A Bee-Hive Optimization Approach to Improve the Network Lifetime in Wireless Sensor Networks

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***Abstract* - In Wireless Sensor Networks (WSN), maximizing the lifetime is a challenging problem. The main task of a network is to receive information from node and transmit to base station for processing. If all nodes forward data packets directly to base station, they will drain their energy quickly. So, routing has to be performed to forward packets from source to destination. This paper proposes Bee Hive Optimization (BHO) approach for increasing the lifetime of WSN. BHO is an algorithm which is used to find the optimized path and thereby improve the efficiency of the network. BHO generates new path by taking energy as the fitness value to analyze different paths and select best optimized path whose energy consumption is very low compared to other paths. The result obtained by performing this operation in BHO is better than compared to other algorithms like ACO and PSO. It creates a better impact in performance in WSN.**

***Index Terms* – Optimization, Wireless Sensor Networks, Energy Consumption, Bee Hive, Routing.**

1. INTRODUCTION

A Wireless Sensor Network (WSN) is created by densely deployed sensor nodes which are powered by batteries. The nodes collect information from the environment and forward the data to base station. Since it is formed by small and inexpensive devices, network deployment becomes easier and cheap. Communication in a wireless environment is achieved through a number of available wireless communication standards like Zigbee or IEEE 802.15.4 standard. But the nodes have limited transmission range, battery power and network size [1]. Wireless Sensor Networks are used for a wide variety of applications such as process automation, surveillance, fire detection, vehicle traffic management and disaster recognition. The routing process [2] in WSN may differ from other normal routing methods because it contains no link to follow and no definite structure, resulting in node failure or energy drain. In mobile sensor networks, it is essential to manage the mobility of the nodes in order to improve the performance of the network. Node Localization [10] is a complex problem in today's mobile computing environment. There is a need to develop algorithms capable of addressing this complexity and used to solve a wide range of location management scenarios. It is a challenge for the traditional centralized, hierarchical or grid architecture to handle the large-scale and active resources.

Several optimization algorithms have been proposed to reduce energy consumption, often referred to as Ant Colony Optimization approach [3, 11] by maximizing the number of connected covers which follows the behaviour of ants. It transforms the search space problem into a structure graph. Each point in the graph represents an task in the subset. Heuristic information is associated to each assignment for measuring its utility in reducing constraint. In each iteration, the number of subsets is determined as incrementing one by the number of connected covers in the best solution. The ants focus on finding one more connected cover and avoid constructing subsets excessively. A local search procedure is designed to refine the solutions by reassigning redundant devices.

Another optimization technique used is Particle Swarm Optimization Approach [4] which aims at optimization by iteratively trying to develop a candidate solution with respect to quality which follows the behavior of birds. The best path should be chosen by taking fitness value based on the minimum distance travelled by the node. This paper proposes an algorithm called Bee Hive Optimization which overcomes problems like energy resources, robustness, packet delay, and data transmission cost and processing capabilities.

2. RELATED WORK

Several optimization techniques have been proposed to increase the life of WSN. This section reviews the related work in the past literature.

In ACO-based approach [3], the lifetime of heterogeneous WSNs can be increased by finding the more number of disjoint connected covers that will satisfy both sensing coverage and connectivity of the network. A construction graph should be designed with each vertex which will denote the assignment of a device in a subset of nodes. The ants will find an optimal path on the construction graph to maximize the number of connected covers based on the information of pheromone and heuristic information. The pheromone serves as a metaphor for the search experience in building connected covers.

In the wireless sensor networks analysis [5], performance of the network is analyzed using artificial neural network. Particle swarm optimization is used as learning algorithm for finding the optimized path and to make the energy of the network more efficient.

Snehal *et al*. proposed a particle swarm optimization based routing (PSOR) [4] algorithm which is mainly designed to increase the life span of WSNs. The algorithm considers the energy levels of the nodes and the lengths of the routed paths. The networks of different sizes are considered and it maintains the life time of network at a maximum by discovering the shortest paths from the source nodes to the base node using a particle swarm based optimization technique called PSO.

Joon-Woo Lee *et al*. proposes a TPACO algorithm [6] which uses three pheromones to produce the solution efficiently and it increases the energy of sensor nodes. One pheromone is local which makes the ant to organize the coverage set with fewer sensors. The remaining are global pheromones, one will optimize the number of sensors per POI and other form sensor set that ant can select the number of active sensors which increases the lifetime of networks.

Zhao *et al.* proposed a greedy algorithm [7] which addresses both sensing coverage and network connectivity, but the algorithm handles only the coverage of discrete points. It is difficult to extend the algorithm to heterogeneous WSNs.

3. BEE HIVE OPTIMIZATION ALGORITHM APPROACH

Bee Hive algorithm [8], proposed by Karaboga in 2005 is a recently introduced optimization algorithm which simulates the foraging behaviour of bee colony for unconstrained optimization problems. The ABC algorithm is developed by inspecting the behaviours of the real bees on finding food source, which is called the nectar, and it will share the information of food sources to the bees in the nest.

3.1 Working Of Bees

The procedure is based on the idea of the colony of bees and how they search and forage for food. Bees are capable to expand themselves over a large area and collect information about the food sources. The idea is that the areas with less effort needed to get to the food source will have more visits than the opposite and it is done by using scout bees. The scout bees go and search for food in random form. When the scout bees return to hive, it finds the quality of food and it communicates the location of food through Waggle Dance [9]. The bee which is performing dance well and fast means that the food location is nearer to hive. All the bees in the hive will watch the dance of scout bee and those gains the information will be called as “onlookers”. Then the colony goes forward with the scout bee and onlookers in the middle and it will direct towards the food source.

3.2 Design Of Bee Hive Algorithm

The implementation of Bee Hive algorithm consists of following steps:

1. Initialise the population in random fashion.

2. Calculate the fitness value for the population.

3. Select the food locations for neighbourhood search through scout bees.

4. Find the fitness value of scout bees. If the fitness value is not satisfied, food source will be abandoned and employed bee will be allocated as scout bees for finding new food source.

5. Otherwise select the employed bees for selected food location to collect food along with the scout bee.

6. Keep the food locations received by bees.

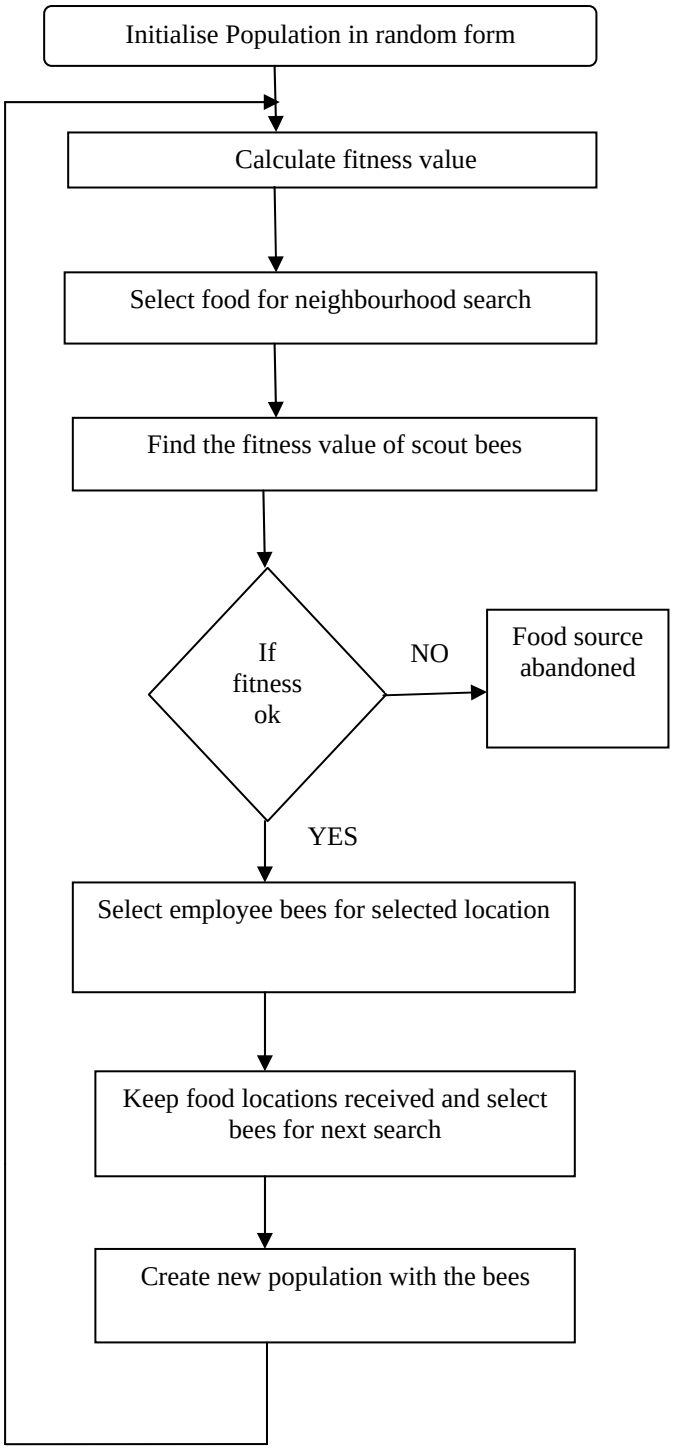
7. Repeat steps 3-6 until stopping condition occurs.

The algorithm starts with scout bees placed randomly in space. The fitness of the places visited by scout bees has been calculated and the bee which has the highest fitness value will be selected and it will be chosen for

neighbourhood search. It performs search in neighbour of selected place and make other bees to move to that location. The bees can also directly choose the place based on the fitness value associated with the places visited by scout bees.

3.3 Flowchart

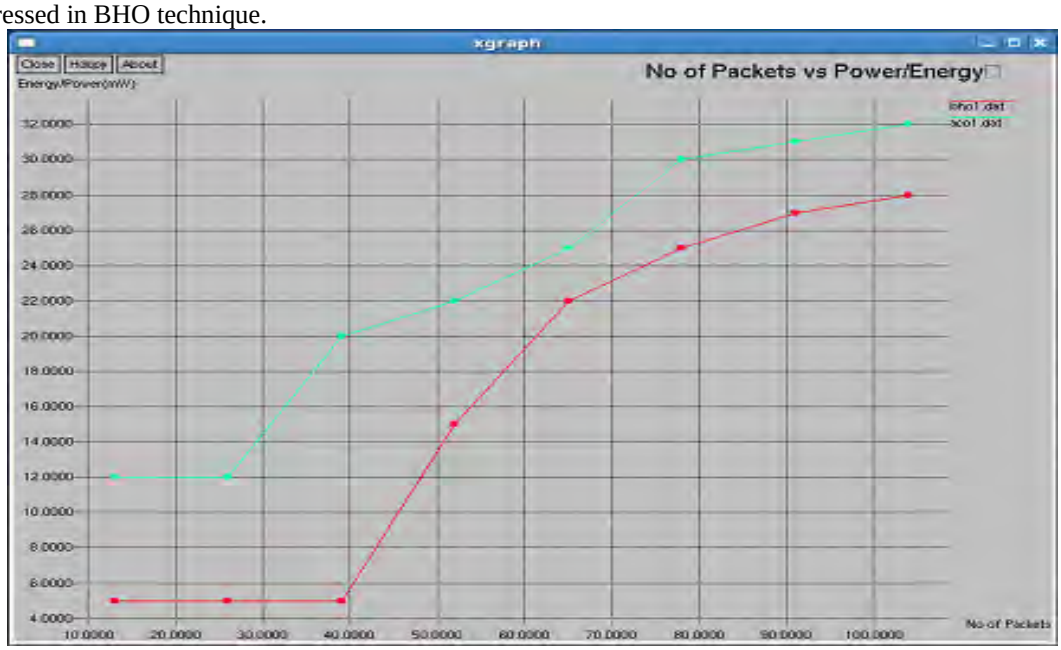
The diagrammatic representation of Bee Hive Algorithm is as follows:



4. IMPLEMENTATION DETAILS AND PERFORMANCE EVALUATION

The mentioned Bee Hive Optimization approach has been simulated using NS2 simulator where the sensor nodes are densely deployed in wireless sensor network and the program is written in OTcl.

For this technique, 16 nodes are considered and it is scattered randomly on 700 x 500 grid. The performance of the network is analysed using parameters such as energy, power, and packet updating time. When the packets are transferred in a network using sensor node, it is identified that the energy consumption is very low in BHO than compared to ACO algorithm. During data transmission, the packet loss is very low and updated time is faster. The algorithm produces better results and the main issue in ACO i.e. energy consumption is addressed in BHO technique.



5. CONCLUSION AND FUTURE WORK

This paper presents a Bee Hive Optimization algorithm to increase the lifetime of wireless sensor network performs better than other algorithms like ACO and PSO. The proposed method produces a diverse search of solution and better optimal solution with low computation complexity. The advantage is that, it provides a clear mechanism of decision making to the specified problem and it can be applied to different areas such as web search, mobile computing, hierarchical optimization and neural networks. The research can be improved by formulating hybrid algorithms consisting BHO aiming at better results. The future of the work targets at imparting security to the network scenario thereby preventing the issues of compromised nodes that may lead to attacks such as DoS, fake or compromised data, flooding etc thereby improving the efficiency even more.

6. REFERENCES

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