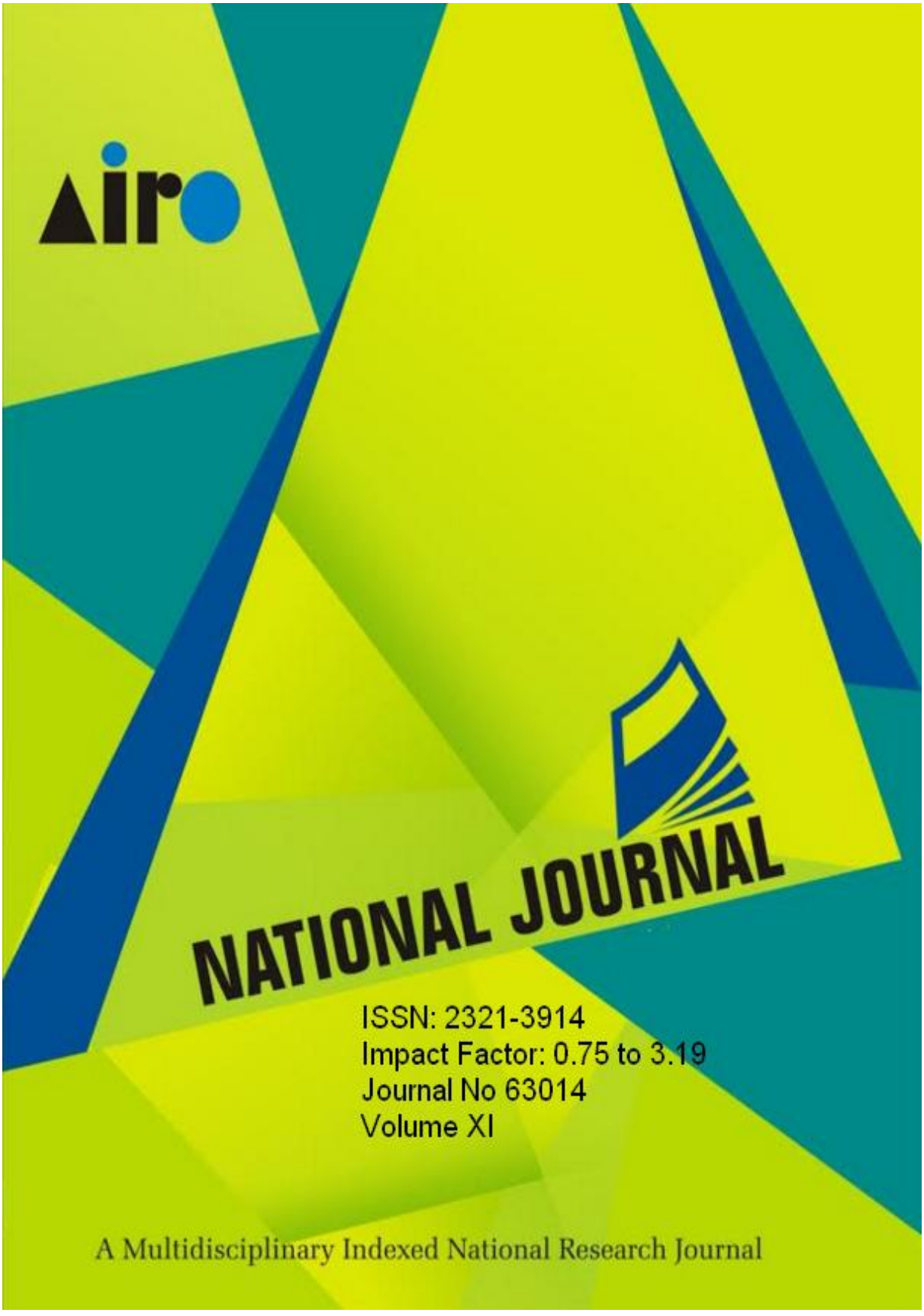
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WIRELESS SENSOR NETWORK TO PRECISION AGRICULTURE ENVIRONMENT PROTECTION

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ABSTRACT

The generation of Wireless Sensor Networks (WSNs) spurred a new direction of research in agricultural and farming area. In these times, WSNs are widely applied in different agricultural applications. In this paper, we eye on the potential WSN applications, and the specific issues and challenges associated with harnessing WSNs for improved farming. To focus on the specific requirements, the devices, sensors and communication techniques associated with WSNs in agricultural applications are analyzed desirably. We present various methodologies to explore the existing solutions proposed in the literature in various categories according to their design and implementation related parameters. In this regard, the WSN deployments for various farming applications in the Indian as well as global scenario are investigated. We focus the prospects and problems of these solutions, while searching the factors for improvement and future directions of work using the new age technologies.

Agriculture has key role in providing the food but climate change, more demand of food and scarcity of water requires modified agriculture methods for agriculture practices. Up gradation with advancement of wireless sensor network, size reduction has increased chances of application of WSN in agriculture field. The proper scrutiny of WSN specific to particular application is complex task for naive user. The objective of this paper is providing an overview of different WSN technologies used in agriculture area. 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 significant application and case study of WSN. At the end we discussed the challenges in WSN and future direction for the work in this field.

Sensor networks are increasingly being implemented for environmental monitoring and agriculture to provide spatially accurate and continuous environmental information and (near) real-time applications. These networks provide a large amount of data which poses challenges for ensuring data quality and extracting relevant information.

Keywords: *wireless sensor network, protection*

INTRODUCTION

Since India is developing country so the contribution of the agriculture plays a major role in the development of the country. Maximum population of the country depends on the agriculture. These days agriculture area is facing number of challenges such as climate change, scarcity of water, irregular rainfall, unavailability of electric power for irrigation etc. To remove these challenges there is urgent need of the system which will give a hand one step towards develop in this area. The conventional practices followed are planting; fertilizing and harvesting are not working properly because of population, now in current scenarios. Wireless sensor network, ad-hoc network, cloud computing, IoT remote sensing etc. are the some of the technologies vigorously becoming popular. We can develop 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 by data collection for which WSN will going to play major role.

Traditionally visual inspection—colour estimation or mould localization—has been used for observing the state and conditions of a crop. Recently, more advanced equipment have been used, such as physical sensors like anemometers or thermometers, and more complex electronic sensors (e.g., pH sensors, gas sensors or hyper spectral analyzers). Nevertheless, data collected from this equipment was cumbersome and not available in real time. Wired sensors networks have been applied as a solution to this problem, but due to the long distances and natural unstructured fields involved, Wireless Sensor Networks (WSN) technology has proven to be a better option. Since the measured parameters have not changed in time, temperature, humidity and solar radiation still remain as the important ones. The introduction of WSN nodes for farm monitoring has led to the possibility for supervising how parameters evolve in real time and how they are related. It thereby provides powerful monitoring equipment. Therefore it allows quick reactions or even predictive actions according to the circumstances. This is probably the reason why many applications have recently emerged using WSN in precision agriculture.

Most WSNs, such as those described in, use WSN humidity sensors for evaluating the specific irrigation requirements for each specific area. Many other projects where WSN technology has been adopted include pesticide control, quality assurance, as well as global monitoring systems. On the other hand, the use of Unmanned Aerial Vehicles (UAV) in agricultural work was started by Japan during the 80s, when Yamaha received a request for developing a new kind of unmanned helicopter for crop spraying purposes. UAVs have been later

introduced in agriculture applications in order to overcome the limitation of conventional remote sensing systems, such as satellites or manned aircrafts, which have shown being inefficient to address agriculture requirements.

REVIEW OF LITERATURES

Wireless Sensor networks can be used for monitoring spatio-temporal changes in climate, hydrology, pressure, motion, soil moisture, plant eco-physiology, pests and reporting best options to the agriculturist. Having such information at regularly would be a big boon for him. In order to ward of the adverse conditions which, challenge the agriculturists, automatic actuated devices can be used to control irrigation, fertigation and pest control. Irrigation management is also one of the important activities in precision agriculture. Microplitis Croceipes, a tiny parasitoid wasp, locates caterpillars attacking cotton plants by keying on a complex volatile organic cocktail emitted from the plant when attacked. Thus, sensors capable of detecting this cocktail would result in early detection and mitigation of these attacks by highly selective pesticide applications or wasp introductions. In precision agriculture (PA), various parameters including soil type and temperature vary dramatically from one region to the other; consequently, any irrigation system must be flexible to adapt to such variations. Off-the-shelf irrigation controllers are usually expensive and not effective in managing scarce water resources. On the other hand, an irrigation management system (IMS) based on wireless sensor networks (WSNs) can accept any desired irrigation scheduling strategy to meet specific environmental requirements. However, WSNs are still under a developmental stage; as such, they are at times unreliable, fragile, and power hungry and can easily lose communication especially when deployed in a harsh environment like an agricultural field [6, 12, and 13]. Crop field monitoring is a crucial practice in agriculture to reduce resource waste and to increase yield in activities like irrigation and fertilization, because it allows farmers to access to solid information on the environmental, soil, and plant conditions and variations of their crops and make decisions from there. Although crop field monitoring have been made traditionally with human resources, single-point agrometeorological stations, and sensor wired networks, this topic immerse in precision agriculture demand a high density and flexible deployment of instrumentations to collect data in real time. WSNs have emerged to offer low-cost, flexible, easy-deployment, and high-accuracy advantages for crop monitoring in real time [8, 13]...

RESEARCH METHODOLOGY

The wireless sensor network deployed in the agriculture field is single-type architecture. Here sensor nodes are distributed on field at different point places from that location it is inspecting to acquire the real time data. In this type of modal there is straight 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 distribute the information of soil moisture. Then finally by collecting data or sharing decision of start of irrigation 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 instructions and go to sleep for specified amount of time quantum. Which cause less consumption of energy by sensor node? For taking the sensible 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

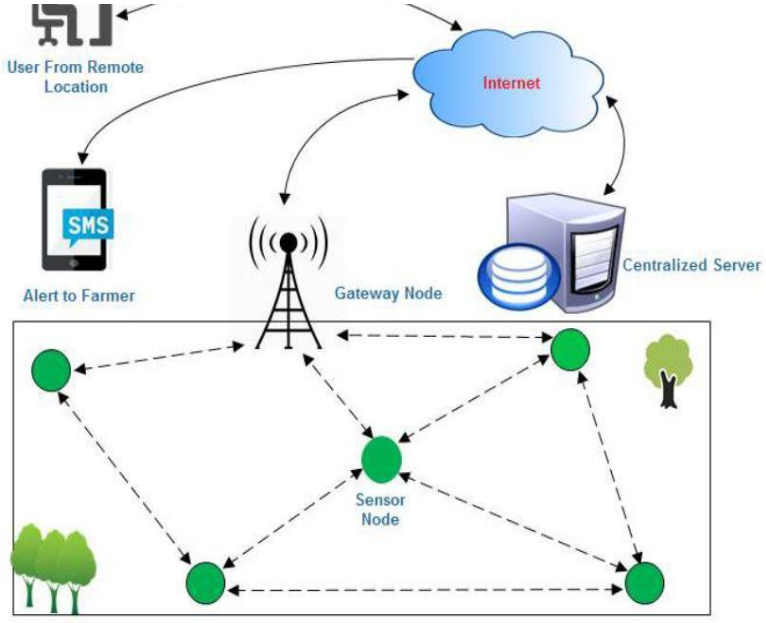

Figure 1. Wireless sensor network deployed on agriculture field.

Design of a wireless sensor network for agricultural domain

This section, we discuss the network architecture considered in various agricultural applications. We classify the architectures in various categories and highlight the potential agricultural applications suitable for each one. Provides a visual depiction of the architectures classified with respect to different parameters. Based on the movement of the networked devices and nodes, we classify the existing architectures in the following categories:

Stationary architecture: In the stationary structure, the sensors are equipped at a fixed position, and during the application duration, they do not change their position. Typically, applications such as irrigation management system, ground water quality monitoring, and controlling the use of fertilizers require stationary architectures.

Mobile architecture: Mobile structures consist of devices that can change their position with time. An example of applications based on such architecture will be an autonomous network of tractors and cell phone carrying farmers serving

the purpose of ubiquitous farming operations.

Hybrid architecture: In the hybrid structure, both stationary and mobile nodes are present. For example, this type of architecture is applicable to farming applications consisting of stationary field sensors, mobile farming equipments, cell phones carrying users, and moving cattle.

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.

Plant Related Sensors:

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

RESULTS AND DISCUSSIONS

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. 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.

Remotely farm monitoring

The number of advanced devices applied for farming which will be controlled remotely. Also an extra input such as satellite images, weather forecast and geographical information will provide more current knowledge related to farm. With those data usage decision related to farming will be taken. 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

Monitoring of vineyard farm

On applying pervasive and mobile computing technologies in vineyard monitoring to increase the quality of production and reduce the production cost and the effect of crop related diseases. We reinvestigate one of the existing works as a case study.

Farming with precision

Precision farming is aimed to generate greater productivity with reduced costs. Wireless ad-hoc and sensor networks are utilized in precision farming to collect field data which can then be analysed to find the best farming conditions. Crop disease risk evaluation Crop diseases, calamity is the root causes of less production and revenue losses.

CONCLUSION

The WSN is the significant technology for the agriculture and farming when we have to manage the dynamic transformations in the environment. We have gone through the different aspects of the WSN technology. There is need of WSN to different types of architecture in the context of agriculture and farming. 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 one 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 uses of WSNs in the agriculture are 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 crop management. As future work is to develop the decision model from the collected data for economically important crop.

The inclusion of WSNs is envisioned to be useful for advancing the agricultural and farming industries by introducing new inventions. In this survey, we have presented a comprehensive review of the state-of-the-art in WSN deployment for advanced agricultural technologies, devices, sensor networks, nodes and applications.

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