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Low Power Consumption Method for Wireless Sensor Network and Energy-conserving strategies

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Abstract: *This paper proposed the method of low power consumption for WSN system. When the RF communication is done each tag node during the WSN systems operating , power consumption is greatest. Therefore, we configure the network with the RF communication module that turn on/off periodically, power consumption less than operating the module all the time without it toggles. Experimental results confirmed that there were no data omissions and the life time can be 12 times longer than existing WSN system.*
Keywords: *WSN, Low power consumption, RF module Toggle, Data omission*.

I. 1 Introduction

With WSN technology, not only small applications such as smart house but also in the larger society such as environmental , military, health and commercial applications [1-2].The WSN system consists of the sensor node, router, sink node, OS, the server, and it is designed to combine two elements: Tag node and Programming. The tag node for WSN is demanded computing power of appropriate level, small size and long life in many applications area. Life of this tag node is decided by size of battery capacity and power consumption. So we will use battery of high capacity or design it for low power consumption in order that increase life of the tag node [3-4]. Until now many researcher have studied about tag node for reducing power consumption and they have designed new tag node hardware and new algorithm [2-4]. However, no one have handled the RF module where consumes the greatest power during the WSN system operation. So we can expect decrease in power consumption if we handle it.

In this paper proposed the method of low power consumption for WSN system and this method is to control RF module with turning on and off it periodically. In order to verify the effectiveness of the proposed system, we performed experiments on the counter synchronization, data loss, and power consumption.

II. Proposed Low Power System

The Proposed method is to control RF module with turning on/off periodically, so save power and prevent data loss. In this paper, we used K-mote based on Telos for sensor node. It use MSP430 and CC2420 ZigBee chip of Chipcon for RF module and it uses two AA-size batteries.

2.1 RF module On/Off cycle

The RF module always turns on, while the tag node operates, and RF module operation is greatest power consumption more than 10 times CPU operation. Figure 1 shows the compare RF module operating period.

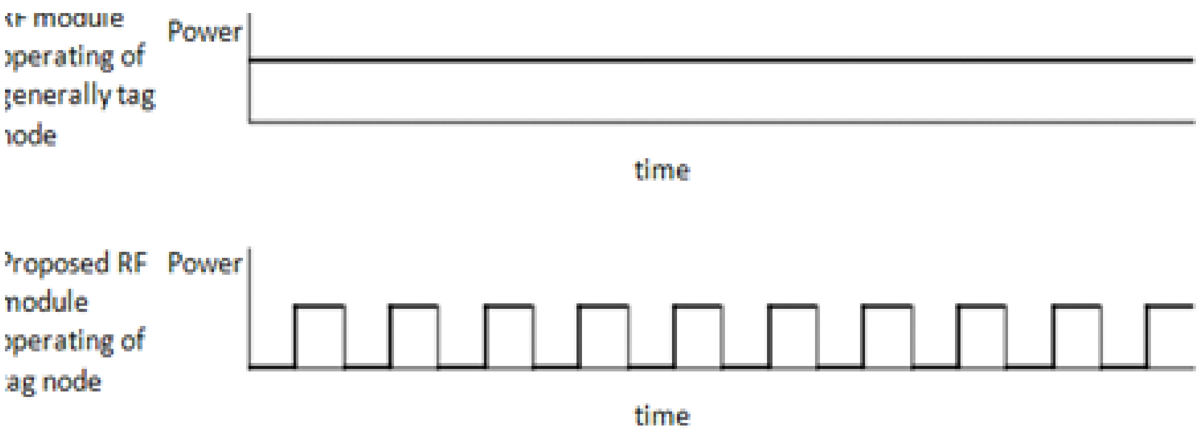

Fig. 1. Compare RF module operating period

2.2 Preventing data loss
2.2.1 Counter synchronization

When we administrate many tag node , the counter synchronization of these is very important. So we have to determine the counter criteria node and time for the counter synchronization. The tag node counter bit update in initial operation such as Figure 2.

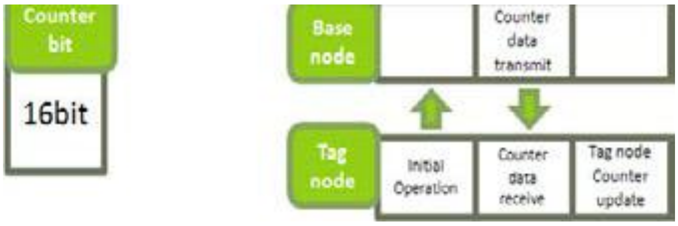

Fig. 2. Counter of the tag node update in initial operation

2.2.2 Tag node and Base station Algorithm

Tag nodes are the target for reducing the power consumption, so we suggested RF module toggle system is applied at these, and select the on/off cycle. Such as Figure 3, this paper's proposed tag node has cycle of on/off RF module power.

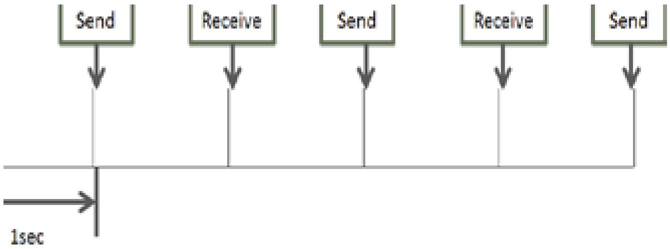

Fig. 3. RF module of the tag node on/off cycle

The Method of Low Power Consumption for Wireless Sensor Network

Base station uses two kinds of bit (Mode bit and Check bit). The mode bit use diving three modes (0: Receive, 1: Transmit and Receive, 2: Transition) at the base station . And the check bit checks the receipt data from the base station at the tag node (0: Normal, 1: Receive data from base station).

III. Experiment

3.1 Counter synchronization experiment

Figure 4 is experiment about counter synchronization using LED, and table 1 is

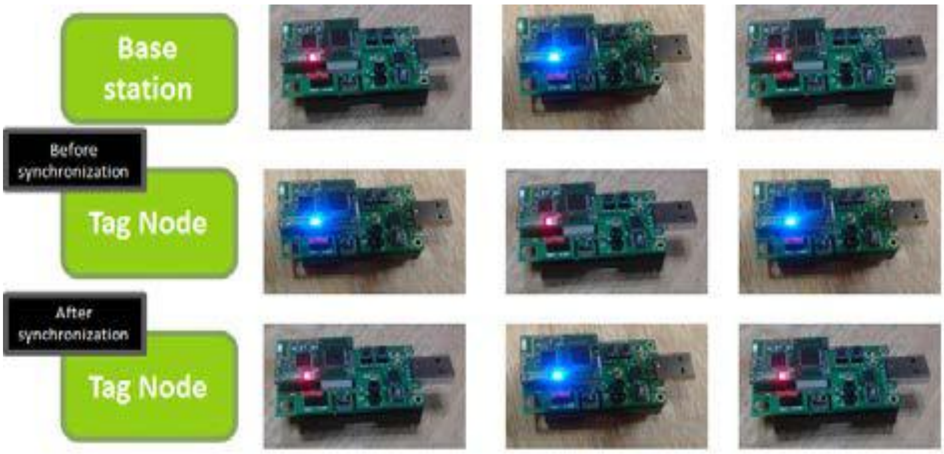

Fig. 4. Counter synchronization experiment using LED

Table 1. Success rate of counter synchronization experiment.	
Distance 5m	Success rate(30th times) 100%
10m	100%
15m 20m 25m	100% 100% 83%

3.2 Data loss experiment

We check the data loss when the tag nodes communicate the each other, and table 2 is result of suceeded receive rate between the tag nodes.

Table 2. Data receive rate experiment result

Number of the tag node	Distance	Data receive rate(30th)
5	5m	100%
10		100%
5	10m	100%
10		100%
5	15m	100%

3.3 Power consumption experiment

Figure 5 shows the ouput volt versus time graph. Through the graph, we can find the excellence that the proposed system is 12 times longer than existing system.

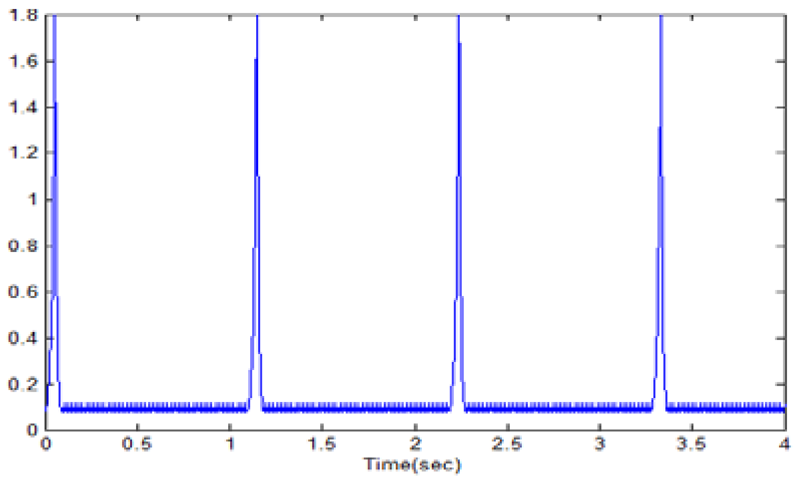

Fig. 5. Output graph using suggested algorithm

IV. Energy-Conserving And Scheduling Strategies

Sensors are usually deployed with redundancy. Therefore, properly scheduling their on-duty time while maintaining the required coverage level is critical. We categorize such solutions into two types: (A) cover set scheme and (B) opportunistic selection scheme. The former is to find a multi-set such that each set provides the basic coverage, while the latter chooses sets by a randomization technique.

(A) Cover set scheme: How to find multiple mutually exclusive sets of sensor nodes such that each set completely covers the field has been proved to be NP-complete in [5], where a greedy heuristic is proposed. Allowing nodes to have different sensing and transmission ranges, [6] shows how to find a minimum connected subset that covers a region of interest.

(B) Opportunistic selection scheme: The probe-based density control algorithm [7] adopts this approach. Nodes are initially in sleep mode. When waking up, they broadcast a probing message within a certain range. If no reply is received within a pre-defined period, they have to remain active. The coverage degree (density) is controlled by sensors' probing ranges and wake-up rates. However, this approach has no guarantee of complete coverage and thus may have blind holes. Ref. [7] also randomly selects sensors to meet the required coverage. It forces a minimum distance between any pair of active sensors so as to maintain network connectivity. The round-based scheme [8] divides the time axis into equal length rounds. Each node randomly generates a reference time in each round. In addition, the whole area is divided into grids. For each grid, we have to compute a schedule based on its reference time such that the grid is covered by at least one sensor at any moment of a round. A node's on-duty time in each round is the union of the schedules of all grids covered by it. This scheme must rely on accurate time synchronization. This is improved by [9], which proves that it is sufficient to only look at the intersection points of nodes' coverage perimeters. This significantly reduces the computational complexity and leaves no blind holes. The result in [9] includes several decentralized protocols that support multi-layer coverage and can balance nodes' energy costs.

V. Conclusion

In order to verify the effectiveness of proposed method, we have done the experiment and it confirmed as follows.

1) Operating cycle: RF module of the tag node minimum operates 0.0897 second. And RF module turns off during 1 second. When the RF module operates, the tag node has two conditions that are send condition and receive condition. It operates send or receives data periodically in 2 second.
2) The base station has three conditions: reception condition, transmission-reception condition and transition condition.
3) Counter synchronization of each tag nodes.
4) No data omissions during RF communication
5) Extended life time of 12 times longer than existing WSN system.

Acknowledgments

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