RESEARCH PAPER | Engineering | Volume : 4 | Issue : 3 | Mar 2014 | ISSN - 2249-555X

A Low Energy Consumption in Precision Agriculture Using Wireless Sensor Network

KEYWORDS: Wireless sensor network, cyclic collection, wake-up synchronization.

A.Gowri Priya
B.Tech [IT], Final year Adhiparasakthi College of Engineering Kalavai.

K.Kannan
(PhD) Senior Assistant Professor, Adhiparasakthi College of Engineering Kalavai.

ABSTRACT *Wireless sensor network is necessary for information and control technologies in application areas such as agriculture. MAC and network layers are designed for a wireless sensor network that is deployed for a precision agriculture application which needs cyclic collection of sensor readings from fixed location in a field. The physical layer have radio that operates in more than one power levels in the transmit mode and many sensitivity levels in the receiver mode. We designed a MAC layer to save power during the wake-up synchronization phase and network layer to custom fit the needs of the application and to minimize the energy consumption. The favour of wireless sensor network in agriculture is for several causes such as high performance, increase the production efficiency when decreasing cost, low-power consumption.*

I) INTRODUCTION

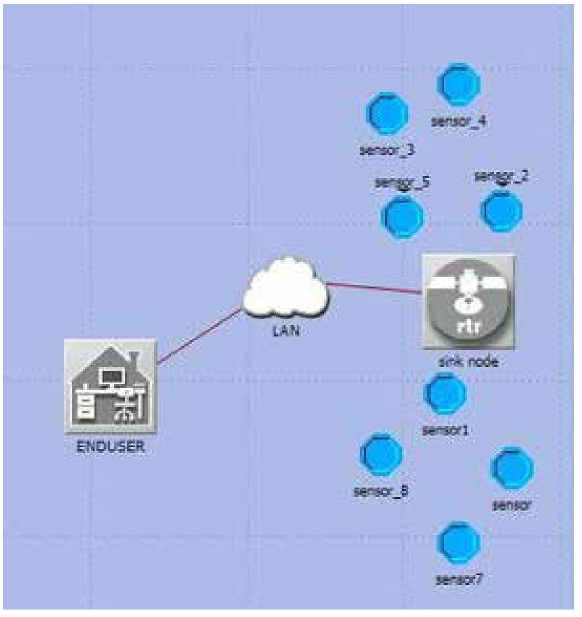
Wireless sensor network are used in various applications such as military, guidance system of intelligent missiles, forest fire detection, flood detection, habitat monitoring, agricultural and industrial monitoring, health monitoring etc. Wireless sensor network has many advantages such as small size, easy installation, low power consumption and effectiveness. In recent years, Agriculture faces many challenges. To overcome this problem sensor motes are distributed in the field. Humanity depends on agriculture and water for survival so monitoring the agriculture is difficult. Nowadays claim for monitoring the environment and remote controlling in agriculture is rapidly growing. Even so some researchers research on the applications of WSN for agriculture. Miranda determined irrigation amount based on distributed soil water measurements using closed-loop irrigation system. Shock determined soil moisture data using radio transmission.

Precision agriculture means the use of information and control technologies in agriculture. A key requirement in this application is effective soil data collection and processing to use the resources efficaciously for increasing the crop yield and decreasing the effect on the environment. In this paper we expound our work on a sensor network for precision agriculture application. To meet the requirements that are cyclic data collection and energy efficiency, we designed MAC and network layers. Our layout depends on adjusting the receiver sensitivity level and sender transmission power during the wake-up phase. Routing scheme balances the consumption of energy on all the nodes in the field.

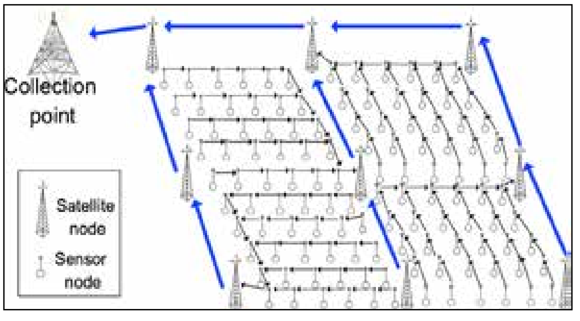
II) WIRELESS SENSOR NETWORKS IN PRECISION AGRICULTURE

WSN consists of three operations such as sensing, processing and communication in order to manage and monitor an environment. In precision agriculture we can make right decision for each zone in the farm. It differs from traditional network. The sensor nodes have interaction with the environment where they are inserted. It captures information about it and combined among themselves and helps to do work which needs to be done for precision agriculture. To achieve these goals, we use some specifics algorithms and protocols.

The sensed data from the nodes are collected by the satellite station that seeks the data which is shown in fig.



III) NETWORK MODEL



We divide the precision agriculture farm into regular square sensor fields shown in the figure. Sensor motes are distributed in each field in a rectilinear form, with the square size 50m x 50m, and at a depth of 30cm. To save energy only neighbour nodes are able to communicate directly with each other. The satellite stations are located at the corners of each field. It has a transmission range of covering all the nodes in the field. The satellite station has 3 main operations but it does

Volume : 4 | Issue : 3 | Mar 2014 | ISSN - 2249-555X

not perform any sensing operations.

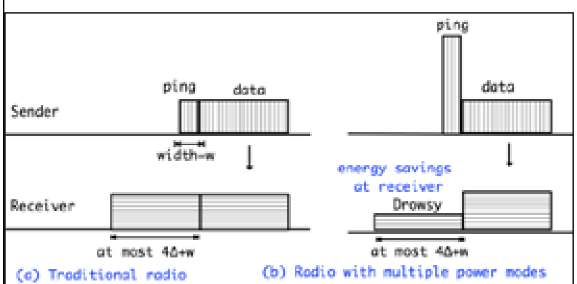
- They relay the information to a base station which is collected from the sensor nodes in a field.
- They send routing and scheduling information to the sensors in the field.
- They contribute in the sensor localization process.

Due to the first point above, the routing depends on a two-level hierarchy that is field level and satellite station level. It saves energy of the sensor nodes. Due to the second point also energy consumption of sensor nodes reduced.

IV) DATA COLLECTION AND ENERGY EFFICIENT WAKE-UP

We can achieve energy efficiency by decreasing the energy consumption by the receiver of the wake-up signal using MAC layer and to achieve load balancing we are using routing and scheduling. There is a term called round. Round refers to a collection of data from all the nodes in a field to a satellite station which acts as a sink.

The relative clock drifts between adjacent nodes can be necessary due to the large sleep periods. To reduce the energy consumption during wake-up phase, the receiver of the wake-up signal attained at a lower sensitivity level while waiting for a wake-up signal from an adjacent node that is transmitted at a higher power level. While transmitting the wake-up signal, then the mode of operation of a node is termed as ping and the mode of operation of the receiver circuit is termed as drowsy.



A) MAC LAYER

In MAC layer setting, schedule and initial clock reset information is delivered to all the nodes in the field at the beginning of each round the routing. After getting this information, the nodes put their radios to sleep mode. They set their timers to fire at the scheduled time for communication. In case of losing data, we permit up to two retransmissions.

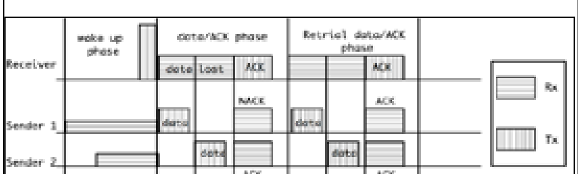


Figure shows the time-line of events for MAC protocols consist of one receiver and two senders. When the first transmission from both the sender fails, they will give a second chance to transmit their data. The combination of ping and drowsy MAC protocol is referred to as PD-MAC.

Let w denote the duration of a ping. Power of transmit and receive modes are referred to as Pt and Pr respectively. Power of ping and drowsy modes are referred to as Pp and Pd respectively. The saved energy during the wake-up phase is,

$$(4+w)\ (Pr - Pd) - w(Pp - Pt)$$

Our MAC and network layers are discussed in the following sections.

B) NETWORK LAYER

In each round, multi-hop routes from all the sensor nodes to a sink are processed. It avoids more than one successful transmission by each node and load balancing is achieved. So energy efficiency is also achieved. To avoid multiple transmissions, a node must forward to a downstream node only when it receives the data from all of its upstream nodes. The nodes forward their data to a sink located at one of the corners in the field. The sink performs the role of rotating among the corners of the field to balance energy consumption. Here interference between sensors in neighbour fields is avoided by appropriate scheduling. To minimize the energy consumption, a node forwards its data to a neighbouring node. When there are a multiple choices for a neighbour, the data are forwarded to one with maximum remaining energy level. So there will be low energy consumption.

V) SIMULATION RESULTS AND INITIAL IMPLEMENTATION

We are comparing the performance of PD-MAC with S-MAC to obtain the performance by simulating the behaviour of two nodes, a sender and a receiver. The result of energy consumption comparison between our MAC and S-MAC shows that PD-MAC protocol achieves a much better performance than S-MAC due to S-MAC has more overhead in the wake-up synchronization phase. Because the nodes listen at the normal receive power level.

VI) CONCLUSION

We designed the MAC and network layers in a wireless sensor network which is applied for a precision agriculture that requires cyclic collection of data. We designed the network with the goal of energy efficiency during wake-up synchronization phase. Our result shows PD-MAC protocol is efficient than SMAC protocol for precision agriculture. Our future plan includes the enhancement of protocol to incorporate fault management that deals with both detection and mitigation.

REFERENCE [1] J. Burrell, T. Brooke, and R. Beckwith. Vineyard computing: Sensor networks in agricultural production. IEEE Pervasive Computing, 3(1),2004. | [2] W. Ye, J. Heidemann, and D. Estrin. Medium access control with coordinated adaptive sleeping for wireless sensor networks. IEEE/ACM Trans. Netw., 12(3), 2004. | [3] T. van Dam and K. Langendoen. An adaptive energy-efficient mac protocol for wireless sensor networks. In Proceedings of SenSys '03,NY, USA, 2003. ACM. | [4] J. Polastre, J. Hill, and D. Culler. Versatile low power media access for wireless sensor networks. In Proceedings of SenSys '04, NY, USA, 2004.ACM. | [5] A. El-Hoiydi and J.-D. Decotignie. Wisemac: an ultra low power mac protocol for the downlink of infrastructure wireless sensor networks. In Proceedings of ISCC '04, Washington, DC, USA, 2004. | [6] A. Ruzzelli, R. Jurdak, and G. O'Hare. On the rfid wake-up impulse for multi-hop sensor networks. In ACM SenSys 2007. ACM, November 2007. | [7] P. Levis, N. Lee, M. Welsh, and D. Culler. Tossim: accurate and scalable simulation of entire tinyos applications. In Proceedings of SenSys '03, New York, NY, USA, 2003. |