

Selection of Nodes on the Basis of Loading Probabilities

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ABSTRACT: An emerging class of Wireless Sensor Network (WSN) applications involves the acquisition of large amounts of sensory data from battery powered, low computation and low memory wireless sensor nodes. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding. In computer science and telecommunications, wireless sensor networks are an active research area with numerous workshops and conferences arranged each year to improve the performance of the network by using the Probability theory. The conclusion is that if balancing is achieved then all the nodes are always at equal energy level, so that there is no need to measure all the nodes. The measurement may be done by any of the nodes. All the nodes will be dead almost simultaneously. This analysis helps in deciding the better nodes. If balancing may not be achieved then we must select the node having lowest Loading Probability. This method of selection of node will be very useful for reducing the Traffic jam and risk of Failure the CH in LEACH Protocol.

KEYWORDS: CH, LEACH, WSN, routing, flooding, topology.

I. INTRODUCTION

One of the main applications of Wireless Sensor Networks is monitoring remote and isolated areas, and collecting information about unexpected phenomenon like a Fire in Forest, volcano eruptions or enemy movement in the battle field. In these applications the channel state is expected to be continuously varying because of the dynamic changes in environmental factors. Also vehicles and rocks movements can crash some nodes which may be the separate parts of the network. In this context it is hard for the network to deliver the collected information, even when transmitting at the maximum power, without strong error correction techniques. Energy conservation in wireless sensor networks (WSNs) is the primary performance parameter, because of their limited energy resources. Thus, some energy saving technologies should be applied.

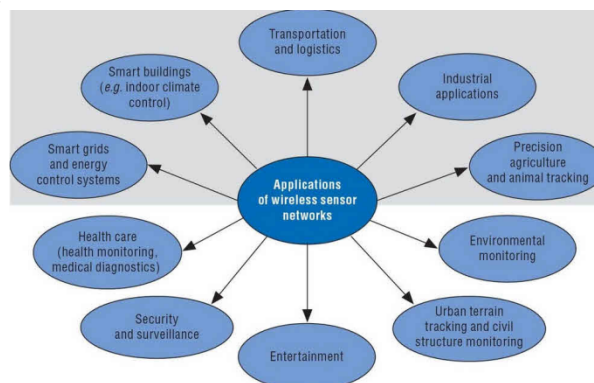


Fig 1: wireless sensor networks

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II. RELATED WORK

Anupkumar M Bongale, Anand Swarup and Shashank Shivam et al 2017 [1], Design and improvement of vitality effective directing conventions for Wireless Sensor Network (WSN) is one of the dynamic research fields. Bunch based steering conventions have turned out to be vitality proficient and LEACH is one of most mainstream group based directing convention for WSN. In any case, LEACH experiences a few downsides, for example, plausibility of picking a low vitality hub as Cluster Head (CH) and non-uniform (unbalancing) dispersion of CHs, and so forth. In this paper EiP-LEACH (Energy affected Probability based LEACH) convention is proposed which is an upgraded adaptation of LEACH convention that is impacted by the vitality parameter for CH determination. EiP-LEACH helps in choosing the better CH hubs and in this manner contributes towards system life prolongation. EiPLEACH is contrasted and fundamental LEACH regarding number of alive hubs, normal vitality exhaustion, First Node Dead (FND) and Last Node Dead (LND) and found that EiP-LEACH is much better [1]. Dharam Vir, Dr. S. K. Agarwal and Dr. S. A. Imam et al 2012 [5] we saw that control sparing is an imperative advancement objective in remote sensor organize, the power devoured amid correspondence is more overwhelming than the power expended amid preparing on account of Limited stockpiling limit, Communication capacity, figuring capacity and the constrained battery are primary confinements in sensor systems. As the lifetime of the system is rely upon the battery life of the hubs, the plan of intensity effective directing conventions is must. By the perceptions we think about that the effect of intensity limitations on hubs in physical layer and application layer of the systems that DSR offers the best mix of intensity utilization and normal start to finish postpone execution. It has been seen that OLSR has preferred system lifetime over other. Future work, we can decrease the waste power utilization of the hubs by diminishing the quantity of directing control bundles and lessening the power devoured by hubs in an expansive system to build the existence time of system.

Arumugam et al 2015 [1], the creators proposed a vitality directing convention relies upon the compelling troupe information and ideal bunch head choice. This convention drags out the lifetime of the system. Yet, regardless it experiences the postponement brought about by multifaceted activities. It generally picks the sensor hub that has higher leftover vitality without thought to some other factors, for example, the area of the sensor hub that might be situated far from BS. The motivation to work in this research area is the Dynamic Processing techniques which play a significant role in saving the time. In general algorithm however, choosing the best Node is not a trivial task and a bad choice will give a poor performance. The document delivery speed between a server and a client (Node) depends on the server load, the file retrieving speed at the server, the available bandwidth between the server and the client, and the client load. In this work, we investigate two problems: one deal with finding the Maximum Loading Probabilities. We call it MaxLP problem. The other deals with finding the best group of k Nodes having Minimum Loading Probabilities. We called it MinLP problem. It is assumed that the network topology, the path bandwidth and server performance are known and static. The main objective of the exploration work talked about in this theory is to investigate the execution of novel key pre-appropriation plans for expanding the versatility of the system. The second objective is to investigate vitality productivity bunching approaches which builds the vitality effectiveness of the system. The sensor hubs are utilized to gather and report information to the sensor hub, known as a sink hub. By utilizing a bunching system progressive directing convention enormously limit the vitality devoured in gathering and appropriating the information.

III. CHALLENGES OF WSN

Energy is the scarcest resource of WSN nodes, and it determines the lifetime of WSNs. WSNs are meant to be deployed in large numbers in various environments, including remote and hostile regions, where ad hoc communications are a key component. For this reason, algorithms and protocols need to address the following issues:

- ✓ Lifetime maximization
- ✓ Robustness and fault tolerance
- ✓ Self-configuration

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IV. PROPOSED METHODOLOGY

In our research, the ultimate aim is to give an idea for selecting the Node in a generic WSN application with essential and definable Load (Throughput) constituents and the relationship among these constituents so that one can explore strategies for minimizing the overall Congestion and traffic of the entire application. Presently the Wireless Sensor Network in India uses the high resolution Image cameras in the node stations, which are able to capture a picture nicely and then transmit the image towards the central office or Server base station. The data gathered from wireless sensor networks is usually saved a central base station (Server). If a centralized architecture is used in a sensor network and the central node fails, then the entire network will collapse, however the reliability of the sensor network can be increased by using distributed control architecture. This architecture has a drawback that there is a lot of energy consumption and congestion during the propagation of data. The most demanding requirement of wireless sensor hierarchy is to increase the lifetime and decrease the Transmission Delay in the architecture as all the Nodes are prepared with critical battery power.

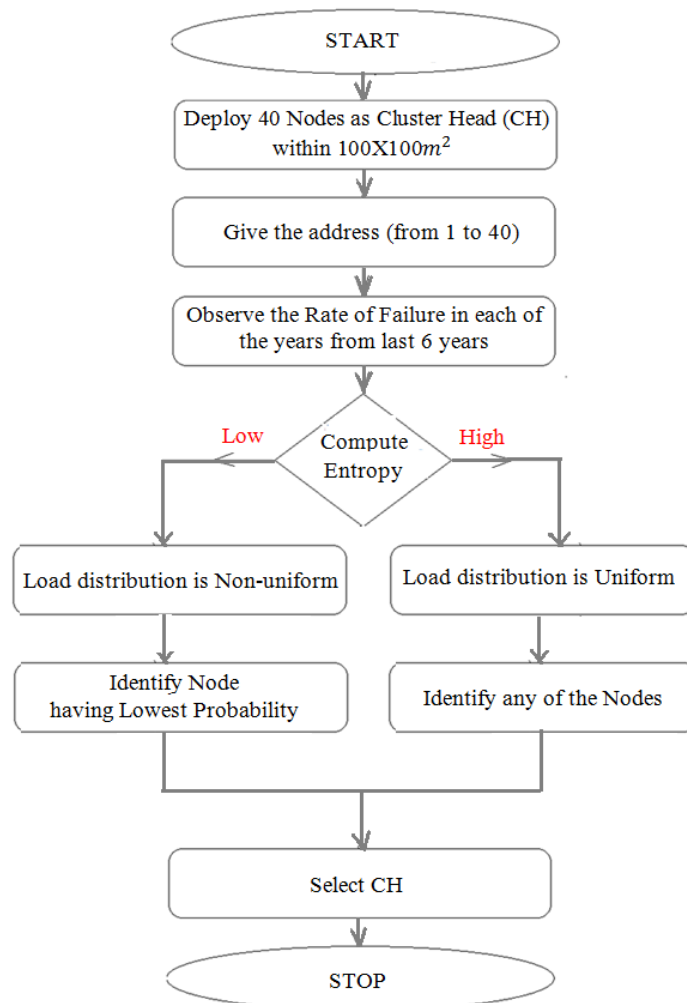


Fig 2: Flow of the Proposed Methodology

Entropy Calculation

A communication system not only dealing with a single node but with all possible nodes, hence a WSN may be

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described in average Load per individual node, called Entropy.

Let M= Total number of nodes

$$H = - \sum_{k=1}^M \frac{1}{P_k} \cdot \log_2 \frac{1}{P_k} \text{ Load/ Node}$$

Then entropy is maximum; if all the nodes have equal load.

$$H_{max} = - \sum_{k=1}^M \frac{1}{M} \cdot \log_2 \frac{1}{M} \text{ Load/ Node}$$

For example if we are tossing a coin, then there may be 2 outcomes Head & Tail; it means P=1/2 and Q=1/2. Now entropy for Binary Numbers [H & T] is-

$$H_{max} = - \left[\frac{1}{2} \cdot \log_2 \frac{1}{2} + \frac{1}{2} \cdot \log_2 \frac{1}{2} \right]$$

$$H_{max} = -\log_2[2].$$

$$H_{max} = 1 \text{ Outcome / Toss}$$

This shows that Average or Entropy is maximum if all the probabilities are equal. It means to achieve the load balancing, routing should be such that all the nodes have handled equal traffic load. This is the condition of balancing the Load. If balancing is used then all the Nodes share equal amount of Load. Therefore, the Failure Probabilities of all the Nodes are almost equal. Now the Leach Protocol will be very secure because it can select any of the Nodes as Cluster Head. By this there is no problem of die the Cluster Head before completing the communication. In our simulation, 50 sensors are deployed in 100X100m² area that generates data from environment events at random times and places within the area. Sensing applications could equally environment temperature, pollution, or others. We considered the prevalent parameters of energy consumption of process, memory and radio units as constant in the individual constituent of all sensors. Also the duration of the experiments was assumed as constant 60 seconds. Monitoring neighbors and providing a secure communication with neighbors at the local level. In addition, the local constituent may include overhearing, idle listening and collision, if they occur. The global constituent is concerned with maintenance of the whole network, selection of a suitable topology and an energy efficient routing strategy based on the application's objective. This may include energy wastage from packet retransmissions due to congestion and packet errors. The global constituent is defined as a function of energy consumption (EC) for topology management, packet routing, packet loss, and protocol overheads. The sink constituent includes the roles of manager, controller or leaders in WSNs. The sink tasks include directing, balancing, and minimizing EC of the whole network and the collection of generated data by the network's nodes.

Table 1: Entropy Calculation for 50 Nodes Loading Probabilities

Node	Probability of Loading (PK)		Log ₁₀ (1/Pk)	PK * Log ₁₀ (1/Pk)	
Node 1	P1	3	0.03	1.52	0.046
Node 2	P2	1	0.01	2.00	0.020
Node 3	P3	3	0.03	1.52	0.046
Node 4	P4	3	0.03	1.52	0.046
Node 5	P5	1	0.01	2.00	0.020
Node 6	P6	2	0.02	1.70	0.034
Node 7	P7	1	0.01	2.00	0.020
Node 8	P8	1	0.01	2.00	0.020
Node 9	P9	2	0.02	1.70	0.034
Node 10	P10	3	0.03	1.52	0.046
Node 11	P11	1	0.01	2.00	0.020
Node 12	P12	2	0.02	1.70	0.034
Node 13	P13	2	0.02	1.70	0.034
Node 14	P14	1	0.01	2.00	0.020
Node 15	P15	2	0.02	1.70	0.034

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Node 16	P16	3	0.03	1.52	0.046
Node 17	P17	2	0.02	1.70	0.034
Node 18	P18	4	0.04	1.40	0.056
Node 19	P19	1	0.01	2.00	0.020
Node 20	P20	2	0.02	1.70	0.034
Node 21	P21	3	0.03	1.52	0.046
Node 22	P22	2	0.02	1.70	0.034
Node 23	P23	1	0.01	2.00	0.020
Node 24	P24	2	0.02	1.70	0.034
Node 25	P25	1	0.01	2.00	0.020
Node 26	P26	1	0.01	2.00	0.020
Node 27	P27	3	0.03	1.52	0.046
Node 28	P28	5	0.05	1.30	0.065
Node 29	P29	2	0.02	1.70	0.034
Node 30	P30	2	0.02	1.70	0.034
Node 31	P31	1	0.01	2.00	0.020
Node 32	P32	2	0.02	1.70	0.034
Node 33	P33	5	0.05	1.30	0.065
Node 34	P34	3	0.03	1.52	0.046
Node 35	P35	1	0.01	2.00	0.020
Node 36	P36	1	0.01	2.00	0.020
Node 37	P37	6	0.06	1.22	0.073
Node 38	P38	4	0.04	1.40	0.056
Node 39	P39	1	0.01	2.00	0.020
Node 40	P40	2	0.02	1.70	0.034
Node 41	P11	1	0.01	2.00	0.020
Node 42	P12	1	0.01	2.00	0.020
Node 43	P13	1	0.01	2.00	0.020
Node 44	P14	1	0.01	2.00	0.020
Node 45	P15	1	0.01	2.00	0.020
Node 46	P16	1	0.01	2.00	0.020
Node 47	P17	1	0.01	2.00	0.020
Node 48	P18	3	0.03	1.52	0.046
Node 49	P19	1	0.01	2.00	0.020
Node 50	P20	1	0.01	2.00	0.020
TOTAL	100	1	H (X) =		1.62816

The condition of applying Probability theory is that the summation of all the Probabilities must be equal to 1. Here summation is 100. Now, divide each of the Probability by 100, and then the summation of all the Probabilities will be equal to 1. Let, calculate the Entropy.

Let Total number of Nodes=50

$$H_{max} = - \sum_{k=1}^{50} \frac{1}{P_k} \cdot \log_2 \frac{1}{P_k} \text{ Load/ Node}$$

$$H_{max} = 1.62816 \text{ Load/ Node}$$

Here, each of the CH has its own Failure rate. It means each of the CH has a different load which shows unbalancing or non-uniform load distribution. This system never is efficient and there is always fear of Failure of CH during propagation. Suppose, Failure Probabilities of all the CH are equal, then Entropy would be higher. Let, this Failure

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Probability is 0.025.

Table 2: Entropy Calculation for 50 Nodes with equal Loading Probabilities

Node	Probability of Loading (PK)			$Log_{10}(1/Pk)$	$PK * Log_{10}(1/Pk)$
Node 1	P1	2	0.02	1.70	0.034
Node 2	P2	2	0.02	1.70	0.034
Node 3	P3	2	0.02	1.70	0.034
Node 4	P4	2	0.02	1.70	0.034
Node 5	P5	2	0.02	1.70	0.034
Node 6	P6	2	0.02	1.70	0.034
Node 7	P7	2	0.02	1.70	0.034
Node 8	P8	2	0.02	1.70	0.034
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Node 30	P30	2	0.02	1.70	0.034
Node 31	P31	2	0.02	1.70	0.034
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Node 38	P38	2	0.02	1.70	0.034
Node 39	P39	2	0.02	1.70	0.034
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Node 41	P11	2	0.02	1.70	0.034
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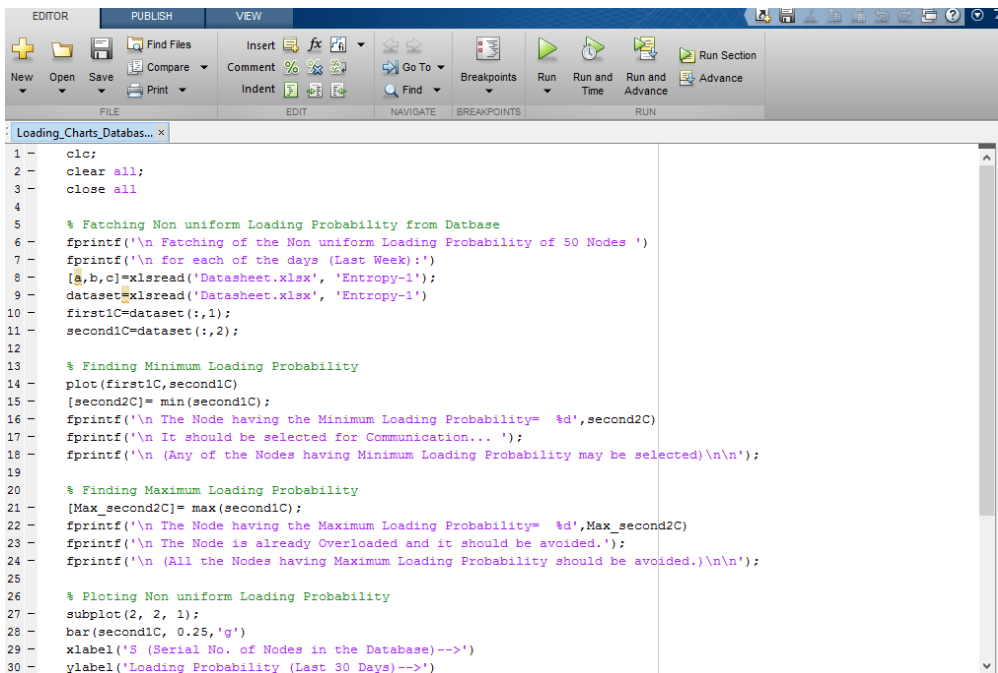
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Node 43	P13	2	0.02	1.70	0.034
Node 44	P14	2	0.02	1.70	0.034
Node 45	P15	2	0.02	1.70	0.034
Node 46	P16	2	0.02	1.70	0.034
Node 47	P17	2	0.02	1.70	0.034
Node 48	P18	2	0.02	1.70	0.034
Node 49	P19	2	0.02	1.70	0.034
Node 50	P20	2	0.02	1.70	0.034
TOTAL	100	1	H (X) =		1.69897

$$H_{max} = -\sum_{k=1}^{50} \frac{1}{p_k} \log_2 \frac{1}{p_k} \text{ Load/ Node}$$

$$H_{max} = 1.69897 \text{ Load/ Node}$$



```

1 - clc;
2 - clear all;
3 - close all
4
5 % Fetching Non uniform Loading Probability from Database
6 - fprintf('\n Fetching of the Non uniform Loading Probability of 50 Nodes ')
7 - fprintf('\n for each of the days (Last Week):')
8 - [a,b,c]=xlsread('Ddatasheet.xlsx', 'Entropy-1');
9 - dataset=xlsread('Ddatasheet.xlsx', 'Entropy-1')
10 - first1C=dataset(:,1);
11 - second1C=dataset(:,2);
12
13 % Finding Minimum Loading Probability
14 - plot(first1C,second1C)
15 - [second2C]= min(second1C);
16 - fprintf('\n The Node having the Minimum Loading Probability= %d',second2C)
17 - fprintf('\n It should be selected for Communication... ');
18 - fprintf('\n (Any of the Nodes having Minimum Loading Probability may be selected)\n\n');
19
20 % Finding Maximum Loading Probability
21 - [Max_second2C]= max(second1C);
22 - fprintf('\n The Node having the Maximum Loading Probability= %d',Max_second2C)
23 - fprintf('\n The Node is already Overloaded and it should be avoided. ');
24 - fprintf('\n (All the Nodes having Maximum Loading Probability should be avoided.)\n\n');
25
26 % Plotting Non uniform Loading Probability
27 - subplot(2, 2, 1);
28 - bar(second1C, 0.25,'g')
29 - xlabel('S (Serial No. of Nodes in the Database)-->')
30 - ylabel('Loading Probability (Last 30 Days)-->')

```

Fig 3: MATLAB Program for Nodes Deployment and Probability Calculation in WSN

V. EXPERIMENTAL RESULTS AND CONCLUSION

By this discussion it is clear, that to increase the security of propagation, routing should be such that all the nodes have handled equal traffic load. This is the condition of balancing the Load. If balancing is used then all the Nodes share equal amount of Load. Therefore, the Loading Probabilities of all the Nodes are almost equal. Now the Leach Protocol will be very secure because it can select any of the Nodes as Cluster Head. By this there is no problem of die the Cluster Head before completing the communication. If balancing is not achieved then the Node having lowest Loading Probability should be selected as CH, which will give less risk of Failure.

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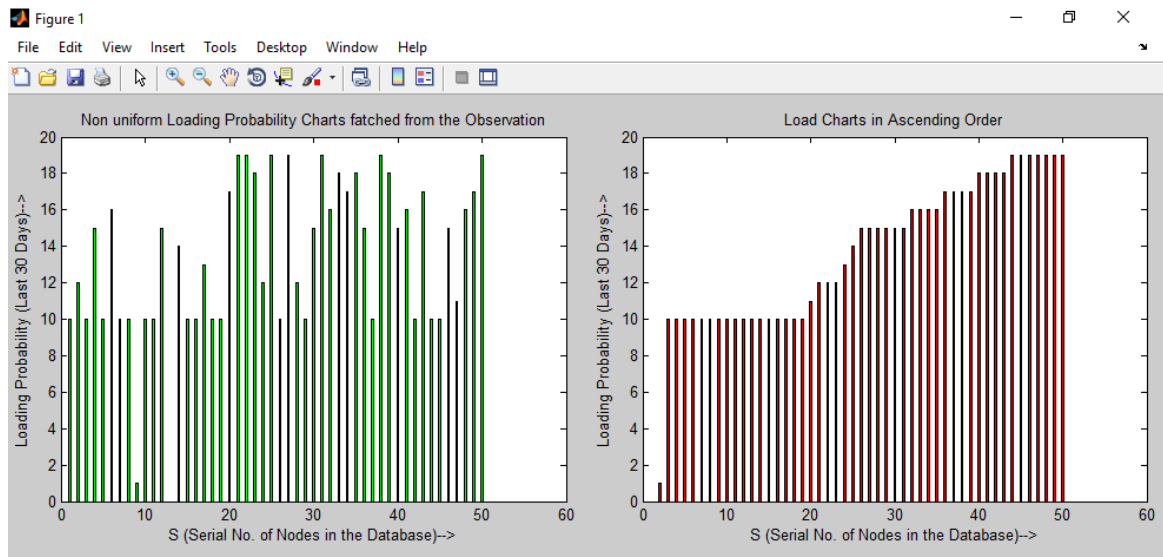


Fig 4: Load Chart of Observed Data in WSN using MATLAB

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