Energy Efficient Adaptive Modulation Scheme for Wireless Sensor Networks

Mandeep Kaur1, Dr Charanjit Singh2
1Research Scholar, 2Assistant Professor
12Punjabi university, Patiala

Abstract- Wireless sensor network is similar to adhocnetworkswhichsense the information and replies back to the base stations. Wireless sensor network is used to collect the information from physical and environmental conditions. WSN is a decentralized type of networkthat is deployed in far places.Since the sensor nodes are small in size, the energy consumption of the sensor nodes is a major issue. To solve this problem, a novel approach is proposed in this paper. The proposed technique is implemented in MATLAB and results are analyzed in terms of certain parameters. It is analyzed that proposed technique performs well in terms of sensed data, black hole nodes and residual energy.

Keywords- Adaptive Modulation, Gateway, Energy Efficiency

I. INTRODUCTION

A set of small devices known as nodes that help in monitoring the surrounding area, collectively generate a wireless sensor network (WSN). The various physical attributes of the surrounding area are measured with the help of the sensor nodes deployed within the regions that are required to be monitored. There are thousands of sensor nodes around present within these networks that use wireless mode for communicating amongst each other [1]. In order to connect the sensor network with the external environment, a special node which is known as base station or the sink node is available within the network.There are highly limited numbers of sensor nodes present within these networks. It is important to ensure that the sensor nodes that are to be deployed over large areas are very less costly due to which the components included within them are also of minimal cost. Therefore, least cost of components is used to generate the sensor nodes such that the structure of these nodes is very similar to that of the modern devices. There is minimal hardware design involved in these networks which results in generating such unique properties as well as limitations to these networks [2]. A parameter is sensed by the sensor network and the gathered data is forwarded to an external user so that it can be of use. It is always possible to sense one or the other information from the surrounding regions. However, measuring a particular parameter and transferring the collected data to the respective user is the major objective here [3]. The concerned user is mainly present external to the region that is being monitored. It is not possible to process the information locally in an extensive manner due to the presence of limited resources on the sensor nodes.The sensor nodes present in the network include batteries within them with the help of which various operations are performed. Thus, the overall lifetime of the wireless sensor networks is determined by the factor known as energy consumption. In these networks, the complications of energy optimization are higher since there is a need to increase the lifetime of the network along with the minimization of amount of energy being consumed. By generating energy awareness within each design and operation aspect, it is possible to perform optimization. Thus, it is made sure that within the groups of communicating sensor nodes and the overall network, the energy awareness is done along with focusing on each of the sensor nodes through this approach.Sensing the data available in surrounding environments is the most important task of sensor nodes of WSNs [4]. Within multi-hop scenarios, it is important to provide routing path for transmitting the gathered data towards the base station using multi-hop. There are large numbers of routing protocols proposed such that a routing path can be defined from source node to the base station. The power as well as resource limitations of the sensor nodes are important to be considered during the designing of routing protocols for WSNs. Further, the time-varying quality of wireless channels as well as the possibility of packet loss and delay is required to be considered here as well. Various routing mechanisms are proposed for WSNs such that the design requirements can be addressed in these networks. A flat network-architecture is adapted by the initial class of routing protocols [5]. Here all nodes that exist within the network are known as peers. Providing least overhead for the maintenance of infrastructure and discovering the various routes possible amongst the communicating nodes to ensure fault tolerance are some of the benefits of the flat network architecture. For providing an efficient, stable and scalable amount of energy within the networks, the structure is provided by the second class of routing protocols. Here, clusters are generated for the network nodes in which a cluster head is chosen on the basis of the node that has the highest amount of residual energy [15]. In order to coordinate the activities amongst the cluster and forward the data amongst the clusters, the cluster head performs various actions [6]. The energy consumption is minimized and the lifetime of the network is increased due to the application of clustering mechanism.For disseminating the

interest of the network, a data-centric approach is utilized by the third class of routing protocols. The attribute-based naming is utilized in this approach through which an attribute is queried by the source node for the phenomenon instead of including an individual node from the network. When the tasks are assigned to the sensor nodes and in relevance to the particular attributes the queries are expressed through the achievement of interest dissemination. For communication, the interest to the sensor nodes by involving broadcasting, geo-casting, attribute-based multicasting and so on, on the basis of various mechanisms. Utilizing the location in order to address the sensor node is done by the fourth class of routing protocols which are known as location-based routing protocols [7]. Within the applications in which there is relevance of the position of nodes in the geographical coverage of network and the queries that are generated by the source node, it is important to use the location-based routing. A particular area that might be of great interest is presented by such a query.

II. LITERATURE REVIEW

Ram Murthy Garimella, et.al (2018) presented that an essential role is played by the energy efficiency in the wireless sensor network. Various algorithms have been proposed by the researchers so far due to the concern of energy problem. Therefore, they proposed a method in this paper in order to fill the research gap. In order to utilize the efficient energy techniques in the wireless sensor networks for the process of data gathering and routing, they utilized the concept of the Hessian matrix in this paper [8]. These wirelesses sensor nodes are distributed in the multidimensional space which is the assumption on which it is based. On the basis of performed experiment, it is illustrated that proposed method can be utilized in any clustering approach using its mathematical design and provides the low-energy communication structure.

DeepaPuneeth, et.al (2018) presented that there are some criterion such as energy efficiency, data reliability, and security that must be fulfilled in the wireless sensor networks. Authors provided the Shamir's ramp secret sharing (SRSS) in this paper using which energy efficiency and data reliability is obtained [9]. Both these approaches have the limitation of compromised node (CN) attack in the condition when a minimum number of nodes are compromised. Hence, they proposed a scheme in this paper which provides the security against CN attacks along with data reliability, efficient energy. The combination of SRSS and a round-reduced AES cipher was there main objective which collectively called as "split hop AES (SHAES)". For the validation of the method near-sink CN attack, they performed various analyses and used simulation results and concluded proposed method superior to other methods.

PeijunZhong, et.al, (2018) presented that with the emerging technology and fast development in the wireless sensor networks applications, more energy efficient routing algorithms have been proposed. These methods have been proposed in order to minimize the major issues faced by this network. They discussed the major challenge in this paper that of how to overcome the hot spot problem since nodes close to base station tend to die earlier than other sensors. Therefore, this issue is alleviated effectively after introducing the concept of mobile sink node [10]. As these sink node can move along certain trajectories due to which nodes of hot spot can be distributed evenly in all direction. They studied the energy efficient routing method in detailed in this paper supported by the multiple mobile sinks. They performed various experiments for which they divided the whole network into several clusters after which investigated the effects of mobile sink on the network lifetime.

FawazAlassery, et.al (2017) used the virtual MIMO technique for high energy efficiency smart WSN [11]. In this approach the data is transmitted through two circumstances. In the first case, the source node received data from one rechargeable relay node that is deployed in the centre of sensing nodes and then these packets are forward to destination node. In second case, the whole sensing nodes are divided into clusters and in each cluster have its own rechargeable relay node is used to forward the data to destination node. The experiments are done by them on both cases, but the second case gave the better results because in this technique the clusters used. In this technique there is direct data transmission in each cluster due to clustering technique and the central relay nodes.

Mehdi Kalantari, et.al (2017) presented that routing in the wireless sensor network is very necessary due to which they proposed a new scheme in this paper. It is based on the concept in which data is collected by the various sensors and transferredto a central node [12]. In electrostatic theory, Maxwell's equation is very similar to partial differential equation, in proposed method. They approximated the identified paths using a sequence of wireless links each between a pair of sensors in order to find the actual routes. As per done simulation and obtained results, it is demonstrated that there is improvement in the network lifetime as compared to other traditional shortest path approach.

M. D. Umale1, et.al (2015) presented that there are various issues in the wireless sensor network (WSN) among those energy consumption is considered as the major issue. The reliable routing and networking protocol are some fundamental aspects that must be fulfilled by the proposed approach. Therefore, energy overhead is minimized and reliable data delivery is provided by the networking protocol [13]. They compared the working of both modulation in this paper for both general and dense WSN and concluded that better energy optimization is provided by the PPM modulation scheme as compared to FSK modulation. There are some limitations in the above mentioned approaches of dynamic energy management due to which the target tracking concept

of WSN was proposed as it provides the effective energy management. Therefore, the target tracking, the grid exclusion and Dijkstra algorithm used for coverage metric and energy metric respectively.

III. RESEARCH METHODOLOGY

Following are the steps followed within the proposed research work.

Step 1: Adaptive Modulation on Sensed information: It is important to include spectrally efficient communication techniques in future developing applications since there is a huge growth in demand of mobile communications and the spectrum available is limited. For enhancing the spectral efficiency within the wireless transmission over the fading channels, adaptive modulation is known to be a very powerful technique. Within the favorable conditions when adaptive modulation is involved, at a given Bit Error Rate (BER) higher spectral efficiency is achieved. However, during the degradation of channel, the throughput is minimized. It is also possible to include the requirements of various traffic classes and services within the adaptation. Improving the modulation and coding scheme as per the channel conditions is the major idea of Adaptive Modulation and Coding (AMC). The system can be converted into highest order modulation using the highest code rates in case when the Signal-to-Noise Ratio (SNR) value achieved is good. It is possible for the system to shift to other low order modulation that has low code rates in case when there are changes in the conditions of channel. The utilization of either adaptive modulation (AM) and adaptive coding (AC) collectively or AM separately has no major difference. However, the highest levels of modulation and highest rates of channel coding are used by mobile WiMAX when the conditions are favorable. In case when there are completely harsh channel conditions, lower levels of modulation and lower rates of channel coding are used by AM. Nevertheless, the combination of AM and AC have provided better performance results.

Step 2: Gateway Node Selection: In the network, the certain number of gateway nodes are deployed which can sense the information and pass it to base station. The sensor nodes aggregate the data to the gateway nodes which later send that information to the gateway node. In the network, there are multiple gateway nodes but the best gateway node is selected on the basis of distance. The cluster head which is willing to transmit data to base station, the distance between that gateway node and cluster head is calculated. The gateway which is nearest to cluster head receive data from cluster head then that cluster head will send data to base station. The data transmission distance will be reduced which directly reduce energy consumption of the network.

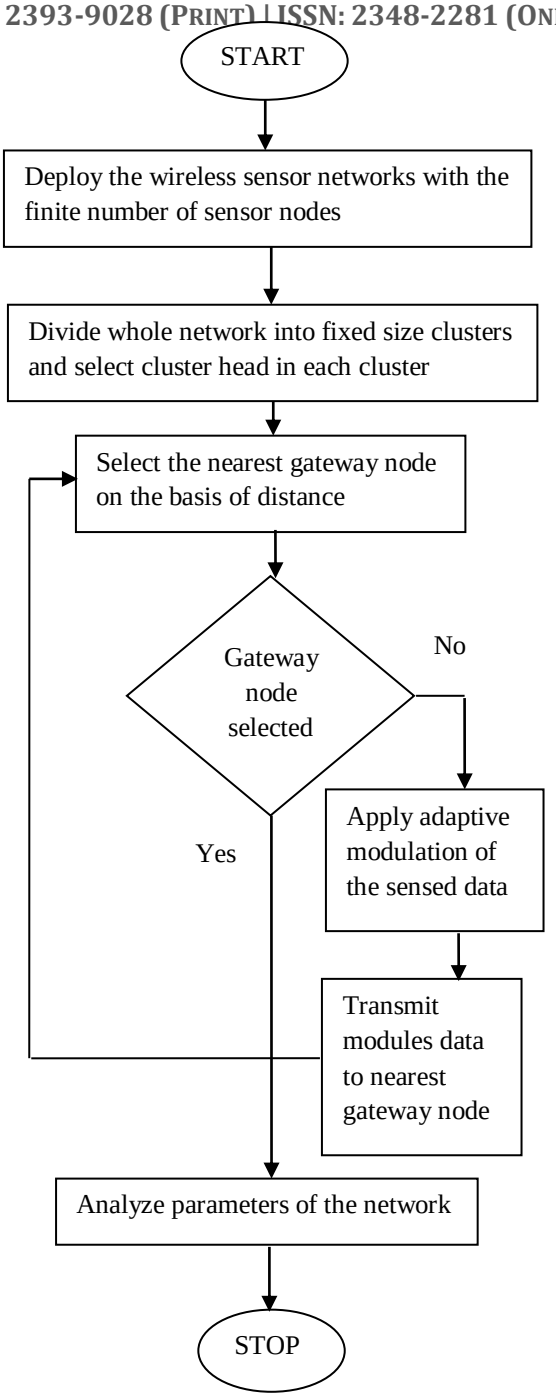

Fig.1: Flowchart of Proposed Work

IV. EXPERIMENTAL RESULTS

The proposed work has been implemented in MATLAB and the results have been evaluated as shown below.

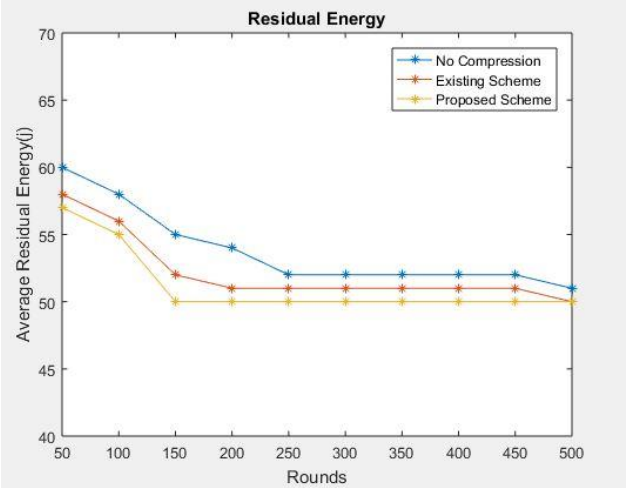

Fig.2: Residual Energy

As shown in figure 2, the residual energy of the three scenarios are compared which are when no compression is applied, the residual energy with the adaptive modulation technique and residual energy when the novel approach is applied. It is analyzed that residual energy of the proposed technique is least as compared to other techniques.

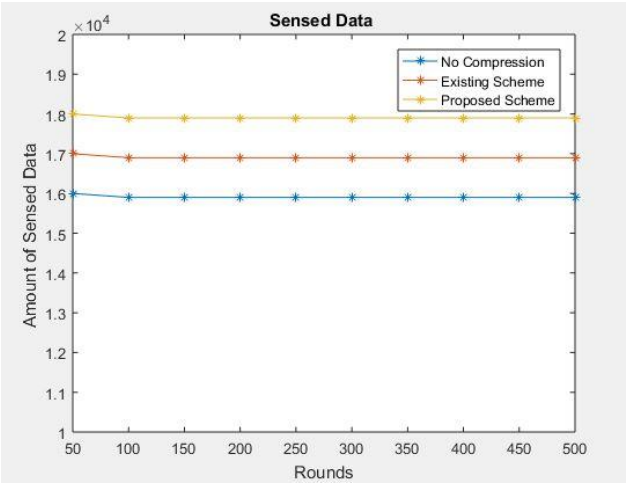

Fig.3: Black out Nodes

As shown in figure 3, the blackout nodes are compared of the no compression; adaptive modulation scenario and proposed scenario are compared for the performance analysis. It is analyzed that black out nodes are least in the novel approach as compared to other algorithms.

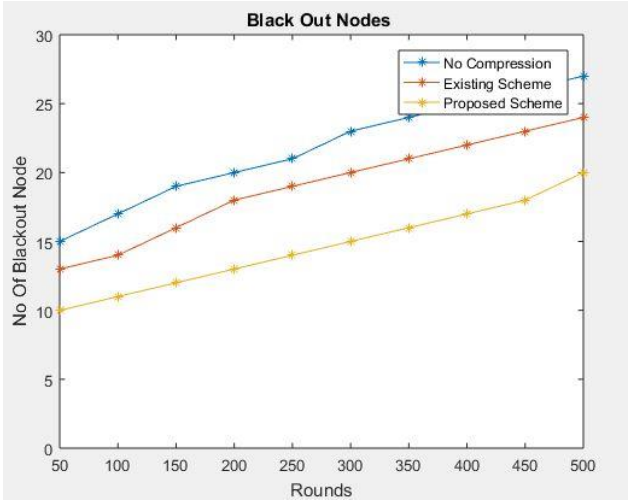

Fig.4: Sensed Information

As shown in figure 4, the amount of sensed data is compared with the three scenarios which are no compression, adaptive modulation and proposed scenario. It is analyzed that proposed scenario has maximum information which is transmitted to the base station.

V. CONCLUSION

There is an increase in demand of wireless sensor networks today. There are different types of sensor nodes present within the networks. The applications are completely based on the several types of sensors involved within them. There are several low-powered, cheap as well as multifunctional sensor nodes deployed within the network that utilize wireless communication in order to transmit important information. Clustering is an efficient approach which can improve the lifetime of wireless sensor networks. In this research work, the gateway nodes are deployed in the network. The cluster heads aggregate data to cache nodes. The gateway nodes will transmit data to base station. The simulation of proposed model is performed in MATLAB and result shows that proposed technique performs well in terms certain parameters.

VI. REFERENCES

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