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P-leach Protocol for Wireless Sensor Network

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Abstract*— Reducing the energy consumption of available resources is still a problem to be solved in Wireless Sensor Networks (WSNs). Many types of existing routing protocols are developed to save power consumption. In these protocols, cluster-based routing protocols are found to be more energy efficient. A cluster head is selected to aggregate the data received from root nodes and forwards these data to the base station in cluster-based routing. The selection of cluster heads should be efficient to save energy. In P-LEACH protocol, dynamic clustering for the efficient selection of cluster heads has been used. The routing protocol works efficiently in large as well as small areas. For an optimal number of cluster head selection it divided a large sensor field into rectangular clusters. Then these rectangular clusters are further grouped into zones for efficient communication between cluster heads and a base station. It performed NS2 simulations to observe the network stability, throughput, energy consumption, network lifetime and the number of cluster heads. In P-LEACH routing protocol out-performs in large areas in comparison with the LEACH, I-LEACH. It has been done in P-LEACH, which residual energy and distance of node from BS are used as parameters for CH selection. To save energy, start the steady state operation of a node only if the value sensed by a node is greater than the set threshold value. The threshold value will be set by the end user at the application layer. P-LEACH is then qualitatively and quantitatively analyzed. It has been done that the P-LEACH in terms of network lifetime and took less energy consumed when the amount of data to transfer to BS. If maximum number of nodes is alive with time, shows the network lifetime. In P-LEACH, 90 nodes are alive for 50 sec. If maximumnumbers of nodes are alive for long time, the network life time increased. It has been found that first node dies at 35 round and half of the node alive =250, last node dies at 1000, network settling time =1.9 sec and protocol overhead (bytes) =16. The result is that the network settling time is increased due to the maximum number of nodes alive and low energy consumption.

I. INTRODUCTION

In recent years, researchers have been attracted by Wireless Sensor Networks (WSNs) due to their potential use in a wide variety of applications. Initially WSNs were used only in the battlefields for military purposes but now their use is extended for monitoring and controlling the different processes in many other civilian areas. A WSN contains different types of autonomous sensor nodes that are used to sense and transfer the data wirelessly to the base station or the next receiver node. Typically hundreds or thousands of low cost sensors are used in WSNs. The technology advancements made it possible to reduce the cost and the size of the electronic devices. A wide range of sensors are available to monitor the different ambient conditions such as temperature, pressure, humidity, movement, and lightening conditions. Low cost and smaller size of sensor nodes does not allow the use of the large battery source. The required lower energy consumption restricts the sensor to use the limited resources such as less memory capacity, low transmit power, and less processing computations. Other than data communication, a periodic routing protocol transmission is required to update the sensor's routing table. The selection of a proper routing protocol can help to prevent the excessive use of routing updates. The goal of this research is to find an energy efficient routing protocol for Wireless Sensor Networks. Our proposed algorithm aims to provide a higher throughput, a fewer number of dead nodes, and overall lower energy consumption compared to other protocols.

LEACH PROTOCAL:

The LEACH (Low energy adaptive cluster hierarchy), all nodes are spread randomly in the network. These nodes divided into the several clusters. In this protocol, the cluster head selects randomly to distribute energy to the whole network to energy node. The cluster head near to the sink

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node and transmit the data frame. The cluster head which transmit the data from all nodes to the sink, it consumes more energy to the other nodes. It's energy consumption of the whole network unevenly and it affects the lifetime of the network. The energy consumption by the cluster head. It can reduce the lifetime of the network. The function of Leach is divided into two phases. Selected cluster head is the administrator of the cluster. The task of CH, creates TDMA-based schedule to assign a time slot to each cluster member for periodic data transmission to CH. Then CH aggregates the data to reduce redundancy among correlated value and they transmit the data to BS directly. The main function of LEACH is divided into two phase.The set-up phase consist of the CH selection and cluster followed by steady-state phase in which selected CH does data collection aggregation, delivery to BS. At the time of set-up phase, a sensor node selects a random number 0 and 1.. If the random number is not greater than the threshold T(n) value then the sensor node select as a cluster head. T(n) is calculated as

$$T(n) = \begin{cases} \frac{p}{1-p\left(r mod\left(\frac{1}{p}\right)\right)} & if\ n \in G \\ 0 & otherwise \end{cases}$$

Where P is the desired percentage for becoming a cluster head, r is the current round cell, G is the set of nodes that have not being selected as a cluster head in the previous 1/p rounds.

PROPOSED TECHNIC: P-LEACH: For the purpose of increasing the lifetime of network, the node had more residual energy and it should have high probability to become the CH. Hence the node's $E_{current}/E_{int}$ for the selection of CH has been used. The energy consumed in transmission of data from CH to BS, is directly proportional to distance between them. It considered the distance between node and BS for the selection of CH. This is done by equally dividing the network into four quadrants. The figure shows four quadrants and if node lies in the same quadrant of BS (3rd quadrant) then the energy is given more weightage compared to distance from BS for CH selection.

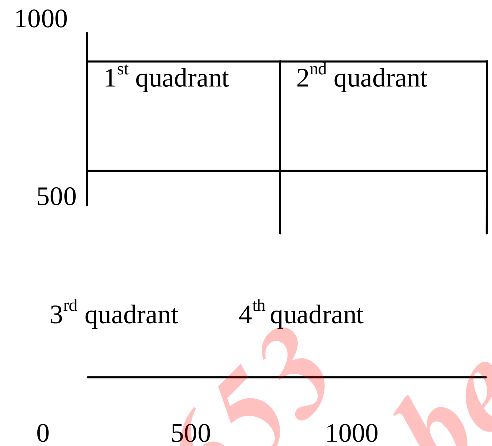

Fig.1: Dividing network in four quadrants with BS at location (50,175)

If the node lies in diagonally opposite quadrants of the BS (2nd quadrant) the energy is given less than the distance from for CH selection. If the node lies in 1st and 4th quadrant then equal weightage is given to distance and energy node. The threshold value for CH selection, T(n), used by n to determine if it will be a CH in the current round is defined as:

$$T(n) = \left\{\left[\frac{p}{1-p*(rmod1/p)}\right]\left[\left(\alpha*\left(\frac{E_{curreny}}{E_{int}}\right)\right)+\left((1-\alpha)*d_{nBS}\right)\right]\right\}$$ if n∈G, n is in same quadrant ass BS

$$T(n) = \left\{\left[\frac{p}{1-p*(rmod1/p)}\right]\left[\left((1-\alpha)*\left(\frac{E_{current}}{E_{int}}\right)\right)+\left(\alpha*d_{nBS}\right)\right]\right\}$$ if n∈G, n is in 2nd quadrant

$$T(n) = \left\{\left[\frac{p}{1-p*(rmod1/p)}\right]\left[\left(\left(\frac{\alpha}{2}\right)*\left(\frac{E_{current}}{E_{int}}\right)\right)+\left(\left(\frac{\alpha}{2}\right)*d_{nBS}\right)\right]\right\}$$ if n∈G, n is in 1st or 4th quadrant

Where p is desired percentage of nodes which are CH, r is the current round, G is a set of node that has not been CH in last 1/p rounds, α is a constant with value 0.75, d_{nBS} is the distance of node from BS. If it is turn to decide to become the CH, a node , n , generates a random number. On the basis on threshold value the CH decided. If v>T(n), nodes becomes CH. The threshold value decided by end user at the application layer.

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The CH Selection is based on weigh age and the distance of nodes from BS in every quadrant. The resulting threshold value for CH selection in every quardrant. The calculation of $E_{current}/E_{int}$ for every node for the checking of cluster head checked in each and every moment. If the cluster head has efficient energy then it remained. If it is not efficient to transmit the aggregated data to BS then the cluster head got changed and the process of the selection of cluster head, start from beginning.

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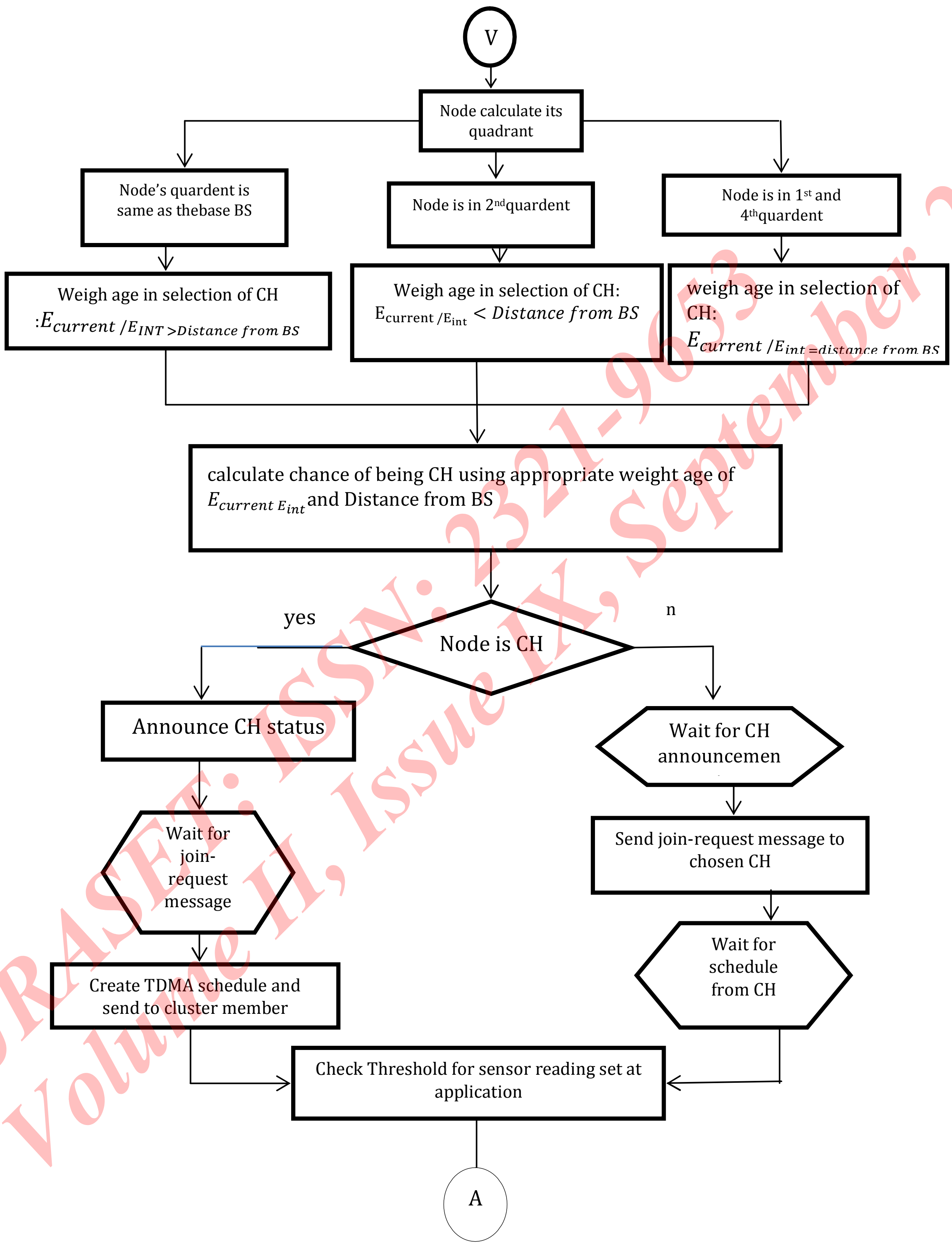

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Fig.1 Flow chart of proposed technique

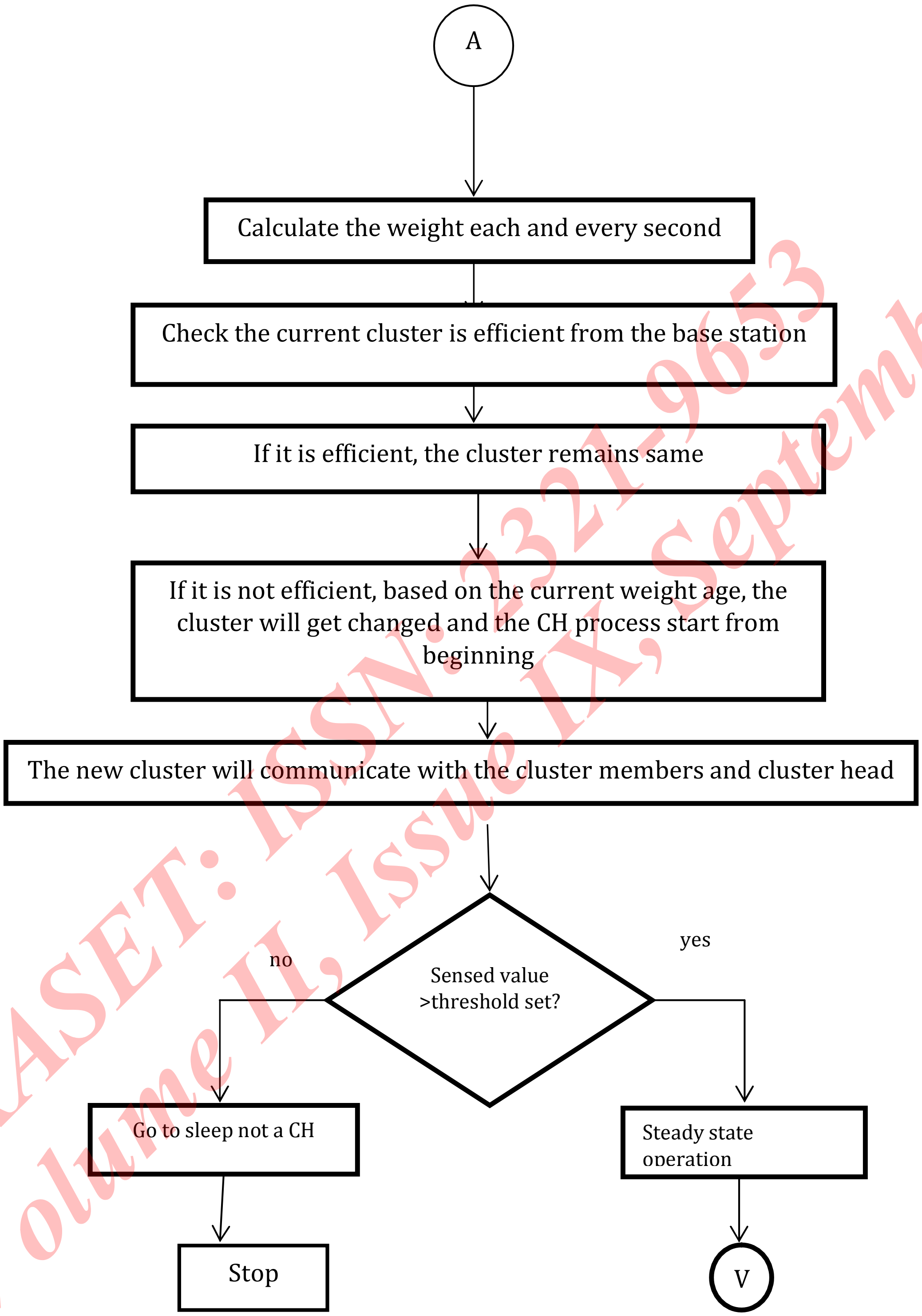

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Fig.2 Flow chart of proposed technique (continued)

II. SIMULATION AND ANALYSIS OF I-LEACH AND P-LEACH

All simulations were out from using NS2. Table 1 shows the simulation settings for all simulations.

Table 1. Simulations settings for all simulations

A. Parameter	B. Description
C. Nodes	D. 1000
E. Network Size	F. 1000m×1000m
G. BS location	H. (50,175)
I. Radio Propagation speed	J. 3×10^8m/s
K. Processing Delay	L. 50µs
M. Radio speed	N. 1Mbps
O. Data Size	P. 500 bytes
Q. Initial energy	R. 20J
S. Bit rate	T. 1Mbps
U. Antenna gain factor	V. 1
W. Antenna height above ground	X. 1.5 m
Y. Signal Wavelength	Z. 0.325 m

For the analyzing the performance of I-LEACH and P-LEACH we investigate following performance metrics.

1. Network lifetime

The network lifetime is that time whenever the first node dies (FND) and for the deployment of the nodes densely, it is the time till half of the nodes are Alive (HNA), and for the redundant deployment of nodes it is time till last node dies (LND).

2. Network Settling time

Network Settling time mean, from the starting of the simulation to form the cluster how much time taken.

3. Network join time

It is the time which is required for the node to become interact into the network.

4. Latency

It is the average time between starting of disseminating data from the source node to received node.

5. Protocol overhead

It is the total number of bytes which are required for maintain the proper network operation.

III. RESULTS AND DISCUSSION

Figure 3shows the total number of nodes that remain alive over the simulation time. The nodes remain alive for long time for P-LEACH because its CH selection algorithm is based on residual energy and distance of node from BS.

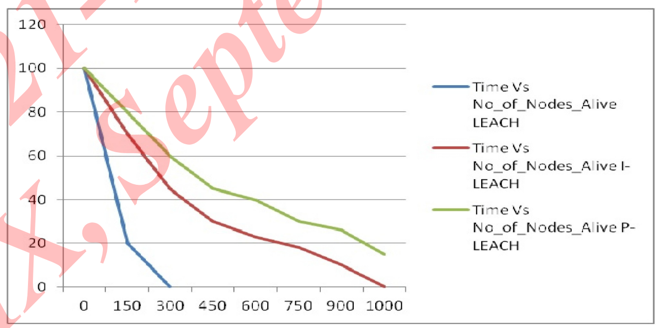

Fig 3. Number of nodes alive overtime.

The threshold value for sensor network is set for application but it checked the cluster head in each and every second that the cluster head has efficient energy. If the cluster head has not efficient energy based on the current weigh age, then the cluster will get changed and the selection of CH process start again from the beginning. The new cluster head communicates with the cluster members or nodes while the I-LEACH uses one time setting of threshold value for CH selection. Energy consumption in P-LEACH decreased by starting the steady state phase but if the cluster head has less energy for the transmission of aggregated data, then the selection of CH is again while in I-LEACH, the cluster head had become weak.

Figure 4 shows the number of nodes that remain alive per amount of data in Kbytes received at the BS. The total amount of data received at BS when all nodes have died in I-LEACH

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is 20 Kbytes whereas in P-LEACH it is 40 K bytes because lifetime of P-LEACH network is more than LEACH.

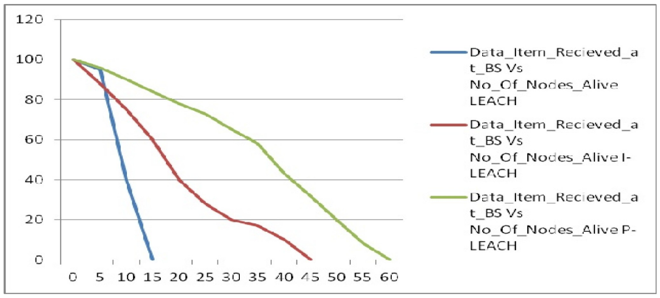

Fig 4. Number of nodes alive per amount of data sent.

Figure 5 shows the total data received at BS over time. It is more in P-LEACH compared to I-LEACH because the number of nodes alive overtime is more in P-LEACH.

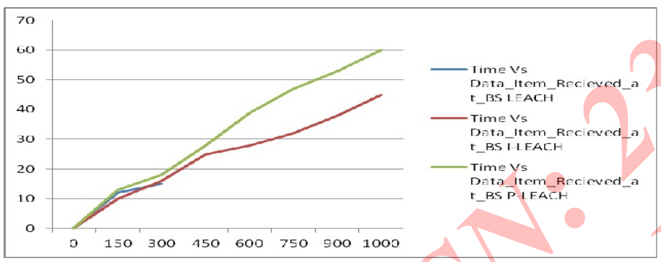

Fig 5. Total amount of data received at the BS overtime.

Figure 6 shows the total data received at BS against energy consumed. In this case again P-LEACH outperforms I-LEACH because the selection of cluster head is depending on the energy consumed. If the cluster head has less energy than the threshold value then selection of cluster head again, but in that case the cluster head is alive for long time and the lifetime of network is long.

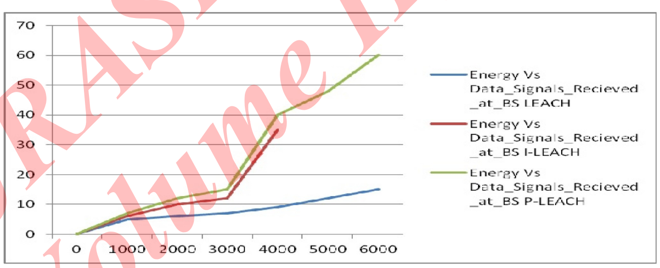

Fig 6. Total amount of data received at BS against energy consumed.

Comparison of quantitative analysis of I-LEACH and P-LEACH is shown in Table 2.

Table 2: Comparison of results of I-leach and p-leach.

AA. **Parameter**	*BB.* **I-LEACH**	*CC.* **P-LEACH**
DD. FND (first node dies)	*EE.* 30	*FF.* 42
GG. HNA(Half of the nodes alive)	*HH.* 210	*II.* 280
JJ. LND(Last node dies)	*KK.* 996	*LL.* 999
MM. Network settling time (secs)	*NN.* 1.716	*OO.* 1.0
PP. Network join time (secs)	*QQ.* 10.386	*RR.* 5.0
SS. Latency (secs)	*TT.* 0.677	*UU.* 0.765
VV. Protocol overhead(bytes)	*WW.* 16	*XX.* 16

IV. CONCLUSION AND FUTURE PLANS

To achieve the wireless sensor network lifetime improvement goal, implementations of various designs have been implemented in WSNs. The examination of routing protocols, specifically hierarchical routing protocols has been done and analysis of LEACH in particular has been done. Routing protocols have great impact in determining the network lifetime since most of the energy is consumed in sending and receiving of data. This work has been carried out with the objectives to study the Improved Low Energy Adaptive Clustering hierarchy (I-LEACH) protocol and extending the I-LEACH protocol to utilize the energy of sensor nodes efficiently that leads to longer lifetime of WSNs. During this work, NS2 is used for simulation purpose. For the purpose of improvement of parameters of P-LEACH protocol simulation analysis has been done and results obtained. To validate our proposed method, simulated results are compared with I-LEACH protocol in NS2. The proposed approach is also applicable for other LEACH based variants. On the basis of results obtained, following conclusions are made:

i) Sensors are required to transmit the data as well as routing packets to the base station. The sensor battery

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life decays drastically if more of these operations are performed.

ii) The control of unnecessary data transmission or reception by using the proper communication protocol can help in better management of battery life.

iii) By considering the influencing factors such as latency, and energy awareness.

iv) The purpose of this research is to find an energy efficient routing protocol for Wireless Sensor Networks. The conclusion of our research is provided.

The future plans include extending the proposed routing scheme to the mobility scenarios with security in Wireless Sensor Networks. Achieving energy efficiency in mobility environment will further increase the capability of Wireless Sensor Networks. The study carried out in this research work will provide guidelines to future researchers in the area.

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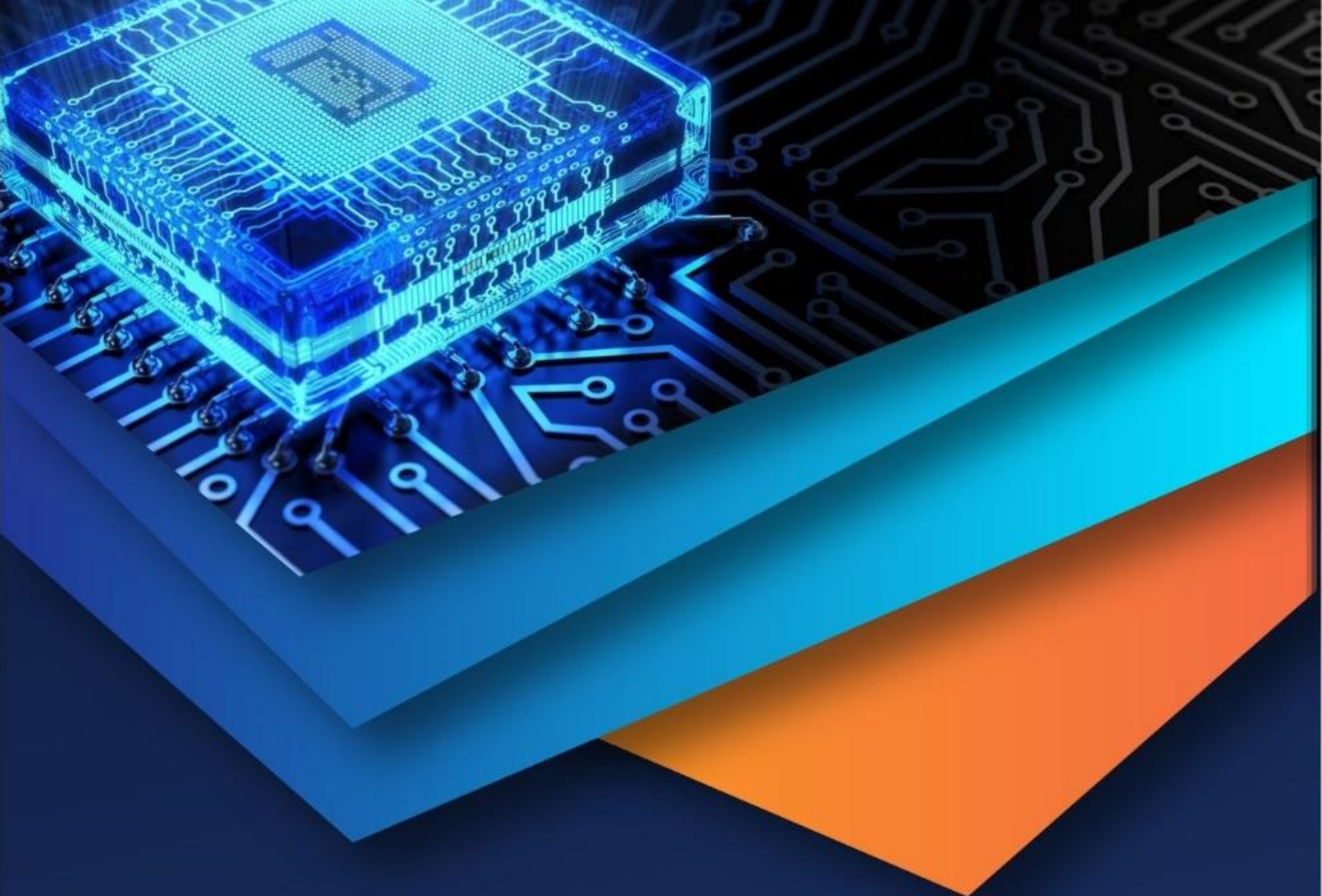

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