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BIO Inspired Hybrid Routing Protocol for Wireless Sensor Networks

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***Abstract**: An Extensive literature survey was carried out in the area of Wireless Sensor Network and it was observed that leach protocol which has been proposed in the literature phase continued some problem, i.e. cluster construction and cluster head selection. In this paper we proposed a new protocol called BIHP (BIO INSPIRED HYBRID ROUTING PROTOCOL), which is useful for longer Network lifetime, low latency and beneficial for energy efficiency in the network. We use Bacteria foraging optimization technique for the selection of cluster head and Hybrid protocol for the improvement of the short coming of previous routing protocol. Finally the simulation results demonstrate that BIHP is helpful for balancing the energy consumption and enhancement of stability period for the network, reduces the energy consumption by the nodes and also reduction in the energy dissipation for the cluster head, in the end we conclude this paper with future research and conclusion.*

***Keywords:** Hybrid, beneficial, BFO, energy efficiency, Stability period, BIHP.*

1. INTRODUCTION

The wireless sensor network is a module of wireless network which compose of sensor's unit, processing unit, communicating unit and power unit. The wireless sensor network is built of "nodes" where each node is connected to several sensors in the network. Today such networks are used in many industrial and customer application for monitoring and control environment purpose. Major challenges in WSNs are to produce low cost, tiny sensor nodes and long network life.

Main feature of Wireless Sensor Networks are:

1) Power Consumption.
2) Unattained operation.
3) Scalability of nodes in Network.
4) Deployment of nodes in the network field.
5) Energy Efficiency.
6) Network life time.
7) Nodes in the network may not have global identification, because of large number of sensors, hard to keep track on it.

The remainder of this paper is organized as follows:
Literature survey is in section II, The network model and radio model are in section III. Bio inspired BFOA in section IV. Our proposed protocol, hybrid routing protocol is introduced in section V. Compared Leach protocol with new proposed scheme in section VI. Finally the paper conclusion in section VII.

2. LITERATURE REVIEW

A WSN is a collection of millimetre-scale, self-contained, micro-electro-mechanical devices. These tiny devices have sensors, computational processing ability (i.e. CPU power), wireless receiver and transmitter technology and a power supply [1]. A survey of clustering algorithms by Ameer Ahmed Abbasi, They had discussed about taxonomy of Clustering attributes and clustering algorithm for WSNs. In this paper they compared the general operation, of popular cluster Method and survey different clustering algorithms for WSNs.

Li. Qing and Qingxin Zhu had proposed the performance of clustering algorithms in energy saving for heterogeneous Wireless Sensor networks. They also proposed and evaluate a new distributed energy efficient clustering scheme for heterogonous Wireless Sensor Networks called DEEC [2].

In recent year a new communication and computation models based on bio inspired society are in great attention. The popular ACO (Ant Colony Optimization), PSO particle swarm optimization (Swarms are used in to solve many problems). Another well know computational methodology received much attention is Bacteria Forging optimization based on the behavior of bacteria pattern, to solve the complex problem in WSNs, developed by K. M passion [3].

3. NETWORK RADIO MODEL

3.1 The Network Model.

The network model we adopted in our research is as followed:
There are N sensor nodes, distributed randomly in a network field, M*N square region (Figure 2).
All nodes have same energy level at beginning stage.
All nodes have same transmitting range at the initial stage.
Node always has data to send to base station.

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Cluster head transmit the aggregated data to the base station directly.
If node residual energy is less then, node is not allowed to become a cluster head.
Node drains all its energy; it is dead and not any more a member of a Cluster [4].

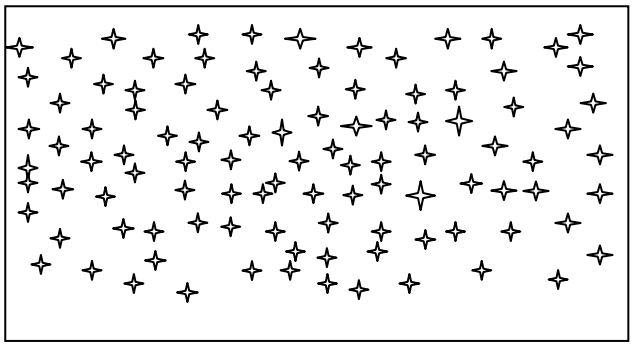


Figure 2: 100 nodes randomly deployed in the Network (✦ is denoted as a node with same energy level).

3.2 Radio Energy Model

According to the radio energy dissipation model in figure 3 and to achieve an acceptable Signal to Noise Ratio in transmitting an H bit over a distance d, the energy expended by the radio is given by:

$$E_{TX}(d,H)=H*E_{elec} + H * €_{fsd}^{2}, \text{ if } d >= d_0$$

$$E_{TX}(d,H)=H*E_{elec} + H * €_{mpd}^{4}, \text{ if } d < d_0 \qquad (1)$$

Where E_{elec} is the energy dissipated per bit to run the transmitter E_{TX} or the receiver E_{RX} circuit, and εfsd^2 and εmpd^4 depends on the transmitter amplifier model used and d is the distance between the sender and the receiver [4].
To receive message the radio expends energy

$$E_{RX}(H) = HE_{elec} \qquad (2)$$

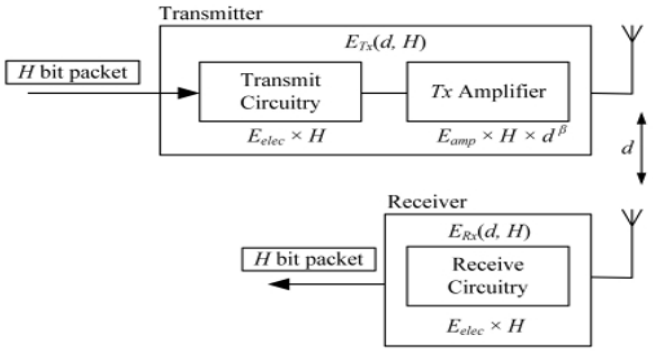


Figure 3: Radio Model

(E_{TX} and E_{RX} are the Energy consumed when sending or Receiving a packet of H bits over a one hope wireless link respectively.)

4. BEHAVIOR OF BFOA

BFO is inspired by the social foraging behavior of Escherichia coil. (Rod shaped bacteria from the family of enterobacteriaceae). E.coil is a singled celled organism that is in our gut. These cells are 45nm in diameter and equipped with a set of rotary motor. Each motor drives a thin long filament. This filament is named as. Flagella help E. coil bacteria to tumble and swim. When flagella are rotated in counter clockwise direction the bacterium swims very fast in forward direction [5]. Where flagella rotate in clockwise direction bacterium starts tumble in search of nutrient in new location as shown in figure (4).

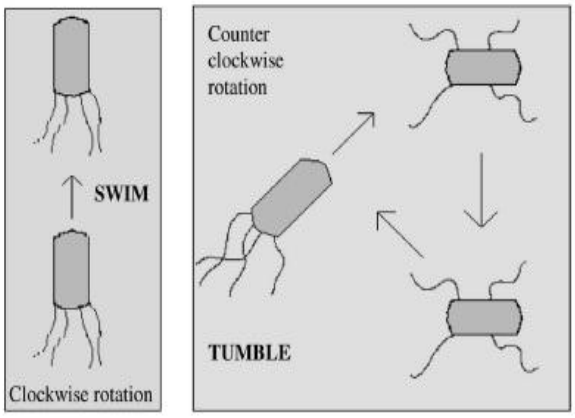
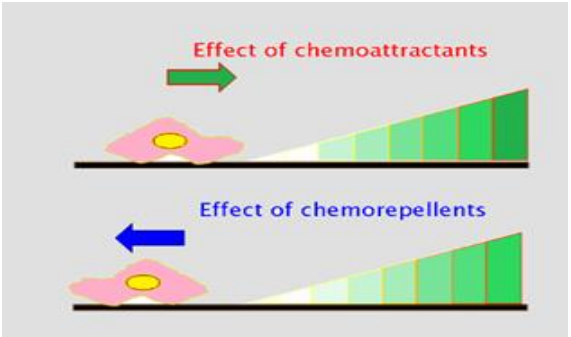


Figure 4 Bacterium swims and tumble.
(BFO has been widely accepted global optimization algorithms of current interest for distributed optimization.)

4.1 Algorithm (BFO)

BFO algorithms mimic's three Principle.
Chemo taxis, Reproduction, Elimination/dispersal.
Chemo taxis:
The process in which bacteria moves and search for nutrient in order to maximize the energy level is Called



chemo taxis [5].

Figure 4:

Swimming and tumbling are the two modes of movement (as shown in figure 4) for the life time of a bacteria to perform in search of nutrient and can be represented by the equation:

$$\Theta^{i}(j+1,k,l)= \Theta^{i}(j,k,l) +c(i)*(\Delta(i) / \sqrt{\Delta^{T}(i)\Delta(i)}) \qquad \ldots\ldots\ldots\ldots(3)$$

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Above equation represent the chemotactic movement of the bacteria, where θ^i (j,k,l) is represented by i^{th} bacterium at j^{th} chemotactic, k^{th} reproduction and lth elimination-dispersal steps. C (i) is the size of the steps taken in random direction and indicates a vector in the arbitrary direction whose element lies between [-1, 1].

Reproduction:

In reproduction step, only the first half of bacteria population survives, and the remaining bacteria split into two which are the placed in the same position as their parent. The fitness value for the ith bacterium during its life after N_c Steps can be represent as:

$$J^i_{health} = \sum_{(j=1)}^{(Nc+1)} j(j,k,l) \quad (4)$$

j_{health} is the health of bacteria, sort the bacteria in ascending values. So the x^{th} bacteria with highest j_{health} values die, and other x^{th} bacteria with the best values split into two. Thus reproduction steps helps to keep the bacteria ratio constant.

Elimination and dispersal:

The BFO algorithm makes some bacteria to get eliminated and dispersed with probability P_{ed} after N_{re} number of reproductive events to ensure that the bacteria do not get trapped into a local optimum instead of the global optima[3-4],[6].

5. NEW PROPOSED SCHEME

5.1 BIHP PROTOCOL:

By combining two protocol, LEACH & PEGASIS we improve the efficiency of the network and enhance the performance by 35% and 19 % higher than LEACH and PEGASIS protocol respectively. Concept behind combining the protocol is to take the advantage of good side of two protocols into one called BIO INSPIRED HYBRID ROUTUNG PROTOCOL (BIHP). We uses the clustering mechanism of LEACH and the Chaining mechanism of PEGASIS, it makes the life time of sensor Networks longer than other protocols, (as shown in fig 5).

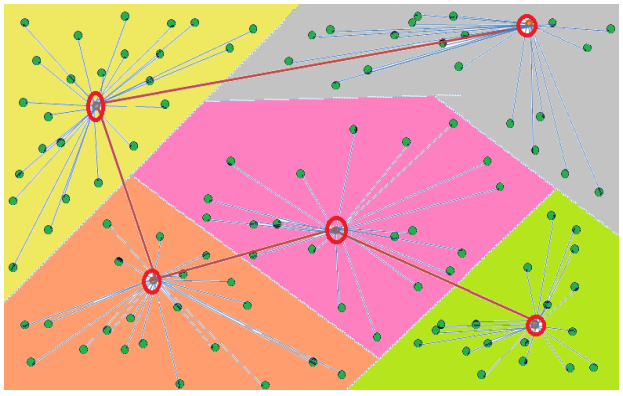

Figure 5: Basic principle of operation for single round

Step1: Cluster Formation using old leach mechanism, (as shown in figure 5)
Step2: Cluster Head Selection using bio inspired optimization algorithms (BFO)
Step3: Select cluster head among clusters for transmitting sensed data to base station USING CHAIN based routing PROTOCOL.
Step4: Leader will transmit the data to base station.
step5: Repeat step 1 for next round.

6. COMPARED PROTOCOL WITH NEW PROPOSED SCHEME.

The performance analysis of proposed hybrid protocol based on cluster and chain routing

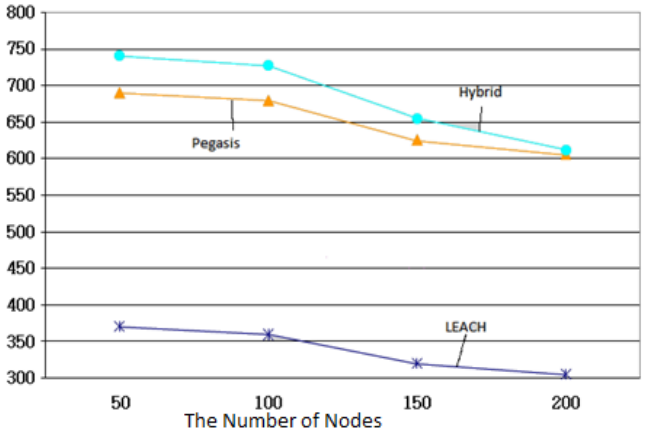

Figure 6: (Performance analysis based on the number of nodes and Rounds)

Algorithms are evaluated in the Matlab, compared with LEACH, PEGASIS algorithms.

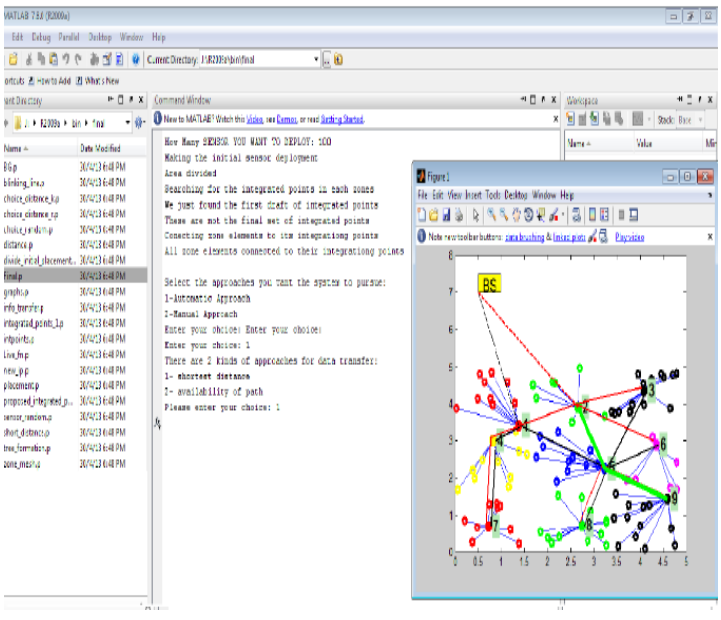

Figure 7: Sample Screen Short

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Simulation Results:

	THE NUMBER OF 100 NODES	THE NUMBER OF NODES 200
	ROUND WHEN, THE FIRST DEAD NODE.	
LEACH	358	254
PEGASIS	680	400
BIHP	738	495

Table 1 Round Comparison table, (the first dead node)

According to the figure 6, we notice that the stable time of new proposed protocol is large as compared to that of LEACH and PEGASIS. Since stable time is important metric for many application such as fire detection or heat detection. We also run simulation for our proposed protocol to compute the round of the first node dies, as shown in Table 1, and obviously we can remark that BIHP is more efficient protocol than leach and PEGASIS. BIHP holds the long period of stability time than LEACH and PEGASIS Fig 9, shows the network lifetime graph of the Sensor Network in the Working period. After a node drains its energy it dies, and can't communicate any more.

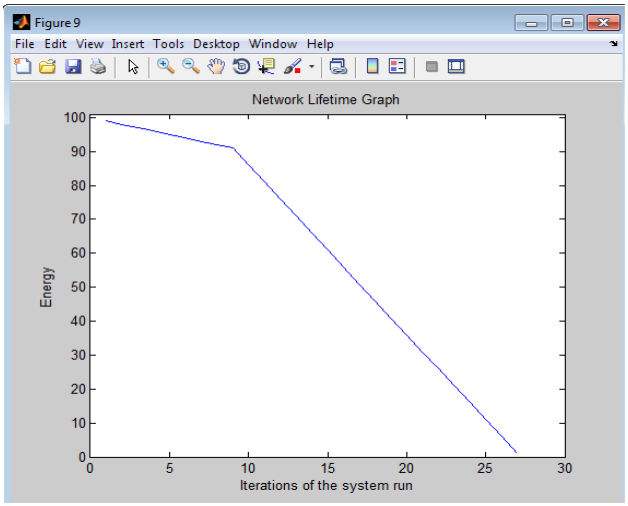

Figure 9: Sample Screen Shots

7. CONCLUSIONS AND FUTURE WORK

In this paper, we review the novel bio inspired technique BFO and Hybrid routing protocol to solve the problem, combine was attempted which improve the energy efficiency of the network up to 35% when compare to LEACH and 19% higher as with PEGASIS protocol.

In our future, we work on other species of bacteria to improve the results and the new hybrid BFO algorithms to solve the cluster head and leader selection problem also we focus on the network security issue in WSNs.

REFERENCES

[1] **Eiko Yoneki, jeqan Bacon "A survey of Wireless Sensor Network technologies: research trends and middleware's role," Cambridge computer lab. September 2005, United Kingdom.**

[2] **Li Qing, Qingxin Zhu, Mingwen Wang "Design of a distributed energy efficient clustering algorithms for heterogenous wireless Sensor networks," University of Electronic Science and Technology of china Chengdu 610054, Volume 29, Issue 12, 4 August 2006, Pages 2230–2237.**

[3] **Y. Liu and K. M Passino "Biominicry of Social foraging Bacteria for Distributed optimization Models principles and Emergent Behaviors," Springer, 2002 (Cited 159).**

[4] **Qiao Li Ling "A low Energy Intelligent Clustering Protocol for Wireless Sensor Network," Industrial Technology (ICIT), IEEE International Conference on 14-17 march 2010.**

[5] **Sotirios P. Chatzis, Spyros Kouteas "Numerical optimization using synergetic swarms of foraging bacterial population", Imperial College London, United Kingdom.**

[6] **I.F. Akyildiz et al, "Wireless sensor networks: a survey", computer Networks 38 (2002) pp 393-422**

[7] **A. A Abbasi and M. Younis, "A survey on clustering algorithms for wireless sensor networks" computer Communication 30, 2007 PP 2826-2841.**