International Journal of
Emerging Research in Management &Technology
ISSN: 2278-9359 (Volume-4, Issue-6)

Research Article

June 2015

Efficiency Enhancement Using Wireless Sensor Networks

Nirbhay Kashyap
Assistant Professor, Department of Computer Science and Engineering
Amity School of Engineering and Technology
Amity University, Uttar Pradesh, India

Abstract:

WSNs have seen huge development as of late due to their area free sensing abilities even in blocked off and perilous locales, minimal effort of sensors and long life of force supply due to low power utilization. The WSNs is a variation of ad-hoc systems and varies from notice systems due to its obligations and exceptional gimmicks. Ad-hoc systems implies every sensor backs a multi-hop routine calculation (a few hubs may forward information bundles to the base station). The WSN lifetime is subject to the accessible vitality, so vitality directing convention is coveted, which can essentially draw out the lifetime of WSN. A WSN obliges coordinated effort among different sorts of sensors with distinctive details, along these lines framing a heterogeneous WSN. Remote advances go for attaining encompassing knowledge. Cell phones embedded in homes, work places and open spots empower omnipresent sensing, processing and correspondence. Versatility likewise suggests that constrained size and limitation on force utilization, consistent integration with different gadgets and settled systems, and expanded information rates are the absolute minimum necessities for intelligent frameworks.

Keyword: WSN,Ns-2,Avrora,Jsim,Atemu,Tosim.

I. INTRODUCTION

A Wireless Sensor Network (WSN) is "a communication system which senses and gathers information from a certain area and sends it to different places of its choice. In other words, WSN interfaces the physical world to virtual world. In such networks the communication system requires networking protocols that are efficient, reliable, scalable and secure". [1]

WSNs can be very useful for target detection and identification by military, and for environmental applications like agricultural farm monitoring. Sensors integrated into structure, machinery and the environment, incorporated with robust delivery of sensed information, may provide diverse enhancement to the society, such as less human errors and failures, natural resource conservation and enhanced productivity in manufacturing sector.

These applications so called "require a good quality of service (QoS)[2]from sensor networks, such as, minimum percentage of sensor coverage in the required area, continuous service during required time slot with minimum (or limited) resources and minimum outside intervention". The sensors may vary from miniature in-built sensors to external sensors like video cameras and position sensors.

WSNs have seen huge development as of late due to their area free sensing abilities even in blocked off and perilous locales, minimal effort of sensors and long life of force supply due to low power utilization. The WSNs is a variation of ad-hoc systems and varies from notice systems due to its obligations and exceptional gimmicks. Ad-hoc systems[3] implies every sensor backs a multi-hop routine calculation (a few hubs may forward information bundles to the base station). The WSN lifetime is subject to the accessible vitality, so vitality directing convention is coveted, which can essentially draw out the lifetime of WSN. A WSN obliges coordinated effort among different sorts of sensors with distinctive details, along these lines framing a heterogeneous WSN. Remote advances go for attaining encompassing knowledge. Cell phones embedded in homes, work places and open spots empower omnipresent sensing, processing and correspondence. Versatility likewise suggests that constrained size and limitation on force utilization, consistent integration with different gadgets and settled systems, and expanded information rates are the absolute minimum necessities for intelligent frameworks.

FEATURES OF WSNs

1) Sensor nodes are typically immobile.
2) WSN may be deployed in harsh environments, so failures may be quite common.
3) The WSNs may be very small, thereby requiring smaller batteries which are bound to have short life-time.
4) Location information only. [4]
5) Communication in WSN's is generally data-oriented instead of address-oriented, meaning routing may be prioritized / aggregated, even dropped, depending on the data contents.
6) To reduce unnecessary overheads, communication in WSNs occurs in very small sized packets.
7) Due to many-to-one traffic orientation, WSNs may create hot-spot problems.

When we start a complex project or when a problem is to be defined, it is advisable to conduct a primary investigation task, known as feasibility study. It is basically carried out to assess whether the project is technically, economically and

operationally feasible. Or we can simplify the above line to say that the project will be supported with existing technology or not, whether it is cost effective or not and will the project work properly or not.
Economic feasibility: "The purpose of the economic feasibility assessment is to determine the positive economic benefits to the organization that the proposed system will provide. This assessment typically involves a cost/ benefits analysis".
Technical feasibility: "The technical feasibility assessment is focused on gaining an understanding of the present technical resources of the organization and their applicability to the expected needs of the proposed system. It is an evaluation of the hardware and software and how it meets the need of the proposed system".
Behavioral feasibility: "An estimate should be made of how strong a reaction the user staff is likely to have towards the development of a computerized system".

II. LITERATURE REVIEW

One of the real undertakings of Wsns is to convey valuable data from information sources to clients at the base force utilization on the grounds that sensor hubs must work on constrained force sources for expanded time. Especially, how to attain shortest path, multi-hop correspondence in these applications is a significant issue in a WSN.
In the first paper mulled over about the issue of element multi-determination information[5] scattering in which various sinks demand sensor readings from the system sources at element information revive rates. This issue is inferred by different paramount qualities of information social affair applications. To start with, in view of a few client prerequisites, a WSN frequently needs to gather and report physical data in a worldly manner. For instance, numerous WSN question handling frameworks, for example, Tinydb, help inquiry as "report to Node I the average temperature of region A once every T seconds." "T is the worldly determination of the appeal detailed by a client. For example, an environmental monitoring WSN may receive two kinds of requests in which a meteorologist requests hourly temperature updates for weather analysis, whereas a biologist requests a temperature monitoring once every several minutes from birds for detailed study of birds breeding behavior. Moreover, "the temporal resolution requested by the same user will change dynamically according to environmental activities. For example, in an intelligent building, a cluster head node normally reports temperature gathered by nearby nodes to the base station once several minutes, and must report sensor data once every a few seconds when a possible fire is detected. Furthermore, as lossy links are common in WSNs, a dissemination algorithm must consider the quality of links in order to obtain a proper reliability level".
In our proposed approach, we will use one of the meta-heuristic algorithms to find a proper solution for the mentioned problem in the paper. We will use one of the Ant Colony Optimization (ACO) algorithms for dynamic data dissemination in WSNs.

2.1) Network Layer Issues:

The issues experienced in the system layer of ad-hoc systems incorporate topology control, information correspondence, and administration access. Topology control issue incorporate finding transmission span, making connections to neighbors, booking hub slumber and dynamic periods, bunching constructing the dominating set (each nodeeither belongs to or has a neighbor form the dominating set), and keeping up the chose structure.
Information Communication issues include:

- "Routing – sending a message from source to destination node"
- "Broadcasting – flooding a message from a source to all other nodes in the network"
- "Multicasting – sending a message from a source to a set of desirable destinations"
- "Geocasting– sending a message form a source to all nodes inside a geographic region"
- "Location updation– maintaining reasonably accurate information about the location of other nodes".

Data Dissemination:

WSNs are involved in various data gathering applications. In various scenarios "there are different sinks which ask for sensor readings from the in-system sources. For transmitting the information from source hub to the end hub it may happen that there exist different courses.[6]Accordingly it gets to be alluring to figure out the way which gives the most improved way. By that we intimate that we have to discover the course which has the minimum vitality utilization. The information that we have to transmit may be asked for at diverse rates".

Link Quality:

The ETX of a link is the predicted number of data transmissions required to send a packet over that link, including retransmissions. The ETX of a route is the sum of the ETX for each link in the route. For example, the ETX of a three-hop route with perfect links is three; the ETX of a one-hop route with a 50% delivery ratio is two. The ETX of a link is calculated using the forward and reverse delivery ratios of the link. The forward delivery ratio, df , is the measured probability that a data packet successfully arrives at the recipient; the reverse delivery ratio, dr , is the probability that the ACK packet is successfully received. These delivery ratios can be measured as described below. The expected probability that a transmission is successfully received and acknowledged is df and dr. A sender will retransmit a packet that is not successfully acknowledged".
Because each attempt to transmit a packet can be considered a Bernoulli trial, the expected number of transmissions is: ETX = 1/ (df .dr).

2.2) Ant Colony Optimization:

Ant Colony Optimization (ACO) is a "new natural computation algorithm from mimic the behaviours of ants colony, and proposed by Italy scholar M. Dorigo in 1990's. The original intention of ACO is to solve the complicated combination optimization problems, such as TSP, so the traditional ACO is a very good combination optimization method. Its basic biologic principle is briefly introduced as follows.

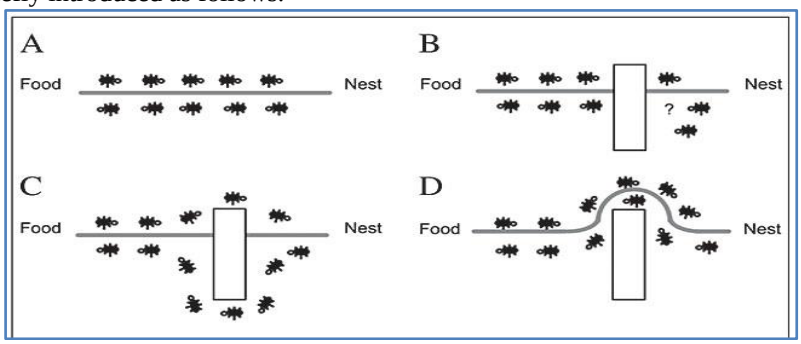

Fig 2.1A real world example of Ant Colony Optimization

2.3) Congestion Control:

Wireless sensor network (WSN) has emerged as a promising technology thanks to the recent advances in electronics, networking, and information technologies. "The data which flows through the wireless sensor network has great impact on the link load. The handling this data against the congestion, its reliability, and loss recovery is very tough task".

As WSN supports different data types like normal data that may in many to one or one to many topology. "Event driven data is generated when particular event is happen. A large amount of data flows from sensors to sink. The emergency data flows through the network for management purpose or some emergency event when occurred. The traffic will be bursty for some application. Here huge amount of data is generated and which disseminated towards the base station. Depending on the application the data formats are different and there size of packets is also different. In that case the data traffic will not be same. The node must handle this traffic as well.

2.4) Collision Control:

Flooding is a general method to transmit data or any information from a sensor node to the base station. Information is transmitted by all the nodes including base station node. Artificial Bee Colony (ABC)[7] algorithm is a new swarm intelligence method inspired by intelligent foraging behavior of honey bees. In the ABC algorithm, the colony of artificial bees is formed of three bee groups: employed bees, onlookers and scouts. A bee waiting on the dance area to determine to choose a food source is an onlooker and a bee goes to the food source visited by it previously is an employed bee. A bee who carries out random search is called a scout. The goal of bees in the ABC model is to find the best solution. Therefore, 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 of the associated solution".

In the ABC algorithm, "the first half of the colony consists of employed bees and the second half consists of onlooker bees. There is only one employed bee for each food source whose first position is randomly generated. At each iteration of the algorithm, each employed bee determines a new neighboring food source of its currently associated food source by (1), and computes the nectar amount of this new food source".

$$v_{ij} = x_{ij} + \theta_{ij}(x_{ij} - x_{kj}) \qquad (1)$$

where$\Theta ij$is an arbitrary generated number ranging from [-1,1]

The food source which is exhausted by the employed and onlooker bees is assigned as abandoned. "Then, the employed bee of that source becomes a scout. In other words, if any position cannot be improved further through a predetermined number of cycles which is called limit parameter, the food source is assumed to be abandoned and employed bee of that source will be a scout. In that position, a new solution is randomly generated by the scout, given as below. Assume that the abandoned source is xi and j ∈ {1,2,...,*D*}, *D* is the solution vector, the scout discovers a new food source which will be replaced with xi and j is randomly selected and shall differ from x".

$$x_i^j = x^j_{min} + rand(0,1)(x^j_{max} - x^j_{min})$$

III. DESIGN AND IMPLEMENTATION

Software design is an important aspect to be considered while building a software project. "Design of software involves conceiving, planning out and specifying the externally observable characteristics of the software product". The goal of design process is to provide a blue print for implementation, testing and maintenance activities.

Data Dictionary:

The "logical characteristics of current systems data stores, including name, description, aliases, contents, and organization, identifies processes where the data are used and where immediate access to information required". Serves as the basis for identifying database requirements during system design.

Various uses of data dictionary are as follows:

1) To deal with small details in large systems is necessary.

2) To convey a typical significance for all system components.

3) To record the highlights of the system.

4) To facilitate analysis of the details in order to evaluate characteristics and determine where system changes should be made.

5) To track omissions and errors in the system.

Comparison Of Different Simulation Softwares:

In this chapter, a comparison of existing simulation environments for WSNs is drawn.

Network Simulator-2 (Ns-2)

NS (the Network Simulator) "is an object-oriented discrete event simulator targeting at networking research[8]. NS-2 is written in C++ and OTcl, an object-oriented version of Tcl. A huge amount of contributed protocol source codes can be found on the website http://nsnam.isi.edu/nsnam/index.php/Contributed Code. Among them there are also some for WSNs interesting wireless protocols such as different variations of 802.11, 802.16, IRUWB, BlueTooth and 802.15.4. Despite the great number of contributing researchers the support for wireless sensor network specific protocols is rather low. As special wireless sensor network framework the Mannasim Framework should be highlighted that provides sensor network specific protocols such as LEACH and Directed Diffusion.

AVRORA:

Avrora "is a set of simulation and analysis tools for programs written for AVR micro-controllers. It has support for different sensor platforms, such as Mica2 and MicaZ, allowing wireless network simulation, dynamic instrumentation and static analysis. Since 2004, Avrora is developed in a research project of the UCLA compiler group. The special characteristic of Avrora is that it operates on the instruction-level, i.e. actual microcontroller programs can be run in the simulator, instead of just simulating software models".

J SIM:

J-Sim "is a component-based compositional simulation environment based on the autonomous component architecture (ACA). The basic entities of ACA are components, which communicated with each other by sending and receiving data using their ports. Application specific models can be defined by sub-classing the specified classes of the WSN simulation framework and adapting them to the desired behavior. At the moment, 802.11 is used as MAC Layer and AODV is provided as routing protocol".

ATEMU:

ATEMU "is one of the first instruction-level software emulators for AVR based systems. Additionally peripheral devices[9] of the MICA2 sensor node platform such as radio is supported. Although at the moment only the MICA2 hardware is supported, ATEMU can be easily extended to support other sensor node platforms. Although ATEMU is the most accurate instruction-level emulator for wireless sensor network research, it lacks from simulation speed, being 30 times slower than TOSSIM, for example".

TOSSIM:

TOSSIM (TinyOS mote simulator) "is a discrete event simulator for TinyOS sensor networks that is part of the official TinyOS package. TOSSIM takes advantage of the component based architecture of TinyOS by integrating it transparently by providing a new hardware resource abstraction layer that simulates the TinyOS network stack at the bit level for normal PCs. Due to this approach low-level protocols up to top-level applications can be simulated with TOSSIM. TOSSIM has an external communication

IV. RESULTS

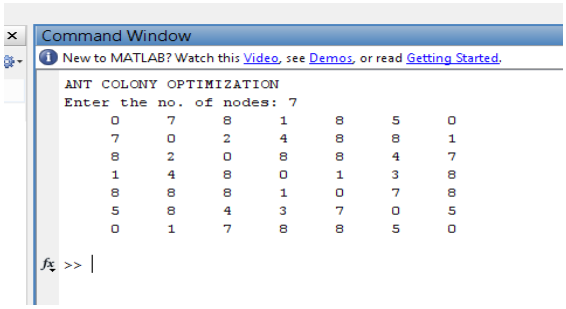

Figure 5.1

Description:

The user enters the number of nodes. The output generated is a result of the random function. A 7x7 matrix is generated which contains the distance between each node.

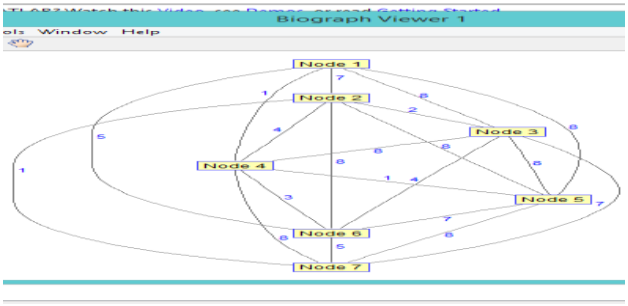

Figure 5.2

Description:

The matrix distances are then transformed into a network containing all the distances which were generated previously.

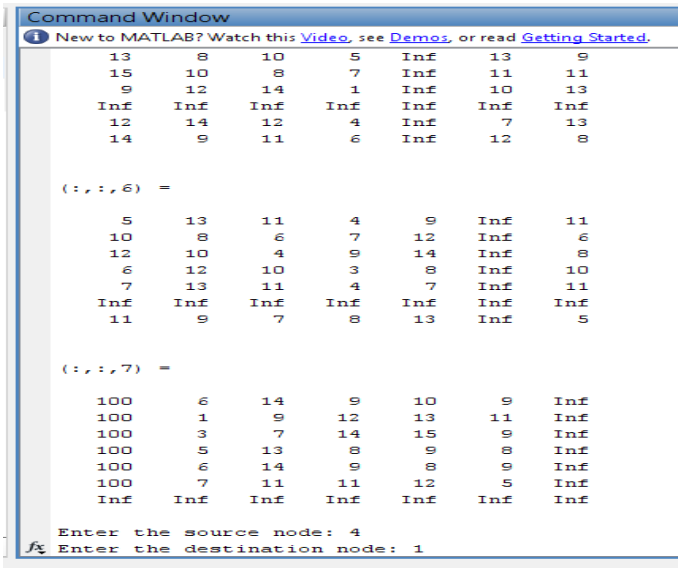

Figure 5.3

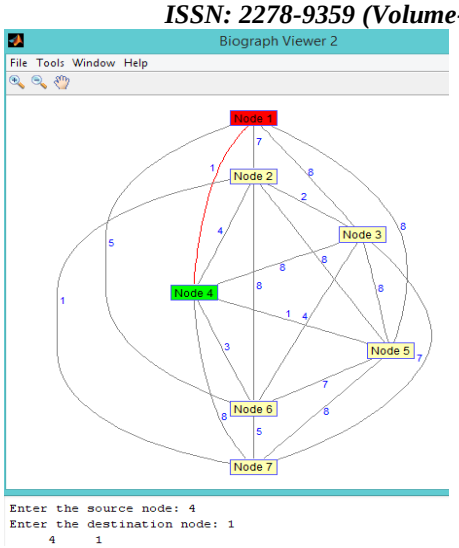

Fig 5.4

Description:
The user is prompted to enter the source and destination nodes.

The shortest distance which is collision and congestion free is highlighted and displayed to the user. And the shortest path is also displayed node wise.
i.e. 4 1

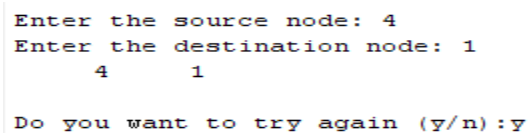

Figure 5.5

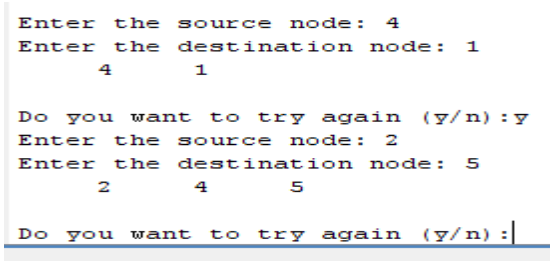

Figure 5.6

Description:
The user is prompted to try once more or not. We enter ‘y’ that is, yes to continue further.

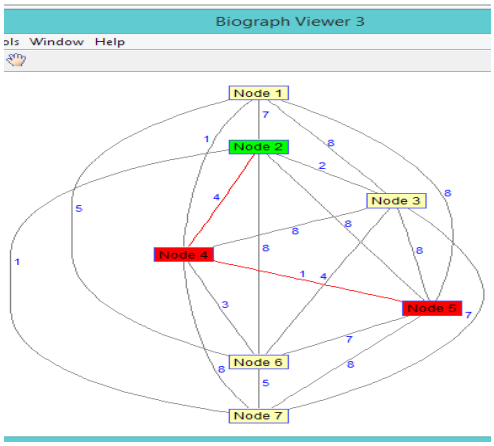

Figure 5.7

Description:
The shortest path which is collision and congestion free is displayed.

Description:
The user is asked to again enter the source and destination nodes.

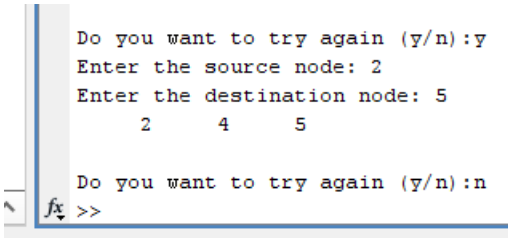

Figure 5.8

Description:
User enters ‘n’ i.e. not to continue and exit the program.

V. CONCLUSION

The project aimed at maximizing the efficiency of a wireless sensor network. Different algorithms were studied and analyzed. We came to know about various things:

1) What are wireless sensor networks?
2) How do they transmit information from one node to other?
3) What are the problems faced in wireless sensor networks?
4) How efficiency can be increased by suing optimal algorithms?

Ant Colony Optimization and its different variations were studied. To prevent collision and congestion is equally important in maximizing the efficiency. A comparison on different simulations was also drawn and the best software was selected.
In ACO, "a number of artificial ants build solutions to an optimization problem and exchange information on their quality via a communication scheme that is reminiscent of the one adopted by real ants".
For collision and congestion, it is better to early detect and prevent them rather than removing them from the network.

VI. FUTURE WORK

The project has a great future scope. It can be extended to a hardware model in which various semiconductor sensor nodes can be constructed and connected to each other seamlessly.

REFERENCES

[1] Dr J.D. Jain, "An Introduction to Wireless Sensor Networks", electronics FOR YOU, pg 44-48, Sept. 2014.
[2] Marco Dorigo, Member, IEEE, Vittorio Maniezzo, and Alberto Colorni, "Ant System: Optimization by a Colony of Cooperating Agents", IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS-PART B CYBERNETICS, VOL 26, NO 1, FEBRUARY 1996.
[3] Das, S., Singh, G., Pujar, S., Koduru, P. (2006), "Ant Colony Algorithms for Routing in Sensor Networks", Proceedings, International Conference on Artificial Intelligence, Las Vegas, Nevada, pp. 457-464.
[4] H. Liu, X. Jia, P. Wan, C. Yi, S. Makki, and N. Pissinou, "Maximizing Lifetime of Sensor Surveillance Systems," IEEE/ ACM Trans. Networking, vol. 15, no. 2, pp 334-345, Apr. 2007.
[5] Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", United Kingdom: Wiley, 2010.
[6] RaziehSheikhpour, Sam Jabbehdari, Ahmad Khadem-Zadeh, "Comparison of Energy Efficient Clustering Protocols in Heterogeneous Wireless Sensor Networks", International Journal of Advanced Science and Technology Vol. 36, November, 2011.
[7] Dr Helonde J B, Dr. Wadhai V, Vivek Deshpande, Shiv Sutar, "EDCAM: Early Detection Congestion Avoidance Mechanism for Wireless Sensor Network", International Journal of Computer Applications (0975 – 8887) Volume 7– No.2, September 2010.
[8] Lewis, F "Wireless Sensors Networks, Smart Environments: Technologies, Protocols, and Applications", ed. Cook DJ, Das SK, John Wiley, New York, 2004; 1-18.
[9] AzniHaslizanAb.Halim, Kartinah Zen, "MAC Protocol to Reduce Packet Collision in Wireless Sensor Network", Proceedings of the International Conference on Computer and Communication Engineering 2008 May 13-15, 2008 Kuala Lumpur, Malaysia.

AUTHOR

Nirbhay Kashyap is working in Amity University Uttar Pradesh and having experience in teaching and administration. He did his B. Tech, M. Tech in the field of Computer Science and Engineering. His research area is digital image processing, soft computing , image compression. He is also CCNA certified professional.

