International Journal of Engineering Research in Electronic and Communication Engineering (IJERECE) Vol 3, Issue 5, May 2016

Design of Energy Efficient WSN Using Smart Sampling and Reliable Routing Technique

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***Abstract*— Wireless sensor networks have a great variety of applications to industry, science, transport, civil industry, and security. Efficiency of Nodes battery energy to improve the network lifetime is the fundamental challenge in wireless sensor network. The design approach of different layered protocols is investigated and since major portion of battery energy is utilized by communication process, it has to be effectively controlled. The concept of smart sampling and reliable routing in WSN is studied to understand that it would result in energy efficient, scalable and load balancing network. In this proposed method the energy efficient WSN is designed using reliable routing technique and smart sampling method**

***Index terms:* Wireless Sensor Networks, smart sampling, energy efficient, reliable routing**

I. INTRODUCTION

Wireless sensor network (WSN) have gained much more attention from researchers. WSN makes use of sensor nodes generally battery-operated. Their prevalence is threatened by a number of technical difficulties, especially the energy reduction, there are many applications known for wireless sensor networks (WSN), and such variety asks for improvement in the currently available protocols and the specific parameters. Network lifetime and energy consumption are some notable parameters for routing which play key role in every application. Wireless sensor networks (WSN) have received a great attention in recent years. They have a great variety of applications such as event detection, target tracking, environment sensing, elder people monitoring, and security. Wireless sensor networks are a novel technology emerging from embedded system, sensor technology and wireless networks. The self organization, rapid deployment and fault tolerance characteristics of wireless sensor networks make them a very Prominent sensing technique for military, environmental and health applications [1]. In addition, a battery supplies the energy to the device to perform the programmed task. This battery often consists o a limited energy budget. In addition, recharging the battery could be impossible or inconvenient because nodes may be deployed in a hostile or critical environment. On the other hand, the sensor network should have a long enough lifetime to fulfill the application requirements. In many cases a network lifetime in the order of several months, or even years, may be required. Therefore, here question is how can one extend the network lifetime for long time without affecting performance. In some cases it is possible to take energy from the external environment like using solar cells as power source. However, external power supply sources often exhibit a fluctuated behavior so that a battery is needed as well. In any case, energy is a mainly a critical resource and must be conserved. Therefore, energy saving is a key issue in the design of systems based on wireless sensor networks.

II. WIRELESS SENSOR NETWORK

WSN is a combination of Wireless, Sensor and Network Technologies .WSN is a special class of ad hoc wireless network that are used to provide a wireless communication infrastructure that allows us to sense and respond to phenomena in the natural environment and in our physical and cyber infrastructure.

A sensor network is an infrastructure consists of sensing, computing, and communication elements that gives the ability to administrator to instrument, observe, and react to events that happen in an environment.. The administrator can be civil, commercial, governmental, , or industrial entity. The environment could be the physical world, a biological system, or an information technology. Sensor systems are seen by observers as an prominent technology that will see a major deployment in the next few years for a variety of applications, not the least being national security. Many applications including data gathering, surveillance, monitoring, and medical telemetry etc. In addition to sensing, one is also interested in control and activation.

Sensor network consists four basic components (1) an assembly of distributed or localized sensors. (2) an interconnecting network (usually, but not always, wireless-based). (3) a central point of information clustering. and (4) a set of computing resources at the central point (or beyond) to handle data correlation, event trending, status querying, and data mining. The sensing and computation nodes are considered as a part of the sensor network; in fact, some of the computing may be done in the network itself. The communication infrastructure and computation associated with sensor networks is often environment specific and rooted in the device and application-based nature of these networks. furthermore, node battery power is a key design consideration. The information collected is typically parametric in nature.

Wireless Sensor Network model: Fig 1 shows sensor node scattered in sensor field.

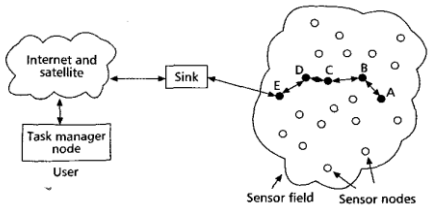

Fig 1: Wireless sensor node model

The sensor nodes are usually scattered in a sensor field as shown in fig 1. Each scattered sensor nodes has the capacity to collect data and route data back to the sink. The end user gets the data that are routed by a multihop infrastructures architecture through the sink as shown in fig 1. The sink node does communication with the task manager node through internet or satellite. The design of the sensor network as shown by fig 1 is impacted by many factors, including fault tolerance, production costs, scalability, operating environment, sensor network topology, hardware, transmission media, and energy consumption[2].

WSN Node Architecture:

Fig 2 shows the architecture of the WSN Node.

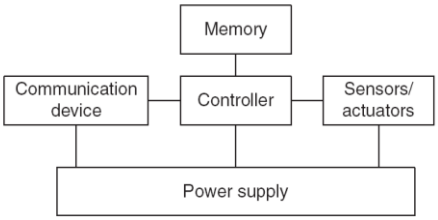

Fig 2: Architecture of the WSN Node.

A basic sensor node consists of five main components. They are

Controller A controller to process all the important data and capable of executing code.

Memory few amount of memory for storing programs and intermediate data; usually, different types of memory are used storing programs and data.

Sensors and actuators These are actual interface to the physical world: devices that can observe and control physical parameters of the environment.

Communication network requires a device for sending and receiving information over a wireless channel.

Power supply As there is no tethered power supply is available, some form of power sources like batteries are necessary to provide energy for sensor node.

Components of sensor node has to operate balancing the trade-off between as small an energy consumption as possible on the one hand and the need to fulfill their tasks on the other hand. communication device and the controller both should be turned off as long as possible as example. The sensors could be programmed to raise an interrupt if a given event like, a temperature value exceeds a given threshold or the communication device detects an incoming transmission.

III. ENERGY SIGNIFICANCE IN WSN

Energy is required in every mini or major operation of any type of application. Sensor nodes are equipped with batteries, but these batteries have a limited life time. Most of the times, the deployment of wireless sensor nodes are very critical that does not allow one to recharge or replace the battery for the sensor nodes. Therefore the battery energy should be utilized in an efficient manner in WSN. Power control schemes for mobile network is a most challenging issue. The solution to such problem is more crucial because effective power management depends on the accuracy with which the nodes are located. Also, the control signal overheads exchanged between the base station & the nodes add substantial amount of burden in energy expenditure. The battery of the sensor nodes can neither be replaced nor recharged in most of the occasions. The subsystem of WSN communication has much higher energy consumption than the computation subsystem. Typically for transmitting one bit may consume as much energy as executing a few thousands instructions. Therefore, it is very much necessary to control and conserve the energy required for data communication. So to conserve energy of batteries in communication a efficient and reliable routing technique has to be designed.

IV. ENERGY CONSERVATION IN WSN

Energy conservation is WSN can be done many ways like using MAC protocols, ANN, Smart sampling etc. As the main purpose of a WSN is information sensing and transmitting it to the sink node, the main problem is to deliver information correctly with minimum energy consumption. Whereas the majority of developed applications for WSNs are event critical based applications, reliable data transfer can be achieved as the main factor of dependability and quality of service seems vital. An important issue in WSN is routing protocol; since it deals with delivery ratio, energy consumption, end to end delay, and network lifetime. Many attempts have been made to propose reliable routing protocols and many are proposed but still there are limitations and issues.

V.DESCRIPTION OF BACK PROPAGATION NEURAL NETWORK

The Artificial Neural Network (ANN) was inspired by researching into the structure of the human brain that has interconnected neurons. An ANN is made up of interconnecting artificial neurons within input, hidden and output layers. It consists two modes of operation: training mode and operation or testing mode. In the training mode, neurons are trained with a particular input pattern to produce the desired output pattern. In the operation or testing mode, when a taught input pattern is detected at the input, the ANN will produce its associated output. A back propagation or feed-forward back propagation ANN has two processing parts within its neurons forward and backward. When an input pattern is fed to the ANN during its training process, the ANN will try to learn and compare its predicted output value with the desired output value. The errors between the predicted and actual valued are then back propagated through the network, and a gradient descent algorithm[9].

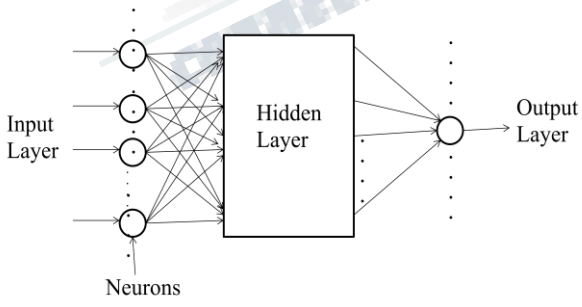

Fig.3: 3 – layered back propagation method

VI. RELATED WORKS

1. Luca Mesin, Siamak Aram and Eros Pasero [6] have investigated about smart sampling and data prediction is employed. A neural algorithm is considered to forecast sensor measurements and their uncertainties to allow the system to reduce communications and transmitted data.

In order to mitigate the problem of shortage of energy in sensors, this paper proposes a smart reduction in data communication by sensors. Indeed, in case the paper have a solution to this end, the components of a sensor, including its radio, can be turned off most of the time without noticeable influence on network operation. Thus, reducing the acquired data, the sensors can be idle for longer and power can be saved. The main idea in devising such a solution is to minimize the correlation between the data communicated. In order to reduce the measurements, we present a data prediction method based on neural networks which performs an adaptive, data-driven, and non-uniform sampling. Evidently, the amount of possible reduction in required samples is bounded by the extent to which the sensed data is stationary. The proposed method is validated on simulated and experimental data.

2. Basavaraj S.Mathapati, Dr.V.D.Mytri and Dr.Siddarama R. Patil [4] proposed An Adaptive energy efficient reliable routing protocol for Wireless Sensor Networks. In order to achieve high data reliability in wireless sensor networks. In this paper, they have developed an Adaptive Energy Efficient Reliable Routing Protocol (AEERRP) with the aim of keeping the power consumption low while achieving high reliability. In their proposed protocol. The data forwarding probability is adjusted adaptively based on the measured loss conditions at the sink. So only for high loss rates, a node makes use of high transmission power to arrive at the sink. Whenever there is low loss rate , it lessens adaptively the transmission power. Since the source retransmitts the data, until the packet loss is low, high data reliability can be achieved.

3.Jamal N. AL-KarakI, The Ahmed E. Kamal [7] have investigated that Wireless sensor networks comprises of small nodes which have capability of sensing, computation, and wireless communications . Many routing, power management, and data dissemination protocols are specifically designed for WSNs where energy awareness is an key design issue. Routing protocols in WSNs might differ on the application depending and network architecture. In this paper they have presented a survey of routing techniques in WSNs. They first outlined the design challenges for routing protocols in WSNs followed by a detailed survey of routing techniques. In general, routing in WSNs can be classified into hierarchical-based routing, flat-based routing, and location-based routing which depends on the network structure. In flat-based

routing, all nodes are assigned equal roles or functionality. In hierarchical- based routing, all nodes will play different roles in the network. In location-based routing, sensor nodes location are exploited to route data in the network. Furthermore, these protocols are classified into query based, multipath based, and negotiation based, Quality of Service-based, or coherent-based routing techniques depending on the operation of protocol, and many other routing protocols are discussed.

In the research works investigated so far there is no effective contribution for conserving network's power considering energy efficient and reliable routing algorithm. However, many authors have focused on several energy efficient routing algorithms which deals with energy consumption but still there are some limitations and issues in existing systems and there is need for an improved design which gives a better results .

VII. PROPOSED WORK

The proposed back propagation neural data transmission combines back propagation with smart sampling enabled reliable packet routing.

We assume around 25 nodes randomly distributed in the sensing field with equal initial energy configured in all the nodes to start with, initially by exchanging the control signals from base station to nodes and in turn nodes to base station. The range or position estimation of the nodes are accomplished based on the communicating source and destination modes. Now the route following shortest path is computed for data transmission using Euclidian distance formula .

$$D(s,d) = \sqrt{(x_d - x_s)^2 + (y_d - y_s)^2} \quad (1)$$

where D(s. d) =distance coverage from source to destination

Before the next communication cycle begins the signal samples are sampled from every node by the base station and is used to train the neurons in the input layer of neural network. The node with differential residual energy levels in the successive cycles would reply for beacon signal initiated by base station. The nodes with same residual battery energy in successive cycles would not reply the beacon signals.

Energy calculation is given by

$$E_r(t) = E_i(t) - (0.1*D) \quad (2)$$

where $E_r(t)$=Residual energy , $E_i(t)$=Initial energy and D= distance coverage

The proposed method aims to conserve battery energy of nodes required for periodic control signal exchange owing to the fact that not all the nodes will be involved in data transmission and few nodes will not have taken part in forwarding or routing the data packets, such nodes will have same residual energy states almost all the time. Also it considers this energy robust nodes for packet forwarding which avoids the occurrence data loss at nodes which does not have battery energy for forwarding data packets. This in turn avoids the energy expended for data retransmission. The proposed work can be implemented and evaluated for reduced power consumption, improved packet delivery ratio and increased throughput.

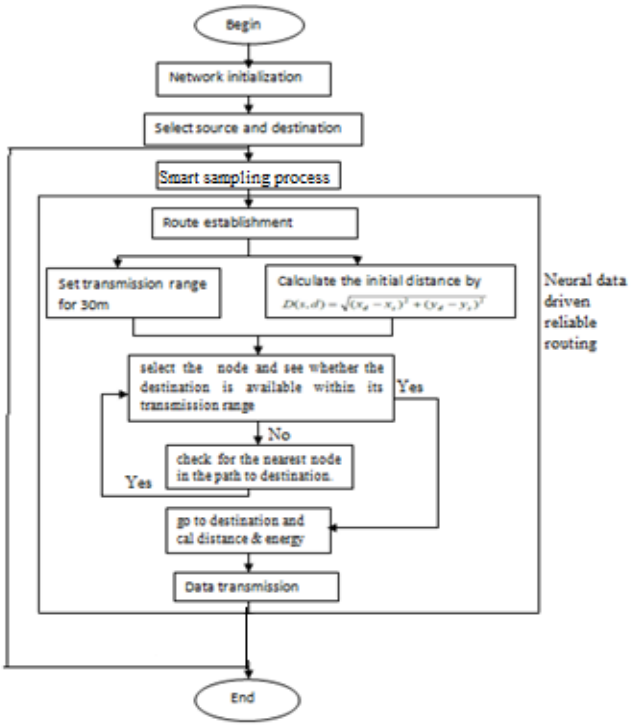

Fig 4 : Flow diagram for proposed work of energy efficient WSN

VIII. CONCLUSION

Wireless sensor networks are becoming a popular technology prevalent in most of the applications of various different areas. The basic limitations with all the applications involving WSN s is the energy resource utilization mechanisms specifically data communication in WSN requires an efficient method of battery energy conservation. The concept of smart sampling and reliable routing in WSN is studied to understand that it would result in an energy efficient, scalable and load balancing network. The proposed method results in efficient energy

consumption , lower delay and decrease in sampling rate by using reliable routing technique and smart sampling method. This proposed work helps in real time transfer of data with improved QOS performance.

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