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Increasing Coverage with Efficiency in WSN using Energy Efficient Algorithms

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Abstract: ***Current years Wireless Sensor networks is a leading area in research due to its number of applications in massive areas .The major concern for Wireless sensor networks is an issue of power of batteries for sensor nodes , several algorithms were transcribed to solve this problem but in so many cases only energy efficiency is considered , coverage problem with energy efficiency is not addressed in most of the cases. To give a better solution for energy efficiency and coverage in this paper modified LEACH protocol is proposed with genetic algorithm, which gives comparatively better results than EBRP protocol.***

Keywords : Wireless Sensor Network, Genetic Algorithm, Coverage, Single hop Communication, K-mean, Cluster.

I. INTRODUCTION

Wireless sensor network (WSN) has emerged as an important area for research . Wireless sensor networks are found suitable for applications such a surveillance, agriculture, smart homes, traffic management, disaster detection etc. The key constraints in the development of WSNs are cost, limited energy, limited memory, inadequate c ability to compute, and the memory scope of the sensor nodes. Many routing protocols for WSNs have been developed. The highest routing difficulties and design problems that disturb routing process in WSN are whether node circulation is defined or not, Energy consumption of node without losing accuracy of data, Data Reporting Model of node, Node Heterogeneity, Fault Tolerance, network support for Scalability, Network Dynamics, Transmission Media, Connectivity, Coverage, area of sensor network, Data Aggregation of repeated data packets, Quality of Service in data delivery. There are many aspects which affect the routing protocol design we consider only the limited computing power of nodes. Rather there are number of approaches for the WSN, the research is based on the Hierarchical approach. A serious phase of applications in WSN is network lifetime. WSN are usable as long as they can interconnect sensed data to processed node.

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Sensing and communication are important activities and they consume energy so power management and coverage preservation can efficiently upturn the network lifetime. sensor nodes transmit their sensed data openly to a BS in some cases. Thus, the nodes situated remote from the Base Station will expire quickly since they waste more energy in transmitting data packets. Clustering is used as a tool for the energy efficient coverage aware routing protocol, and in this protocol network is organized in clusters. Such a sensor network contains two types of nodes; cluster head and cluster members. For steadiness of the energy cluster heads varies time to time in request degeneracy of nodes. Many protocols are made which is based on energy efficiency and some are based on coverage. Thus, there is a necessity of a novel protocol system, which is based on both energy efficiency and coverage to increase the network lifespan. In this paper, we evaluate energy efficient coverage aware routing protocol for homogeneous wireless sensor network in which genetic algorithm used for cluster head selection for WSN. Modified LEACH protocol is used with Multi hop communication is used , previously in all algorithms single hop communication is used. Multi hop communication gives more coverage and energy efficiency in case of systems where sensor nodes are more.
For node selection Genetic Algorithm is used. In this case , energy optimization is increased, life cycle improved .
Data transmission is improved.in case of delay and latency , delays in transmitting or processing data decreases .
Implementation of modified LEACH in which clustering algorithm is used node to node communication is carried out.

A. Leach Protocol

The LEACH protocol is one of the bench-mark protocols in the Wireless Sensor Networks. LEACH protocol has two phases: Setup phase and Steady state phase. In the setup phase, nodes are organized into clusters and in the steady state phase data is transferred from cluster head to sink via single-hop method. In each cluster a node is selected as a cluster head and the remaining nodes are called cluster-members. Data collected by the member nodes, locally processed by the cluster head. Due to local data processing and data transmission from cluster head to base station, cluster heads consume more energy than energy consumed by member nodes. Our paper has highlighted the practical implementation of protocol in NS2 and determines network lifetime.

1. Limitations

In LEACH location of the cluster head is on random basis.

This is also true for the number of cluster member in a cluster. An optimum solution for both of above mentioned issues is always required. Establish control over location of cluster heads and size of the clusters in terms of number of members always has been considered as a challenge and solving this problem requires efficient clustering algorithms in energy consumption and network load balancing. In the following section, a new approach is suggested for the optimal selection of cluster head using genetic algorithm. The approach is based in the compactness of nodes in the network. Following figures express the effect of density in nodes organization. Figure 1(a), shows the nodes organization just according to nodes energy and regardless of density that is not optimal in number of nodes. Figure (b), express the nodes organization according to nodes density that is more optimum location for the cluster head.

B. Genetic Algorithm

Using principles of search and optimization genetic algorithms works for randomized search.

Genetic algorithm starts with initial population in which chromosomes are in random fashion which includes chromosomes with genes. Crossover and selection operators are used to find out best solutions. For creating new population, two methods are used mainly as Steady state Genetic algorithms and Generational genetic algorithms.

one or two members from population are substituted in the steady state case where as in generational genetic algorithm, all the produced individuals are substituted for each generation. Proposed algorithm uses generational method.

C. Network and Energy Parameters

1. Network Lifetime:

Network lifetime is calculated as the number of rounds where first node dies based on routing protocol. According to the residual energy of nodes in each round like 1/p ,it decides which node will be the cluster head. Died nodes will not be part of the network .

2. Coverage:

Coverage for a node means it is in the sensing range of a network.

Coverage= Number of point of network covered by sensing range of at least one node/ total number of points in the network* 100.

The novelty of my work is the design, implementation and verification of a new protocol which uses k-mean and genetic algorithm. The suggested algorithm Energy Efficient with Coverage Routing Protocol for Wireless Sensor Network is designed for homogeneous wireless sensor network. Proposed algorithm is based on both critical issue energy and coverage. Simulations results show that proposed algorithm rises the network lifetime by decrease in the energy consumption and coverage.

II. LITERATURE REVIEW

In this section, we will study different people and scientist works on current problem. By reading this, you will get idea about past working of current system. The Literature review briefly described what actually implemented in that paper.

To increase the life time of sensor nodes, Nagrajan introduced a unique algorithm , in which it uses concept of periodic active or idle states in the network. In this concept the idle node checks for the failure of nodes if any active node is not working then the state for the idle node changes from idle to active. This saves energy of sensor nodes as the node uses energy if its in active state otherwise in idle state it saves energy thus increases network life time[1]

Protocol proposed by Tejashree Borbande suggested a concept where it resolves problem of confidentiality . It uses concept of RSA algorithm in which groups are formed at each layer to share data which maintains security of data and communication cost is also decreased this protocol is systematic and can be used in multilayer scenarios[3].

By comparing AODV and CBRP protocols Sreevidya suggested energy efficient routing scheme . Clustering is always preferred in wireless sensor networks where sensor nodes transmits data to cluster heads to avoid unnecessary communication costs in the network. This proposed protocol improves energy efficiency in wireless sensor networks as well as data transmission . It is always good to use routing protocol which is cluster based [4].

LEACH-SM protocol is introduced by Bilal Abu Bakr which suggested the concept of the spare nodes in which nodes are chosen in parallel to decide whether it should be passive spare node or active node . Spare nodes go asleep maintaining the adequate target coverage. By identifying spare nodes network can save energy and increase lifetime . The spare selection phase is added for knowing the spare nodes in the network[5].

Based on the concept of force field attitude of mobile robotics, Andrea Veronica Gonz. proposed technique for lively nodes formation. For different WSN setups large amount of experimentation work is carried out to see effect of this method. It depends on the density whether it is greater or low how the sensor nodes are sensed for example in low desity networks more nodes are sensed. When the nodes are deployed in mesh then , mobile nodes shows more improvement as compare to static nodes in the network[6].

Clustering in wireless sensor networks is beneficial for saving energy , Harsha P.M. suggested method for cluster head selection by using mobile based LEACH-ERE. It shows conclusion for relation among methods which are created on lifetime of the network. Packet delivery ratio is different according to the fix and mobile nodes .There are various techniques which are used for the cluster head selection and by using various protocols for energy efficiency. The proper protocols and techniques should be there to improve energy efficiency and coverage with different protocols[7].

By using the concept of Ant colony algorithm for finding location of nodes S.Niranchana suggested system which asses position of node and then these positions are used to forcast location of the nodes. If the target is not defined then set of nodes are located. It will help to save the total travlled distance. The optimization ACO is used to find repositioning of nodes and calculation is done by using interval theory. This proposed method showed simulation results which are better for static nodes[9].

Nandkumar Kulkarni proposed comparison of AODV, DSDV, and DSR these three routing protocols. Alongside through Random Deployment (RD) design of wireless sensor node QRD is examined in this study. In which QRD systematically spaced area with even coordinates which is not a case with randomly deployed nodes. The performance of AODV,DSDV and DSR is measured based on total energy consumed ,

coverage that is sensor node sensed in the network. Simulation is carried out by using NS-2. It shows that DSR protocol shows best results among all for RD and QRD both. .If we compare AODV and DSDV then AODV performs better[10].

Concept of dual mode of communication as RF and acoustic , is proposed by Pushpendu Kar to avoid loss of information which is caused by trans faulty behavior. Effects of trans faulty behavior of sensor nodes are isolation of sensor nodes from network, creation of dynamic communication holes in the network. To overcome these issues, ReDAST was suggested which intends for dependable and effective data gaining in the sensor network. This may cause increase or decrease of size of network dynamically. This dual mode concept of communication will cover targeted area of sensor nodes and improve efficiency of sensor nodes [11].

For densely deployed Wireless sensor networks there is an issue of information discovery where the initial point of search is not aware of the target information . Therefore Kiran K. Rachuri suggested two protocols as Increasing ray Search which energy efficient and K-IRS which is enhanced variant of IRS. The advantage of IRS is that it will improve energy efficiency and latency in various application circumstances. The main principle of this protocol is to maximize the the like hood of defining target location with less energy consumption. It uses set of trajectories called rays in which search packet travels. It will reduce overlaps in transmission also. Only subset among all sensor nodes conveys the search packet[12].

To guarantee coverage and energy efficiency , new controlled layer development (CLD) routing protocol was suggested by Yun-Sheng Yen. For reducing network lifetime it deals with cascading problem. It has advantages over Probing environment and adaptive sleeping(PEAS) and two tier data dissemination(TTDD) protocols in terms of energy and coverage of network. It shows in results that this protocol can give coverage and increase the lifetime of network compared to Probing environment and adaptive sleeping protocol(PEAS)[13].

P.K.Poonguzhali, projected CHRP protocol which is more feasible than HEED it can give more network coverage with better lifetime, it depends on the inner cluster nodes if the inner cluster nodes are above 6 then it gives 90% of coverage. Even if the growth of the nodes are more then also network lifetime doesn't affect. It shows better performance more than 50% than HEED in case of number of inner cluster nodes increases[14].

As per the suggested work of Utkarsha S.Pacharaney, by developing a topology that can give maximum coverage with high reliability should also increase the lifetime of the network at the same time it should keep minimum number of nodes those are in active state in densely populated sensor network. Both structured and non-structured distribution scheme should be considered where ,perfect location of the sensor nodes is calculated by base station and sensor nodes are unsymmetrically deployed .The condition is satisfied for minimum number of sensor nodes with increase in energy efficiency as all sensor nodes have same power and sensing range is also same. The conclusion is that if sensor nodes are minimum in the network then it upturns energy efficiency with coverage14.

A trust based QoS algorithm proposed where it includes advantages and limitations of LEACH was proposed by Junwei Wang. To preserve load balances in the phase of cluster head selection, energy controller and coverage scale are implemented. In any network , reliability is most important concern , to increase reliability trust valuation mechanism is planned. To validate data in the transmission phase, authentication and ACK mechanism also placed .The protocol proposed in this paper not only gives better lifetime of network but also guarantees about reliability of data transmission with less packet loss. Proposed algorithm upgraded performance of network as compare to the other typical algorithms in wireless sensor networks.[16].

III. PROPOSED SYSTEM

Suggested algorithm has two phases namely Early phase and Steady phase in each round. In this study, multi-hop communication is used for the usual nodes and from cluster head to Base Station. Threshold value is selected by Network administrator for the cluster head selection process. In Early phase residual energy , k-mean and probability parameters are sent by each node to compute fitness function. K-mean i.e. degree of coverage means sensor node enclosed by k nodes which are in its sensing range. According to the result of internal function, the node starts a counter. The nodes are selected by the network administrator with maximum result of internal function and inform its candidature as cluster head to the base station. The objective of the process to find the cluster heads with higher capabilities and distribute them in the network so that the total network energy consumption is minimized and coverage get preserved.

Details of algorithm:

Early phase: Population and fitness function is be used to choose cluster head and cluster member in the early phase. In primary round of algorithm select K initial cluster heads h1, h2……, hK from the n nodes {z1, z2,……,zn}.

Step1: Primarily all nodes have matching chance to turn into a cluster head.

Step2: F(t) is the fitness function for the cluster head selection and defined as

F(t)=(Er * T(n) * Kmean))

Where

Er=Residual energy of the node

T(n)= likelihood of node to elect as cluster head as assumed by LEACH

Kmean= Degree of coverage

There is a straight relationship among energy, kmean and probability with the output of function, so amended value of inputs will produce a larger output the ideal value found for a particular node will be appropriate as a cluster node.

Step 3: calculating this built in F(t) function, all nodes sort in descending order. Network administrator selects number of cluster heads for each network. for cluster head selection, candidate nodes direct their information to the sink .// calculating fitness function.

Step 4: Selection of Cluster: Head BS chooses the cluster head and the outcome is sent to the network.

At the BS a predefined number of nodes presented themselves as the candidate of cluster head will regulate the length of the chromosome. Each of the genes in this chromosome is identifier of number of network nodes. Single-point crossover is performed on chromosome which is selected and mutation is performed, that may change a bit by leap or jump a bit state to generate one or more new chromosomes. A chromosome is nominated that has least difference of energy from last round and with finest probability and great distribution function as cluster head to network. Remaining nodes are fix to the nearest cluster head.// cluster head selection process.

Step 5 BS will direct the information to nominated cluster head

Step 6: Cluster Construction: Nominated cluster head direct announcement to regular nodes. Non cluster head nodes link to nearby CH to form cluster.

Step 7: Sensing unnecessary node to sleep state

If k-coverage of area>2 then node organized in that area will goes into sleep mode. Selection of node will be done by round robin algorithm.

Steady State Phase

After early state each node recognizes its cluster head. In each period a cluster head only gain one package form each member nodes of the cluster. Cluster head united the data and send to it Base Station.

Pseudo-code of the Proposed Approach:

BEGIN

1: Identify the probability (p), number of nodes (n);

2: Einit(s)=E0, s=1,2, …, n;

Initial Phase

1: Each node compute Fitness Function F(t)

2: Start Counter 4: CCH{s}=TRUE; //node s be a candidate CH

3: Send to Base Station (IDx,) (Xx,Yx) // The first predefine number of node reaches at threshold value will sends their candidacy to the sink for cluster head selection.

5: GAinBS //BS perform the GA on the node which sends their candidacy for cluster and select cluster head for the network.

6: SendToCH ← BS send message to selected cluster head.

7: if (CH{s}=TRUE) then

8: BC (ADV) ← transmit an advertisement message;

9: Join (IDi); //non-cluster head node i join into the closest CH

10: K-coverage of area> 2 then node in that area will goes into sleep mode //Selection of node will be done by round robin algorithm

11: Cluster(c); // cluster c formation;

12: end if

STEADY-STATE PHASE

1: If (CH(s)=TRUE) then

2: Obtain (IDi, Data) //get data from members;

3: Combined (IDi, Data) //combined received data;

4: TansToBS (IDi, Data); //convey received data;

5: else

6: TansToCH (IDi, Data); //transfer sensed data;

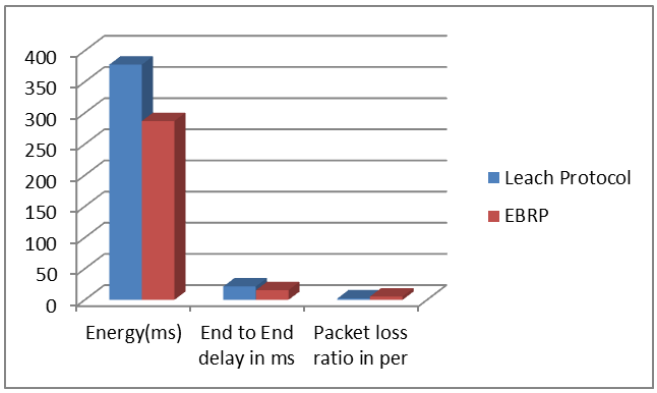
7: end if

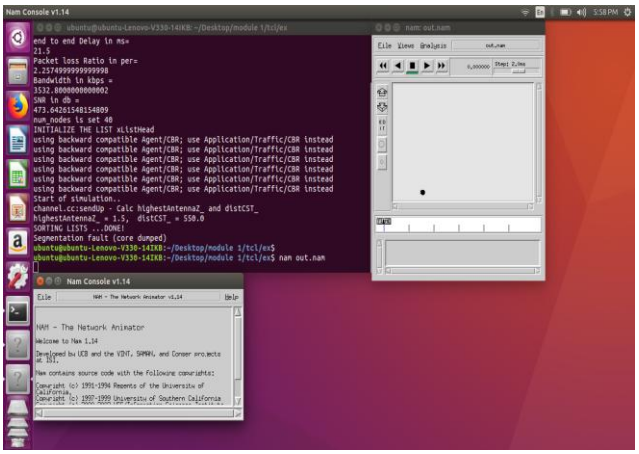
8: end if

9: } // round is completed END

IV. COMPARITIVE RESULTS

Parameters	Leach Protocol	EBRP
Energy(ms)	377.55	287
End to End delay in ms	21.5	15.5
Packet loss ratio in per	2.2574	5.236





V. CONCLUSION

In this work, we have studied number of research papers for energy efficiency of wireless sensor networks from existing research work, many of them identified that increasing energy in sensor nodes or keep that energy high as much as possible is challenging task. In this research paper, the results have been analyzed in various ways like cluster creation, cluster head selection, data transfer rate, end to end delay,

accuracy packet loss ratio, and most important how much energy sensor nodes have by comparing modified leach with EBRP we concluded that Leach which is modified in terms of communication mechanisms like Multi hop communication is used , previously in all algorithms single hop communication is used.

Multi hop communication gives more coverage & energy efficiency in case of systems where sensor nodes are more. For selection of nodes, Genetic algorithm is used.

As, energy optimization is increased, life cycle improved .

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