# IOT Based Smart Greenhouse System Using Mobile Application

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**Abstract- The abstract encapsulates the essence of the IoT-based Smart Gardening System in a concise manner. It outlines the system's core functionalities, emphasizing its reliance on sensor technologies and automation to monitor and control environmental factors crucial for plant health. Specifically, the abstract highlights the role of sensors such as DHT11 for temperature and humidity monitoring, and soil moisture sensors for assessing soil moisture levels. Furthermore, it underscores the system's ability to automate irrigation processes based on real time sensor data, thus ensuring optimal growing conditions while minimizing manual intervention. By providing a high-level overview of the project, the abstract serves as a succinct reference for understanding its scope and objectives. The agriculture sector faces numerous challenges, including unpredictable weather conditions and the need for efficient resource management. To address these challenges, the integration of Internet of Things (IoT) technology in agriculture has gained significant attention. This project aims to develop an IoT-based Smart Greenhouse system equipped with a mobile application to monitor and control greenhouse conditions remotely.**

## 1.INTRODUCTION

The traditional methods of agriculture are rapidly evolving with the integration of modern technology, particularly through the advent of the Internet of Things (IoT). In response to the growing demand for sustainable and efficient farming practices, the concept of smart agriculture has emerged as a promising solution. At the heart of this evolution lies the Smart Greenhouse system, a sophisticated application of IoT technology tailored specifically for controlled environment agriculture. The Smart Greenhouse system represents a paradigm shift in the way crops are cultivated, offering unprecedented levels of precision, automation, and remote management. By harnessing the power of interconnected sensors, actuators, and data analytics, this system empowers farmers and greenhouse operators with real-time insights into environmental conditions and the ability to optimize growing conditions with unparalleled precision. This project end evoalate to develop an IoT-based Smart Greenhouse system, coupled with a mobile application interface, to provide users with seamless control and monitoring capabilities. The integration of IoT technology with greenhouse operations holds immense promise for revolutionizing agricultural practices, offering benefits such as increased crop yields, resource efficiency, and sustainability. In the following sections, we will delve deeper into the methodology, key features, and objectives of the IoT-based Smart Greenhouse system with a mobile application, highlighting its potential to transform the agricultural landscape and contribute to the advancement of smart farming technologies.

## 2.LITERATURE REVIEW

"Smart Greenhouse Automation System Based on IoT" (2017) by S. Divya and R. Ilango: This paper presents an IoT-based smart greenhouse system that utilizes sensors to monitor parameters such as temperature, humidity, soil moisture, and light intensity. The system employs actuators to control ventilation, irrigation, and shading based on the collected data.

"Design and Implementation of IoT-Based Smart Greenhouse Monitoring and Controlling System" (2019) by H. A. Almansoori et al.: This study proposes a smart greenhouse system that integrates IoT technologies for real-time monitoring and control. The system includes sensors for environmental monitoring and actuators for controlling fans, heaters, and irrigation systems. Data collected from the greenhouse are transmitted to a cloud platform for analysis and visualization.

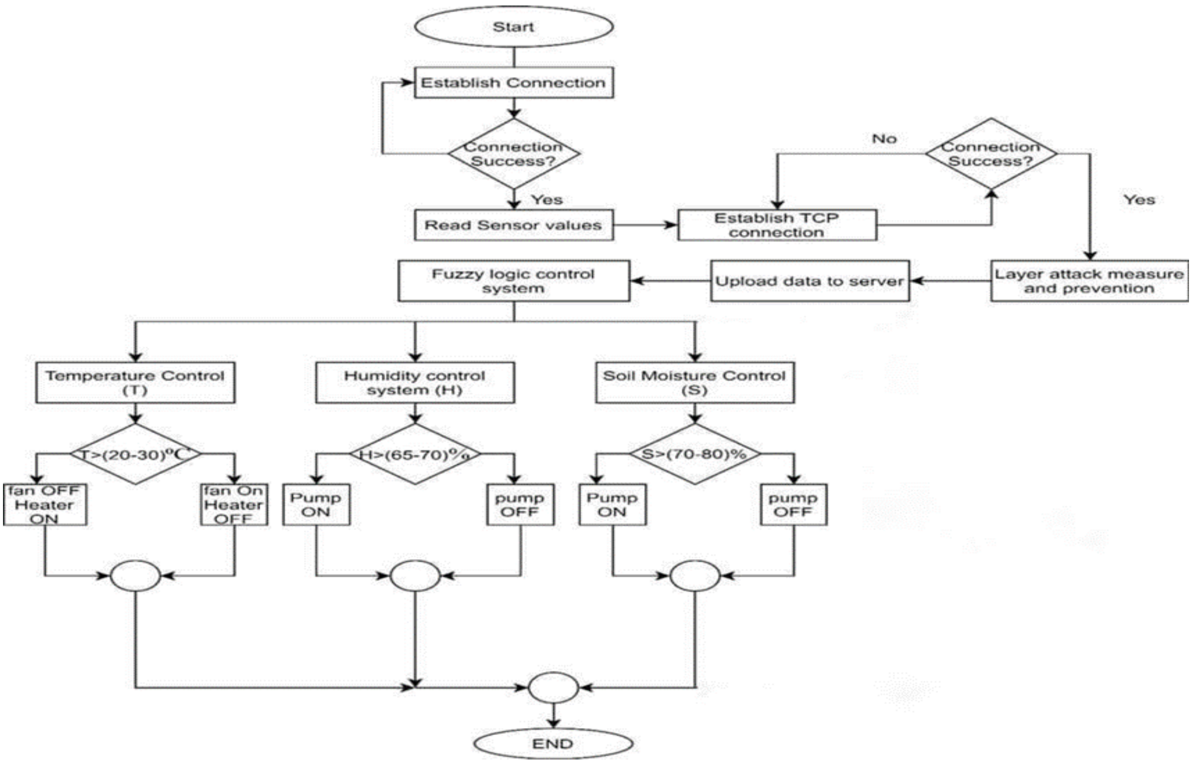
"IoT-Based Smart Greenhouse: A Review" (2020) by M. A. M. Yasin et al.: This review article provides an overview of IoT-based smart greenhouse systems, including their architecture, components, and applications. It discusses the role of IoT in improving crop yield, resource efficiency, and sustainability in greenhouse agriculture.

"Smart Greenhouse Monitoring and Controlling System Using IoT" (2020) by S. S. Barhate et al.: This paper describes the development of a smart greenhouse system that employs IoT technologies for remote monitoring and control. The system integrates sensors for measuring temperature, humidity, soil moisture, and light intensity, along with actuators for automated irrigation and ventilation. Electrical Engineering

## 3.PROPOSED SYSTEM

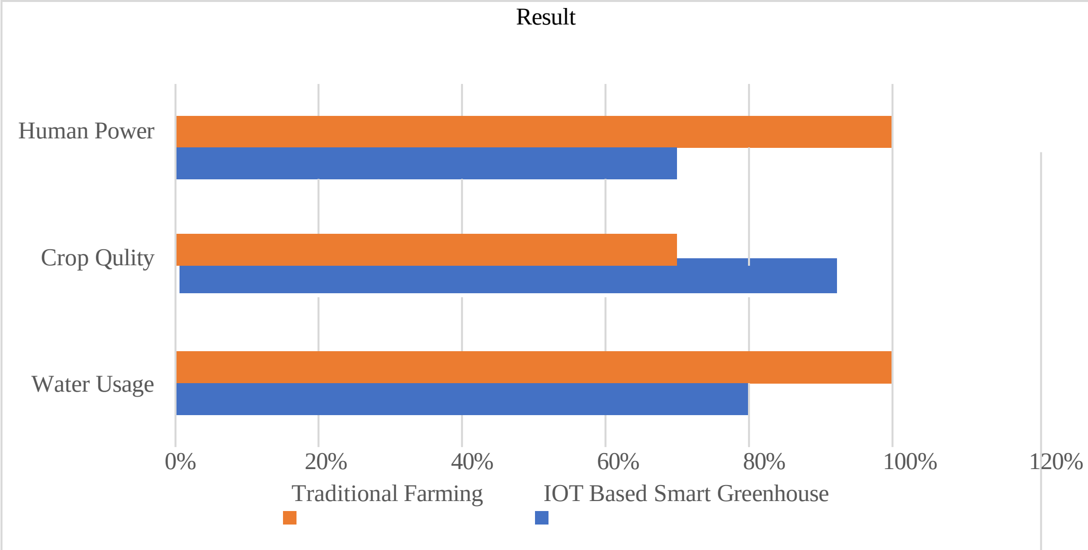
The methodology section outlines the systematic approach employed to achieve the objectives of the project, beginning with the hardware setup involving integration of DHT11 sensors for temperature and humidity monitoring, soil moisture sensors for soil moisture measurement, and a microcontroller such as Arduino or Raspberry Pi for data processing and control. It proceeds to detail the coding process, including algorithm development for sensor data reading, analysis against predefined thresholds, and triggering appropriate actions such as activating relay modules for irrigation control or updating the user interface with real-time sensor data. Development of a web or mobile interface using tools like HTML, CSS, JavaScript, or IoT platforms such as ThingSpeak or Blynk is covered to enable remote monitoring and control of the gardening system. Components used include NodeMCU ESP8266 for IoT applications, two-channel relay modules for switching electrical circuits, soil moisture sensors for measuring soil moisture content, water pumps for irrigation, and humidity sensors for monitoring moisture levels in the air. Ventilation fans are incorporated to maintain optimal growing conditions within the greenhouse. Mathematical modeling involves quantifying relationships between environmental conditions, plant growth parameters, and system inputs/outputs, with considerations for sensor data processing, control algorithms, optimization models, simulation, data analysis, and feedback control. An IoT-based smart greenhouse system controlled via a mobile application is proposed, featuring user-friendly interfaces for real-time monitoring, remote control of devices, alerts and notifications, data analytics, integration with IoT devices, energy efficiency measures, and robust security protocols to ensure privacy and prevent unauthorized access. Integration of these features aims to enhance efficiency, productivity, and sustainability of greenhouse operations while enabling remote management and optimization of resources.

## 4.FLOW CHART



## 5.RESULT ANALYSIS

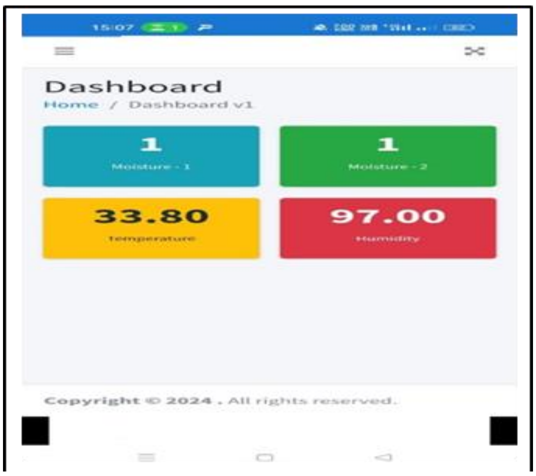
| Criteria | IoT-based Smart Greenhouse | Traditional Farming |
|---|---|---|
| Water Usage | 80% less water usage | 100% water usage |
| Crop Quality | 90% improved crop quality | 70% crop quality |
| Human Power | 70% less human power | 100% human power |



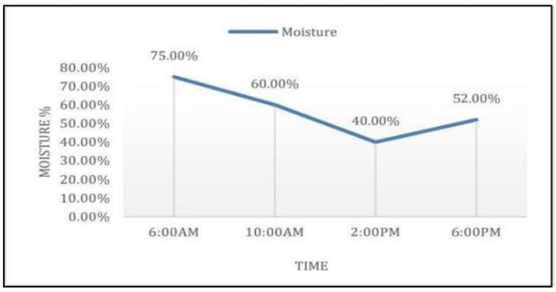

| ● Aspect | IOT based Smart greenhouse | Traditional Farming |
|---|---|---|
| ○ Environmental Monitoring | Sensors continuously monitor temperature, humidity, light intensity, soil moisture, CO2 levels, and nutrient levels. | Relies on manual observation and periodic measurements of environmental conditions. |
| ○ Control Systems | Automated control .systems adjust environmental parameters based on sensor data and user inputs. | Environmental control is limited to natural conditions or manual intervention (e.g., opening windows,watering by hand). |
| ○ Resource Usag Management | Optimizes resource usage (water, energy, nutrients) through data-driven decision- making and automation. | Resource usage may be less efficient due to reliance on manual methods and less precise control over environmental conditions. |
| ○ Crop Yield and Quality | Maximizes crop yield and quality by maintaining optimal growing conditions and minimizing stress factors. | Yield and quality may vary depending on natural conditions, with increased susceptibility to pests, diseases, and weather events. |
| ○ Long-term Sustainability | Promotes long-term sustainability by conserving resources and reducing environmental footprint. | Sustainability depends on farming practices and their impact on soil health, biodiversity, and ecosystem resilience. |
| ○ Automation and Efficiency | Increases efficiency through automation of tasks such as irrigation, climate control, and nutrient management. | relies on manual lower for many tasks, potentially leading to inefficiencies and increased lower costs. |

## 6.ANALYSIS

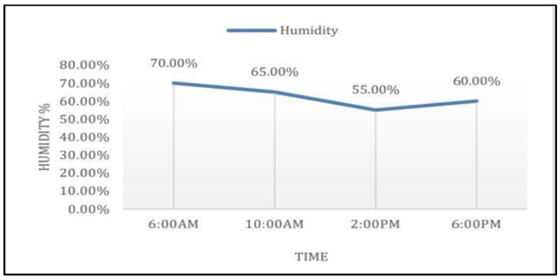
shows the mobile application, which is integrated with a GSM device that enables mobile computing services. The same environmental results of soil moisture, humidity, and temperature of plants are shown on the application screen. Users and gardeners will be able to treat their plants with more care by using these real-time results. Fig(a).



(b) elaborates on the moisture profile of the garden. In Fig. (b), time slots are shown on the x-axis, while the moisture in percentage is shown on the y-axis. In the early morning time slot, the moisture is high. But as the time increase to noon, the moisture decreases, and in the evening, it again increases as shown in Fig.(b)




(c) illustrates the humidity reading of the garden at different time slots. Time is taken on the x-axis, while the humidity values are taken on the y-axis. The difference in recording the humidity is 4 hours in Fig. (c). Initially, the humidity value is high in the morning, but with sunrise, it decreases.




## 7.COMPLIANCE WITH ETHICAL STANDARDS

The authors declare that current research work was conducted in accordance with ethical standards and policies. We have strictly followed the ethical standards and policies governing research involving human or various technical domains. Any human or technical context involved / inherited in the research were treated ethically, and informed consent was obtained from all participants (or authors). Due Credit is provided to the legitimate authors of the source by citing them in the manuscript and also they are mentioned in the reference list.

## 8.COMPETING INTERESTS

The authors declare that they have no competing interests that could influence the interpretation of the research findings or the presentation of the manuscript. Any potential conflicts of interest, financial or otherwise, related to the publication of this research have been disclosed transparently.

## 9.CONCLUSION

The conclusion section summarizes the key findings and outcomes of the project, reflecting on its significance and implications for smart gardening practices. It emphasizes the project's contribution to sustainable and productive gardening by leveraging IoT technology to optimize environmental conditions and resource utilization. Through the integration of sensors, actuators, and data analytics, the IoT-based Smart Gardening System offers an innovative solution for enhancing plant growth and minimizing manual intervention. Furthermore, the conclusion underscores the broader implications of the project for agriculture and horticulture, highlighting its potential to revolutionize traditional gardening practices and promote greater efficiency and sustainability. By reflecting on the project's achievements and suggesting avenues for future research and development, the conclusion provides closure while inviting further exploration and innovation in the field of smart agriculture and IoT application.

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