that address the unique challenges in this domain. For example, CTP provides address-free data collection with a low overhead and without centralized control. Data dissemination protocols such as Trickle, Deluge, and DIP distribute data to network nodes in a fully distributed fashion, while keeping broadcast traffic low. Isolated sensor networks have worked well in the past, but the new set of emerging applications in IP-based smart objects has increased the demands for integration with existing network infrastructures and heterogeneity in hardware, software, and communication technologies. IP-based sensor networks have recently become popular for this emerging area. Although significant progress has been made in routing protocols for low power IP, as demonstrated by the emerging RPL IETF standard the integration of IP routing with a standard duty-cycled MAC layer is still a challenge that we have addressed with GREENNET. Open Interconnect Consortium defines an open specification for interoperability across connected devices. It considers that secure and reliable device discovery and connectivity are a foundational capability to enable IoT. With respect to the issue of adaptation to harvested energy, several authors proposed duty-cycle adaptation protocols based on the prediction of light variability and the battery level. Kansal [1] Proposed an energy prediction model based on an exponentially weighted moving-average filter. They assumed that the energy available at a given time of a day is similar to that available during the previous days, which is only partially true for outdoor conditions. GreenNet aims at a different environment, namely indoor under artificial lights with variations that depend on the outdoor light conditions and also on how artificial lights are switched on indoor. There is a need to change the CHs at every round considering residual energy so that CH selected should have high energy Hence an efficient CH replacement algorithm is needed to conserve energy within the network and load balancing among all the clusters is required to increase the network lifetime. The modified version of LEACH requires lesser maintenance of routing tables because for a normal node, it will maintain local topology in the creation and for CH node it will maintain global limited topology. The algorithm will also find the route which will have reduced the number of hops, route discovery time and energy computation. Further, the proposed method reduces the problem of the energy hole by providing mobility to the sink node. Sink node moves to different clusters to collect the creation so the location of the sink needs to be known at each iteration. From each cluster, a special node called agent node is selected to update the location of the sink. Based on different tiers for data transmission nodes are classified as a normal node, CH, agent node and one movable sink node.

2.1. Node Implementation Algorithm

This algorithm helps to deploy nodes in a particular area of interest. Inputs to be given are a number of nodes as per the requirement and the location of nodes is mentioned in x and y coordinates in a specified area. A node deployment matrix is generated with Node ID's and its x and y positions.

2.2. Cluster Creation Algorithm

Purpose of this algorithm is to spread nodes into multiple areas. Cluster Creation algorithm divides the area into multiple Clusters. A set of nodes are allocated to each cluster. This is the algorithm which is responsible for the creation of clusters in a network. The total area is divided into clusters with each cluster bounded by the limits with some minimum and maximum. The region y is bounded within the limits" ymin" and" ymax". Set of nodes are allocated to each cluster. A number of clusters on x-axis endpoints and y-axis endpoints, nodes per each cluster are given as inputs to the algorithm. Based on this algorithm it is possible to assign nodes with its node identity to the different clusters. Based on the architecture shown above node deployment and cluster creation algorithms are responsible for the deployment of nodes and forming the clusters across given area which are depicted in figure.

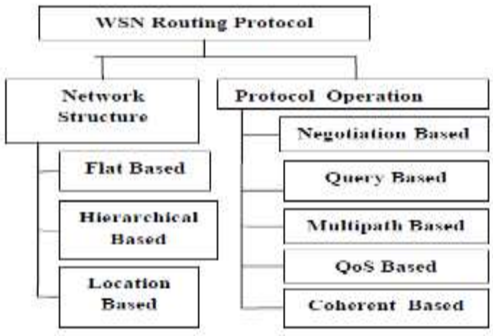

Fig. 1: Block diagram of the proposed method

2.3. Cluster Head Selection

The algorithm is responsible for electing the special node in each cluster called CH node. It is selected based on the residual energy of the node and distance of a node with respect to other nodes in a cluster. It has the location in the creation of all the nodes within the respective cluster and responsible for intracluster communication. Random CH selection leads to various problems as mentioned above hence CH selection has got more importance. It reduces the transmission energy required for each node hence energy dissipation in a network is reduced. It uses global limited network topology hence CH's can communicate with each other to reduce the number of hops during transmission from source to destination.

2.4. Agent node Selection

Since we are assuming the mobile sink node, movement of the sink node within the network needs to be tracked regularly. After every iteration location of the sink, the node needs to be updated that be done by selecting a single node from each cluster called an agent node. Agent node is used when the destination is only a sink node. If the data packet needs to be transferred from source to the destination node where the destination node is other than sink node then there is no need of agent node in the route discovery process. It is elected based on the residual energy of the node and distance of a node with respect to sink node. AN and CH nodes are not the same for one cluster for the same iteration. Both nodes are different for different iterations.

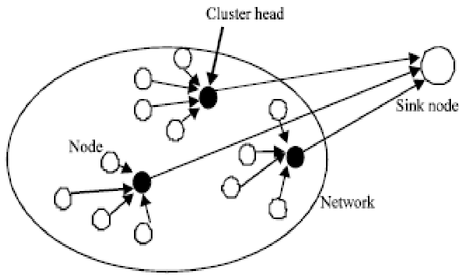

Fig. 2: Cluster-based working on LEACH in WSN

2.5. Route Discovery using Modified LEACH

The route from source to destination is made by using a modified LEACH algorithm. Here route is discovered from source to destination with the involvement of CH when the destination node is not a sink node. Collected data from a node is sent to the respective CH data aggregation is done at the CH only. Then this CH communicates with the CH of the destination node. If destination will be a sink node then collected data from that node which sent to the respective CH which is then passed to the agent node of the respective cluster then communicates with the A's of other clusters. Finally, data packets are transmitted to the cluster which is closer to the sink node. Transmission energy required by the nodes for each iteration can be reduced and the Optimized path to the destination is found from the above algorithm which results in low power dissipation hence increases the lifetime of the network.

2.6. Route discovery using I- LEACH

It is similar to that of the modified LEACH algorithm only difference is the concept of Agent node is not used in I-LEACH. The single node from each cluster is elected as CH which performs the multiple tasks such as collecting sensed creation, data aggregation and updating the location creation of sink node at iterations. CH in this algorithm performs the function of AN in the M-leach approach. A number of sensor nodes are equal to a number of routing tables in a network large number of routing tables exist. There is a need to make the routing tables simpler which can be possible by using the above approach. The concept of agent node is removed it makes most routing tables simpler. Maintaining the routing table at each node for routing process dissipates most of the nodes energy hence there is a need to conserve this energy dissipation which can be achieved by the I-LEACH algorithm. The number of hops for data transfer from source to destination is reduced in case of I-LEACH. Hence to prolong the network lifetime it is better to approach than other previous approaches.

Route Discovery Algorithm- Improved LEACH

Fig.3999. Improved LEACH Algorithm Route discovery Process

Steps for Route discovery:

1. Source Node & Destination Node is inputted to the given algorithm.
2. Check whether the source and destination nodes are in the same zone. If Yes then SN Communicates directly with the destination node.
1. If Source Node & Destination Node are not in the same cluster. Then check whether source node is CH. If source node is CH. Then add CH to the route. Otherwise, find the CH of the source node then add the source node to route and CH of the source node to the route.
3. Check whether the destination node is CH if yes then destination node is added to the route. Else find the CH of the destination node and add to route then add destination node to the route.

Weaknesses: Clustering is a fine method which, if implemented properly, can lead to energy efficient networking in WSNs. However, the assumptions made by the protocol raise a number of issues as explained in [13]. LEACH assumes that all nodes can communicate with each other and are able to reach the sink, LEACH assumes that all nodes have data to send and so assign a time slot for a node even though some nodes may not have data to transmit, LEACH assumes that all nearby nodes have correlated data which is not always true, LEACH requires that all nodes are continuously working uniformly (this is not realistic in a random distribution of the sensor nodes, for example, where cluster-heads would be located at the edge of the network), there is no mechanism to ensure that the elected CHs will be uniformly distributed over the network (hence, there is the possibility that all CHs will be concentrated in one part of the network), periodic dynamic clustering carries significant overhead which may off-set energy gains derived by the clustering option.

The impacts of heterogeneity of nodes, in terms of their energy, in wireless sensor networks that are hierarchically clustered are analyzed. In these networks, some of the nodes become cluster heads, aggregate the data of their cluster members and transmit it to the sink. We assume that a percentage of the population of sensor nodes is equipped with additional energy resources. This is a source of heterogeneity which may result from the initial setting or as the operation of the network evolves. We also assume that the sensors are randomly (uniformly) distributed and are not mobile, the coordinates of the sink and the dimensions of the sensor field are known. We show that the behavior of such sensor networks becomes very unstable once the first node dies, especially in the presence of node heterogeneity. Classical clustering protocols assume that all the nodes are equipped with the same amount of energy and as a result, they cannot take full advantage of the presence of node heterogeneity.

1. The method is applied in a sensor field of area 100×100 m.
2. A number of nodes in the field are 100.
3. The initial energy of a node is 0.5 joule.
4. Advanced nodes have α time more energy than a normal node.
5. Hence energy of advanced node becomes = initial Energy× (α).
6. Initially, the dissipated energy is zero & residual energy is the amount of initial energy in a node, hence total energy Et is the amount of residual energy.
7. The average distance between the cluster-head and the base station is calculated [15]. dbs= 0.765 × (one dimension of field/2)
8. The optimum number of clusters is calculated [15]

$$K_{opt} = \sqrt{n/2\pi}\sqrt{Efs/Eamp}.M/D.Dbs$$

Where, n is the number of nodes, εfs, εamp represent amplifier energy consumptions for a short distance and long distance transmission, M is one dimension of the field.

1. The average distance between the cluster members and the cluster-head is calculated by[15]

$$D_{ch} =_t M/\sqrt{2\pi \text{Kopt}}$$

2. Also, we calculated the average energy Ea of a node after the particular round with the knowledge of total energy and a particular number of round numbers.[15]

$$Ea= 1/n(Et \times (1 - r/Rmax))$$

Here, r is the current round and Rmax is the maximum number of rounds.

3. We calculated the dead statistics before assigning a cluster head, and its value renewed every new round.
4. The new expression for optimum probability can be calculated from different energy levels and optimum probability defined earlier, for the cluster head selection in nodes which have higher energy.

3. ENERGY HARVESTING

When a node benefits from periodic light, it may become energy balanced. Energy balance depends on the available light intensity and suitable duty cycle. Although such systems could achieve very low power consumption and reasonable performance the incurred a significant complexity because of cross-layer interactions and no modular designs. Recently, there has been a movement toward IP-based sensor networking platforms [9], seeing that layered IP-based sensor network systems could be made as efficient as those based on monolithic designs. The ongoing Open WSN project aims at providing an open source protocol stack based on IoT standards for a variety of software and hardware platforms with respect to the issue of adaptation to harvested energy, several authors proposed duty-cycle adaptation protocols based on the prediction of light variability and the battery level. Kansal et al. [13] proposed an energy prediction model based on an exponentially weighted moving-average filter. They assumed that the energy available at a given time of a day is similar to that available during the previous days, which is only partially true for outdoor conditions. GreenNet aims at a different environment, namely indoor under artificial lights with variations that depend on the outdoor light conditions and also on how artificial lights are switched on indoor. Vigorito et al. [15] proposed a model-free approach to adapt the duty cycle. Their solution uses an objective function based on the battery level. We have not adopted this approach, because the exact value of the battery level is really hard to obtain on the GreenNet platform and also on many other platforms. Nevertheless, the battery level, even if it is an approximate value, can serve as a complementary in creation [14].

We evaluated the performance of the proposed method through simulations conducted in MATLAB environment. Comparison of LEACH, M-LEACH are shown in below figures all three routing algorithms are compared with respect to a number of hops, delay in iterations, routing overhead, a number of dead nodes and alive nodes and total residual energy of the network after few iterations whereas in simulations obtained we have considered for 20 iterations.

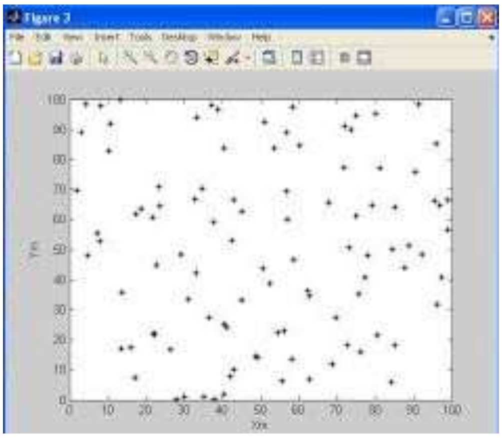

Fig. 3: Field topology

4. IMPLEMENTING LEACH IN MATLAB

In this work, the following assumptions were made. 1) Nodes are homogenous. 2) The nodes have initial uniform energy, of 0.5 joules. 3) Each sensor node initially has the ability to transmit data to any other sensor node or directly to BS. 4) The sensor nodes are stationary. 5) Packet size is the same for all nodes, with a minimum packet size of 2000kbit. Nodes have unique IDs. A node belongs to only one cluster but may change its cluster affiliation during each round. It was assumed that the sensor node is scattered all over the field.

The graph in figure 6 illustrates the number of rounds for which a node is alive at given time intervals for LEACH protocol.

The parameters used for system implementation are shown in Table 1. number of nodes, initial battery energy and number of clusters can be varied to obtain the appropriate results. The destination node can be a normal node or sink node. If it is sink node then updating the location of sink needs to be considered.

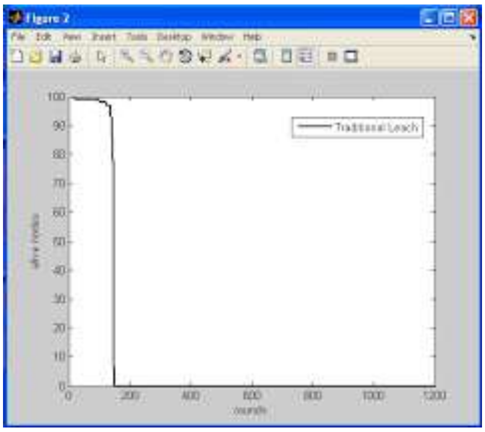

Fig. 4: Comparison of the number of alive nodes as the round proceeds

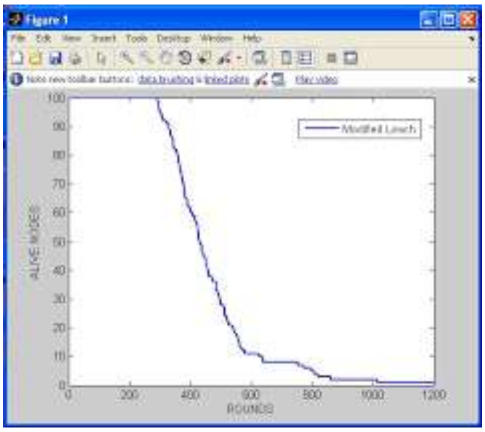

Fig. 5: Comparison of the number of alive nodes as the round proceeds

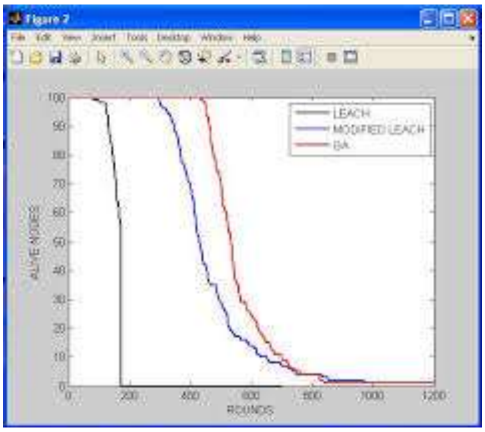

Fig. 6: Comparison of the number of alive nodes as the round proceeds

Table shows the simulation results obtained using LEACH and presented modified LEACH protocols for BS located at different positions. The initial energy for all nodes was 0.5(J) and the probability p used in LEACH is 5%, the same as the settings in [10]. The number of rounds required when the number of dead nodes is 1%, 20%, 50%, and 100% are recorded during simulations. From our results, the proposed protocol outperforms LEACH in terms of the lifetime of the network. For use of an appropriate routing protocol to ensure efficient data transmission through the network. In processing and analysis. Gathering information from a WSN in an energy efficient manner is of paramount.

Table 1: Comparison of network lifetime between LEACH and proposed LEACH

Base Station (x,y)	Protocol used	Nodes dead			
		1%	**20%**	**50%**	**100%**
(100,150)	**Leach**	100	140	150	170
	Modified Leach	400	420	460	600
	Proposed Leach	430	450	510	700
(150,175)	**Leach**	100	150	160	180
	Modified Leach	390	420	460	680
	Proposed Leach	440	460	530	800

5. CONCLUSION

The core operation of a WSN is to gather and convey the collected data to a distant BS for further importance in order to prolong its lifespan. This calls this research project, we have proposed an Amend implementation of LEACH protocol based on energy heterogeneity and optimize it through a genetic algorithm. The result of simulations conducted indicates that the proposed approach is more energy efficient and hence effective in prolonging the network lifetime compared to LEACH.

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