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ENERGY AWARE INFORMATION DISSEMINATION STRATEGIES TO IMPROVE LIFETIME OF A WSN

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Abstract— The wireless sensor node can only be equipped with a limited power source. In some application scenarios, replenishment of power resources might be impossible. Sensor node lifetime, therefore, shows a strong dependence on battery lifetime. Hence, power conservation and power management take on additional importance. The main task of a sensor node in a sensor field is to detect events, perform quick local data processing, and then transmit the data. Power consumption can hence be divided into three domains: sensing, communication, and data processing. One of the most commonly used Power management techniques is to allow a node to follow sleep-wake up-sample-compute-communicate cycle. Based on the amount of the battery availability, by adopting the proper information dissemenitation schemes, the network life time can be extended. This process relies on hardware support for implementing sleep states, permits the power consumption of a node to be reduced by many orders of magnitude.

Keywords—WSN, Energy Consumption, Information Dissemination Schemes, Mobile Sensor Node.

I. INTRODUCTION

A wireless sensor network consists of thousands of sensor nodes, deployed according to some predefined pattern, over a region of interest. A sensor node has many stringent resource constraints, such as limited battery power, signal processing, computation and communication capabilities, and a less amount of memory. Group of sensor nodes are collaborated with each other to achieve a bigger task efficiently. A sensor node is made up of four basic components: a sensing unit, a processing unit, a transceiver unit and a power unit. Sensing units are composed of two subunits: sensors and analog to digital converters (ADCs). The analog signals produced by the sensors are converted to digital signals by the ADC, and then fed into the processing unit. A transceiver unit connects the node to the network. One of the most important components of a sensor node is the power unit. There are also other subunits, which depends on the application. In many applications, the sensor nodes are often difficult to access, the lifetime of a sensor network depends on the life time of the power resources of the nodes. However, designing energy efficient and low duty cycle radio circuits is still technically challenging task. The main task of a sensor node in a sensor field is to detect events, perform quick local data processing, and then transmit the data. The total power will be consumed to perform the three important tasks: sensing, data processing and communication.

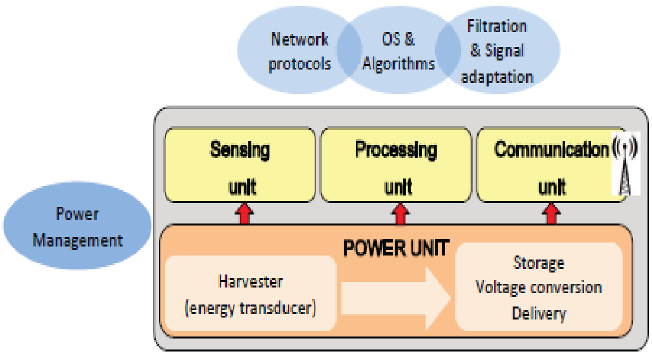

Figure 1.0 The functional blocks of a Sensor Node

Sensing power varies with the nature of applications. The complexity of event sensing also plays an important role in determining energy expenditure. A sensor node consumes maximum energy in data communication. This involves both data transmission and reception. It can be shown that for short-range communication with low radiation power, transmission and reception energy consumption are nearly the same. A sensor node consists of a short range radio which is used to communicate with neighbouring nodes and the outside world. Radios can operate under the Transmit, Receive, Idle and Sleep modes. It is important to completely shut down the radio rather than put it in the idle mode when it is not transmitting or receiving because of the high power consumed in this mode. A sensor node must have computational abilities and be capable of interacting with its surroundings. The limitations of cost and size lead us to choose complementary metal oxide semiconductor (CMOS) technology for the micro-processor. A CMOS transistor pair draws power every time it is switched. This switching power is proportional to the switching frequency, device capacitance. Reducing the supply voltage is hence an effective means of lowering power consumption in the active state. When a micro-processor handles time-varying computational load, simply reducing the operating frequency during periods of reduced activity results in a linear decrease in power consumption. Communicating one bit over a wireless medium at short ranges consumes more energy than processing that bit. With the current technology, the energy consumption for communication is several magnitudes higher than the energy required for computation. One of the power management strategies is to practice the energy aware information dissemination.

II. INFORMATION DISSEMINATION SCHEMES

There are four established techniques for information dissemination in WSNs:

Continuous/periodic dissemination: The sensor node continuously reports data in a periodic manner. In this way, packets are pushed from the network even when the sensed parameter has not significantly changed, hence containing little useful information since the previous transmission.

Query-driven dissemination: The user initiates data transfer by querying data from the network. Qualifying nodes reply to these queries with packets.

Event-driven dissemination: The sensor node decides for itself what data are worth reporting to a sink node. In that way, redundant transmissions can be minimized. In continuous reporting, the choice of period duration has a considerable effect on network performance. If a short period is chosen, a large proportion of the packets are likely to be redundant containing little useful information, while still consuming energy. If a long period is chosen, the network is likely to suffer from the missing of events. While the missing of events can be avoided by locally aggregating the average sensed values. In this paper we designed an experiment to implement all the above strategies by using the two mobile sensor nodes which are used to transmit the sensed information from the region of interest to the base station. Recent progress in low power embedded systems has led to the creation of mobile sensor nodes. Autonomous node mobility brings with it its own challenges, but also alleviates some of the traditional problems associated with static sensor networks. Mobility is the ability of a sensor node to move intentionally, and without human assistance. Methods have been suggested to use mobile sensor nodes to physically transport energy in the network from areas where it is available in plenty to other regions where energy availability is scarce.

III. PROPOSED SYSTEM

A system is designed to sense a temperature in a region and will be transmitted to the base node by using a WSN having two manually deployed mobile nodes and one base node. To optimize the power consumption of a WSN, depending upon the available amount of the battery, this system is free to be operated in one of the three strategies.

Periodic data Dissemination:

If the available battery power of the mobile node is greater

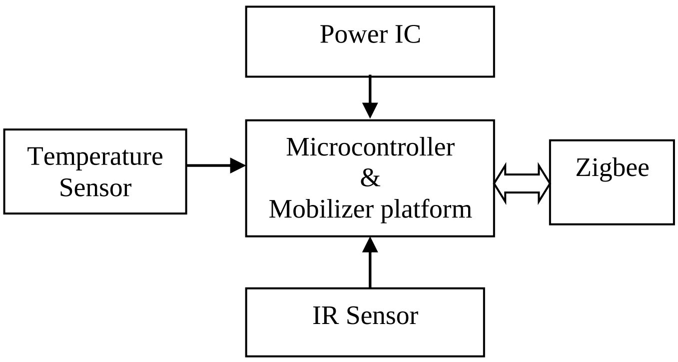

Fig.2.0 Construction of a Mobile Sensor Node

than 75%, it will transmit the data to the base node in a periodic manner. The temperature sensor connected to the mobile node senses the temperature from a region and it will be processed by using the microcontroller and will be transmitted to the base node. The information received by the base node should consist of the amount of the battery power remained and the temperature value.

If the available battery power of static node is greater than 50% but less than 75%, it transmits the averaged value of the sensed samples for every 2 seconds. During the processing time of the data, the transceiver of the base node and the mobile node should be maintained in sleep state.

Event driven Data Dissemination:

If the available battery power of the mobile node is greater than 25% but less than 50%, the temperature sensor continuously sense the temperature values and it will be stored in the controller and the present sensed value will be compared with the previously stored value in the microcontroller. If there occurs a significant deviation in temperature, say 2^0 C then the mobile node will transmit the information to the base node. If the present temperature is 28^0 C, let us suppose the present sensed value is 29^0C, the transceiver of the mobile node will not transmit this information to the base node. It has to transmit only when the temperature is 30^0C or greater values. When the microcontroller recognized a deviation, an interrupt will be generated to awaken the transceiver of the mobile node. During this time the transceiver of the mobile node is maintained in sleep state.

Query driven Strategy:

If the available battery power of the mobile node is greater than 5% but less than 25%, a request will be sent from the base node directly to the mobile node to transmit the temperature present at that time. Based on the request generation only, the mobile node has to sense the temperature and should be transmitted to the base node. Along with the request an interrupt awakens the transceiver and the microcontroller of the mobile node from sleep state to the active state. If the available battery power of the node is less than 5%, the redundant mobile node has to move towards the present mobile node to sense the temperature from the region. This mobile node continues the temperature sensing and can also be operated in all the above specified strategies. Mean while the first mobile node battery can be recharged for the further use.

IV. RESULTS

If the available battery power of the mobile node is greater than 75%, it will transmit the data to the base node in a periodic manner. The information received by the base node should consist of the level of the battery power and the temperature value.

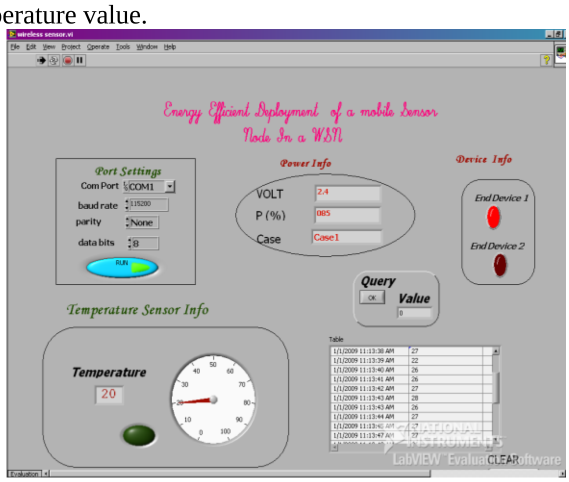

Figure 3.0 Continuous transmissions of data from the static node to the base node.

If the battery power of mobile node is greater than 50% but less than 75%, it transmits the averaged value of the sensed samples for every 2 seconds.If the battery power of the mobile node is greater than 25% but less than 50%, the sensor continuously sense the temperature and it will be stored in the controller. If there occurs a deviation of 2^0 C then the mobile node will transmit the information to the base node.

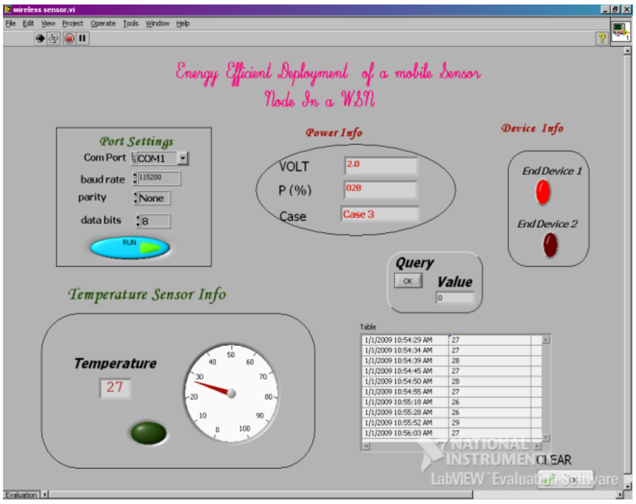

Figure 3.2 Event driven data transmission strategy

If the available battery power of the mobile node is less than 5%, the redundant mobile node has to move towards the sensing field and present node has to move away from the field. The new mobile node can also be operated in a similar manner as the previous node.

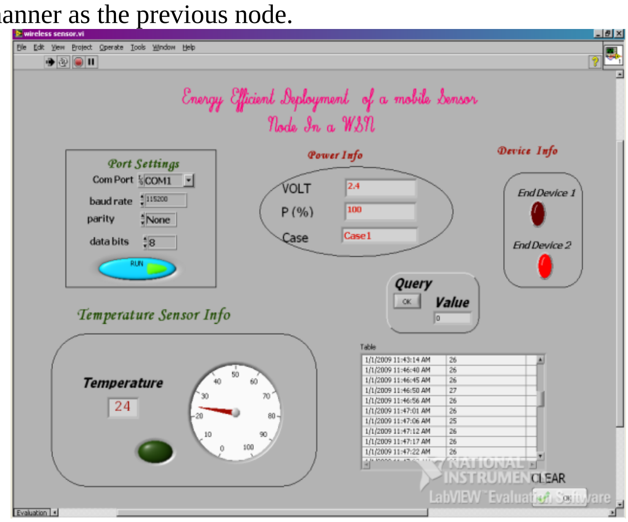

Figure 3.3 Switching of the data transmission task to the second mobile node.

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