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Energy Efficiency for Wireless Sensing Element Networks Operating ACO

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ABSTRACT

To collect relevant data from the field, wireless sensor networks made up of low-power nodes are used. It is essential to gather the data in WSNs in an energy-efficient way. Network routing frequently employs Ant Colony Optimization, a swarm (large no. of ants move) intelligence-based optimization technique. Minimizing energy use is regarded as a key performance criterion in sensor networks to ensure the longest possible network lifetime. For wireless sensor networks, a novel routing strategy utilizing the Ant Colony Optimization algorithm with Leach clustering is put forth. Included with the suggested strategy are illustrative examples, thorough descriptions, and the findings of performance comparison tests. The results of the simulations demonstrate that the proposed algorithm offers viable options that enable node designers to successfully carry out routing duties with the most shortest path for data transmission.

***Keywords* -** *Ant Colony Optimization, Chain-cluster based routing, Energy efficiency, Network lifetime, Wireless Sensor Networks.*

1. Introduction

Researchers have been watching the recent advancements in wireless communication technology for the past ten years. A WSN (Wireless Sensor Network) is a robust network with less the unexpected infrastructure, that is made up of a various dispersed sensing element nodes.[1] Sensors are randomly or manually placed throughout this suitable network on the physical environment. The WSNs include the many of the observing applications for the natural tragedy interference, irrigation management in agriculture environment, and the tracking applications for the military techniques that are similar from the tracing techniques or also similar to basaltic measurement.

1.1 Wireless sensor networks have some drawbacks.

- Have limited storage capacity (a few hundred kilobytes)
- Have a little processing power (8 MHz)
- Work in sporadic communication– Use a lot of power.
- Requires Little Energy - Protocols for Constraints
- Have batteries with a limited lifespan
- Passive devices give off very little energy

1.2 Area of Effective WSN

This field has enormous potential in a variety of application areas. A wireless detector network often has hundreds or even thousands of sensing nodes. [1] It's intriguing to make these nodes more affordable. This fact also inspires a simple, yet efficient algorithm and the protocol for electronic communication over the detector network, as well as for the successful operation of the network. Even though the detector nodes are supposed to be static at all times, their mobility has given rise to many more sophisticated applications, such as enhanced infrastructure observing and chasing.

Due to the increased rate of topology amendment, the efficiency of the detector nodes will make algorithms and protocols more difficult. The quality of the sensor nodes is considered, and a routing protocol has been proposed for such a mobile sensor network.[1] The base station is considered to be both powerful and static. The base station is responsible for cluster formation and head node selection. The sensor field is divided into several virtual grids throughout the clustering process. The cluster-building technique takes into account the problem of sensor node mobility.

Single-hop phenomena is used for the communication between common sensor nodes, and as a result, the cluster head node. [1] And based on this topology, the communication between the base station and the cluster head node is similarly multi-hop in nature. The protocol's performance should be as equal as possible in terms of the energy potency, time potency, etc. Many methods are used to make communication successful, however in this case we are aim to employ the Ant colony optimization (ACO) algorithms to increase the effectiveness of wireless sensor networks.[4]

2. Problem Formulation

2.1 Demand and importance

Applications based on the wireless sensor networks are constantly evolving with these applications. Because one of WSN's top priorities is energy conservation and it all depend on wireless networks. In light of these sensor networks, we suggested an energy-efficient paradigm for wireless applications and the applications are based on networks and set of ideas of sensor network of WSN. The primary consideration in the selection of networks and the various techniques put out to address accuracy and that accuracy issues is efficiency.

The creation of inexpensive, low-power, and compact sensor nodes has drawn growing interest as a result of the developments of network in low-power wireless communications, analogue, and digital electronics. Sensor nodes can perceive their immediate all surroundings, carry out the basic calculations, and communication of sensors with one another. Combining of these tiny sensors in the huge numbers creates and these creates a new technology platform that known as Wireless Sensor Networks,[2] there is something that might prevent it from happening or being true their finite capacity.

2.2 Research Methodology

Algorithms that used in it come in a variety of forms and offer a variety of methods for addressing the urgent problems of network power usage and network communication. The core of the Ant Colony Optimization is a great intelligence of number of honeybees emigrating together[3] from a hive in company with a queen to start a new colony elsewhere. A complex collective behavior in the swarm intelligence comes from the actions of numerous simple entities around there. Ant Colony Optimization is a solving tool for combinatorial problem-

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solving.[2] It is a well-known meta-heuristic that was influenced by how actual ants forage and how it's work. To increase the algorithm's efficiency, there are some steps to be follow with certain actions and these actions must be taken.

2.3 Energy of the nodes in WSN

Each node that present in wireless networks starts out with a certain quantity of energy[1]. Every time a node that present in it transmits data, it expends energy since electronic circuits need to be powered while doing so that means it release some energy during working. Moreover, the spacing in between the nodes affects energy and how much energy is consumed by the space of the nodes while working.

2.4 Routing techniques with an emphasis on energy conservation

There are routing protocols it depends on the efficiency of energy that use the idea of energy efficiency[3] or have applications of the sensing network in WSN. This type of model takes into account some of the different current methods, including how the quality of network, what are the delivery rate of packet, and congestion. Normally, the control supervision, network topologies, and network model all affect the congestion by the supervision of control.

- Study the existing techniques for the Reduction of Power Consumption during working.
- Research these Techniques for the identification of issues and problems in the network.
- Flow Development of a newly proposed technique known as Ant Colony Optimization (ACO) on LEACH to send data or messages by shortest path.
- Implementation in MATLAB for simulations of the different algorithms.
- Produce the Relevant Results that we need and better than previous.

3. Proposed Work

Here is very important to finding a solution that can randomly deliver a relevant solution with a highly effective requirement management that is necessary. In this situation, it is suggested that work be properly done on swarm intelligence that means groups of ant colony, for which there are numerous research-related algorithms and that are based on this intelligence. Ant Colony Optimization and BEE Colony Optimization are two examples of well-known common names suggested[3] and we can use these in our algorithms that are based on these. These methods are capable of resolving the issues that we are having with in the current system while working, but they can also be improved by using these methods and also saves energy. Therefore, we need an improved ACO that is employed for "Energy saving." This suggested methodology combines two ACO, or Ant Colony Optimization, optimization algorithms that we use in our algorithms.

3.1 Benefits

• By combining two ACO optimization methods, the current system will be able to find multiple solutions to the issue in the current system and choose the optimal one that benificial.

•The best case for all the outcomes can be accomplished by thanks to the random solution approach.

3.2 Techniques Used

Two optimization techniques are coupled to produce effective energy efficiency [3]results. The following is a quick description of each optimization algorithm:

3.2.1 Ant Colony optimization

An approach for creating metaheuristic algorithms for the combinatorial optimization problems in system is called as ant colony optimization (ACO).[2] There are some principle rule, Since the initial presentation of the principal algorithmic rule that can be categorized within this framework in 1991, a number of distinct variations of the fundamental principle have been documented in the literature and how it works. The crucial feature of ACO algorithms is the fusion of posterior data on the structure of the previously discovered good solutions with a priori data on the structure of a prospective solution.[2][4]

In order to avoid or neglect the native optima, metaheuristic algorithms of colony optimization use one of the two types of basic heuristics: the first one is a constructive heuristic that starts with a null or zero solution and adds components in it to create a passable complete one,[2] or the other one is a local search heuristic that starts with a full complete solution and it iteratively modifies the some of its components to achieve a much better one result. In this, despite being iterated, the component of metaheuristic enables the low-level heuristic. To obtain better solutions than it could have done on its own with no extra energy element required. The regulating mechanism is typically accomplished by either limiting the solution or randomizing the set of native neighbor solutions to take into account in the native search of elements (as is the case with simulated tempering or tabu search), or by merging elements obtained from the completely distinct solutions of it.

The explicit use of the elements from prior solutions in the system is an attribute of ACO algorithms. That is similar to GRASP, they can implement a very useful low-level solution while incorporating a population framework and randomizing the development in a Monte Carlo technique both as in optimization.[6] Genetic Algorithms similarly advise a Monte Carlo combination technique of different solution elements, but in the case of ACO, the probability distribution of elements is clearly delineated by previously acquired solution elements.

3.2.2 ABC Algorithmic Program

According to the ABC algorithmic software that we use,[5] the bee colony size is sufficient for both the number of bees that are actively working with each other and the number of bees who are present for just watching. Wherever each used bee is assigned to one work, the primary solutions are generated randomly by doing this algorithm. Then, for the each iteration done in this, each iteration used bee chooses a fresh candidate solution for iteration and computes its standard of its each iteration.

In cases where the new option of this type of iteration and work of bee is superior, the used bee picks it. Otherwise, the old solution is retained and no new changes happen if not consider as to superior in this case. Each participant that has been working in the ACO-based method looks for a suitable network path[5] that has the lowest cost comparison to others. The final destination node (sink) is node d after the ants have been launched from the source node s and have passed via neighbouring repeater nodes r. The launching of the new ants for reasons is carried out whenever a node has to send data or messages to a particular location that is referred to as a base or base station that is the final place of the data transfer by the ants.

4. Simulation and Results

The proposed routing strategies have been shown using the MATLAB simulation tool. On 200 Nodes, evaluation is done. For clustering, Leach will run for ten rounds while sending packets to the base station. The final round

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will optimize energy. Following the Final cluster in the final round, ACO will begin working and, after 100 iterations, will choose the optimum route based on the route's cost.

Experiment 1

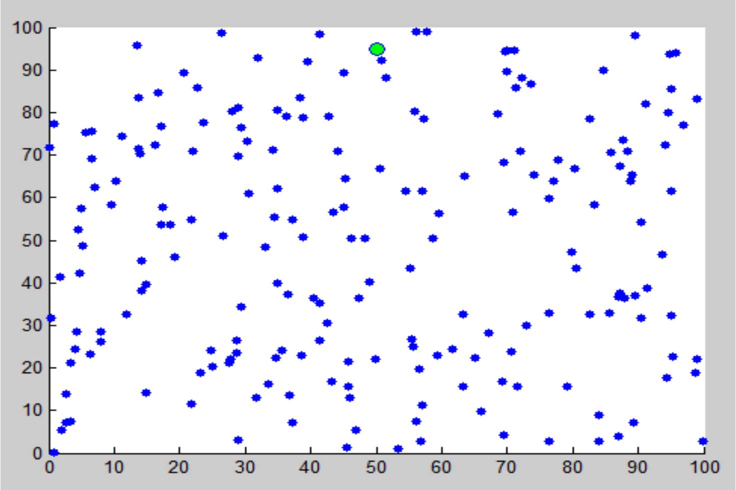

Fig.1 200 Nodes

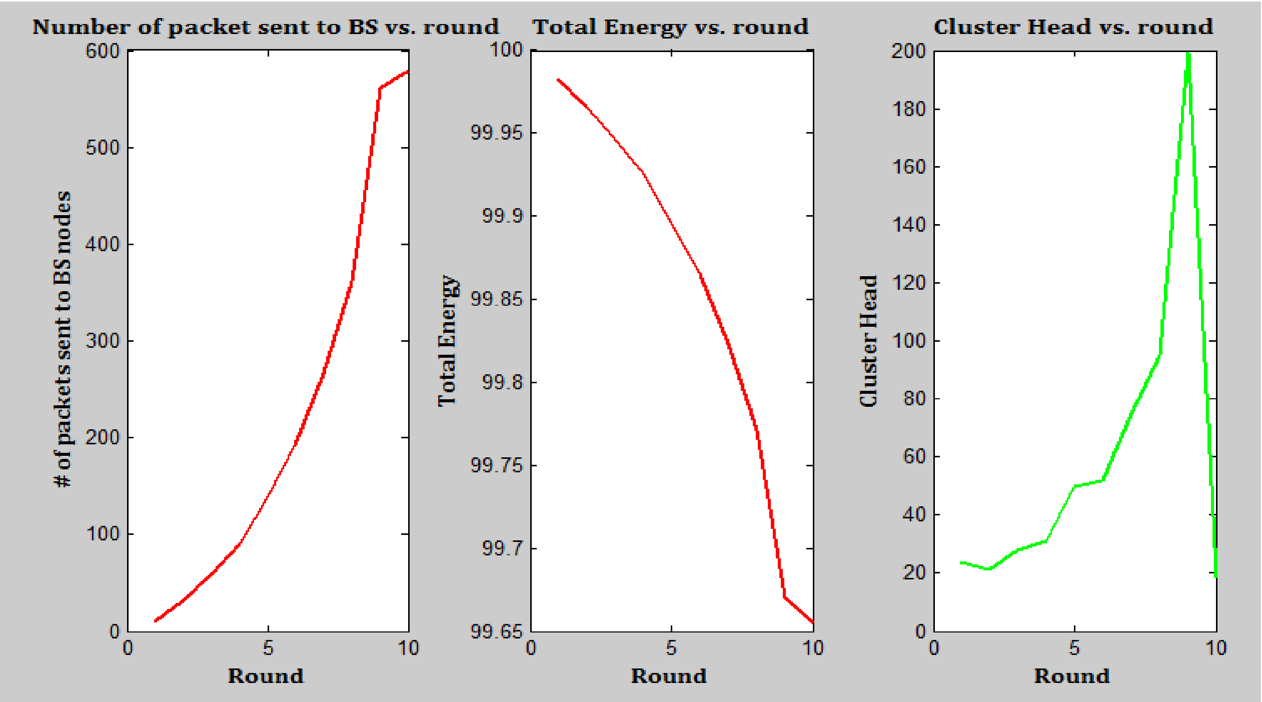

Fig.2 Results by LEACH

Results at Round 10

LEACH Round no. 10.

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TABLE:1

Total No. of Clusters Channel Head	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Channel Head Nodes	2	7	22	47	63	64	77	93	104	108	109	115	132	142	156	170	180	189

At round 10, ACO will begin operating to locate the optimum path and determine cost on 18 nodes that LEACH has chosen as the cluster head. The outcomes of 100 iterations are shown below.

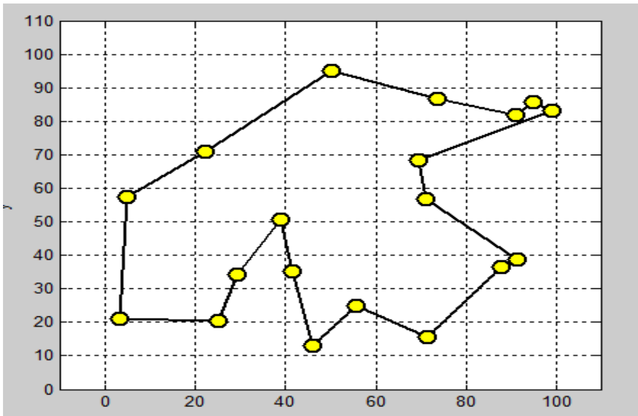

Fig.3 ACO on clusters

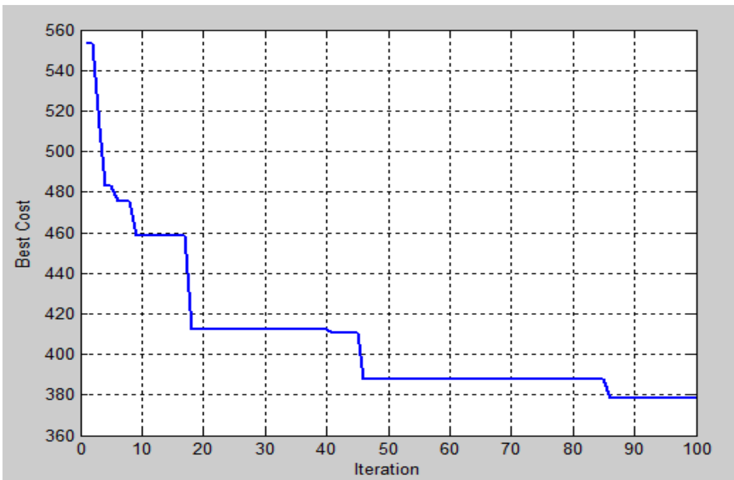

Fig.4 Cost of route at 100 iterations

Clustered Nodes created using LEACH were judged to have the best cost by ACO, which was 378.2918.

Experiment 2

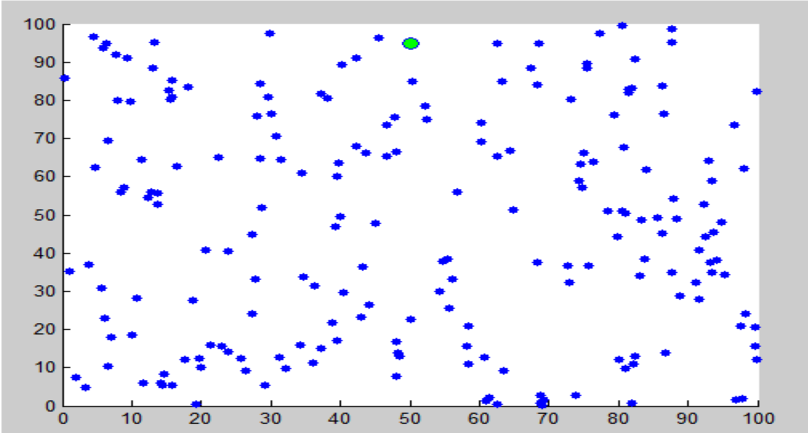

Fig.5 200 nodes

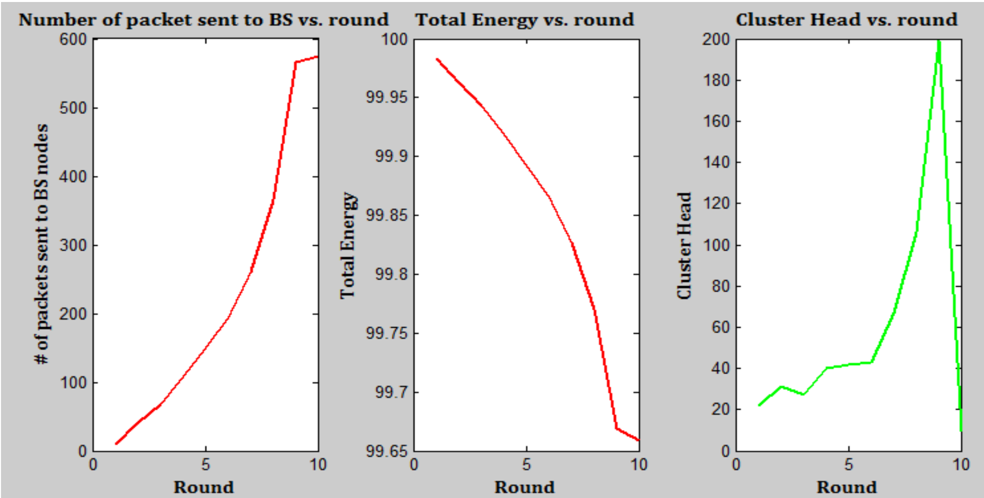

Fig.6 Results by LEACH

Fig.2 demonstrates the number of packets transmitted to the base station in each round, the amount of energy used, and the number of clusters produced in each round. Since round 10 produces clusters with the highest energy efficiency, we ran ACO on those clusters.

Results at Round 10

LEACH Round no. 10.

TABLE:2

Total No. of Clusters Channel Head	1	2	3	4	5	6	7	8	9
Channel Head Nodes	23	43	44	96	102	104	154	184	194

At round 10, ACO will begin operating to locate the optimum path and determine cost on 9 nodes that LEACH has chosen as the cluster head. The outcomes of 100 iterations are shown below.

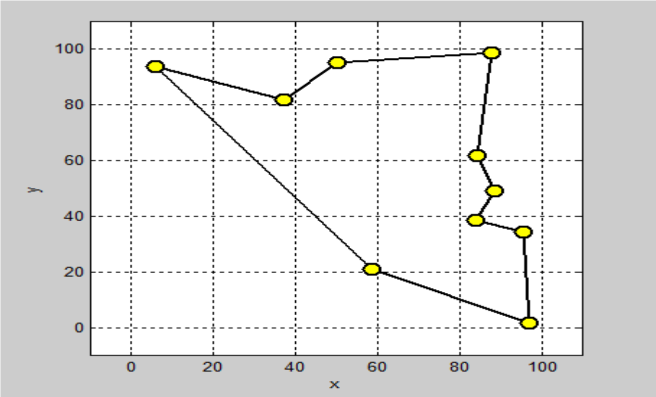

Fig.7 ACO on clusters

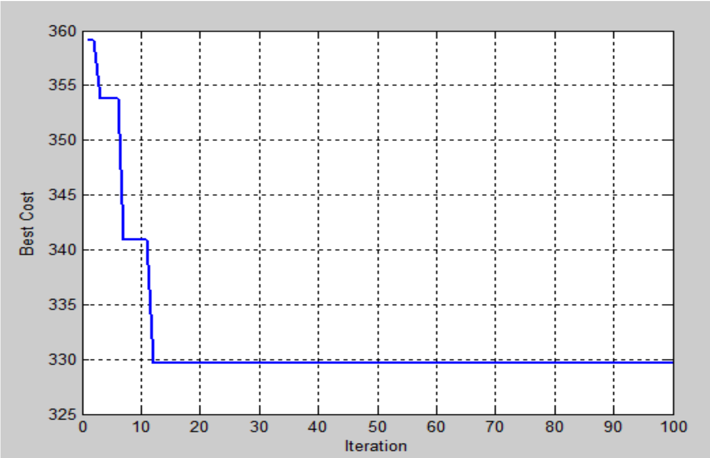

Fig.8 Cost of route at 100 iterations

Clustered Nodes created by LEACH were found to have the best cost by ACO at 329.6305.

5. Comparison of Work

To find the energy and compare it to prior research, we ran 10 tests for Nodes 10-100 with a 10-node gap.

TABLE: Parameter values for Simulation

Total Nodes	10-100
Yard Width X	100
Yard Height Y	100
Base Station X	50
Base Station Y	95
Round	10
Packet length	100
Cluster Packet Length	500

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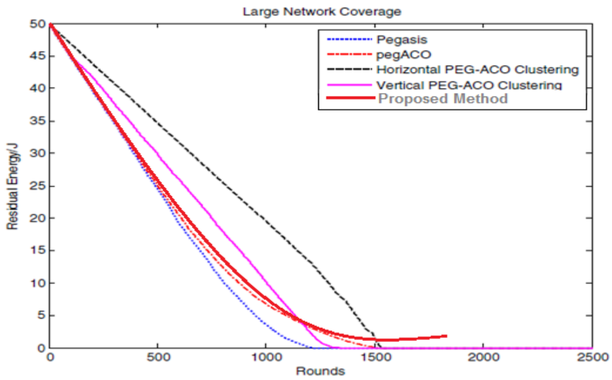

Fig.9 Existing versus Proposed Work-Energy versus Round

6. CONCLUSION

We have introduced a novel method for WSN routing activities in this research. The development of an adaptive strategy was done in order to fulfill our goal of minimizing network lifespan while yet achieving rapid knowledge transmission. The primary consideration while constructing wireless sensor networks is energy consumption. LEACH is the most often used routing protocol when using a clustering strategy. LEACH was optimized using an ACO method. We successfully created an optimized method that provides the optimal path and conserves energy for nodes by combining the ACO optimization methodology with the LEACH protocol. This can lengthen the lifespan of the nodes in wireless sensor networks. According to the simulation results, the suggested ACO with LEACH methodology is more effective than the current method. The proposed approach is more extensive than the existing work. In the suggested work, energy efficiency is more evident.

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