International Journal of Engineering Trends and Technology (IJETT) – Volume 23 Number 9- May 2015

A Review on Precision agriculture using Wireless Sensor Networks

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***Abstract* — For agricultural environment develop a smart application is the main purpose of the system. The system contain various observations regarding to agricultural environment such as temperature, humidity and soil moisture along with other factors can be of importance. A normal way to compute these factors in an agricultural environment meant individuals manually taking dimensions and inspecting them at different times. The system use agriculture monitoring application in which use wireless mechanism for sending data to central server which can collect data, stores and also perform analysis on it for displaying on client mobile.**

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Keywords*— *Wireless Sensor Network, Precision Agriculture, Topology Control Network.

I. INTRODUCTION

Wireless Sensor networks(WSN) are getting lots of popularity in recent years due to their wide applications like military and disaster surveillance, industrial product line monitoring, agriculture and wildlife observation, healthcare, smart homes etc. A large number of sensor nodes working together collect information from the environment and then transmitting this data to a base station forms the sensor network. A wireless sensor network is design for sensing and processing parameters like temperature, humidity and sound. After sensing data sensor nodes sends it through wireless channels.

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Wireless Sensor Network

Due to advance recent technology the developed of small plus low cost sensors became economically feasible and technically. The sensing node compute ambient situation connected to the environment close the sensor and transforms them into an electric signal. Processing such a signal reveals various properties concerning substance located and events happening in the vicinity of the sensor. A great amount of these disposable sensors able to the networked in most applications so as to require unattended functions. Hundreds or thousands of these sensor nodes contains by a Wireless Sensor Network (WSN) and all that sensors contain the ability to communicate any in the middle of every other or straight to an external base-station (BS). A larger number of sensors allows for sensing above big geographical regions with better accuracy. Figure 1 shows the diagram of sensor node mechanism. Mostly every sensor node comprise first sensing, second processing, third transmission, fourth mobilizer, fifth position finding system, and last one is power units (some of these components are optional like the mobilizer).

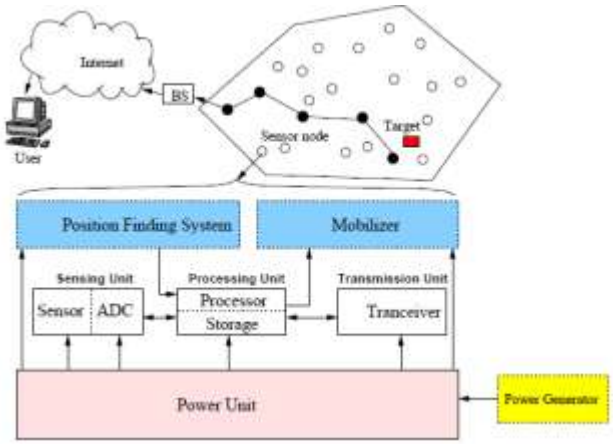

Fig 1: Sensor Node component

Basically, each sensor node consists of sensing, processing, transmission, mobilize, position finding system, and power units. Sensor nodes are usually scattered in a sensor field, which is an area where the sensor nodes are deployed. Sensor nodes coordinate among themselves to produce high-quality information about the physical environment. Each sensor node bases its decisions on its mission, the information it currently has, and its knowledge of

its computing, communication, and energy resources. Each of these scattered sensor nodes has the capability to collect and route data either to other sensors or back to an external base station. A base-station may be a fixed node or a mobile node capable of connecting the sensor network to an existing communications infrastructure or to the Internet where a user can have access to the reported data.

The WSN is a structure comprised of radio frequency (RF) sensors, transceivers, microcontrollers and power sources. Modern advances in wireless sensor networking technology include to the development of low cost, low power, multifunctional sensor nodes. Sensor nodes allow environment sensing collectively with data processing. Instrumented with a range of sensors, for example humidity, temperature as well as volatile compound detection which allow monitoring of dissimilar environments. Sensors can be network with other sensor systems in addition to exchange data with external users. Sensor networks are used for a variety of applications like machine monitoring, wireless data acquisition plus maintenance, environmental monitoring, smart buildings and highways, site security,safety management, and in numerous other areas. A WSN protocol consists of the transport layer, application layer, data link layer, network layer, physical layer. Also WSN contains mobility management plane, power management plane and the task management plane.

II. LITERATURE SURVEY

In the agricultural field most of researchers found that the give way of agriculture goes on falling day by day research trends. Use of technology is most important part of agriculture which reduce human efforts power. Some of the researches try to build technology which is more helpful for increasing the agricultural yield.

System shows advanced development in wireless sensor networks was used in observing different parameters in agriculture. With the evolution of miniaturized sensor devices tied with wireless technologies, it was able to remotely observing parameters such as humidity, moisture and temperature. In this System organize to develop, design and execute a wireless sensor network connected to a middle node using Zigbee, which in turn was associated to a Central Monitoring Station (CMS) from end to end General Packet Radio Service (GPRS) or Global System for Mobile (GSM) technologies.The system also obtained Global Positioning System (GPS) parameters connected to the meadow and sent them to a central monitoring station. This system was usual to facilitate farmers in evaluating soil situation and be active accordingly [1].

To develop high tech poly house wireless sensor build with AVR ATmega8L microcontroller and RF Zigbee module for protected data transmission. Use of smart sensor module occur to develop the precision and reliability. Humidity is continuously monitored on base station [2].

The system develop a application for observing various factors such as soil moisture, humidity and give remote monitoring using zigbee which sent data wirelessly to a middle server which assemble data, accumulate it and permit it to be display as required and also be sent to the client mobile [3].

The system for the automatic irrigation by remotely which was founded on embedded system to gather farmers energy, money and time also use only when there will be need of water.In this approach, the soil test for water content, salinity and chemical constituents and fertilizer requirement of data, collected by wireless and processed for better drip irrigation plan. This was reconsider various monitoring systems and proposed an automatic monitoring system model using Wireless Sensor Network (WSN) which help the farmer to progress the yield [4].

The system developed by Aji Hanggoro and Rizki Reynaldo based on Greenhouse monitoring and controlling using Android mobile application was designed to monitor and control the humidity inside a green house. Here software was used as an android mobile phone and used Wi-Fi connection via serial communication to a microcontroller and to a humidity sensor [5].

Smart sensor based monitoring system monitored various agricultural parameter remotely and proposed inductor model for monitoring with wireless protocol implemented using field programmable gate array (FPGA) which was used for the analysis and monitoring of data , a display element and a relay as a control unit[6]

This review aimed to provide monitoring of marine environment and provided advantage of easy deployment, in real time monitoring. System had provide architecture of WSN-based oceanographic monitoring systems with a general architecture of an oceanographic sensor node ,sensing parameters and sensors, wireless communication technologies, deployment of wireless sensor networks for marine environment monitoring [7].

Multi parameter monitoring system by using wireless sensor network was designed based on low-power Zigbee wireless communication technology for system automation and monitoring. Real time data was collected by wireless sensor nodes and transmitted to the base station using zigbee. Data was received, saved and displayed at base station to achieve soil temperature, soil moisture and humidity monitoring. The data was continuously monitored at base station and if it exceeds the desired limit, a message was sent to farmer mobile through GSM network for controlling actions. Advantage of flexible networking for monitoring equipment, convenient installation and removing of equipment, low cost and reliable nodes and high capacity [8]

Monitoring greenhouse environment parameter and controlling was takes placed efficiently by both automatic and manual manner. Manually controlled zigbee network sent status of agricultural environment parameter to the control room from which itcontrolled the activities and sent to the controller back. These microcontroller based circuits was used

to monitor values of parameter, continuously modified and controlled in order to optimize them to achieve maximum plant growth and yield controller communicates with the a variety of sensor modules in order to Control the light, drainage process efficiently inside a greenhouse by actuating a cooler, fogger, dripper and lights respectively according to the necessary condition of the crops. [9].

An automated multisensor greenhouse monitoring system controlled and monitored various parameters inside and outside greenhouse using microcontroller [10].

This system was based on modernizing the irrigation technology in agriculture and also provided for adequate irrigation by using ARM7TDM1 core and GSM. Which was serves as an important part and responsible for controlling the irrigation on field and sent to receiver through receiver signals. This project was used to detect the exact field condition as well as weather condition in real time. The information was given on user request in the form of SMS. GSM modem was controlled with the help of standard set of AT (Attention) commands. These commands were used to control majority of the functions of GSM modem [11].

To increase the productivity of the farms one has to use optimum water for irrigation system that was used.to improve water management and for the controlling the parameter of farm. Wireless sensor network was described for which it store and utilized rainwater to increase the crop productivity, to reduce the cost for cultivation and make use of real time values. [12].

Precision farming by using wireless sensor network monitoring agricultural parameter promise higher yields and lower input costs by real-time and automatic monitoring of site specific environmental and soil conditions using different sensors and thereby improved crop management reduced waste and labour costs. This system was presented a test bed implementation of a wireless sensor network for automatic and real-time monitoring of soil and environmental parameters influencing crop yield. The system presented practical issues and technical challenges including the integration of sensors, placement of sensors in outdoor environment, energy management scheme and actual power consumption rates [13].

These system monitored multi parameter of agricultural using low power zigbee wireless communication technology for system automation and monitoring. Real time data was collected by wireless sensor nodes and transmitted to base station using Zigbee. Data was received, saved and displayed at base station to achieve soil temperature, soil moisture and humidity monitoring. The data was continuously monitored at base station and if it exceeds the desired limit, a message was sent to farmer mobile through GSM network for controlling actions [14].

In This review system various agricultural parameters was monitored and controlled by using peripheral devices like valve, watering pump etc. where monitoring was done automatically by using microcontroller to improve the farmer yield [15]

System was presented for the Monitoring System for Vegetable Greenhouses based on a Wireless Sensor Network designed for monitoring the life conditions of greenhouse vegetables. The complete system architecture included a group of sensor nodes, a base station, and an internet data centre. For the design of wireless sensor node, the JN5139 micro-processor was adopted as the core component and the Zigbee protocol was used for wireless communication between nodes. With an ARM7 microprocessor and embedded ZKOS operating system, a proprietary gateway node was developed to achieve data influx; screen display, system configuration and GPRS based remote data forwarding. Through a Client/Server mode the management software for remote data centre was achieved real-time data distribution and time-series analysis. Besides, a GSM-short-message-based interface was developed for sending real-time environmental measurements, and for alarming when a measurement is beyond some pre-defined threshold. The whole system had been tested for over one year and satisfactory results have been observed, which indicate that this system was very useful for greenhouse environment monitoring [16].

System proposed by Liu Yumei, Zang Changli developed monitoring system of soil based on wireless sensor networks used a wireless sensor network as information acquisition and processing platform. The coverage was big, effectively resolves the disadvantages of wired communications. Adopting the technology based on Zigbee, GPRS and Web Services technology, it designed a set of low cost, low power consumption, flexible automatic networking temperature humidity monitoring system of soil. And the system was a complete set of wireless sensor network induction, acquisition, storage, application, reporting, solution, has a good man-computer exchange interface [17].

Automated Irrigation System Using a Wireless Sensor Network and GPRS Module Developed algorithm with threshold values of temperature and soil moisture that was programmed into a microcontroller based gateway to control water quantity. This system is used for optimizing water resources for agriculture production, the places with water scarcity. The system had a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit handles sensor information, triggers actuators, and transmits data to a web application. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. The automated system was tested in a sage crop field for 136 days and water savings of up to 90% compared with traditional irrigation practices of the agricultural zone were achieved. Three replicas of the automated system have been used successfully in other places for 18 months. Because of its energy autonomy and low cost, the system has the potential to be useful in water limited geographically isolated areas [18].

System used three commercial sensors which was capable to measure four climate variables. Collected data was used to evaluate the network reliability and its ability to detect the microclimate layers, which typically existed in the greenhouse between lower and upper flora. It was also able to show that the network could detect the local differences in the greenhouse climate caused by various disturbances, as direct sunshine near the greenhouse walls. This was first step in the area of greenhouse monitoring and control, and it is all about the developed sensor network feasibility and reliability [19].

This system presented effective method for crop monitoring in which the sensor motes had several external sensors namely leaf wetness, soil moisture, soil pH, atmospheric pressure sensors attached to it. Based on the value of soil moisture sensor, the mote triggers the water sprinkler during the period of water scarcity. Once the field was sprinkled with adequate water, the water sprinkler was switched off. Hereby water could be conserved. Also the value of soil pH sensor was sent to the base station and in turn base station hints the farmer about the soil pH via SMS using GSM modem. Obtaining the soil pH value in his mobile the farmer selects the necessary fertilizer and crop for his next season. Hereby the amount of fertilizer could be reduced. In order to overcome the lack of information and technical support and to increase the rice production, a development of rice cropping monitoring using WSN was proposed to provide a helping hand to farmers in real-time monitoring, achieving precision agriculture and thus increasing the rice production. Thus automated control of water sprinkling and ultimate supply of information to farmers was done as a result of this project using wireless sensor network [20].

A remote sensing and control irrigation system using distributed wireless sensor network aiming for variable rate irrigation, real time in ground sensing, controlling of a site exact precision linear go irrigation system to maximize the productivity with minimal use of water was developed by Y. Kim *et al*. The structure described particulars about the design and instrumentation of changeable rate irrigation, wireless sensor network and real time in field sensing and control by using appropriate software. The whole system was developed using five in field sensor stations which collects the data and send it to the support station using total positioning system (GPS) where necessary action was taken for controlling irrigation according to the database available with the system. The organization provides a hopeful little cost wireless result as well as remote controlling for precision irrigation. [21]

In one of the studies connected to wireless sensor network, researchers measured soil connected parameters such as temperature and humidity. Sensors be placed under the soil which communicates with transmit nodes by the use of effective communication protocol providing very low duty cycle and hence increasing the life time of soil monitoring system. The system was developed using microcontroller, universal asynchronous receiver transmitter (UART) interface and sensors while the transmission was done by hourly sampling and buffering the data, transmit it and then checking the status messages. The drawbacks of the organization were its cost and operation of sensor under the soil which causes attenuation of radio frequency (RF) signals. [22]

M. Haefke *et al.* residential a ZigBee based smart sensing stage for monitoring ecological parameters such as temperature, relative humidity, pressure as well as sunlight with the employ of microcontroller which provide as a smart weather station. The explore was based on characteristics such as use of low cost tools, accurate sensors and flexibility in data handling. Use of XBee module provided the wider range and reduced the current consumption of the circuit. The analysis was done by fabricating six prototype weather stations tasting for more than 24 hours. For better results and analysis system has to be reviewed for more time period. [23].

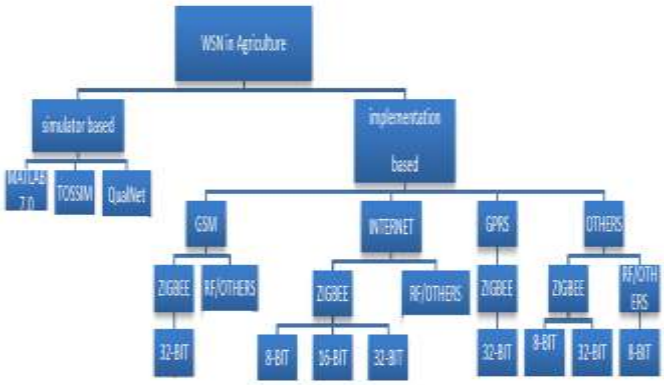

Fig 2: Classification of Existing Systems.

Table: Classification of Existing Remote Monitoring and Control Systems.

Technology	Monitoring System	Module Interfaced	Processor used	Sensor Interfaced
Zigbee, internet	Laptop	-	89c52	Moisture sensor
Zigbee, GPRS	Mobile	JN5121	ARM9	Soil moisture/ temperature
RF	LCD	CC1110	8051	-
Zigbee, internet	Laptop, pda	CC2420	MSP430	Temperature/ humidity/ illumination
GSM, RFID	-	-	-	Camera nodes, cattle sensor network, soil moisture.
RF, internet	Laptop, PDA	C43271	C43271 Psoc	TOUCH, TEMPERATURE, moisture, LIGHT
Single sensor node	-	-	89C52	Temperature/ humidity / ph
zigbee	PC	nRF905	89C51	Temperature/ humidity
Zigbee	TFT-LCD	nRF905	MCF52235	Temperature/ humidity
Zigbee, Internet	PC	Zigbee module 3160	SPCE061A	Temperature/ humidity/soil temperature/ soil moisture/co2/ illumination
Zigbee, internet	Laptop, pda	MSENS SoC		Air Temperature/ humidity/soil temperature/ soil moisture/ anemometer /radiometer /rain gauge/ CMOS image
Zigbee, internet	PDA	Zigbee transreceiver	8-Bit MCU	Light/ temperature / humidity
Zigbee, internet	PDA	JN5121 with On chip 32 bit core		Light/ temperature / humidity/ wind speed
wired ADSL, internet	NRF905	PC	Atmega-128	-

III.PROPOSED SYSTEM DESCRIPTION

WSN have the ability to reach out to the sensors which gives real time data on field helps to achieve real time monitoring ,data collection and control at fields from remote location. Farming efficiency and production can be improved by precision agriculture if the WSN technology can be ready to make the farms. Wireless Sensor Networks has the potential to complete this. Wireless Sensor networks can be used for monitoring pressure, temperature, soil moisture, and reporting best options to the agriculturist. Having such information at regularly would be a big help for him. In sequence to region of the adverse conditions which challenge the agriculturists, automatic actuated devices can be used to control agri-parameters.

The Precision agriculture system performing following functions like:

1. Sensing agricultural parameters.
2. Identification of sensing location and data gathering.
3. Transferring data from crop field to control station for decision making.
4. Actuation and Control decision based on sensed data.

Following figure shows the Architecture of WSN system in Precision Agriculture to monitoring the agri-parameters.

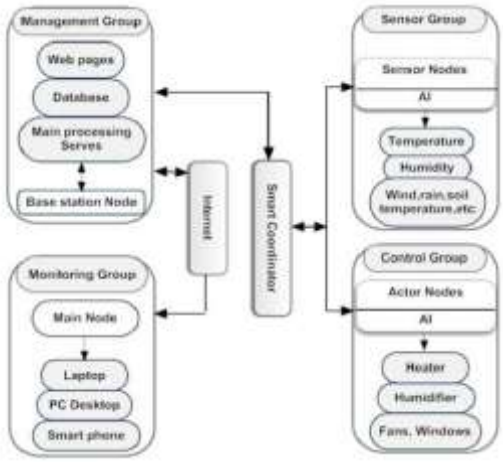

Fig 3: Architecture of WSN system in PA

Following figure shows the System Flow of Precision Agriculture using wireless sensors.

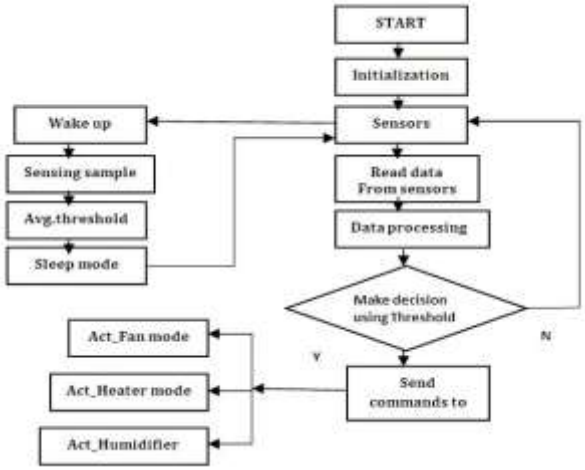

Fig 4: System Flow of Precision Agriculture using wireless sensors.

III. CONCLUSION

Wireless sensor Networks are important for the research purpose. Agriculture monitoring system using WSN is a efficient and reliable system for effectively monitoring environment parameters. Wireless applications can reduce the human power but it requires to check updates or changes in it. System require to focus on tools and developing devices to alert, manage and display the disaster or weather warning using wireless sensor network.

ACKNOWLEDGMENT

The author would like to thank Mrs. Manisha Bhende for their guidance and support.

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