An Efficient routing protocol based on Modified Ant Colony Optimization and Cuckoo Search In Wireless Sensor Network

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Abstract- WSN is a static network of tiny sensors. Each sensor is defined with some energy. As the data is transferred over the network each sensor spends some energy and cost in sending, receiving and forwarding data. Network life depends on how much energy and cost spends in each transmission. Opportunistic routing has been shown to improve the network throughput, by allowing nodes that overhear the transmission and closer to the destination to participate in forwarding packets, i.e., in forwarder list. The nodes in forwarder list are prioritized and the lower priority forwarder will discard the packet if the packet has been forwarded by a higher priority forwarder. One challenging problem is to select and prioritize forwarder list such that a certain network performance is optimized. In this work, we focus on selecting and prioritizing forwarder list to minimize energy consumption by all nodes. We present an energy-efficient opportunistic routing strategy, denoted as EEOR. Benefit of this approach is that the data retransmission will never occur. The parameter included in this work is: Establishment of optimal multiple path. The work is implemented in Mat Lab and the analysis is drawn in the form of graphs.

Keywords- Wireless sensor technology, Cluster Heads, Beaconless Forwarder Planarization, Directed Diffusion

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 [4, 6].

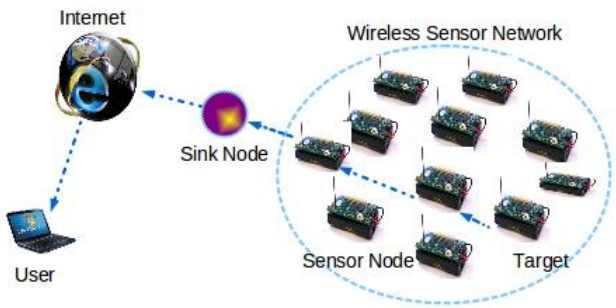

Figure 1: Wireless Sensor Network [14]

Wireless Sensor Networks (WSN) as referred to [14, Figure.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.

1.2 Need of WSN

There are a few such requirements that must be applied to most of the application of the sensor network [11].

(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 [9].

1.3 WSN Architecture

The architecture of WSN technology comprises of the following:

1.3.1 WSN: Model

The architecture of WSN technology is based on the OSI architectural model. It basically includes three cross layers and five normal layers as represented in [10, Figure 2].The sensor network includes the five layers namely, application, transport, n/w, data link, and physical layer whereas the cross layers namely, task management, mobility management, and power management. These layers accomplishes the network operation and helps in functioning of the sensors together to boost the network efficiency [10, 13].

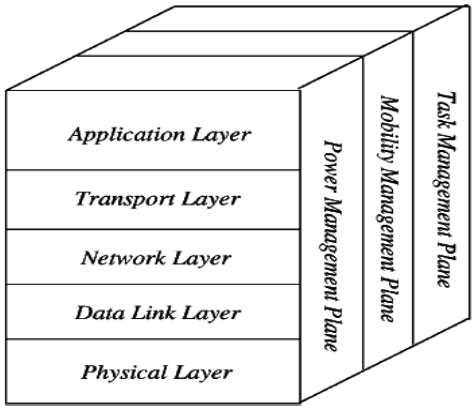

Figure 2: Architectural Model [10]

(a) Application Layer: It is liable for managing the network traffic and offers software for large applications converting the data into a clean and clear form in order to find the information in a positive manner.
(b) Transport Layer: The function of this layer to maintain reliable operation and to avoid the problem of congestion. The protocols used for such a layer use distinct mechanisms for loss recovery and recognition and such a layer is basically needed where a system thinks or plans to contact with other form of networks [8]. Generally, this layer can get separate into an event driven or packet driven form. Some of the populous protocols used in transport layer are PORT (Price-Oriented Reliable Transport Protocol), PSFQ (pump slow fetch quick), and STCP (Sensor Transmission Control Protocol).
(c) Network Layer: The main aim of this layer is the process of routing. But the main tasks are in partial memory, buffers, and power conserving applications. This layer relies on a simple idea of routing where the basic need is to explain the redundant and the reliable lanes varying from protocol to protocol according to convinced form of scale, known as metric
(d) Data Link Layer: It is usually liable for the process of data multiplexing (frame detection), MAC, & error control, data streams, and confirms the reliable operation that may be ether point to point or point to multipoint.
(e) Physical Layer: It basically provides an edge for the process of transferring the bit streams above the (physical) medium. This type of layer relies on generating of carrier frequency, frequency selection, Modulation & data encryption, and signal detection. It is suggested in areas where there is low rate of power consumption particularly in WSNs with low consumed power, low cost, communication range, and density in order to boost the battery life used for the working operation.

1.3.2 Components of WSN

There are three main components in WSN: nodes, gateways and software. Spatially distributed cluster heads interface with sensors to monitor assets. The collected data transmit to gateway wirelessly, and can operate independently. It is connected to a host system where the data can be collected, processed, analysed and presented by using software [8] [12]. To extend WSN distance and reliability, special type of measurement node is used such as router node. WSN is a widely used system because of its low costs and high efficiency. WSN contains sensor nodes which basically utilized for detecting, imparting and information preparation. Sensor nodes can be utilized as a part of numerous fields like businesses, military, and farming applications, for example, transportation activity checking, natural observing, keen workplaces and front-line observations. In these applications, sensors are conveyed in a specially appointed way and work independently [7].

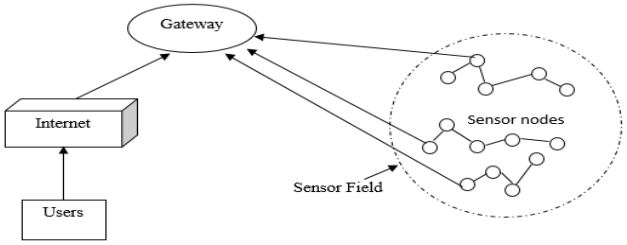

Figure 3: Components of WSN

1.3 Routing Protocols

The routing approaches adapted by different mobile network are shown and discussed. These protocols are given below [1][2, 3] in figure 4. ***1.3.1 The Network Structure Protocol:*** It basically consists of the following routing protocols:

1. Flat Based Routing: Such kind of routing technique is used in identical network with randomized parameters guidance. All the network nodes are of same type and the multi hop route is used to optimize the network route. In most of the intra- cluster mobile network, these kind of routing approach is been used to carry out the network communication.

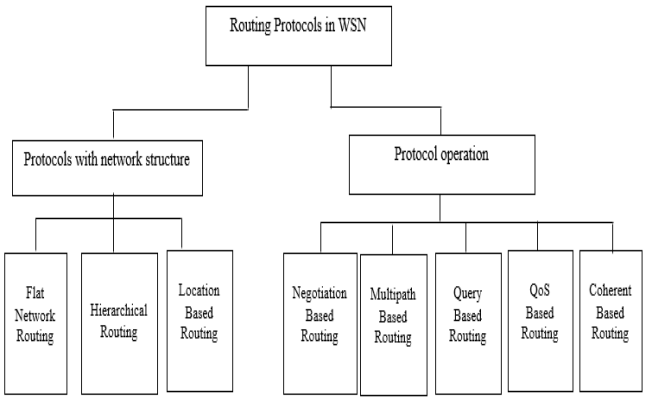

Figure 4: Routing Approaches/Protocols

The first data-centric protocol used is named as SPIN. In order to remove the redundancy of data, the SPIN performs data negotiation between the sensor nodes. After the discovery of SPIN many other data-centric protocols were developed as explained briefly in the section.
(a) SPIN (Sensor Protocols for Information via Negotiation): The planning done behind the SPIN methodology was to perform data naming using descriptors or meta-data of very high level. The SPIN negotiation property helps in solving the major redundancy issues.
(b) Directed Diffusion (DD): This was developed after the SPIN protocol. The main objective of Directed Diffusion to diffuse the data through the sensing nodes with the help of utilization of data naming scheme. The DDs are highly energy efficient as they occur on demand basis and there is no such need for keeping the network topology (globally).
(c) Rumor Routing (RR): It represents a compromising condition between the notifications of flooding events and the queries of flooding. The major plan of this type of protocol is to set up the paths leading to each and every event.

1.3.2 Hierarchical Routing

In this routing technique, the inter cluster communication is carried out. The nodes can identical or different but the nodes in a same network are considered as identical. The network area chosen in this network type is generally big and measurable.
(a) Low-energy adaptive clustering hierarchy (LEACH): The main advantages of such type of protocol is as follows:

- The sensors within the network have synchronized form of clocks in order to know the initialization of new cycle process.
- It rotates the CHs randomly to balance the energy based consumption.

Some of the major LEACH shortcomings are:

- It uses single-hop routing and a results it is not applicable to large network applications.
- Member nodes extra overhead.
- The CHs concentrate in the same area as they are selected on random basis.

(b) Power efficient gathering in sensor information systems (PEGASIS): It forms an extension of LEACH protocol forming sensor nodes chain such that each of the sensor node receives and transmits from its neighbors. Here, only one node gets selected from

the whole chain which transmits to the sink. The data collected moves on node to node strategy and is eventually sent to the sink (BS). PEGASIS helps in avoiding the formation of clusters and that's why uses only node for the transmitting purpose instead of using nodes in a multiple form. If in this case the sensor dies or fails due to low limited power or energy, then the chain is gain modelled with the use a greedy approach bypassing the failed type sensor.

(c) Hybrid, Energy-Efficient Distributed Clustering (HEED): The important features of such type protocol are illustrated as below:

- It does not need unique capability of node such as the awareness of the location etc.
- It helps in extending the nodes lifetime thereby stabilizing the neighboring nodes.
- In order to form clusters, the nodes only need local information of its neighbors.

(d) Threshold sensitive energy-efficient sensor network (TEEN) Protocol: Some of the main advantages of using such kind of protocol is described as follows:

- The critical time data reaches instantaneously.
- It is usually supported by thresholds in the process and the transmission of data is controlled in an often manner so as to decrease the consumption of energy and to improve the utility and effectiveness of the data received.
- The threshold small value provides an accurate imaginative network picture, at an increased cost of energy-based consumption.

(e) Adaptive threshold sensitive energy efficient sensor network (APTEEN) Protocol: It captures both the LEACH and the TEEN protocols. Thus it represents a hybrid clustering based routing allowing the sensor nodes to send the data periodically. APTEEN supports distinct queries such as:

- Historical-based query, in order to analyze the past values of data.
- One-time query for viewing the network.
- Persistent queries to observe an event.

1.3.3 Location Based Routing: The routing technique explained here for the guidance of network node and tracking of node under the location guidance and creation. This routing technique relies on the node location and the signal strength of various positions over the network.

(a) GEAR: It mainly used to reduce consumption of energy for the network routing setup, but and it also provides better delivery of the data packet.

(b) GAF: Geographic Adaptive Fidelity basically favors the WSN energy consumption. It works on three of its important stages: discovery, active and sleeping. In discovery mode, the sensor exchanges the messages relying on the learning mechanism of the other sensors. In the active stage, it works efficiently and in the final sleeping stage, it turns the radio in an off state for energy conservation.

(c) MECN: Minimum energy communication network (MECN) maintains and establishes WSNs minimum network of energy utilizing low power consuming GPS. This type of protocol has two of its phases:

- It usually takes 2d plane position and models a graph (thin).
- It searches the best link possible on the enclosure graph and utilizes the shortest distributed path algorithm with consumption of energy as a cost metric.

(d) SMECN: It is a modified version of MECN. It consumes less energy as compared to MECN and the cost of its maintenance is also low but the major drawback is that it introduces more overheads as searching the sub-networks with small number of edges is a very complex process.

1.3.4 Operational part of protocol

(a) Multi path-based: This method provides an efficient methodology that handles multiple paths.This pathway provides an additional/alternative path when the primary method fails. The system's fault tolerance level and the reliability increases due to alternative path provided.

(b) Query-based: This type of routing uses the queries that are usually issued by the base station. Here, the base station send certain queries and requests for collecting the information in the network with the help of sensor nodes. The nodes is responsible for collecting and sensing the data information and it reads the different queries and if the matching occurs with the requested data form, then it starts sending the requested data to the base station that act as a requested node. This method is known as Directed Diffusion.

(c) Negotiation-based: The negotiation based protocols uses a highly coded descriptors in order to eliminate the data redundancy. To disseminate the data, the process of flooding is done as the flooded form of data forms overlapping structures and the collision usually occurs during such a transmission process [9] [10].

(d) Quality of Service (QoS)-based: This type of protocol requires to maintain both the energy and the quality within the network. The first ever routing protocol used is Sequential Assignment Routing (SAR) using QoS for the decision-based processing.

(e) Coherent-based: In this methodology the data collection plays a significant part of the event. Within the network, the process basically relies on two types of data processing techniques. One is the coherent type and the other is the non-coherent type technique. In case of non-coherent technique all types of nodes collect the data and processes it before sending it to its nearest neighbour for further processing and the sensor nodes performing such processing are named as aggregators whereas in case of coherent routing, just after the minimized processing operation, the data or the information is sent to the aggregator.

II. RELATED WORK

Umar, IdrisAbubakar, et al. [1] 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. Shelke, Maya et al. [2] 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. . 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. Tan, Cheng Kiat, et al. [4] introduced FAEM data collection protocol which is used for energy efficient multicast multichannel routing in wireless sensor networks. It works on the basketball net topology in which it establishes a table for each node and also pre-assigns the channel

which is different from the neighbor nodes. Time is divided into duty cycle and each cycle consists of two phases. The first phase called iterative scheduling phase and second phase called as slot-based packet forwarding phase. In this network tree upload nodes are called parent node and download nodes are called child node. Results of the proposed method give low energy consumption, low latency, and high data reliability. Kulshrestha et al. [5] introduced an adaptive energy balanced and energy efficient approach for data gathering in wireless sensor networks. This method considers the neighbor nodes and link reliability to determine the energy consumption on nodes. This mechanism reduced the end-to-end delay and energy consumption in the wireless networks. In this work, the author uses 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. . Bouachir, Ons, et al. [6] introduced EAMP-AIDC energy-aware protocol which works on the basis of duty cycle optimization. Duty cycle considers the active and sleep periods of the nodes which are used for balancing of the nodes. This experiment is performed on OMNET++ and gives better energy consumption and enhanced the energy savings over the network. Hong, Chao, et al. [7] 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. Shafieirad et al. [8] 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. [9] 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 Ruhrup, Stefan, et al. [11] Beaconless forwarder planarization (BFP) scheme determines correct edges of a local planar sub-graph without hearing from all neighbors. This paper also shows the impact of sub-graph on message complexity. Worst case message complexity is also measures in this paper. The simulation results of this paper also show that the average case message complexity by using CNG and GG. A theoretical framework is used for delay function. Frey et al. [12] explained the design issues in the routing protocols of wireless sensor network. Author presents a routing technique based on geographic routing. Author surveyed on the different techniques of routing. In this author presents the beaconless routing algorithm. Author also discussed the effect of routing on the physical layer. Zheng, Ming-Cai [13] proposed minimum hop routing link reliability protocol for wireless sensor network. This protocol is mainly used to enhance the reliability in WSN. This protocol set the limits of the nodes to the neighboring node during data transmission. It also extends the period of the transmission to enhance the reliability. In this process communication overhead in not increased due to level space controlling. Wu, Shibo et al. [14] presented the GPER geographical power efficient routing (GPER) for the wireless sensor network. In this routing process, each node is able to make local decision that how far to transmit the data. This protocol works in very scalable and power efficient way. Each node first establishes a sub-destination within its maximum radio range. The node, however, may decide to relay the packet to this sub-destination through an intermediary node, if this preserves power. The simulation result of this paper shows that it saves the energy and provides more efficient results.

III. THE PROPOSED METHOD

3.1 Proposed Methodology

First thing incorporated in the proposed scheme will be routing the packets according to modified ACO. Basic ACO is modified using NLP method (node-link parameters-based selection). Since this is based on any colony optimization, therefore the fourth factor that determines the fitness of the solution will be the pheromone value of the path. Higher this factor, more fit will be the path.

We define fitness function of the path as:

$$F(p) = (1-\alpha)* \text{ Length} + \beta* \text{ Energy factor} + \gamma* \text{ Stability of the path} + \lambda* \text{ Pheromone value}$$

Where $\alpha,\beta,\gamma, \lambda$ are constants with sum equaling to 1.

When destination node receives the FANT packets, it will formulate all the paths to the source node. These paths will represent the initial solutions. The fitness function of each solution will be computed. From the initial solutions, the solutions having fitness value lesser than the average fitness value of the entire solution set will be removed. Thus, destination node will now be filtered initial solutions for which levy's walk will be applied to find a new solution. In the existing work, the fitness value used for initial solution is calculated using the hop count and levy's walk obtains the new solutions based on same fitness value, i.e. hop count. In the proposed work, the fitness value for any solution will be based on three factors described in NLP and levy's walk will be generated according to the same. After generating the new values, if the fitness value of new solution is more than the old solution, then old solution will be replaced by new one and vice-versa. The destination node will send BANTs to the source node for the newly generated solutions. The source node will choose the solution having highest fitness value to route the data to destination node

3.2 Algorithm Used

Ant Colony Optimization: As explained by CH. V. Raghavendran [13], in recent years, the interest of the scientific community in ACO has been increased. Because of robustness, and adaptive nature, ACO has finally managed to find its applications in routing, assignment & scheduling. The basic idea behind ant-based routing algorithm is food searching strategy of real ants. The ants deposit pheromones on the ground while searching the environment for food. This pheromone attracts other ants and the ants tend to follow trails of previous ants. This mechanism enables the ants to find shortest paths between the nest and a food source. There are chances that when ants fan out to find food, any ant finds a short path to a new food source. It then takes some food with it and makes its way back to the nest. Since it is attracted by its own pheromone trail, it is likely that the ant follows its own path back to the nest, thereby leaving a second pheromone trail. If other ants happened to take a longer path to the food source, they arrive after the first ant and, when trying to make their way back to the nest, there is a good chance for them to be attracted by the short path, where already two pheromone trails have been laid. This reinforces the short path even more and makes it more attractive. Concerning the longer path, pheromones tend to evaporate after some time, so in the long run the long paths will be forgotten and almost all ants will take the short path. The characteristics of ants are similar to the characteristics of

MANETs. This helps us to apply the food searching characteristics of ants for routing packets in MANETs. The basic principle of an ant routing algorithm is mainly the depositing of pheromone on the path followed by the ant. They follow simple rule of following the path which has higher concentration of pheromone. The pheromone concentrations on a path allow the other ants to find their way to the food source. Thereby more ants follow the same path and more and more pheromone is deposited on the path which is the shortest route to the food source.

3.3 Proposed methodology: Flowchart

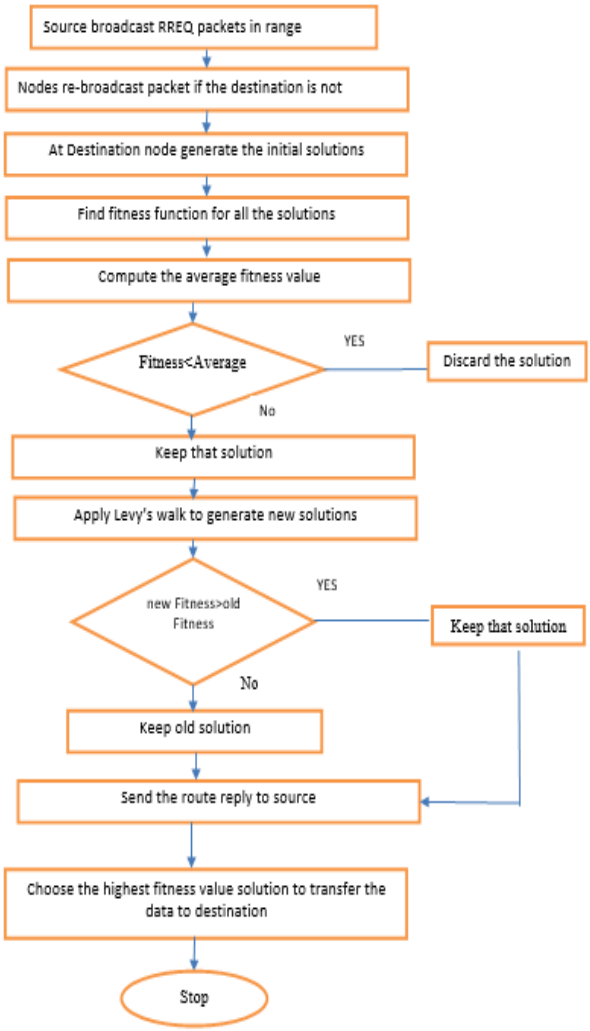

Figure 5: Proposed Flowchart

IV. RESULT ANALYSIS

4.1 Simulation Analysis

Table 1: Simulation Scenario

4.2 Result Analysis

Parameter	**Value**
Area	2000*2000 m^2
Sensor nodes	100-700
Initial energy of node	0.5 J
Number of rounds	5000
Communication range	100 m
EFS (energy for data receiving)	1PJ/m^3(pico joule)
Packet size	2000 bit
Message size	200 bit
E_{DA}	5nj/bit
D_0	87m

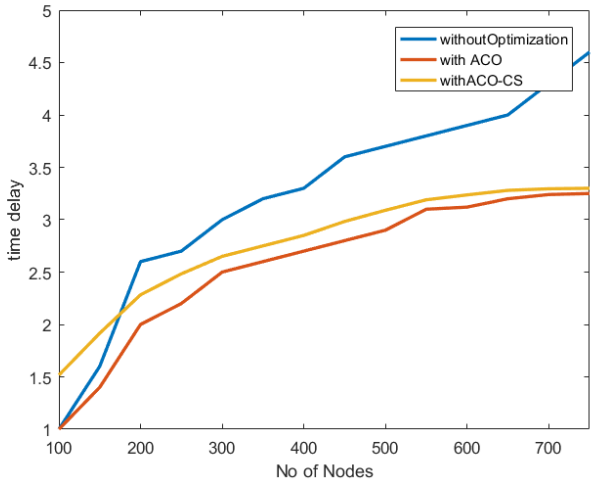

Figure 6: Time Delay vs. No. of Nodes

Figure 6 is plotted between time delay and no.of nodes. Without Optimization time delay is maximum and with ACO it reduces. Further with ACO-CS it reduces even more and becomes stable.

WITHOUT Optimization : x-axis (no. of nodes) = 650 (max value); y-axis (time delay) = 4 (max value)

WITH ACO : x-axis (no. of nodes) = 630 (max value); y-axis (energy) = 3.1 (max value)

WITH ACO-CS : x-axis (no. of nodes) = 600 (max value); y-axis (energy) = 3.2 (max value)

Table 2: Time delay vs. No. of nodes (without ACO, with ACO, with ACO-CS)

Graph b/w time delay (y-axis) and no. of nodes (x-axis)	WITHOUT OPTIMIZATION	WITH ACO	WITH ACO-CS
	x-axis = 650 y-axis = 4	x-axis = 630 y-axis = 3.1	x-axis = 600 y-axis = 3.2

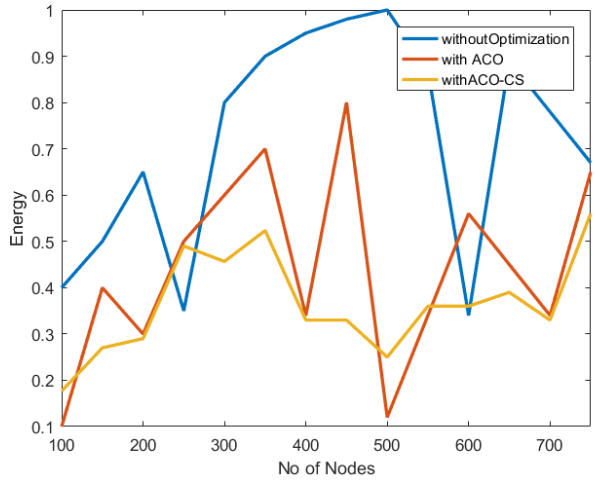

Figure 7: Energy vs.No. of Nodes

This graph (figure 7) shows the relation between energy and no.of nodes. Without Optimization energy used is maximum and with ACO-CS it reduces. Further with ACO it reduces even more. The values are shown below:

Further with ACO it reduces even more. The values are shown below:

WITHOUT Optimization : x-axis (no. of nodes) = 500 (max value); y-axis (energy) = 1 (max value)

WITH ACO : x-axis (no. of nodes) = 450 (max value); y-axis (energy) = 0.1 (max value)

WITH ACO-CS : x-axis (no. of nodes) = 350 (max value); y-axis (energy) = 0.9 (max value)

Table 3: Energy vs. No. of nodes (without ACO, with ACO, with ACO-CS)

Graph b/w energy (y-axis) and no. of nodes (x-axis)	WITHOUT OPTIMIZATION	WITH ACO	WITH ACO-CS
	x-axis = 500 y-axis = 1	x-axis = 450 y-axis = 0.1	x-axis = 350 y-axis = 0.9

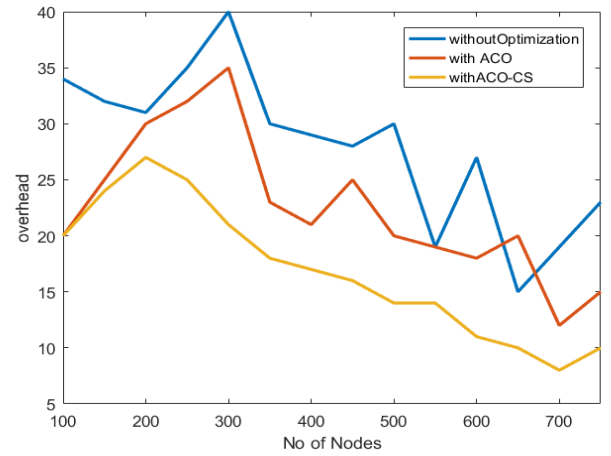

Figure 8: Overhead vs. No. of nodes

This graph (figure 8) depicts the relation between overhead and no.of nodes. The maximum value is without Optimization and with ACO it reduces. Further with ACO-CS it reduces even more. The values are shown below:

WITHOUT Optimization : x-axis (no. of nodes) = 260 (max value); y-axis (overhead) = 34 (max value)

WITH ACO : x-axis (no. of nodes) = 260 (max value); y-axis (overhead) = 20 (max value)

WITH ACO-CS : x-axis (no. of nodes) = 200 (max value); y-axis (overhead) = 20 (max value)

Table 4: Overhead vs. No. of nodes (without ACO, with ACO, with ACO-CS)

Graph b/w overhead (y-axis) and no. of nodes (x-axis)	WITHOUT OPTIMIZATION	WITH ACO	WITH ACO-CS
	x-axis = 260 y-axis = 34	x-axis = 260 y-axis = 20	x-axis = 200 y-axis = 20

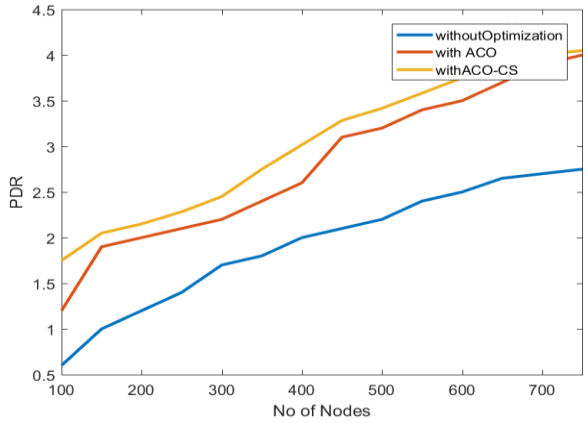

Figure 9: PDR vs. No of Nodes

This graph (figure 9) depicts the relation between PDR and no.of nodes. The Preliminary Design Review (PDR) forms the Allocated Baseline of a system and ensures that the system is operationally effective. The graph shows the system is more stable with ACO-CS.

WITHOUT Optimization : x-axis (no. of nodes) = 650 (max value); y-axis (PDR) = 2.5 (max value)

WITH ACO : x-axis (no. of nodes) = 630 (max value); y-axis (energy) = 3.7 (max value)

WITH ACO-CS : x-axis (no. of nodes) = 620 (max value); y-axis (energy) = 3.8 (max value)

Table 5: PDR and no. of nodes (without ACO, with ACO, with ACO-CS)

Graph b/w PDR (y-axis) and no. of nodes (x-axis)	WITHOUT OPTIMIZATION	WITH ACO	WITH ACO-CS
	x-axis = 650 y-axis = 2.5	x-axis = 630 y-axis = 3.7	x-axis = 620 y-axis = 3.8

Table.6: Comapartive analysis

Graph b/w overhead (y-	WITHOUT OPTIMIZATION	WITH ACO	WITH ACO-CS

axis) and no. of nodes (x-axis)	x-axis = 260 y-axis = 34	x-axis = 260 y-axis = 20	x-axis = 200 y-axis = 20
Graph b/w energy (y-axis) and no. of nodes (x-axis)	x-axis = 500 y-axis = 1	x-axis = 450 y-axis = 0.1	x-axis = 350 y-axis = 0.9
Graph b/w time delay (y-axis) and no. of nodes (x-axis)	x-axis = 650 y-axis = 4	x-axis = 630 y-axis = 3.1	x-axis = 600 y-axis = 3.2
Graph b/w PDR (y-axis) and no. of nodes (x-axis)	x-axis = 650 y-axis = 2.5	x-axis = 630 y-axis = 3.7	x-axis = 620 y-axis = 3.8

IV CONCLUSION

The generation of devices with actuating capability of communication brings the vision of Wireless sensor network (WSNs) closer, where the actuation and sensing functions seamlessly combine into the environment along with possible generation of new capabilities through rich access of newly built sources of information. The evolution on the basis of future generation mobile system will basically depend on the user's based creativity in modelling advanced applications. WSN presents a technology i.e. ideal emerging to attract the domain by providing newly built data. This paper helps to improve the routing either with or without the process of optimization. But the analysis done on the basis of optimization process helps to improve more in terms of parameters such as drop, energy etc.

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