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AUTOMATIC IRRIGATION SYSTEM USING WSN

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***Abstract*— An automated irrigation system is developed to optimize water use for agriculture crops. The system has a distributed wireless sensor node network of soil moisture, temperature sensors and humidity sensor placed in the soil. Energy conservation is a very critical issue in wireless sensor networks. In this paper a TDMA based MAC protocols are used to conserve the energy in wireless sensor networks which is used in an irrigation syste. An algorithm is developed with threshold values of moisture level, temperature of the soil and humidity sensor that are programmed into microcontroller based gateway to control irrigation in a field. Also two methods based on TDMA scheduling are used. The first one is direct communication method, in which each node transmitted the data directly to the sink node and other one is data aggregation method in which nodes are grouped into clusters to save energy.**

***Keywords*— TDMA scheduling, Wireless sensor networks, Energy efficiency, Automatic irrigation**

I. INTRODUCTION

In India agriculture uses 85% of available freshwater resources and this percentage will continue to be dominant in water consumption because of population growth and increased food demand. There is an urgent need to create strategies based on science and technology for sustainable use of water [1]. There are many systems to achieve water savings in various crops, from basic ones to more technologically advanced ones. Traditional irrigation methods were able to meet the rapidly growing food requirements of the nation. But in majority of the case, the knowledge regarding the optimum conditions for a particular crop is not known to a farmer. This causes a huge loss in terms of utilization of land in our country. Availability of energy is one of the important factors in the irrigation system [2].

Presently, rural irrigation depends on the natural resources and experience of skilled farmers. There is a frequent electric supply failure and rectification of the same takes weeks together in rural areas which adversely affects the irrigation and farmers may have to adopt for other sources of electricity and it is costly too. Presently there is no efficient and controlled utilization of water or fertilizer.

Automatic irrigation is done with the help of 3 sensors and solenoid valves. The data given by the sensors are interpreted by microcontroller and it turns on the motor according to the need of soil.

Wireless sensor networking is an emerging technology that has a wide range of potential application including agriculture [2]. These sensors are deployed in random manner. Sensor nodes are usually battery operated. Sensor life time depends mainly on the life time of battery. So power saving is a critical issue in WSN. The main functions of a wireless sensor network are sensing; processing; and communication [5]. The sensing circuitry consumes less power than the processor. But the power consumption of the radio communication is much more than that of the processor Except for the transmission, receiving and sensing durations, nodes can be put to sleep and highest amount of power savings possible. This paper describes the actual formation of sensor nodes and different algorithms for energy saving data transmission in WSN.

II. PROPOSED SYSTEM

In this section we provide a brief description on "*Energy Efficient Automatic Irrigation System Using WSN*".

- Develop a WSN based system to monitor and control the conditions in automatic irrigation to obtain maximum productivity
- Also, control the supply of water and fertilizers to crops according to the growth of crops
- Saving the energy while transmitting data from nodes to BS (Base Station) by using scheduling technique

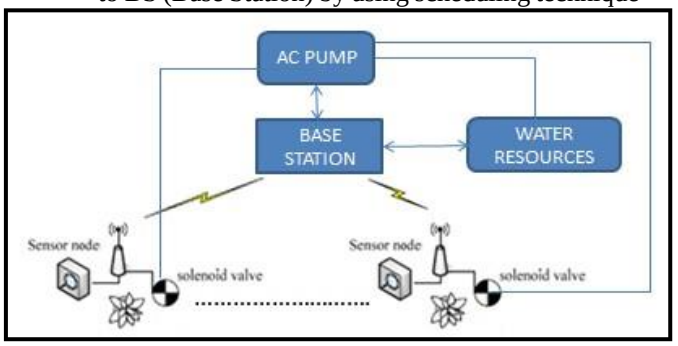

Fig. 1. System Framework

The system framework fig.1 consisting of sensor nodes, solenoidal valve, base station, ac pumps etc. The automatic irrigation done with the help of highly accurate sensors makes irrigation system a unique product. One of the most important benefits of the product is that a single farmer can manage more than one field. This makes the product truly unique in its kind.

A. Sensor Node

Each node consists of a moisture sensor, the temperature sensor and humidity sensor [6]. Fig. 2 shows the block diagram of sensor node and BS. The node's microcontroller program corrected and formatted sensor values and then output the results to the on board transceiver. Most of the time the sensor node was in the receive mode so that the energy consumption was minimized.

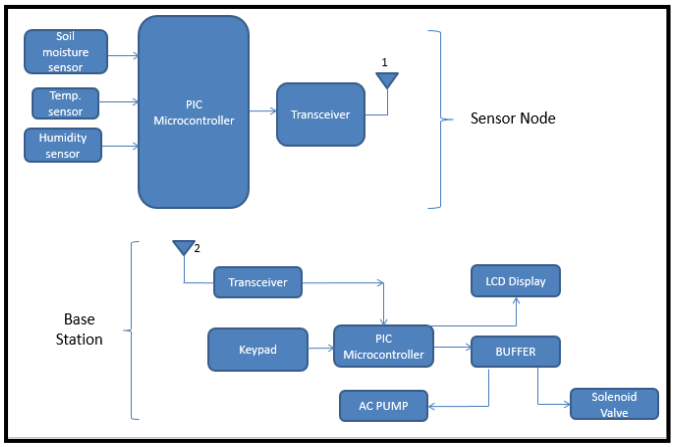

Fig. 2. Sensor Node

The sensing of environment and data transmission occurred whenever it was requested by the base station.

B. Base Station

The base station consists of a transceiver, microcontroller and LCD display. The basic block diagramis shown in fig. 2. After getting the value of the moisture level, the temperature and humidity; the base station compared this value with the threshold value which was already stored in the uc of BS.

III. Working of System

This system hereby reported, consisted of two section fig. 3, Sensor Nodes and Base Station, linked by transceivers that allowed the transfer of soil moisture, humidity and temperature data, implementing a WSN that uses ZigBee technology.

A. Sensor Node Module

Due to advancement in technologies and reduction in size, sensors are becoming involved in almost every field of life. Agriculture is one of such domains where sensors and their networks are successfully used to get numerous benefits. A SN (Sensor Node) consist of three sensors as soil moisture, humidity and temperature sensor and one ZigBee transceiver. Which collects data from soil and feedback to BS. There may be 3 to 4 SN are used in field [6].

Following fig. 4. Shows flowchart for sensor node. Each node get acknowledgement form BS. While BS provide specific time slots to each node and at their each interval nodes are activated whenever the base station will call for information from sensor nodes. If the node is active then it will send the information to the BS and if it has not specific value it will go to sleep and BS will provide next time slot to next node and same process continues.

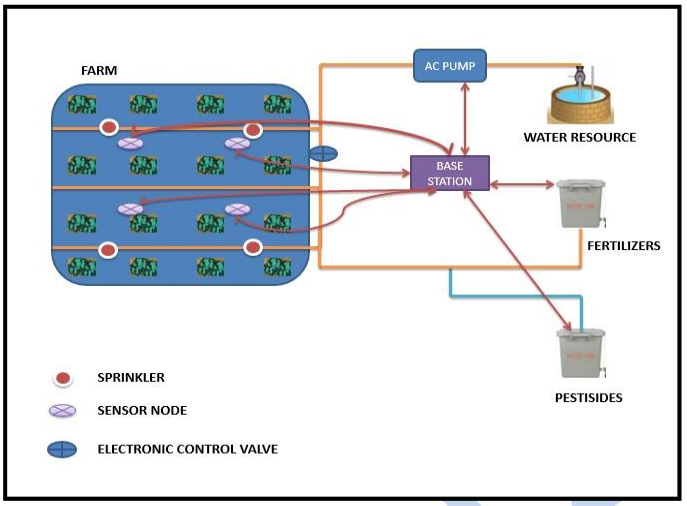

Fig. 3. Working frame of the system

B. Base Station Module

Base Station consist of two transceiver; one for SN and another for server. Also it has LCD display for to show the values of soil parameter. A keypad for selection of operation of modes of irrigation system i.e. Automatic, Semi-automatic and Manual mode. In Automatic mode, the user set the flow rate of water and quantity of water through keypad in the BS's microcontroller for specific period of time. In semi-automatic mode, the water management is automatic for specific period of time and apply the scheduled for fertilizer and pesticides for plants in the farm. In the Manual mode, the user/farmer makes the whole irrigation system off as per scheduled. Fig.5 shows the actual flowchart for working of BS using TDMA scheduling.

IV. Methods of Data Communication

Two methods based on TDMA scheduling are used which are as follows [5].

A. Direct Communication Method

In direct communication method, each sensor node sent its data directly to the base station as shown in fig.6. If the nodes were far from the base station, each node required large amount of transmission power. This reduced the system life time.

So when the nodes were close to the base station this system was efficient.

B. Data Aggregation Method

In case of data aggregation the cluster node collected the data from all the nodes and aggregated them depending on different techniques. The data being sensed by the nodes in the network were transmitted to a base station as shown in fig.7.

In this model base station was fixed and located far from the sensors. Data collected from each node was combined together into a small set of information. Data aggregation is also known as data fusion.

For data aggregation nodes were designed in such a way that if the transmitting node failed, it would not affect the network performance and also due to the presence of error bound the

header transmitted the data only if the aggregated data was beyond the limit

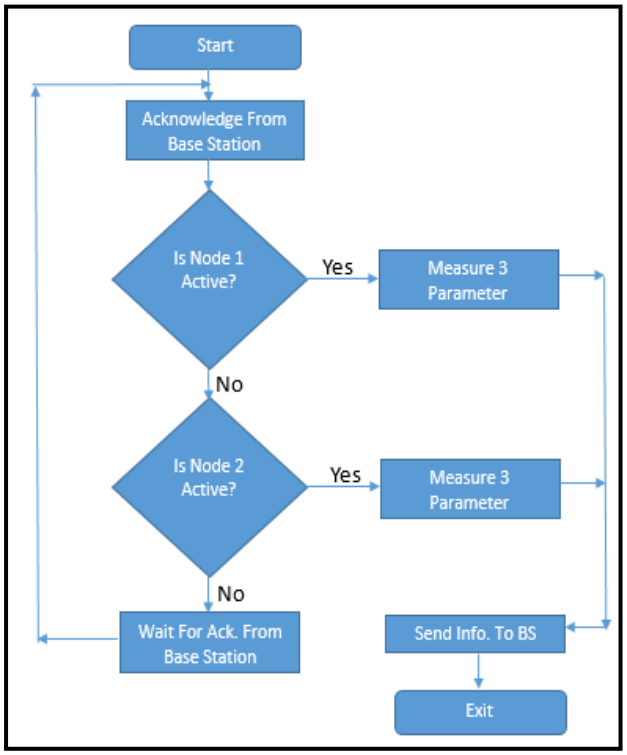

Fig. 4. Flowchart for SN

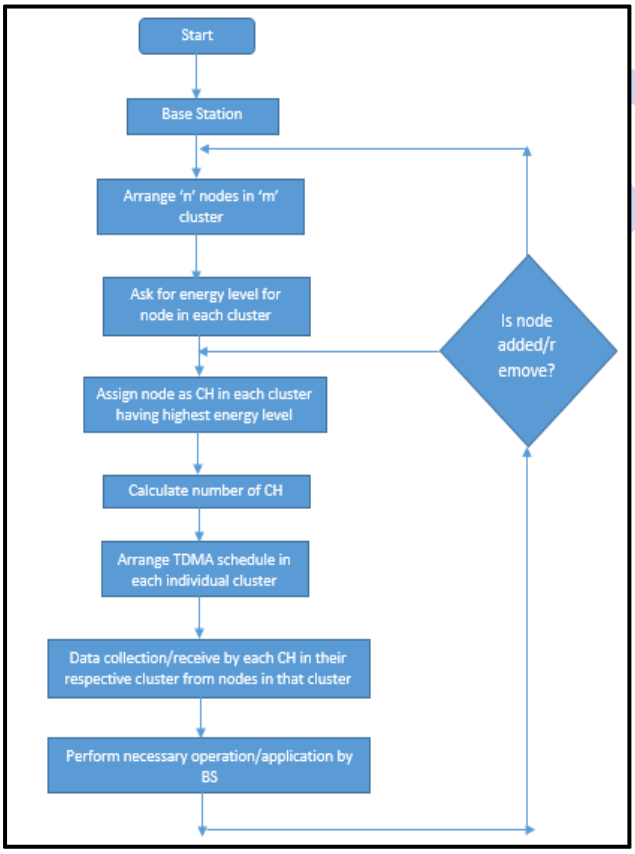

Fig. 5. Flowchart for BS using TDMA scheduling

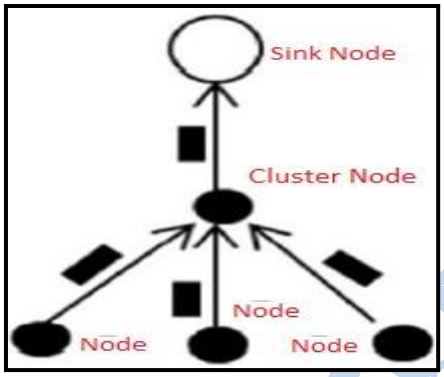

Fig. 6. Direct Communication Method

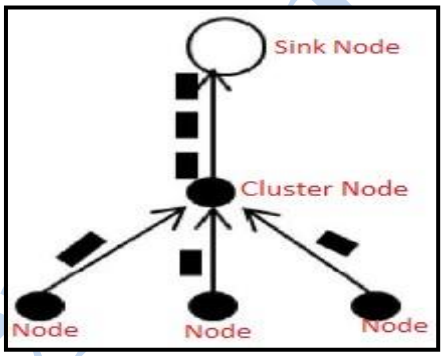

Fig. 7. Data Aggregation Method

Nodes organized themselves into clusters with one node acting as the cluster head. In this case, a sink/base station acted as the super cluster head [4] [5].

The communication between sink and cluster heads was based on the TDMA. The communication within each cluster was also based on TDMA. The basic operation is same as the single – hop method [3] [5].

V. SUMMARY

Wireless sensor network is group of scattered sensor devices placed at physical location for the purpose of measuring environmental attributes. They are small in size so can easily deployed. Sensor Node has ability of sensing and measuring. WSN supports observing and scheming of physical environments from remote locations with good accuracy of data. The automated irrigation system will be feasible and cost effective for optimizing water resources for agricultural production. Data communication method supports the fair data collection in WSN with minimum delay and less number of retransmission. Scheduling with TDMA can be done with minimum scheduling length and fair use of bandwidth and time.

REFERENCES

[1] Gutierrez Joaquin Villa-Medina, Juan Francisco, Nieto-Garibay, "automated irrigation system using wireless sensor network and GPRS module" IEEE Trans. On Instrumentation and Measurement J, Vol. 63, pp 2014.

[2] Ming Xia, Yabo Dong, "W-MAC: A Workload-Aware MAC Protocol for Heterogeneous Convergecast in Wireless Sensor Networks", February 2011.

[3] Pravin Varaiya, "TDMA Scheduling Algorithms For Wireless Sensor Networks", Springer, 2009.

[4] Kristina Kunert," TDMA-based MAC Protocols for Wireless Sensor Networks: State of the Art and Important Research Issues", pp.2011.

[5] M. Nesa Sudha," Energy efficient data transmission in automatic irrigation system using wireless sensor networks", Computers and Electronics in Agriculture, Vol. 78, pp. July 2011.

[6] Waltenegus Dargie," Fundamentals of Wireless Sensor Networks", published 2010 John Wiley & Sons Ltd.