Monitoring Water Level in Agriculture using Sensor Networks

Iqbal Singh, Meenakshi Bansal

Abstract- Recent advances in communications technology and wireless sensor networks made new trends to emerge in agriculture sector. One such new trend is Precision Agriculture. In this paper we are giving brief outline of using Wireless Sensor Networks (WSN) in Monitoring water level in the farm area for Precision Agriculture. This algorithm offers a maximum opportunity of 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. Our algorithm which picks up the information for water level can be further optimized by using optimization algorithms, which lead to smoothening of packet delivery ratio, thereby increasing the packet delivery ratio by choosing the right cost path with the help of optimization techniques like genetic algorithm, neural networks.

Keywords: Precision Agriculture, wireless sensor networks, topology under control, stationary base station.

I. INTRODUCTION

Wireless sensor networks have recently come into prominence because they hold the potential to revolutionize many segments of our economy and life, from environmental monitoring and conservation, to manufacturing and business asset management, to automation in the transportation and health care industries. The design, implementation, and operation of a sensor network requires the confluence of many disciplines, including signal processing, networking and protocols, embedded systems, information management and distributed algorithms.

Such networks are often deployed in resource-constrained environments, for instance with battery operated nodes running underneath. These constraints dictate that sensor network problems are best approached in a hostile manner, by jointly considering the physical, networking, and application layers and making major design tradeoffs across the layers.

importance of calculating water level in a farm highlights the increasing need for advanced technologies to help monitor water and manage water quality.

The Precision Farming is the conjunction of a new management perspective with the new and emerging information and communications technologies leading to higher yields and lower costs in the running of large scale commercial agricultural fields.

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Precision farming ensures quicker response times to adverse climatic conditions, better quality control of the produce and yet a lower labor cost. Emerging wireless technologies with low power needs and low data rate capabilities, which perfectly suites precision agriculture, have been developed [4]. The sensing and communication can now be done on a real-time basis leading to better response times. The wireless sensors are cheap enough for wide spread deployment in the form of a mesh network and offers robust communication through redundant propagation paths [5].

The Precision farming system has the following parts:

a) Sensing agricultural parameters

b) Identification of sensing location and data gathering

c) Transferring data from crop field to control station for decision making

d) Actuation and Control decision based on sensed data

Agricultural Sensors, positioning systems for detecting location of sensors, actuators like sprinklers, foggers, valve-controlled irrigation system, etc. are already available in market. However, very limited work has been done so far on the technologies to be used to transfer sensor data wirelessly from crop field to the remote server.

II. RELATED WORK

Nowadays, the number of the development of more complicated and advanced monitoring and control systems is increasing due to the availability of cheaper and pervasive components such as processors and hardware in the current market. The trend is moving towards wireless solutions due to an increased interest in it as compared to the current wired-based systems [6]. In addition, modern wireless technology can very much improve the efficiency of data collection and agriculture techniques, as compared to the traditional time consuming and labor-intensive manual practices [7]. The study on temperature remote monitoring and alerting system in greenhouse had successfully been done, which lead to the development of a reliable and cost effective system. The proposed system utilizes wireless sensor for temperature level detection as well as GSM and SMS technologies for sending alert notification message to the farmers. The research could be extended to include more environmental variables to be monitored in the agricultural greenhouse which relate to the increment of fruits and vegetables productivity. For example, other than temperature, the soil and water acidity level in the greenhouse also play important role to the quality of fruits.

[1]. anurag d, siuli roy and somprakash bandyopadhyay developed architecture for Precision Agriculture based on wireless sensor networks. The architecture comprises of three distinct components: (a) Intelligent nodes with sensors/actuators (b) The wireless mesh network for communication and the design of a new routing algorithm and (c) The control and actuation.[2]. Assurance of optimal environmental conditions has a direct influence on watermelon seedlings growth performance. At present, farmers usually observe the environmental temperature only through a thermometer, and manage the watermelon seedlings by experience in rural areas. Therefore, in order to solve the problem of poor accuracy and waste of labor, X. Zuo1, W. Gao2, G. Zhang2, J. Zhao2, Y. Zhu2 and D. Xia2 [8] have used the devices based on the wireless sensor network to real time monitor the parameters in the plastic greenhouse of watermelon nursery, including temperature, humidity and light. Then the environmental parameters will be sent to the monitoring system and be analyzed.

III. PROPOSED METHODOLOGY

In this paper, we are proposing a topology under control WSN in which sensor nodes are placed in the farm area. Nodes 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 L is the length, Let W is the width of the farm and Let H is the height of the water in the farm. Suppose n be the number of sensors in the farm represented by an array of sensors and m be the number of sink nodes in the farm now Set the position of sensor and sink nodes in the farm and the base station location. (Monitoring station) 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 1 i.e. angle theta
(b) Angle 2 i.e. angle beta
(c) Find minimum angle

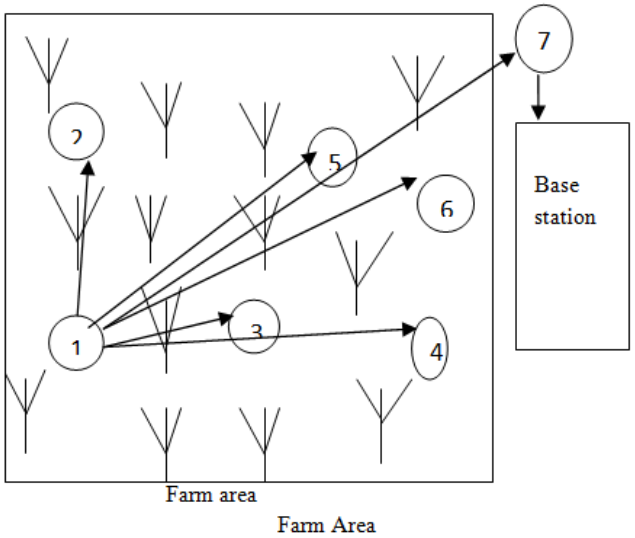
If connections (i,j)==1 i.e. there is a link, then calculate minimum threshold

If (min==0) then Find possible node(x, y)

Send packet information i.e. water level information

Otherwise connections (i,j)= infinity

So values of sensor nodes are stored in sink nodes. Then sink node sends the stored values to base station. Appropriate action will be taken on the basis of values.



Farm Area

Figure 1: Relationship between source, forwarder and sink nodes

In this figure 1 we have taken a farm area for the rice crop. We assume node 1 as source node and node 7 as sink node and all other nodes are forwarding nodes. Now according to our algorithm each node calculates its distance between node to node, node to forwarding node, node to sink node and also angle between two nodes. In this figure node 1 is assumed as source node. Now source node calculates its distance from the all other nodes and the shortest path will b taken for travelling the data to the next node. Minimum threshold will be calculated with the help of distance and minimum angle. If the minimum threshold is equal to zero then it will find the possible node and send the packet information i.e. water level information to the destination. Otherwise connection is set to infinity. So values of sensor nodes are stored in sink nodes. Then sink node sends the stored values to base station. Appropriate action will be taken on the basis of values.

IV. CONCLUSION

This paper presents the design of real-time water level monitoring based on ZigBee wireless sensor network. In typical Indian scenario the farmers are not highly sensitive about usage of technology such as deploying wireless sensors for water level indication. Because our routing algorithm although dependent upon the distances of wireless information from source to sink(monitoring station) as well as minimum angles between source and destination nodes are also considered as one of the main reason for creating routing pipe. This algorithm offers a maximum opportunity of 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.

FUTURE SCOPE

This current algorithm which picks up the information for water level can be further optimized by using optimization algorithms, which lead to smoothening of packet delivery ratio, thereby increasing the packet delivery ratio by choosing the right cost path with the help of optimization techniques like genetic algorithm, neural networks etc.

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