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Research Article

A STUDY OF WIRELESS SENSOR NETWORK TECHNOLOGIES INPRECISION AGRICULTURE

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ABSTRACT
In current trends, Wireless sensor networks (WSN) technology can be used extensively in various agricultural applications such as underwater monitoring, infrastructures, and improve the quality and productivity of farming, etc, New wireless communication technologies are also a necessary part of increasing the efficiency of agriculture in today's era. In this work, an optimized ZigBee-based wireless technology is used to observe the agricultural lands and smart greenhouses. The prediction of soil moisture helps the farmer to make the right decision about their crops plantation.

Keywords*: Wireless Sensor Networks, ZigBee, Soil Sensor*

INTRODUCTION

Because of readily available the Wireless sensor networks (WSN) are widely used for a variety of applications such as environmental risk monitoring, medical monitoring, traffic signal control, agricultural monitoring, disaster management, and etc., because of low cost. WSN has some capabilities such as computation, sensing, and also wireless communication between the two or more devices. The small sensor node communicates within a short distance and is a collaboration to accomplish the specific application objectives of WSN [1]. In recent decades, the wireless sensor network has created a remarkable impact in the agriculture sector. This helps the farmers to constantly monitor their crops and further improve the productivity of their crops also.

The sensors commonly used by the farmers in their agricultural lands are soil temperature, soil moisture, and soil humidity sensors. Due to the use of cognitive intelligence in the Internet of Things (IoT) along with wireless sensor networks and cloud technologies in smart agriculture play a vital role to meet the following parameters. These results increase the yield productivity by the effective utilization of input parameters such as soil, fertilizers, and pesticides, monitoring the livestock, predicting the pest and diseases, scanning storage capacities like water tank level, monitoring the crops are fed, and watered well [3]. In addition, the Internet of Things (IoT) was designed with the support of microcontrollers and communication devices and are operated together to bring about a remarkable change in technology [4,5]. The WSN is generally considered to be the successor to ad hoc networks. It is defined as a network of wireless devices, called nodes, which integrate processing, communication, and acquisition capabilities and communicate via wireless links [6].

WSN has made a collection of environmental or physical conditions in order to transmit data cooperatively and autonomously for treatment points to control a particular phenomenon [7,8]. Sensor networks include three basic functions as detection, communication, and computation analysis, making them active in the creation of smart environments [6]. WSN has many intrinsic characteristics at the different levels of the network which was formed by the sensor nodes and is suitable for all types of environments like rural or urban [6]. Here, each individual process must be optimized to improve its efficiency. Processes such as sensing and operating systems are most probably based on application

requirements while using IoT devices, so reducing their energy consumption is difficult [9].
In this work, Zigbee technology is proposed along with the efficient wireless sensor nodes in the agricultural sectors. According to this approach, the minimum number of nodes used in the wireless network and the distance between the nodes are to be considered to establish an inexpensive wireless sensor network. It is revealed that this research work approach assured the usage of the number of nodes to at least enhance network sustainability.

Wireless sensor networks
The wireless sensor network is designed with numerous sensor nodes which are connected to each other through any wireless connection module. These nodes have a different variety of abilities such as processing, transmission, and sensation that are self-organizing and they can be deployed precisely or randomly [6]. In general, the sensor nodes extend over the sensor field in WSNs. It has the capabilities to route and gathers data at each node to create and incorporate a global view of the controlled field. For the subsequent process, the collected data are routed directly or through sensors to a collection point using the multi-step architecture, which is known as a base station.
The base station will function as a gateway node when there is a need for connection and communication with the external network for decision-making and data analysis [10],[11]. The wireless sensor networks structure is shown in figure 1[6].

Similarly, the automatic irrigation scheme for agricuture using WSN, ZigBee and sensor are shown in the figure 2.

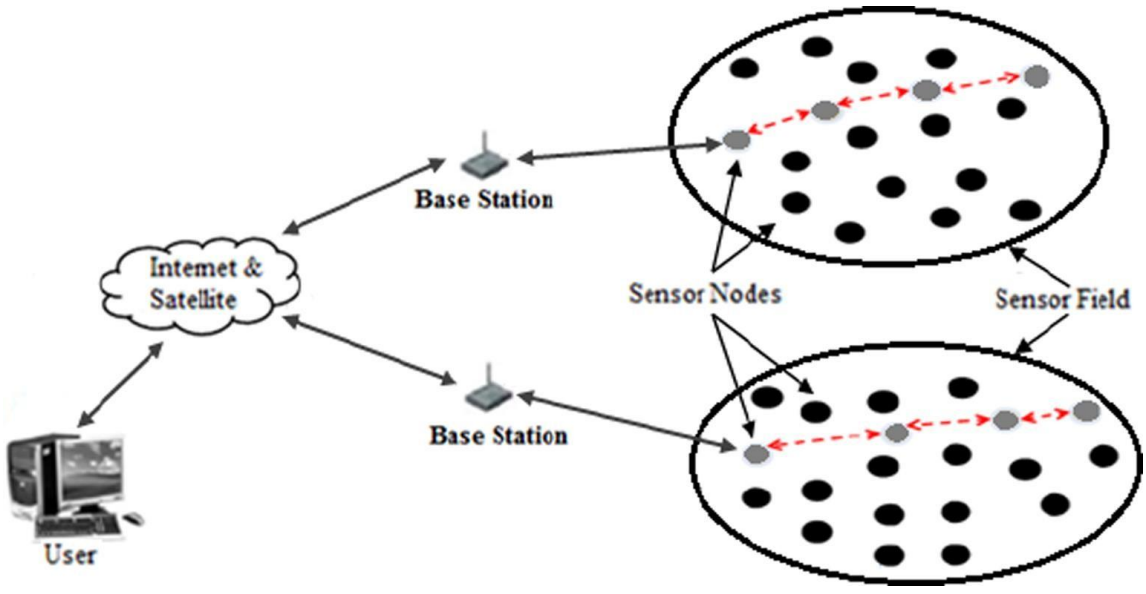


Fig. 1. Structure of wireless sensor network

Smart Agriculture
Smart agriculture is designed for the farmers to monitor their agriculture yield in real-time as well as cost-effectively. Wireless Sensor Network plays a significant role in improving agriculture recently. Farmers are able to collect live information about the land and process their operation using wireless sensor networks. The agriculture domain needs several requirements that are following [12]:

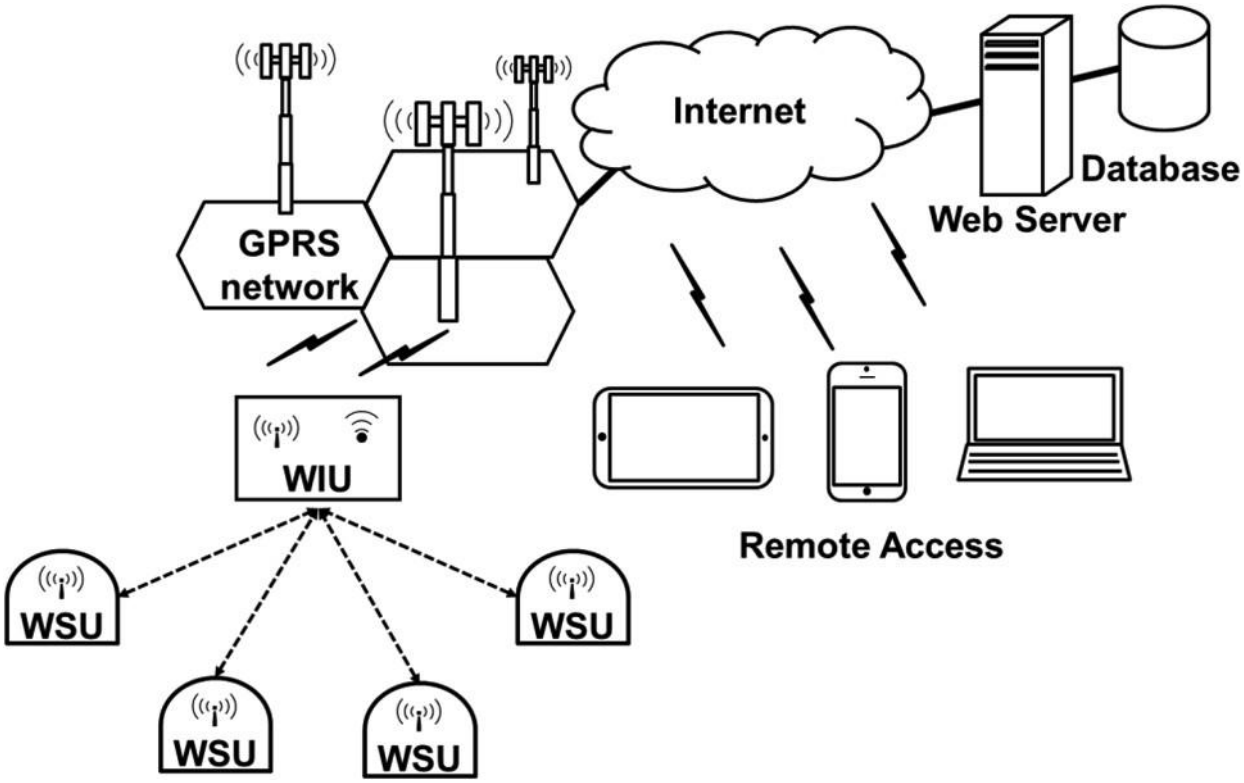


Fig. 2. Automated irrigation system (configuration of a wireless information unit and wireless sensor units) using WSN, ZigBee, and GPRS (Gutiérrez et al.,2014).

(a) Real-time data collection from fields such as humidity, soil moisture, temperature, andrainfall, etc.
(b) Processing the collected data
(c) Send alert messages to the farmer.
(d) Monitoring the land.
(e) Distribution of water requirement to crop.

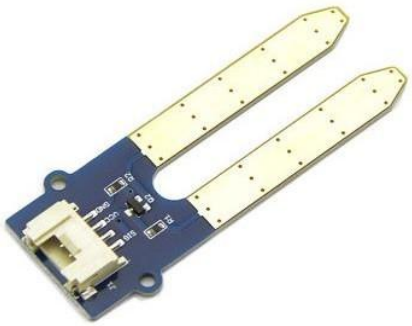
Wireless communication technology
Many wireless communication technologies are used in the wireless sensor network to significantly communicate data for develop the irrigation systems. There are several technologies such as ZigBee, Wi-Fi, and Bluetooth, which are widely used.

ZigBee:
ZigBee is introduced by the ZigBee Alliance for wireless communication technology[6],[13]. The frequency range of Zigbee works at 915 MHz, 868 MHz, and 2.4 GHz and its data rate are 250 kbps making it suitable for intermediate and periodic data transmissions from an input sensor or devices. The main features of ZigBee is to be low-cost, simple to use and install, consumes less power, energy, and usage of unlicensed radio frequency bands

GPRS:
GPRS (General Packet Radio Service) is also a one of the wireless communication service that works on a mobile network using IP address. It offer internet services and also used to transmit data packets over cellular networks. It operates in the frequency band of 2.4 GHz and its distance coverage is extended up to a few kilometers.

Microcontroller:
It is used to connect all the hardware components together. The ATmega328P is used and which contains six analog-to-digital converter that can connect and read data from analog sensors.

Grove Soil Moisture Sensor:
The soil Grove Soil Moisture Sensor (Grove - moisture sensor) is used measured parameter in agricultural monitoring for real time applications.This sensor has a remarkable amount of less current usage and reduces the device lifetime when environmental conditions are being measured [9].



Procedures and steps for establishing a smart irrigation system using WSNs

A. Install the group of sensor nodes in the agricultural area to be irrigated in order to set up a WSN.
B. Monitoring the different environment parameters such as soil parameters (e.g., temperature and moisture) and weather parameters. (e.g., temperature, wind speed, and humidity) at predetermined times depending on the type of soil and crop being used.
C. For further analysis the measured data and transmitting the obtained data to the coordinator node.
D. Exploitation and utilization of the processed data by the coordinator node in such a way that the control unit will make the decision to open or close the electro valve, and thus activate or deactivate the irrigation system.
E. For future purpose the processed data are recorded and saved.

CONCLUSIONS
Recently, farmers are facing huge problems in getting a good yield of crops due to improper weather conditions. Because of this farmers are facing a lot of financial problems in their agriculture. Therefore, in this work the automated irrigation and soil monitoring system using WSN, ZigBee, and sensor. In addition, this proposed work helps the farmers to monitor their agricultural yield in real-time and as well as be cost-effective. Similarly, it reduces the effort of the farmers and also increases the utilization of wireless sensor networks along with the sensor to improve the crop yield and minimizes the usage of water resources.

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