Energy Efficiency Communication Protocol for Wireless Sensor Network

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Abstract— Wireless sensor network (WSN) have been identified as one of the most important technology for 21st century. But the energy consumption is the major problem for the implementation of wireless sensor network now days. This paper presents the design and implementation of an energy aware sensor node, which helps to solve above mentioned problem about WSN. An energy efficient strategy, which aims at reducing energy consumption from both the sensor node level as well as network level in WSN, is proposed. For energy efficient Communication, distance between transmitter and receiver is estimated and then required lowest transmission power needed to transmit the measurement data is calculated and determined. After that actual communication takes place. Between two consecutive measurements sensor nodes are set to sleep mode for energy saving purpose under normal operating conditions. It is observed that energy consumption within whole network under different network configurations giving better results. It can give best results by choosing most efficient from one of them is also useful.

Key words: energy efficiency, received signal strength indication (RSSI), periodic sleep/wake-up method, wireless sensor network (WSN)

I. INTRODUCTION

The number of wireless sensors is typically considered as wireless sensor networks. The real time applications of wireless sensor network have been increased recently and this will increase even more in the next years. However for the full deployment of wireless sensor network introduces energy consumption problem. Previous research includes duty cycling and data driven approaches. Duty cycle-fraction of the time node will be in active mode. Duty cycling can be achieved using sleep/wake up protocol and Mac protocol. Sleep/wake up protocol uses sparse topology and energy management approach to improve the network life time by setting some of the redundant nodes to be in sleep mode. The traffic adaptive medium access protocol is designed to reduce the energy consumption by assigning the nodes to low power idle state whenever they are not in transmission or reception mode.

II. RELATED WORK

Duty cycling can be achieved through sleep/ wake-up protocols and media access control protocols with low duty cycle. For example, sparse topology and energy management approach has been proposed to improve the network lifetime by setting some redundant nodes to sleep mode. The traffic-adaptive medium access protocol has been designed to reduce energy consumption by allowing sensor nodes to assume a low-power idle state whenever they are not working in transmission or receiving mode.

Different approaches introduce by different researchers, such as duty-cycling and data-driven approaches, for minimizing energy consumption. In the data-driven approaches can be categories into two parts: data compression and energy-efficient data acquisition. As an example, the transmission data is in compressed form by using a variable data length coding method using Walsh function, and it will provide improvement in energy efficiency in signal transmission.

In this way, the energy consumption for communication decreases as the data to be transmitted decrease. For energy-efficient data acquisition, an adaptive sampling algorithm consisting of duty cycling and adaptive sampling is proposed to reduce energy consumption in a sensor network. The traffic-adaptive medium access protocol has been designed to reduce energy consumption by allowing sensor nodes to assume a low-power idle state whenever they are not working in transmission or receiving mode.

Furthermore, a combination of sleep scheduling with block transmission approach has been proposed to achieve energy saving in a wireless sensor network. Motivated by the prior research, an energy-saving strategy consisting of node-level energy and network-level energy saving through a WSN. This paper is an extension of, in which the periodic sleep/wake-up scheme is added into the sensor node design to further achieve the node-level energy saving.

III. PROPOSED SYSTEM

We have to presents the design and implementation of an energy-aware sensor node, which can help in constructing energy-efficient WSNs. An energy-efficient strategy, which aims at minimizing energy consumption from both the sensor node level and the network level in a WSN, is proposed. To minimize the communication energy consumption of the sensor node, the distance between the transmitter and the receiver is estimated before available transmission, and then, the lowest transmission power needed to transmit the measurement data is calculated and determined. The sensor nodes are also set to sleep mode between two consecutive measurements for energy saving in normal operating conditions. Furthermore, energy saving can be achieved by estimating the energy consumption within the whole network under different network configurations and then by choosing the most energy-efficient one.

A. Architectural Overview

Fig.1 and 2 illustrates proposed system architecture and overall dataflow of the proposed system respectively. In this architecture it can be composed the configuration manager, simulator, node, duty cycle finder, transmission adjust and communication module. In the configuration manager to generate a number of nodes and also these nodes are initialized, these nodes are communicated with its given

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range to communication established from all the nodes are data transmission to one sink node. the sensor nodes in the network is energy constrained and each component in a sensor node consumes a certain amount of energy, power supply becomes important to ensure proper operation of the entire WSN as the number of sensors deployed in a network grows.

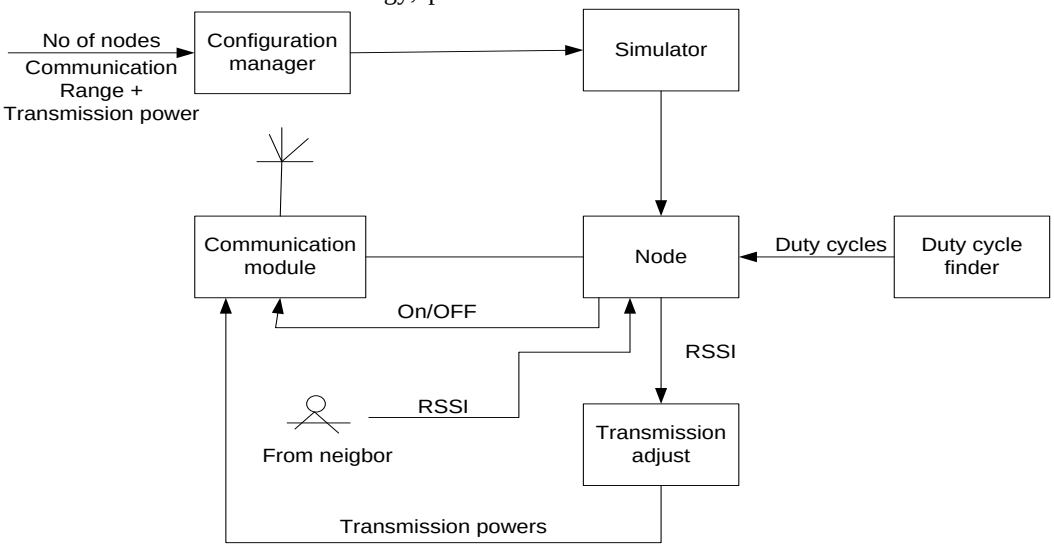

Fig. 1: Proposed System Architecture.

B. Communication Module

In the two sensing schemes designed for the WSN, it is assumed that the transmission power is minimized to ensure reliable reception at the receiver end, according to the communication distance between two sensor nodes. Hence, awareness of the communication power as well as the adjustability of the transmitter's output power becomes critical in performing the sensing scheme for the designed sensor node. By assuming a unit signal gain provided by antennas, the output power of the communication module is dominated by the consumption for power amplifier. To transmit 1 bit to the receiver, the output power and associated received power are expressed as

$$P_{Tx} = (\sum amp * R) * \hat{d}^{\alpha} \quad (1).$$

$$P_{Rx} = \frac{PTx}{d\alpha} = (\sum amp * R) * \left(\frac{\hat{d}\alpha}{d\alpha}\right) = P_s \left(\frac{\hat{d}\alpha}{d\alpha}\right) \quad (2).$$

where R denotes the data transmission rate, $\hat{d}$ and d are the estimated and actual transmission distances between the transmitter and the receiver, respectively, and PS = ∑amp * R is the receiver sensitivity denoting the minimum signal power that the receiver can discern. From (2) It is seen that, if the estimated distance $\hat{d} < d$, then the received signal cannot be identified and the communication between sensor nodes fails. On the other hand, if $\hat{d} > d$ (overestimation), which means a received power that is higher than receiver sensitivity, then a portion of the transmission energy will be lost on the propagation path while not affecting the results of signal reception. In this case, the energy efficiency problem is translated to the effective estimation of communication distance between two sensor nodes.

Since all of the sensor nodes are equipped with both transmission and receiving capabilities, we can estimate the distance between sensor nodes through received signal strength indication (RSSI). For example, considering the case where sensing scheme is applied for local data transmission from a sensor node to its sink node, the sink node sends a test code with maximum transmission power $P_{Tx*\ max}$ .By measuring the received power P_{Rx} on each sensor node, the distance to the sink node can be calculated as

$$\hat{d}\alpha \geq PTx_{*\ max} / P_{Rx}. \quad (3)$$

Hence, by minimizing the estimated distance for data transmission, the minimum required power to ensure data communication is expressed as

$$P_{Tx} = PS * P_{Tx*\ max} / P_{Rx}. \quad (4)$$

In this module is chosen as the RF transceiver used in the sensor node design is a low cost true single chip UHF transceiver designed for very low power wireless applications. The received signal power P_{Rx} in is translated to a decibel (dBm) value—RSSI. The relationship between P_{Rx} and RSSI is defined as follows:

$$RSSI = 10 * \log_{10} P_{Rx.} \quad (5)$$

RSSI is the relative received signal strength in a wireless environment, in arbitrary units. RSSI is an indication of the power level being received by the antenna. Therefore, the higher the RSSI number, the stronger the signal. If a distant transmitter is moved closer to a receiver, the strength of the transmitted signal at the receiving antenna will increase. Measuring the strength of the signal at the receiving antenna is one method of determining the quality of the communication link.

C. Periodic Sleep/Wake-Up Method

A duty cycle is the percentage of one period in which a signal is active. A period is the time it takes for a signal to complete an on-and-off cycle. The node-level energy saving is also achieved through the periodic sleep/wake-up scheme. As we know if a WSN is deployed in remote fields or under harsh environments where manually recharging batteries for sensors is not feasible, one typical alternative approach for energy saving is to turn off some sensors and to activate only a necessary set of sensors while providing a good sensing coverage and network connectivity simultaneously. In slowly varying parameter measurements, such as temperature, not all sensor nodes are needed to stay in active mode. Therefore, in order to save energy consumption, the sensor nodes are designed to be put into a sleep mode with a

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timer that determines their sleep duration. When the timer overflows, an interrupt happens, and it will wake those nodes up and will then perform measurements and data transmission.

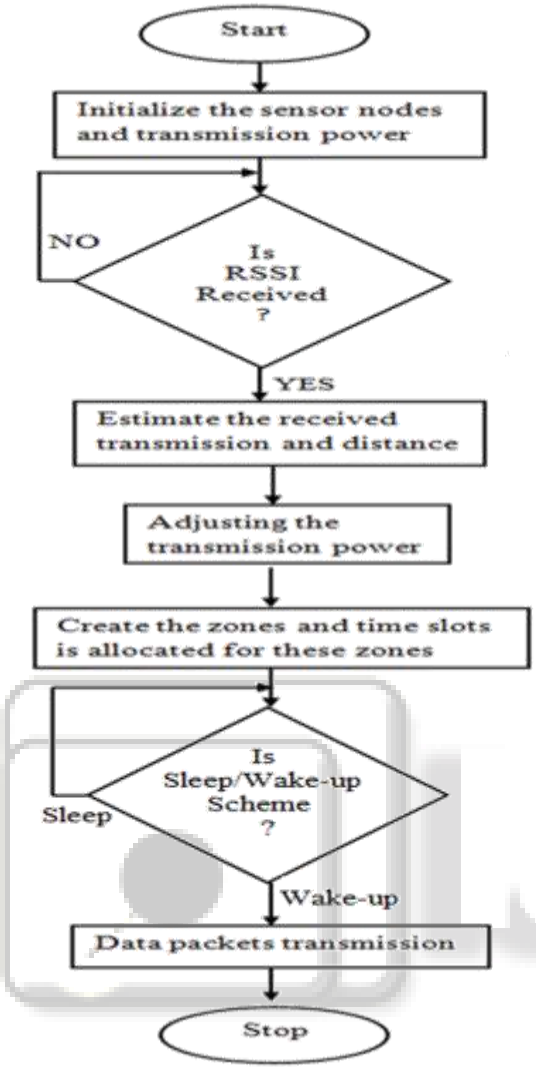

Fig. 2: illustrates the overall dataflow diagram of the proposed system

In this paper the energy consumption of each node is reduced by its associated modules and the total energy consumption is reduced by various techniques.

1) If the sensor node is with low energy then we need to put it in sleep mode till it regains its energy.
2) The distance between the transmitter node and based on that the energy will be calculated and the path or scheme with lowest energy will be used to transfer the data.

IV. Simulation and Results

The simulation is performed on Linux Ubuntu 10.04. The experiments are implemented and run in the network simulator ns-2 (version 2.35). The performance metrics chosen for the energy efficiency communication is for the energy consumption.

Fig.3 shows the data transmission between the source nodes to sink node. In the diagram red circle is indicates sink node, green and yellow circle is indicates the node on and off. In that first the nodes are green has forwarding packets to sink node, after forwarding these nodes becomes off and alternatively yellow nodes are on.

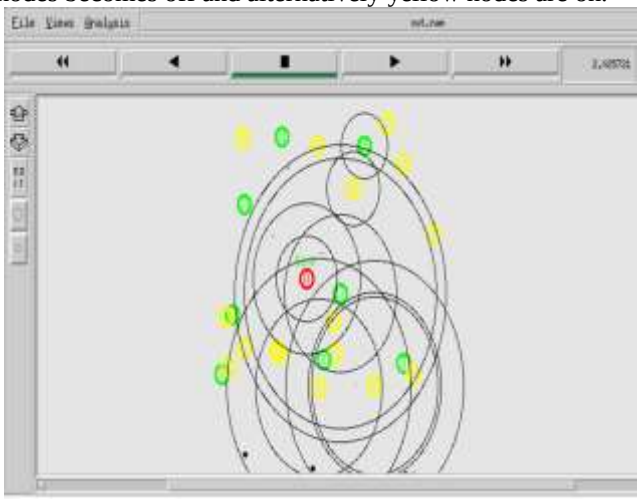

Fig. 3: data transmission between the source nodes to sink node.

Fig.4 and 5 shows the performance comparison of number of sensor nodes and also energy consumption with respect to time is to consume the energy with adaptive and fixed transmission. The red line in the graph indicates the energy consumption in adaptive transmission. Green line in the graph indicates the energy consumption in fixed transmission. In this graph the dot shows the energy consumes with respect to number of sensor nodes.

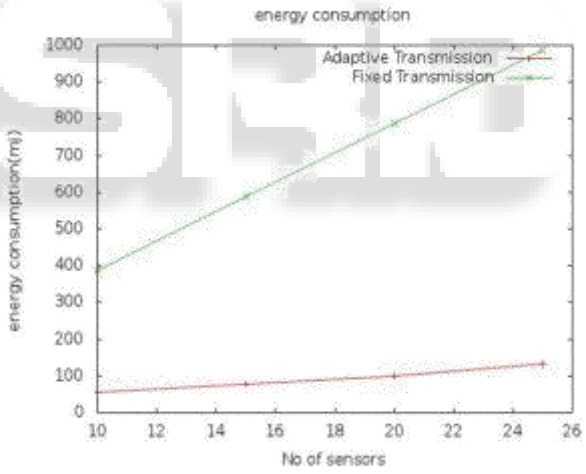

Fig. 4: the performance comparison of number of sensor nodes.

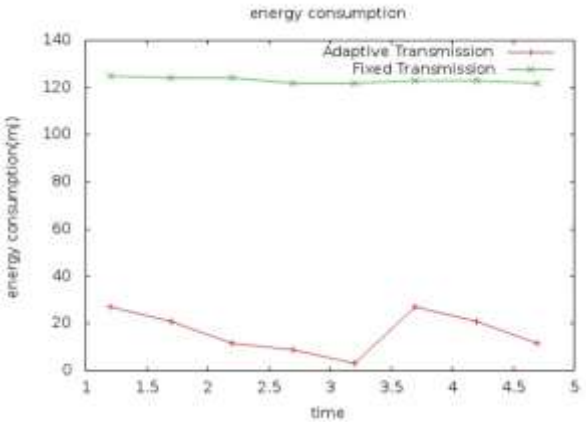

Fig. 5: shows the performance comparison of energy consumption with respect to time.

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V. CONCLUSION

We have presented the design and implementation of an energy-aware sensor node, which can help in constructing an energy-efficient WSN through "node-level energy saving" and "network-level energy saving." The "node level energy saving" is achieved by adaptive transmission power setting and by the periodic sleep/wake-up scheme, while the "network-level energy saving" is achieved by adaptive network configuration. The experimental tests have confirmed the effectiveness of the presented schemes for energy saving in a WSN.

REFERENCES

[1] C. Chong and S. P. Kumar "Sensor networks: Evolution, opportunities, challenges," Proc. IEEE, vol. 91, no. 8, pp. 1247–1256, Aug. 2003.
[2] R. Gao and Z. Fan, "Architectural design of a sensory node controller for optimized energy utilization in sensor networks," IEEE Trans. Instrum. Meas., vol. 55, no. 2, pp. 415–428, Apr. 2006.
[3] Tiwari, P. Ballal, and F. L. Levis, "Energy-efficient wireless sensor network design and implementation for condition-based maintenance," ACM Trans. Sens. Netw., vol. 3, no. 1, pp. 1–23, Mar. 2007.
[4] C. Alippi and C. Galperti, "An adaptive system for optimal solar energy harvesting in wireless sensor network nodes," IEEE Trans. Circuits Syst. I, Reg. Papers, vol. 55, no. 6, pp. 1742–1750, Jul. 2008.
[5] F. Salvadori, M. Campos, P. Sausen, R. Camargo, C. Gehrke, C. Rech, M. Spohn, and A. Oliveira, "Monitoring in industrial systems using wireless sensor network with dynamic power management," IEEE Trans. Instrum. Meas., vol. 58, no. 9, pp. 3104–3111, Sep. 2009.
[6] Ruchi Mittal, M.P.S Bhatia, Wireless Sensor Networks for Monitoring the Environmental Activities 2001.
[7] C. Sha, R. Wang, H. Huang, and L. Sun, "An energy-saving strategy based on sleep scheduling and block transmission for wireless multimedia sensor networks," Int. J. Pervas. Comput. Commun., vol. 6, no. 2, pp. 248– 267, 2010.
[8] G. Nan, G. Shi, Z. Mao, and M. Li, "CDSWS: Coverage-guaranteed distributed sleep/wake scheduling for wireless sensor networks," EURASIP J. Wireless Commun. Netw., vol. 44, pp. 762–776, Feb. 2012.

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