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BSRS: Best Stable Route Selection Algorithm for Wireless Sensor Network Applications

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Abstract -Topological changes in sensor networks frequently render routing paths unusable. Such recurrent path failures have detrimental effects on the network ability to support QoS-driven services. Because of connectivity richness in sensor networks, there often exist multiple paths between a source and a destination. Since many applications require uninterrupted connectivity of a session, the ability to find long-living paths can be very useful. In this paper, we propose *Best Stable Route Selection (BSRS)* approach based on Artificial Bee Colony based search algorithm, ensures that contributes stable quality performance of network and to calculate the best stable path services randomly based on QoS parameter requirements and existing circulation load; so that efficient route selection can easily capture by designing of proposed *BSRS* approach. The implementation of the proposed BSRS technique is implemented using NS2 simulation environment and the AODV routing protocol is used to incorporate the proposed algorithm. The experimental results are measured in terms of end to end delay, throughput, packet delivery ratio, and energy consumption and routing overhead. The results show the proposed BSRS algorithm improves the flexibility of network node and performance of network when multiple inefficient paths exist.

Keywords: *Wireless Sensor Network, QoS, NS2, network node, ACO, ABC, Stable Route, Path Selection*

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I. INTRODUCTION

Wireless communications become significantly available and inexpensive with the development of various network technologies, such as Wireless Local Area Networks (WLANs) and 4G cellular systems. Today, people sitting at either ends of the country can communicate with each other with the help of wireless technology. But **e**nergy efficiency is a critical issue for battery-powered sensor devices in wireless sensor networks and routing based on energy relate parameters is used to extend the network lifetime. Quality-of-service (QoS) routing, in sensor network, is difficult because the network topology may change constantly and the available state information for routing is inherently imprecise. Designing of Routing protocol is an important issue for a mobile ad-hoc network. Due to frequent changes in the topology of the network this becomes a major technical challenge. Node crash and link break in the network may cause losses of the networks resources [1] [2].

A. About WSN

Wireless sensor networks are the collection of nodes where each node has its own sensor, processor, transmitter and receiver and such sensors usually are low cost devices that perform a specific type of sensing task. Being of low cost such sensors are deployed densely throughout the area to monitor specific event. The wireless sensor networks mostly operate in public and uncontrolled area; hence the security is a major challenge in sensor applications. Wireless sensor network (WSN) is a heterogeneous system combining thousands to millions of tiny, inexpensive sensor nodes with several distinguishing characteristics. It has very low processing power and radio ranges, permitting very low energy consumption in the sensor nodes, and performing limited and specific sensing and monitoring functions [3].

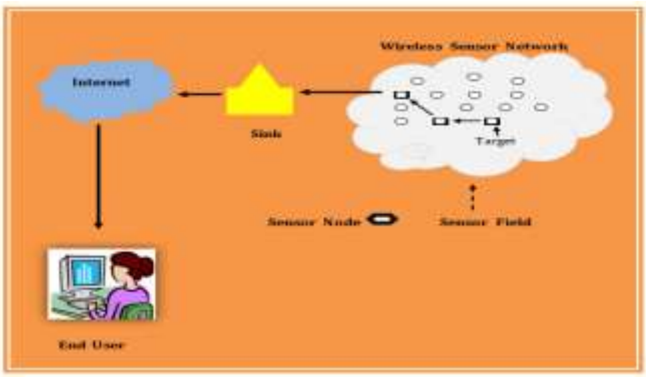

Figure 1: a typical WSN Model

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Wireless sensor nodes contain array of sensors in case of multiple data collection. The sensor node can be put for continuous or selective sensing, location

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sensing, motion sensing and event detection etc. A base station links the sensor network to sense, process and disseminate information of targeted physical environments [4] [5].

B. Best Path Selection Routing

In WSN single path routing may fail in most of the cases due to frequent node mobility. Consequently, Multi path routing scheme has been employed. Multiple paths between the source node and the destination nodes could be found using Multipath routing protocol. These multiple paths make the transmission more reliable and more efficient. To transmit data only best path is selected among the available paths based on some metric such as delay, bandwidth availability, delivery ratio, route stability etc [6].

Routing in WSN has been a challenging task because of high degree of node mobility. Using alternative path may resolve this problem. Multiple paths between source and destination are determined by route discovery. Routing protocol selects an alternative path based on some metrics such as hop count, speed of path, time to deliver content, path reliability, and its bandwidth. Routing protocols in conventional wired networks generally use either distance vector or link state routing algorithms, both of which require periodic routing advertisements to be broadcast by each router. The Traditional shortest path algorithms work correctly only when all nodes maintain routes to all destinations. However, in on-demand routing protocols, a node need not maintain routes to all destinations. To overcome the problems associated with the link-state and distance-vector algorithms a number of on demand routing protocols have been proposed for WSN (Dynamic Source Routing (DSR) protocol and Ad-hoc Ondemand Distance Vector (AODV) routing protocol etc.) [7].

The remaining content of the paper is organized as follows: Section II describes related work. In Section III, proposed scheme is discussed for making WSN flexible for data transmission, Implementation of the proposed scheme is covered in Section IV and Result Section is V. Finally conclusion and future directions are given in Section VI.

II. LITERATURE SURVEY

Many of the proposed WSNrouting protocols in the literature have limited provisioning for QoS and use paths discovered without regard to path reliability or longevity. Possessing a priori knowledge of the mobility-induced in a path-selection algorithm will reduce the overhead as a result of fewer path failure notifications and of less need for path rediscovery. This in turn will make better use of the scarce bandwidth in the network.

In a wireless sensor network, routing messages between two nodes s and t with multiple disjoint paths will increase the throughput, robustness and load balance of the network. The existing researches focus on finding multiple disjoint paths connecting s and t efficiently, but they do not consider length constraint of the paths. A too long path will be useless because of high latency and high packet loss rate. ***Kejia Zhang et al. [8]*** deals with such a problem: given two nodes s and t in a sensor network, finding as many as possible disjoint paths connecting s and t whose lengths are no more than L, where L is the length bound set by the users. This paper proposes an efficient distributed algorithm for this problem. By processing in a distributed way, the algorithm is very communication efficient. Simulation results show that our algorithm outperforms the existing algorithm in both aspects of found path number and communication efficiency.

Energy conservation in Wireless Sensor Networks (WSN) is a crucial venture as their miniaturize nature limits their power capabilities. An effective way of energy conservation is the adoption of efficient routing of data from source to sink. ***M. Okwori et al. [9]*** investigates the performance of two meta-heuristic algorithms, Ant Colony Optimization (ACO) and Firefly Algorithm (FA) on optimal route detection in a WSN routing management system. An adapted ACO was used to search for optimal routes between selected sources and sink nodes, after which a developed Discrete FA ran same search. Performance of both were tested on sensor networks deployed randomly, in a clustered pattern and finally randomly-clustered. Evaluators used were energy budget of reported routes. Results show that FA was able detect routes with less cost than those detected by ACO for short routes while ACO performed better with longer routes. Considering the enhanced speed of performance of ACO in comparison to FA and the local search nature of FA, it would be beneficial for future work to explore a hybridized FA-ACO algorithm.

Wireless Sensor Network WSN is tightly constrained for energy, computational power and memory. All applications of WSN require to forward data from remote sensor node SN to base station BS. The path length and numbers of nodes in path by which data is forwarded affect the basic performance of WSN. In this paper Aniket. ***A. Guravet al. [10]*** present bio-Inspired Ant Colony Optimization ACO algorithm for Optimal path Identification OPI for packet transmission to communicate between SN to BS. Our modified algorithm OPI using ACO considers the path length and the number of hops in path for data packet transmission, with an aim to reduce communication overheads.

Wireless Sensor Network WSN is tightly constrained for resources like energy, computational power and memory. Many applications of WSN require to communicate sensitive information at sensor nodes SN to Base station BS. The basic performance of WSN depends upon the path length and numbers of nodes in the path by which data is forwarded to BS. In this paper ***Aniket. A. Gurav et al. [11]*** present bio-inspired Ant Colony Optimization ACO algorithm for Optimal Path Identification OPI for packet transmission to communicate between SN to BS. This modified algorithm OPI using ACO is base-station driven which considers the path length and the number of hops in path for data packet transmission. This modified algorithm finds optimal path OP as well as several suboptimal paths between SN & BS which are useful for effective communication.

Tsirigos and Z.J. Haas [12] proposed the Distance- Based Energy Efficient sensor Placement (DBEEP) for lifetime maximization, which jointly optimize the load balance, communication range, and network size in a time driven linear WSN. DBEEP identifies the traffic load balancing as a critical issue that must be addressed at each node in a balanced traffic flow. This is important since the load balancing on a particular node can increase the network lifetime. The DBEEP comes with an energy model that assumes those nodes, which only relay data to the next node in the direction of the radius is lost. In this model, the configuration refers to the arrangement of those related nodes that are deployed along the radius. If the adjacent nodes have$d_1 > d_2 \dots > d_n$ the connected coverage of the inside nodes will be ensured

III. PROPOSED WORK

To solve the issue of best path selection, which show that route stability during network life time Here, we enlist basic 3 modules of our methodology that construct entire system that proving efficiency and effectiveness of this work.

1. **Basic Assumption**
2. **Assigning Parameter**
3. **Algorithm Selection**

1. Basic Assumption:

For securing network, the proposed algorithm is developing using different constraint. So that we basically we need to assume some constraints to progress further. In this, firstly we create a normal network where with different number of network e.g. 50, 100, 120, 160 and 200.

Initialize the Network, with N nodes where$N = 1, 2, 3, \dots\dots$,, in ideal condition

S initiates a RREQ message with the following components:

– The IP addresses of S and D

– The current sequence number of S and the last known sequence number of D

– A broadcast ID from S. This broadcast ID is incremented each time S sends a RREQ message.

The pair of the source S forms a unique identifier for the RREQ.

For route discovery, we process a route request RREQ to all other node except the node which is generating request. Therefore, source node wait for the route reply i.e. RREP which is coming from that node to its match broadcast ID and IP address.

Secondly, for processing proposed method, we use some network parameter to process the use of ABC algorithm from this we get the best result of route selection. In next point we assume some basic parameter which is used to help algorithm manipulation for is discussed.

2. Assigning Parameter

In this section we describe assigned parameter to proposed approach by we have apply ABC algorithm. Following are the parameter:

✓ **Buffer Length:** The buffer or queue length of a node demonstrates the amount of workload which is processed by any node. In this context the amount of buffer length is free to use indicate the node if free and can able to serve better the cluster members. This here for the length of buffer the letter B is used.

✓ **Signal Strength Power:** The signal strength of a node shows the transmission power ability thus for more optimal node selection the signal strength of the node is used. The signal strength of the node can be represented using the letter S for further discussion.

A single line-of-sight path between two sensor nodes is seldom the only means of propagation. The two ray ground reflection model considers both the direct path and a ground reflection path. It is shown that this model gives more accurate prediction at a long distance than the free space model.

✓ **Number of Connection:** A single node shows how many connections are employed in network to the particular node. This is simply the connectivity of the node. If there are diverse numbers of node which are moving randomly and node connected to one to other. Therefore communication is happened using node connection.

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3. Algorithm Selection: This is the main phase of methodology that proven the effectiveness of best route selection. Our approach is different to base approach in terms of algorithm. In base method Ant Colony Optimization base user connectivity is proposed, but in proposed Based Stable Route Selection method we are using Artificial Bee Colony (ABC) algorithm. Following are the basic explanation of ABC algorithm:

Based on the behaviour of the bees in nature, various swarm intelligence algorithms are available. These algorithms are classified into two; foraging behaviour and mating behaviour. Artificial Bee Colony is a predominant algorithm simulating the intelligent foraging behaviour of a honeybee swarm, proposed by Karaboga and Basturk. In ABC algorithm, the colony of artificial bees contains three groups of bees: employed bees, onlookers and scouts [10].

A bee waiting for the dance area for making a decision to choose a food source is called onlooker and one going to the food source visited by it before is named employed bee. The other kind of bee is scout bee that carries out random search for discovering new sources. The position of a food source represents a possible solution to the optimization problem and the nectar amount of a food source corresponds to the quality (fitness) of the associated solution. A swarm of virtual bees is generated and started to move randomly in two-dimensional search space. Bees interact when they find some target nectar value [35].

3.3.1 Proposed Algorithm

The entire process of the Best path selection approach can be summarized as the algorithm the table 3.1 shows the process of the proposed algorithm:

Table 1: Best Stable Route Selection Algorithm

Input: Number of Node

Output: Best Route Selection O

Process:

1. Source node initiate route discovery by RREQ
2. Destination send replay by RREP
3. Source wait for all replay
4. Prepare routing table T
5. $for(i = 1; i < T.length; i++)$
   a. $Route_l = T.nextHop$
6. End for
7. $POP_l = Route_l$
8. $for\ each\ node\ N\ in\ POP_l\ do$
   a. Find signal strength S, degree of node D, Buffer length B
   b. $Fit = node.computeFitness(S, D, B)$
   c. Aggregate Fit to path as $FitPathVal$
9. End for
10. $O = ABC.Optimize(POP_l, FitPathVal)$
11. Return O

IV. IMPLEMENTATION

The simulation is being implemented in the Network simulator [14]. Protocol used here is AODV.

Table 2 Simulation Scenarios

Parameters	Values
Antenna Model	Omni Antenna
Dimension	1000 X 1000
Radio-Propagation	Two Ray Ground
Channel Type	Wireless Channel
Traffic Model	CBR
Routing Protocol	AODV
Mobility Model	Random Waypoint
Number of Node	50, 100, 120, 160, 200

*1. Simulation of existing BIOSARP with AODV Routing Protocol:*In this network recreation the network is configured using the AODV routing protocol with existing approach. The given simulation screen shows that all nodes are spread in topography area to communicating each other simultaneously data packets are transfer from source to destination. The simulation of base BIOSARP is implemented with different nodes size 50, 100, 120, 160, 200.

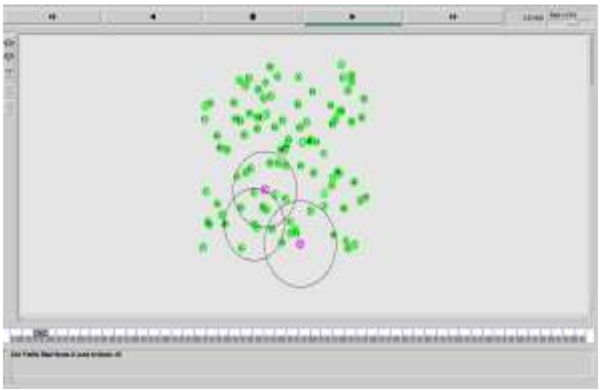

Figure 2 BIOSARP under AODV

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*2. Simulation of Proposed BSRS i.e. Best Stable Route Selection using AODV Routing Protocol:*In this phase, proposed best route selection method is demonstrated in figure 4.3. In this simulation screen the green nodes show as normal network nodes under AODV modification. When proposed method is deployed network performance is improve and huge number of packet is delivered to the destination. The proposed method is very efficient when there are multipath exist when nodes are communicating for data communication. Consequently, huge numbers of data are received on destination side. The entire working of the proposed work is performed effectively and maintains route stability of all session of communication.

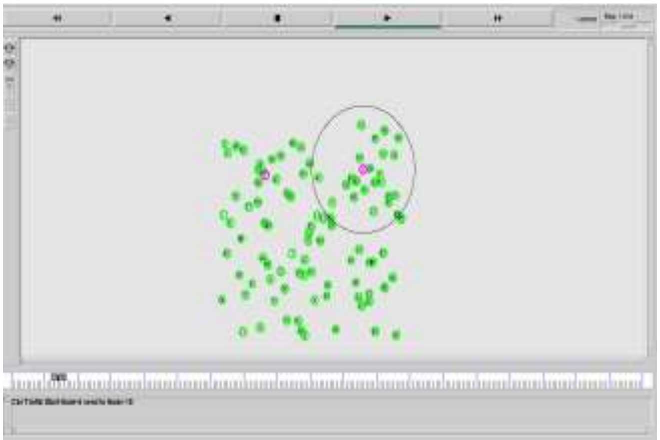

Figure 3 Proposed Stable Route Selections

V. RESULT ANALYSIS

A. End to End delay

End to end day on network refers to the time taken, for a packet to be transmitted across a network from source to destination device, this delay is calculated using the below given formula.

$$E2EDelay = ReceivingTime - SendingTime$$

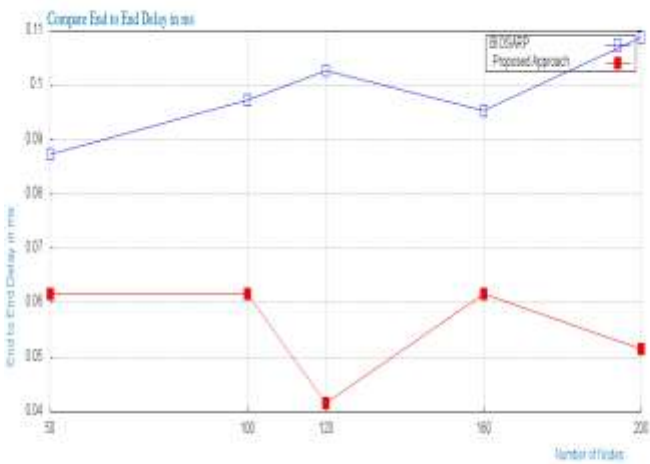

Figure 4 End to End Delays

Figure 4 shows the comparative End to End Delay of the base BIOSARP approach and the proposed best stable path finding technique. In this figure 4 the X axis contains the number of nodes in network and the Y axis shows the performance of network in terms of milliseconds. According to the obtained results the proposed technique is produces less end to end delay as compared to traditional technique under different nodes. Therefore the proposed technique is applicable for efficiently select available stable route produces less amount of time.

B. Packet Delivery Ratio

The performance parameter Packet delivery ratio sometimes termed as the PDR ratio provides information about the performance of any routing protocols by the successfully delivered packets to the destination, where PDR can be estimated using the formula given:

$$PDR\ (\%) = \frac{TotalDeliveredPackets}{TotalSentPackets} X100$$

The comparative packet delivery ratio of the networks is given using figure 5, in this diagram the X axis shows the number of nodes in the network and the Y axis shows the amount of packets successfully delivered in terms of the percentage. The blue line of diagram represents the performance of the base BIOSARP technique and the red line shows the performance of the proposed technique. According to the obtained results the proposed technique delivers more packets as compared to the traditional technique even when the network contains various multiple routes from source to destination therefore the proposed technique able to escape the inefficient route and improve the network performance.

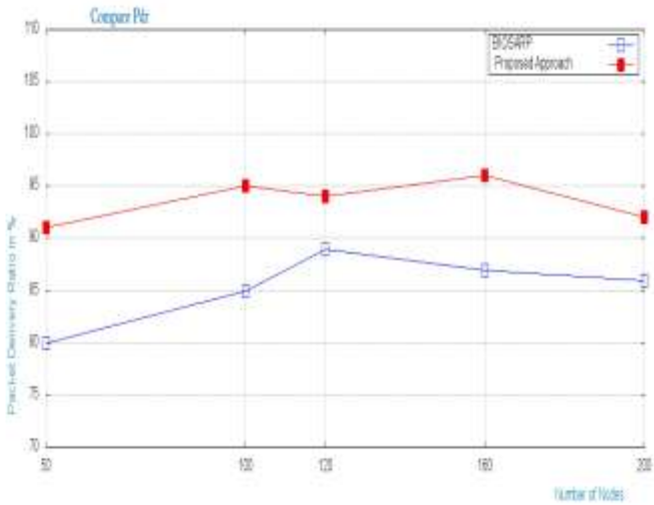

Figure 5 Packet Delivery Ratios

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C. Throughput

Network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

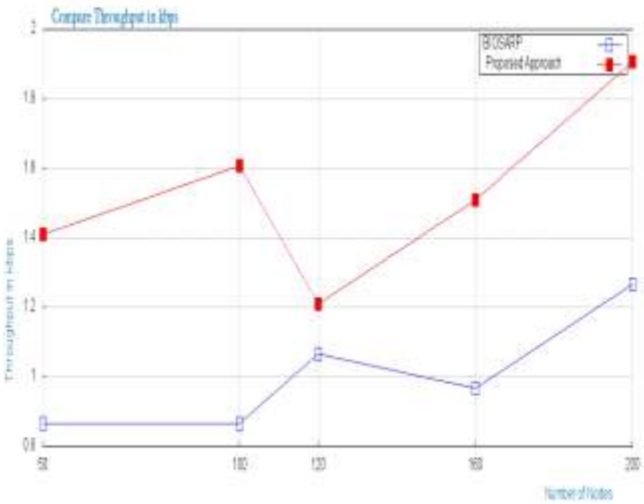

Figure 6 Compare Throughput

The comparative throughput of the network is demonstrated using figure 6 in this diagram the X axis shows the number of nodes in network and the Y axis shows the throughput of the network in terms of KBPS. The red line in this diagram shows the performance of the proposed technique and the blue line shows the performance of the traditional BIOSARP method. According to the achieved performance the proposed technique improve the throughput of the network also therefore the technique is effectively avoid the network traffic because route stability and there are multiple disjoint routes exist as compared to the traditional BIOSARP technique.

D. Routing Overhead

During the communication scenarios it is required to exchange the packets for different tracking and monitoring purpose. Therefore the additional injected packets in network is termed as the routing overhead of the network. The comparative routing overhead of both the route stability approach i.e. base BIOSARP and the proposed BSRS technique is given using figure 7. In this diagram the X axis shows the amount of network nodes exist during the experimentation and the Y axis shows the routing overhead of the network. In this diagram for demonstrating the performance of the proposed technique the blue line is used and for base approach BIOSARP shows using blue line. According to the achieved performance the proposed technique produces less routing overhead as compared to the traditional BIOSARP technique. Therefore the proposed technique offers higher bandwidth utility as compared to the traditional routing technique under different number of nodes.

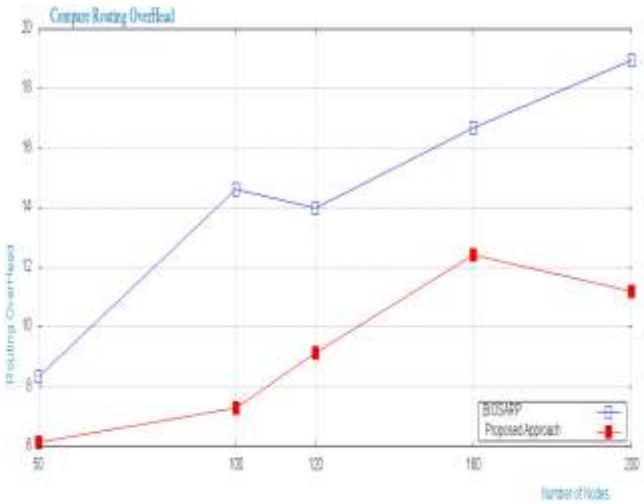

Figure 7 Routing Overhead

E. Consumed Energy

The amount of energy consumed during the network events is termed as the energy consumption or the energy drop of the network. In networking for each individual event a significant amount of energy is consumed. The given figure 8 shows energy consumption of the network for different number of nodes. The red line of the diagram shows the amount of energy consumed with the AODV routing protocol under BSRS algorithm additionally the blue line shows the amount of energy consumed during the proposed algorithm based network. In the traditional BIOSARP the network energy is frequently consumed as compared to the efficient path selecting algorithm. Therefore the proposed technique is effective and able to recover the network whereas different nodes are simulated.

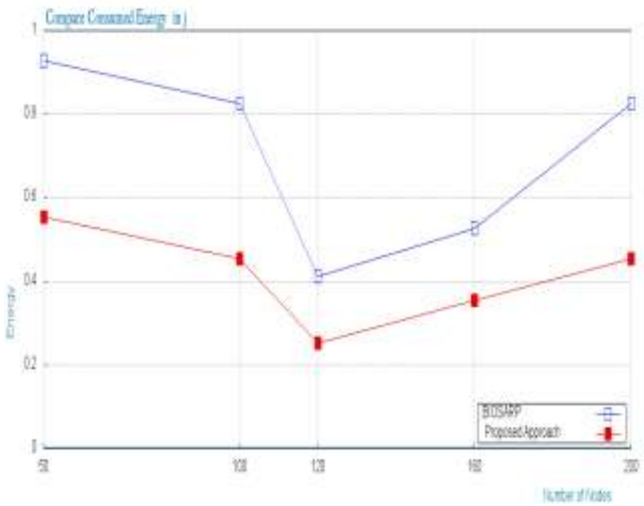

Figure 8 Energy Consumption

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VI. CONCLUSION

Wireless sensor networks (WSNs) have attracted significant attention over the past few years. Finding the optimal path in dynamically changing resource constrained WSN is challenging. The main purpose of wireless sensor networks is to collect sensing data in target environments. It is important to guarantee that the sensing data are transmitted to the sink node. In normal WSN, multi hop routing has been established using Co-operative Communication. Links unreliability poses a critical issue in such an environment. This Proposed work allowed the network to establish stable routes necessary to correct and efficiently deliver network data to the destination in a more reliable manner. To discover optimal route which is ensure high stability for a long time that maintain the all communication session during each simulation of network. Proposed approach is based on the Ant Colony Optimization heuristic search algorithm. Therefore, for a long time, it means that to get most optimal path, we need different number of ants like 50, 100, 120, 160 and 200 to explore the map and find optimal solutions. The proposed BSRS based best route selection for high stability has achieved better data aggregation in an efficient and effective manner in terms of the parameters such as Packet Delivery Ratio, Energy Consumption, End to End Delay and Routing Overhead.

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