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# A Review of Wireless Sensor Network For Agriculture

Mr. Sunil N. More
Department of Computer Engineering
KJ College of Engineering and Management Research
Pune, India
*moresunil01@gmail.com*

Mr. Mininath Nighot
Department of Computer Engineering
KJ College of Engineering and Management Research
Pune, India
*imaheshnighot@gmail.com*

***Abstract*—** Agriculture has key role in supplying the food but climate change, more demand for food and scarcity of water demands modified agriculture methods for agriculture practices. Advancement of wireless sensor network, size reduction has increased chances of application of WSN in agriculture field. The proper selection of WSN specific to particular application is complex task for novice user. The objective of this paper is providing an overview of different WSN technologies used in agriculture domain. In this work, we provide information about WSN, their standard and technologies such as types of WSN architecture, Wireless communication, different wireless sensors along with specific application and case study of WSN. At the end we discussed the challenges in WSN and future direction for the work in this field.

***Keywords-****Wireless Sensor Network, Precision Agriculture,*

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## I. INTRODUCTION

India as developing country the contribution of the agriculture is major in the development of the country. Most of the population of the country depends on the agriculture. Now days it is facing number of challenges such as climate change, scarcity of water, irregular rainfall, unavailability of electric power for irrigation etc. To overcome these challenges there is urgent need of the system which will help one step towards growth in this domain. The traditional practices followed are planting, fertilizing and harvesting are not working now in current scenarios.

Wireless sensor network, adhoc network, cloud computing , IoT remote sensing etc. are the some of the technologies increasingly becoming popular. We can apply the wireless sensor network system in agriculture application to monitor the farm. WSN can be used as tool which helps to do the smart farming. As precision agriculture which tells specific production from particular location and decision making by data collection for which WSN will going to play major role [5][7][8][14].

**Need of WSN in Agriculture**

Wireless sensor network are deployed on the application field. Which sense real time environment. Here we list different kind of data which collected by sensors related to environment and soil.

- Soil moisture, soil temperature, salinity, water level
- Humidity, temperature, wind speed, wind direction, rainfall

Those collected data will be send to the centralized server location where the data analysis will be done and accordingly the decision making system will be finalized. The collected data is very important for taking the different decisions related to agriculture. If the decision system is best designed for any particular application then definitely there will be advantage to the farmer. This will further help for optimal as well as quality production from the farm.

**Architectures of WSNs:**

The figure 1 shows the wireless sensor network deployed in the agriculture field. This is single-tier architecture. Here sensor nodes are distributed on field at different application places from that location it is going to sense the real time data. In this type of architecture there is directly communication between the sensor node and sink node. According to application requirement there will be communication among the sensor nodes eg. If sensor nodes have to take the decision about the irrigation to farm in that case they will share the information of soil moisture. Then finally by collecting data or sharing decision of irrigation start will be taken. Normally those nodes are placed at the range of communication between each other. Node sense the data as per the conditions specified in the algorithms and go to sleep for specified amount of time quantum. Which cause less consumption of energy by sensor node. For taking the intelligent decisions there is need to store the sensed data which will only possible by providing memory at the sensor node end.

At centralized server end the collected data from the field will be stored which will be used for data mining algorithms as input to find out some hidden patterns.

If end user wants to observe the real time situation then there is provision of web application which provide the interface to the system. By using web application user can see the current temperature, humidity on the field. He will also query through it and gets the information. In some of the application it is also possible to control the system remotely from the user. If the system is deployed for irrigation control in that case he will start or stop it remotely. That information will also send to the user with the help of SMS on mobile phone or as email to the user. There is another type of architecture called multi-tier. Here different levels of hierarchies are maintained. Lower hierarchy passes the information to the higher hierarchy till it reaches the remote sink node and which further forwarded to remote server [9][10].

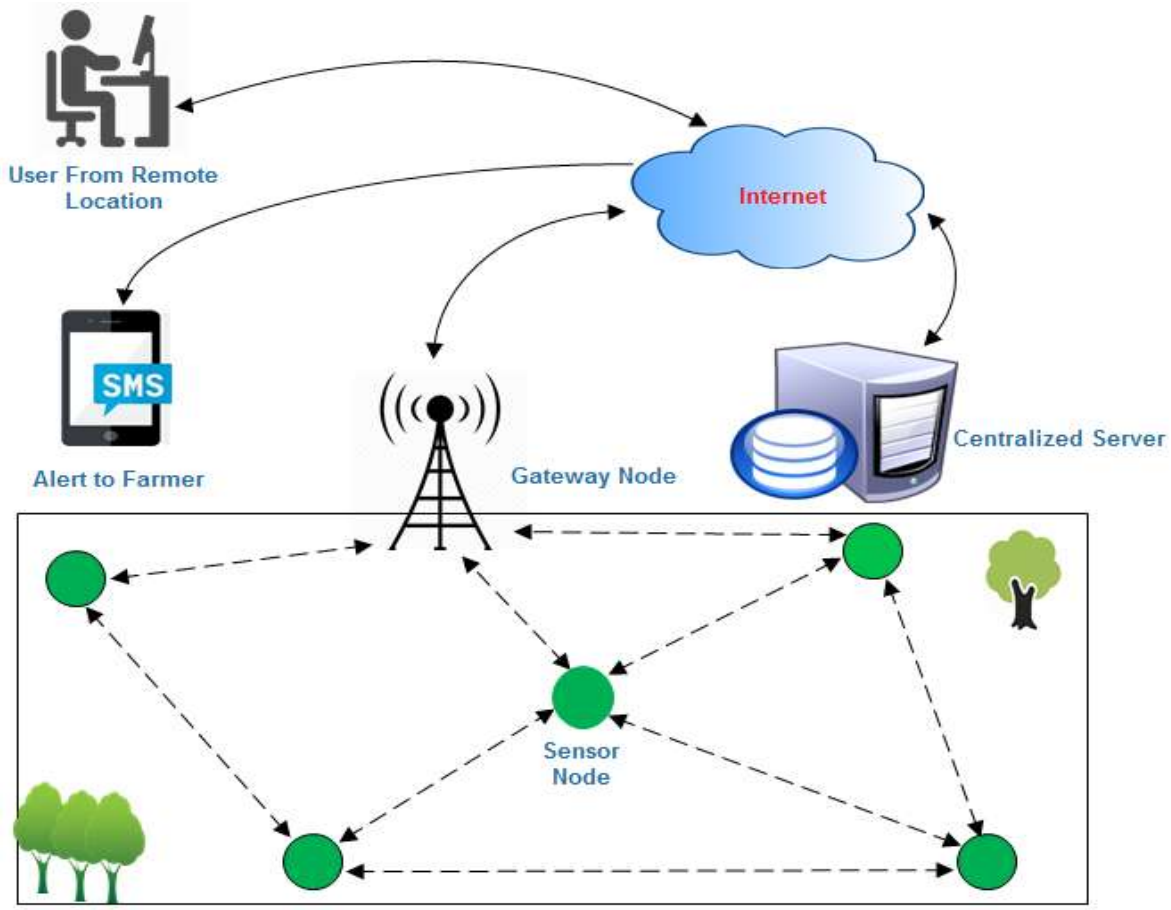


Figure 1. Wireless sensor network deployed on agriculture field.

**Wireless Communication**

**ZigBee:**

Low cost, energy efficient and reliable zigbee is normally preferred for wireless sensor network communication. It is based on IEEE 802.15.4 standard. It is having data rate of 20-40kbps to 250kbps. It is mostly suitable for pesticides and fertilizer control, irrigation management in case of agriculture application [12] [17].

**WiFi:**

It is based on IEEE 802.11, IEEE 802.11 a/g/n standard used for connecting to internet wirelessly or WLAN for data exchange. It is most widely used and available in number of devices. It is having range of 100m outside and data transmission rate 2-54Mbps.

There are also some of the other communication technologies such Bluetooth, GPRS, 3G, 4G and WiMAX. Each of these having differences in data transmission and range capacity.

**Different Applications of WSN in Agriculture**

**Irrigation Management:**

For modern day farming there is need of modified irrigation method which optimizes the water usage. The irregular rainfall, depletion of ground water level and scarcity of water are the motivations for modified methods [3]. The irrigation scheduling can be done based on weather, plant and soil-moisture base. Also the application of water for the crop with proper amount will also helpful for the growth of crop and maximum nutrients gets available in that case.

**Diseases and pests control**

To do the prediction about the diseases there is need of ground level real time data. Based on that data prediction model will be developed those will help to predict diseases and pests. The data collection will be temperature, humidity etc. from the field.

**Fertilizer Management:**

The optimal production with quality depends on use of fertilizers. The proper application of fertilizers to the crop is one of the challenging tasks. The availability of nutrient to the soil will be monitored continuously by using WSN and accordingly the plan of application of fertilizers to the soil will be decided. Which will also helps to maintain the nutrient balance and avoid excessive use of fertilizers cause the pollution in soil, water and air.

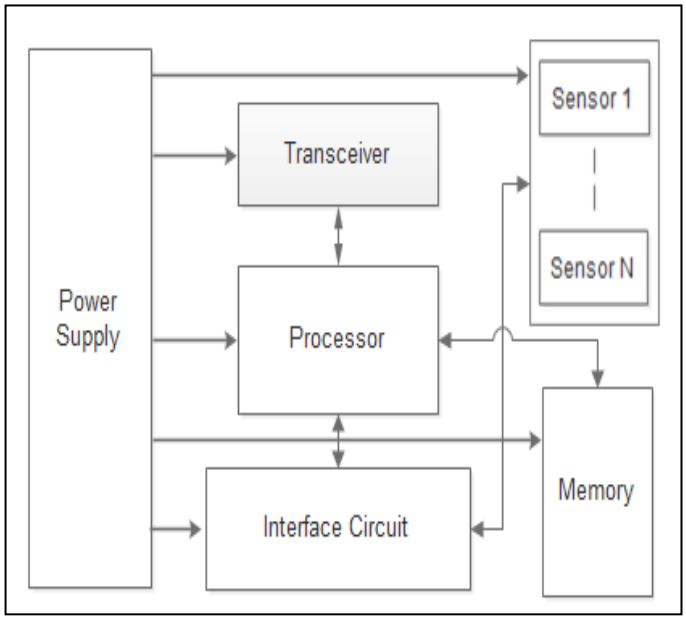


Figure 2 Structure of Sensor Node.

**Remotely farm monitoring**

Here number of advanced devices used for farming which will be controlled remotely. Also additional input such as satellite images, weather forecast and geographical information will provide more information related to farm. With those data usage decision related to farming will be taken [4] [16].

Also there are number of applications of WSN such as cattle monitoring, quality of ground water, monitoring green house gases. The internet of things will help to control and diagnosis the farm devices like pump, light etc.

**Application Specific Sensors**

**Soil Related Sensors:**

Those sensors going to provide the real time parameters information related to soil from the field [2]. Those parameters are soil moisture, soil temperature, salinity, water level and rain or water flow. According to the information provided by it there will be decision related to fertilizers and pesticides application, irrigation etc. will be taken.

**Environment Related Sensors:**

These sensors going to give information of humidity, temperature, atmospheric pressure, wind speed, wind direction, rain fall etc. The collected information will help to build prediction model and hence prediction related to diseases and pests [11].

**Plant Related Sensors:**

These sensors collect the information related to plant such as leaf wetness.

**Case Study:**

Wireless sensor network deployed for groundnut crop field. The experiment conducted in semi-arid region of India[1]. The aim is to findout any relation between crop-weather-environment for that there is need of data at micro level. Experiment conducted during the consecutive seasons i.e. Two kharif and two rabi. The crop losses are majorly due to disease and pests in semi-arid region and having most effect on groundnut crop which is the economically important crop. Precision agriculture aspect with data driven for dynamic disease management where real time data is collected from the field such as temperature, humidity, leaf wetness and stored in the centralized server. Those data will be used as raw input to data mining algorithms which is going to find out the hidden pattern. As increase in the humidity and temperature in between specific range values is most favorable atmosphere for the diseases and pests generation and attack. Dynamics obtained with data mining and training with multivariate regression model and validated with field surveillance data and ARI model. The finding from those is LS disease is due to minimum temperature, leaf wetness, high humidity and age of crop. Those results are used for prediction models and cumulative prediction model has better performance compare to ARI model.

**Challenges in WSN**

**Autonomous and Intelligence:**

The operation of WSN system must be autonomous and surviving till long time. Intelligence allows the system react to the dynamic event immediately.

**Cost:**

If the cost of the WSN system is low then there are again more chances of its application.

**Low maintenance and easy to operate:**

There is need of the system to run for long time with low maintenance cost. Also the end user of the system is nontechnical person so it must be easy to operate.

**Battery Power and scheduling algorithms:**

As major problem with WSN design is energy consumption. So develop such algorithms which will consume less energy.

**WSN as Source of Big Data:**

As WSN is used as subsystem in number IoT application and going to generate the large volume of the data [15]. This data now as one of the source of the big data[13]. So processing the big data in case of WSN is one of the challenging task because the data generated in this case is unstructed. There is need to do the data in-network processing so whatever the data send to the server will be structed as well as easy to process. Also in some of the application the data generated is redundant. To avoid redundancy so approaches like data fusion are used. Which send the only important data.

## CONCLUSION

The WSN is the key technology for the agriculture application when we have to handle the dynamic changes in the environment. Here we have discussed different aspects of the WSN technology. Why there is need of WSN to different types of architecture in the context of agriculture application. Normally the WSN architecture will be decided depends upon the actual application. Single-tier architecture or star topology is the most common type of architecture of the WSN for small type of farm. Also different wireless communication technology such as ZigBee, WiFi, Bluetooth, GPRS, 3G, 4G and WiMAX. Each having differences in their data transmission speed and coverage area. As ZigBee is normally used due to low cost and less energy consumption in this scenario. There are number of applications of WSNs in the agriculture domain such as irrigation management, soil nutrient management, remote controlling and monitoring etc. As IoT given new direction in case of WSN where we can monitor, control and diagnose the agriculture devices. As the system having some of the challenges such as cost, ease of use etc. that must be tackled further. Case study given the success of WSN system for groundnut crop. As future work is to develop the decision model from the collected data for economically important crop.

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