IMPROVED WIRELESS SENSOR NETWORK STABILITY DURING ROUTING BY HYBRID SWARM OPTIMIZATION APPROACH

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Abstract- Wireless sensor network is a group of nodes that are connected to each other by wireless connection. These type of network work on the dynamic topology of the network because positions of nodes in the wireless network are changing continuously. The nodes in WSN are basically made up of small electronics device which are used for sensing, computing and transmitting the data. The nodes are run on the battery power during communication process. The battery consumption in WSN is very high due to high computation operations on it. In the recent years WSN grows at very high at the research area is also increased in this field to provide effective computation. By considering the network structure routing is categorized into two parts that are flat and hierarchical routing. In this proposed work cluster are made by WCA-GA (Grey Wolf optimization) on the basis of distance and energy parameters. The cluster head is also selected on the basis of WCA-GA and MO in three different metrics. At the end the performance evaluation of the proposed work is compared with the existing approach Leach on the parameters of Throughput, Dead node, Alive nodes, energy.

Keywords- *WSN, optimization, energy*

I. INTRODUCTION

The distinct advancement done in the field of wireless technology possibly developed the use of wireless sensor networks (WSN) consisting of small devices which are used for collecting the information with proper cooperation planning with each of its part. These small type of devices are generally known as the nodes and it consists of memory used for storing the data, CPU for data processing, transceiver enabling the communication signals between the sender and the receiver, and the battery for energy fulfilling requirements. The sizing of each and every sensor node varies according to the applications in use. For example, in surveillance or military-based applications it might be assumed very small (microscopically) and the cost is dependent on its parameters such as processing speed, battery, and memory size. Wireless Sensor Networks (WSN) as referred to [1, Fig.1.1] are the application based networks which consists of a number of sensor nodes. It represents an arrangement of many sensor gadgets which speak with wireless networks with the assistance of restricted vitality expending steering conventions.

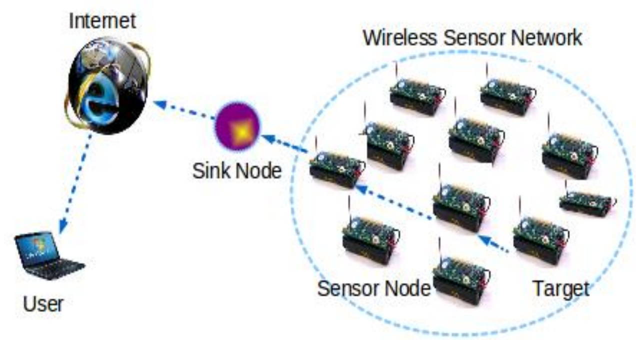

Figure.1.1 Wireless Sensor Network

WSN are thick wireless networks of little, cheap, low-control, disseminated self-ruling sensors which amass and proliferate natural information to encourage checking and controlling of physical conditions from remote areas with better exactness. For the most part, it is accepted that every sensor in a system has certain limitations as for its vitality source, power, and memory and figuring capacities. It contains a door that gives wireless network back to the wired world and dispersed nodes. It can likewise be characterized as a system of gadgets that can impart the data accumulated from an observed field through wireless connections. The information is sent through different nodes with an entryway and the information is conveyed to different networks like wireless Ethernet. These networks are utilized to control physical or ecological conditions like sound, weight, temperature and so forth. WSN nodes have constrained battery limit. As the use of WSN is increasing rapidly and simultaneously this technology is facing various major challenges of energy constraints depending upon the limited lifetime of batteries as each of its node relies on energy demand for performing the basic operational activities which has become the major reason behind the failure in wireless sensor networks. One node interruption may result in shutting down the overall operation of the system. The nodal operation relies on active mode, idle, and sleeping modes. In case of active modes, energy is consumed while transmitting or receiving the data. In case of idle mode, the node consumes the energy same as consumed in active type node whereas in case of sleeping mode, the node gets shut down in order to save the energy. To build the life expectancy of WSN the usage of vitality in a productive way is a most normal issue. As the utilization of WSN are expanding at a very fast pace and using numerous varieties of sensors with limited batteries for target following, physical condition observing and so on. These applications require fast correspondence between sensor nodes. The WSN technology uses the following steps to keep the safe for its longer usage.

- Scheduling the nodes state (receiving, idle or sleep, and transmitting).
- Changing the range of transmission between the sensing nodes used in the process.
- To reduce the redundant or the unwanted data.
- Use of efficient data collecting methods and the routing protocols.

1.2 WSN: REQUIREMENTS

There are a few such requirements that must be applied to most of the application of the sensor network.

(a) Network size: Most of the applications requires a larger network covering more area and therefore helps in monitoring large events.

(b) Lifetime: The basic need of extending the duration of the WSN is of greater importance as the sensors are not accessed after the process of their deployment.

(c) Minimizing the faults: A network of faulty nature uses various sources to generate more forms of incomplete data or information. In context of sensors, it generally refers to monitor such an environments i.e. broken and many of its events are missing. In case of applications relying on transmitting to the sink, it usually means that the packet loss is very high, and the event knowledge is of incomplete nature, therefore the data gathered is not or reliable nature. So, this condition must be kept in mind that for a reliable collective form of event to its sink plays a significant role on WSN technology. So, in communication protocols such type of requirements explains the following criteria-based strategies:

- **Scalability**: The protocol used for the process of communication must be of reliable nature such as maintaining and establishing the connectivity among each of the sensor. When the size of the sensor becomes large, the protocol must perform in a normal way.
- **Reliability**: In terms of packet loss, it represents one of the major concern for providing a high level of efficiency in control and monitoring systems. Therefore, it is desired to take account of multi-hop availability, employing techniques which are highly energy efficient which would further improve the lifetime of the network.
- **Multi-hop communication compatibility**: In this case the sensors do not communicate with the sinks directly. So, it is usually preferred that the sensors use the other neighbor sensors as hops for the process of communication.
- **Lower energy consumption**: The process of energy consumption should be slow between the sensors and the sink in order to increase the lifetime of the working sensor.
- **Latency**: This is usually defined by the time taken by the node to monitor, communicate, and sense the working operation or activity. The nodes collect the data, processes it and further send it to the receiver or the destination place. The latency is based on the working activities including the time taken by sensor to send the data in low density or heavy load traffic network.
- **Processing Time of Node**: It highlights the performing time of the sensor node starting from the initiation of the operation, sensing, processing or storing data, and receiving or transmitting the data over the network.
- **Transmission Scheme**: The nodes of the sensor collect the data and transmit it to the base station or the sink using either a multi-hop or flat schemes.
- **Network Power Usage:** It represents the power or energy used by the sensor nodes which helps them to perform the allotted activities such as processing, sensing or forming the groups within the area specified.

II. RELATED WORK

Shelke, Maya et al. [1] proposed a congestion-aware routing protocol in the wireless sensor network. It works on the opportunistic theory and selects the optimized route. For scheduling on the network, it uses sleep mechanism. The proposed protocol reduced the congestion on the network and enhances the node's life and entire network life time. It also reduced the partitioning of the network. It mainly used to provide the appropriate path on the wireless network to the nodes.

Hong, Chao, et al. [2] introduced a Forwarding Area Division and Selection routing protocol in the wireless sensor network. This protocol used to classify the collisions in two forms that are same slot collision and distinct slot collision. It reduces the probability of same slot collision and it balances the load by using dynamic load balancing approach. Forwarding area division method is applicable on nodes within the same area and selecting sub area by reducing the number of candidates. This process reduced the same slot collision. Adaptive forwarding area selection is used to channelize the subarea dynamically. The simulation result of the proposed method reduced the packet delay, energy consumption.

Chincoli et al. [3] worked on the transmission power control in wireless sensor networks by using cognitive methods. In this protocols are divided into two types proactive and reactive. Cognitive protocols that are used this work are fuzzy logic, swarm intelligence and reinforcement learning. These protocols improve the energy level and quality of service management. This paper also gives information related to benefits of these protocols.

Umar, IdrisAbubakar, et al. [4] introduced the state free geographic forwarding protocol which worked on the concept of cross layering and combines the task of routing and media access control layers which minimizes the energy consumption. MAC protocols are able to mitigate the hidden terminal problem using handshake mechanism. This mechanism reduced the end-to-end delay and energy consumption in the wireless networks. In this work, the author uses Directional Compact Geographic Forwarding approach to reduce the excessive overhead in the multi-hop network. The result of the paper shows that it reduced the message overhead, energy consumption, and end-to-end delay.

Shafieirad et al. [5] proposed an energy-aware opportunistic routing protocol for wireless sensor networks. This protocol analyzed the energy available on the sensor node, distance from the other node and the amount of data transmission between the nodes. This protocol does not require any prior information related to the network topology. The experiment also tested by using the numerical results and it clearly shows that it enhanced the data delivery ratio.

Oh, Hoon et al. [6] introduced a slotted sense MAC protocol for timely and reliable data transfer in the wireless sensor network. This protocol allocates the sharable slot to each tree which produces topology independent schedule and makes it highly responsive. This protocol provides a reliable data transmission over the nodes. The sharable slot features the proposed method improve its performance by enhancing the data delivery ratio.

Agrawal, Deepika, et al. [7] Fuzzy based unequal clustering algorithm is proposed by the author in this article to enhance the lifetime of the wireless sensor network. It balanced the energy consumption by making the unequal clusters. Cluster heads are selected by using the fuzzy logic. Density, energy and base station distance are the input variables of the network. Rank and competition radius are the outputs of the fuzzy system. The performance of the proposed algorithm is compared with existing protocols and found that the proposed algorithm performs better.

Kirubakaran et al. [8] IW- MAC (invite and wait) protocol is proposed to provide efficient wireless sensor networks. This protocol is used to provide the efficient use of battery power by sensor nodes. It transfers the minimum control packets and maximum data packet in the given time. Energy on the nodes is used to transfer the data and reduce the overhead of control packets and channel reservation. This approach is used to save the energy during the data transmission on the nodes.

Gowtham et al. [9] proposed congestion control and packet recovery in cross-layer approach. It reduced the problem occurred by the traffic like congestion and contention on the data link layer and transport layer. This protocol recovers the missing packets by storing the copy of the data packets. To avoid the congestion on the network it assigns the priority to the nodes for transmitting data. On the basis of priority, the packets are transmitted to the next node. The packet which has the highest priority transmitted first and then next according to the assigned priority. The performance of the packet is tested on the simulator and gives effective results.

Swain et al. [10] work on the diagnosis of fault in the wireless network and proposed a protocol for it named as Heterogeneous Fault Diagnosis Protocol. This protocol consists of three phases that are clustering phase, fault detection phase, and fault classification phase. This method detects the faulty nodes and classification is done by using probabilistic neural network protocol. The simulation result of the proposed method is tested on NS-2 simulator.

Huang, Haojun, et al. [11] energy-efficient multicast geographic routing protocol (EMGR) is proposed by the author to provide the efficient and scalable wireless sensor network. It is a multicast tree which formed by the set of destination and the source node based on the energy. This protocol provides low energy consumption, computational overhead and high packet delivery ratio.

Kumberg, Timo, et al. [12] proposed a simple and effective cross-layer routing protocol called as T-ROME. In this nodes are containing wake up receivers. This by the protocol used to save energy skipping nodes during data transfer. In this protocol, Markov chain model is also used for verification. This protocol enhanced the performance of the wireless sensor network.

III. THE PROPOSED METHOD

Water Cycle Algorithm (WCA)

The latest bio-inspired algorithm is the water cycle optimization algorithm. This algorithm's main concept is simulating the behavior of grey wolf living in a pack. They have a serious hierarchy of social dominance. Alpha is known as the level leaders and is responsible for decision making in the pack. The wolf pack persistence is based on the decision of alpha. Beta is known as the second level subordinate wolves. The beta operation is for help in making the decision for alpha or other activities.

Delta is known as the third level subordinate wolves. This category member consists of elders, scouts, hunters, caretakers, and sentinels. For region boundary observation and in any danger case, scouts are liable for the warning. The protection and pack's safety guarantee is given by sentinels. The expertise wolves are the elders, denoted as alpha or beta. Alphas and betas are helped by hunters while prey hunting and caring for the ill, weak, and wounded wolves by caretakers and providing food for a pack. Omega is the lowest level. All dominant wolves with omega wolves have to comply.

Methodology Steps

Step1 : Deploy the wireless Sensor network.
Step2 : Apply the leach routing process.
Step3 : Simulate the blackhole attack on the wireless Sensor network and parallel optimize by WCA algorithm.
Step4 : {
Initialize the water cycle optimization

- Update the fitness function.
- Check the objective function
- Check it optimize or not it optimized then analysis the time and dead node otherwise check the counter is greater than 0 or not. If the counter value is less than not converge and ignore the node during routing. Else again initialize the value at WCA.

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4.4 MO

The current trend encourages connecting the WSN to outside networks in order to allow remote data collection and control, which involves the use of the MO protocol.From the viewpoint of network, there are two types of mobility: node mobility and network mobility. The node mobility is when a node (robot, vehicle, animal, etc.) changes its attachment point. While the network mobility occurs when a router, with all devices attached to it, changes its attachment point and all of these nodes appear as a single entity. This case of mobility can be found in many applications, such as military applications.

From the viewpoint of mobility, there are also two types of mobility, micro and macro mobility (Figure.3): (i) the micro-mobility is when nodes move within the same field (e.g. nodes move within the same network or to another network that uses the same MO prefix). Within this area, a Mobile Node (MN) can change its access point without changing the MO prefix. (ii) In contrast, the Macro-mobility is when nodes move between different areas.

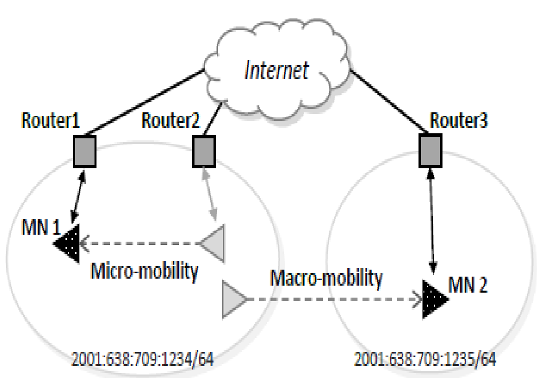

Figure 4.2 MO Based Wireless sensors Network

IV. RESULT ANALYSIS

describes the detailed result or the proposed work by using tables and graphs of the results. The performance evaluation of the proposed WCA_GA Leach is compared with MO Leach and with Leach also. The comparison based on the number of rounds and the nodes in the cloud. The comparison is based of the following parameters:-

- Live Nodes
- Dead Nodes
- Throughput
- Average residual Energy

5.2 RESULT ANALYSIS

Table 5.1 Number of Live Nodes

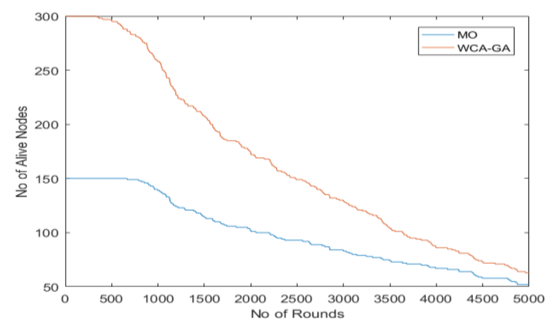

Figure 5.1 Number of live nodes in WCA_GA Leach and MO Leach

The above given Figure 5.1 represents the live nodes in the number of rounds on the two algorithms WCA_GA Leach and MO Leach. The Blue line on the graph represents the WCA_GA Leach and red line represents the MO leach nodes. The round starts from the 0 to 1000 and the maximum number of live node is present in round 200 and changes according to the number of nodes changes

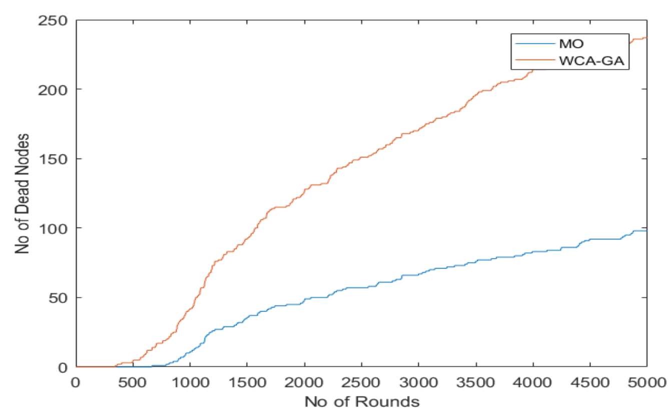

Figure 5.2 Number of dead Nodes in WCA_GA Leach and MO Leach

The above given Figure 5.2 represents the dead nodes in the number of rounds on the two algorithms WCA_GA Leach and MO Leach. The Blue line on the graph represents the WCA_GA Leach and red line represents the MO leach nodes. The round starts from the 0 to 1000 and the minimum number of dead node is present in round 150 and changes according to the number of nodes changes. The graph curve concluded that the number of dead nodes in WCA_GA leach is less than MO.

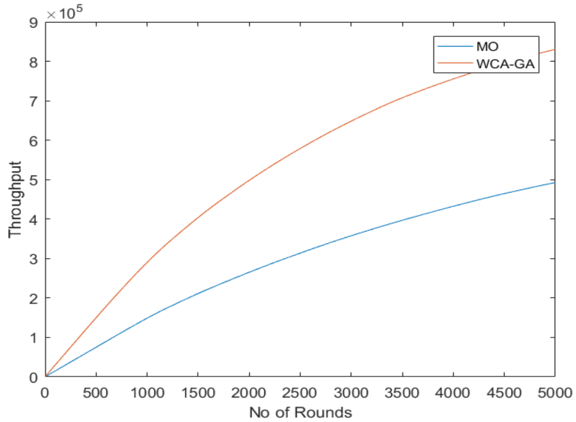

Figure 5.3 Throughput on WCA_GA Leach and MO Leach

The above given Figure 5.3 represents the throughput in the number of rounds on the two algorithms WCA_GA Leach and MO Leach. The Blue line on the graph represents the WCA_GA Leach and red line represents the MO leach nodes. The throughput of the grey wolf optimization algorithm with Leach is better than the existing MO.

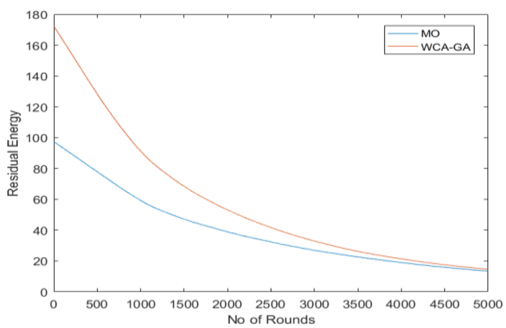

Figure 5.4 Average Residual Energy WCA_GA Leach and MO Leach

The above given Figure 5.4 represents the average residual energy in the number of rounds on the two algorithms WCA_GA Leach and MO Leach. The Blue line on the graph represents the WCA_GA Leach and red line represents the MO leach nodes. The average residual energy of the grey wolf optimization algorithm with Leach is better than the existing MO.

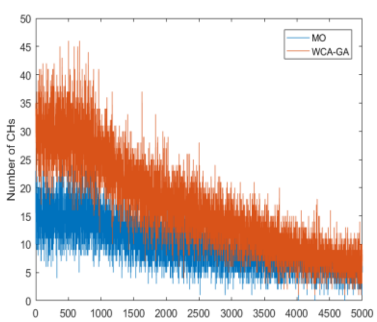

Figure 5.5 Cluster Heads according to rounds

The above given Figure 5.5 represents the cluster head in the number of rounds on the two algorithms WCA_GA Leach and MO Leach. The Blue line on the graph represents the WCA_GA Leach and red line represents the MO leach nodes. The spikes in the graph represent the changes in the algorithms according to the rounds

IV CONCLUSION

Wireless sensor networks have gained a lot of attention is the last few years and used by the peoples in various applications and also in the military services. In WSN it is very challenging process to design a robust and scalable routing protocol which performs well at the time of data congestion on network. In the proposed work particle swarm optimization algorithm is used to provide the optimal result in the nodes of WSN. WCA_GA work on the biological behavior of the swarms a provides effective solution. In this work WCA_GA is used for selection of cluster heads according to their size. It works on the alive nodes, dead nodes and the energy consumption by the nodes. The results depict the WCA_GA performs better than the existing approach MO LEACH and Leach in every scenario.

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