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A Survey on Energy Efficient Sleep Scheduling in Wireless Sensor Network

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Abstract: A wireless sensor network(WSN) is avery large collection of sensor nodes which organized into different form like tree, mesh etc. This sensor nodes are work on the power sorce i.e. battery which is essencial for its communication. To save the power of the network we used the scheduling technique with WSN to increase the life of the network. In sleep scheduling most of the nodes are put into sleep mode to increase the lifetime of the network.sleep scheduling is very important to become a network more efficient and flexible. Main aim of sleep scheduling algorithm is to live the network for long period of time.The different technique is used with the sleep scheduling like routing and tree based algorithme which is really improve the performance of the network. In the tree based network sink node is used with other sensor node with sleep scheduling but the sink having the unlimited energy supply which is always in active mode. In tree network sleep scheduling is apply with only with the nodesother than sink.In this paper we are study the different types of sleep scheduling techniques like Energy-efficient Scheduling, Energy EfficientTDMA SleepScheduling,Balanced-energy SleepScheduling, Optimal Sleep Scheduling, and Dynamic Sleep Scheduling and methods used in it which work with the wireless sensor network for saving the energy of the sensor nodes and prolong the life of the network. Each technique of sleep scheduling is used for impoving the efficiency of the network and every technique having some limitation while prolong the life of the network.

Keywords: Scheduling, Wireless Sensor Network,sleep Scheduling, Energy-efficient Scheduling, Energy Efficient TDMA Sleep Scheduling.

I. INTRODUCTION

A wireless sensor network is a set of sensor nodes organized into different types of networks like tree,mesh etc. A Wireless Sensor Network (WSN) contain different hardware part for sensing and computation which working in a group to detect and monitor environmental changes in plains, forests, oceans, etc. WSN devices are limited in their energy, processing, and communication capabilities.The sensor nodes are work whenit having the power which is provided by the battery which is placed in remote area so it is not very easy to replace and recharge the battery after deployment. Thus, the design and development of low-energy algorithms and protocols are essential for sensor networks. Especially, the energy consumption of wireless exchange of data between nodes strongly dominates other node functions such as sensing and processing. [2].

A wireless sensor network is a combination of many sensing nodes called wireless sensor nodes, each node is small, very less in weight and portable. Each sensor node is contain a transducer, microcomputer, transceiver and power source for communication.

This sensor nodes are work on the power sorce i.e. battery which is essencial for its communication. To save the power of the network we used the scheduling technique with WSN to increase the life of the network. In sleep scheduling most of the nodes are put into sleep mode to increase the lifetime of the network. Sleep scheduling is very important to become a network more and more efficient and flexible.in this paper we are study different methods of sleep scheduling which continuely work for WSN to improve the life of network.

1. Scheduling:

Scheduling is necessary for improving the life of network which save the time and energy so the network becomes more robust flexible and efficient.In the Multiprogramming operating system scheduling is used with the processes to increase the throughput of the system. Such operating systems run multiple processes which is to be loaded inside the executable memory at the same time and that process shares the CPU by using the technique called multiplexing.

All the waiting processes are stored into the queue for execution. When the process are load into the system,it isstoredinto the job queue.This queue is a collection of all processes of the system which is handle properly by using scheduling for improving the performance of the system.

2. WSN Scheduling:

A Scheduling in WSN, is called as the packet scheduling, which is used for manages the sequencing of packets in wireless sensor network of the transmit and receive queues of the wireless network interface controller, which is use

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circular data buffer.Different schedulers are available for the every operating system. Wireless sensor networks are collection of a many number of sensor nodes which communicate using the radio channel. The WSN is developed for sensing a certain physical variable, gathering data and forwarding them to the base station where the information is processed for further purposes. Wireless sensor network is used with the scheduling which definitely increase the network validity for the long period of time.

3.Types of WSN Sleep Scheduling :

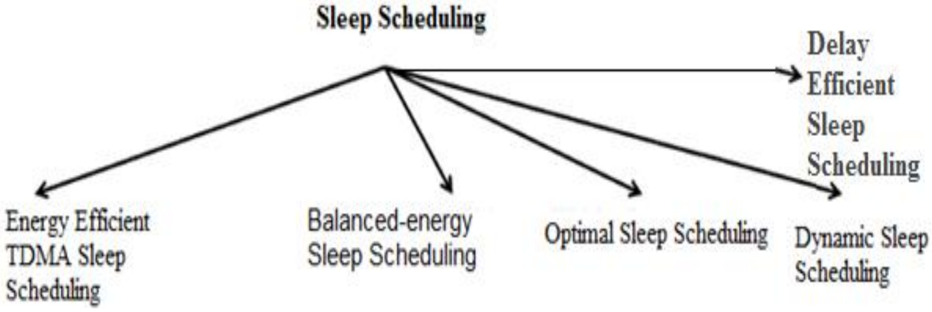

Figure: 2 Classification of Sleep Scheduling

3.1. Energy Efficient TDMA Sleep Scheduling:
The energy efficient TDMA protocols divide time into slots, which are allocated to sensor nodes.This slots are assign for switch on the radio during the assigned time slots, and switch off the radio when not transmitting or receiving in the sleep scheduling. In order to be interference free, a simple approach is to assign each communication link a time slot, and thus, the number of time slots is equal to the number of communication links of the network. This scheme requires much more time slots than necessary, which increases the delay and reduces the channel utilization significantly. This is because multi-hop networks are able to make space reuse in the shared channel, and multiple transmissions can be scheduled in one time slot without any interference.To minimize the number of time slots use TDMA link scheduling while producing an interference-free link scheduling, and it has been shown that the problem is NP-complete. Several approximate algorithms have been proposed in the link scheduling problem. However, if the TDMA link scheduling is used as the start the mechanism in the scheduling with sleep mode, a node may start up numerous times to communicate with its neighbors. Important thing noticed here is startup time is on the order of milliseconds, while the transmission time may be less than that if the packets are small. Consequently, the transient energy consumption during the startup process can be higher than the energy during the actual transmission. Because of starting a sensor node too frequently, it not only needs extra time, but also costs extra energy for the state transition. Therefore, the state transition, for example from the sleep mode to the active mode, should be considered for an energy efficient TDMA sleep scheduling in WSNs

Advantage:
1) To maximize the life of wireless sensor network.
2) To reduce packet loss during Sleep Scheduling.

Disadvantage:
1) This scheme requires much more time slots than necessary, which increases the delay and reduces the channel utilization significantly.
2) Overlapping of data may beoccure in thistechnique.

3.2. Balanced-energy Sleep Scheduling:
The sleeping technique has been used to conserve energy of battery powered sensors. Rotating active and inactive sensors in the cluster, some of which provide redundant data, is one way that sensors can be intelligently managed to extend network lifetime. Some researchers even suggest putting redundant sensor nodes into the network and allowing the extra sensors to sleep to extend the network lifetime. This is made possible by the low cost of individual sensors. When a sensor node is put into the sleep state, it completely shuts itself down, leaving only one extremely low power timer on to wake itself up at a later time and energy costs of both computation and communication activities were considered in the task allocation problems for wireless networked embedded systems with homogeneous elements. In order to extend the network lifetime, the authors' goal is to balance the energy dissipation of the elements during each period of the application with respect to the remaining energy of elements. We use a probabilistic approach to balance the energy consumption of the sensor nodes while maintaining the balance the energy consumption of a large fraction of the sensor nodes in a cluster, we need to manipulate the sleeping probability of each sensor node according to its distance from the cluster head. However, unlike the DS scheme where the only criterion was to choose the sleeping probabilities to reduce overall energy consumption, the goal here is to ensure the average energy consumption of a large number of the nodes is the same. Assuming that the nodes start with approximately the same initial energy, this will ensure that these energy-balanced nodes run out of energy at approximately the same time, thereby extending network lifetime while maintaining adequate sensing coverage. To accomplish this goal, we propose and analyze the balanced energy Scheduling (BS) scheme. [10]

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Advantage:

1) Redundant sensor nodes and using the extra sensors to sleep to extend the network lifetime.
2) To balance the load in network which improve the efficiency of the WSN Network.

Disadvantage:

1) while balancing the load in network which cannot pass data to long distance because some route require more energy and some route require less energy.

3.3. Optimal Sleep Scheduling:

A wireless sensor network whose nodes sleep periodically; however, rather than evaluating the system with a given sleep control policy, we impose a cost structure and search for an optimal policy amongst a class of policies. In order to approach the problem in this manner, we need to consider a far simpler system than those used in the a for mentioned studies. Thus, we consider only a single sensor node and focus on the tradeoffs between energy consump-tion and packet delay. As such, we do not consider other quality of service measures such as connectivity or coverage. The single node under consideration in our model has the option of turning its transmitter and receiver off for fixed durations of time in order to conserve energy. Doing so obviously results in additional packet delay. We attempt to identify the manner in which the optimal sleep schedule varies with the length of the sleep period, the statistics of arriving packets, and the charges assessed for packet delay and energy consumption.[12]

Advantage:

1) This technique is used to minimize the dalay in Communication.
2) Optimal sleep scheduling improve the lifetime of the WSN.

Disadvantage:

1) In this technique do not maintain the quality of service such as connectivity or coverage.

3.4. Dynamic Sleep Scheduling:

The dynamic sleep Energy conservation is important during periods with no activity and also during occurrence of events. It is critical to reduce traffic overhearing since the transceiver consumes similar energy for idle listening as transmission. The overhearing can be minimized if nodes can determine when they are expected to send and receive packets. To facilitate energy savings during event occurrence, smart sleeping schedule can allow nodes to sleep for short periods when a node is neither transmitting nor receiving.

Although sleep-scheduling in sensor networks has been an active area of research, scheduling to conserve energy for nodes carrying traffic has not received much attention. MAC layer protocols that put nodes to low duty-cycle usually lead to low throughput and high event reporting latency. While for some applications like event tracking, throughput and latency are also important metrics besides energy saving. To save energy on nodes carrying traffic, TDMA based link scheduling is widely studied to put nodes to sleep when they do not transmit or receive packet while it is in the way of traffic. The per-packet scheduling is based on information collected from all links. For the global coordination excessive messaging is neccessory which cause delays in link scheduling. Minimizing the limitation of centralized scheduling, TRAMA proposes distributed scheduling at each node based on information collected within a fixed number of hops. Although TRAMA can conserve energy, the conservative local coordination results in latencies that exceed 100 times the latency of CSMA based approaches. Thus TRAMA is useful only in scenarios where latency and throughput are not critical metrics of performance, which is hardly the case in most sensor networks. The contribution of this paper is an energy efficient MAC layer sleep scheduling protocol for sensor networks that maintains high through put as well as low latency. [1][2]

Advantages:

1) To Avoid the packet loss while communication In the wireless sensor network.
2) With dynyamic sleep scheduling used with the MAC layer which improve the high throughput.

Disadvantages:

1) To control the traffic isvery difficult..
2) Large network may cause the problem of data loss.

3.5 Delay Efficient Sleep Scheduling:

Wireless sensor networks (WSN) are expected to operate for months if not years on small inexpensive batteries with limited lifetimes. Typically the primary goal of these networks is energy efficiency. Previous works have identified idle listening of the radio Which conserve more energy. Measurements on existing sensor device radios show that idle listening consumes nearly the same power as receiving. In sensor network applications where the traffic load is very light most of the time, it is therefore desirable to turn off the radio when a node does not participate in any data delivery.

The S-MAC medium access protocol introduced synchronized periodic duty cycling of sensor nodes as a mechanism to reduce the idle listening energy cost. In S-MAC each node follows a periodic active/sleep schedule, synchronized with its neighbouring nodes. During sleep periods, the radios are completely turned off, and during active periods, they are turned back on to transmit and receive messages.[10][8]

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Although the synchronized low duty cycle operation of a sensor network is energy efficient, it has one major deficiency: it increases the packet delivery latency. At a source node, a sampling reading may occur during the sleep period and has to be queued until the active period. An intermediate node may have to wait until the receiver wakes up before it can forward a packet received.
This approach provides some reduction in sleep latency at the expense of greater energy expense due to extended activation and overhearing, but is not sufficient for long paths. In a recent work, we investigated an alternate approach to delay-efficient sleep scheduling, designed specifically for wireless sensor networks where the communication pattern is restricted to an established unidirectional data gathering tree. In this case, we showed that the sleep latency can be essentially eliminated by having a periodic receive-transmit-sleep cycle with level-by-level offset schedules, in which data cascades in step by step from the leaves of the tree towards the sink, with nodes going to sleep as soon as they transmit their packets to the next level, and waking up just in time to receive the next round of packets.[10]

Advantages:
1) Avoid collision while broadcasting in WSN.
2) To Reduce the Energy Consumption and delay in communication.

Disadvantages:
1) It is very difficult To minimizing the Delay in communication whilebroadcasting the massage.
2) Difficult to maintain latancy parameter.

IV. SLEEP SCHEDULING IN WNS:
Reliability has always been one of the top concerns in communications system design. With the advent of wireless sensor networks (WSNs), the notion of reliability takes on a whole new network meaning because of the unique operational characteristics introduced by WSNs that set them apart from other networks. First of all, the emphasis on energy efficiency is paramount in the majority of WSN applications because each sensor network node is equipped with only a finite amount of battery supply. As the operational reliability of each node is completely compromised once its energy is depleted, the highest priority in WSN network design is to prolong system lifetime as much as possible through the use of energy-efficient hardware components and power management techniques. Second, since each WSN is expected to be comprised of thousands of nodes or more, per unit cost hence becomes a major factor in sensor network node design and component selection. A balance must be struck show between choosing low-cost yet perhaps inferior components and maintaining sensing application reliability without making WSNs excessively expensive. In light of the influences of energy efficiency and cost, a few primary implications of reliability in WSN design are as follows: [3]

4.1 Hardware reliability:
This measure is related to the propensity of the on board hardware components in succumbing to failure during normal WSN operations. While the specifics on WSN hardware design for maximizing reliability are beyond the scope of this paper, engineering intuition suggests that it is a good idea to select hardware components that are as simple in architecture as possible.

4.2 Sensing reliability:
In WSN applications, all sensor nodes cooperate together to monitor physical phenomena of interest across the sensor field. As individual network nodes can sense the appropriate physical phenomena within their sensing range only, important events may be missed by all sensor nodes because of possible inadequate sensing coverage. i.e., provided comprehensive sensing coverage requires meticulous network planning and node deployment strategies. Redundant nodes may be introduced to the sensor field to offer additional reliability for sensing coverage, though trade-offs must again be weighed with respect to per node costs and network management complexity.[4][7]

4.3 Communication reliability:
In most WSN applications, the overall traffic profile is very simple as packets only flow from sensor network nodes to the data sink and vice versa, with very few inter-node exchanges. Despite this simplicity in traffic flows, the WSN is still expected to deliver sensor network data and network control messages with high fidelity in a timely fashion. Aside
from packet loss effects presiding over unstable wireless links, the inherent multi hop nature of WSN communications network present additional uncertainty in guaranteeing packet transport reliability that the common protocols used in the Internet paradigm are inadequate to handle. In particular network shows, it remains a considerable challenge to preserve the network connectivity in conjunction with low-duty cycle sleep-scheduling strategies intended for maximum energy conservation. Summarizing all the design concerns pertinent to guaranteeing WSN reliability, the real engineering challenge henceforth is to devise a comprehensive yet manageable network organization and communication paradigm that can harmonize all of the criteria without creating significant conflicts in optimization objectives. The ultimate designing goal is to balance, through a cross-layer organization scheme, the sensing requirements, end-to-end data communication overhead, and network control effectiveness with energy efficiency. Defined the concentrates solely on the WSN design for wide-area event-driven surveillance applications and it is organized in the following manner. First, describes related concepts and prior work in achieving energy-efficient and reliable WSN design. In propose a new organizational methodology, called Sense-Sleep Trees (SS-Trees) that aims to maximize energy efficiency in WSN

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design. In the next, a network-flow-model based approach for computing SS-Trees is presented. Evaluated on the validity and effectiveness of the proposed SS-Tree computation approach is provided. Finally, gives some concluding remarks and future research outlook.[4]

V. CONCLUSIONS

We have study the WSN scheduling with the different type of wireless sensor network scheduling. We have focus on sleep scheduling in WSN schemes and obtained their study in proposes a cross-layer organizational approach based on sleep scheduling, called Energy-efficient Scheduling, Energy Efficient TDMA Sleep Scheduling, Balanced-energy Sleep Scheduling, Optimal Sleep Scheduling, and Dynamic Sleep Scheduling, Sense- Sleep Trees (SS-Trees). All the sleep scheduling patterns such as Low-Energy Adaptive Clustering Hierarchy Centralized Sleeping Protocol (LEACH-CS), Comparing LEACH-CS to the famous LEACH-C protocol and we also introduced new energy efficient sleep patterns such as crossed-ladders pattern which outperforms other methods. We also presented the new cross-layer idea, called multi- parent technique, where by assigning multiple parents with different wakeup schedules to each node in the network, significant performance improvement is achieved.

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