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Implementation of energy efficiency in agriculture using wireless sensor networks

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Abstract:

In the past few years wireless sensor networks had rapid growth in technology. Wireless Sensor Network technology is expected to create significant impact on our lives in the coming decade. Several applications of wireless sensor networks like home automation, environmental monitoring, health care, agriculture. In this paper we are proposing a system based on wireless sensor networks to save energy in agriculture and monitoring crops.

Keywords *WSN,ADC,motes,agriculture, Transceiver, sensors.*

1. Introduction

Wireless sensor network is a major technology that drives the development of agriculture. The science and engineering questions associated with agriculture center around increasing the efficiency to prosper in a sustainable manner. Increases in agricultural efficiency will stem from networking sensors to elucidate important spatiotemporal patterns and integrating their data streams so as to not only display or record information, but to actuate human and autonomous responses. WSN is an intelligent private network made by a large number of sensor nodes which do specific function. Wireless transmission allows deploy the sensors at remote, dangerous, and hazardous location. WSN has several advantages including easy installation, cost-effectiveness, small size and low power consumption. In recent years, Agriculture faces many challenges, while humanity depends on agriculture and water for survival, so precision agriculture monitoring is critical and the demand for environmental monitoring and remote controlling in agriculture is rapidly growing. Hyun-Joong Kang [1] simulates the performance of sensor node running with low power operation in greenhouse environment to the impact of crop's growth when obstacle exists in inter-node's communication point. In California, Beckwith *et al* designed deployed and analyzed output of a large scale implementation of a wireless sensor network in a vineyard [2]. 65 motes with a maxi-mum of 8 hops were deployed in a planned area where no neighbor discovery features were implemented and a table driven protocol was used rather than a self organizing network. Data was recorded every five minutes with a grid of sensor nodes each separated 15m from the other. Wall and King [3] explored designs for smart soil moisture sensors and sprinkler valve controllers to implement plug-and-play technology and proposed architectures of distributed sensor networks for site-specific irrigation automation.

This paper presents saving energy in harvesting and monitoring crops to avoid external disturbances

2. Wireless sensor networks in harvesting:

A Wireless Sensor Network usually is formed by numerous wireless sensor devices. The Wireless Sensor Networks consists of devices spread in an environment in order to monitor and manage it, based on the specific physical phenomena. Those small devices are called sensors [3, 4]. By using computer resources and appropriate technology, such activities are done automatically. The sensor nodes interact with the environment on which they are inserted, capturing information about it based on interesting physical phenomena and collaborating among themselves, helping to do tasks that need to be done in this method. In order to achieve these goals, the use of specific algorithms and communication protocols are essential, once the nodes are distributed in the environment and need to self configure the network and adapt themselves to it. These sensors can be programmed to record measures like temperature and humidity. All the data which are collected from the sensors, using a wireless multi-hop routing technology [6], end up in a sink node which transfers them to the end user through wireless network, internet or LAN [6,7], as it is shown in Fig. 1

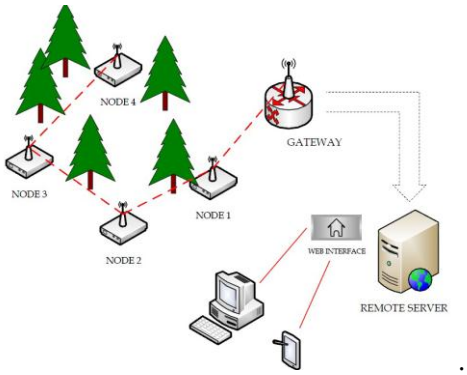


Fig: WSN Architecture

3. The Design process:

The design of WSN includes various disciplines like database, query processing, networking, algorithms and distributed systems. The basic functionality of WSN generally depends on the applications but the following requirements are typical. I) determine the value of required parameter II) Classify the object that has been detected. III) Track an object. [5]
The hardware components of WSN must include the sensing and actuation unit, the processing unit, the communication unit, power unit and other application dependant units. Sensors generally have four basic hardware subsystems. A) Power, B)Computational logic and storage, C) Sensor transducers, D) communication unit. Sensors have five basic software subsystems. I) Operating system microcode(middleware), II) Sensor drivers, III) Communication processors, IV) Communication drivers, V) Data processing mini-apps. Sensor nodes have to deal with certain resource constraints like power consumption, communication, computation, and uncertainty in measured parameters. [6]

A sensor node is equipped with a limited energy source and hence has a lifetime that is dependent on that source. In a WSN, each node can originate data and also has to route data. When few nodes deplete their energy resources, topology changes occur which may require rerouting of data packets. A sensor node's task is to sense data, perform some processing and then transmit the data. Energy consumption in a node can therefore be divided into three areas, communication, processing and sensing [7]. The basic components of a WSN node are, a processing unit, a sensing unit and a transceiver. Some sensor nodes also contain optional components such as a location ending system, solar cells, relays and etc. The basic components of a sensor node are shown in Figure 2.
The processing unit consists of a processor and memory. This unit is responsible for managing the tasks of the sensor unit. The sensing unit generally consist of a sensor and an analog to digital converter (ADC). The ADC converts the analog data from the sensor to digital data that can be processed by the processor. The transceiver connects the sensor node to the network. The transceiver usually uses radio frequency (RF) for communication between the nodes.

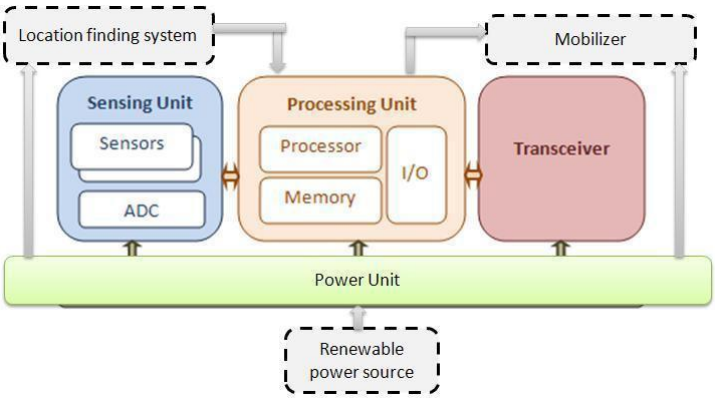


Fig 2: Node Architecture

A node traditionally expends most of its energy during communication. The transceiver unit consumes energy during both start-up and active states. As the size of the packets become smaller the energy consumed during transmission decreases.

4. Conclusion:

Sensor networks are an emerging field with increasing applications day by day. The WSN designed in this project is used in precision agriculture applications where various environmental parameters that accept plant growth are monitored and control decisions are made based on it. A multi-hop routing protocol was designed and implemented on this system. The validity of the protocol was analyzed by performing field tests and the results were quantified. Large amount of energy can be conserved by switching the radio's into sleep mode when they are not in use. As the nodes maintain a local neighbor table, it is important that the memory does not overawe or become too clustered to accommodate new sensor nodes.

5. Acknowledgements

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