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A Review of Leach Hierarichal Protocol

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ABSTRACT

LEACH protocol is normally used for low energy adaptive protocol which saves energy in terms of the transmission of the data. Leach protocol has its own advantages and disadvantages like it does not care about the delivery of the data. This paper describes the ethical leach protocol and the ways of the optimization of the leach protocol through different optimization protocols like ACO,BCO, and GA.The algorithm which has to be choosen for the optimization depends upon the type of situation where the LEACH model falls. This paper discusses the advantages of using different optimization protocols for the enhancement of the LEACH PROTOCOL. The time factor has also been considered in this paper. This paper overall focuses on LEACH enhancement in terms of energy and time and throughput of the data.

I. INTRODUCTION

Wireless Sensor Network (WSN) is a class of wireless ad- hoc networks which consists of spatially distributed autonomous sensor nodes to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. at different locations. Energy consumption is the core issue in wireless sensor networks because nodes are battery operated. It is desirable to make these nodes as cheap and energy-efficient as possible and rely on their large numbers to obtain high quality results. Consequently many protocols have been proposed in order to minimize the energy consumption of these nodes. By analyzing the advantages and disadvantages of conventional routing protocols, LEACH (Low- Energy Adaptive Clustering Hierarchy) Protocol was developed [2, 5], a clustering based protocol that minimizes energy dissipation in sensor networks. However, LEACH outperforms classical clustering algorithms by using adaptive clusters and rotating cluster-heads, allowing the energy requirements of the system to be distributed among all the sensors. Instead, when the cluster-head die, the cluster will become useless because the data gathered by cluster nodes will never reach the base station. So, there is a requirement to improve LEACH protocol to enhance the performance. In this paper we propose an Improved Leach Protocol that further enhances the Power consumption, simulation results bring out that our protocol outperforms Leach protocol in terms of energy consumption and increases the total lifetime of the WSN.

II. LEACH PROTOCOL

Low Energy Adaptive Clustering Hierarchy (LEACH) proposed by Wendi B. Heinzelman, et al. is the first hierarchical, self-organizing, adaptive cluster-based routing protocol for wireless sensor networks which partitions the nodes into clusters, in each cluster a dedicated node with extra privileges called Cluster Head (CH) is responsible for creating and manipulating a TDMA (Time division multiple access) schedule and sending aggregated data from nodes to the BS where these data is needed using CDMA (Code division multiple access). Remaining nodes are cluster members.

LEACH outperforms static clustering algorithms by requiring nodes to volunteer to be high-energy cluster-heads and adapting the corresponding clusters based on the nodes that choose to be cluster-heads at a given time. At different times, each node has the burden of acquiring data from the nodes in the cluster, fusing the data to obtain an aggregate signal, and transmitting this aggregate signal to the base station. LEACH is completely distributed, requiring no control information from the base station, and the nodes do not require knowledge of the global network in order for LEACH to operate. Distributing the energy among the nodes in the network is effective in reducing energy dissipation from a global perspective and enhancing system lifetime.

III. BACKGROUND

Low Energy Adaptive Clustering Hierarchy (LEACH): Low Energy Adaptive Clustering Hierarchy (LEACH) cluster-based routing protocol for a wireless sensor network which divides the network into small areas called clusters. In each cluster, a dedicated node called a Cluster Header (CH) is selected. The CH has the responsibility for creating and manipulating a TDMA (Time division multiple access) schedule. The CHs also has the responsibility to aggregate and send the data collected from other nodes of the cluster (member nodes) to the base station. The LEACH protocol is divided into rounds and each round consists of two phases: the set-up and steady phases.

Setup phase: Each node decides independently if it will become a CH or not. This election probability is based on the last time a node has been elected as a CH. The node that hasn't been a CH for long time is more likely to elect itself than other nodes that have been CHs recently.

In the setup phase, each CH inform their neighbor nodes with an advertisement message that it has become CH. Non-CH nodes choose the advertisement message with the strongest received signal strength. The member nodes then inform to the chosen CH that they have become a member of that cluster using a "join message" which contains their identifications. After this phase, the each CH knows the number of member nodes and their identifications. Based on the number of member nodes of the cluster, the each CH creates a TDMA schedule and broadcasts it to its cluster members.

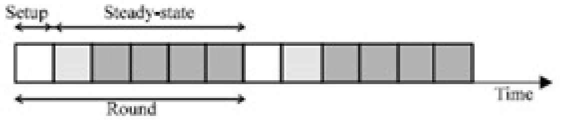

Fig. 1: LEACH Protocol Phases

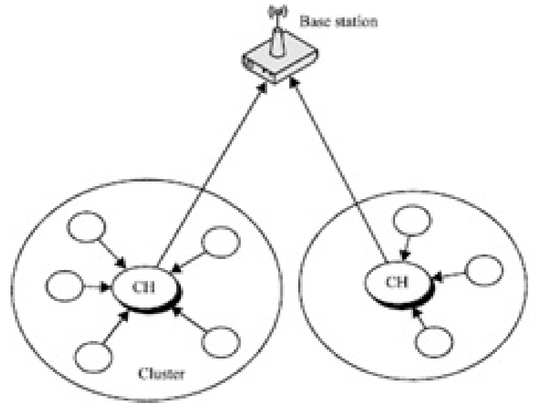

Fig. 2: LEACH Protocol Clustering

LEACH – Low Energy Adaptive Clustering Hierarchy

LEACH is a cluster-based protocol, which includes distributed cluster formation. LEACH randomly selects a few sensor nodes as cluster-heads and rotates this role to evenly distribute the energy load among the sensors in the network. In LEACH, the cluster-heads compress data arriving from nodes that belong to the respective cluster, and send an aggregated packet to the BS in order to reduce the amount of information that must be transmitted to the BS.

IV. COMPARATIVE STUDY

A lot of research work has been done in the contrast of LEACH protocol optimization. M Shankar proposed a high performance Leach Protocol on the basis of adaptive clustering in which clusters are chosen on a random basis whereas Pragati proposed a tora protocol which enhances the energy on the basis of adhoc network. Nguyen proposed their work on the basis of the geometric distance approach. The distance approach coding enhances the protocol structure on the basis of clustered index of the cluster heads. Alisha Gupta has added terms in Leach and homomorphic encryption has been added by her and she has also used heterogeneous encryption term. According to her,heterogeneous structure enhances the capability of the system if the data is encrypted and it is not sent directly.

V. OPTIMIZATION TECHNIQUES

A. Bee Colony Optimization

BCO is the SI system where the low level agent to the system is the bee. BCO is the name given to the collective food foraging behavior of honey bee. The bee system is a standard example of organized team work, well coordinated interaction, coordination, labour division, simultaneous task performance, specialized individuals, and well-knit communication. In a typical bee colony there are different types of bees. There is a queen bee, many male drone bees and thousands of worker bees.

Types of bees:

1. The Queen's responsibility is of laying eggs so that new colonies can be formed.
2. The Drones are males of the hive and are responsible to mate with the Queen. This is their sole role in the hive. They are discarded from the colony during their down fall.
3. The worker bees are the females of the hive. They are the main building blocks of the hive. They build the honey bee comb, clean it, maintain it, guard it, feed the queen and drones. Apart these side responsibilities the main job of a worker bee is to search and collect rich food. There are two types of worker bees namely scout bees and forager bees. Both of them are collectively responsible for the collection of food but they play different roles.

What does Scout do?

1. The Scout bees fly around and search for food sources available randomly.
2. They return back to the hive after they exhaust their energy and distance limits.
3. Upon returning to the hive they share their exploration experience and a lot of important information with the forager bees.
4. The scouts tell the foragers about the location of rich food sources which comprises of the direction (angle) of the food source from the hive w.r.t. sun and distance from hive. This is done using a dance called "waggle dance" which is in the figure of digit "8". It also indicates the quality of food.

What does Forager do?

1. The forager bees closely observe the scout bee in order to learn the directions and information given by scout. It then goes to collect food.

Following is the flowchart which gives the basic structure of the working of the bee colony system.

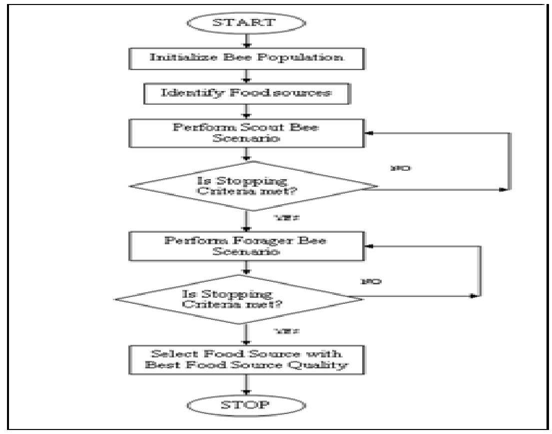

Figure 2.Flowchart for Basic BCO Steps.

Artificial Bee Colony (ABC) was introduced by Karabora in 2005. It was developed to solve real parameter optimization problem. In ABC the BCO's foraging behavior is simulated.

The ABC differs from a real BCO since in ABC we use only scouts and foragers in equal proportion as initial population. The main steps of ABC are:

2. Initialization of food sources.
3. Scouts perform exploration of available food sources randomly until stopping criteria is met.
4. Each Forager exploits the respective scout's food sources until stopping criteria is met.
5. Forager chooses the best food source as per quality.

B. Ant Colony Optimization

ACO [1, 24] is a class of algorithms, whose first member, called Ant System, wasinitially proposed by Colorni, Dorigo and Maniezzo. The main underlying idea, loosely inspired by the behavior of real ants, is that of a parallel search over several constructive computational threads based on local problem data and on a dynamic memory structure containing information on the quality of previously obtained result. The collective behavior emerging from the interaction of the different search threads has proved effective in solving combinatorial optimization (CO) problems. Following, we use the following notation. A combinatorial optimization problem is a problem defined over a set **C** = c1, ..., cn of basic components. A subset **S** of components represents a solution of the problem; **F** ⊆2**C** is the subset offeasible solutions, thus a solution **S** is feasible if and only if **S** ∈**F**. A cost functionz is defined over the solution domain, z: 2**C** □ **R**, the objective being to find a minimum cost feasible solution S*, i.e., to find S*: S* ∈**F** and z(S*) ≤ z(**S**),∀**S**∈**F**.Given this, the functioning of an ACO algorithm can be summarized as follows (see also [27]). A set of computational concurrent and asynchronous agents (a colony of ants) moves through states of the problem corresponding to partial solutions of the problem to solve. They move by applying a stochastic local decision policy based on two parameters, called trails and attractiveness. By moving, each ant incrementally constructs a solution to the problem. When an ant completes asolution, or during the construction phase, the ant evaluates the solution and modifies the trail value on the components used in its solution. This pheromone informationwill direct the search of the future ants.

Furthermore, an ACO algorithm includes two more mechanisms: trail evaporationand, optionally, daemon actions. Trail evaporation decreases all trail values over time, in order to avoid unlimited accumulation of trails over some component.Daemon actions can be used to implement centralized actions which cannotbe performed by single ants, such as the invocation of a local optimization procedure, or the update of global information to be used to decide whether to bias thesearch process from a non-local perspective.

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More specifically, an ant is a simple computational agent, which iteratively constructs a solution for the instance to solve. Partial problem solutions are seen as states. At the core of the ACO algorithm lies a loop, where at each iteration, each ant moves (performs a step) from a state ι to another one ψ, corresponding to a more complete partial solution. That is, at each step σ, each ant k computes a set **A**kσ(ι) of feasible expansions to its current state, and moves to one of these in probability. The probability distribution is specified as follows. For ant k, the probability pιψk of moving from state ι to state ψ depends on the combination of two values:

- The attractiveness ηιψ of the move, as computed by some heuristic indicating the a priori desirability of that move;
- The trail level τιψ of the move, indicating how proficient it has been in the past to make that particular move: it represents therefore an a posteriori indication of the desirability of that move.

Trails are updated usually when all ants have completed their solution, increasing or decreasing the level of trails corresponding to moves that were part of"good" or "bad" solutions, respectively.The general framework just presented has been specified in different ways by the authors working on the ACO approach.

C. Particle Swarm Optimization [PSO]

PSO is originally attributed to Kennedy, Eberhart and Shi [1] and was first intended for simulating social behavior, as a stylized representation of the movement of organisms in a bird flock or fish school. The algorithm was simplified and it was observed to be performing optimization. The book by Kennedy and Eberhart describes many philosophical aspects of PSO and swarm intelligence. An extensive survey of PSO applications is made by Poli. In computer science, particle swarm optimization (PSO) [6] is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. PSO optimizes a problem by having a population of candidate solutions, here dubbed particles, and moving these particles around in the search-space according to simple mathematical formulae over the particle's position and velocity. Each particle's movement is influenced by its local best known position and is also guided toward the best known positions in the search-space, which are updated as better positions are found by other particles. This is expected to move the swarm toward the best solutions.

Main Objective

The PSO [6] algorithm is an evolutionary computing technique, modeled after the social behavior of a flock of birds. In the context of PSO, a swarm refers to a number of potential solutions to the optimization problem, where each potential solution is referred to as a particle. The aim of the PSO is to find the particle position that results in the best evaluation of a given fitness function. In the initialization process of PSO, each particle is given initial parameters randomly and is „flown" through the multi-dimensional search space. During each generation, each particle uses the information about its previous best individual position and global best position to maximize the probability of moving towards a better solution space that will result in a better fitness.

VI. CONCLUSION:

LEACH protocol is normally used for low energy adaptive protocol which saves energy in terms of the transmission of the data. The above paper concludes that the Leach protocol is one the effective protocols for energy minimization and it has a lot of optimization points which can be optimized using different optimization protocols like Genetic algorithm and others.

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