Region Chain Based Routing Protocols for WSNs

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Abstract **-Wireless sensors nodes are made up of tiny electronic devices which are able of sensing, computing and transmitting data from harsh physical environments like a surveillance field. These sensor nodes depend on batteries for energy, which get depleted at a faster rate because of the computation and communication operations they have to perform. It is randomly deployed in harsh environment, disaster areas, where replacement of battery or recharge is difficult. For this reason, network lifetime is crucial for WSN. Therefore, to maximize the network lifetime, efficient utilization of energy is considered. Energy efficient protocols are designed to make efficient utilization of energy resources. In order to extend the lifetime of sensor nodes, it is preferable to distribute the energy dissipated throughout the wireless sensor network .Routing protocols are mainly designed to use energy of the sensor nodes efficiently. In this paper, we have proposed Region Chain based Routing Protocol which ensures maximum utilization of energy. Later, a comparison of Region Chain Based Routing protocol with Chain Routing with Even Energy Consumption CREEC[2] has been done and found out that energy consumption can be decreased up to 15-20% and reliability of a network can be considerably enhanced using this method.**

Index Terms **- Wireless Sensor Networks (WSNs), Routing protocol, chain routing .Chain Leader on the basis of maximum energy.**

I. INTRODUCTION

Wireless Sensor Networks consists of very small sensors [1] that are characterized by limited processing power and energy resources. All sensor nodes have limited power supply, limited memory and have the capabilities of information sensing, data processing and wireless communication. In a WSN, if one node dies, it could lead to a separation of the sensor network. Thus, every sensor node should live as long as possible to maximize the lifetime of the wireless sensor network. Sensor nodes are scattered in a sensor field (figure1) .Each of these scattered nodes has the abilities to aggregate data and route to the base station (sink) and then to the end users

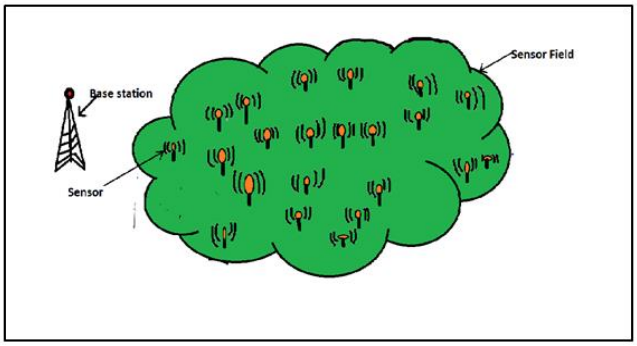

Figure1: Sensor Field

II. COMMUNICTATION ARCHITECTURE FOR WIRELESS SENSOR NETWORKS

Wireless sensor network is a network made of a numerous number of sensor nodes with sensing, wireless communications and computation capabilities. These sensor nodes are scattered in an unattended environment (i.e., sensor field) situated far from the user as shown in Figure2**.**

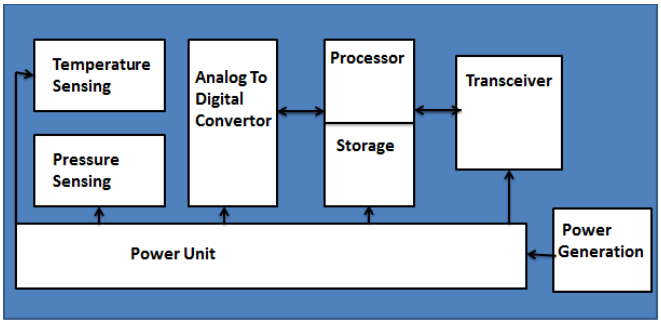

Figure2: Communication Architecture for WSN

The upper side of the architecture above in (Figure2) represents the communication architecture for (Wireless Sensor Networks). The main entities that build up the architecture are: The Sensor nodes that form the sensor network. Their main objectives are making discrete, local measurement about phenomenon surrounding these sensors, forming a wireless network[6] by communicating over a wireless medium, and collect date and rout data back to the user via sink (Base Station).

1. The sink (Base Station) communicates with the user via internet or satellite communication. It is located near the sensor field or well-equipped nodes of the sensor network. Collected data from the sensor field routed back to the sink by a multi-hop infrastructure less architecture through the sink.
2. Phenomenon which is an entity of interest to the user to collect measurements about. This phenomenon sensed and analyses by the sensor nodes.
3. The user who is interested in obtaining information about specific phenomenon to measure/monitor its behavior.

III. MOTIVATION

The main objective of a routing protocol is to efficiently utilize the energy of the nodes. Since these nodes are not rechargeable and in order to make them useful for a longer period of time, routing protocols have been proposed. Region Chain Based Routing Protocols that improve the lifetime of network and stability period of a network. And RCBR protocol is improvement of CREEC. This proposed protocol shows better life time as compare of CREEC [4] protocol, where 65% of nodes have maximum energy.

Radio Model

RCBR Protocol assumes a simple first order radio model in which the radio dissipates Eelec = 50 nJ/bit for powering the transmitter or receiver circuitry and Eamp = 0.1nJ/bit/m2 for the transmit amplifier to achieve an acceptable Eb/No. We also take d2 energy loss due to channel transmission. Thus, to transmit a k-bit message distance d the energy is given as:

Assumptions and Radio Energy Model

Various assumption of our model is discussed. First order radio model is being used.

Assumptions

1. BS is fixed and placed inside the field.
2. Sensors are static and deployed manually.
3. Sensor nodes are homogeneous .i.e. all the sensor nodes have same initial energy, a battery.
4. All the sensor nodes have knowledge of its location and energy.

Radio Energy Model

We assumed a simple model for the radio hardware energy dissipation where the transmitter dissipates energy to run the radio electronics and the power amplifier and the receiver dissipates energy to run the radio electronics as shown in figure3.

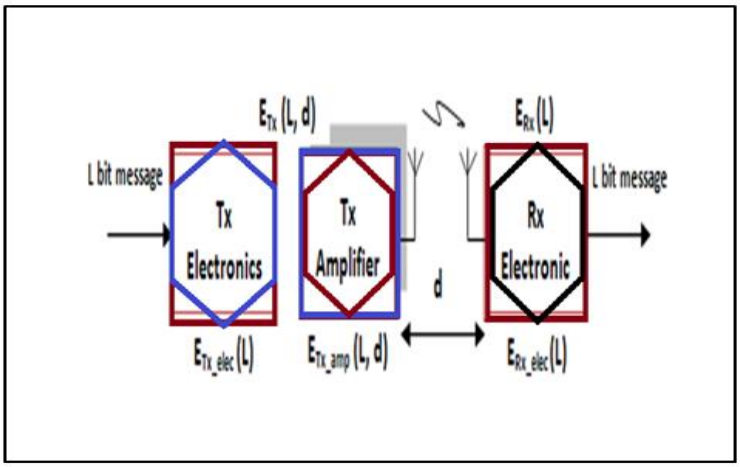

Figure3: Energy model for WSN

The formula for transmitting k-bit message a distance d using radio model.

$ETx(K, d) = Eelec \times L + \varepsilon amp \times L \times d2$ ----------(1)

Eelec is the energy spent in transmitting and receiving data for a sensor

εamp is the energy spent in amplifying

1. To receive message:

$ERx(L) = ERx\text{-}elec(L) = Eelec \times L$----------2)

IV. SIMULATION RESULTS

Network is static and nodes are deployed and events are assumed to be happened at last two nodes of every region, while field is divided into two region. The energy of sensor nodes cannot be recharged. There exists only one base station, which is deployed at a fixed place inside the field so that there is no loss of energy while transmitting the aggregated data to the base station.

The performance of RCBR protocol is being evaluated by simulation we used OMNet++. For performance evaluations following parameters are taken into account:

1. Energy consumption.
2. Network Throughput

Simulation Setup

Network size is considered as 100m X 100m and the numbers of nodes are 50 which are scattered manually in the sensor field.BS is located inside the field. Parameters for our simulation are as follows:

Parameters	Value
Network size	100 m × 100 m
Number of sensor Nodes	50
Eelec	50 nj/bit
Eamp	0.1nj/bit
Initial Energy of Nodes	100 j
Base station	(97,100)
Data packet size	2000 bits
Energy of chain leader	1000j

Table 1: Network Specifications

RCBR (Region Chain Routing Protocol)

An efficient routing protocol is the one which consumes minimum energy and provides better and efficient coverage area. Minimum consumption of energy leads to better network lifetime and. Therefore, good coverage area is essential in getting the required information from the whole network area. Because if the coverage area is not good enough, then there would be some small areas left unattended in the network. The main objective of a routing protocol is to achieve minimum energy utilization and full coverage area. The sensor nodes are deployed in the harsh environment, it is impossible to replace it or recharge it. So it is better to utilize the battery power efficiently. Keeping this in mind many energy efficient protocols[4] have been proposed till date. Chain based routing has helped a lot in order to enhance the lifetime of the sensor network and reduce the communication cost. All the Conventional based chain protocols divides the sensor network into number of chain leader. The sensor nodes send their sensed data to their respective Chain leader (CL) and the CL performs data aggregation and then sends the aggregated data to the BS. Thus CL drains energy more quickly than other nodes in the clusters, reducing the lifetime of the networks. Some chain protocols like CREEC swap the nodes when energy is decreasing and each time node link is increasing then to reduce the longer link trim algorithm are used which makes the complex in calculation and time consuming. But fixed chain leader do not allow new nodes to join the chain and thus the nodes performance is not affected by nodes dying. To avoid this chain based routing protocols were proposed. PEGASIS is a chain based protocol [5] but it suffers from transmission delays due to long links (LL).

In order to avoid this we proposed Region Chain Based Routing Protocol (RCBR) for wireless sensor network. The main goal of this protocol is to enhance the lifetime of the network and reduce the communication cost by evenly distributing the energy load among all sensor nodes. This protocol is static with minimum steps to create chain without making the longer link. RCBR divide the field into two regions and chain is formed where chain leader (non-leaf node) accumulates the data from two sub-chains and further transmits it to the base station. During data transmission throwing energy is calculated for every round. Each filed has two chain leaders (CL), it is assumed that event is occurred at the last two nodes as shown in the figure4. Last two nodes aggregate the data until it reaches to the CL and further transmit it to the BS. No shortest path is created to transmit the packet since predefined path is given. Every round throwing energy is calculated which is based upon the transmitting energy. In the proposed technique, we divide the network area into two regions explained in the following section.

Formation of Regions

In RCBR, the CLs (chain leader) are elected on probabilistic basis and threshold is calculated for each node. Network is divided into two regions where 25 nodes are present in both the region (R1 and R2) as shown in Fig. 4.

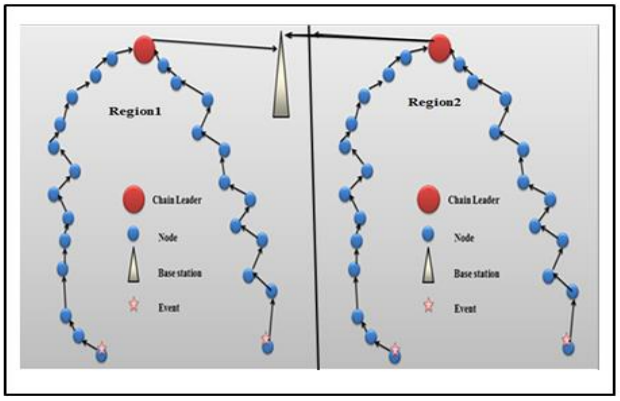

Figure4: Region Chain Based Routing protocol

V. RESULTS ANALYSIS

Energy consumption

Figure5 shows the energy consumed by all the nodes during the simulation run. It is clear that Region Chain Based Routing Protocol RCBR uses less energy. This is possible because last two nodes of each region transmit to its close neighbor in the chain and then to the Chain leader (CL).Then the CL sends the data to the BS where throwing energy and transmitting energy is calculated for every super round.

Throwing Schedule

This section calculates the number of throwing nth(k) to be assigned to any node k for a super round. Every node can unify the throwing energy. We first calculate yth(k) in a Nd-node WSN. For simplicity we assume a super round to be rounds 80 long. Because throwing occurs once in a round, yth (k) becomes:

yth(k) = 10…….1)

k=1,2,•••Nd

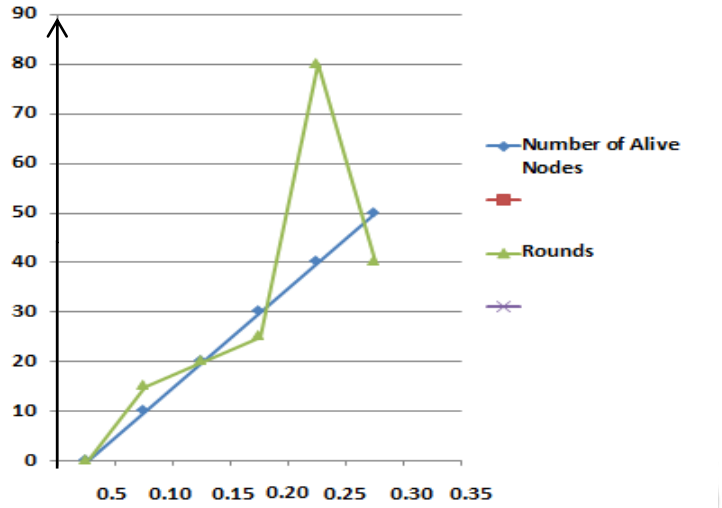

Figure5: Number of alive nodes per round

The comparison of two routing protocol (Figure5.1) on the bases of energy consumed. Energy consumed by RCBR is less than the CREEC protocol. Initially every node will have same energy, as the data is sent in every round, energy gets low and CREEC protocol consumes more energy. Proposed protocol is better than the CREEC protocol and 55% nodes are alive than C

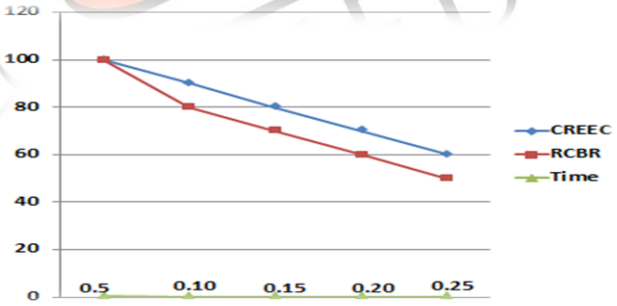

Figure5.1: Different Protocols

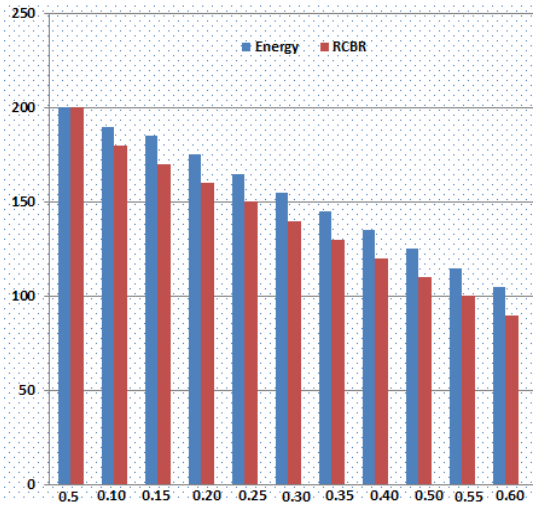

Figure5.2: Different energy Levels of protocol

As shown above from the above graph event it is noticed that the life time of node is maximum. It also shows how much energy is left for all nodes at 80th round. The number of connections between can also be predetermined in the uniform network. The routing protocol can be specifically designed for the uniform network. But it is the performance on more realistic platform that provides a measure of protocol`s real world efficiency.

Performance Parameters

Network Lifetime: Alive nodes are those nodes which have maximum energy to sense and transmit data. The lifetime of a network depends upon the number of alive nodes in the network. As long as there is one alive node in the network, its lifetime counts. So the lifetime of a network refers to the time period from the start of the network till the death of the last node. Figure5.6 shows the number of alive nodes. It can be seen that the network lifetime of our protocol is 55%. It shows that limited nodes limited energy and no delay of packets and easy to deployed. As graph is describing that initial energy was 0 and increases up to 100nj since nodes are limited (50 nodes) so energy does not deplete and maximum nodes are alive that can further transmit the data.

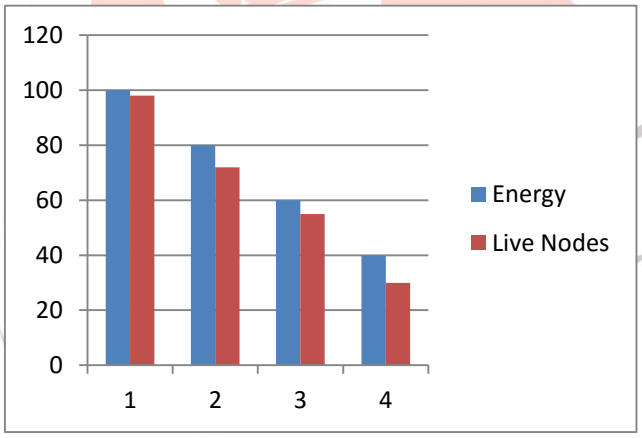

Figure5.3: Number of alive nodes

VI. CONCLUSION

This proposal is a modification to Chain Routing with Even Energy Consumption Protocol by Jisoo Shin and Changjin Suh [2] by introducing a convergecast is a popular routing scheme in wireless sensor networks (WSNs) in which every sensor node periodically forwards measured data along configured routing paths to a base station (BS). The steps used in CREEC are complex when chain has to create. So, we proposed Region Chain Based Routing protocol with aim of keeping the energy consumption low while achieving high reliability. This protocol avoids the complexity so that energy can easily be calculated at every round with minimum number of chain without using the shortest path algorithm .Since limited nodes are used in proposed model and predefined path and events there. The data forwarding probability is adaptively determined based on the measured loss conditions. So only for high loss rates, a node uses high transmission power to reach the sink and whenever the loss rate is low, it adaptively reduces the transmission power. Since the source rebroadcast the data, until the packet loss is minimized, high data reliability is achieved. By simulation results we have shown that the proposed protocol achieves high reliability while ensuring low energy consumption and overhead.

VII. FUTURE WORK

As a future work we intend to increase the network of proposal protocol with the existing protocols. We would also move on to the real time implementation in a deployed sensor network to find out further issues in order to make it more efficient. In our protocol we also consider time critical data, which is not considered in other routing protocols. Time critical data should reach

the destination quickly without much delay. Our protocol facilitates the concept of Hierarchical Chain-Based routing for efficient routing of data and the sensor nodes communicate directly with the BS minimizing the delay occurred in transmitting critical data. The evenly distribution of work load among the nodes ensure lesser power dissipation hence increasing the yield. Our future plan includes the improvements to our simulation experiments with more variations for better comparison results, such as changing the position of the BS, and changing the probability of becoming Chain leader as chain leader is fixed in proposed protocol.

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