Advanced IoT-Based Automated Greenhouse Monitoring System Using Arduino and GSM Modules for Sustainable Agricultural Enhancement

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ABSTRACT

Purpose: The purpose of this study is to develop a cost-effective IoT-based greenhouse monitoring system that automates the control of critical environmental parameters such as temperature, humidity, soil pH, and electrical conductivity (EC). The research aims to address inefficiencies in traditional manual methods and provide a scalable solution that can be adapted for diverse agricultural applications.

Design/methodology/approach: A structured survey of 25 greenhouse farmers in the Gampaha District of Sri Lanka identified key environmental challenges, including temperature and humidity management and nutrient delivery. Based on these findings, an IoT system using Arduino and GSM modules was designed and simulated using Proteus software to evaluate its ability to maintain optimal conditions. Real-time data is transmitted via GSM modules, allowing remote monitoring and control.

Findings: The system successfully regulated temperature, humidity, and pH levels, providing consistent environmental conditions. The simulation results showed rapid responsiveness and reliable data transmission, demonstrating the system's potential to reduce manual intervention and optimize crop growth.

13th Annual International Research Conference – 2024
Faculty of Management and Commerce, South Eastern University of Sri Lanka
ISBN: 978-955-627-030-3

Practical implications: The system offers a low-cost and adaptable solution for small-scale farmers, enhancing crop productivity while minimizing labor costs. Its flexible configuration enables application to different crop types, making it suitable for varied greenhouse setups.

Originality/value: This research presents a unique, scalable IoT solution for small- and medium-scale greenhouses, contributing to sustainable agricultural practices by integrating real-time monitoring and automated environmental control.

Keywords: ***IoT, Greenhouse Monitoring, Arduino, Sustainable Agriculture, Crop Adaptability.***

ISBN: 978-955-627-030-3