

# Wireless sensor Networks (WSNs) in Precision Agriculture

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**Abstract—** Wireless Sensor Network (WSN) is a newly emerged technology that has been spread all over the world rapidly into various multi-disciplinary fields. WSN is also used for the monitoring of environment and control of different parameters in the Precision Agriculture (PA). From the last many years we are using this WSN technology in Agriculture field. Due to sudden change in the environment it's a big problem for the farmers that how they manage the equally distribution of rain water according to the requirement of crops. There is no availability of ideal irrigation method which is suitable for all weather conditions, requirement of soil or for the variety of crops. We observed that due to the wrong prediction of weather, soil structure, variety of crops cultivated and by using wrong irrigation method to crops farmers bear a huge financial loss. Farmers also have a problem for choosing of fertilizer which is needed for the soil. A big problem in agriculture for the farmers is the weeds which produce in a crop and decrease the production rate. After observing all these problems in agriculture field for the farmers that the real time information from the fields will provide a solid base for farmers to adjust strategies at any time. By monitoring and understanding individual crop and its requirements, farmers can potentially identify the various fertilizers, irrigation and other requirements. In this paper we are going to implement the Wireless Sensor Network (WSN) technology by using different type of sensors for the correct measurement of temperature, soil, water for an ideal irrigation method. (Abstract)

*Key words:* Precision Agriculture, Wireless sensor networks

## I. INTRODUCTION

We study about the precision agriculture on large scale than we are come to know that there are too much problems which are facing by farmers in agriculture field. Some of the problems we discuss here in this paper and then we gave the solutions of some problems.

The main problem in the agriculture field for the farmers is the irrigation method. The farmers are illiterate and they have no idea that which is the ideal irrigation method due to which they have lost to much water. Some time they lost water in the tunnels and some time they chose a very hot time of the day during which sun rises over the head and too much water turns into vapour due to the evaporation method. A problem for the farmers is the management of water in the fields because we know that they have no information that how much water is needed for a specific crop. Due to this reason the excessive amount of water can destroy the crop and similarly the lack of water is also destroy the crop.

Another problem is that after how much time a crop need of water because we know that our farmers don't have idea about this. We should need to know that when and after how much time our crop need of water because we know that "Water is the blessing of GOD" so we can't waste the water unnecessarily and also in Pakistan there is lack of water.

Sudden change of weather and temperature is also become a big problem for the farmers because in the underdeveloped countries farmers don't have such instruments or technology which they can use for the measurement of the weather. We know that when there is sudden change of anything it's too much difficult for anyone to handle the situation.

For example : Farmers produce a crop like wheat which don't need too much water like rice crop and after some days a sudden change occurs and their starts raining or a huge water comes from flood then it's a big problem for farmers that how they manage this water because excessive amount of water can ruin the crops.

A problem which the farmers are facing is that they don't know that which fertilizer is need of soil or crop. They have no knowledge about their land that which fertilizer is the need of his/her land. They also don't know how much amount of fertilizer is required for the crop or area of filed/land due to which some time they gave the excessive amount of fertilizer which destroy the crops or in spite of improving the production

rate of crop this fertilizer is the cause of decreasing the production rate of crops.

One problem is that which we are facing is the old methods of agriculture. Our farmers are still now follow their forefathers methods they are not agree for using the new technology and method in agriculture. They still depend upon the prediction methods without using of technology due to which there will be a great chance of wrong prediction of weather, soil structure and variety of crops.

Farmers have bad dealing with their land because they don't know about their land/field that for which crop their land/field given a best output product. Due to this reason they may be have a huge loss of crops as well as money.

The main objective is to indicate when the field or specific parts of it are at risk of developing fungal diseases.

After finding all these problems in our agriculture system we are come to know that we are facing a huge economical loss annually taking into account of income loss, productivity decrease, material cost etc.

This paper will gives us an efficient approach to find and overcome the problems or faults of agriculture related to the decision making, resources optimization, use of best methods and technologies. Mostly we focus on Wireless Sensor Networks (WSNs) because we know that now a day the use WSNs is the way due to which we monitor the agriculture and also we help the farmers to optimize the use of natural and artificial resources in their all tasks of agriculture. It gives the advantages of precision agriculture approach not only for productivity but also the optimization of resources.

## **II. Using WSN in Precision Agriculture:**

As we know that throughout the world especially in the under developed countries farmers are illiterate and they don't have necessary information about their field or land.

For example: They don't know that how can they improve their productivity rate by using less amount of resources , how can they store their resources inspite of wasting them unnecessarily, how can they manage the wastage of water , fertilizer, grains and pesticides. So they use unnecessary amount of water and fertilizer which have negative effect on land fertility and also pollute the land as well as underground water and crop. Now a days for the increasing number of our population we must need to improve the productivity of our crops so that it should be enough for our population. Another fact is that we know that in our country Pakistan agriculture

is the backbone of our economy and almost 70% population of our country Pakistan depends upon the agriculture. So due to these reasons we must need to improve our whole agriculture system. For the improvement of this system the use of new technology in agriculture must inevitable. We should need to build new systems by using new technologies, techniques, management strategies which can assist the farmers by giving them all the necessary updates and credible information to improve their productivity of crops, this process is called "Precision Agriculture". Precision Agriculture (PA) helps the farmers to be more efficient by minimizing the loss of fertilizer, pesticides and water, PA do this by measuring the weather, humidity, soil condition or PH at different times and different places and then deliver the required amount of water or fertilizer on the exact location. This measurement can be done only with the help of a network of hundreds or thousands of sensors. These sensor after taking the measurements send it to the base station and base station send these information to farmers and after getting these information farmer start their work to give required amount of water , fertilizer and pesticides on exact location. After implementing this system we will be able to decrease the financial loss of farmers and also get a greater amount of the productivity from the land.

## **III. Methods and results:**

### **Irrigation Method:**

First of all we are going to solve our irrigation method because irrigation of agriculture has been considered to be one of the most water consumers in the world. To solve this problem we are placing a system in the fields which is based on wireless sensor networks (WSNs). The whole system consist of a number of wireless nodes, which are driven by battery and battery is charged by solar energy by using solar panels, the nodes transmit data via other wireless nodes to a base station. The WSN which is capable of self-organizing and mesh networking requires minimum maintenance. As we know that the wireless sensor network (WSN) uses low power nodes, mesh networking technology enables transmission of data from one node to any other node in the network, without using high power nodes. The mesh networking technologies provide greater flexibility in node placement any fault within two nodes to communicate is managed by re-routing through any other possible alternative route within the network. We also have a benefit with this technology that a failed node does not disable the network, as the other dependent nodes re-route through other available nodes. When first time we placed the wireless sensors in the field and we activate the base station, the sensor network is self-formed by allocating unique addresses to each node and finds the most efficient communication path to relay

data from each node to the base station. The base station receive the data from the route nodes, processes the data and make a decision according to the requirement than sends an alert message or email to the farmer or user.

We place the sensors in the fields for measuring the soilmoisture and temperature in case of irrigation method because our DBMS make decision for irrigation on the bases of the information that it get from the soil-moisture, temperature and whether measuring sensors. Sensors measure these parameters and send measurement to root node and root send this measurement to DBMS by using gateway and GPRS. After getting these measurements for sensors DBMS system compare these measurements with already given scale of measurements if soil-moisture is low then require amount of soil-moisture then DBMS sends a message or alarm to the user cell phone of user which is connected to the DBMS through internet.

Figure (A) shows the implementation and the measurement method of overall irrigation method.

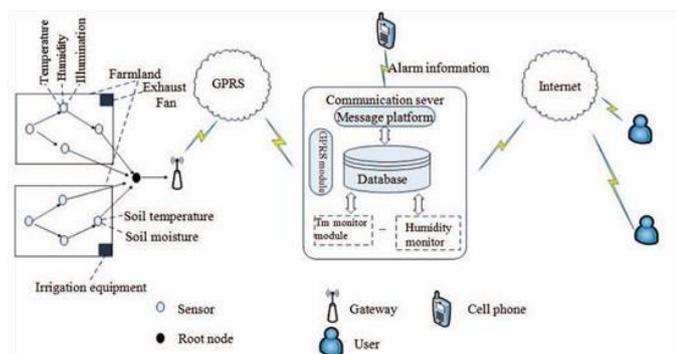


Figure (A)

### Soil Moisture:

To make an ideal irrigation method we must need to know about soil moisture because if we know about soil moisture than we are able to implement an ideal irrigation method. Efficient water management plays an important role in irrigated agricultural systems. We make an idea about automatic field data monitoring system that has been developed recently to collect the data more efficiently. For the measurement of soil moisture wheat field consist of base station, a computer, four soil moisture probes, a monitoring camera, a battery, an antenna, a wireless LAN and a data storage memory. The four soil

moisture probes were placed in the wheat field in the depth of 10cm, 20cm, 30cm and 40cm.

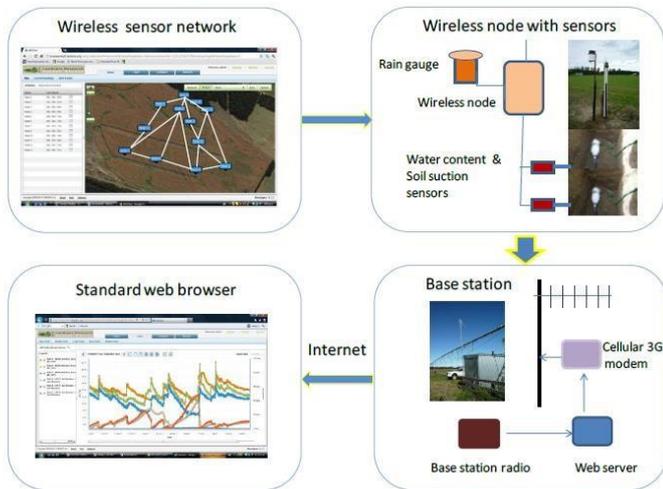
The access point and server was placed in the range of 700m so that it can be easily accessed by the node sensors. Wireless transmission reached about 1km of visible distance between server and access point but the transmission is completely blocked by trees, buildings and mountains that's why direct visibility between server and access point is critical in wireless LAN transmission. So this is the suggestion that we use different field servers at small distance which can access each other easily and cover whole fields.

Data from the fields was successfully collected on the storage memory of server. The soil moisture sensors are inserted in the root zone of the plants. The VH400 probe was selected to estimate the soil moisture because of low power consumption (<7 mA) and low cost. The probe measures the dielectric constant of the soil using transmission line techniques at 80 MHz, which is insensitive to water salinity, and provides an output range between 0 and 3.0 V, which is proportional to the volumetric water content (VWC) according to a calibration curve provided by the manufacturer. The sensor was powered at 3.3 V and monitored by the microcontroller through an ADC port. The soil water content in the wheat field was approximately 37% at the beginning of March decreased to 30%, 27%, 24% and 16% in the soil depths of 40 cm, 30 cm, 20 cm and 10 cm at the end of May.

We compare these rating of water content with already given approximately rating of water content for the wheat fields if the rating in below the required soil moisture rating than an email or message is send to the farmer so that he make a way or strategy through which he complete the deficiency of water content in the field.

The efficiency of plant water use greatly affects the amount of biomass and grain yield in wheat. Less soil moisture in plots is the result of higher transpiration that may associate greater accumulation of photosynthetic products to grains, such as a

measurements were made through the digital thermometer DS1822. The sensor converts temperature to a 12-bit digital word and is stored in 2-B temperature registers, corresponding to increments of 0.0625 °C. The temperature is required through



higher harvest index.

Figure (B) shows the implementation and the measurement method of soil moisture.

Figure (B)

**Temperature:**

We are going to measure the temperature in the wheat field by using WSN technology because we need the temperature measurements for an ideal irrigation method. Soil temperature

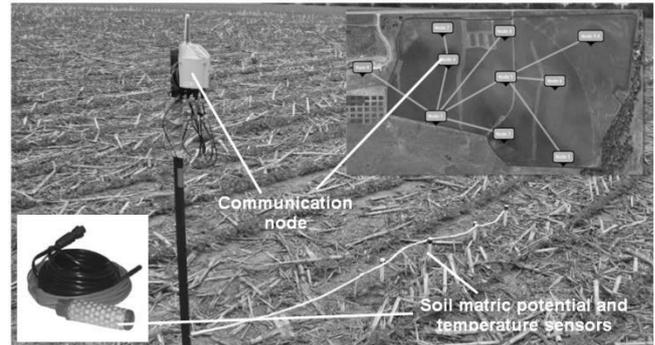


Figure (C)

**IV. Conclusion:**

a reading command and transmitted using 1Wire bus protocol implemented in the micro controller through one digital port. The thermometer has ±2.0 °C accuracy over -10 °C to +85 °C temperature range and a unique 64-bit serial number. Sensors measure these parameters and send measurement to root node and root send this measurement to DBMS by using gateway and GPRS. DBMS after getting these measurements for sensors DBMS system compare these measurements with already given scale of measurements if temperature is high then required temperature then DBMS sends a message or alarm to the user cell phone of user which is connected to the DBMS through internet. So that user / farmer make an irrigation method to overcome the high temperature of the fields which is not good for the crops production in the fields.

Figure (C) shows the implementation and the measurement method of soil temperature.

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When applying a wireless sensor network (WSN) to agriculture, the first thing to determine is whether agricultural site is dynamic or static. Next will be the sensors proper to the environment information of the crops to be measured, number of sensors for each sensor node and the data measurement cycle. If one sensor node will have multiple sensors, there will be more power consumption to operate sensor, in addition to the data transmission/reception. The capacity of the sensor to be used would be chosen considering all these.

We have purposed a system that collects the agricultural date measurement and analysis process with the decision making process (DBMS) for determining when and where the need of irrigation in field and how much need of water. The deployment of smart water management system will be very helpful and extremely important in agriculture field because we know that 80% water will be used during irrigation method in the fields which decrease the availability of water in some regions.

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