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A Survey on Hybrid DE/BBO Approach for Pegasis Protocol

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Abstract: WSN is being widely used because of its features like low cost, distributed nature etc. As WSN contains sensor nodes that are of small size and contains small sized battery that becomes low during the process of transmission and receiving of data thus to increased lifetime of battery routing protocols are developed that transmit data by opting the smallest path for data transmission thus saving the energy and increasing the lifetime. One such routing protocol is PEGASIS that uses the concept of chain formation while processing the data. A large amount of energy is lost while forming chain. DE/BBO is one of the techniques described in paper that uses exploration and exploitation process to form chain thus improve the lifetime of battery and thus increasing its efficiency.

Keywords: *WSN, BBO, migration.*

1. INTRODUCTION

Wireless Sensor Networks have the characteristics of low energy consumption, low cost, distributed nature and self-organizing that have brought a revolution in the field of information transformation [1]. The WSN is compose of hundreds or thousands of sensor nodes distributed over an area that can sense the condition of surrounding environment such as humidity, temperature etc to provide as day to day information. Each sensor nodes sense and collects data and send to nearby base station (BS). The main advantage of WSN is that it can be applied in any field and at any conditions. Some of the examples include military applications to detect hostile environment, in environment monitoring by detecting the climatic conditions for flood, droughts etc, to detect forest fires for earlier prevention from becoming disaster. The sensor nodes which are involved in these applications are of small size and self-organizing and communicate using wireless interface. Each node contains a power controller and an antenna that adjust according to area of coverage with its wireless transmission. Typically, these sensor nodes are involve in collecting audio, seismic, and other types of data and hence collaborates to perform the analysis of data. The main problem lies in battery consumption as these are of very small size and consists of small sized battery. A large amount of energy is lost during the process of receiving and transmitting of data to base station and hence nodes are died soon where as if the sensor nodes are transmitting data through multiple hops, nodes that are near to base station will die thus making some area completely unused and causing the partition of networks. Thus it is necessary to minimize the energy consumption, by transferring data through path that uses low energy and hence minimizes the total transmission power thus enhancing networks lifetime [2].

2. ARCHITECTURE OF WIRELESS SENSOR NETWORK

After the initial step, the sensor nodes are responsible for self-organizing and forming an appropriate network infrastructure with multi hops connections between sensor nodes. After this the sensor nodes starts gathering data in form of seismic, infrared etc. about the surrounding environment, using either continuous or event-driven working nodes. It often provides location information using global positioning system (GPS) or some of the location based algorithm. All the information is gathered and is analyzed by forming global view of the monitoring objects [2]. The WSN are deployed over wide area and thus uses large number of nodes. If the nodes lost all the energy, it is wasted. We do not consider it to recharge and reuse sensor node and hence because of this reason the cost of node for practical uses are high deployed in harsh and complicated environment, the sensor nodes are difficult to recharge once their energy is consumed. The nodes even have limited

communication capacity and computing power. So how to optimize the communication path, improve energy-efficiency as well as load balance and increase the network lifetime has become an important consideration while designing of routing protocols of WSN. Hierarchical based routing protocols are widely used for their high energy-efficiency and good expandability. The main idea of them is to choose some nodes in charge of certain routing region. These selected nodes have greater performance as compared to other nodes which leads to the incompletely equal relationships between sensor nodes.

3. ROUTING TECHNIQUIE IN WIRELESS SENSOR NETWORK

WSN consist of small size nodes with sensing, computation and wireless communication capabilities. Many of the routing protocols are there for routing information, power management, and for data transmission have been designed by keeping the energy factor as important issue [3]. Routing protocol can be developed based on application and network architecture overall the routing techniques are classified into three categories based on network structure as flat, hierarchical, location-based, negotiation based, QoS based and coherent based depending on protocol operation. In flat network all nodes performs the same function, which hierarchical protocols form the cluster of nodes in order to select cluster head, to save energy by performing aggregation and reduction of data. Location based protocols utilizes location information to transfer data to the target region rather than whole network. LEACH (Low- Energy Adaptive Cluster Hierarchy) and PEGASIS (Power-Efficient Gathering in Sensor Information System) are the typical hierarchical-based routing protocols. Over the enhancement of LEACH, PEGASIS is a chain based routing protocol. It saves significant energy compared with the LEACH protocol by improving the cluster configuration and the delivery method of sensor data.

4. PEGASIS

The PEGASIS algorithm is based on the LEACH algorithm [3]. The main concept in PEGASIS is to form chain among all the sensor nodes so that each node can receive form and transmit to the closest neighbor. Gathered data moves from node to node, get fused and a designated node transmit data to base station. A node takes turns transmitting to the base station so that the average energy spent by each node per round is reduced. The method of building chain with greedy algorithm performs quite well. So, PEGASIS algorithm has some advantages as follows:

1) Each node's only communicate with its neighbor node and data fusion takes place.
2) The distances of the connected nodes with each other have been shortest.
3) Nodes take turn to be the cluster head so it takes no energy.

5. BIOGEORAPHY-BASED OPTIMIZING ALGORITHM

BBO was introduced by Dan Simon in 2008. The concept arises from Biogeography (Island biogeography) where a particular area is considered to find the richness or availability of species based on the environment factors like temperature, humidity, rainfall etc. The field was first practically observed by ecologist R. MacArthur and E. Wilson in year 1960 who coined this as a term Island Biogeography. The theory considered an 'island' i.e. an area consisting of suitable and unsuitable habitat. Migration and Mutation are the two important factors that affect the availability of species. Migration can be defined as movement of species in order to find the suitable living conditions for them [4] [5]. It is of two types: Immigration can be defined as movement of species to an area i.e. whereas emigration refers to movement of species into an area. Both immigration and emigration is affected by distance of nearest island neighbor, size of island, habitat Suitability Index (HIS). Higher the HIS larger the number of species found in that area and vice-versa.

The BBO considered a large area of candidates. Solution is generated for each candidate having it's HIS value. Each solution that will be generated will be called as Habitat which is a collection of Suitability Index Variable (SIV) [6] that demonstrates the suitability of habitat to an area which it belongs. The relation between species count, immigration, and emigration is shown in figure 5.1. Another important factor called Mutation can be defined as sudden change to HIS due to uncertain events.

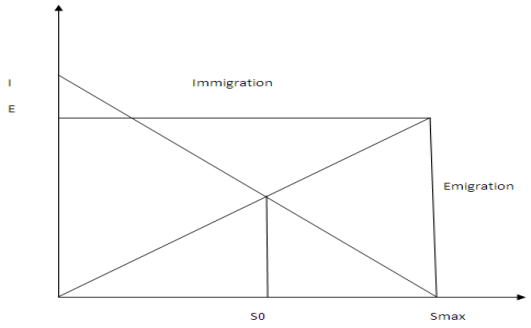

Figure 5.1 Relation between all factors that affect living condition of species.

Diversity increases due to mutation the relationship can be shown in equation 1.

$$M(s) = Mmax(1 - Ps)/Pmax \ldots\ldots\ldots\ldots \quad (1)$$

Where M(s) is the user defined parameter, Ps is the species count of habitat, P_{max} is the maximum species count of habitat. The different variations of BBO are: elitism, duplicate replacement and blending. BBO has also been hybridized with several other EAs, including particle swarm optimization, differential evolution, evolution strategy, opposition-based computing, case-based reasoning, artificial bee colony algorithm, bacterial foraging optimization, harmony search and the simplex algorithm.

6. DE/BBO APPROACH

DE algorithm is used for exploring the search space and locating the region of global minimum whereas BBO is good at exploitation for global optimization. Therefore, to use both techniques we have use hybrid DE/BBO approach which combines the exploration and exploitation process [7].

A. Hybrid Migration Operation

The main technique of DE/BBO is the hybrid migration operator figure6.1.1, which combines DE operator with the migration operator of DE/BBO [10].The offspring U_i consist of three components: DE mutant, migration solutions and corresponding parent's X_i. F is the mutation scaling factor, NP is size of parent population, and CR is the probability of crossover function.

ALGORITHM 1 FOR MIGRATION OPERATION

1: **for** i = 1 to NP **do**
2: Select uniform randomly r1!= r2, != r3!= i
3: jrand = rndint(1,D)
4: **for** j = 1 to D **do**
5: **if** rndreal(0, 1) < _i **then**
6: **if** rndrealj [0, 1) > CR or j == jrand **then**
7: Ui(j) = Xr1 (j) + F × _Xr2 (j) − Xr3 (j)_ {The original mutation operator of DE.}
8: **else**
9: Select Xk with probability ∝ μk
10: Ui(j) = Xk(j)
11: **end if**
12: **else**
13: Ui(j) = Xi(j)
14: **end if**
15: **end for**
16: **end for**

Figure 6.1.1 Hybrid DE/BBO approach

B. Experimental Setup

Population Size	100
Upper and Lower limit	(0, 1)
Integration Factor	1
Immigration and Emigration Factor	1
Crossover Rate	0.9
Number of Nodes	100
Data	2000
E_0	0.5
E_{fs}	50 X 10^(-9)
E_{mp}	50 X 10^(-9)

The following algorithm 2 has been used to improve the PEGASIS protocol during chain formation with the defined parameters as illustrated above.

PEGASIS ALGORITHM 2

Step 1: Initialize all the WSN parameters
Step 2: Deploy number of nodes
Step 3: Implement PEGASIS protocol
Step 4: Initialize DE/BBO parameters for routing
Step 5: Define migration factors
Step 6: Routing updates with each rounds
Step 7: Checking life time and data consumption

Figure 6.1.2 PEGASIS implementation with DE/BBO

7. RESULT OF EXPERIMRNT

The following figure will describe the changes obtained in the graph with the new technique of chain formation.

A. Residual Energy Graph

The amount of energy left after the receiving and transmission of data as shown in figure 7.1.1 and figure 7.1.2. The difference in energy can be seen as one following down earlier whiles other staying for long time**.**

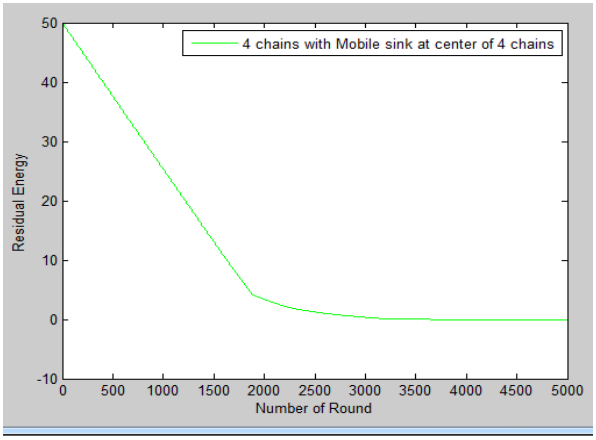

Figure 7.1.1 Old residual energy

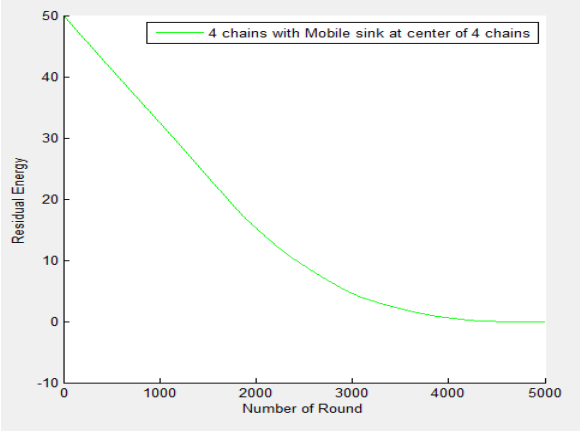

Figure 7.1.2 New residual energy

B. Graphs For The Alive Nodes

The figure 7.1.3 and figure 7.1.4 shows the graph for the number of the alive nodes after the process of 5000 rounds.

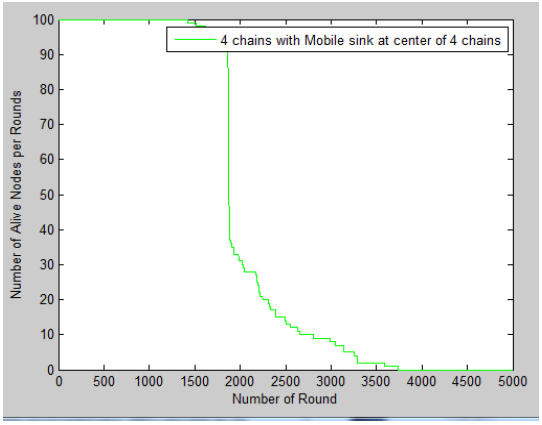

Figure 7.1.3 Number of Alive node in old process

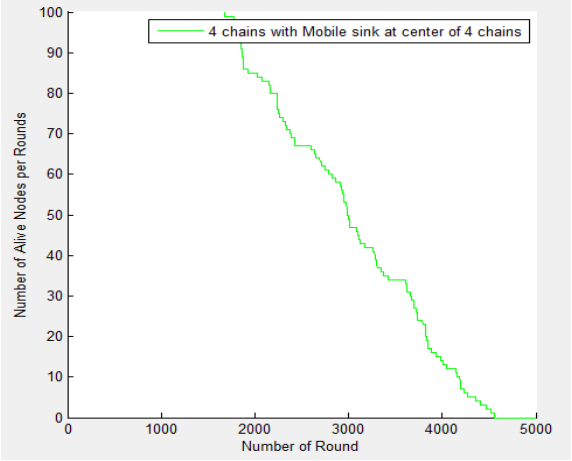

Figure 7.1.4 Number of alive nodes in new process

8. Conclussion And Future Work

Although PEGASIS has been developed become an improvement over LEACH protocol. A large amount of energy is consumed while chain formation. Therefore, to improve its efficiency a large amount of energy has to be saved while chain formation therefore we have used the DE/BBO approach that works on migration factor while selecting the shortest path for the chain selection. Further improvement can be done by layering the nodes and again searching the best possible nodes from previous region thus utilizing the already used nodes and saving the energy for long time.

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