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Analysis of Energy Efficient and Fault Tolerance in Wireless Sensor Network

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Abstract:
Wireless sensor is the very emerging field of the world. Sensor node are having very limited energy and power capacity, due to this , such places it is very difficult to recharge or replace battery of these sensor nodes. To reduce energy consumption and avoid the waste of power of these sensor nodes various techniques has been applied so far. Among various kind of techniques clustering is the most efficient technique to reduce energy consumption of network. In this work, LEACH protocol has been used for clustering in which cluster heads are selected on the basis of distance and energy. The LEACH protocol is been implemented in simulated environment and analyze their performance graphically. The LEACH protocol is energy efficient protocol to reduce their energy consumption different modes is applied on the sensor nodes. These modes are sleep, Active and ready mode. These modes are applied on LEACH protocol and this enhancement is called RFID protocol. In this work, further enhancement will be proposed in RFID protocol for clock synchronization. In the proposed

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improvement the clocks of the sensor nodes will be synchronized on the basis of time lay technique. When the time of the cluster head gets mismatched then the cluster head will adjust its clock according to the sink node timing and sensor nodes.

Keywords: WSN, LEACH, RFID, IOT

Introduction

There are numerous nodes deployed within specific area in a wireless sensor network. These nodes are deployed in order to monitor the surrounding area of those nodes. In order to provide communication amongst the nodes present in the network, the sensor hub is present in the network, which consists of sensors, actuators, memory and processor. In order to transmit the data through sensor nodes utilizing radio frequencies, infrared, and so on. There is no wired connection present within these networks. A random fashion is set across the nodes and the messages are transferred which thus provides an ad-hoc network environment within the networks. The battery present within the nodes of WSN is of smaller size. In addition, the nodes are located at far distances where human is not able to reach. Therefore, the major concern within the WSNs is the usage of battery within them. This also affects the overall lifetime of the nodes and thus the deployment of the network. The sizes of various constraints such as battery size, processors, information-storing memory and so on are important within these networks. The consumption of energy is required to be advanced within the networks with the help of various optimization algorithms. Various time constraints are present within the detected and routing information sent across the WSNs.

It is not possible for a hub to communicate with the other hubs through any direct links. The range is out of reach and the information thus to be transferred is passed with the help of various nodes that lie within the path in the network. This process is known as multi- hoping communication. For processing requests across the network, various nodes co- ordinate with each other and transfer the data to each other. There is a shared communication provided within the network and so they are not concentrated. One can add as well as remove the

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nodes within the network in the wireless sensor networks. This can also provide various changes to be made within the network topology. A hub within the network that gathers all the important information is known as sink. Within the time constraints, the information can be utilized for certain purposes by exchanging the particular information with the outside world with the help of internet.

LITERATURE SURVEY

Xu Lu, et. al. (2018) proposed a new technique to minimize the energy consumed in wireless sensor networks. This technique is known as Square partition- based node scheduling algorithm. As WSN helps in solving the issues of nodes in Iot and scheduling of nodes is an important method to improve the energy efficiency in the network. In this, author has used a unused energy model to analyze the passive nodes' energy consumption. A clustering technique proposed to consider the radii of sensing and communicating nodes. After this coverage of nodes is considered in this so that less coverage is used in node scheduling.

M. Benaddy, et.al. (2017) presented applications of wireless senor network in almost every field such as medical applications, environmental monitoring, battlefield applications, transportation, emergency conditions, security applications and many more. Various techniques so far are proposed by many researchers in this area for the reliability of WSN such as retransmission or redundancy or multipath routing protocols. They proposed an algorithm in this paper for the reliability of transmitted data in the wireless network. The proposed algorithm has used multipath principle. It also focused on the energy consumption constraints based on which each node is separated from other node according to the distance between the nodes. The proposed algorithm is implemented and simulated for the evaluation purpose and the calculation of performance and also compared with other algorithms in order to check the efficiency of this method.

Sarath Pattahthil, et al. (2017) have considered the problem of optimal distributed scheduling for delay minimization. They did focus on static scheduling policies where the

CSMA channel access rates are determined by the long- run traffic statistics, but not the instantaneous queue states. In case of heterogeneous traffic flow, such kind of static scheduling is preferable over the max- weight like dynamic scheduling. In this paper, the authors have formulated the problem of optimizing the channel access rates of different links subject to an upper bound on the access rate of each link. As this is a hard non- convex optimization problem that's why the authors have proposed approximate solution that is asymptotically optimal in the limit as the maximum permissible channel access rate grows to infinity.

Than Dinh, et. al. (2016) presented an approach to find out the sleep timings of sensor nodes that is when a node will go into the sleep state and when in the active state. Author proposed a technique or protocol "L- MAC: A wake up time self- learning MAC protocol for wireless sensor networks". In this author used the beacon message to coordinate the wakeup timing of neighboring nodes. So it can incur extra communication overhead. Therefore, in L-MAC protocol nodes continuously sends the beacon messages to the sink node or to the base station. This protocol has less energy consumption compared to the asynchronous techniques or MAC protocols. By using this L- MAC end to end packet delay is reduced. As delay is reduced and energy consumption is also reduced and packet delivery ratio also increased by this approach.

Tuan-Duc Nguyen, et. al. (2016) A low power water level observing station and an energy efficient wireless data collecting network has been proposed in this paper for the wireless sensor network. They also compared several low power consumption wireless modules in this paper. For the designing of the wireless sensor network, they selected an efficient wireless module. For the connectivity of the various water level monitoring stations, they designed the power efficient wireless sensor network so that collected data can be transferred to remote location. They selected the solar power supply that provides surety of long-term operation in the environment. They also proposed a model for the water level monitoring station which has low power consumption. In order to prove the energy efficiency, they calculated the

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power consumption of the proposed station. As per results, it shows that the proposed wireless sensor network and water level monitoring station has been widely utilized in urban environment due to its low power consumption and low cost design. It helps in improving the functionalities and lifetime of WSN.

Research Methodology

In the existing technique the clustering of grids is static but in our proposed work, the clustering of grids is dynamic. The situations arising can change and adjust them accordingly. According to the situation and the calculations build on the behalf of battery power consumption the node data sent is easily adjustable. The major concern here is to avoid the battery wastage of power . The cluster head selection is also done on the basis of minimum battery consumption through election algorithm. For instance, let us consider a network which has number of batteries placed in it each having the data send capacity in milli ampere.

Each battery available in the network forwards the data from source to destination with the help of AODV algorithm. There are three clusters and so their respective cluster heads are also present. The maximum sensing capacity and minimum battery consumption factors help in selecting the cluster heads. So the battery with both the mentioned factors is chosen as cluster head.

Characteristics of Sensor Nodes:

Various characteristics of the sensor node used to assess the performance of WSN are:

Fault tolerance: The failure of a node is a possibility within every network. In case when any node failure occurs within the network, the fault tolerance is the property that helps in controlling the functionalities of the network.

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Mobility of nodes: The mobility of the nodes is free as there is a need to increase the communication efficiency of the network. The types of applications are an important factor to be considered.

Dynamic network topology: There is a standard topology followed between the links of sensor nodes. This can help the network to work in a dynamic nature.

Communication failures: In case there is a need to exchange the data amongst other nodes, it is to be ensured that there is no delay occurring within the network towards the sink node or the gateway node of the network.

Heterogeneity of nodes: Various sensor nodes are situated within the sensor networks. These nodes need to work in cooperative manner in order to provide corrective mechanism.

Scalability: There are innumerable sensors nodes present within the network. There is highly scalable network environment present within WSN.

Independency: There is no central control point present within the wireless sensor networks.

Programmability: Reprogramming or reconfiguring is required within WSN such that the random changes made within the network can be adapted in the network.

Utilization of sensors: There is a need to provide maximum performance along with less energy within the sensors.

Cluster Head selection: Fixed size clusters are formed then in each cluster one cluster head is chose, cluster are head chosen by the LEACH protocol based on the remaining energy on nodes. Nodes represent their resources to the neighboring nodes. Cluster head communicate

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with each other to transmit the data to the sink node. One sink node is selected based on the highest energy.

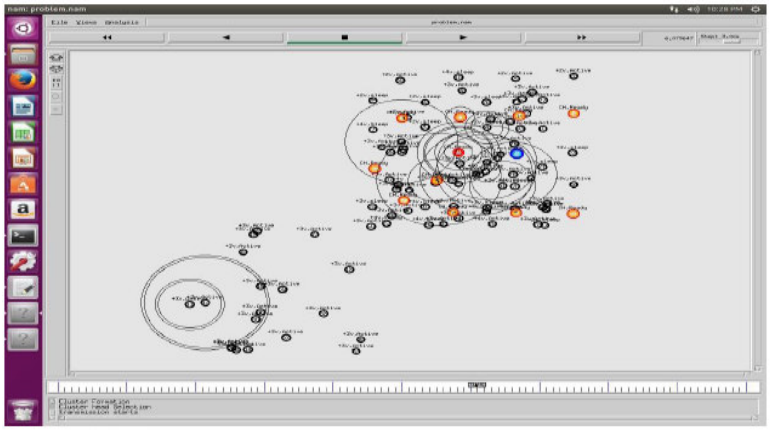

Figure 1: Cluster Head Selection

Sink Deployment and cluster formation: Cluster formation is done on the sensor nodes. From sensor nodes, clusters are formed which communicate with each other to transmit the information to the base station.

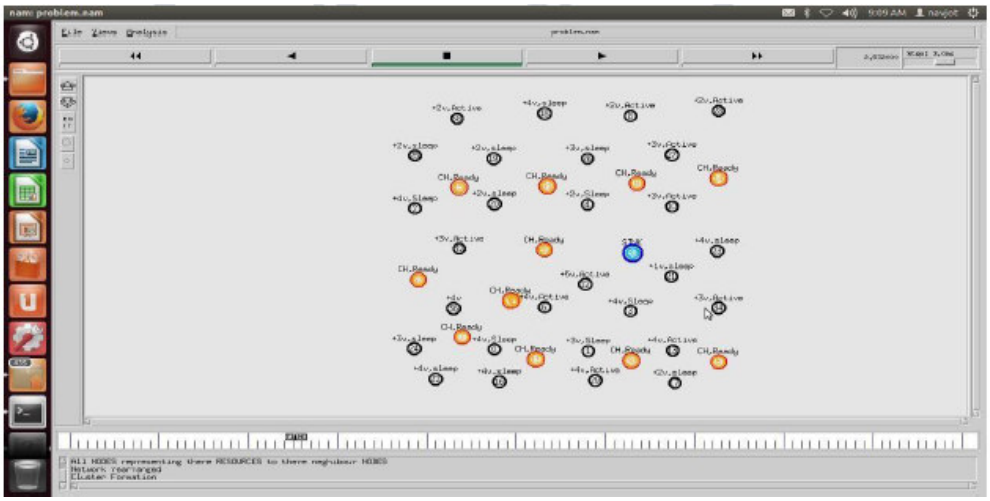

Figure 2: Sink Deployment

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Conclusion

Wireless sensor network is collection of many small power devices named as sensor nodes that are randomly deployed in the sensor network at various locations or sometimes at remote locations. Sensor nodes mainly comprises of four main components, sensors, processor, power management unit and transceiver which have the communication ability with the other nodes. Various methods have been developed till now to save the energy. One is clustering. In clustering, various clusters are formed with the nodes. In each cluster there is a cluster head. Cluster head are chosen based on the distance and residual energy of nodes. LEACH protocol is used for the clustering of nodes. Then three different modes are applied on the LEACH. These are sleep, active and ready. When a node is sending the request and communicating with sink node or cluster head than it will be in ready mode. If it is only sending the requesting, than waiting for its turn than it is in active mode otherwise, node is in sleep mode

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