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Wireless sensor network based automatic drip irrigation management

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Abstract: India is an agricultural country, and hence a lot of water is required for farming. Water should be used in a proper way. In this paper is presented the "Wireless Sensor Network based Automatic Drip Irrigation Management". An automation of irrigation systems has several positive effects. Once installed, the water distribution on fields or small-scale gardens is easier and does not have to be permanently controlled by an operator. In this paper we are giving brief outline of improving Throughput and Average end to end delay of information gathered from the agriculture field for Precision Agriculture. This system provide delivery of water level information signals to base station as it also computes a threshold as well as does calculates values based on transmission range. This over all computational mechanism helps us to build a robust mechanism for delivery of information to base station thus reducing the packet loss. A Wireless Sensor Network is a system consisting of radio frequency transceivers, sensors, microcontrollers and power sources. Recent advances in wireless sensor networking technology have led to the development of low cost, low power, multifunctional sensor nodes. Sensor nodes enable environment sensing together with data processing. Sensors are able to network with other sensor systems and exchange data with external users. Sensor networks are used for a variety of applications, including wireless data acquisition, environmental monitoring, irrigation management, safety management, and in many other areas.

Keywords: Wireless sensor networks, Drip irrigation, Precision agriculture

Introduction

A general Wireless Sensor Network protocol consists of the application layer, transport layer, network layer, data link layer, physical layer, power management plane, mobility management plane and the task management plane. Currently two standard technologies are available for Wireless Sensor Network: Bluetooth and ZigBee. This technology provides license free operations, huge spectrum allocation and worldwide compatibility. In general, as frequency increases, bandwidth increases allowing for higher data-rates but power requirements are also higher and transmission distance is considerably shorter. Multi-hop communication over the ISM band might well be possible in Wireless Sensor Network since it consumes less power than traditional single hop communication. The objective of this research, To optimize the design of automated drip irrigation management using wireless sensor and To minimize the cost of automated drip irrigation system for the small land holding farmer (Arun and Lakshmi, 2002; Singh and Bansal, 2011; Prasad 2012; Prakas and Kumar, 2012; Rashid *et al*., 2014; Thakur, 2014).

Sensor network using crop management: For developing an efficient system of Agricultural crop management, the foremost input is the availability ofaccurate data. This data includes soil properties, agronomic data, physicochemical parameters, atmospheric data, Temperature data, wind speed, solar radiation, evaporation data etc, preferably on a day-to-day basis or even hourly basis. Normal laboratory analysis of these parameters and manual decision-making take a long time even with the most sophisticated analytical techniques. Most of the sampling procedures are not in-situ and samples have to be brought from the field to laboratories for analysis, a lot of time. By the time the results are available and decisions taken, the farm conditions might change making the decision inappropriate. Quick and quality decision-making at the farm level can enhance agricultural productivity and quality manifold (Torre-Neto, 2000).

Decision-making process can handle and analyse several input and output parameters at the same time involving large Monitoring of physical and environmental parameters including soil moisture, soil temperature, soil pH, leaf temperature, relative humidity, air temperature, rainfall, vapour pressure and sunshine hours is done through a wireless sensor network. It comprises spatially distributed sensors to monitor physical or environmental conditions. It is a comprehensive system that integrates sensing, wireless and processing technologies and is capable of spatially and temporally sensing different physical parameters without loss in the sensing accuracy. The parameters are processed and wirelessly transmitted to a centralised data storage system through a gateway from where they may be remotely accessed and analysed by the user (Shabadi *et al*., 2014).

Wireless sensor network in agriculture: Wireless Sensor Network technology can broadly be applied in the field Irrigation management Fertilizer control and Pest management in agriculture. The sensors that can be interfaced to the temperature, relative humidity, solar radiation, rainfall, wind speed and direction, soil moisture and temperature, leaf wetness and soil pH sensors. These sensor-readings can be integrated with a decision support system that aids the management of resources to the crop ().

Materials and Methods

Design of the drip irrigation management system: Automatic control of irrigation mechanism requires regular monitoring of different

parameters for this purpose, wasp-mote agriculture. The experimental setup, each node was commu-nicating directly with gateway. But for covering more area, one of them is working as a relay node in addition to its own activities for other nodes because they are not within the specified communication range. The dotted arrows represent wireless communication where the solid arrow represents wired communication through a defined USB port. The gateway is connected through USB port in our experiment. Each sensor node is capable of sensing temperature, air humidity and soil moisture.

Drip irrigation automation: The drip irrigation technique applies water drop by drop to the plant's root zone. Water is supplied frequently, often daily, to maintain favorable soil moisture condition and prevent moisture-stress in the plant with proper use of water resources.The drip irrigation automation there is different important component.

Controller: It is heart of the whole system, means it controls the all activities of the system. It has memory in which control programs are saved.

Signal Conditioning: It is very essential. Generally the signal obtained from sensors are weak hence we uses signal conditioning in order to keep signal in to its original state. That means it works as like amplifier.

Sensors: Sensor Sense the different physical parameters like light, ph_value of soil, temperature and humidity and converts these sense data into electrical signals (either voltage or current).ADC values and Sensor data we can apply to generate optimum watering plan & Minimum Water, Maximum Productivity, Maximum Profit.

Valve unit: Valve unit has the same connection with wireless module and thesame properties with Sensor Unit. It has an output for controlling the valve.This valve was operated digital outputs on the microcontroller.

Solenoid Pilot Valve: A solenoid pilot valve is an electromechanical valve. The valve is controlled by an electric current through a solenoid coil. Solenoid valves may have two or more ports: in the case of a two-port valve the flow is switched on

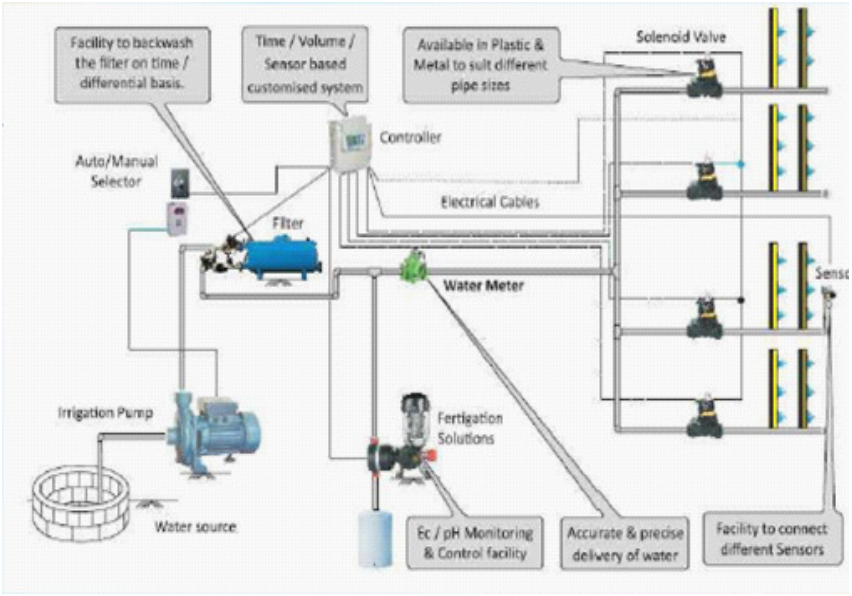

Fig.1: Drip Irrigation management (courtesy by Jain irrigation system ltd)

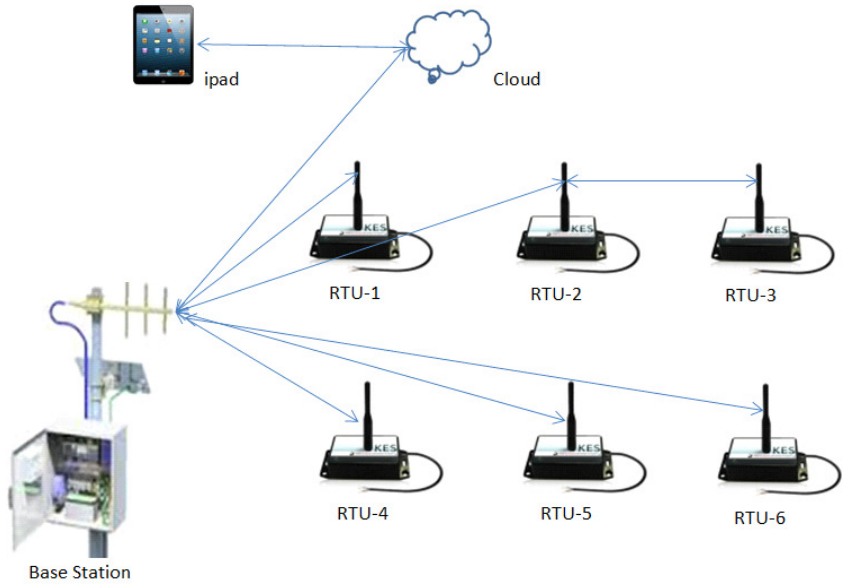

Fig. 2: Block Diagram of wireless network system

Fig. 3: Temperature Sensor

or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

WSN Network: Wireless Sensor Network based drip irrigation system is a real-time feedback control system which monitors and controls all the activities of the drip irrigation system. A typical system includes a delivery system, filters, pressure regulators, Hydraulic valve, solenised pilot valve, hydraulic tube and gauges, chemical injectors, measuring sensors and controllers. Wireless Sensor Network framework (Remote Terminal Unit) installed in the field may gather various physical parameters related to irrigation. These includes ambient temperature, relative humidity, soil temperature, drip water flow, soil moisture, soil pH, water pressure, flow rate, amount of water, chemical concentration and water level. The data is sent to the central server wirelessly through gateways. Based on the data ranges, the central server generates necessary control actions, which are routed to the respective controllers through control buses enabling implementation of closed-loop automation of the drip irrigation system. The basic feature of the product is to enable switching ON and OFF of the motor remotely.

Temperature sensor : In this study we use digital output sensor. Temperature sensors directly connected to microprocessor input and thus capable of direct and reliable communication with microprocessors. The sensor unit can communicate effectively with low-cost processors without the need of A/D converters.

Proposed algorithm: In this paper, we are proposed sensor topology are mobile whereas the base station is stationary and it collects the data from sensor nodes and process them. This work proposes that how to deploy the sensed data to the base station in Wireless Sensor Networks. For this purpose firstly set the farm area. The base station RTU send the data nearest RTU and configured then after configuration send the signal data next station. Suppose the number of Radio Terminal Unit in the farm is more. Now set the position of Radio Terminal Unit the monitoring base station location. Set the transmission range for each node. Now for each Radio Terminal Unit, calculate distance from : (a) Node to node (b) Node to sink (c) Node to forwarding node, Then Radio Terminal Unit sends the stored values to monitoring base station. On the basis of water level information, the switch is on or off.

Results and Discussion

The conventional flood-type methods consume a large amount of water, but the area between crop rows remains dry and receives unbalanced moisture only from the incidental rainfall whereas the drip irrigation technique applies a small amount of water directly to the plant's root zone drop by drop (Chaitali, 2015; Phene *et al*., 1992; Rane *et al*., 2015). Wireless sensor based Irrigation System was developed which control the flow of water as per the requirement in different field and result are achieved satisfactory. So by using wireless sensor network drip irrigation technique, we can control the wastage of water and applies of accurate amount of water in the crop requirement. By using soil moisture sensor, there is no need of laborers. When the numbers of sensors are increased, then there is a large amount of power consumption by sensors to deliver the water information to the monitoring base station. So it is mandatory to minimize the power consumption by using optimization techniques.The implementation of this project gives the water saving and also plant can get optimum level of water which will increase the productivity of crop (Thomson *et al*., 1987; Shabadi *et al*., 2014; Prathyusha *et al*., 2013).

Future scope : The implementation of Sensor Network based Automatic Drip Irrigation we can control the water wastage and we apply the fertilizer and chemical accurate quantity of the agricultural field. In future we can centralized the sensor network we can control and watch the water requirement in the overall state. We can distribute water according to requirement. We can calculate the total consumption of water like as Industrial purposes, Agricultural purposes, drinking purposes.

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