International Journal on Future Revolution in Computer Science & Communication Engineering
Volume: 3 Issue: 10
ISSN: 2454-4248
205 – 208

A Comparative Analysis of Optimization Algorithms for Wireless Sensor Network

Brijesh Kundaliya
V.T.Patel Department of Electronics and Communication
CSPIT, Charusat University
Changa, India
Brijeshkundaliya.ec@charusat.ac.in

Dr. S. K. Hadia
V.T.Patel Department of Electronics and Communication
CSPIT, Charusat University
Changa, India
Skhadia.ec@charusat.ac.in

Abstract— As we know that next era will be of IoT (Internet of things). According to cisco, one of the giant in Networking filed, in 2008 the n umber of thing connected to the internet was greater than the number of people living on the Earth. By 2020 that number will increase up to 50 billion. That clearly indicates that we all are surrounded by the sensors. So, the Wireless Sensor Network (WSN) will be the important part of our life in future. The sensor node is equipped with very small power supply. Failure of WSN or a single node of that network will cause for a serious effect on an operation, especially when WSN is used in critical application like military, healthcare monitoring etc. So power conservation is the biggest issue in WSN. Different kind of optimization algorithm used to get optimal output at each and every possible phenomenon where we can save the power. Routing and sensor deployment are two main issues where we can get fruitful output using optimization algorithm. This paper gives the brief detail of optimizing in WSN at different phenomenon.

Keywords*-Optimization, Ant Colony, ABC, Leach-Ant.*

*****

I. INTRODUCTION

Wireless sensor network are taking leads in all the existence application. It makes the life easy, faster, and comfortable. By WSN it is possible to observe the difficult terrain of the world, which is quit helpful for the science and future growth. A doctor can monitor the health of patient from remote location, a scientist can take reading of a deep sea phenomenon from his laboratory, an army Man can have look of border or information deep within the enemy line. That all are happens due to wireless sensor network. The use of wireless sensor network will be increased day by day. There are several constrain in wireless sensor network when we deploy them in the field. Basically those problems split into 5 different categories. [12]

1) **Hardware:** A single sensor node consists of Sensing Unit, Trans-receive unit, Processor Unit and Power supply. Other than that several application based unit are also there like GPS tracker, mobilizer etc. They all need to fit in minuscule box. So, size is one of the concerns with hardware. Other than size, all that hardware must work at very low energy. When we deployed thousands of sensor nodes in network, so it must able to work in density. A last but not the least it must be cost effective too.
2) Environment: The node normally deployed adjacent to proximity of in to the proximity which we want to observe. It may be far away from the base station or laboratory. Nodes are normally untended. It is either used with heavy military weapon or at the top of mountain or at the deep of valley or in to the deep sea. Sensor must be adaptable with all such kind of environment issue.
3) Deployment: Hundreds or thousands of nodes are deployed when we built wireless sensor network for observing particular proximity. When we deploy such a huge number of sensors it required careful monitoring. With minimum number of node it is able to cover a large area.
4) Transmission Media: Wireless sensor network as name indicates that it deal with wireless media either RF, Infrared or may be Light as a medium. It should be chosen such that it is globally accepted. More over there is always the issue of security in wireless media so we need to use appropriate transmission technique which will enhance the security of data.
5) Power Supply : It is the main issue related to all the layer of network. As we know that node is accoutred with very low power. With that minimum power node need to drive all its subunits. In critical application like military or healthcare monitoring we cannot tolerate the failure of a single node ,which cause a serious consequence.

II. OPTIMIZATION IN WIRELESS SENSOR NETWORK

Optimizing means find the best among the many. It is obvious that we all are optimizers as we all are find the best possible thing or solution in our day to day life. If talk in systematic

 ISSN: 2454-4248
205 – 208

way, Optimization is a mathematical discipline that concerns the finding of the extreme (minima and maxima) of numbers, functions, or systems. This era started with Pythagoras of Samos (569 BC to 475 BC), a Greek philosopher who made important developments in mathematics, astronomy, and the theory of music. He is often described as the first pure mathematician. His most important philosophical foundation is ‘‘that at its deepest level, reality is mathematical in nature.’’ [1]

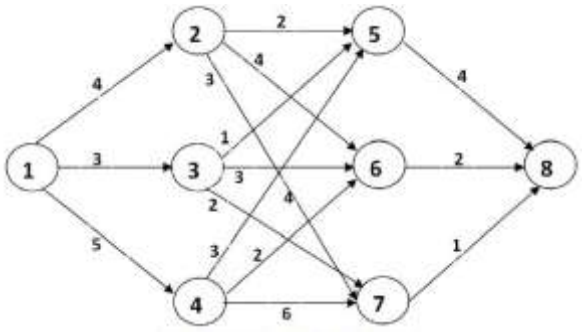

Figure 1: Multiple paths for one destination [9]

There are several optimization algorithm are available base on swarm intelligent behaviour. If we are specifically talking about the wireless sensor network, a sensor node needs to perform two basic operations, as data generator (sensing the data) and as a data transmitter (sending the data). It loses its energy in both the operation. But for sensing data require some minimum energy in that we cannot do much. But by wisely choosing the path from sender to receiver we can save a lot of energy. Same way we can save the energy by carefully deploying the sensor in the field so that we can cover a maximum area by minimum number of a sensor. In both the case we can apply the optimization algorithm to find the optimum solution.

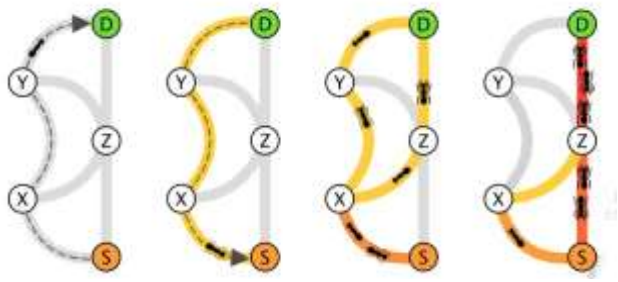

Figure 2: Path selection by Ant [8]

In 2001 Kassabalidis et al [2] proposed optimization algorithm based on ant behaviour for the routing. They consider the shortest path for transmitting the data, which eventually save the energy. That gives the better result compare to tradition method like flooding or broadcasting. As shown in figure Ant needs to find the path between source and destination. Different ant will follow the different path and share their information with other ant. Eventually they all find the shortest path between that source and destination. When shortest path is found between sender and receiver all the traffic are being diverted to that shortest path, which leads to heavy traffic on that path cause maximum energy consumption at particular path. That excessive energy consumption results in to node death. This is not the desired condition.

In 2006 T. Camilo at al. [3] comes with modification in ant colony algorithm given by Kassabalids et al. Here they not only consider the shortest path for the routing but they also consider the low energy path for the same. They called that algorithm as Energy Efficient Ant based Routing algorithm (EEABR). It gives the better output compares to previous one. They compare their result with Basic Ant based algorithm (BABR) and improved ant based routing algorithm (IABR). On each network energy level they were used of 50, 30 and 20 Joules. They compare the result for minimum energy, Average Energy, Standard deviation and Energy Efficiency. EEABR performs better in all the above criteria then the others. But there is one problem with that approach here they not consider the energy balancing issue. As we know that each node consumes their energy in sensing the data and sending the data. It is very important to manage the energy balancing in between them.

Comparison Criteria (100 Node network)	EEABR	BABR	IABR
Minimum Energy	High	Low	Medium
Average Energy	High	Low	Medium
Deviation	Low	High	Medium
Energy Efficiency	Good	Poor	Good

TABLE I. COMPARISON BETWEEN EEABR, BABR AND IABR

In 2010 Agraval et al [4] gives new idea of combining the tradition routing algorithm with optimization algorithm. Here they combine LEACH algorithm with ant colony algorithm for getting best out of that two. They applied LEACH-Ant algorithm in large network get significant good result compare to simple LEACH protocol. To evaluate the performance of ant-Leach and Leach algorithm they used MATLAB simulation with 100 nodes spread over an area of 100m*100m field. Life time of node is increased by 50% in Ant-Leach algorithm compare to normal Leach algorithm. At initial level the data transfer rate are almost same, but as time passes the data transfer rate of Ant-Leach algorithm is increased. Reason behind that the life time of node in the Ant-Leach algorithm is higher so after some time there is more number of node in active mode. But they get limited enhancement due to limitation of ant colony algorithm. In ant colony algorithm convergence is endorsed but time taken for convergence is not definite.

Comparison Criteria (100 Node network)	LEACH	LEACH-Ant
Life time	**Low**	**High (Get 50% rise compare to Leach)**
Data Transfer Capacity	**Low**	**High (As time increases performance get better than normal Leach)**

TABLE II. COMPARISON BETWEEN LEACH AND LEACH-ANT

In 2015 Luo Xu et al [5] modified ant colony algorithm and applied it for Wireless sensor network routing. Here they use

 ISSN: 2454-4248
205 – 208

local as well as global information for the routing at the same time they also consider the transmission distance and net energy of the node as in [3]. They introduce penalty function and dynamic weight factor in dynamic probability formula updating the routing table. Algorithm gives best output in term of quality but due that extra function it becomes complicate and stagnant.

In 2016 Wang et al [6] apply improved version of GA named as IOA (Immune Optimization Algorithm) for clustering and routing optimization. Algorithm used to reduce the transmission distance by efficient clustering. Effective clustering author able to get better result compare to LEACH and SEP (Stable Election Protocol) protocol. Lifetime of node is increases. Author uses MATLAB 2014 platform for the comparison for the network containing randomly distributed 100 nodes. Author give one important concluding mark for the future research that, there are many situation where sensor node is near to base station then the cluster head. If in such a situation if we are able to incorporate the function that will allow direct communication between sensor node and base station, than we can avoid multi hope communication and able to save the energy as well as time.

Comparison Criteria (100 Node network)	LEACH	SEP	IOA
Node Life time (Number of Round after which First node die)	181	156	263

TABLE III. COMPARISON BETWEEN LEACH, SEP AND IOA

In 2017 yongjun Sun et al [7] developed improved version of ant colony algorithm. Here they not only use the transmission distance as a parameter but also use the transmission direction as parameter. Moreover they include the participation scale which will give the recent scenario of the network. Author take assumption that all the sensor node in network is stable and isomorphic, which may be not possible in real life application where we use different type of sensor in a one application. Author compares the performance of their algorithm with its predecessor: OARA, LEACH-ANT, and EEABR. The comparisons are given in table 5. Author performed comparison for 100 nodes distributed in the region of 100m*100m. Here they assume that all nodes have the same energy at the initial condition.

Comparison Criteria (100 Node network)	OARA	LEACH-Ant	EEABR	Yongjn sun' alg0rithm
Death time of First node	40	51	35	91
Number of Death Nodes	11	7	10	4
Energy Consumption	1.1342	1.232	1.3561	0.3622

TABLE IV. COMPARISON BETWEEN OABR, LEACH-ANT, EEBAR AND PROPOSED ALGORITHM

In October 2005 Devis Karaboga [11] comes with optimization technique based on Honey Bee's natural forging behaviour. He classified honey bee in three different categories: Employed Bee, Onlooker Bee and Scout. Bees are always in search for new food source and each food source has been occupied by the one honey bees. The bee which have the food source will be consider as Employed bee and which don't have the food source known as Unemployed bees which further classified ans scout and Onlooker. Scout will randomly search in all the direction for the best food source once bee find food source they consider as an Employed bee. They came to the hives and perform the waggle dance by which they communicate the information of direction, distance and quality about the food source. There are various improved version of ABC are evolved by time and used in various application for the optimization purpose [14]. In 2016 Ado Adamou et al. [10] use ABC algorithm for the Energy efficient clustering. They compare the performance of ABC with PSO and LEACH algorithm for the energy consumption and through output. Energy consumption in ABC is very less and through output is remarkable high compare to PSO and LEACH. The research shows that ABC is more convincing then ant colony in some application.[13]

III. CONCLUSION

There are other optimization algorithm are used for wireless sensor network for optimization in routing or optimization in clustering for the energy saving purpose. This paper gives abbreviated summery from the see of available paper. Main focus is on ant colony algorithm and its different variant, their upper hand in performance as well as issue with them. The convergence time is the biggest drawback of ant colony algorithm but it gives surety of solution. ABC may also be the excellent algorithm for the optimization. Research shows the ABC gives noteworthy improvement in result when it compare to PSO and LEACH.

REFERENCES

[1] Optimization Techniques: An Overview S. Kiranyaz et al., Multidimensional Particle Swarm Optimization for Machine Learning and Pattern Recognition, Adaptation, Learning, and Optimization 15, DOI: 10.1007/978-3-642-37846-1_2, _ Springer-Verlag Berlin Heidelberg 2014

[2] I. Kassabalidis, M. A. El-Sharkawi, R. J. Marks, P. Arabshahi, and A. A. Gray, "Swarm intelligence for routing in communication networks," in Proc. Global Telecommun., vol. 6. Nov. 2001, pp. 3613–3617.

[3] T. Camilo, C. Carreto, J. S. Silva, and F. Boavida, "An energy-efficient ant-based routing algorithm for wireless sensor networks," in Proc. ANTS 5th Int. Workshop Ant Colony Optim. Swarm Intell., Brussels, Belgium, 2006, pp. 49–59.

[4] T. Agarwal, D. Kumar, and N. R. Prakash, "Prolonging network lifetime using ant colonyoptimization algorithm on LEACH protocol for wireless sensor networks," in Recent Trends in

 ISSN: 2454-4248
205 – 208

Networks and Communications. Berlin, Germany: Springer-Verlag, 2010, pp. 634–641.

[5] L. Xu and X. Wu, "Application of ant colony optimization algorithm in WSN routing," Comput. Eng. Sci., vol. 37, no. 4, pp. 740–746, 2015.

[6] Jingyi Wang, Yuhao Jing, Xiaotong Zhang, Hongying Bai, "Clustering Protocol based on Immune Optimization Algorithms for Wireless Sensor Networks" 2nd IEEE International Conference on Computer and Communications, 2016

[7] Yongjun Sun, Wenxin Dong, and Yahuan Chen, "An Improved Routing Algorithm Based on Ant Colony Optimization in Wireless Sensor Networks" IEEE communications letters, vol. 21, no. 6, june 2017.

[8] Adrin wilke, " Ant colony algorithm" ,Bio inspired networking Seminar, Henix Nixdorf Institute, University of Paderbone,2011.

[9] https://www.codeproject.com/Articles/668185/Network-routing-using-Ant-Colony- optimization

[10] Ado Adamou ABBA ARI, Blaise Omer YENKE, Nabila LABRAOUI. "Energy efficient clustering algorithm for wireless sensor networks using the ABC metaheuristic" International Conference on Computer Communication and Informatics (ICCCI -2016), Jan. 07 – 09, 2016, Coimbatore, INDIA

[11] Karaboga, D. An idea based on honey bee swarm for numerical optimization. Technical report–TR06,2005, Computer Engineering Department, Engineering Faculty, Erciyes University, Kayseri. October -2005

[12] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "A survey on sensor networks," IEEE Commun. Mag., vol. 40, no. 8, pp. 102–114,Aug. 2002.

[13] Hadia Sarman K, R. A Thakker and Kirit R Bhatt " Implementation and comparative analysis of the optimizations produced by evolutionary algorithms for the parameter extraction of PSP MOSFET model" International Journal of Electronics, ISSN 0020-7217, Volume 103, Issue 5, 2015Taylor and Francis, United states, Impact Factor 0.75

[14] Hadia Sarman K and Kirit R Bhatt " Design of CMOS Buffer Chain Circuit by using Artificial Bee Colony Algorithm" European Journal of Scientific Research, ISSN 1450-2016X,Vol 133, 2015.