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Precision Agriculture using Greenhouse Real Problems and Possible Solutions

Chirag Bhatt[1],Nikita Joshi [2],Dr.S.G.Desai[3]

[1]Research Scholar , Rai University , chiragbhatt005@gmail.com
[2]Assistant Professor, Silver Oak College of Engg & Tech, nikita.joshi.bhatt@gmail.com
[3]Professor and HOD , Sal Institute of Technology and Engineering Research, subhash1948@yahoo.com

Abstract

As population increases, it becomes necessary to improve the efficiency of farming practice. Advancement in wireless sensor network made this idea possible which was nearly impossible few decades ago. Real-time data can be collected using Wireless sensor network which can be useful for taking various types of decision for farming practice. so that large amount of output can be gained using limited amount of resources and there is no waste of resources. Study some of the agricultural parameters such as soil, Water, crops, Irrigation, Chemical fertilizers issues and environmental issues of specific region. Greenhouse is the advanced facility available in which climate conditions can be controlled. There are so many real greenhouse problems like irrigation, climate control, and database design and for that sensor based precision agriculture management system required.

Keywords-*Precision Agriculture ,Wireless Sensor Network, Climate Control, Irrigation ,Database design*

I. INTRODUCTION

As population increases, it becomes necessary to improve the efficiency of farming practice. Advancement in wireless sensor network made this idea possible which was nearly impossible few decades ago. Real-time data can be collected using Wireless sensor network(wsn). Which can be useful for taking various types of decisions for farming practice. Therefore, large amount of output can be gained using limited amount of resources and with limited waste of resources. Precision Agriculture refers to a series of practices and tools necessary to correctly evaluate farming needs [1]. Traditional agriculture is practiced by performing a particular task, such as planting or harvesting, without any predetermined data. Smarter decisions can be made by collecting real-time data.

In order to achieve precise control to production environment, it is necessary to perform three tasks namely, first monitoring parameters such as temperature, humidity and illumination which are associated with the production environment, as these parameters are the main influential factors for the product yield and quality. Secondly, control and management decision is determined based on the analysis of the collected data. Finally, based on the control decision, automatic or manual control mechanism is implemented to complete the required environment control and adjustment[2].

Data collection techniques can be classified as wired and wireless. Wired sensor network uses wires to transfer data in the network. Wireless network transmits data though various wireless communication technologies such as IEEE 802.11 , IEEE 802.15.4 etc. Problems with wired sensor network are expensive installation, difficult to maintain, limited mobility and scalability.

Wireless sensor network(WSN) consists of many sensors which are deployed in monitored area. Many hybrid wireless sensor networks such as terrestrial WSN, Wireless underground sensor network(WUSN) are used for precision agriculture.

Some architectures are proposed for specific applications of precision agriculture such as irrigation, fertilization etc. There are some issues in these architectures such as limited lifetime of sensors, coverage problem, path loss due to soil-air communication those are need to be addressed.

II. LIRETATURE REVIEW

Properties of sensor network[3]

1. Sensor nodes can be deployed inside the phenomenon or close to it. For second approach some computation is needed to distinguish the target data and noise.
2. Nodes are deployed randomly. It is good in some situations such as disaster etc. where we don't have time to establish structure.
3. Data is aggregated through cooperative effort of nodes.

Difference Between sensor networks and Ad hoc networks[3]

1. Density of sensor nodes is higher than Ad hoc network.
2. In sensor network topology changes frequently.
3. Sensor nodes mainly use broadcast communication paradigm whereas most ad hoc networks are based on point-to-point communications.
4. Sensor nodes are limited in power capacities, and memory.
5. Sensor nodes don't need global ID.
6. Power used in multi-hop communication of sensor network is lower than single hop communication of Ad hoc network due to high density of sensor network.

Sensor networks applications[3]

WSN has many applications in real life area. Some of them are discussed below.

1.Military application

WSN has application in military which is called C4ISRT(command, control, communications, computing, intelligence, surveillance, reconnaissance and targeting) .
This application is used

- to keep track of our resources
- to keep watch on sensitive area
- to gather data about previous war.

2.Environmental applications
WSN is used in environmental application for tracking the movements of birds, small animals, and insects; monitoring environmental conditions that aect crops and livestock; irrigation; macro instruments for large-scale Earth monitoring and planetary exploration; chemical biological detection; precision agriculture; biological, Earth, and environmental monitoring in marine, soil, and atmospheric contexts; forest fire detection; meteorological or geophysical research; flood detection; bio-complexity mapping of the environment; and pollution study.

3.Health applications
WSN is used in this area for

- Remote monitoring of patient.
- Tracking and monitoring of patients and doctors.
- Sensors are attached with drugs.

Therefore, by matching sensor of patient and drug anybody can decide proper medicines can be provided to patient.(considering allergies of patient).

4.Home applications
In the home environment there are several home networks, such as: Internet access, computers and devices interconnection, audio and video distribution, security and surveillance system, energy saving systems, automation and control systems. Each one of these applications has band width, data rate, maintenance and installation requirements that are quite different and specific .A wireless sensor network plays a very important part in these scenarios, being, usually, a solution with lower implementation costs.

5.Energy Used in Building: Innovative, lower cost sensor and control yield better energy efficiency
40 Percent of the energy consumed in US due to building, but the studies indicates that advanced sensor and control have the power to reduce the energy consumption of building by 20-30 percent. The ultra-low power smart sensors collect and send data to a receiver, which can capture data from many different peel-and-stick nodes and provide the information to the energy-consuming system. They received more information, the energy management of building is better.

6.Automatic Door Sensor
Here sensor installed in the door, when object appear infront of that door it automatically sense it and open the door in the same way when object disappear then door closed automatically. Therefore it is useful for physically handicap people. It is widely used at airport all over the world, i.e John F. Kennedy International Airport

7.Flight Tracking
This tracking system helps to identify the flight and its location. System that collect both flight track and identify aircraft from radar sensor. It is beneficial to first time user who visits the airport.

8.Other applications
Environmental control in office buildings: The air conditioning and heat of most buildings are centrally controlled. Therefore, the temperature inside a room can vary by few degrees; one side might be warmer than the other because there is only one control in the room and the air flow from the central system is not evenly distributed. A distributed wireless sensor network system can be installed to control the air flow and temperature in different parts of the room. It is estimated that such distributed technology can reduce energy consumption.
Interactive museums: In the future, children will be able to interact with objects in museums to learn more about them. These objects will be able to respond to their touch and speech. Also, children can participate in real time cause-and-eect experiments, which can teach them about science and environment. In addition, the wireless sensor networks can provide paging and localization inside the museum. An example of such museums is the San Franciso Exploratorium that features a combination of data measurements and cause and eect experiments

III. PRECISION AGRICULTURE

The Precision Agriculture(PA) is sequence of practices and to measure farming needs[4]. The effectiveness and accuracy of PA are highly depend on soil condition. Precision Agriculture attention on the natural component, with chemical filtering, water content, nutrients and soil mechanisms. The goal is to utilize new technologies, such as GPS, satellites and sensors to judge the variations in a field more correctly. Consequently, farming performs, including sowing, irrigation, fertilizer management, and pest control can be arranged autonomously according to the impost of the field[4]. The precision green house agriculture management based on combined information and production based farming system. The wsn is field that can be used to monitoring and control the irrigation, temperature and humidity the agriculture parameter to make greenhouse[5]. The Green house management efficient solution for automatic monitor, control and irrigation system. It is practical that farmer has huge loss to estimate of wrong weather and incorrect irrigation method. The precision agriculture provide real time criticism on a different number of crop and environment adjustable[6].

Why WSN?
Sensor is needed to monitor the parameters so that only required amount of resources are provided. And Wireless system is used for easy maintenance, Scalability, mobility. It is a system contained of radio frequency transceivers, sensors, micro controllers and power sources. They are moderately low cost, consumes low-power, small devices equipped with limited sensing, data dispensation and wireless communication capabilities, which perfectly match the precision agriculture where decisions are complete at micro-climatic level at right input[7].

Why Precision Agriculture?
Precision agriculture acting an important role in modern agriculture, as it may be used to more precisely appraise best sowing density, estimate fertilizers and other inputs needs, and more precisely predict crop harvests. Demand of food is increases day by day. Resources for agriculture are limited. Technology made devices very cheap, small sized and

efficient. So it is good if we can apply technology in agriculture to gain more yield using less resources[8].

Why Green House?
It is observed that farmers have to tolerate huge financial loss due to wrong prediction of weather and improper irrigation method to crops. Advancement in sensor network (WSN) technology enabled automatic function in a greenhouse for Precision application low-cost and environmental friendly Greenhouse Monitoring System (GHMS) is presented based on WSN technology. In this particular application, GHMS is used to monitor key environmental constraints such as the temperature, humidity and soil moisture[9]. Greenhouse gives us controlled environment.

IV. PROBLEM STATEMENT

1) I had visited two greenhouse farms and gain the information about greenhouse.
Name of organization: Neel Agrotech Ltd
Name of Person : Bhaskardev Panchal
Description of Meeting :As per discussion with Bhaskardev Panchal today's agriculture totally depends on season/weather. Greenhouse having a controlled environment.
Today's agriculture based on seasonal crop and farmer can't do farming of seasonal crop in another season.so greenhouse having a system to take any selected crop in any season. I visited greenhouse which has Capsicum crop but there is no automatic irrigation system based on Wireless sensor network. Here human interface is needed for switch on/off irrigation pipeline. So proper soil moisture can't be measured. As an when water supply needed there is no notification system.

2) Another problem of climate control is there. Generally in greenhouse temperature and humidity sensor are deployed. but only one sensor are there so it can't measure accurate result when that sensor goes down or become faulty. At that time also human interface is needed. There is no such powerful climate control mechanism in it. There is no fault tolerance mechanism in it.

3) To design any greenhouse management system crop requirements should be stored in any database. Data must be accessible whenever needed. Database design is also one problem in this area.

V. PROPOSED RESEARCH WORK

Design a sensor based precision agriculture management system required for controlled environment like Greenhouse for some specific group of crops. So system needs minimal changes while changing.

a) It provides agricultural services like Irrigation, Ec-Ph control, Weed control and pest control.
b) Ec-pH should be measured directly from soil.
c) It is compatible with a group of crops. so minimal amount of change is needed while changing the crop.
d) System configuration should be easily modifiable while changing the crop. for that purpose user friendly interface should be designed.
e) Report generation is provided.
f) Event based feedback is provided.
g) Wireless sensor network can self organize itself while making modification in location of sensors.
h) It should be fault tolerant. If any node fails or restarts, it should be easy to add that node in network again.
i) Crop requirements should be stored in database and should be accessible whenever required.

Architecture is divided in modules. Each modules are related with each other. Figure 1 shows this relation.

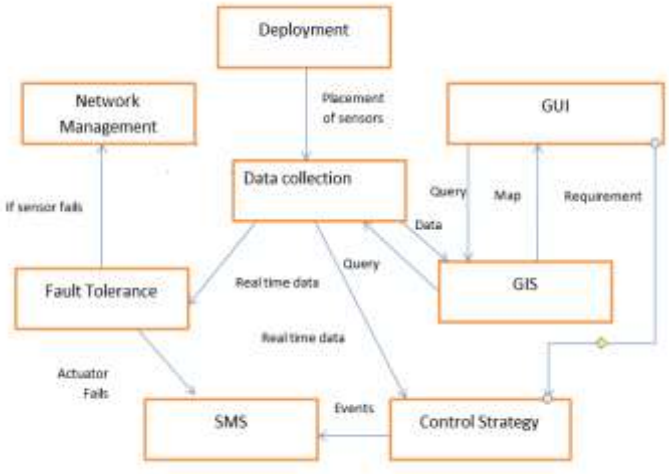

Figure 1:-Proposed Architecture

The proposed architecture consists following components.

1) Sensors: Monitoring is important activity in precision agriculture.
Following types of sensors are used for monitoring parameters.
Soil pH sensor
Soil humidity sensor(Tensiometer)
Light sensor
Temperature sensor
Humidity sensor
Camera

2) Communication Technologies: Sensors will collect data and then send it to base station using communication technology. Wireless communication technologies used for this purpose is Wi-Fi, Bluetooth and Zigbee.

3) Greenhouse specific controller: Greenhouse specific controllers work as gateway. Which collects data from sensors, process it and sends necessary data and event notification to base station. It also controls actuators in greenhouse.

4) Decision Making System at base station: There are some algorithms which decides what action should be taken using data received from sensors and threshold values stored

in database. Decision making system is installed at base station.

5) Actuators: Base station will send control information to actuators like irrigation valve, sprinkler, fan, curtains, forgers etc.to maintain climate condition and fulfill requirements of crop.

6) Database management system : This system takes data through GUI and stored in database. Data sensed by sensors are stored in this database. Control system accesses data from this database to take decisions.

7) GPS: Global positioning system is used for localization of sensors and vehicles of fertilization, weed control etc.

VI. RESEARCH OBJECTVE

1) As population increases, it becomes required to improve the efficiency of farming practice. The wireless sensor network prepared idea possible which was almost impossible before few times. The Real time records data can be collected in Wireless sensor network. So that large amount of data output can be enlarged using limited amount of resources and there are no waste of resources. To study some of the agricultural parameters like soil, crops, Irrigation, Water, Chemical fertilizers matters and environmental problems of precise region. The agricultural constraints that Use different sensors to sense the agricultural parameter, Gather transmit the information. The Architecture which is useful in rural development and inspection of reading. The WSN is network complete by a large number of sensor nodes which do particular function. Precision agriculture and WSN applications combine an exciting new area of research that will importantly advance quality in agricultural production and precision irrigation. There are prospective solicitations of wireless sensor network technology in agricultural structures such as real time field monitoring, automated irrigation control, monitoring environment and remote operation of field[10].

2) Greenhouse is the advanced facility available in which climate conditions can be controlled. We are going to design a flexible sensor based agriculture management system for controlled environment like greenhouse.

3) Solutions are needed for minimizing all forms of losses incurred after harvesting till the harvested commodity reaches a consumer or a processor. Each commodity has its own types of losses, with the farming location and conditions adding their own variations. Solutions may have to address a range of factors, from estimation of the losses caused by farming practices, marketing, existing policies, to development of appropriate technologies, to deployment of solutions, and verification of and learning from their field effectiveness[11].

4) Methods are needed to easily, and in as much as possible, remotely and noninvasively estimate the quality of agricultural and food products. Quality refers to everything that impacts on the product's nutritional value, safety, taste, flavor, and visual appeal. It also includes any adulteration or contamination such as sometimes encountered in milk, sugar, and pulses, as well as any traces of fertlizers, pesticides and the like in vegetables, etc[11].

5) There is much room for agricultural development in spite of its growing complexity. A faster and more diversified growth would stimulate pull and push effects between agriculture, industries and services and thus accelerate the overall growth of the economy. No less important would be the reduction of poverty through more job creation. As for the farmers, they have shown remarkable resilience in the past. With adequate government support there is no reason why they should not proceed further. Finally, the issues are even more important in India where agriculture carries more weight than in China on GDP and labour force system for controlled environment like greenhouse[12].

6) The farming practice is based on assumptions only. Resources are provided by predetermined data. Requirement cycle of Different crops using data and analysis of working on them. Collecting real time data on weather, soil and air quality, Smarter decisions can be made. The automatic control Mechanism is implemented to complete the required Environment control and adjustment .It improve efficiency Of crop and increase the production plan.

7) Greenhouse technology, the automation of agricultural parameters becomes a necessary part deployment of WSN based greenhouse management which is designed and implemented to realize modern precision agriculture. Sensor node hardware to the management system, the whole system architecture is explained. In this precision Green house management approach to monitor and control the climate.

VII. FUTURE WORK

We are going decide a maximal group of crops and design a system which is flexible with this crops and fulfill all the properties described in problem statement.

Below mentions are milestones of our work.

1) Decide maximal group of crops.
2) Decide strategy for each individual module of greenhouse management system
3) Design and architecture including specifications of placement of sensors and other nodes of architecture
4) Decide algorithms for providing flexibility in architecture.
5) Verify architecture using simulation.
6) Design an database management system to store and retrieve data efficiently.

REFERENCES

[1] Dong, X., Vuran, M. C., and Irmak, S. (2013). Autonomous precision agriculture through integration of wireless under-ground sensor networks with center pivot irrigation systems. Ad Hoc Networks, 11(7):19751987.

[2] Xia, J., Tang, Z., Shi, X., Fan, L., and Li, H. (2011). An environment monitoring system for precise agriculture based on wireless sensor networks.

[3I.F. Akyildiz, W. Su*, Y. S. E. C. (2002). Wireless sensor networks: a survey. Broadband and Wireless Networking Laboratory, School of Electrical and Computer Engineering, page 393422.

[4] Dong, X., Vuran, M. C., and Irmak, S. (2013). Autonomous precision agriculture through integration of wireless under-ground sensor networks with center pivot irrigation systems. Ad Hoc Networks, 11(7):1975-1987.

[5] Akshay C., NitinKarnwal, A. K. R. K. s. K. T. E. D. S. Y.(2012). "wireless sensing and control for precision greenhouse. IEEE.

[6] Ibrahim Mat, Mohamed Rawidean Mohd Kassim, A. N. (2014a). Precision irrigation performance measure using wirelee sensor network. IEEE.

[7] A. K. Tripathy, J. Adinarayana, D. S. S. M. U. B. D.K. D. R. R. G. S. S. N. M. H. T. K. K. (2011). Data mining and wireless sensor network for agriculture pest/disease predictions.

[8] Rolando A. Crdenas Tamayo1, M. G. Lugo Ibarra1, J. A. G. (2010). Better crop management with decision support systems based on wireless sensor networks. IEEE.

[9] Ibrahim Mat, Mohamed Rawidean Mohd Kassim, A. N. (2014b). precision irrigation performance measure using wireless sensor network. IEEE.

[10] Chirag Bhatt, Nikita Joshi, S. D. (2015). Agriculture reforms using wireless sensor network. International Journal For Technological Research In Engineering, pages 2347 - 4718.

[11] ITRA (2015). Information technology research academy. INDIAN COUNCIL OF AGRICULTURAL RESEARCH (ICAR).

[12] S.G.Desai (2012). Agricultural prospects and the rural economy in china and india. International Conference, GECSA-12 on Global Economic Crisis and Strategic Advantage.