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DEVELOPMENT OF A LORAWAN WIRELESS NODE FOR MONITORING SMART GREENHOUSES

Hongbin Jin[1], Emmanuel Bicamumaku[1] , Md Aminur Rahman[1], Md Nasim Reza[1,2], Kyu-Ho Lee[1,2], Sun-Ok Chung[1,2*]

[1] Department of Smart Agricultural Systems, Graduate School, Chungnam National University, Daejeon 34134, Republic of Korea. [2] Department of Agricultural Machinery Engineering, Graduate School, Chungnam National University, Daejeon 34134, Republic of Korea

*Corresponding Author: sochung@cnu.ac.kr

ABSTRACT

The adoption of Internet of Things (IoT) technologies in the smart greenhouse domain is rapidly advancing. Greenhouse planting improves quality and yield by controlling factors affecting crop production. Temperature, humidity, and light intensity in greenhouses are important factors affecting crops. Monitoring and regulating these parameters is conducive to improving the quality and yield of crops. Traditional greenhouse monitoring systems that use wired connections often have problems with complex and inconvenient wiring. Wireless systems using technologies like Wi-Fi or Bluetooth also face issues, such as limited range and unstable connections. Low Power Wide Area Network (LPWAN) technologies, especially LoRaWAN, offer a new solution with advantages like long communication distance, low power use, low cost, and wide coverage. This project aims to build a prototype of a monitoring system for greenhouses, using an IoT setup based on LoRaWAN modules. The experimental setup consisted of a greenhouse simulator (2.53 m × 2.0 m × 2.0 m). Environmental data, including temperature, humidity, CO_2, and light, each incorporating temperature-humidity sensors and a LoRaWAN transceiver for long-range wireless communication. In this system, ChirpStack is installed on a Raspberry Pi, which functions as the LoRaWAN network server. The LoRaWAN gateway and the Raspberry Pi are connected to the same Wi-Fi network, allowing seamless communication between them. The sensor nodes transmit environmental data using the LoRaWAN protocol, and the gateway forwards the packets to the ChirpStack server running on the Raspberry Pi. The ChirpStack server handles data decoding and device management and forwards the data to an external application server or database for further processing and visualization. Environmental parameters such as temperature, humidity, CO_2, and light were measured with high accuracy. The sensing nodes consistently transmitted data at regular intervals without significant delays. While the study demonstrated the accuracy of the system, it is recommended that further research be conducted to test its monitoring status within a real greenhouse environment.

Keywords: Greenhouse simulator, LoRaWAN, IoT, node, wireless communication

INTRODUCTION

Low-power wide-area network (LPWAN) technology offers advantages over traditional wireless technologies, including low power consumption and long-range communication capabilities. Among these, Long-Range Wide Area Networking (LoRaWAN) provides a medium-range access mechanism, enabling numerous nodes to communicate with the network management system via LoRa modulation (Jabbar et al, 2022). This experiment aims to verify the accuracy of the collected data and the transmission performance of the sensor node.

MATERIALS AND METHODS

The greenhouse monitoring system was developed using an IoT architecture based on LoRaWAN communication. In the experimental greenhouse simulator, each node integrated a DHT22 temperature-humidity sensor, a CM1106 CO_2 sensor, and a P5144-9 light sensor with an MKR WAN 1310 microcontroller to enable long-range wireless communication. The data were transmitted via the LoRaWAN protocol from the sensor nodes to a SenseCAP M2 gateway, which forwarded the packets to the ChirpStack server deployed on a Raspberry Pi for decoding, storage, and further processing The greenhouse monitoring system was developed using an IoT architecture based on LoRaWAN communication. In the experimental greenhouse simulator, each node integrated a DHT22 temperature-humidity sensor, a CM1106 CO_2 sensor, and a P5144-9 light sensor with an MKR WAN 1310 microcontroller to enable long-range wireless communication. The data were transmitted via the LoRaWAN protocol from the nodes to a SenseCAP M2 gateway, which forwarded the packets to the ChirpStack server deployed on a Raspberry Pi for decoding, storage, and further processing.

RESULTS AND DISCUSSION

Nodes accurately measured and transmitted environmental data, with temperature deviation within ±0.5 °C and humidity deviation within ±2% RH. Data were transmitted at fixed one-minute intervals with a successful packet delivery rate of 95% . The experimental setup verified the reliability of the system in a simulator.

CONCLUSIONS

This node provides an efficient solution for monitoring greenhouse environments. It also has a wider transmission range and higher stability. Future work will focus on evaluating its long-term performance and robustness under real greenhouse conditions.

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