Novel Technique for Adaptive Modulation in Wireless Sensor Networks

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Abstract: The wireless sensor networks are the decentralized type of network which sense data and pass sensed information to base station. The network is deployed on the far places and size of the sensor nodes is very small due to which energy consumption, quality of service is the major issue of the network. The data which is sensed by the sensor networks are of low frequency due to which network interferences affect the network. In this work, the adaptive modulation scheme is proposed which is based on PCA algorithm which selects best modulation signal to increase frequency of the data. The proposed and existing algorithm is implemented in MATLAB and results are analyzed in terms of various parameters.

Keywords: WSN. Modulation, PCA, SVM

I. INTRODUCTION

Wireless sensor network is a collection of nodes that are organized in a cooperative network. These nodes are the sensor nodes which communicate over the wireless medium. All sensor nodes use the direct transmission or multi-hop transmission to communicate with the base station because all sensor nodes are immobile. Sensor nodes sense conditions at different locations at a fixed rate and always have data to send to the base station. Sensors are used in heating, ventilation and air conditioning etc. Hundreds of sensors are used in these systems by using wires [1]. The cost of wiring can be a few hundred of dollars. The installation of these wires is more difficult for accessing conditions and their re-configurability. For reducing cost and provide easy reconfiguration, replace the wired sensors with wireless sensors. Wireless sensor nodes can improve the quality and coverage of sensor networks. To enhance the system capability, add more sensor nodes with multiple modalities. 802.11 is pre-existing so sensors could be deployed easily without modifying data distribution infrastructure [2]. So we can use sensors in remote locations, including outdoor environment. To add the new sensors and utilize higher data rate sensors is directly proportional to maximum data rate supported by the physical channel. Adaptive modulation is a method to provide balance between Bit Error Rate and spectral efficiency. It is possible to make more effective use of adaptive modulation in a slowly varying fading channel with the noise based on SNR estimation [3]. Phase of high gain of power or lower fading will improve the SNR which allow the higher modulation schemes to be worked with less probability of error [4]. On the other side phase of greater bet the fading will deteriorate the SNR and force us to work with lower modulation method in order to make transmission more effective. In wireless communication Adaptive modulation or Link Adaption indicates the identification of the coding modulation and signals and protocol parameters depends on the circumstances of radio link [5]. Adaptation Modulation and Coding (AMC) have offered a different link adaptation method that promises to raise the overall system capacity. AMC provides the flexibility to match the modulation coding method to the average channel conditions for each user. With Adaptation Modulation the power of the transmitted signal is held constant over a frame interval and the modulation and coding format is changed to match the current received signal quality or channel conditions [6]. In a system with AMC users close to the Node B are typically assigned higher order modulation with higher code rates (e.g. 64 QAM with R=3/4 turbo codes) but the modulation-order and/or code rate will decrease as the distance from Node B increases.

Literature Review

Katayoun Sohrabi, et.al (2011) presented in this paper [7] algorithms for wireless sensor network which is a self-organized networks, in this larger number of static nodes with highly constrained energy resources. In wireless sensor networks some protocols which supported the slow mobility by a subset of the nodes, energy efficient routing, and formation of sensor networks for carrying out cooperative signal processing functions among a set of the nodes. Wireless sensor networks used for such applications as surveillance, widespread environmental sampling, security and health monitoring.

Yu Cheng et al. (2012) presented in this paper [8] a theoretical analysis of the maximum throughput of a wireless mesh backhaul network that is achievable over a practical carrier sense multiple access with collision avoidance (CSMA/CA) medium access control (MAC) protocol. They resort to the multi commodity flow (MCF) formulation augmented with the conflict-graph constraints, a novel approach to take into account the collision overhead in the distributed CSMA/CAMAC. NS-2 simulation results are presented to demonstrate the tightness of the upper and lower bounds that are newly developed, compared to those based on the MCF formulation assuming a slotted system and centralized scheduling.

Ossama Younis et.al (2012) proposed in this paper [9] a distributed clustering approach for long-lived ad-hoc sensor

networks. Proposed approach does not make any assumptions about the presence of infrastructure or about node capabilities, other than the availability of multiple power levels in sensor nodes. They presented a protocol, HEED (Hybrid Energy-Efficient Distributed clustering), that periodically selects cluster heads according to a hybrid of the node residual energy and a secondary parameter, such as node proximity to its neighbors or node degree. HEED terminates in O(1) iterations, incurs low message overhead, and achieves fairly uniform cluster head distribution across the network.

R.VALLI et.al (2013) introduced in this paper [10] the fundamental component of resource management in Wireless Sensor Network (WSN) is transmitter power control since the sensors are miniature battery powered devices. This paper analyses a game theoretic model with pricing in which the game is formulated as a utility maximizing distributed power control game considering the residual energy of the nodes along with adaptive modulation. Simulation results show that the game with pricing provides maximum utility by consuming lesser power. The adaptive modulation strategy also minimizes the energy consumption and maximizes the network lifetime by selecting the optimal constellation size.

Jakob Salzmann, et.al (2011) proposed in this paper [11] a distributed clustering approach for long-lived ad-hoc sensor networks. Proposed approach does not make any assumptions about the presence of infrastructure or about node capabilities, other than the availability of multiple power levels in sensor nodes. They presented a protocol, HEED (Hybrid Energy-Efficient Distributed clustering), that periodically selects cluster heads according to a hybrid of the node residual energy and a secondary parameter, such as node proximity to its neighbors or node degree. HEED terminates in O(1) iterations, incurs low message overhead, and achieves fairly uniform cluster head distribution across the network.

Zibouda Aliouat et.al (2013) explained in this paper [12] that Wireless Sensor Networks (WSN) are now commonly admitted as a promising networking paradigm bringing huge benefits in industrial and socio-economical domains. However, although the applications dedicated to WSNs are in constant increase and research activities are intensely carried on, WSNs remain hindered by some weaknesses and lacks preventing them to reach their full maturity. In this paper, they propose an energy economical and Fault Tolerant Multilevel Routing Protocol, borrowing idea from the well known TEEN and LEACH protocols. Simulation results via NS2 simulator showed convincing and interesting protocol performances.

II. RESEARCH METHODOLOGY :

Adaptive PCA is a dimensionality Reduction Technique normally used for data aggregation. The base paper is based on the adaptive modulation in the wireless sensor networks. The data which is sensed by the sensor nodes are of very low frequency due to which the network interferences affect the sensed data. The adaptive PCA algorithm is applied in this work which will select the carrier signal according to the type of data that whether it high frequency or low frequency. The data which is selected will be modulated using the PCA algorithm. The PCA algorithm is the principle component analysis technique which will select the best data according to selected component.

1. Algorithm:

Input: Sensor nodes, sensed data (d)

Output: Transmit high frequency data

STEP 1. Deploy the sensor networks with the finite number of sensor nodes

STEP 2. Divide whole network into fixed size clusters and select cluster head in each cluster

STEP 3. The cluster heads in each cluster will be selected on the basis of energy and distance

STEP 4. Calculate the accuracy of sensed data (α_i)

STEP 5. If all α_i of S_i >=desired of data (α_i)

Then

Packet type ==low frequency

Else

Packet type==high frequency

STEP 6. If (Packet type==low frequency)

Then

Insert high frequency carrier signals

Else

Low frequency carries

STEP 7. End

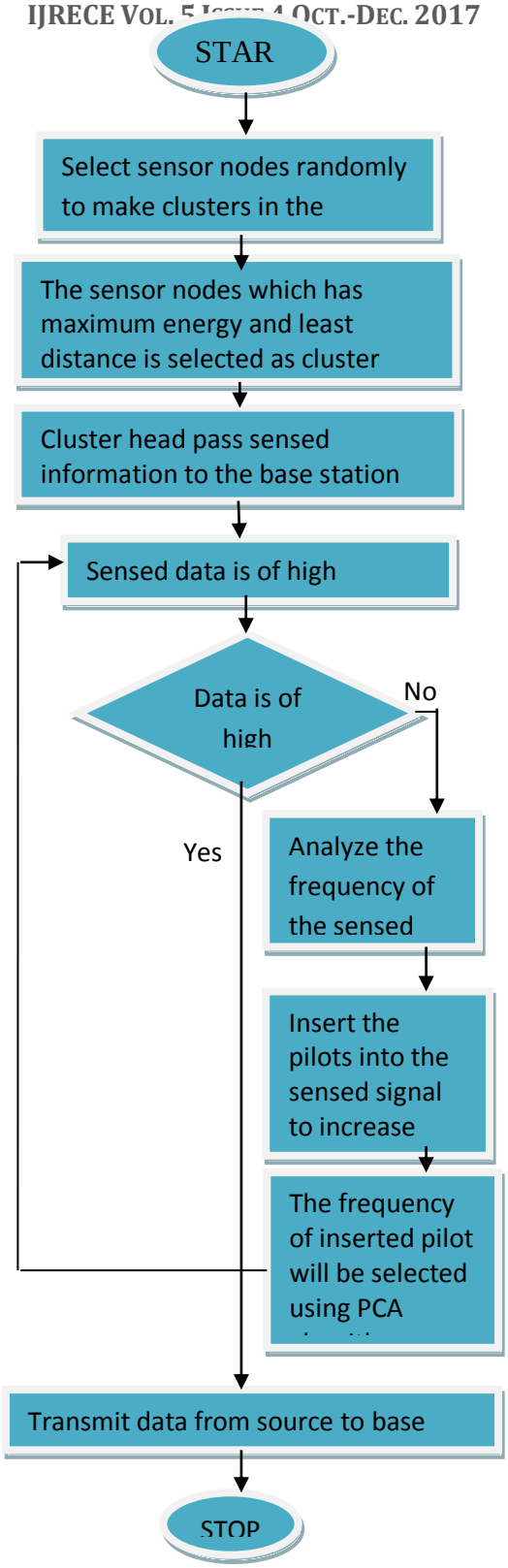

Fig 1: Flowchart of Proposed Algorithm

III. EXPERIMENTAL RESULTS

The simulations are performed in MATLAB and the results of the proposed algorithm are evaluated on the basis of various performance parameters such as Energy consumption and Bit error rate.

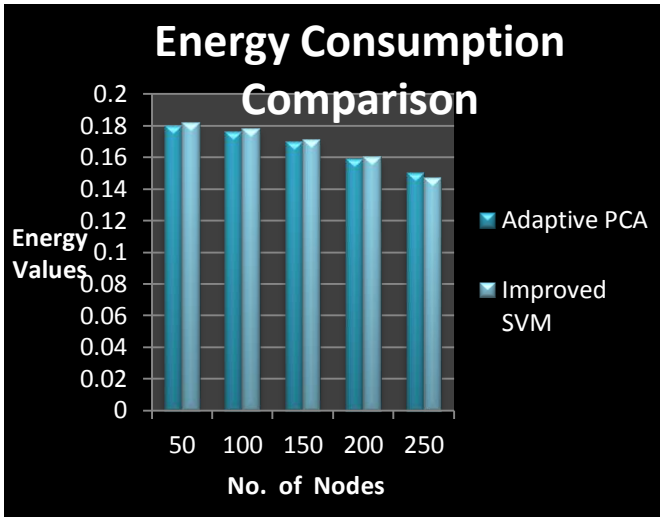

Fig. 2: Energy Consumption Comparison Graph

As shown in figure 2, comparison of Energy Consumption in Adaptive PCA Technique and Improved SVM Technique based on number of rounds is depicted.

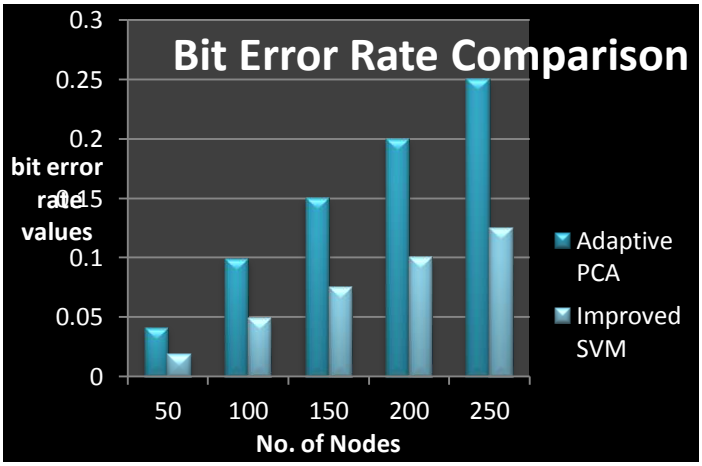

Fig 3: Comparison of Bit Error Rate

As shown in figure 3, comparison of Bit Error Rate in Adaptive PCA Technique and Improved SVM Technique based on number of rounds is shown.

IV. CONCLUSION

In this work, it has been concluded that wireless sensor networks is the decentralized type of network in which quality of service and energy consumption is the major of the network. The data which is sensed by the sensor nodes are very low in frequency due to which network interferences affect sensed data.

In this work, PCA algorithm is applied which selects the signal for the modulation of the sensed information. The performance of proposed and existing algorithm are tested in MATLAB and it has been analyzed that proposed algorithm performs well in terms of bit error rate and energy consumption

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