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To Enhance Life Time of WSN using Neural Network Approach

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Abstract: *Wireless Sensor Networks (WSNs) are characterized by dense tiny sensors that have only limited energy supply .Wireless sensor networks can enable numerous embedded computing applications. One of the primary benefits of wireless sensor networks is their independence from the wiring costs and constraints. One of the major challenges in constructing such networks is to achieve the pre-defined information accuracy while maintain long network lifetime. If batteries must be replaced often, not only will the initial cost savings be lost, but also many remote sensing applications may become impractical. Therefore, long battery life is essential; power efficiency is a critical requirement for wireless sensor networks. We have devised several novel techniques for minimizing power consumption in wireless sensor networks. In our purposed work we defined the neural network approach to enhance the network lifetime.*

Keywords: *WSN, Power Consumption, Energy, Clusters*

1. INTRODUCTION

Wireless Sensor Network (WSN) has came forth as an important new field in wireless communication. Due to recent advances in Micro-Electronic-Mechanical Systems (MEMS) and wireless communication technologies, small, low cost, and smart sensors deployed in a physical environment and interconnected by wireless links and thus provide new opportunities for sensing the physical aspects like motion, pressure, temperature, and attacks etc in a variety of civilian and military applications. To be more specific about the application areas like in environmental monitoring, battle field surveillance, and industry process control [9]. The basic units of WSN are sensor nodes. Sensor Nodes monitor physical conditions such as temperature, pressure, motion or pollutants etc. These sensor nodes are deployed in different environments like commercial, civil, climate and habitat monitoring, intelligence data gathering without human intervention. Wireless Sensor Network consists of hundreds or thousands of sensor nodes that are thickly deployed in the physical area. These sensor nodes have not any predefined location as they are deployed mostly from aircrafts in the difficult terrains. Sensor nodes have little processing capability as constrained processor is embedded on

the sensor node. With the vast research area in this field it has resulted in the ability to integrate sensors, radio communications, and digital electronics into a single integrated circuit (IC) package. This capability is enabling networks of very low cost sensors that are able to communicate with each other using low power wireless data routing protocols. A wireless sensor network (WSN) generally consists of a base station or in simple terms as gateway that can communicate with a number of wireless sensors via a radio link. Data is collected at the wireless sensor node, compressed, and transmitted to the base station directly or, uses other neighboring sensor nodes to forward data to the sink or base station. Wireless sensor networks are special type of ad-hoc networks which may operate in single-hop or multi-hop ad-hoc networks. The ideal wireless sensor network is densely populated and scalable, consumes very little power, is smart and software programmable, reliable and accurate over the long term, affordable cost to purchase and install, and requires no real maintenance. Selecting the optimum sensors and wireless communications link requires knowledge of the application and problem definition. Battery life, sensor update rates, and size are all major design considerations. Examples of low data rate sensors include temperature, humidity, and peak strain captured passively [3] [6]. Examples of high data rate sensors include strain, acceleration, and vibration. Sensor nodes are battery equipped thus limited energy and replacement is impractical and have

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limited computational capacity. Hence battery power should be efficiently utilized in order to increase the lifetime of WSN. Enormous work should be carried out in order to maximize the battery utilization for longer period. The task of SN deployed in the real sensing field is to notice the events, perform less processing and then transmitted useful information to the Base stations (BS).Thus power consumption in SN is mainly due to three fields: sensing, routing or communication and data processing. The main objective of this WSN is to reliably detect event features based on the collective information provided by sensor nodes. These integrated sensor nodes are highly energy constrained. Replenishing energy up to tens of thousands of nodes in possibly harsh terrain via replacing batteries is infeasible. Hence, one challenge is to reduce the power consumption while achieve the pre-defined information accuracy in WSNs. Therefore, it may be unnecessary for every sensor node to transmit its data to the base-station. Instead, a smaller number of sensors used for measurement might be adequate to communicate the event features to the base-station for a certain reliability level and with minimum the energy expenditure. There has been some research effort to study the correlation in WSNs. However, most of them only investigate the information theoretical aspects of the correlation. Wireless sensor networks have immediate utility in a variety of industrial, medical, consumer and military applications. We studied several such applications and classified them based on their modes of acquiring and propagating sensor data.[11] We find the following three classes to be the most common:

Periodic Sampling - For applications where a certain condition or process needs to be monitored constantly, such as temperature in a conditioned space or pressure in a process pipeline, sensor data is acquired from a number of remote points and forwarded to a data collection center on a periodical basis.

Event Driven - There are many cases that require monitoring one or more crucial variables and transmit only when a certain threshold is reached [5]. Common examples include fire alarms, door and window sensors, or instruments that are used intermittently.

Store-and-Forward - In many applications sensor data can be captured and stored or even processed by a remote node before it is transmitted to the central base station. For example, a temperature sensor that periodically senses and records the cargo temperature during transit for several days, and when the cargo gets to its loading dock for unloading, the device can detect the presence of a network and transmit all the accumulated temperature data to the network base station.

The critical requirements of these applications are:

Long Battery Life - In many applications, sensors are placed in locations that are not conveniently accessible. Moreover, if the batteries must be replaced often, not only will the primary benefit of wireless networks be lost,[2] but also many remote sensing applications may become impractical. Therefore, long battery life is essential in wireless sensor networks. The energy efficiency of sensor networks is a critical issue.

Small Form Factor - It is obvious that devices must be small enough to be embedded in their operating environment. This requirement affects the choice of batteries - even AA batteries are too bulky to power the sensor node, so using coin cell batteries is the only option in many situations.

Low-data Rate - Since the sampling rate is usually small, the number of bits transmitted per second by individual nodes is low.

Low Cost - Since the number of sensor nodes in a system can be large, the cost of individual nodes must be minimal to be of practical use.

Centralized Archictecture - Most of these applications consist of a sophisticated central node and several simple end nodes. For instance, several different types of sensors in a building are controlled by a single building automation controller.

2. LITERATURE SURVEY

Heinzelman et al., (1999) proposed **Sensor Protocols for Information via Negotiation** in which before actual data transmission can take place it uses meta-data via communicating between sensors as an advertisement mechanism [3]. Whenever any nodes receives data it advertises(ADV) it to neighbours, and only interested neighbours can respond by sending request message(REQ) .Then node with data can forward data(DATA) to the requested nodes. It removes the problem of flooding such as redundant information passing and overlapping of sensed areas, thus enhancing the energy efficiency. The main limitation of SPIN data advertisement is that it cannot guarantee of data delivery mostly in case of far away nodes.

Younis et al., (2002) proposed An **Energy Aware Routing** scheme called EAR. In Energy-aware routing nodes are grouped into clusters. Cluster heads namely gateways are less energy constrained nodes. Gateways maintain the states of the nodes and sets up multi hop routes. Sink only communicates with the gateway [7]. Gateway informs other nodes about in which slot they should listen other's transmission and in which slot to carry the transmission of sensed data. The sensor can be in four states; sensing only, relaying only, sensing-relaying and inactive. A cost function is defined between any two nodes in terms of energy consumption, delay optimization and other performance metrics. Using this cost function, a least-cost path is found between sensor nodes and the gateway.

Ossama Younis et al., (2004) proposed **HEED (Hybrid Energy-Efficient Distributed clustering)**.It is somehow based on the concept of LEACH by using the residual energy and network topology features (e.g. node degree) in cluster selection to achieve energy balancing. It is based on hybrid approach, cluster head selection is based randomly as it was in LEACH [10]. But the nodes will join only the particular cluster whose communication cost is minimum. It uses multi-hop topology, using an adaptive transmission power in the inter-clustering communication. It terminates in constant number of iterations, independent of network diameter. These features make HEED more energy efficient than existing schemes already given before. The major limitations in HEED protocol are [**Al-Karaki et al**.]: (i) the use of tentative CHs that do not become final CHs leave some uncovered nodes. As per HEED implementation, these nodes are forced to become a CH and these forced CHs may be in range of other CHs or may not have any member associated with them [1]. As a result, more CHs are generated than the expected number and this also accounts for unbalanced energy consumption in the network (ii) The CHs near the sink have more work load so may die early. (iii) Overhead occurs as several iterations are performed to form clusters and lots of packets are broadcasted in each iteration.

Lindsey et al., (2002) have proposed **Power Efficient Gathering in Sensor Information Systems (PEGASIS)** protocol. It is an enhanced version of LEACH protocol. That is a chain based protocol provides improvement over LEACH algorithms. Each node aggregates the collected data with its own data and then passes the aggregated data to the next node in the chain and finally to the designate node which transmits it to BS [8]. Using greedy algorithm, the nodes will be organized to form a chain, after that BS can compute this chain and broadcast it to all the sensor nodes. Energy saving in PEGASIS over LEACH takes place by many stages [**Al-Karaki et al.**]: First, in the local data gathering, the distances that most of the sensor nodes transmit are much less compared to transmitting to a cluster-head in LEACH. Second, only one node transmits to the BS in each round of communication. Also the number of transmissions to BS is reduced. It employs multi hop transmission and selecting only one node to transmit the data to the sink or base station while in LEACH it uses single hop [4]. Since the overhead caused by dynamic cluster formation is eliminated.
For larger networks, PEGASIS adds excessive delay for distant nodes. And the single designated node can be a bottleneck which is responsible to transmit the data to BS. It is based on some assumptions which make solutions not practical in real world like any node can send information directly to base station. And all nodes are aware of locations of sensor nodes in WSN.

Intanagonwiwat et al., (2000) proposed **Direct Diffusion** which is a data centric protocol, in which main idea is based on diffusing data through sensor nodes using naming scheme for data based on interest in communication. A query broadcasted by the sink through its neighbours .And interested nodes can send data in response to the query. The interest entry also contains several gradient fields. A gradient is a reply link to a neighbour from which the interest was received [12]. It is characterized by the data rate, duration and expiration time derived from the received interest's fields. Hence, by utilizing interest and gradients, paths are established between sink and sources. Several paths can be established so that one of them is selected by reinforcement. Thus it will result in using the efficient path which will consume less power. If the path fails between source and sink then an alternative path is utilized. Thus it will increase the overhead by keeping the alternatives paths. Thus it may not be possible to be applied to large sensor networks.

3. PURPOSED WORK

In this purposed work, the communication between the various nodes is defined. As nodes in a WSN can be classified as live or dead depending on whether they have any energy left or not. The energy in the nodes plays a vital role in the WSN. In the last decades, the communication is taken place directly between the various nodes. It is very time consuming. Hence to solve this problem, the sensor nodes are geographically grouped into clusters and capable of operating in two basic modes: the sensing mode and

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the cluster head mode. In the sensing mode, the node senses the task and sends the sensed data to its cluster head. In cluster head mode, a node gathers data from its cluster members, performs data fusion, and transmits the data to the Sink node. Hence the communication is taken place between different Cluster heads. Hence the WSN sends any data to sink, after that sink sends data to cluster head and the communication starts[7].

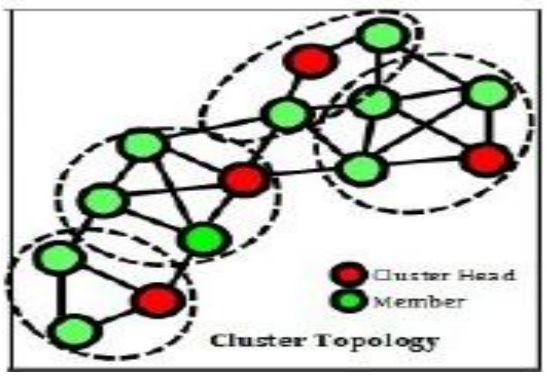

Figure 1: WSN with cluster head.

In the figure 1, there are several nodes defined. In this the green nodes defines the member of the network. The red nodes defined the cluster head of the nodes.

The cluster head is also responsible for re-clustering, adding, deleting node. The routing algorithm works in three major phases: initialization phase, dynamic clustering phase and data transmission phase. In this case, a collaborative model is used. in this model an alive node plays three roles: sensing, relaying and sleeping.

The nodes can change their roles dynamically with respect to time. A node might be sensing a source for a while, but when the source moves to a different location, this node might act as a relay or power itself down. Every node is composed of three cores, i.e. sensor core, computation core and communication core. Hence in this case the nodes either in the position to sensing, pure relaying or sleeping. In this case the energy consumed by Computation can be ignored.

To solve this problem, a neural network based technique called adaptive learning is used. In this case, the clusters are defined. Battery level is assign to each node present in the cluster. The node with high battery level is assign as the cluster head. When the communication is take place in the cluster, each node gives its own information to the cluster head, and the cluster head further transferred it to the sink. This process is repeated every time. Hence the battery level of the cluster head is decreases. With this the network may be dead. Hence with the help of adaptive learning, the node with high battery level is chosen. By the use of this technique, the network never is dead, and the lifetime of the network is increased.

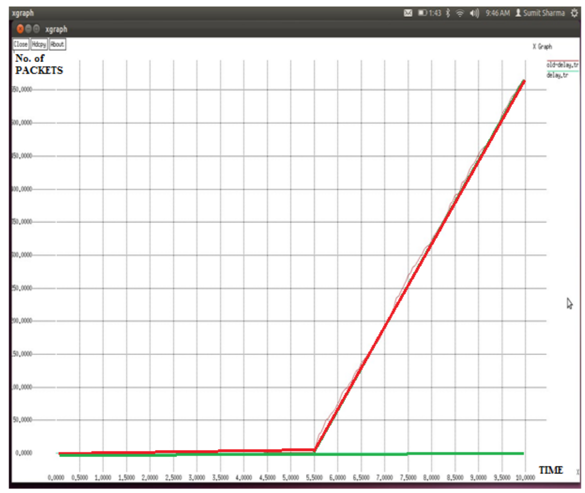

Figure 2: Delay graph.

Here red line represents delay in old scenario and green line represents delay in new case. In our old case delay increased because of packet loss but by using new technique we overcome this problem and simulation results of delay are shown in this graph.

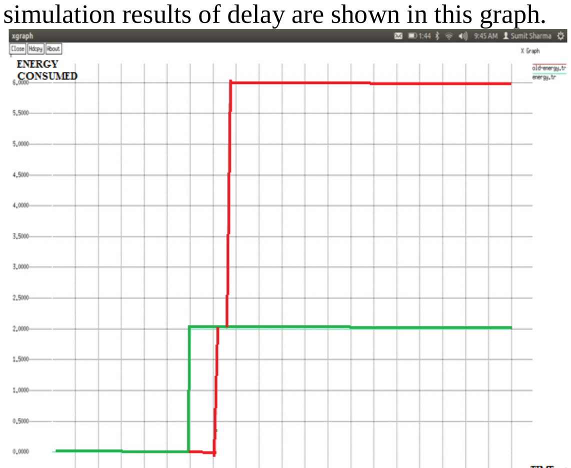

Figure 3: Energy graph

Here red line shows energy consumed in old case and green line shows the energy consumed in new case. Here energy consumed in old case is more than new case it means our new technique helps to save energy also.

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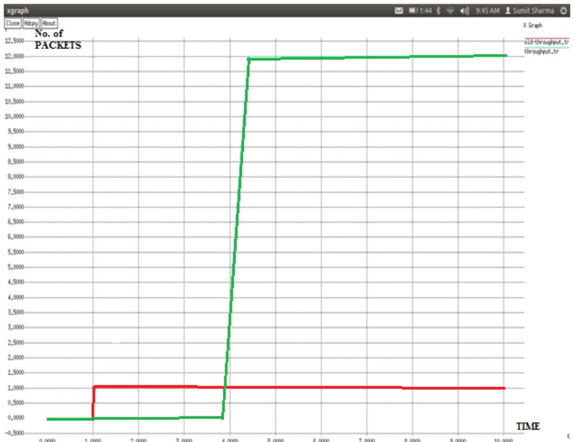

Figure 4: Throughput graph

Here red line shows throughput of old case and green line shows throughput of new case and from both curves it will clearly shown that in new case throughput is high because there is a less packet loss in this case.

4. CONCLUSION

This paper has proposed a neural network based energy efficient routing and clustering protocol for WSNs. The selection of CH is done using adaptive learning mechanism. Simulations results show that it performs better than existing routing protocol in terms of residual energy and .number of alive nodes. So the proposed scheme can be used in wide areas of sensor networks where energy efficiency is a critical issue.

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