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Efficient Data Transmission in WSN using AODV Protocol Considering Throughput

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Abstract*: Creating an environment using Wireless Sensor nodes, deployed with limited resources to monitor and communicate within themselves is termed as Wireless Sensor Network (WSN). Due to the limited resources used, one of the important factors to be considered is network lifetime. Secure Real-Time Load Distribution (SRTLD) is a routing protocol which will boost the network life time. SRTLD protocol contains some issues such as very high power consumption due to broadcasting at every hop, added delay and data loss. This reduces the data transmission rate in the WSN. Ant Colony Optimization (ACO) proves to be a meta-heuristic algorithm practically, as it used the ant's behavior to find optimized route. Biological Inspired Self-Organized Secure Autonomous Routing Protocol (BIOSARP) applies a self-organized autonomous routing protocol which is secure and also biologically inspired. It uses a better algorithm considering only pheromone value for the sake of Data Transmission. But in absentia of pheromone value another alternative way to find path is not an easy task. In this paper, we calculate energy level, cost as well as throughput of each node by the usage of AODV protocol and arrive at an optimal routing path. The results of AODV are promising and proved to outperform the simulation tool in terms of network connectivity time, energy-efficient routing and data delivery ratio.

Index Terms*: Secure real-time load distribution, Ant colony optimization, autonomous agent, packet delivery ratio, energy efficiency, adhoc on demand distance vector routing.

I. INTRODUCTION

WSN's comprises of randomly places nodes in an environment. Every node contains limited energy, so the nodes contact the central nodes via neighboring nodes. Since there are various possible routes to reach the central node, an optimal path must be selected. And also, if in case one single optimal path is used repeatedly, all the nodes along that path gets deprived of their energy which further results in sensor destruction. IEEE 802.15.4 sets the standard for the architecture of WSN systems. It aims at cheaper ubiquitous communication among neighbor devices. However, when it comes to failures in WSN, it's usually caused due to exhaustion of the battery power, durations of inactivity and its vulnerability to get destroyed because of its small-size.

The main challenge of the dynamic WSN is the short network life time. Routing protocol like SRTLD has improved life time when compared to other protocol such as MMSpeed, RPAR. It uses broadcast packets to discover the surrounding nodes and calculates every time during the transmission of data packets. This protocol depends on optimal forwarding which calculates the quality of the link, packet delay time, and the unconsumed power of neighboring sensor nodes. The parameters chosen for a next node using multi-path forwarding and location aware routing will be used to build the security. The conversion of packet header with authentication provides additional security for effective packet transfer. SRTLD routing protocol have some limitation [7] since it is broadcasting the request to all nodes it consumes high energy. Although it increases the life time of the WSN, there is a loss of packet and hence the data transmission rate in the WSN reduces.

The Biological Inspired Self-Organized Secure Autonomous Routing Protocol (BIOSARP) is a novel approach to improve SRTLD with self-optimized secure routing mechanism which is autonomous also. BIOSARP protocol relies on the decision of optimal forwarding which is decided by the Ant Colony Optimization (ACO). Attributes such as end-to-end delay, data reception rate and battery power, etc. are the deciding factors for calculating pheromone value in ACO. BIOSARP protocol for routing was designed in such a way in order to reduce the overhead of broadcast packet as a result of minimized delay, lower power consumption as well as reduced packet loss in WSN. This paper proposes the implementation, design and simulation result about adhoc on demand distance vector routing protocol (AODV) protocol. The AODV protocol gives optimal routing path based on calculating energy level, cost and throughput of every node. Furthermore, AODV simulation results is compared with those of SRTLD, BIOSARP in which comparison shows about that AODV outperforms improved network lifetime, packet delivery ratio, improved energy-efficient routing.

II. RELATED WORK

A. Secure Real-Time with Load Distribution (SRTLD)

SRTLD having five different modules like routing management, location management, neighborhood management, power management and security [7]. The location was measured in location management; each sensor node finds its location based on the distance to three pre-determined neighbor nodes. The transceiver power and the transmission power of the sensor node measured in power management module.

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The neighbor hub the board finds a subset of sending hubs and keeps up a neighbor table of the sending competitor hubs. The ideal sending decision, information exchange choice, and steering way developments are kept up by directing administration. The security mechanisms like encryption, decryption and authentication during the packet transmission are managed by the security management.

SRTLD depends mainly on optimal forwarding (OF). In order to calculate the OF, three parameters are calculated in turn by the routing management such as packet velocity, link quality and remaining power. Subsequently, the data packet will be forwarded to an one-hop neighbor with optimal forwarding by the router management. Security of the environment will be enhanced if parameters such as multi-path forwarding and location aided routing are chosen for next hop. Additionally, packet header can be converted along with authentication which will provide more security.

B. BIOSARP

Biological inspired self-organized Secure Autonomous Routing Protocol (BIOSARP) has been introduced to enhance SRTLD since it consumes high energy consumption and less packet delivery ratio which was proved in [10]. In BIOSARP IACO algorithm is used which has three operational modules they are route management, neighbor management and power management. The system design and brief description of these three functional modules are described in [3].

Chandni and Kanika Sharma [10] took into account many routing protocols of WSN and concluded that ACO is best. ACO is more suitable for general purpose routing and optimizing, which purely depends on the foraging behavior of ants. Pheromone is a chemical substance which these ants deposit while walking to and from any food source. And thereby they arrive at a shortest path for other members of the group. In the same way in ACO, nodes/agents are placed as artificial ants which in turn solved many problems of optimization. The ant like agents moves in the network hopping from node to node, updating their routing tables called as pheromone table. Thus as they visit each node, they record what they learned during their traversal. Subsequently, the best path is chosen by the agents from the updated pheromone table.

In [14], the lifetime of the sensor nodes is maximized by introducing a novel ACO algorithm which has two main aspects. First the algorithm uses two types pheromone to find the coverage cover efficiently in heterogeneous WSN and the second one is the introduction of low power state. In [13], to verify the built up connection with the base station, Benamar Kadri proposed to execute a handshake amid the course disclosure stage. In this manner, every sensor when gets a FANT, utilizes the BANT as help to execute a handshake to share a symmetric scrambling key with the base station.

Life time of the nodes in WSN can be increased by using a novel ACO algorithm with two main aspects. Firstly, the algorithms use pheromone of two types to find coverage cover in heterogeneous WSN as well as to introduce a reduced power state. While taking security of established links into account, Benamar Kadri proposed an algorithm in which a handshake is executed during the phase of route discovery itself. Hence, every sensor node will receive a FANT, and the BANT is used exclusively to provide support in order to carry forward a handshake, such that, a symmetric encryption key can be shared with the base station.

The BIOSARP and SRTLD are compared in [10] using NS2 simulation tool and proved that BIOSARP produce 11.7% less energy than SRTLD and provides high delivery ratio 2.19% because in SRTLD the delivery ratio decreases due to massive broadcast at every hop. At last Concluded in [10] that because of its self-ruling and self-improved usefulness, BIOSARP performs better in intensely stacked and assaulted ongoing WSN.

III. PROPOSED WORK

The proposed design is shown in Fig.1. First multiple mobility nodes along with some coverage has to be setup. The process begins when we forward the data packet from source to destination. To start with the source node checks whether the pheromone esteem is available in the steering table of the neighbor node. On the off chance that the routing table contains the pheromone value at that point the past way is picked dependent on improved ant colony optimization (IACO) protocol to advance the data packet. Generally the course determination depends on solicitation to course utilizing Adhoc on demand distance vector routing protocol (AODV).This proposed protocol uses four parameters to calculate the next node they are throughput, cost, hop count and the remaining energy. Number of bits that can be transmitted by every node to its goal is known as the per-node throughput. Furthermore, the entirety of per-node throughput over every one of the nodes in a system is known as the throughput of the system.

In the proposed system BIOSARP and AODV protocol are combined. Initially the source node sends the route request to all nodes; it will wait till it reaches the destination. Now the destination node selects the reliable node by considering the parameters like remaining energy, throughput, cost and hop count in absence of pheromone value. Then they send the response to the source node in the selected path. Source node forwards the packet through the path and the pheromone value is simultaneously updated for the nodes in selected path. The source sends all packets to the destination on the selected optimum path.

If the source node sends many packets through that optimum path then the energy, throughput of that path decreases which will leads to packet drop. The proposed AODV protocol will send the broadcast to the neighboring node from where packet drop occurred and sends the packet to the destination node successfully instead rebroadcasting from source node. By using this protocol the packet delivery ratio, network lifetime increases.

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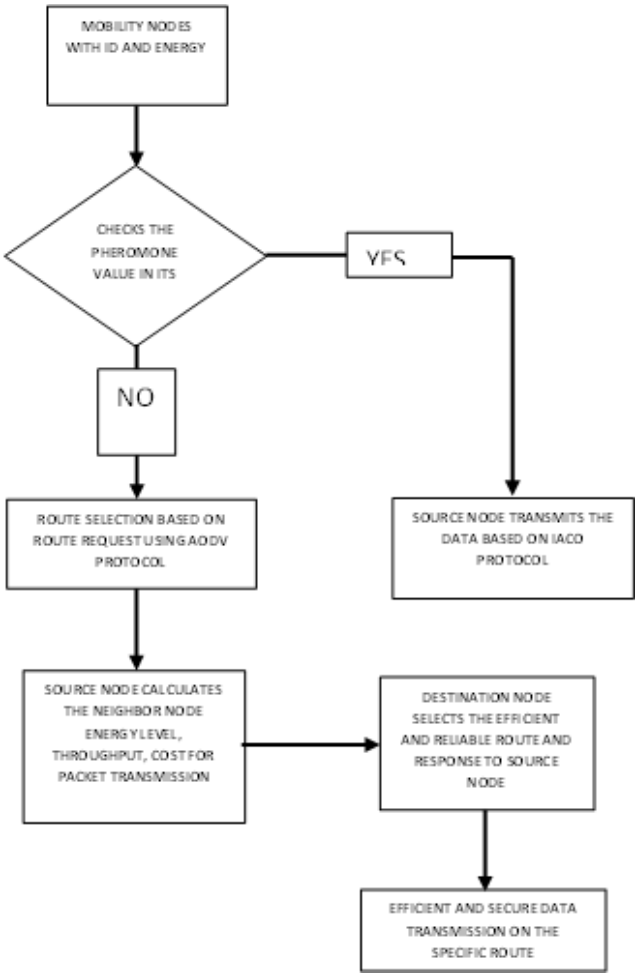

Fig.1 Proposed Design Approach

IV. SIMULATION RESULTS

This section will explain the difference between the SRTLD, IACO and AODV protocol in terms of packet delivery ration, energy consumption, end-end delay, throughput and life time of network

A. Packet Delivery Ratio Packet Delivery Ratio (PDR)

The PDR can be evaluated as the proportion of the quantity of conveyed information bundle between the destination and the source. Figure 2 appears as the check of hub increment it shows signs of improvement since possibility of course breakage diminishes. For figuring the PDR the accompanying recipe can be utilized: number of information bundles that are sent by.

$$PDR = \frac{\sum \text{Number of packet receive}}{\sum \text{Number of packet send}}$$

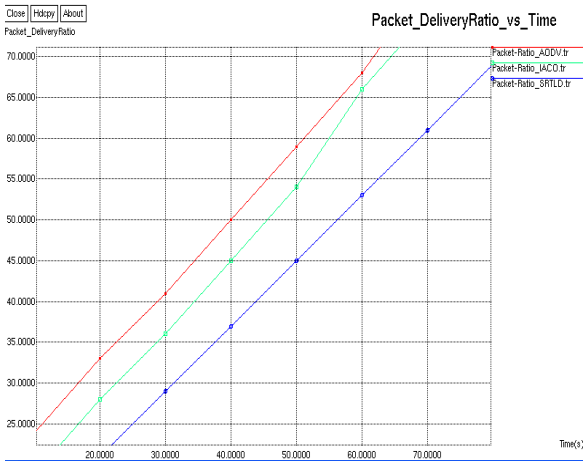

Fig.2 Delivery ratio comparison between SRTLD, IACO and AODV protocol

Figure 2 above show that AODV give high delivery ratio when compared with other two protocols. SRTLD gives poor delivery ratio.

B. Throughput

Number of bits that can be transmitted by a node to its destination is known as the per-node throughput. What's more, the aggregate of per-node throughput over every one of the nodes in a system is known as the throughput of the system

Throughput = File Size / Transmission Time (bps)

Figure 3 below shows the proposed protocol adhoc on demand distance vector routing protocol performs better than improved ant colony optimization.

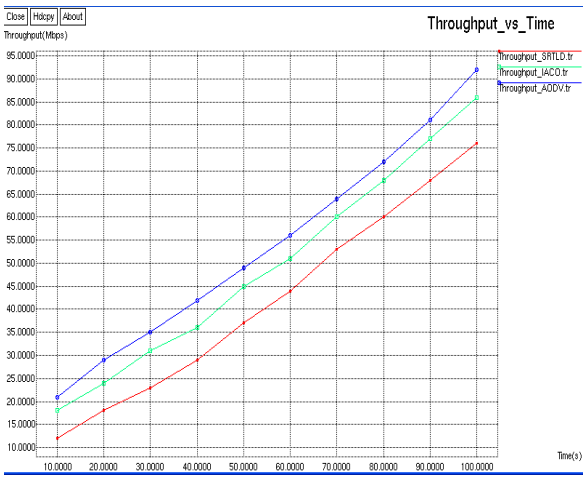

Fig.3 Throughput comparison between SRTLD, IACO and AODV protocol

C. End-End delay

End to end delay is the ordinary time taken by a data group to get in contact in the goal. It is like manner joins the delay brought about by course exposure process and the line in data pack transmission. Simply the data packages that viably passed on to objectives that checked. Equation to ascertain is

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∑ (arrive time – send time) / ∑ Number of connections

The below figure shows SRTLD have high end-end delay when compared with AODV protocol. The lower estimation of end to end delay displays the better execution of the convention.

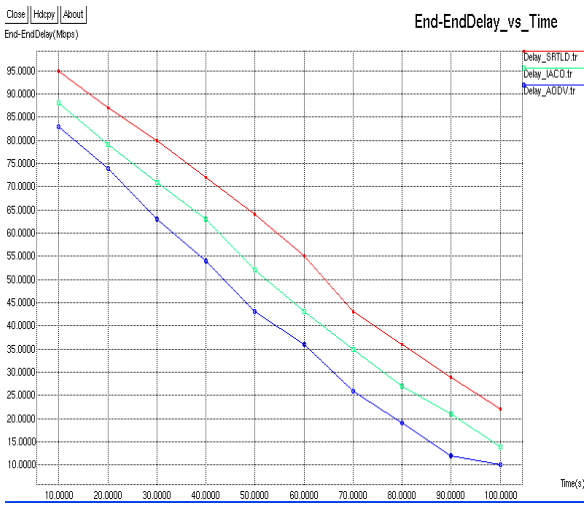

Fig.4 End-End delay comparison between SRTLD, IACO and AODV protocol

D. Network Performance

Network performance implies the aggregate life time of the system. Network lifetime is the time at which the main system node comes up short on vitality to send a packet, on the grounds that to lose a node could imply that the system could lose some usefulness. This is the principle challenge in the remote sensor organize.

Figure 5 below shows that the life time of the wireless sensor networks is increased when AODV protocol is used.

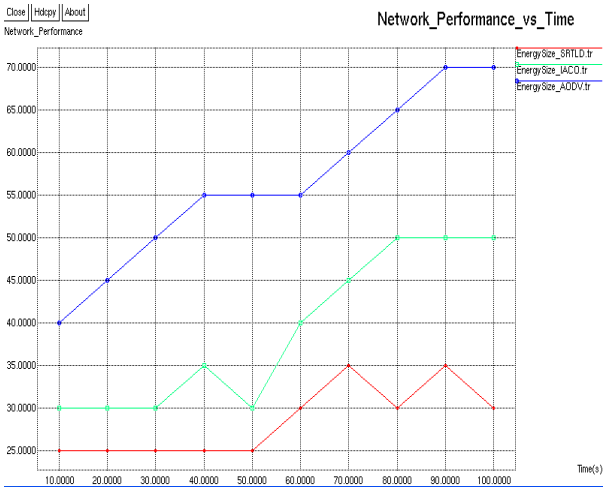

Fig.5 Network performance comparison between SRTLD, IACO and AODV protocol

E. Energy consumption

The energy consumption in this is not about energy consumed for sending packet but about the how much of data energy can be sent through each node. When comparing SRTLD, IACO and AODV protocols .The SRTLD has only limited energy level when compared to other protocols. The IACO also consumes energy but it is far better from SRTLD. The AODV protocol will provide about more energy consumption for each node for packet transmission which will not leads to loss of packet. If it is so, then it chooses alternate node with high energy. So, the below Figure 6 shows that AODV protocol is said to give better performance than the other two protocols.

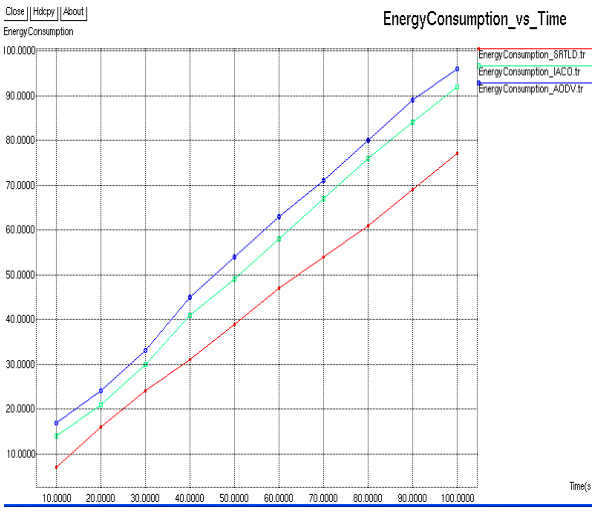

Fig.6 Energy consumption comparison between SRTLD, IACO and AODV protocol

V. CONCLUSION

We have proposed AODV protocol for selecting optimum route to transfer packet from source to destination through mobility nodes in an efficient way. We have enhanced from IACO protocol which is used in BIOSARP in which pheromone value is used for finding route to send packets. The pheromone value may fade away so it should broadcast again to update pheromone value and find path this may take long time and more energy consumption. Even packet delivery ratio is not so high. So we have implemented AODV which considers parameters like hop count, costs, throughput and energy level. These parameters from all the nodes reaches destination and destination choose efficient and optimum path for packet transmission and sends back to source node.

The source node transfers packet continuously with pheromone update and if in case any drop occurs it chooses nearby next node and transfers continuously. Network lifetime is the major challenge in the wireless sensor network; this is also increased using the proposed protocol. Using NS-2 simulator three protocols are compared based on packet delivery ratio, throughput, energy consumption, end-end delay, network performance and showed that AODV protocol Perform best in all these.

REFERENCES

1. M. C. Vuran and I. F. Akyildiz, “XLP: A cross-layer protocol for efficient communication in wireless sensor networks,” *IEEE Trans.Mobile Comput.*, vol. 9, no. 11, pp. 1578–1591, Nov. 2010.
2. S. S. Iyengar, Hsiao-Chun Wu, N. Balakrishnan, and Shih Yu Chang, “Biologically Inspired Cooperative Routing for Wireless Mobile Sensor Networks” IEEE SYSTEMS JOURNAL, VOL. 1, NO. 1, SEPTEMBER 2007.

3. K.Saleem, N.Fisal, S.Hafizah, S.Kamilah and Rozeha A. Rashid "Ant based Self-organized Routing Protocol for Wireless Sensor Networks" International Journal of Communication Networks and Information Security (IJCNIS) Vol. 1, No. 2, August 2009.
4. K. Saleem, N. Fisal, S. Hafizah, S. Kamilah, and R. A. Rashid, " A Self-Optimized Multipath Routing Protocol for Wireless Sensor Networks" International Journal of Recent Trends in Engineering, Vol 2, No. 1, November 2009.
5. G. Chen, T.-D. Guo, W.G. Yang, and T. Zhao, "An Improved ant-based routing protocol in Wireless Sensor Networks," in Collaborative Computing: International Conference on Networking, Applications and Work sharing, 2006. Collaborate Com 2006, Nov 2006, pp.1-7.
6. Rutger Claes Tom Holvoet," Ant Colony Optimization applied to Route Planning using Link Travel Time predictions" IEEE International Parallel & Distributed Processing Symposium 2011.
7. Kashif Saleem, Norsheila Fisal and Jalal Al-Muhtadi, "Empirical Studies of Bio-Inspired Self-Organized Secure Autonomous Routing Protocol "IEEE SENSORS JOURNAL, VOL. 14, NO. 7, JULY 2014.
8. Sasikumar P Shriram K Vasudevan Ramesh M" Heuristic Approaches with Energy Management for Node Placement in Wireless Sensor Networks" International Journal of Computer Applications (0975 – 8887) Volume 1 – No. 3, 2010.
9. M. Ghanaat Pisheh Sanaei, H. Zamani and B. Emami Abarghouei, "Performance Analysis of SRTLD and BIOSARP Protocols in Wireless Sensor Networks", International Journal of Computer Science and Telecommunications Volume 4, Issue 4, April 2013.
10. Chandni and Kanika Sharma, "Comparative analysis of routing protocols in Wireless sensor Network" , IRACST - International Journal of Computer Science and Information Technology & Security (IJCSITS), ISSN: 2249-9555 Vol. 3, No.1, February 2013.
11. Parul Khurana Inderdeep Aulakh, "Wireless Sensor Network Routing Protocols: A Survey" International Journal of Computer Applications (0975 – 8887) Volume 75– No.15, August 2013.
12. Dr. Vuda sreenivasarao, Sreedevi kadiyala, Chandra srinivas potluri, capt. Genetu yohannes "Improving Performance Analysis Of Routing Efficiency In Wireless Sensor Networks Using Greedy Algorithm" (IJARAI) International Journal of Advanced Research in Artificial Intelligence, Vol. 1, No. 2, 2012.
13. Benamar Kadri , Mohammed Feham , and Abdellah Mhammed "Efficient and secured Ant Routing for wireless sensor networks" International journal of network security,Vol16,No.2 Mar 2014.
14. Saburi Parvatkar, Deipali Gore"An ACO Approach to Maximize Lifetime of Heterogeneous WSN "International journal of Computer Science and Information Technologies,vol5(4), 2014.
15. Navjot Singh , Parminder Kaur "Optimization of Energy by using IWD Algorithm in WSN" International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 6, June 2014.
16. Kashif Saleem Norsheila Fisal "Energy Efficient Information Assured Routing based on Hybrid Optimization Algorithm for WSNs" 2013 10th International Conference on Information Technology: New Generations.
17. A. Ahmed, L. A. Latiff, and N. Fisal, "Simulation-based real-time routing protocol with load distribution in wireless sensor networks," Wireless Commun. Mobile Comput., vol. 10, no. 7, pp. 1002–1016, 2009.
18. R. Jovanovic, M. Tuba, and D. Simian, "Comparison of different topologies for Island-based multi-colony ant algorithms for the minimum weight vertex cover problem," WSEAS Trans. Comput., vol. 9, no. 1, pp. 83–92, Jan. 2010.
19. M. Garcia, S. Sendra, J. Lloret, and A. Canovas, "Saving energy and improving communications using cooperative group-based wireless sensor networks," Telecommun. Syst., vol. 52, no. 4, pp. 2489–2502, 2013.
20. (2010, Aug. 14). Cygwin Information and Installation [Online]. Avail-able: http://www.cygwin.com/

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