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An efficient LoRa-based smart agriculture management and monitoring system using wireless sensor networks

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ABSTRACT

The objective of this paper is to build up a LoRa-based smart agricultural management and monitoring system using Wireless Sensor Networks (WSNs) in rural areas, in order to replace the current technology of the agricultural monitoring system. A private network server is created and interfaced with a gateway that collects data or signals from end nodes and transmits the data to the cloud without the use of routers. The data can be used for end user application. The network interface is fulfilled by LoRa by solving communication failure problems and energy saving data transmission. This intelligent agriculture platform improves the efficiency of agricultural techniques.

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KEYWORDS
LoRa; smart agriculture; Wi-fi; wireless sensor networks; temperature

1. Introduction

In recent years, due to the decrease in the usage of water and an increase in the crop yields, the implementation of the automated agricultural monitoring system is an important thing (Suresh et al. 2020; Karthik et al. 2020; Subasri et al. 2020). The availability of computer systems and modern electronics in the field of agriculture has shaped new research challenges. In recent years, many surveys and studies were conducted to measure the impact of agriculture transformation. In the past years, ZigBee and Bluetooth standards majorly established the low-power and short-range networks, enabling the users to use mesh network topology (Nishikori et al. 2017; Xiao and Li 2020). Even though they are considered for low cost, their major drawback is the coverage, usually up to 100 m (Dharshan et al. 2021; Kaushik et al. 2021; Patel et al. 2021; Senthil Kumar et al. 2021 Sharmila et al. 2021). Low Power Wide Area Network provides another solution for building long range and power, and also low rate transmission technology (Kabeel et al. 2020; Sheela et al. 2020; Ashokkumar et al. 2021). Long-range radio links are the major difference between LPWAN and previous technologies (Mekki et al. 2019). Another important key characteristic of LPWAN is star topology. LoRaWAN, NB-IoT and Sigfox are some examples of LPWAN. Each and every technology has its own advantages and disadvantages. All these technologies have a coverage distance of several kilometres and have their own advantages and disadvantages, in terms of the scalability, cost, data rate and power consumption. Among them, Lora is a new technology having the highest of which the LoRaWAN protocol operates (Germani et al. 2019). It has the highest radio link budget and the best cost effective in this range against power tradeoff among its models. That is the reason for choosing LoRa modem as a radio link. At present, there are lot of developments happening in LPWAN networks. But, single technology cannot provide solutions to all the challenges. Thus LPWANs area unit employed to handle exclusively some on challenges in IoT. LPWANs are used specifically when there is a need for extended coverage, need of low power consumption network, involving devices with high data rates and with some delay tolerance. Particularly, monitoring the system conditions is perfect where LPWANs work perfectly. The main objective of the paper is to incorporate IoT and transreceiving technology into the smart field environment (Siddique et al. 2019). Various types of sensor data are measured with their accuracy and these data integrated into the input of the sensor component.

An automatic miniaturised greenhouse monitoring system was developed (Ibrahim et al. 2019). This system will monitor constantly and continuously on environmental factors in the orangery, to make sure that it stay in preset levels of temperature and humidity. If the greenhouse surrounding condition is slightly diverge from preset values, and then the monitoring system will automatically turn the sensors in the devices to compensate the preset level conditions. For this monitoring system, four different types of sensors were used for automatic greenhouse monitoring setup implementation. All the data and signals from the sensor are given to the microcontroller which acts as the main control unit. These values are transferred to the

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