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Research Paper on Drip Irrigation Management using wireless sensors

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Abstract—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 algorithm provides the Throughput of 180 bits/seconds. Besides delivery of water level information packets/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 WSN is a system consisting of radio frequency (RF) 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—Precision Agriculture, wireless sensor Networks, drip irrigation , water level monitoring.

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1. Introduction

A general WSN 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 WSN: ZigBee and Bluetooth. Both operate within the Industrial Scientific and Medical (ISM) band of 2.4 GHz, which provides licensefree 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 WSN since it consumes less power than traditional single hop communication.

2. PLANTATION MANAGEMENT USING WIRELESS SENSOR NETWORK

For developing an efficient system of plantation management, the foremost input is the availability of accurate data. This data includes soil properties, agronomic data, physicochemical parameters, atmospheric 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.

Computer-aided decision-making process can handle and analyse several input parameters at the same time involving large databases.

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(WSN).

WSN 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.

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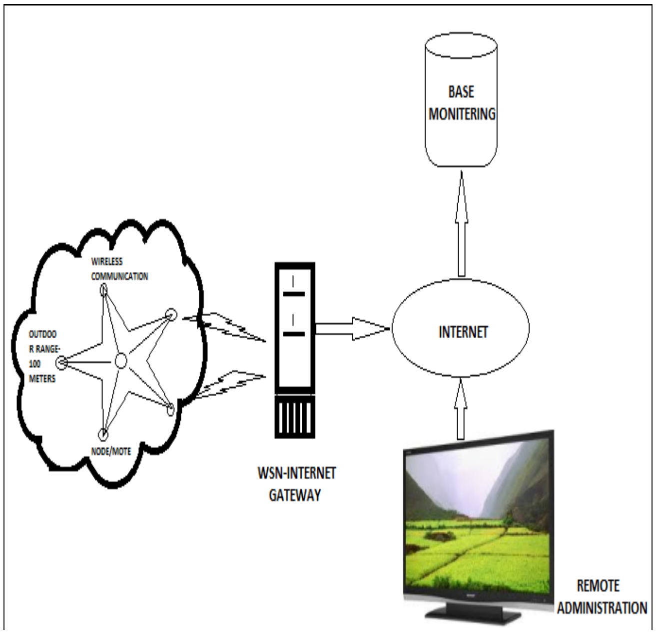

Fig.1 Block Diagram of wireless network system

The system architecture of a WSN-based system consists of different sensors interfaced to electronic hardware with data processing capabilities. The electronic hardware is also equipped with wireless communication modules allowing the sensed data to be processed and transmitted according to a selected protocol. These hardware nodes are called motes in WSN terminology. Each of the motes is interfaced with a set of sensors depending on the application domain. The sensors may be programmed to sense at specific intervals or periodically in a day.

3.WSN IN AGRICULTURE

WSN technology can broadly be applied into three areas of agriculture : a) Fertilizer control, b) Irrigation management and c) Pest management.
The sensors that can be interfaced to the mote are 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.

4. DRIP IRRIGATION AUTOMATION

Conventional irrigation methods like overhead sprinklers and flood-type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surface is saturated and often stays wet long after irrigation is completed. Such a condition promotes infections by leaf mold fungi. Flood-type methods consume a large amount of water, but the area between crop rows remains dry and receives moisture only from the incidental rainfall.
The drip irrigation technique slowly applies a small amount of water 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.
WSN-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, valve or gauges, chemical injectors, measuring sensors/ instruments and controllers.
WSN framework installed in the field may gather various physical parameters related to irrigation. These includes ambient temperature, ambient humidity, soil temperature, drip water temperature, soil moisture, soil pH, water pressure, flow rate, amount of water, energy calculation(power),chemical concentration and water level.
The data is sent to the central server wirelessly through the motes and 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. The device ensures that all the fault conditions are checked and only then the motor is started.

5. PROPOSED ALGORITHM

In this paper, we are proposing a Mesh topology in which sensor nodes are placed in the farm area. sensors in our proposed topology are mobile where as 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. Now Let D is the length, Let B is the width of the farm and Let V is the height of the water in the farm. Suppose Ws be the number of sensors in the farm represented by an array of sensors and Sn be the number of sink nodes in the farm. Now set the position of sensor and sink nodes in the farm and the monitoring station location. Set the transmission range for each node. Now for each node, calculate distance from:

(a) node to node

(b) Node to sink

(c) Node to forwarding node

Also calculate

(a) Angle a

(b) predict minAngle for next route based on fuzzy time series, if the current angle (a) is available as predicted , continue with path (Find possible node (x,y)), else hold packet for limited time.

If connections (i,j)==1 i.e. there is a link based on transmission range, send the packet information i.e. water level information. The packet reaches to the sink node and stored there. Else connections (i,j)= infinity ;End of if structure. So values of sensor nodes are stored in sink nodes. Then sink node sends the stored values to monitoring station. On the basis of water level information, the switch is on/off.

6. RESULT DISCUSSION

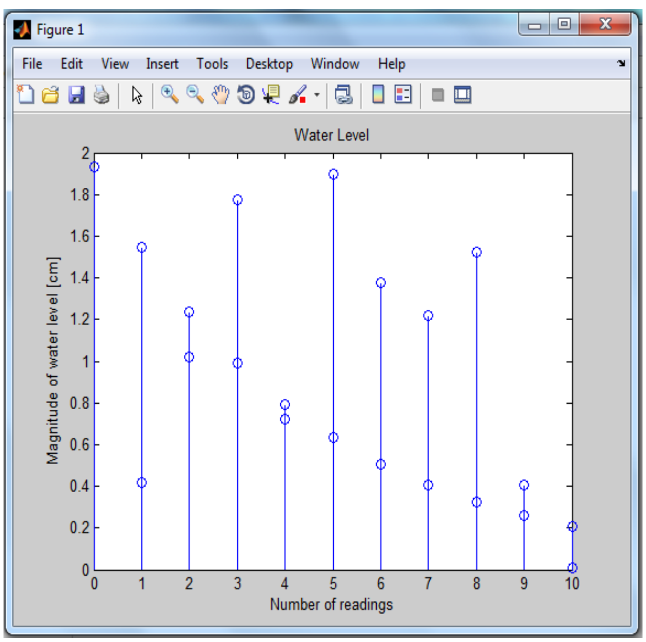

Fig. 2 Screenshot of Water Level Information

In this screenshot , we obtain an information of water level by using wireless sensor. On the x-axis , we are the taking Number of readings of one sensor whereas on the y-axis we are taking the Magnitude of water level. Here we have taken the ten water level readings of one sensor and correspondence measuring the magnitude of these water level readings. The next step is to deliver the obtained water level information to the forwarding node and then to the sink node i.e. Base-station. This process is known as Packet Delivery. In the percentage form it is known as Packet Delivery Ratio i.e. PDR

PDR=[∑ Number of packet receive / ∑ Number of packet sent] × 100

The greater value of packet delivery ratio means the better performance of the protocol.

The PDR is inversely proportional to PLR(Packet Lost Ratio).Packet lost ratio is the total number of packets dropped during the simulation.

PLR = [Number of lost packet / (Number of lost packet + Number of packets received successfully.)] × 100

The lower value of the packet lost means the better performance of the protocol.

7. GRAPHICAL COMPARISON OF BASE PAPER ALGORITHM AND IMPROVED FUZZY TIME SERIES BASE ALGORITHM

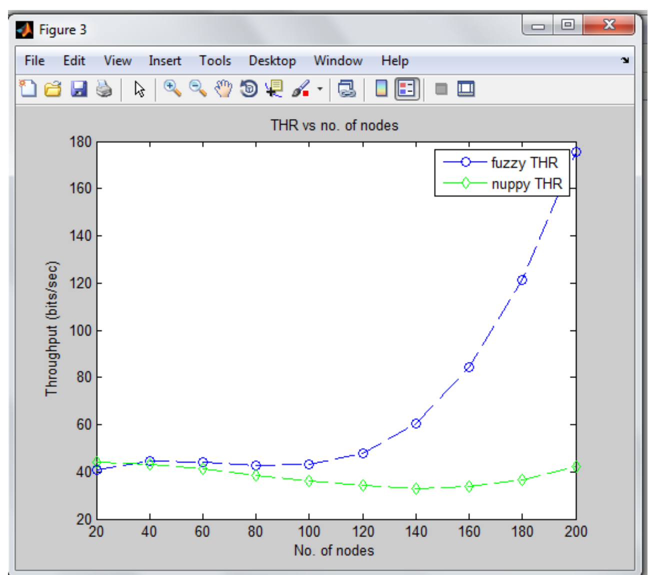

Fig. 3 Throughput Vs Number of nodes

By using fuzzy time series algorithm, we get the Throughput greater than 40 bits/sec. Blue line is showing this process. It is known as Fuzzy THR. Where by using base paper algorithm, we get the Throughput between 40 to 45 bits per sec. The base paper algorithm is shown here by the name of Nuppy THR. Green line is showing this process. In this comparison graph we see that there are 200 number of nodes over which we calculated the throughput. The throughput of fuzzy time series is increasing with increasing the number of nodes.

8. GRAPHICAL COMPARISON OF BASE PAPER ALGORITHM AND IMPROVED FUZZY TIME SERIES BASE ALGORITHM

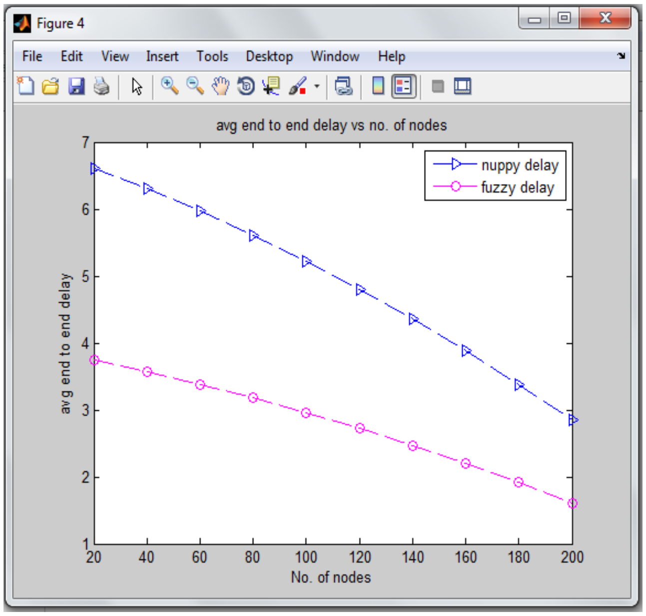

Fig. 4 Average end to end delay Vs number of nodes.

Here Nuppy delay is represented by the blue line whereas fuzzy delay is represented by purple line. The nuppy delay is the base paper delay in which the average end to end delay is coming in between 7 to 4 msec. whereas the Fuzzy average end to end delay is coming in between 4 to 1 msec. so by applying the fuzzy time series algorithm , we get the better average end to end delay.

Hence in improved Fuzzy based algorithm , we get the reliable water level information rather than in Nuppy algorithm.

9. CONCLUSION

Conventional Flood-type methods consume a large amount of water, but the area between crop rows remains dry and receives moisture only from the incidental rainfall whereas the drip irrigation technique slowly applies a small amount of water to the plant's root zone. So by using the fuzzy time-series based algorithm in wireless sensor drip irrigation technique, we can control the wastage of water and secondly by using wireless sensor, there is no need of laborers.

10. FUTURE SCOPE

In our work, we deploy 200 sensors for the delivery of water level information to the monitoring station. When the number of sensors are increased , then there is a large amount of power consumption by sensors to deliver the water/packet information to the monitoring station. So it is mandatory to minimize the power consumption by using optimization techniques.

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