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Task Scheduling in Wireless Sensor Nodes with Multiple Sensing Units: Survey

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ABSTRACT

A wireless sensor network consists of a large number of such sensor nodes which are densely deployed in wide area. The technological improvement has made these low-power devices very cost effective. Sensor nodes are able to gather information about data processing, and communication. Information gathering is done by actual sensors, such as measuring the temperature, air pollution, pressure, etc. Some supporting functionalities such as power supplies, are required to build a complete sensor node. A sensor node is containing multiple sensors, radio and a processor. Therefore multiple sensing units of a sensor node may be active at some particular time. It is very difficult to schedule the tasks of sensing units as corresponding event of interest. A newly generated task is schedule of sensing units in a power-aware manner. In this survey paper is based on task scheduling in wireless sensor nodes with multiple sensing units. The newly generated task is arrived at anytime in a sensor node. Therefore the task is executed on other sensing unit in a single sensor node. It is very difficult to handle this situation. So in this survey paper is focus on the task scheduling algorithm in a sensor node with multiple sensing units.
Keywords: WSN, Task Scheduling, Event Miss, Sensing Unit

1. INTRODUCTION

Wireless networks can provide us with fine-granular observations about the physical world where we are living [1]. The sensing unit is sense new data, it simply known as correlated event of interest may occur. If is not able to deal with newly coming event then its result is event miss. The new task is arrived at anytime in a sensor node while it executing a task of another sensing unit, it is difficult to handle this situation [4]. This problem become irreverent at the time when the event is generated for short duration and sensor node might be busy in processing another task. This kind of problem is removing with the help of task scheduling in a sensor node from a multi sensing unit. The problem is generated is called event miss.

2. SYSTEM ARCHITECTURE OF MULTI SENSING UNIT

A wireless network is made of spatially distributed sensor nodes. The sensor is used for monitoring physical or environmental conditions. TinyOS [2] is a component based operating system designed to run in resource constrained wireless devices. A key concept in TinyOS is the use of event based programming [2]. The design is based on a generalized architecture. It shared a CPU in between application and protocol processing. The figure 1.1 illustrates a modular view of a typical sensor node with multiple sensing units(SU) and multiple radio(R). Each sensing unit has an A/D (i.e., analog to digital) converter to convert the sensed analog data to digital data. As shown in Figure 1.2, multiple sensing units in a sensor node is sharing the resources like CPU, memory (M) and multiple radio unit to process the sensed data gathered by the sensing units. The control unit (CU) controls and coordinates the data flow among the components of the sensor node. Once an event is detected by the sensing unit, the analog data is converted to digital data using A/D unit and stored in the memory and/or sent to CPU for processing and finally sent to the radio for transmission [3].

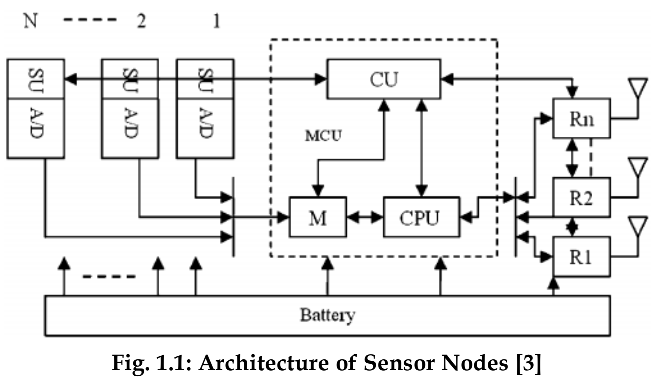

Fig. 1.1: Architecture of Sensor Nodes [3]

3. TASK SCHEDULING ALGORITHMS

The various task scheduling algorithms are discussed as follows:

3.1. Divisible Load Theory (DLT)

Wireless sensor networks using Divisible Load Theory (DLT) [3] for workload scheduling. This approach is providing optimization strategies of sensing workload scheduling. This technique is used because sensors having limited battery power and the desirable condition is complete a task as quickly. In this model each source node processes an appropriate fraction of the entire workload [2], and sends the data to sink node as using routing protocol in network. There is main focus is workload is scheduled among the sensor nodes and reduce the finish time of the workload. So there is two representative network models are presented such as SHMS and TLH. These two model is contributions include as first derive a optimal solutions of the workload scheduling to minimize the finish time of a sensing task in two different network models [2]. The second utility rate as collaborative information processing in WSNs and integrated the optimal result. The third is formulating an energy model and it focus the energy consumption behaviour.

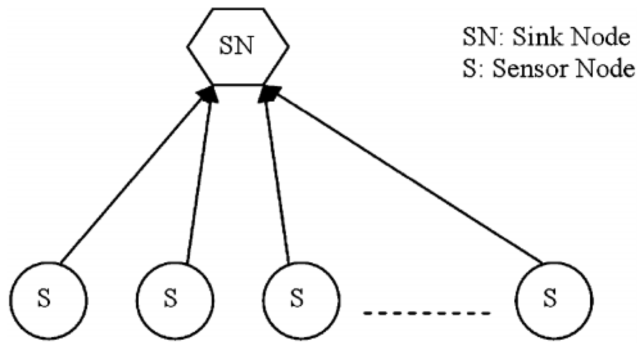

Fig. 1.2: Single-hop Multi-source Sensor Network(SHMS)

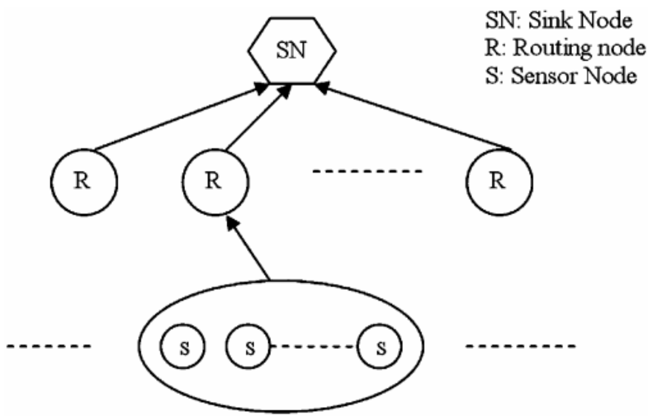

Fig.1.3: Two-Level Hierarchical Model

In figure.1.2 is shown as first model is SHMS, the amount of data is relatively small. It retrieves a process data from single sensor node and the retrieve data is only from source and routing nodes. They are not considering a processing time.

Second model is Two-level hierarchical model (TLH) is shown in figure.1.3. It collected data from a set of sources. There routing nodes perform some processing as data collected, the processing time is nontrivial.

There are some advantages as: First, It provides optimization strategies of sensing workload scheduling. Second, it saves battery power as it completes a task quickly. But there are some drawbacks: First, it does not define the timing of best power state when the predicted future tasks. Second, it uses a single sensing unit in a sensor node which consumes more energy in scheduling compared to that of multiple sensing units in a sensor node.

3.2. Multiple Sensing Unit Scheduling Algorithm (MSUS)

MSUS [4] objective of the algorithm is to minimize the event-misses and saving energy in wireless sensor network. It focuses on event-driven task scheduling algorithm, called MSUS (multiple sensing unit scheduling). This algorithm is explained a best power state based on the priority and timing requirements. It predicted future tasks as interest of event for all the sensing units of a sensor node. An *event* occurs when a sensing unit picks up a signal whose power level goes above or below certain predefined threshold [4]. It defines a *task* as the required to process the data generated by multiple sensing units as the form of captured event. The generation of tasks is depending on arrival patterns of events. It follows certain probability distribution functions. There a sensor node having a list of priority of corresponding sensing units. The task is required for processing of generated data which is captured by sensing unit. The task of a sensing unit has a limited execution time and a deadline. The execution time is referring as complete its execution and deadline is referring as time the processing has to be completed. The new task is occurrence of the corresponding events of interest in a sensing node. The task is executed is known as current task. The scheduling of task in sensor node by choosing best power states. So that the result in minimum energy consumption.

There are some advantages as: First, the scheduling of task is based on the priority and timing requirements to minimize the event-misses. Second, the scheduling of task in sensor node from multiple sensing units by choosing best power states resulting in minimum energy consumption. But it does not talk about the routing node and how the data is transmitted in a network.

3.3. Collaborative Task Scheduling Algorithm (CTAS)

CTAS [5], this algorithm is based on coarse-grain scheduling in a sensor group (cluster) and fine-grain scheduling within a sensor node. The algorithm is designed for a collaborative task scheduling algorithm, called CTAS. This algorithm is used for to minimize event misses and energy consumption by exploiting power modes and overlapping sensing areas of sensor nodes [5]. The CTAS is focus on the idea of two-level scheduling approach. In the first level is based on coarse-grain scheduling as shown in Figure.1.4, at the group level to the execution of tasks collaboratively at group. It is used for obligatory information on the coverage based relationship of neighbouring sensor nodes in a group. The second level is based on fine-grain scheduling is shown in figure.1.5, at individual levels to schedule the tasks correlated to the assigned event types. This scheduling is handled the processing of event tasks when the sensor node having multiple sensing units share the same limited resources. There sensor node might be in a assertive power state which is processing the a particular type of events. In the fine-grain scheduling is selects the best power mode for sensing unit of a sensor node and reduce the event misses. The task scheduling is divided into level as event-types *scheduling* and *data transmission scheduling.*

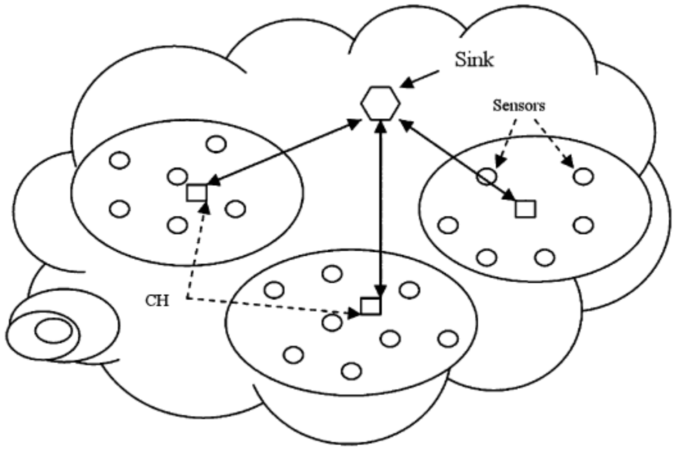

Fig.1.4: System Model (Coarse-Grain Scheduling in a Sensor Group)

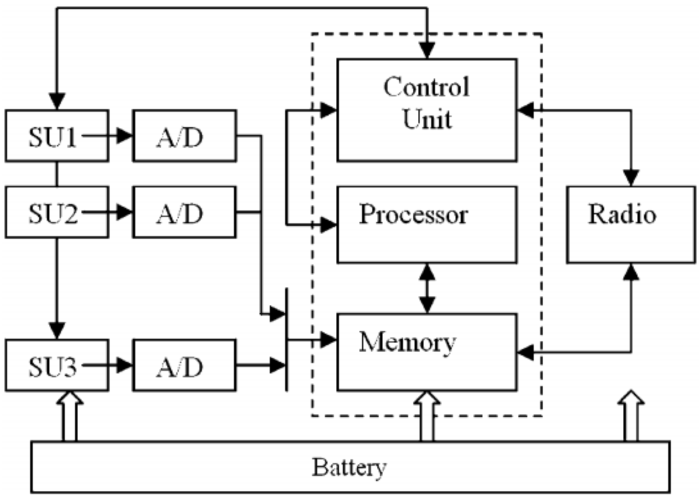

Fig.1.5: Sensor Node Architecture (Fine-Grain Scheduling within a Sensor Node)

There are some advantages as: First, It schedules the task in two level as event-types scheduling and data transmission scheduling. So that it is minimize the event misses and energy consumption. Second, it also overcomes the problem of overlapping sensing areas of sensor nodes. But it does not talk about data redundancy and about which type of data is processed in a network.

3.4. Adaptive Task Scheduling Protocol (ASPEN)

ASPEN [6], an adaptive task scheduling protocol, called ASPEN is focus on event miss-ratio statistical assurances in wireless sensor networks. This algorithm is proposed for cluster-level and node level. In cluster-level the two coarse-grain task scheduling algorithms and node level one fine grain task scheduling algorithm is proposed. The data is generated by multiple sensing units simultaneously, therefore the resulting in event misses. So that the adaptive task scheduling protocol is used for event miss-ratio statistical assurances. The first coarse-grain scheduling algorithm is used for discard misses during assignment minimum number of event types to observe of event processing. In the second coarse-grain scheduling algorithm remove the redundant data on the bases of event type. It transmits the accurate data from sensor node to the cluster head after removing the duplicate data. At the last is fine-grain scheduling algorithm is conclude the sequence of processing data in a sensor node with multiple sensing unit. This is used actual power modes to avoid event misses. This algorithm is divided in to three steps:

Step 1: The sensor node senses the environment and assignment of event types. The event type is determined by aggregated coverage results. The result is occurring on the bases of event miss-ratio requirement.

Step 2: Each sensor node with multiple sensing units is known the power awareness of processing of events. In a sensor node is assigned multiple event type select the best power mode and avoiding event misses [6].

Step 3: At the last sensor node is send the data to the cluster head in timely manner after remove the redundancy of data.

4. CONCLUSION

The survey paper is based on task scheduling algorithm in wireless sensor nodes with multiple sensing units. The task scheduling algorithm is minimize the event miss and save the energy in a sensor node with multiple sensing unit. The algorithms reduced the miss rate of event and consider the power and timing constraints.

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