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Clustering of Wireless Network Using Artificial Bee Colony

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ABSTRACT - ***Wireless network is the most important and rapidly growing communication medium in the 21st century. Hence, the wireless network attracts the researcher in the networking field of domain for the past few decades. Virtualization of Network becomes an important issue in the networking field of domain, which extended for other networking field such as utility computing, grid computing and cloud computing. The virtual networking capability provides the feasibility of running multiple architectures. There are many research issues in the virtual mobile networking such as optimal routing, providing reliable MAC, effective congestion management, efficient transport control, energy efficient clustering. This proposed research work focus the energy efficient clustering using swarm intelligence technique. The proposed work applies Artificial Bee Colony (ABC) which has been a recently developed swarm intelligence technique that proves as an optimization technique. The ABC broadly applied for many engineering applications in the literature. The proposed energy efficient clustering using ABC proved better clustering model than the existing traditional clustering techniques.***

Keywords:
Wireless Network, Clustering, Artificial Bee Colony Swarm Intelligence

1. INTRODUCTION

Using virtual network (VN) over public networks such as Internet, service providers can package and ship user data from multiple access points to the corresponding destinations in a safe and efficient way (Sharony, 1996). Various protocols have emerged to enhance the integrity of the confidential information transferred across public networks (Pattanavichaiet l, 2012). The Internet has also been proven to be cheap and effective in delivering information all over the world. The virtual network can diversify the future Internet Architecture into separate virtual networks according to different applications and requirement (Lee et al, 2010). The importance and real time example of virtual network is explained in the following example.

Traditional mobile operators invested huge amounts of money in the 1990s to build the current 2G wireless networks. In general the wireless networks such as GSM are proven to be stable. It is ambiguous that most of the wireless network and bandwidth of the network are not yet exhausted (Qian and Wu, 2008). Furthermore, the marketing departments of mobile operators now consider the commercial possibility of selling mobile subscriptions through new channels. The concept of mobile virtual network operator (MVNO) is developed for extending the wireless network. In the list of wireless network, few of them are new operators. These are the mobile these are the mobile virtual network enablers (MVNE) (Cheboldaeff, 2010).

When a mobile router has multiple interfaces and uses each interface to connect different locations of wireless networks. Therefore, the mobile router can offer multiple virtual subnets to its mobile network nodes. In mobile network, the mobile node will select one of its mobile router's interfaces for forwarding the communications data, based on the information advertised in the access network by the mobile router.

From the above, the selection of best subnet depending on the mobile network node's applications' requirements, or decision of the internet service provider (Park et al, 2008). The mobile router will forward the traffic from the mobile network node based on its selection. In this way, mobile network nodes can communicate to the Internet as each of mobile network nodes belongs to separated network.

An empirical model is constructed based on multiple regressions (Lee and Moon, 2010). The empirical results

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can establish many business opportunities. For example, a core business strategy on customer value proposition and identifying the market basket analysis problems. The best market segment implementation is to enhance the profitability and sustainable growth in order to increase the competitiveness of the mobile company's market and business performance.

The military training programs, emergency preparedness simulations, and online games place strict requirements on network performance are collectively called Collaborative Virtual Environments (CVEs). In CVE, the participating users share the 3D virtual environment through their mobile devices in an ad hoc network.

Boukerche et al, (2010) proposed a Gnutella peer-to-peer network over mobile ad hoc networks (MANETs) to support Mobile Collaborative Virtual Environment (MCVE) applications. Both architectures share some common features such as decentralization, self-reorganization, and self-healing. However, peer-to-peer networks and MANETs operate on different network layers, and thus, cause poor performance. To address this problem, the authors defined a cross-layer approach to improve the overall performance of CVEs over MANETs. The network layer should be aware of the user's physical position in the virtual environment (VE) in order to minimize network traffic and cope with a moderate workload between nodes.

A flat mobile ad hoc network has an inherent scalability limitation in terms of achievable network capacity. It is seen that when the network size increases, per node throughput of an ad hoc network rapidly decreases (Bhagavathula et al, 2002). This is due to the fact that in large scale networks, flat structure of networks results in long hop paths which are prone to breaks. These long hop paths can be avoided by using virtual nodes concept working as mobile backbone network (MBN). There are some specific virtual power capable nodes functionally more capable than ordinary nodes (Kush et al, 2009).

Recent days, there are few new kinds of algorithms are evolved, for example, Ant Colony Optimization (ACO) Algorithm, Honey Bee Algorithms, Fire Fly Algorithm. These algorithms are called as swarm intelligence, which is a new discipline of study that contains a relatively optimal approach. The swam intelligence solve problems based on the behavioral limitations inspired from the social insects, birds and animals

In which, the ACO attracts many researchers in the past. The “ACO Algorithm” is a study derived from the observation of real ants’ behavior, and uses these models as a source of inspiration for the design of novel algorithms, which is the solution for optimization and distributed control problems. The Honey Bee Mating algorithm is the growing technique, which is proposed in late 2005, for many engineering applications (Chandramohan et al, 2011a, 2011b, 2011c, and 2011d).

2. PROPOSED ENERGY EFFICIENT ABC CLUSTERING

The design and working nature of the proposed ABC is redefined in order to provide optimality. The existing ABC has few pitfalls such as the improper number of scout bee will lead local optimal problem, slow convergence and as a result non feasible especially for computer network routing.

The bees search for food sources in a way that maximizes the ratio

$$\forall (E, H) \Leftrightarrow F(\theta_i) = \frac{E}{H} \qquad (1)$$

Where, E is the energy obtained, H is the hop count, number of Inter Mediate Peer (IMP), between hive to the food source. Here E is proportional to the nectar amount of food sources discovered by bees and it works to maximize the honey being stored inside the hive. In a maximization problem, the goal is to find the maximum of the objective function, F(θ).

F(θ) is the nectar ratio, shown in equation (1), $\theta \in R^P$. R^P represents the region of the search area.

Assume that θ_i is the position of the ith food source; $F(\theta_i)$ represents the nectar ratio of the food source located at θ_i and it is proportional to the energy $E(\theta_i)$.

If the nectar ratio, F (θ), of the food source is higher than the minimum threshold, then the scout bee initialises the waggling dance with rhythm above the food source (which is called as dance floor). This waggling dance is a visualization technique that to transfer information to the insight worker bees. If the worker bees are beyond insight, the rhythm of scout bee may reach the worker bee. Based on the visual and or audio information from the scout bee, the worker bee from one hive or more hive will reach the dance floor (food source) for collecting the nectar.

$$T(\theta_i) = \begin{cases} \alpha \bullet F(\theta_i) & F(\theta_i) > F_{th} \\ 0 & otherwise \end{cases} \qquad (2)$$

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$$R(\theta_i) = \begin{cases} \beta \bullet F(\theta_i) & F(\theta_i) > F_{th} \\ 0 & otherwise \end{cases} \quad (3)$$

Where the $T(\theta_i)$ is the duration of waggling dance, $R(\theta_i)$ is the volume of rhythm, F_{th} is the minimum threshold of the nectar value and α, β are the constant which is termed as time scale factor and volume scale factor.

$$0 < \alpha < 1 \quad (4)$$

$$0 < \beta < 1 \quad (5)$$

If the value of α and β are small, then convergence becomes fast. If the value of the same is high, more precise result will occur.

The bees search for food sources and collect the nectar (E). This process initiates the waggling dance on the floor for T time units (based on the equation 2) with an R volume of the rhythm (based on the equation 3).

If the dancing time of the bee is elapsed, then it will search the neighbouring dancing bee and goes to the dance floor of neighbouring bee to watch the dance as guest bee. Suppose more than one dancing bee found near, and then the bee chooses the one with higher rhythm (Rhythm of bee proportional to nectar). The energy level of the ad hoc nodes or sensory nodes is mapped as the rhythm of the ABC. When a guest bee enters the dancing floor, the data from this guest bee is stored in the nectar (routing) table of dancing bee. The mapping of biological terms with the networking terms for the proposed ABC clustering methology are described in table 1.

Table 1: **Mapping of Biological Terminology with Network Terminology**

Bio-logical terms	Network Routing
Bee	Hello message
Food Source (or Flower)	Node
Nectar	Energy / Power
Nectar (or Patch) Table	Routing Table
Waggling Dance	Waiting Time
Elite Site	Cluster Head
Hive	Control Station (Real /Imaginary Node)

The working principles of proposed ABC based clustering algorithm is shown in the following pseudo code.

1. PSEUDOCODE FOR PROPOSED ABC BASED CLUSTERING ALGORITHM

Procedure ABC_Clustering
Initialization
Generate the initial population of the bees
Selection of the best bee as the queen
Selection of the maximum number of mating flights (n)
Main Phase
do while i ≤ n
    Initialize queen spermatheca, energy and speed.
    Select α
    do while energy > threshold and spermatheca is not full
        Select a drone
        If the drone passes the probabilistic condition **then**
            Add sperm of the drone in the spermatheca
        endif
        Update Speed
        Update Energy
    enddo
    do j = 1, Size of Spermatheca
        Select a sperm from the spermatheca
        Generate a brood by applying a crossover operator between the queen, the selected drones and the adaptive memory
        Select, randomly, a worker
        Use the selected worker to improve the brood's fitness
        if the brood's fitness is better than the queen's fitness **then**
            Replace the queen with the brood
        else
            if the brood's fitness is better than one of the drone's fitness then
                Replace the drone with the brood
        endif
    endif
  enddo
enddo
return The Queen (Best Solution Found)
end Procedure

2. RESULTS AND DISCUSSION

The proposed work is simulated in Network Simulator 2 (NS2) and performance of proposed work is compared with existing well known protocols. The simulation environment is shown in Table 2. The

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performance in terms of latency and throughput on various numbers of nodes are recorded in Table 3 and 4.

Table 2: Simulation Environment

Parameter	Value
Number of sensors	50,100, 200, 300, 400, 500, 1000
Total Time of Simulation	10 Sec
Protocols Compared	LEACH, CGSR (Cluster-head Gateway Switch Routing)

Table 3: Latency of Data Transmission

No of Nodes	CGSR	LEACH	Proposed ABC
50	65	63	60
100	81	77	74
200	100	95	91
300	123	117	114
500	152	146	141
1000	188	179	173

Table 4: Throughput of Data Transmission

No of Nodes	CGSR	LEACH	Proposed ABC
50	165.7	170.2	171.7
100	205.2	210.9	212.8
200	202.6	208.3	210.1
300	200.1	205.6	207.5
500	197.7	203.1	204.9
1000	195.2	200.6	202.5

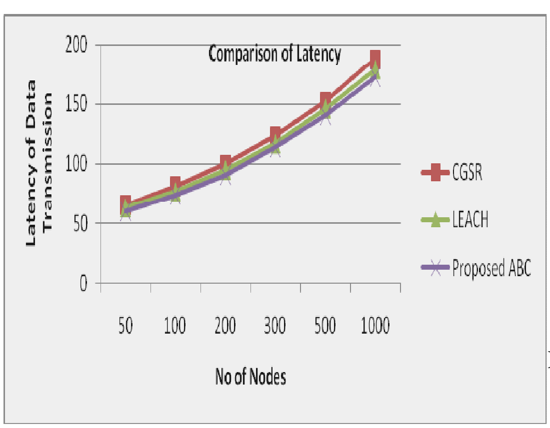

Figure 1: Comparison of Latency

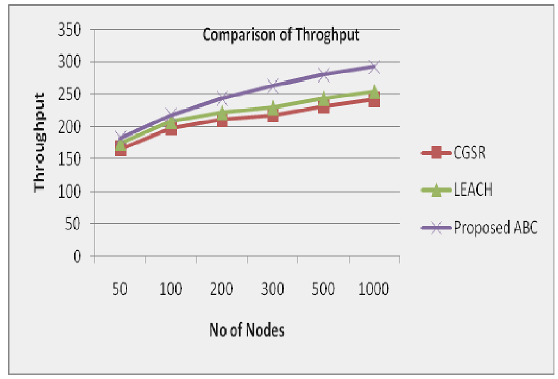

Figure 2: Comparison of Throughput

5. CONCLUSION

From the result and performance analysis, it is obvious that the Latency of proposed work is improved around 5% more than LEACH and around 8% more than CGSR. Similarly the throughput of proposed work is improved around 15% more than LEACH and around 10% more than CGSR. Hence, it is concluded that the proposed work out perms than existing methodologies.

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