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Review on Different Issues and Challenges in Wireless Sensor Networks

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***Abstract*—** Wireless networking technology has seen a successful development in recent years. It was seen that the wireless sensor network has widely discovered its way in various types of applications and systems with various requirements and characteristics. As a result, it was difficult to discuss specific application requirements regarding hardware issues and software support. This is especially challenging in a multidisciplinary research area such as a wireless sensor network, where close collaboration between users, application domain experts, hardware designers, and software developers are essential to implement the proficient systems. WSN's design is quite dependent on it's environment, application design objectives, costs and hardware. The wireless sensor network includes many aspects, which should be reviewed for further improvement. In the present paper, we are going to expose these aspects through a survey of research being studied. In this paper, an overview of the issues and challenges of extensive research involved in the design of WSN has been presented.

Keywords- *Wireless sensor networks, issues , challenges*

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I. INTRODUCTION

In recent years, the development in wireless sensor networks (WSN) is increasing rapidly. In wireless sensor networks, sensor nodes (small and cost-effective sensing devices with wireless radio transceivers) are deployed on a large scale for monitoring the surroundings, the basic without basic amenities i.e electricity supply, wired internet connection and human contact. Every sensor node is able to assemble, count and communicate with other nodes. Sensed data is processed at the node or cluster level before sending to the base station. WSNs are very useful for collecting information from areas where accessibility is difficult and rarely accessible. WSNs have the ability to provide low cost solutions for problems in military, medical, climatic conditions and much more. However, due to the power of limited storage capacity and sensor nodes, many research issues and challenges are being faced by researchers while setting up a practical sensor network. In this research paper, a brief summary of these challenges and obstacles has been presented for the overall benefit of researchers working in the following section in this challenging area.

II. RESEARCH ISSUES AND CHALLENGES IN WIRELESS SENSOR NETWORKS

Major issues that affect the design and performance of a wireless sensor network are as follows:

A. Energy:

The sensor requires energy for various functions. Energy is used in the process of collection, processing and communication of sensed data; also, continuous listening for reliable operation by node components (CPUs, radios, etc.) require a large amount of energy even if they are in idle state. Batteries that provide power should be replaced or recharged after consumption which sometimes becomes difficult due to environmental conditions. The most important research challenge for WSN researchers is to design, develop and implement energy efficient hardware and software protocols for WSN.

B. Self Management:

After deployment of sensor nodes in a wireless sensor network, it should be able to work itself without any human involvement. It should be able to handle network configuration, optimization, maintenance and repair by its own.

C. Hardware and Software Issues:

There are thousands of nodes in the sensor network, it is only possible to deploy a large amount of nodes in an area if node is cheap. Reasonably priced flash memory is advised to be used in sensors. Power consumption and computational capabilities of the node are determine by the central processing unit(CPU) of the sensor node. Also, a large number of microcontrollers, microprocessors and FPGA (field program gate arrays) can also be used for flexible CPU implementation. For reducing the power consumption , three operating states i.e active, sleep and idle should be used in a microcontroller. For FPGA, the consumption of energy cannot be reduced; Apart from this, separate blocks cannot be made for this. Deploying FPGA to reduce power consumption is a major challenge. Besides this other issue like radio range of sensor node should be high to ensure network connectivity and data collection in a network, radio ranges are important because the monitored environment can not have an established infrastructure for communication. In a wireless sensor network, software and hardware independent of each other also Algorithms and protocols should be designed in such a way that they become less complex and helpful in reducing energy consumption.

D. Operating System:

WSN should have less complex operating system than the normal operating system. It should have a simple programming pattern. Application developers should be able to focus on their application logic rather than solving low level hardware problems such as scheduling, preempting

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and networking. TinyOS, Mentis operating system and Nano-Queplus are the various operating systems developed for sensor nodes.

E. MAC Layer Issues:

Some of the major reasons for energy waste are found on the Medium Access Control (MAC)layer: collision, control packet overhead and sleeping hearing hence MAC solutions have a direct impact on energy consumption . Power-saving error control technology is difficult to implement because it requires very high computing power requirements, and the fact is that long packets are not generally practical.

F. Quality of Service (QoS):

WSN is being used in various real-time and important applications, so it is necessary to provide good Quality of Service by the network to the user. However, this is difficult because the network topology can change continuously and the state information available for routing is naturally indefinite. A mandatory amount of bandwidth should be supplied in a network so that it can obtain the minimum required QoS. Sensor network is having uneven traffic because the data is collected from multiple nodes to a sync node. The mechanism of QoS should be designed for an uneven QoS constrained traffic. In order to meet the delivery requirements in a sensor networks, routing need to sacrifies the energy efficiency. Even if multihops reduces the amount of energy consumed for data collection, overhead due to it also slow down the delivery of packets. QoS should be able to support the scalability of the network. Addition or removal of sensor nodes should not influence the QoS of WSN.

G. Security:

Confidentiality between the sensor node and the base station is a must needed factor in the sensor network as is not being deployed only in battlefields, but it has also for critical systems such as surveillance, building surveillance, burglar alarms and airports and hospitals, all this makes the Security a very challenging issue. In the sensor network, it is necessary for each sensor node and base station to verify that the data actually sent by the reliable sender and the false nodes are not sent by an malicious agent to accept false data. Security helps in maintaining the integrity of the data. Some of the different types of threats in sensor networks are passive information collection, Sinkhole attacks, Sybil attacks, prohibition of service attacks and jamming.

H. Architecture:

To implement some functionality in a network, some set of rules and regulations are needed to be consider. Along with set of rules some interfaces, functional components, protocols and physical hardware embrace an architecture. Sensor network architecture should be durable and scalable such that if the number of nodes has increased then QoS of network should not be reduced, because wireless sensor networks are definitely not a fixed set of communication protocol as they have to meet a wide range of application scenarios.

I. Data Collection and Transmission:

The main purpose of the sensor node is to gather the data. Sensor process and transmits the data after sensing it from the surrounding and then sends it to the sink. Collected data can be redundant which should not be transmitted to the sink to save the energy used in the transmission process.

J. Calibration:

Actual sensor readings obtained from the sensors should be adjusted to the right values by comparing them with the standard values and this process is called Calibration. Breakdown of sensor nodes makes the manual calibration very difficult, also the random noise makes manual calibration of the sensor very expensive.

K. Deployment:

Implementation of wireless sensor networks in real world space is called Deployment. Deployment of the network depends on the location of the application as it is not an easy task. Wherever it is difficult to reach those places, the sensors have been thrown from the helicopter or sometimes kept according to some topology. Battery recharging of batteries in sensor nodes or battery changing is a challenging task in real-world scenarios.

L. Limited Memory and Storage Space:

A sensor is a small in size having small amount of memory and storage space for code. To create an efficient security mechanism, it is required to limit the code size of the security algorithm With such a limit, the software designed for sensor should also be small.

M. Physical Attacks and Security:

Sensor nodes can be deployed in an open surroundings with bad weather etc. It is likely that the sensor has to face a physical attack in such an environment. The physical securities of the sensor node cannot be guaranteed. Node hardware can be modify by the attacker or can be replaced it with other fake node.

N. In-network Processing:

Energy can be save by some algorithms which removes the repeated data which is of no use. Since nodes can check the data, they can determine average or directionality for example reading from other nodes. For example, in some monitoring applications, it is generally a case when many sensor nodes monitor and register the same values. Due to spatial correlation between sensor annotations, this kind of data redundancy inspires the technology for in-network data collection and mining.

O. Decentralized Management:

The large scale and energy constraints of many WNSs have made it inadequate to rely on centralized algorithm for implementation of network management solutions such as topology management or routing. Instead, sensor nodes should cooperate with nearby nodes to make localized decisions without global knowledge. As a result, these decentralized (or distributed) algorithms will not give accurate optimal, but they can be more energy efficient.

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P. Fault Tolerance:
While the network is operational, the failure of node should not affect the functionality of the network. In case of any error, the network should be able to adapt the changes by changing its connectivity. In that situation, an efficient routing algorithm is applied to change the overall configuration of the network.

Q. Robustness:
Each node should be as strong as possible in order to support the lifetime necessities. In a typical deployment, hundreds of nodes have to work in synchronization for years. To attain this, the network system should be built so that it can bear and adapt the individual node failure. System modularity is a powerful tool that can be used to develop a strong system. By separating system functionality into separate sub-pieces, each function can be fully tested in isolation before binding all in one application. For this feature, the system components should be autonomous and have a narrow interface to prevent unexpected contacts. Apart from increasing the strength of the network for the node failure system, a wireless sensor network should also be strong for external interference. The strength of wireless links for external interference can be greatly enhanced through the use of multi-channel and spread spectrum radio. It is normal for the convenience of existing wireless devices running on one or more frequencies. The ability to avoid congestion frequencies is necessary for a successful deployment.

R. Interpreting Data and Formation of Knowledge:
Addressing noise, physical world data and developing new interference techniques are the major challenges for data analysis. Ambiguity in analyzed data can make the user in doubt about the performance of the network. To change this raw data into useful knowledge techniques are required in an energy efficient manner.

S. Heterogeneity:
In this group all the nodes are unequal and do not have the same potential to sense and process the data. Cluster of nodes is a good example of a heterogeneous group in which cluster head is powerful than other cluster members. When two completely different WSNs are required to communicate with each other the this kind of heterogeneity take place. Integrated communication interfaces will be required to allow proficient information exchange in unlike systems and nodes.

T. Multimedia Communication:
Sensor network gather and communicate the Multimedia information. In addition to the data distribution mode of scalar sensor network, multimedia data consists of snapshots and streaming multimedia content. Processing and delivery of multimedia content is not autonomous and their contact has a big effect on possible QoS. Transmission required very high bandwidth.

U. Real Time Operation:
Real-time performances can be attained by real time wireless sensor networks over a very long life time. Energy harvesting has shown assurance as a competent technology for long-term wireless sensor networks, Due to the limited capacity of energy storage, it introduces new challenges for scheduling in real time processor.

V. Synchronization:
In the sensor network, there is a general time-frame for local clocks of nodes in the time synchronization in a network. The sensor has a clock in the system which helps in analyzing the accurate data and predict the future behavior of the system. Some applications like environmental monitoring, navigation guidance, vehicle tracking, etc. require global clock synchronization. Devices such as GPS (Global Positioning System) receiver or NTP (Network Time Protocol) results in more energy consumption. Sensor nodes must be synchronized with each other, because this can lead to incorrect data estimation. Some synchronization protocols have high precision, so they require more resources which means more loss of energy. Therefore, the synchronization should be according to the application.

W. Secure Localization:
Sensor network's utility depends on its ability to find each sensor correctly and automatically on the network. A sensor network designed to detect the defect needs precise location information to specify the location of the fault. Unfortunately, an attacker can easily influence information of non-secure location by reporting incorrect signal strength, repeating signals, etc.

III. CONCLUSIONS

Various research issues and challenges of the WSN experienced by the researchers have been shown in this work. There are many challenges in the sensor network, that's why researchers have investigated more about it because of its large applications. A detailed analysis shows that wireless sensor network is an integrative area. Basic requirement of the network is the flexible architecture to ensure good quality service as well as energy efficient algorithms and protocols to make it practical and realizable. Less energy consumption is a main interest and various research issues are eventually tried out to reduce it from all means. In general, a comprehensive approach and coordinated effort is desiderated from the research community to make WSN a reality. These efforts have significance because the WSN has a huge potential for the overall assistance of human resources and there is a possibility of extensive computing in the future.

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