Improve Precision Agriculture with Wireless Sensor Nodes in Greenhouse System

Tejal K. Joshi[2], Nehal Rajput[2]
[1, 2] Assistant Professor, Dept of Computer Engineering
[1, 2] Swarrnim Startup And Innovation University

Abstract- *In the agriculture industry. Farming provides a holistic system approach, which helps farmers to increase profit and quality. An Agriculture fields faces remarkable losses due to the diseases. These diseases came from the pests and insets, which reduces the productivity of the crops. Pesticides and fertilizers are used to kill the insects and pests in order to enhance the crop quality. WSN is widely used in some fields like, medical, military, bio-technology etc. By using WSN technology in PA we can immediately take real time data. Thru WSN technology we can easily get temperature, humidity in air. WSN takes data and it immediately transfer to central station. In this paper, Greenhouse Smart Management System (GSMS) using WSNs is designed and developed to automatically control, manage and monitor the agricultural parameters and activities inside the greenhouses [5].*

Keywords- Precision Agriculture(PA), Wireless Sensor Network(WSN), Zigbee, GSM, CDMA, Ad-Hoc Network, LAN, WAN, MAN, Green house

I. INTRODUCTION

An Agriculture is the backbone of our country and economy which accounts for almost 30 percent of GDP and employs 70 percent of the population. To get better profit and quality in this system we need some components like, WSN, GPS, camera, laser scanner 2D and laser scanner 3D, barometer, solar system, green house effect technology. WSN is the wireless Sensor Network which is used for collecting physical parameters such as light intensity, sound or temperature [1]. WSN has wide variety of tiny nodes with restricted memory space and limited computation capacity.

Wireless Sensor Network (WSN) is the ideal candidate to provide effective and economically viable solutions for a large variety of applications ranging from health monitoring, agriculture, environmental monitoring to military operations. WSN is a modern technology which integrates the knowledge of sensors, automation control, digital network transmission, information storage and information processing. The WSN is field that can be used to monitoring and control the irrigation, temperature and humidity the agriculture parameter to make greenhouse [2].

PA is precise in both the size of the crop area it monitors as well as in the delivery amounts of water and fertilizer. The data collection, monitoring and materials application to the crops allows for higher yields and lower cost, with less impact to the environment. Each area receives only what is required for its particular space, and at the appropriate time and duration [3].

Number of sensors is available in market based on their need. Soil water measure sensor, soil moisture content sensors, pH level, soil electrical conductivity level checking sensors.

WSN has different networking standards in long range and short range. They are LAN, WAN and PAN. WAN contains GSM, GPRS, CDMA. LAN contains WI-Fi and PAN contains ZigBee, bluetooth and Ultra wide band.

II. PRECISION AGRICULTURE IN GREENHOUSE USING WSN

PA is based on satellite farming or site specific crop management. It is a farming management concept based on observing, measuring and responding to inter and intra field variability in crops. Precision agriculture is a new expansion in traditional agriculture. In precision agriculture, data is used to derive for taking decision which employs control and modification solutions for to gain better product [9].

Now a days Precision agriculture using WSN is very useful .Some of positive impacts to use of precision agriculture like Water recourses will be utilized efficiently under the precision farming also it provides opportunities for better resource management and reduce wastage of resources.

There are some barriers regarding precision agriculture like, high capital costs may discourage farmers to not adopt this method of farming, needs expert advice before actual implementation of sensors, it is an extremely difficult task particularly the collection and analysis of data.

If we want to achieve precision control to production environment, it is necessary to perform three tasks like, temperature, humidity and illumination which are related with the production environment. Other tasks like to control and managing decision, which is determined based on the analysis of the collected data.

There are two types of data collection techniques: 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. The problems with wired sensor network are installation is quite costly; maintenance is difficult, limited mobility and scalability.

Wireless sensor networks (WSNs) contain many sensors which are deployed in monitored area. Many hybrid wireless sensor networks such as terrestrial WSN, Wireless underground sensor network (WUSN). We can also transmit data through wire and transceiver devices on the ground to avoiding transmitting through soil. This is called terrestrial wireless sensor network. In the WUSN the underground node sends the data through soil to above ground node [11].

The Wireless Sensor Network system for Precision Agriculture which requires a centralized control unit with user interface, communication gateways and routers, power elements and most importantly are the sensors [10].

Greenhouse Smart Management System (GSMS) using WSNs is developed to monitor and control theAgricultural parameters in greenhouses. When the sensed agricultural parameters exceed threshold values, specific actions are triggered and activated such as fan, pump and buzzers, for a period of time [1].

III. GREEN HOUSE MANAGEMENT SYSTEM:

As shown in Fig. 1, GSMS sensor node components. Sensors are deployed in planned manner inside the greenhouse[21]. Sensor nodes measure the ambient relative humidity and temperature. The communication among sensor nodes is multi-hop communication where the messages are relayed from sensor node to another sensor node until reach to the sink node. The sink node forwards the messages to the farmer via Bluetooth (BT) connectivity. According to the sensed relative humidity and temperature, the GSMS aims to determine the right time for irrigation to open the irrigation plumb and for cooling to activate the cooler fan.

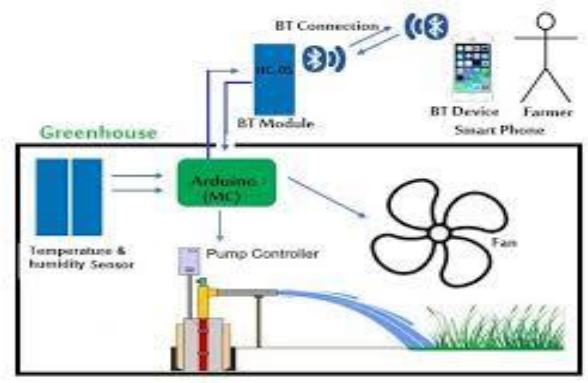

Fig.1 shows GSMS Sensor node components [21]

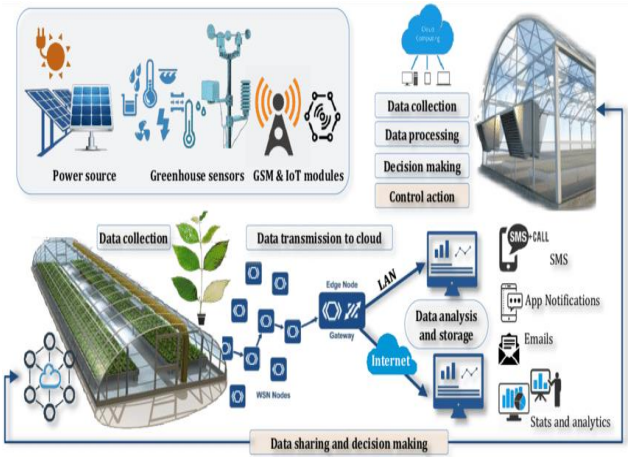

Fig.2 shows data sharing and decision

IV. REQUIRED COMPONENTS HARDWARE AND SOFTWARE

For better crop management and to get better data of temperature, humidity level and water level of soil thru sensor network we need some hardware components temperature sensor, humidity sensors, Actuators, Bluetooth module, Arduino Uno Microcontroller.The GSMS software application is developed in Android operating system so that it can operate in smart phones.

V. PROPOSED ARCHITECTURE AND ITS WORK:

For working of our sensor nodes a new architecture is proposed, which is shown below.

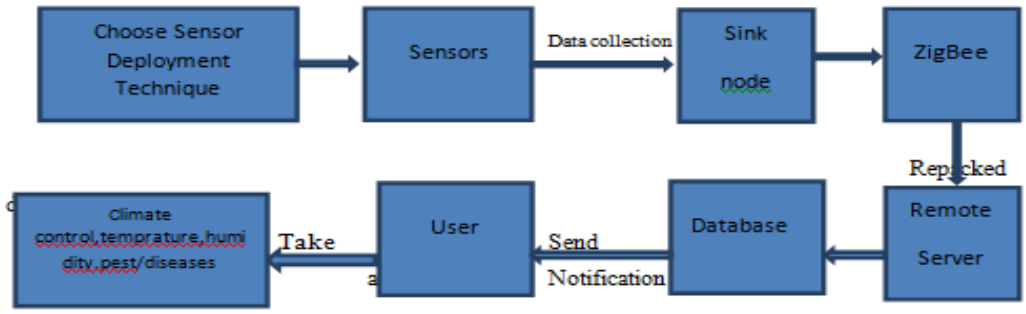

Fig.3 Proposed PA architecture using WSN

This figure shows the proposed precision agriculture architecture using wireless sensor network. Here, I generate new architecture based on the existing architecture. In existing architecture there is no any particular method for sensor deployment, no any fix technology but in my proposed architecture before doing farming in greenhouse I choose some particular method/technique for deployment of nodes also I have fixed ZigBee technology for my proposal.

Using this architecture we get, Selection of deployment technique, reduce crop production cost, require minimum amount of nodes, improve the efficiency of crops, maintain the records of data into database, check and control the climate, humidity and irrigation, get better result.

VI. DEPLOYMENT OF SENSOR NODES IN THE COVERAGE AREA

In the deployment of sensor network Coverage is a fundamental issue. We found the three regular sensor deployments techniques: triangular, square and hexagonal for deployments for coverage of the deployment area. Now we compare these three deployments strategies. For every deployment strategy, we calculate an upper bound and a lower bound of the optimal distance of sensors from each other that make sure k-coverage of the area.

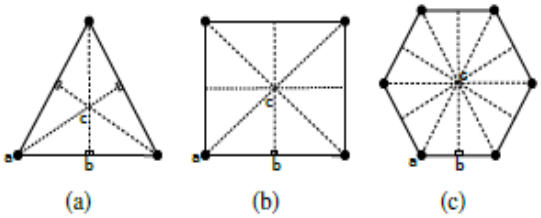

Fig. 4 Sensor Deployment (a) triangular (b) square (c) hexagonal deployment [19]

These are the basic deployment strategies of nodes. After the experiments it shows that triangular method is best for deployment of nodes. For Experiment we take equation like,

$$(ECAR) = \frac{\text{Efficient coverage Area}}{\text{Coverage Area}}$$

Optimal 1-coverage of Deployment Area

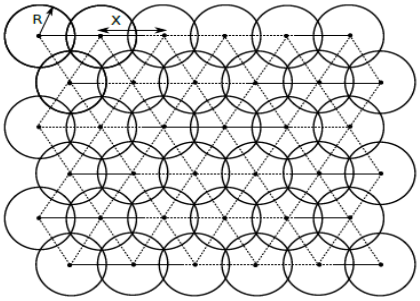

Fig. 5Deployment area[20]

Fig. 4 shows how sensors in the deployment area for triangular, square and hexagonal. Note that x and y scales both equal X for square deployment, while for triangular and hexagonal deployments, x and y scales equal X and$\sqrt{3}/2$ X respectively.

VII. CONCLUSION

Development in Precision Agriculture through wireless sensor network in greenhouse it is now a day's extremely constructive. Using Greenhouse concept we can improve the excellence of crops, monitor and control the temperature and humidity. According to existing system and our proposed work, we get some deployment strategies like, triangular, square and Hexagonal for sensor nodes in the greenhouse shed using ZigBee technology. And after experiments on those strategies we choose one of the best for our farming. The system presented here is user friendly, low cost and can be easily implemented. Techniques may be vary by based on crop.

REFERENCES

[1] Yousef E. M. Hamouda , Faculty of Applied Sciences, Computer Department , Gaza, Palestine "Precision Agriculture for Greenhouses Using a Wireless Sensor Network"IEEE 2017.

[2] Rolando A. Cárdenas Tamayo1, M. G. Lugo Ibarra1, J. Antonio GarcíaMacías "Better Crop Management with Decision Support Systems Based on Wireless Sensor Networks"IEEE 2010

[3] A.K. Tripathy, J. Adinarayana, D. Sudharsan,S.N. Merchant2, U. B. Desai,K.Vijayalakshmi3, D. Raji Reddy, G.

[4] a.Sreenivas, S. Ninomiya, M Hirafuji, T. Kiura, K.Tanaka "Data Mining and Wireless Sensor Network for Agriculture Pest/Disease Predictions"IEEE 2011

[5] E. Raymond Hunt, Jr., Craig S. T. Daughtry, Steven B. Mirsky, and W. Dean Hively "Remote Sensing With Simulated Unmanned Aircraft Imagery for Precision Agriculture Applications"IEEE 201

[6] Hay C, Nitin Karnwal, Abhfeeth K.A., Rohan K han delwal, Tapas Govindraju, Ezhilarasi D., Sujan Y." Wireless sensing and control for precision Greenhouse management" IEEE 2012.

[7] Grac¸aliz Pereira Dimuro , Denis Teixeira Franco "A System Based on Interval Fuzzy Approach to Predict the Appearance of Pests in Agriculture"IEEE2013

[8] Xiaoqing Yu , Pute Wu , Wenting Han Zenglin Zhang "A survey on wireless sensor network infrastructure for agriculture" Elsevier 2012

[9] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci "Wireless sensor networks: a survey" Elsevier science 2002

[10] K. M. Nielsen. Andemen. S. Pedersen. Bak J. D. Nielsen "Control of an Autonomous Vehicle for Registration of Weed and Crop in Precision Agriculture."IEEE 2002

[11] Jianfa Xia, Zhenzhou Tang, Xiaoqiu Shi, Lei Fan, Huaizhong Li "An environment monitoring system for precise agriculture based on wireless sensor networks" IEEE 2011

[12] Ibrahim Mat , Mohamed RawideanMohdKassim, Ahmad NizarHarun "Precision Irrigation Performance measure using Wirelee sensor network" IEEE 2014

[13] Xin Dong , Mehmet C. Vuran , Suat Irmak" Autonomous precision agriculture through integration of wireless underground sensor networks with center pivot irrigation systems"Elsevier science 2012.

[14] J.A. Ferre, A. Pawlowski, J.L. Guzm´an, F. Rodr´ıguez, M. Berenguel "A Wireless Sensor Network for Greenhouse Climate Monitoring"IEEE 2010.

[15] Wei Cao, Ge Xu, EceYaprak, Robert Lockhart, Taiqian Yang, YanqingGao" using Wireless Sensor Networking (WSN) to Manage Micro-Climate in Greenhouse"IEEE 2008.

[16] Bartosz P kosawski, PiotrKrasi ski, MichaSiedlecki, AndrzejNapieralski "Autonomous Wireless Sensor Network for Greenhouse Environmental Conditions Monitoring".

[17] C.Alippi,R. Camplani, C. Galperti and M. Roveri, "A Robust Adaptive, Solar-Powered WSN Framework for Aquatic Environmental Monitoring," in IEEE Sensors Journal,2011.

[18] Xueqing Wang , Shuxue Zhang'" Comparison of Several Sensor Deployments in Wireless Sensor Networks"IEEE 2010.

[19] Akshay C.,NitinKarnwal, Abhfeeth K.A., Rohan Kh sads Khandelwal,TapasGovindraju, Ezhilarasi D., Chiragbhatt, dushyantsinh Rathod "Mitigating Dynamic Denial of Services Attack in Wireless Sensor Network"IJTRE 2014.

[20] Vijay thakor,chiragbhatt ,mehulpatel "precision Agriculture prosapect using Wireless Sensor Network",IJITE 2015.

[21] Parvin Asadzadeh Birjandi, Lars Kulik,Egemen Tanin K-coverage in Regular Deterministic sensor Deploment" IEEE 2013.

[22] https://www.google.com/search?source=univ&tbm=isch&q=GSMS+sensor+node++images&sa=X&ved=2ahUKEwjqscaIrabqAhU9zDgGHQcIAfoQ7Al6BAgJEBk&biw=1366&bih=657