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Quality Improvement Techniques in WSN : A Review

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ABSTRACT

Wireless Sensor Networks are used for data sensing, processing the data and communicating with other sensor tools. The interface between user and the network is a sink or base station, the sink gathers information and results from the network which in turn can be retrieved by the user by injecting queries. The major problems in wireless sensor networks are data faults, functional faults, low efficient batteries, node misbehaviour. Various algorithms such as Genetic, Extended AODV, Bayesian, Distributed fault detection algorithms have been proposed to overcome these issues with high accuracy. The communication between the sensor nodes are improved using multicast routing algorithm .The sensor are powered by batteries which are of limited resources and often degrading ,this reduces the efficiency of sensors. Fault tolerances are also of major concern in wireless sensor networks which can be overcome by using best effort fault tolerance algorithm. Inspite of all the proposed algorithms, the performance degradation in WSN still exists. The goal of this paper is to suggest the way for improving the quality of WSN and discusses about various issues that are existing in the real time and its appropriate proposed methods with newer techniques and technology. Recent researches in wireless sensor networks are of great impact in various areas such as emergency navigation, environmental surveillance, traffic monitoring , condition based equipment maintenance ,habitat monitoring and disaster management.

Keywords: Wireless Sensor Network, Efficiency, Techniques, Researches

I. INTRODUCTION

Wireless Sensor Network (WSN) were initially used in military applications for surveillance but today it has a diverse applications[1] in all field such as meteorology, agriculture etc. WSN consist of a number of sensor nodes working together to sense physical and environmental conditions. The design of WSN significantly depends upon applications it consist of radio transceiver, micro controller and energy sources[12]. It is of varying size depending on the complexity, cost, energy, speed and memory. The main characteristic of WSN includes ability to withstand harsh environment, ease of use, scalability of large scale of deployment and heterogeneity of nodes [9]. In the beginning WSN used Traditional Layered Approach (TLA) which had the following limitations:

- TLA could not share information among various layers , hence each layer was not having the complete information which to the problem of optimization
- TLA had less ability to adapt environmental changes
- TLA has less efficient interface between different users

In order to overcome these limitations, a new approach was proposed called as Cross Layer Design (CLD)[12] .This design made optimal modulation to improve performance such as QOS , data rate etc. Sensors in WSN are considered as small computers which basic in terms of interface and components whereas smart sensors has an inbuilt Micro-Electro Mechanical System(MEMS) technology which limit the processing and computing resources and are relatively inexpensive than traditional sensors.

The WSNs are broadly classified as unstructured and structured. The unstructured WSN consist of a dense

collection of sensor nodes [1] which are deployed in ad-hoc [4] manner. The network maintenance and detecting failures in unstructured WSN is difficult because of the dense collection of sensor nodes. The structured WSN consist of sensor nodes deployed in pre-planned manner, which has an advantage of lower network maintenance and management cost. There are five types of sensor networks terrestrial WSN, underground WSN, underwater WSN, multimedia WSN and mobile WSN.

- Terrestrial WSN conserve energy with multi-hop optimal routing and minimizes delay using low duty cycle operation.
- Underground WSN has a number of sensors buried underground, with lots of communication issues due to signal loss and high level of attenuation which are tackled using efficient communication protocol.
- Underwater WSN has a number of sensors deployed under water which has the ability to self-configure and adapt to ocean environment
- Multimedia WSN are used for tracking various forms of multimedia, they inter connect with each other for data retrieval, process, correlation and compression.
- Mobile WSN can move on their own within a geographic area, they have the ability to sense compute and communicate like static nodes.

II. WSN ARCHITECTURE

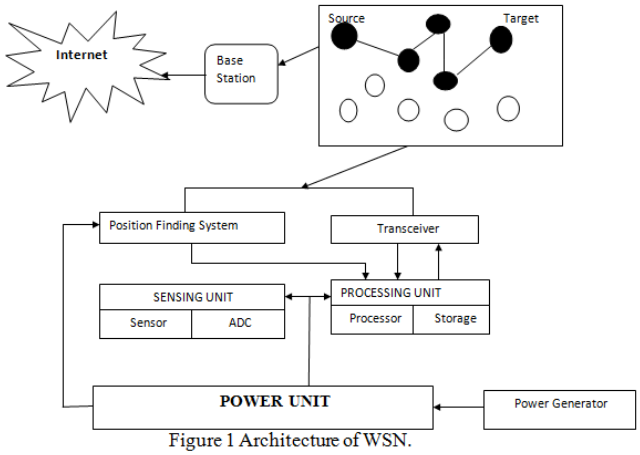

Figure 1 Architecture of WSN.

The emerging field WSN includes sensing, computation and communication modules in a single device. In Figure 1 the WSN Architecture is shown which includes hardware and software parts. The mesh networking connectivity will find possible communication path by hopping data from node to node in order to reach the destination [10]. WSN has the power to deploy large number of tiny nodes which are capable of assembling and configuring themselves. The overall architecture of WSN can be explained in a simple equation:

Sensing + CPU+ Radio = Thousands of applications. (1)

A. Data Collection

The researchers collect data from hundreds of points over a period of time and analyses it. Data collection is the main objective of WSN which helps us to keep a record of worldly happenings. Instead of collecting entire data and analysing it, the researchers started collecting data at particular time interval as they thought that it saves memory [3]. But still the problem of memory exists as the nodes send the entire information it has collected to the controller. To address this problem each node can have software which allows summarizing the content it has gathered and sends the summarized information to the controller [2].

B. Security Monitoring

Security Monitoring means monitoring one or more sensors to detect an anomaly which might be faults, misbehaviours [4] or failures. In case of any malfunctioning the report is sent to the controller which takes the necessary steps. The immediate thing that the controller must do is to ensure that further communication is not done through the faulty nodes. Then controller may replace the sensor, or eliminates faulty sensor from the network etc.[1].

C. Lifetime

The lifetime of a sensor depend on the energy supply. Each node is designed to manage its local supply of energy so that it could maximize its networks lifetime [3]. In order to ensure a long lasting lifetime of a node a constant supply of energy is required. The problem is that it is practically not possible to supply constant energy all the time. So in future a new technique can be implemented to overcome this issue which may be of borrowing energy from high energy neighbour nodes, being in sleep mode at the non-sensing time etc. [7].

D. Power

Low power sensors will help in meeting the multilayer application requirements. The low ultra-power operation is achieved by combining low power hardware components and low duty cycle operation techniques. The power is also a main concern as the overall system of WSN functionality relies over it. The limitation in present system is that power consumption is high as the sensor hardware's consumes most of the power for activation, in radio on mode power consumption is high etc. a simple low power consuming WSN can be proposed in future[9].

E. Communication

The communication rate has a significant impact on performance of WSN. High communication rate will lead to high effective sampling [1][2] rate and low network power consumption. The problems with communication lies in choosing the error free path, transmitting through high energy nodes, communication in compressed form etc. instead of choosing the shortest path for communication the feasible path can be chosen which increases the efficiency[8].

F. Radio

The radio system is the important system in WSN as it is the primary energy consumer which is involved in wide variety of applications. The radio system has been well explained in WSN architecture. Low power radio consumes the same amount of energy in both transmit and receive mode. Instead of DSSS, FHSS can be used to communicate on a single carrier frequency. The other factor related to radio systems is the ability to quickly enter and exit low power sleep modes. It is necessary to power the radio once per second in order to make it react to emergency events within seconds [2].

G. Processor

The processor includes flash storage, RAM, ADC, digital I/O. These should be integrated tightly to work in embedded system applications. The unit key requirements are energy consumption, voltage requirements, cost and support for peripherals. The processing rate must be high and the system must be capable of processing concurrently. Multiprocessing is the key issue here. A system with well-equipped units which are highly capable of acting in severe workload must be discovered [3].

III. RELATED WORKS

In this part, among the various concepts of WSN a few are discussed below. The work of [1] depicts about DBA that improves the fault detection accuracy and fault probability that is adjusted by exploiting the border nodes and thus avoiding the impact of large number of faulty nodes. The paper [2] discusses about the Silent Failures which are diagnosed and also about the violation of Correlation patterns that indicates failures. The objective of paper [3] is to obtain state information from the problematic sensors, here each sensor participates in fault diagnosis and transmits these evidences to the neighbour nodes. In paper [4] it is proposed that detection and Isolation of misbehaviour nodes helps to improve the quality of communication. The attributes of sampling data discussed in paper [5] is reduced by RS, in order to select the decision making attributes. The work of [6] is to detect the sensor nodes fault in DSN and also to provide fault tolerance mechanism, which is energy efficient and responsive to network by using GA. The paper [7] suggests that a trust value is obtained based on packet forwarding ability of the node. The objective of paper [8] is to save energy, bandwidth cost and other resources using multicast communication. It also suggest to use DMT based EAODV to choose forwarding routes which can connect more multicast receiver and solves routing optimization problem .In paper [9] efficient detection and recovery algorithm is used to detect faulty nodes and recover them, they include the combination of bootstrapping, grade diffusion and genetic algorithms. The AFD-CAN discussed in paper [10] is designed for low cost resource constrained distributed embedded system, where it uses a definite and bounded number of testing rounds and messages to complete one diagnostic cycle.

IV. DISCUSSION

In the recent years, many technologies are implemented for the easy use. New techniques are enhanced in various areas such as medical monitoring, agricultural fields, wetland monitoring, forest areas, homeland security, Military and conservation of natural resources. Flexibility plays a major role in Wireless sensor network because it can solve various problems in different domains. Various new devices like DOT, Tiny OS, COTS, Mica used for application purpose [4][5]. Although new sensors are being implemented each day

the problem of size, power consumption and cost still exists.

The existing algorithms are sink based diagnosis, localized fault detection algorithms, Bayesian, genetic algorithm, online deviation Multicast routing algorithm etc. [7]. These algorithms have many disadvantages .They are

- Highly Inaccurate judgment
- Unnecessary communication
- Power consumptions
- Energy inefficient
- Link failure
- Energy depletion
- Chemical spill
- Security

The main advantage of WAS is their flexibility in solving problems in various applications and domains. WSN are successfully applied in domains such as

- Area monitoring: few areas depict few phenomenons that have to be monitored. Such areas are deployed with sensors. These sensors are used to detect the events (pressure, temperature etc.), the events are reported to the sink or base station, which are responsible to take appropriate action.
- Military applications: They are actually an integral part of the control, communication, computing, command, intelligence, surveillance, battlefield and targeting systems.
- Environmental applications: To cover many applications in WSN to earth science researches such as glaciers, volcanoes, forest fires, greenhouse etc.
- Transportation : The WSN collects the real time traffic information and feeds into a transportation model after which an alert is given to the drivers about the congestion due to traffic

To maximize the life time of the WSN, the network has to be properly designed and apply various protocols to reduce the design issues listed below

- Scalability: The number of nodes used in a network depends upon the applications; the deployment density varies from network to network. If the node has several neighbors within their transmission range, the node density will reach a level called high-resolution data. Adequate protocols are to be used to scale the levels to maintain required performance.
- Hardware constraints: Basically all sensor nodes need to have a sensing unit, processing unit, transmission unit and a power supply. Apart from these every additional functional unit comes with additional cost to increase the efficiency, physical size, performance and to reduce the power constraints.
- Fault tolerance: Sensor nodes are frequently deployed in dangerous.
- Environment sensing: Environment is a place where sensing becomes a necessity. Nodes can fail due to various problems like physical damage in hardware, low energy levels, and technical issues. The protocols deployed in a sensor network detect these failures and handle a relatively large number of failures and also maintain the overall functionality of the network. This is relevant to the routing protocol design, which chooses alternate paths are available for transmission of packets. Different environments pose different fault tolerance requirements.

To solve these problems, the proposed system should run in efficient manner. For security purposes, the encryption and authentication algorithms should be used [9]. In order to maintain the time synchronization, nodes should sleep and awake concurrently.

V. CONCLUSION

This paper discusses about the key issues, important requirements, technologies in WSN. WSN plays an intelligent role in capable of handling the application in various fields .WSN has diverse applications at present but it still lacks in its efficiency and performance. Hence, by designing new protocols the WSN can be made reliable. With various approaches WSN can be provided with long network lifetime .It helps in preventing and monitoring the natural disaster, environmental surveillance, emergency navigation etc. The future work includes deploying error free hardware and software modules in WSN. It needs supplying constant power,

high communication rate, and low power consumptions, reliable and highly protected systems. These are achieved by finding new algorithms with variety of techniques and technologies or by combining the advantage of any two existing algorithms.

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