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Comparative Analysis of Rzleach with HNNPSORZLEACH in Wireless Sensor Networks

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ABSTRACT

In this paper, we have proposed a new HNNPSORZLEACH protocol called neural network based particle swarm optimization rendezvous nodes with Leach protocol for the efficient selection of routing. The significant improvement has been shown using HNNPSORZLEACH in comparison with RZLEACH in terms of throughput, dead nodes, alive nodes and remaining energy. Our expectations are demonstrated by simulation results. The exploring ascertains the stable region and maximized lifetime of a network by using HNNPSORZLEACH over RZLEACH.

Keywords: *HNNPSORZLEACH, Rendezvous nodes, LEACH, Throughput, Dead nodes, Alive nodes, Remaining Energy*

I. INTRODUCTION

A wireless sensor network (WSN)[1,5] comprises of hundreds to several thousand low-power multi-functional sensor nodes, doing work in an unattended environment, and having sensing, computation and communication capabilities. WSNs have managed to establish the connection between the physical world, the computing world and human society. WSN consists of a large number of tiny sensor nodes distributed over a large area with one or more powerful sinks or base stations (BSs) collecting information from these sensor nodes. All sensor nodes have limited power supply and have the capabilities of information sensing, data processing and wireless communication.

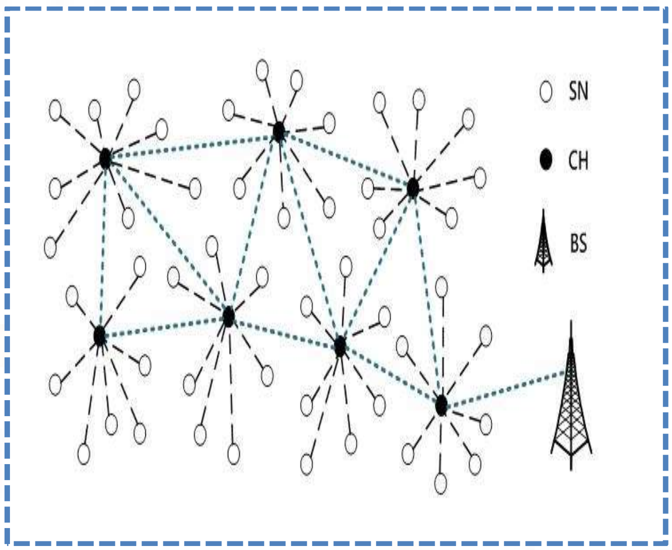

Fig. 1.1 Wireless Sensor Networks [1]

A Wireless Sensor Network is a self-configuring network of small sensor nodes communicating among themselves using radio signals, and deployed in quantity to sense, monitor and understand the physical world. Wireless Sensor nodes are called motes. WSN provide a bridge between the real physical and virtual worlds. Allow the ability to observe the previously unobservable at a fine resolution over large spatiotemporal scales. Have a wide range of potential applications to industry, science, transportation, civil infrastructure, and security. Processor in various modes (sleep, idle, active).Power source (AA or Coin batteries, Solar Panels).Memory used for the program code and for in memory buffering. Radio used for transmitting the acquired data to some storage site. Sensors for temperature, humidity, light, etc.

The components of WSN system are sensor node, rely node, actor node, cluster head, gateway and base station which are explained below.

a) Sensor node: Capable of executing data processing, data gathering and communicating with additional associated nodes in the network. A distinctive sensor node capability is about 4-8 MHz, having 4 KB of RAM, 128 KB flash and preferably 916 MHz of radio frequency.

b) Relay node: It is a midway node used to communicate with the adjacent node. It is used to enhance the network reliability. A rely node is a special type of field device that does not have process sensor or control equipment and as such does not interface with the process itself. A distinctive rely node processor speed is about 8 MHz, having 8 KB of RAM, 128 KB flash and preferably 916 MHz of radio frequency.

c) Actor node: It is a high end node used to perform and construct a decision depending upon the application requirements. Typically these nodes are resource rich devices which are outfitted with high quality processing capabilities, greater transmission powers and greater battery life. A distinctive actor node processor capability is about 8 MHz, having 16 KB of RAM, 128 KB flash and preferably 916 MHz of radio frequency.

d) Cluster head: It is a high bandwidth sensing node used to perform data fusion and data aggregation functions in WSN. Based on the system requirements and applications, there will be more than one cluster head inside the cluster. A distinctive cluster head processor is about 4-8 MHz, having 512 KB of RAM, 4 MB flash and preferably 2.4 GHz of radio frequency. This node assumed to be highly reliable, secure and is trusted by all the nodes in the sensor network.

e) Gateway: Gateway is an interface between sensor networks and outside networks compared with the sensor node and cluster head the gateway node is most powerful in terms of program and data memory, the processor used, transceiver range and the possibility of expansion through external memory.

f) Base station: It is an extraordinary type of nodes having high computational energy and processing capability. Attractive functionality of sensor nodes in a WSN includes effortlessness installation, fault indication, energy level diagnosis, highly reliability, easy coordination with other nodes in the network, control protocols and simple network interfaces with other smart devices. In WSN, based on the sensing range and environment, the sensor nodes are classified into four groups, namely specialized sensing node, generic sensing node, high bandwidth sensing node and gateway node. The radio bandwidth for the sensor nodes are <50 Kbps, <100 Kbps, ≈ 500 Kbps and >500 Kbps respectively. On board processing, computational rate and communication ranges differ from node to node in WSN. Particularly for some dedicated application sensor nodes with different capabilities are used. For example, smart specialized sensing nodes are preferred for special purpose devices, intelligent generic sensing node preferred for generic functions. For interconnectivity functions high end smart bandwidth sensing node and gateway nodes are preferred. Sensor networks are clustered with gateway, relay node, actor node and cluster head, and every other node within the communication range. Cluster is a collection of group of sensor nodes in that particular sensor field. There may be more than one cluster in WSN. Based on the parameters like computation rate, processing speed, storage, and communication range, sensor nodes are identified and selected for WSN formation.

II. CLUSTERING

In Hierarchical organization, clustering [2,9] approach can be used to improve the scalability period and extends the network lifetime. Clustering is a very effective way to reduce energy consumption in the wireless sensor networks. Hierarchical routing is also known as clustering routing. In clustering approach, the sensor nodes are arranged into the number of clusters. Each cluster would have a head and that is called as the cluster head (CH) of a cluster and left nodes are chosen as cluster members (CMs). Every cluster member collects the data from geographical area and then transmits it to the cluster head. After collecting all of the data from the cluster members the cluster head aggregates the data and then further send it to the base-station by using single-hop or multi-hop communication. The CH are responsible for receiving an aggregating data from their CMs, and sends the aggregated data to a long distance, so the energy consumed by CH is more than that of CMs.

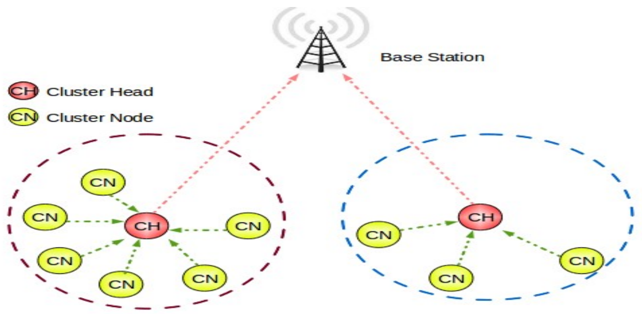

Fig 2.1 Cluster Formation

III. LEACH: LOW ENERGY ADAPTIVE CLUSTERING HIERARCHY

Low-Energy Adaptive Clustering Hierarchy (LEACH) protocol[3,6] is basically works on the following assumptions that all nodes can transmit with having enough power to reach the base station, that the nodes can use power control to vary the amount of transmit power, and that each node has the computational power to support different MAC protocols and perform signal processing functions. The working of LEACH is divided into rounds. Each round starts with a set-up phase when the clusters are organized, followed by a steady-state phase when data are transferred from the nodes to the cluster head and on to the BS as:

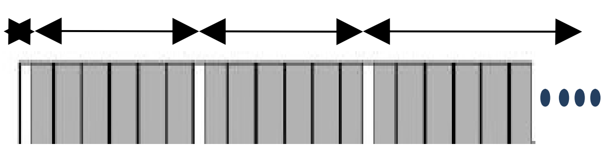

Fig. 3.1: Set-up and Steady-state Phase

Set-up Phase: During the setup phase, the CHs are selected based on an elective percentage of Deployed nodes also by considering a factor that so far how many times an individual node performed the role of cluster-head. The selection depends on decision made by the node by choosing a random number lies between 0 – 1. If chosen the number is less than a set threshold T(n) then the sensor node becomes a cluster-head for the existing round. However threshold value T(n) is calculated as

$$T(n) = \begin{cases} \dfrac{P}{1 - P * (r \bmod \frac{1}{P})} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases}$$

Where p is the probability of the node being selected as a cluster-head node, r is the number of rounds passed, and G is the set of nodes that have not been cluster heads in the last 1/p rounds, mod denotes modulo operator. Nodes that are cluster heads in round r shall not be selected in the next 1/p rounds. Once the CH selection is done, all nodes join the corresponding cluster according to the broadcast signal intensity of the CH node. When the CH assigns time slots for members using TDMA mode, the network will enter the steady phase.

Steady State Phase: Steady Sate operation is broken into frames, where nodes send their data to the CH at most once per frame during their allocated slot. CH then sends the aggregated data to Base-Station (BS) in one hop manner in a network.

IV. PARTICLE SWARM OPTIMIZATION

Particle swarm optimization (PSO) is a population based optimization technique proposed by Kennedy and Eberhart. PSO technique is basically inspired by the social behavior of bird flock searching for the food. PSO has been extensively applied to a number of engineering fields for optimization due to its unique searching mechanism, computational efficiency and an easy Implementation. In PSO, the term particle refers to population of members which are mass-less and volume less (or with an arbitrarily small mass or volume). Each particle in the flock represents a solution in a high dimensional space with four vectors, its velocity, the best position found so far, its current position, the best position found by its neighborhood particle and adjusts its position in the search space based on the best position reached by itself (pbest) and on the best position reached by its neighborhood particle (gbest) during the search process. It on the basis of behavior of animals in which there is no head or group leader such as flock of animals. In flock of animals find food randomly which is nearest to food position. Animals inform to each other about position of food. It will happen again and again until food source found. According to PSO, velocity and acceleration is changed to its lbest and gbest locations. The first one is lbest and the second one is gbest. Particle swarm optimization (PSO) is a computational method that reduces the problem by iteratively trying to improve the candidate solution with improved quality. PSO optimizes a problem by having a population of candidate solutions. PSO is an algorithm modelled on swarm intelligence, that locate a explanation to an optimization crisis in a search space, or model and expect public activities in the existence of objectives. The PSO is a stochastic, population-based computer algorithm based on SI. The particle swarm suggests this type of communal optimization. A problem is given, and some way to estimate a proposed clarification to it exists in the structure of a fitness function. A communication organization or social network is also defined; allocate neighbors for each individual to cooperate with. Then a population of persons defined as arbitrary guesses at the problem clarification is initialized. These individuals are aspirant solutions. They are also known as the particles, hence the name particle swarm. An iterative process to enhance these candidate solutions is set in motion. The particles calculate the fitness of the candidate solutions repeatedly and retain information about the location of best success. The individual's best solution is called particle best or the local best. Each particle formulated this information accessible to its neighbors.

V. EXPERIMENTAL SET-UP

To implement the proposed design and implementation has been done. Table 5.1 has shown the some constants and variables [4,7,8] which is used for experimental set up. Here, the parameters are standard values used as benchmark for WSNs.

Table5.1:- Simulation Parameters

Parameter	Value
Area(x,y)	200,200
Base station(x,y)	Moving
Nodes(n)	100
Probability(p)	0.1
Initial Energy(Eo)	0.5 J
Transmiter_energy	50nJ/bit
Receiver_energy	50nJ/bit
Free space(amplifier)	10nj/bit/m2
Multipath(amplifier)	0.0013pJ/bit/m4

Simulation Results

This section describes the simulation evaluation of the RZLEACH protocol and HNNPSORZLEACH using the MATLAB simulator. The parameter which used in the simulation environment are described in the table. The base station is moving. In this scenario, the routing is done by the particle swarm optimization technique and following results are obtained.

On applying the clustering technique, the following results will be achieved.

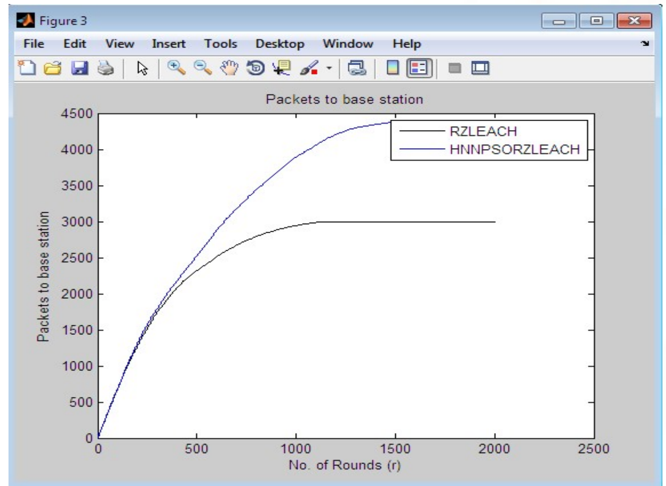

Fig. 5.1: packets transferred to the base station

Fig.5.1 is showing packets transferred. X-axis is representing the rounds and Y-axis is representing the number of packets transferred. The black dotted line represents the performance of RZLEACH protocol, while the blue dotted line represents the HNNPSORZLEACH protocol. From the figure, we observe that the number of packets transferred are more in case of HNNPSORZLEACH protocol and in RZLEACH the packets transferred are less.

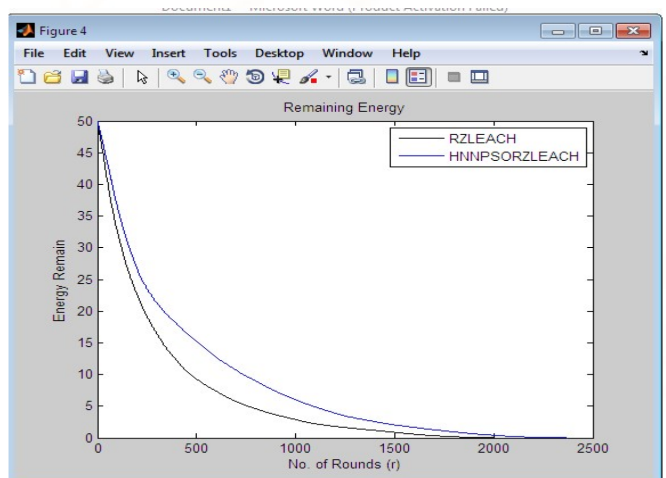

Fig.5.2 Remaining Energy

Fig.5.2 is showing the remaining energy .X-axis is representing the number of rounds and Y-axis is representing the energy remain. From this figure, we observe that in the case of RZLEACH protocol, the energy is less than that of HNNPSORZLEACH protocol.

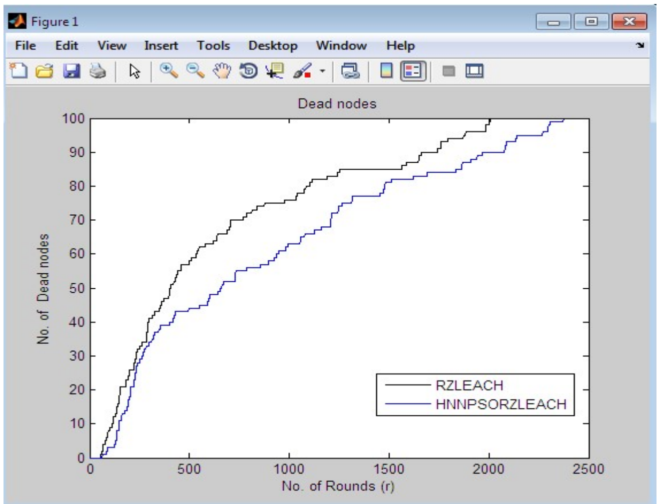

Fig.5.3: Dead Nodes

Fig.5.3 is showing the dead nodes. X-axis is representing the number of rounds and Y-axis is representing the dead nodes. From the figure, we observe that all the nodes are dead at 2000 round in case of RZLEACH protocol and in HNNPSORZLEACH, all the nodes are dead at 2500 rounds.

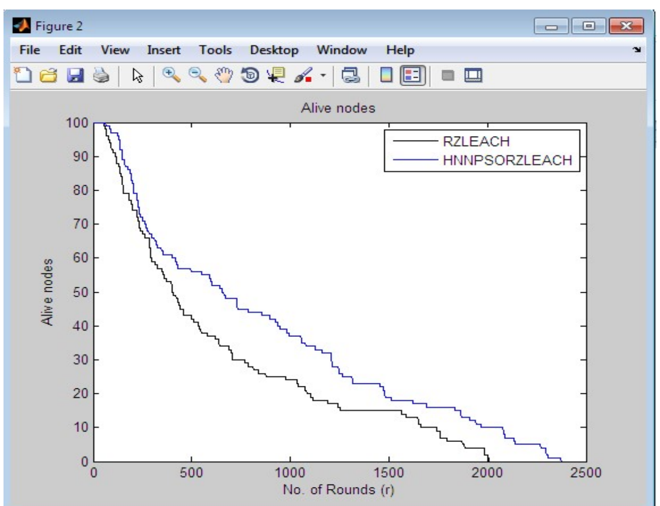

Fig. 5.4: Alive Nodes

Fig.5.4 is showing the alive nodes. X-axis is representing the number of rounds and Y-axis is representing the alive nodes. From the figure, we observe that the nodes become alive at 2000 round in case of RZLEACH protocol and in HNNPSORZLEACH, the nodes are alive at 2500 rounds.

VI. Conclusion and future scope

To improve the energy efficiency, many protocols has been proposed. HNNPSORZLEACH has shown quite significant results in WSNs environment. The proposed technique enhanced the routing process and makes the network more stable and efficient and has a long lifetime. This technique is designed in the data analysis toolbox used in the MATLAB tool. This work has not used for the 3D WSN, therefore we will extend the proposed technique for 3D WSNs environment in future work.

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