ISSN: 2393-8528

Contents lists available at www.ijicse.in

International Journal of Innovative Computer Science & Engineering

Volume 4 Issue 3; May-June-2017; Page No. 74-79

Comparative study on WSN homogeneous and heterogeneous architecture

WSN- An Architecture Study

P. Kalai Kannan

Assistant Professor, Department of M.Sc. Software Systems

KG College of Arts & Science, Coimbatore- 35, Tamilnadu, India

Kalaikannan.p16@gmail.com

Received 06 April 2017; Accepted 09 May 2017

ABSTRACT

An important thing in managing wireless sensor networks is its lifetime, Here in this research work it has been proposed with a data centric approach to increase the lifetime by studying various parameters used in the wireless sensor networks. As by studying on various parameters, the first one by focusing on the optimized routing technique which helps to avoid the data traffic in wireless sensor networks. The next on is Sensors aggregation, the signals strength passed through the network was increased, thus helps to tune the performance what the end user expected out of WSN. The next parameter is by using mobile relays the lifetime can be extended. The mobile relays are very active in the performance tuning methodology, where it moves around the network very faster than any other static nodes.

These mobile relays help other sensor nodes to relieve the burden it receives and face. Mobile relays have the capacity to increase the WSN twice faster. The next one is to increase its performance by deriving a new querying technique and increasing its energy and storage resources using more floating nodes.

Keywords: WSN, Mobile realys, Routing, Sensors aggregation.

INTRODUCTION

Wireless sensor networks woks a lot for automatic detection, and recovery from urban disasters. Nowadays sensor networks have captured the attention and imagination of many researchers, encompassing a broad spectrum of ideas. Most important thing is they are embedded in the real world Sensors detect the world's physical nature, such as light intensity, temperature, sound, or proximity to objects Sensor networks are a large **collection of nodes**. Individually, each node is autonomous and has short range, collectively; they are cooperative and effective over a large area.

Two variants in sensors:

i) Short range sensors
ii) Long range sensors

So depends on the applications that we going to implement it will differ. Here I have planned to use few long range sensors and many short range sensors to track an environment, the environment which covers a large area. Most important thing is, the lifetime of a sensor nodes, Mostly the sensors are powered by the batteries in a remote location and if the sensor nodes have to collect a data form a location and send it to the base station, its lifetime have to be extended to provide an uninterrupted service to the base station. Sensor nodes lifetime is based on its **service** and **power** it consumes. To be noted, all the sensors must consume same amount of energy and its lifetime must be same to avoid the discontinuous service.

So **as a research** after analyzing various parameters few **constraints are concentrated** which help to increase the lifetime.

The constraints are:

i) Optimal routing
ii) Data aggregation or aggregating nodes
iii) Power consumption [Uniform battery energy – using solar cells to recharge batteries]
iv) Maximum lifetime routing problem

Literature Review

The success of Wireless sensor networks and its most part of the uses in all the areas of the networks which lead to an important problem of energy supply constraints afford by the WSN. In order to give long time life for the WSN, it was aimed to use solar

**Corresponding author: P. Kalai Kannan |*

supporters along with each node in the target area. Thus it has been motivated to use the solar supported circuits along with sensor nodes that act like rechargers which use to recharge the batteries even at the optimal weather conditions that help to extend the lifetime of your wireless sensors networks. By using a SET (Solar energy transfer) mechanism which continuously supplies the energy for battery enabled sensors.

The recommended implementation is especially effective in

Important atmospheric condition wherever traditional solutions do not work and is characterized by a versatile enough design for immediately hosting, in a plug in fashion, different solar panels and battery typologies.

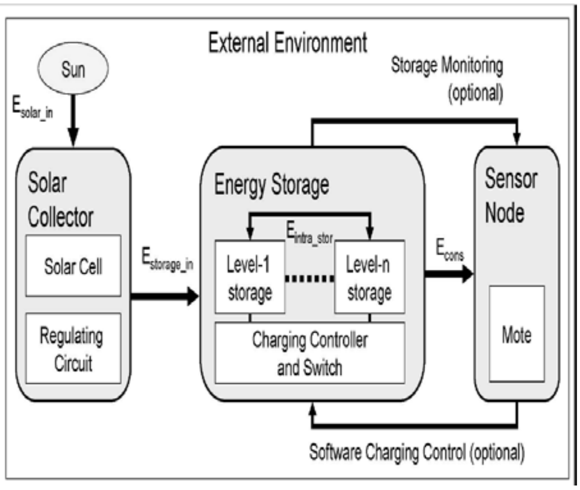

Figure 1: Solar cells fro Sensors

Cluster Aggregation

In the above diagram, the base stations are refers as Data gathering node, here we have three clusters:
1. Cluster1 [With nodes named 1, 2, 3]
2. Cluster2 [With nodes named 4, 5, 6]
3. Cluster3 [With nodes named 7, 8]

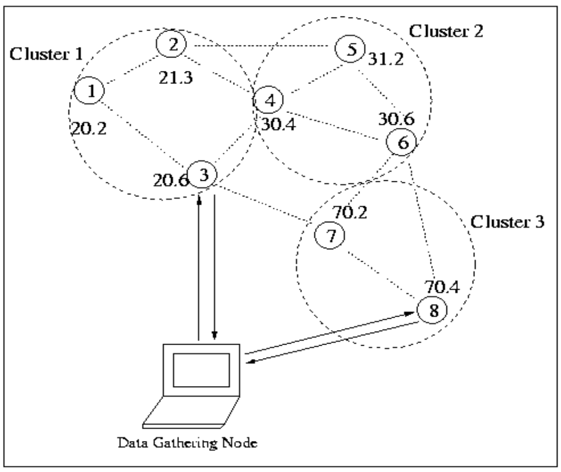

Figure 2: Clustering of Nodes

Here all the clusters are integrated and the data transfers happen in a parallel model structure, which has both request and response. The CFSN nodes in the structures are 3, 8 and all remaining nodes are DCN nodes. Here the CFSN nodes acts like a bridges to forward the data's with highest signal strength.

Optimal routing

WSN consists of small nodes with sensing, computing & wireless communication capabilities. Generally the routing techniques are classified into three categories based on the underlying network structure.
1. Flat based
2. Hierarchical
3. Location based.

OPR (Optimal path routing)

Optimal path routing which finds out a short path out of many paths to the base station. Formally the sensor nodes are scattered arranged in a target area, and the data's are passed from one nodes to other nodes sequentially and that may cause duplication of data's in the path, but eventually increases the sampling rate of data's in the path & here WSN acts like a smart bridges in transferring the data's.

.In OPRs(OPR selective routing the sensors are programmed to send the collected data to a partial sensor nodes which involves in transferring the data's to the base station, where it will be analyzed for taking proactive or reactive actions,/this OPRS routing is implemented by focusing on the target area & assign some [Catch & forward sensor nodes].These CFSN involve in transferring the data's to base station, where instead of passing data's to all the nodes in the target area, passing the data's to selective path which increases the lifetime of sensor nodes based on its operation & operating power.

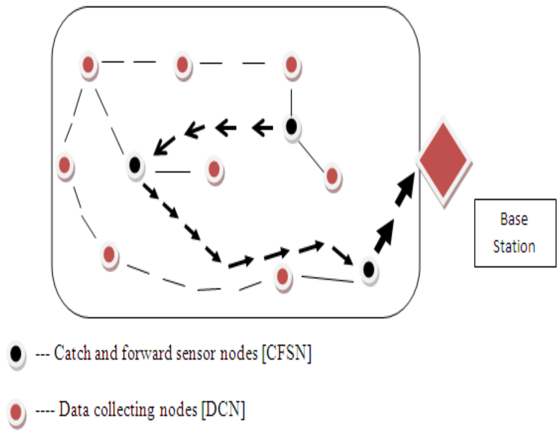

Figure 3: Data movements in WSN

a) Diagrammatic view: In the above diagram, the target areas are managed using many data collecting nodes and few CFSN nodes. The data's collected from various nodes present in the networks used to send its collected data to the nearest CFSN nodes, these nodes intern pass the collected data to the nearest CFSN and finally the CFSN nodes present nearer to the base station will relay the data's to the base station where it will get processed by the software's associated with WSN.

b) Nodes purposes & its role in target area: Here we have two different nodes; one for collecting the data's [DCN] which pertains to be important to know about the target area, another one which are few in numbers which helps to catch the data's collected by the DCN and forward it to the processing part named as Base station.

Error Control architecture:

Transferring data's in an Energy-efficient and reliably in wireless sensor networks using clustering methodology [Data Aggregation]:

For energy efficient data transfers in wireless sensor networks, clustering has been used as an effective mechanism which helps to route the data's in WSN. However in hierarchical approach of data transferring which leads to packet loss or increase in the failure rate[PER- packet error rates].Though to avoid the PER ,clustering approach has been used, by using this we can have a energy efficient routing schemes for delivery the data's from one nodes to the other.

In WSN, due to the limited sources of energy, delivering sensory data from one node the other or nodes to base station requires an energy-efficient routing solution. Normally routing protocols are classified into two data centric and hierarchical, where in the data centric, we used to concentrate on the data transfer and not in finding the efficient rout for data transfer, next in the hierarchical approach, where the data transfer happens in a sequential manner, which takes much time comparing to the other protocols which are predefined, to avoid this we have used an clustering techniques where the nodes are **aggregated,** and the data transfers are in the form mesh networks, which enable the WSN with advanced way to transfer the data's in a n energy efficient manner.

In cluster based routing protocols, densely populated sensor nodes are grouped together to form a cluster based topology. By forming such clusters the network can be managed in a distributed manner. In each cluster, one of the members will be selected as the cluster head to control and manage the data exchanged between nodes in the cluster and report the collected data to a base station through one or more clusters. Each cluster head maintains the cache table that holds the information like nearest DCN nodes and CFSN nodes in the cluster, base station hardware and IP addresses. This particular cache table which acts as a synchronizer, that which used to synchronize the whole WSN. Those all are synchronize each cluster will be managed by their own cluster heads.

Here in these clustering pattern, the lifetime for the intermediate nodes which acts as a bridges [CFSN], used to exhaust more energy that leads to wasting of battery powers, that may cause the CFSN nodes to get out offline sooner, which leads to disconnection of few DCN in this aggregate cluster pattern, thus in order to protect those intermediate CFSN bridges we needs to derive a algorithm and resolve this problem.

Heterogeneous Architecture

To maximize the lifetime of WSN, it were proposed that using connected target coverage, error control mechanism during the data transfers to control the PER [Packet error rate], optimal routing and data aggregation models to increase the data transfer rate, and finally using mobile relays to increase the signal strength of the data's. So by integrating all these techniques framing a heterogeneous architecture to maximize the lifetime of the WSN [Wireless sensor networks].

Study on the current System:

i) CTC Problem:

In these CTC problem with the objective of maximizing the network lifetime by scheduling sensors into multiple sets, each of which can maintain both target coverage and connectivity among all the active sensors and the sink. By considering the CTC problem as maximum cover tree problem, it has been derived a approximation algorithm, so using this we can cover maximum number of targets using the Approximation algorithm H (M) = ∑ 1<= i <=m).But the protocol cost for it to practice is so much higher and can't be affordable, so we moved to an another faster heuristic algorithm which is similar to approximation algorithm named as Communication weighted greedy cover algorithm. Here this CWGC algorithm performs much better than the others in terms of the network lifetime and the performance improvement can be up to 45% than the best known basic algorithm.

ii) Optimal routing and data aggregation in WSN:

Here it was proposed that by jointly optimizing data aggregation and routing it can be useful to maximize the network lifetime. To integrate the data aggregation and routing a model was proposed and to optimize the technique a smoothing function had been used. This scheme can significantly reduce the data traffic and improve the lifetime of the network.

The distributed algorithm can converge to the optimal value efficiently under all network configurations.

iii) Error control mechanism in WSN:

Error control is of significant importance for Wireless sensor networks because of their severe energy constraints and the low power communication requirements. By analyzing various error control schemes like Multi-hop routing and broadcast nature in WSN, the error control mechanism have been designed. By comparing various forms of data transfer modes like ARQ (Automatic repeat request), FEC (Forward error corrections), Hybrid-ARQ they developed a simulation results, where the FEC and hybrid- ARQ shows the improved performance rates.

The major constraints concentrated are hop length distance between nodes, if there is any increase in the hop length distance which shows a decrease in the energy consumption and also end-end latency and PER (Packet error rates).so comparatively the hybrid ARQ and FEC shows better performance than the ARQ.

iv) Using Mobile relays:

Here by comparing the static sensors and few mobile relay sensors nodes, the efficiency of mobile relays are described. The mobile relays which have more energy than the static sensors, they can move around the network and help relieve the sensors those are burdened with high network traffic, thus extending the nodes lifetime. The performance of a large dense network with one mobile relay and show that the network lifetime improves over that of purely static network by up to a factor of four. The mobile relays needs to stay only within a two-hop radius of the sink. They constructed a joint mobility and routing algorithm which can yield a network lifetime close to the upper bound.

The mobile relay which has the efficiency of doubling the network lifetime in a randomly deployed WSN.
This Architecture holds various parameters like

i) data Aggregation model
ii)Using Mobile relay nodes
iii) Optimal routing procedures
iv) Using solar cells for recharging sensors
v) Error Control mechanisms

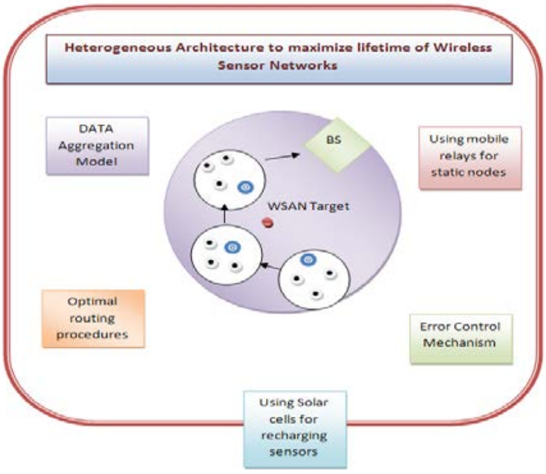

Figure 4: Heterogeneous WSN

Scheduling algorithm for mobile relay in a densely populated network

i) Method: Scheduling mobile relay

Step 1: Set $m_{r,}$=0 , ø = 2pi, sensor nodes=s1,s2,…..sn,BS =0,Target = Tar1,2…..TarN.
Step 2: While mobile relay is in the position m_r=0
Step 3: Initial selection is random without any data transfer.
m_r=S1,S2……Sn.
Step 4: From the base station suppose mobile relay gets any message related to congestion or data delay, it use to give preference to those particular sectors
If BS = 1 then move m_r to Tar > other(N -Tar)
Step 5: When BS =0 the m_r =0,1,2….n(Sequential)
Step 6: else BS =1 the m_r , comparing all the least squares, go to target where there is a highest weight.
Step 7: Relieve the burden of the sensors based on the waiting time of sensor nodes.
If (Wt(S) > S(Ns(Tar))) move m_r to Selective S.
Step 8: Soon after completing its work of the first node move to the next node. , m_r Next S.
Step 9: After completing a particular square it searches for the next weighted square are using the random move, it will move to the next target.
m_r = 0 Search next (Tar with highest Weight)

ii) Algorithm for shortest optimal path using data aggregation model

Step 1: G= (N, A), Energy E, paths P1, P2…. $P_{n.}$ Targets are T1, T2…… $T_{n.,}$ X_i --- Data's
Step 2: N, A, E are initiated with default values for startup.
Step 3: Data Aggregation using Packet filters of redundant information.
DA model =**f** (**P** (Xi))
Step 4: Mapping nodes with targets (N ∞ T)
Step 5: Initiating the Paths P for every Sensor nodes N (N==P)

Step 6: Finding the shortest path using a value set for every nodes. (e.g. N1=0,N2=1..P1=0,P2=1)
Step 7: While transferring the data's find out the least path using the value set for the path
If (∑ p1,p2,p3 >∑ p1,p4,p5) || (∑p1,p3,p4 > ∑p2,p4,p5)
the scroll down window on the left of the MS Word Formatting toolbar.
Step 1: G= (N, A), Energy E, paths P1, P2…. P_n. Targets are T1, T2…… T_n, X_i --- Data's
Step 2: N, A, E are initiated with default values for startup.
Step 3: Data Aggregation using Packet filters of redundant information.
DA model =**f** (**P** (Xi))
Step 4: Mapping nodes with targets (N ∞ T)
Step 5: Initiating the Paths P for every Sensor nodes N (N==P)
Step 6: Finding the shortest path using a value set for every nodes. (e.g. N1=0,N2=1..P1=0,P2=1)
Step 7: While transferring the data's find out the least path using the value set for the path
If (∑ p1,p2,p3 >∑ p1,p4,p5) || (∑p1,p3,p4 > ∑p2,p4,p5)

COMPARISON OF SENSING RANGES

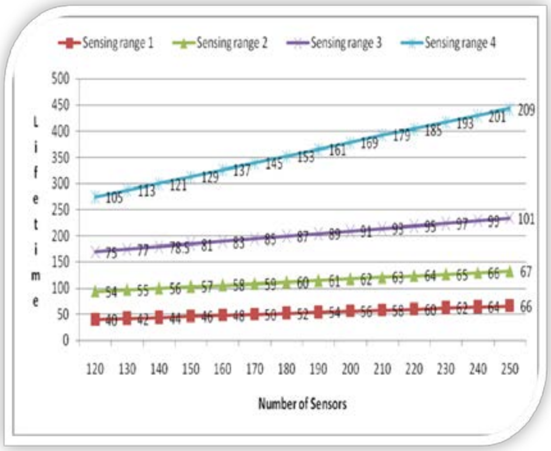

FIGURE 5: COMPARING SENSING RANGE

No. Of Sensors	120	130	140	150	160	170	180	190	200	210	220	230	240	250
Lifetime Sensing range 1	40	42	44	46	48	50	52	54	56	58	60	62	64	66
Sensing range 2	54	55	56	57	58	59	60	61	62	63	64	65	66	67
Sensing range 3	75	77	79	81	83	85	87	89	91	93	95	97	99	101
Sensing range 4	105	113	121	129	137	145	153	161	169	179	185	193	201	209

Table 1: Network Lifeteime for different sesning range values

As the number of sensors used at a particular target increases automatically the lifetime of the sensors are also get increased

Results and Discussions

S.no	Technical	Lifetime(%)
1	WSN with ECM	10
2	WSN with Energy model	10
3	WSN with Frame relay	35
4	WSN with OR	45

Table 2: Homogeneous Architecture

S.no	Technical	Lifetime(%)
1	WSN with ECM and OR	55
2	WSN with Frame relay and EM	45
3	WSN with ECM,OR,EM	65
4	Integration of ECM,OR,EM and FR	100

Table 3: Heterogeneous Architecture

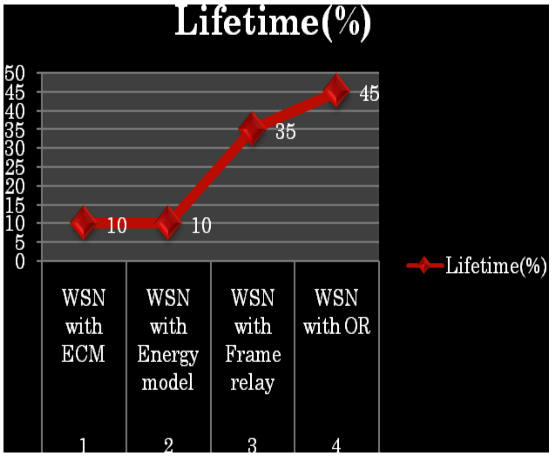

Figure 6: Lifetime of Homogeneous WSN

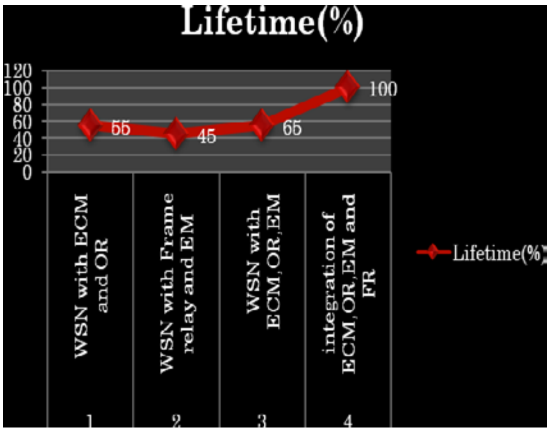

Figure 7: Lifetime of Heterogeneous WSN

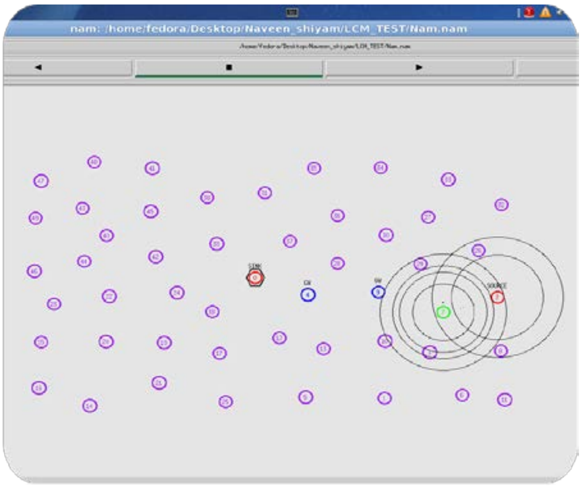

Figure 8: Simulation using NS2 for Data clustering

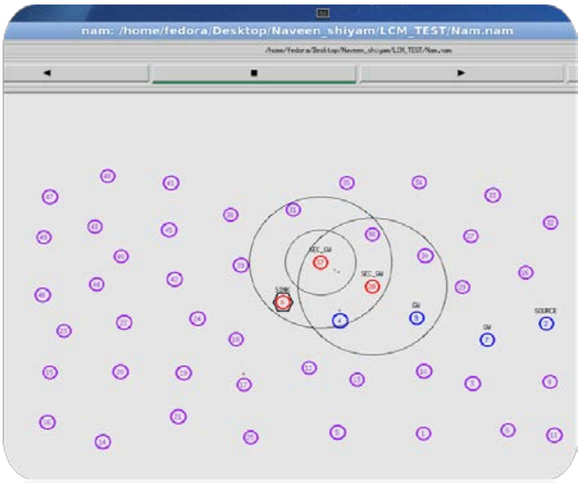

Figure 9: Simulation using NS2 for Data movements in WSN

Conclusion

This architecture instead of concentrating on one constraints that which make the network work faster, focusing on constraints like Data aggregation model Optimal routing technique, Using mobile relay, Different sensing ranges Solar cells, Error control mechanisms, which helps us to increase the lifetime of the wireless sensor networks.

References

1. *Jenq-Shiouleu and Tung-hungchiang,Minchiehyu, kuan-wusu,* "Energy efficient clustering scheme for prolonging the lifetime of Wireless Sensor Networks with Isolated Nodes" ieee communications letters (volume: 19, issue: 2, feb. 2015).
2. *M. Reddy, P. Jagadeeswara, S. Prakash, P. Chenna Reddy,* "Homogeneous and heterogeneous energy schemes for hierarchical cluster based routing protocols in WSN: A survey", *Proc. 3rd Int. Conf. Trends Inf. Telecommun. Comput.*, vol. 150, pp. 591-595, 2013.
3. *Cisil Baby; S. Ranjitha; H. N. Suresh* , "An Efficient Energy Savings Schemes Using Adjacent Lossless Entropy Compression for WSN" 2016 International Conference on Computational Science and Computational Intelligence (CSCI) Year: 2016 Pages: 1026 – 1030.
4. *Azizi Ridha,*"Comparative study of transport protocols in WSN" Information and Communication Technologies Innovation and Application (ICTIA), Year: 2014 Pg : 1 – 11.
5. *Yunhe Li; Zhihua Yang; Qinyu Zhang*, "Efficient load balance data aggregation methods for WSN based on compressive network coding" 2016 IEEE International Conference on ElectronicInformation and Communication Technology (ICEICT) Year: 2016, Pages: 111 - 115,
6. *Slavica Tomovic; Igor Radusinovic, "*Performance analysis of a new SDN-based WSN architecture 2015 23rd Telecommunications Forum Telfor (TELFOR) Year: 2015 Pages: 99 – 102.
7. *Saurav Ghosh; Sanjoy Mondal; Utpal Biswas, "*Efficient data gathering in WSN using fuzzy C means and ant colony optimization" 2016 International Conference on Information Science (ICIS) Year: 2016, Pages: 258 – 265.
8. *Amr Y. Mostafa; Samy S. Soliman; Nada El-Gaml; Ramez M. Daoud; Hassanein H. Amer; Ahmed Khattab, "*WSN lifetime elongation via hybrid routing" 2016 28th International Conference on Microelectronics (ICM), Year: 2016 , Pages: 177 - 180
9. *Brad Goold; Hong Zhou,"*Performance analysis of localization algorithms in a WSN-based monitoring system" 2016 10th International Conference on Signal Processing andCommunication Systems (ICSPCS), Year: 2016, Pages: 1 – 5.
10. *Utpal Kumar Paul; Sudipta Chattopadhyay*, "An energy saving routing scheme for WSN based crop field monitoring system" 2016 IEEE Annual India Conference (INDICON)Year: 2016, Pages: 1 – 5.