$$T_{s(i)} = \begin{cases} \dfrac{p(i)}{1 - p(i)\left(r \bmod \dfrac{1}{p(i)}\right)} & if s(i) \in G \\ 0 & otherwise \end{cases} \quad (20)$$

where is the set of nodes that have not been CH in the last $1/p_i$ rounds.

Cluster Formation

After the selection of CHs, the CH nodes broadcast an advertisement (ADV) message to the whole network using non-persistent carrier sense multiple access (CSMA) MAC protocol. This small message contains the CH's ID and a header which specifies the type of the message. After receiving the message, the non-CH nodes choose the CH on the basis of minimum communication distance by calculating the signal strength of the ADV message from different CHs.

After selecting the CH by the non-CH nodes they send a join-request (JOIN-REQ) to their corresponding CH for which they form the cluster. Again the join message is a short message consisting of the CH node's ID, non-CH node's ID and the header. The clustering done in this algorithm is a soft clustering where the nodes are not restricted to a cluster but in every round the clusters changes dynamically.

Data Transmission

The data then sensed by the environment and transmits to the CH where the data aggregated and processed so that only useful data get transmitted to the BS and small data transmission must preserves the energy. The CHs close to the BS uses single hop or direct transmission where as the CHs far away from the BS uses multi-hop transmission/communication i.e. they transmit there data to the next CH close to the BS and soon.

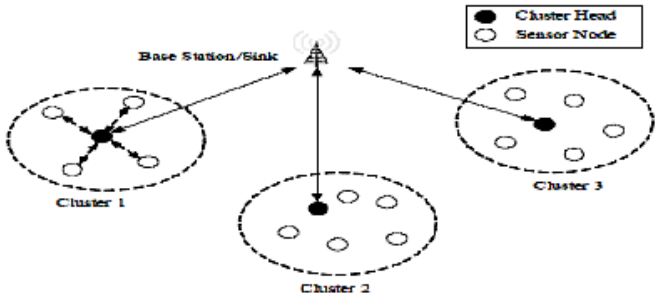

Figure 2: Single-hop Communication

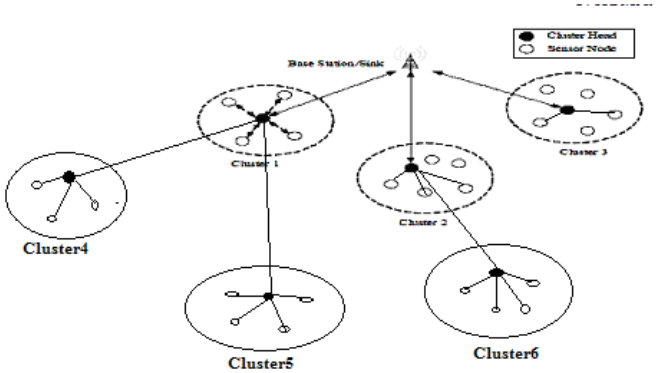

Figure 3: Multi-hop Communication

4. Simulation Results

The simulation is performed on MATLAB version 7.9.0.529 with intel (R) Core (™) 2 Duo CPU with 2GB RAM. The results are as follows:

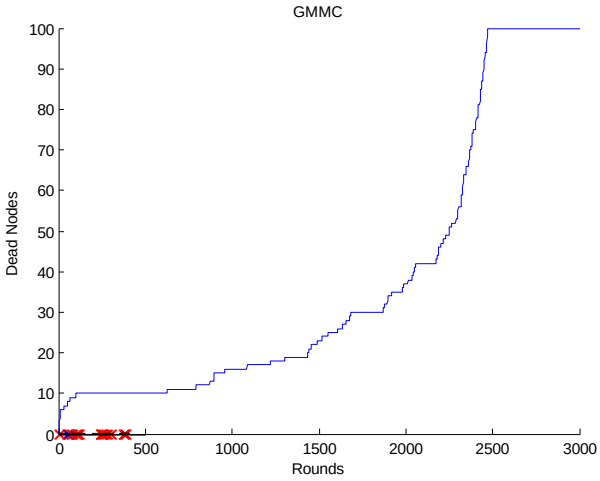

Figure 4: Stability

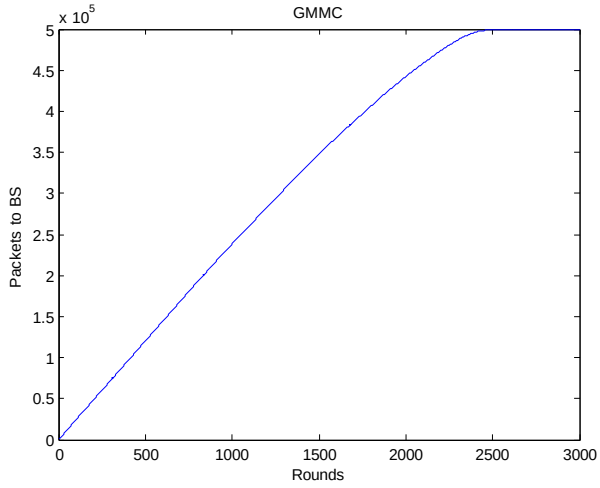

Figure 5: Packets to BS

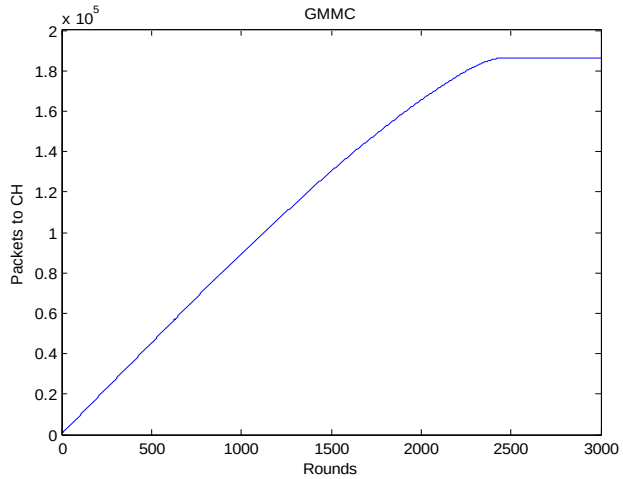

Figure 6: Packets transmitted to CHs

Table 2: Results

S. No	*Parameters*	*GMMC*
1	All Node Dead	2450^{th} round
2	Packets send to BS	$5x10^5$
3	Packets send to CH	$18x10^4$

5. Comparison with Established Model

In this method, our effort was to enhance the energy efficiency of the network. We focused on the lifetime of the network by enhancing the overall lifetime of the nodes. We also took into account the number of CHs formed, number of packets transmitted from node to CH and from CH to the BS. The evaluation of GMM is performed on MATLAB. In our opinion the proposed model enhances the lifetime and energy efficiency of the network. The performance of the GMM is compared with the LEACH protocol.

We consider a wireless network with 100 nodes distributed randomly within a region of 100m x100m and assume that the BS is at the centre of the region. The number of rounds considered to be 3000. Various factors used to be compared between GMM and LEACH protocols.

Stability

It is not necessary that initially the probability of the nodes to become CH is same. In GMM, our approach was to evaluate the probabilities of the nodes on the basis of certain criteria whereas in LEACH all the nodes assumed to have equal probability.

Figure7 shows that by varying the probability in the initial stage of the network cause an overall enhancement of the network. In case of LEACH, the last node dead at 1100^{th} round while in cadse of GMMC the last node dead at 2450^{th} round. This approach shows that the last node dead in GMMC is 1350 rounds more than the LEACH protocol.

Considering the varying probability into account the overall stability of the network has been enhanced.

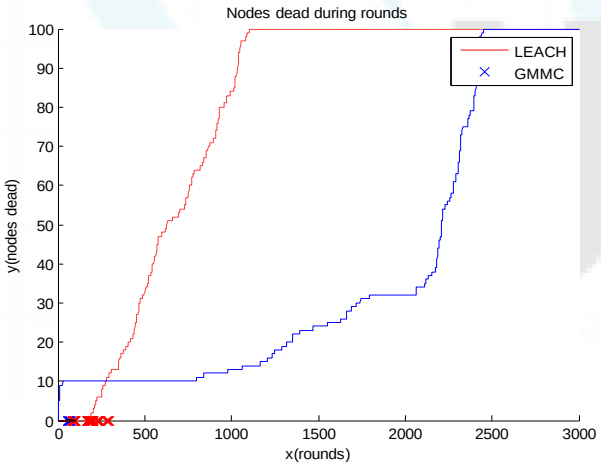

Figure 7: Comparison of the Stability

Packets to BS

Figure 8 shows that the number of data packets transmitted from the CHs to BS is more in case of GMMC as compared to the LEACH protocol. The number of packets transmitted by the GMMC is approx. $5x10^5$ while in case of LEACH it is approx. 7300. This shows that GMMC transmits $49x10^4$ data packets more from CHs to BS then the LEACH.

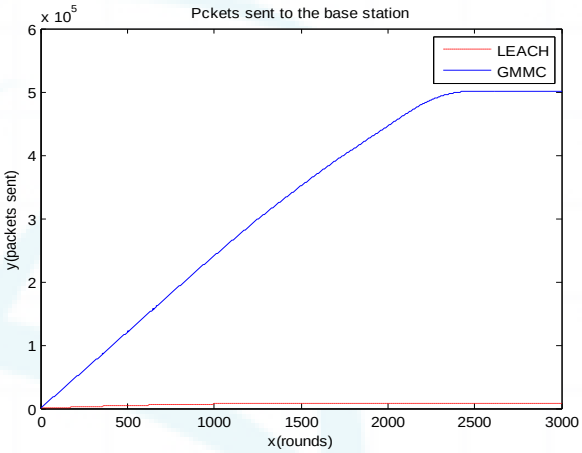

Figure 8: Comparison of the packets sent to the BS

Packets to CHs

Figure 9 shows that the number of data packets transmitted from the non-CH nodes to the CHs is more in case of GMMC as compared to the LEACH protocol. The number of packets transmitted by the GMMC is approx. $18x10^4$ while in case of LEACH it is approx. $58x10^3$. This shows that GMMC transmits $12x10^4$ data packets more from non-CH nodes to the CHs then the LEACH.

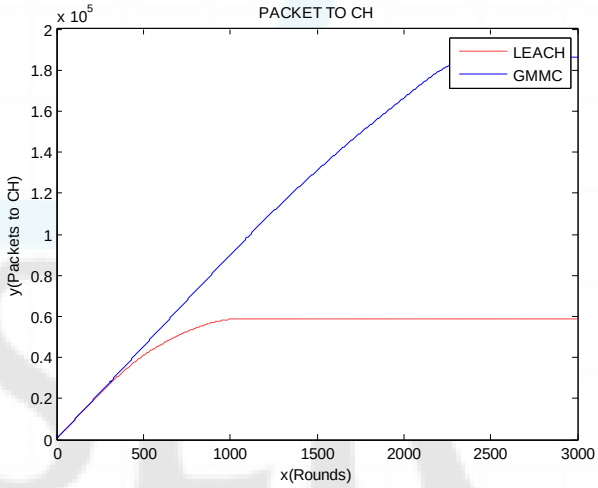

Figure 9: Comparison of the packets sent to the CHs

CH Formation

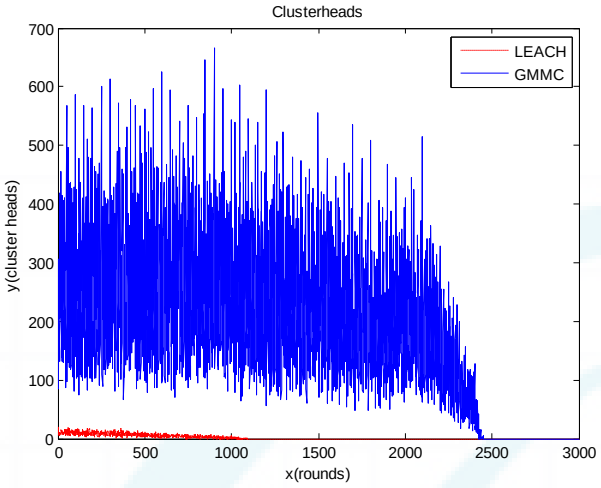

Figure 10: Comparison of the CHs formation

Figure 10 shows the comparison of CH formation between the GMMC and the LEACH protocol. The CHs formed in the GMMC is much more than the formation in LEACH protocol.

Number of Nodes Alive

Fig.11 shows that the last node alive in case of GMMC is approx. at 2400th round while in case of LEACH protocol last node remains alive at 1100th round.

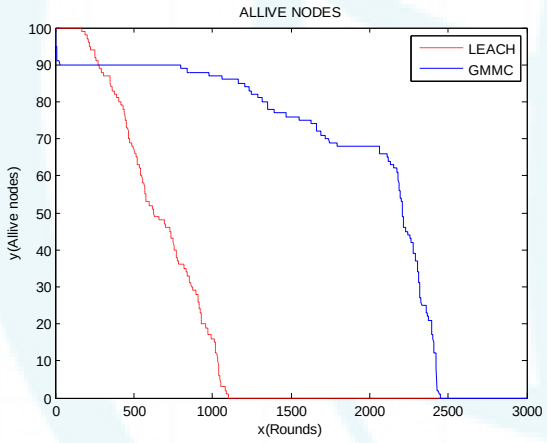

Figure 11: Comparison of the last node alive

6. Conclusion

The work is an attempt to improve Energy efficiency of wireless system by incorporating a model into a wireless sensor system. Discussing design issues and taking practical constraints into account, the attempt is made to develop application oriented system to increase Energy Efficiency and improve the performance of Wireless Sensor network.

With the application of Gaussian Mixture Model into the wireless sensor network protocol the system becomes more practical. The results establish that there is improvement in Energy performance of system.

The work is compared with established protocols in terms of results for various parameters in order to establish model based approach to the protocol architecture practically .With better results, practical wireless based applications will be benefited by incorporation of this model and will provide improvement in the system performance facing acute Energy constraints.

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