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Green House Monitoring System

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***Abstract*: The proposal highlights the importance of continuous control and monitoring in greenhouses for optimal crop growth, which traditionally requires expensive, complex equipment and extensive wiring. Conventional systems also lack remote monitoring capabilities, making them less convenient for growers and planters. To address these issues, an innovative, event-based greenhouse control system is proposed. This system offers cost-saving benefits, low maintenance, and superior performance, while reducing dependency on human labor. It aims to simplify operations and enhance efficiency in greenhouse production practices.**

***Keywords*: greenhouse control system, event-based control, crop growth optimization.**

1. Introduction

Greenhouses, typically constructed with glass or clear plastic, serve as controlled environments for cultivating crops, protecting them from harsh external factors while allowing for natural light transmission. They play a crucial role in enabling the growth of plants that require specific climate conditions. In Malaysia, where high humidity and heat prevail throughout the year, greenhouses help grow temperature-sensitive crops like apples, strawberries, pears, tomatoes, and more, especially in regions like Cameron Highlands Agrotechnology Park. In Western countries, greenhouse technology is also widely adopted to overcome seasonal climate variations, improving productivity and profits. For example, Holland employs greenhouses to grow lilac bushes and enhance agricultural output.

Modern greenhouse management systems aim to regulate key internal factors, such as temperature and humidity, which are vital for plant growth. Over recent decades, advanced sensors have been incorporated into these systems to monitor environmental conditions accurately. However, traditional wired systems, while easy to install and extend, pose challenges in terms of maintenance costs and complexity, particularly for large greenhouses. Additionally, while monitoring temperature and humidity is essential, it is increasingly recognized that detailed, crop-specific growth data is equally important for optimizing production efficiency.

The evolution of greenhouse technology and management systems continues to address these challenges, offering innovative solutions to enhance cultivation, reduce costs, and increase automation. This progression is essential for meeting the growing global demand for food and improving agricultural sustainability.

2. Literature Survey

A. Role of Agriculture in Society

- Agriculture is fundamental to societal welfare and international economic exchange.
- Increasing global food demand highlights the need for innovative and sustainable farming solutions.

B. Challenges in Conventional Farming

- Climate change delays crop seeding, limiting agricultural production growth to only 3% above demand.
- Improper use of fertilizers and pesticides degrades soil quality and reduces crop nutrition.

C. Importance of Greenhouse Technology

- Greenhouses provide controlled environments, improving crop growth, transplantation, harvesting, and yield.
- Suitable for cultivating flowers, fruits, and vegetables in tropical nations where land availability is limited.

D. Automated Greenhouse Systems, Shankaraiah et al. 2019

- Prototype greenhouse controls humidity, temperature, and soil moisture using sensors like DHT11 and LM35.
- Features include plant image capture and feedback control for precise calibration and settings adjustment. b. Shelvane et al. (2019):
- Developed a Raspberry Pi-based system for real-time remote monitoring.
- Integrated sensors (DHT11, soil moisture sensor, LDR) monitor temperature, humidity, soil water content, and light intensity.
- Hardware controls resources like cooling fans, artificial lights, and motor pumps.

E. IoT-Based Smart Farming a. Gondchawar et al. 2016

- Introduced a GPS-controlled robot for tasks like spraying, weeding, moisture sensing, and security.

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- Smart irrigation and real-time field data-based intelligent decision-making integrated into the system.
- Warehouse features include temperature and humidity control and theft detection, managed via remote smart devices.

3. Methodology

A smart greenhouse system utilizing the Blynk IoT app represents a groundbreaking innovation in automating greenhouse operations to reduce labor and resource costs while optimizing plant growth. This research introduces a real-time, mobile-app- based monitoring system to revolutionize greenhouse agriculture. Conducted at the Department of Computer Science and Engineering, American International University-Bangladesh (AIUB), from February to April 2023, the study leverages the capabilities of the Blynk IoT application to provide seamless monitoring and control of greenhouse parameters, both manually and remotely.

The system incorporates multiple environmental sensors, such as temperature, humidity, soil moisture, light intensity, and Light Dependent Resistor (LDR) sensors, to gather continuous data. It allows farmers to oversee and manage greenhouse conditions with ease. A fire sensor is integrated for safety, while tailored alerts notify users of changes like irrigation needs or temperature adjustments. The system automates the operation of essential components such as fans, lights, and humidifiers when environmental parameters fall below predefined thresholds. Additionally, a water pump, activated by soil moisture levels, ensures optimal irrigation and can also be remotely controlled.

The results demonstrate that the proposed system provides real- time updates on sensor data and efficient device control through the mobile app, with rapid processing subject to internet quality. Upon successful implementation, this innovative system is expected to significantly benefit farmers in Bangladesh by transforming greenhouse management. By improving efficiency, reducing costs, and enhancing crop yields, it paves the way for more sustainable and advanced agricultural practices. This approach has the potential to redefine farming techniques and set new standards in agricultural technology.

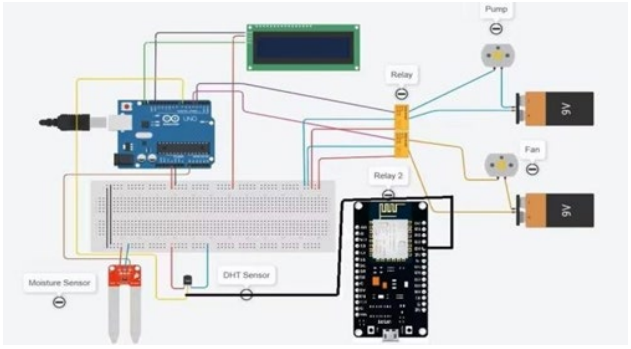

Fig. 1.

4. Hardware Components

1. Raspberry Pi Zero (Version 1.3) The Raspberry Pi is an affordable, compact computing device that connects to a monitor or TV and functions with a standard keyboard and mouse. It is ideal for experimenting with computing and learning programming languages like Scratch and Python. The Raspberry Pi Zero version includes a camera connector, specifically compatible with the Raspberry Pi Zero Camera Cable, allowing enhanced functionality for projects involving camera integration.
2. Soil pH Sensor This sensor measures the pH of the soil, which is crucial for plant growth. Every plant thrives within a specific pH range, and monitoring soil pH determines fertility and nutrient availability. The sensor consists of two stainless steel probes that are inserted vertically into the soil to classify the pH as acidic, alkaline, or neutral. Soil pH plays a significant role in supporting microorganisms and maintaining nutritional balance, except for plants like sweet potatoes and blueberries, which prefer unique pH conditions.
3. Soil Moisture Sensor The soil moisture sensor measures the volumetric water content in soil or similar materials. Its two exposed pads act as electrodes to detect the conductivity changes caused by water content. When linked to a module and ADC (MCP3208 12-bit 8-channel) chip, the sensor provides real-time data, enabling precise water management for crops.
4. DS18B20 Sensor The DS18B20 temperature sensor delivers high-resolution data (9-bit to 12-bit), which reflects the temperature of a given environment. Using a one-wire transport protocol, it connects to internal chips via a single information line and draws power directly from this line. This sensor is widely used in mechanical systems, thermostatic controls, consumer electronics, and thermometers due to its versatility and energy efficiency.
5. GSM Module (900A) The GSM/GPRS module uses a Subscriber Identity Module (SIM) and radio frequencies (850MHz, 900MHz, 1800MHz, and 1900MHz) to enable GSM communication. It can send SMS notifications to farmers and interact with the Raspberry Pi to automate message-based communication, enhancing user convenience and system connectivity.
6. LDR (Light Dependent Resistor) Module This module measures light intensity and functions as both a digital and analog sensor. The onboard photoresistor detects light levels, where its output increases in the absence of light and decreases when exposed to light. Sensitivity can be adjusted using an onboard potentiometer, enabling precise control for applications like automatic lighting systems.
7. Water Pump The water pump operates on mechanical and hydraulic principles to deliver sufficient pressure for water flow. When the soil becomes dry, the pump, connected to the Raspberry Pi via a relay, activates to supply water as required. This ensures efficient irrigation and optimal crop hydration.

5. Problem Statements

In Malaysia, the majority of greenhouses still depend heavily on absence of an efficient control system results in operational

inefficiencies and increased labor costs. To ensure optimal productivity, it is imperative to implement a control system reduces reliance on manpower, minimizes operational costs, and enhances plant production.

Furthermore, Malaysia's equatorial climate, characterized by consistently hot and humid conditions throughout the year, presents challenges for crop cultivation. By integrating an advanced control system, greenhouses can create ideal conditions for crop growth, irrespective of external weather or environmental factors. This approach is expected to significantly improve productivity and profitability for the agricultural sector.

6. Scope of Study

The primary focus of this project is the application of an effective control system to enhance greenhouse operations. However, the scope is not confined solely to its application. Various control system methodologies will be implemented, compared, and analyzed to identify the optimal solution that aligns with the project objectives.

The project incorporates techniques acquired during academic coursework and internship experiences to ensure accurate and consistent results. At the conclusion of the study, a comprehensive analysis of the results will be conducted to determine whether the project successfully meets its objectives. Additionally, suggestions and recommendations for improving the project across various dimensions will be formulated.

It is acknowledged that there are certain limitations to the project that lie beyond the researcher's control, which may impact the outcomes.

7. Conclusion

The greenhouse control system plays a crucial role in advancing crop and plant production, regardless of scale. Modern farmers increasingly recognize that investing in such systems can significantly lower operational and production costs when managed effectively. By implementing a control system, reliance on human labor is greatly reduced, addressing the errors traditionally associated with manpower. Moreover, these systems enhance efficiency and reliability, surpassing human performance in accuracy and consistency. Ultimately, the objectives of this project have been successfully achieved, demonstrating the transformative potential of control systems in agriculture.

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