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Automated Polyhouse

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Abstract: *The advent of Internet of Things (IoT) technology has revolutionized various industries, including agriculture. In this context, an IoT-based automated polyhouse emerges as a promising solution for optimizing crop cultivation within a controlled environment. This system utilizes a network of sensors and actuators to monitor and control essential parameters such as temperature, humidity, light, and irrigation. Through real-time data collection and analysis, farmers can remotely manage and automate the polyhouse, leading to improved crop yield, reduced resource consumption, and enhanced efficiency. This abstract explores the concept and benefits of an IoT-based automated polyhouse, highlighting its potential to transform modern farming practices and contribute to sustainable agriculture.*

Keywords: Polyhouse, IoT, Humidity sensor, Organic foods, Polyhouse, Temperature Sensor

I. INTRODUCTION

An IoT-based automated polyhouse is a high-tech greenhouse that uses internet-connected devices to automate and monitor the growing conditions inside. It uses sensors to measure factors like temperature, humidity, light, and water levels, and adjusts them automatically for optimal plant growth. This technology allows farmers to remotely control and manage their polyhouses, saving time and effort. By using IoT, the automated polyhouse helps farmers grow crops more efficiently, reduce manual labor, and improve the quality and quantity of their harvests.

1.1 Benefits of IoT based Polyhouse Farming

1. Improved Crop Yield: The use of IoT sensors enables precise monitoring and control of environmental factors such as temperature, humidity, and light, ensuring optimal conditions for plant growth. This leads to higher crop yields and better-quality produce.
2. Resource Efficiency: IoT technology helps in efficient resource utilization. By collecting data on soil moisture levels, nutrient levels, and weather conditions, farmers can optimize irrigation, fertilization, and energy usage, reducing waste and conserving resources.
3. Remote Monitoring and Control: IoT devices allow farmers to remotely monitor and control their polyhouses through smartphones or computers. This means farmers can keep track of crucial parameters, receive real-time alerts for any issues, and make necessary adjustments from anywhere, saving time and effort.
4. Reduced Labor and Costs: Automated systems in IoT-based polyhouses reduce the need for manual labor. Tasks such as climate control, irrigation, and pest management canbe automated, reducing labor costs and increasing operational efficiency.
5. Data-Driven Decision Making: IoT sensors generate vast amounts of data on plant health, environmental conditions, and productivity. Analyzing this data provides valuable insights that help farmers make informed decisions, optimize farming practices, and improve overall productivity.
6. Pest and Disease Management: IoT sensors can detect early signs of pests or diseases, allowing farmers to take prompt action. This helps in preventing the spread of diseases and reducing crop losses, leading to healthier plants and higher yields.
7. Scalability and Flexibility: IoT-based polyhouse systems can be easily scaled up or down based on the farming needs. Additional sensors and devices can be added as per requirements, making it a flexible and adaptable solution.

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Overall, IoT-based polyhouse farming enhances productivity, reduces costs, improves resource efficiency, and provides farmers with greater control and insights for effective decision making.

II. LITRATURE SURVEY

"Internet of Things-Based Smart Polyhouse for Precision Agriculture: A Review" (2021) by Tanwar, S., Tyagi, S., & Kumar, N.: This review explores the application of IoT in smart polyhouses for precision agriculture, discussing the technologies and solutions employed to achieve optimal crop growth and productivity. It covers topics such as sensor integration, data analytics, and automation techniques. [1]

"A Review on Internet of Things (IoT) Based Polyhouse for Smart Agriculture" (2020) by Kulkarni, A., Bhardwaj, S., &Navale, V. This review provides an overview of IoT-based polyhouses and their role in smart agriculture, discussing the technologies and advancements used to create efficient and sustainable farming environments. It covers topics such as sensor networks, automated control systems, monitor.[2]

"Internet of Things (IoT) in Agriculture: A Review on Technology Solutions and Application Domains" (2019) by Bera, M., & Pal, S.: This review explores the applications of IoT in agriculture, including polyhouse systems, analyzing the technology solutions and domains where IoT has made significant contributions to agricultural practices. It covers topics such as smart irrigation, crop monitoring, and pest management.[3]

"An IoT Based Automated Greenhouse Monitoring and Control System" (2018) by Rajasekar, P., &Subashini, S.: This study presents an IoT-based automated greenhouse system that monitors and controls environmental conditions using wireless sensor networks, enabling precise and efficient plant growth management It emphasizes the effective implementation and integration of various sensors, actuators, and advanced control algorithms to continuously monitor and precisely regulate the crucial environmental conditions within the greenhouse for optimal plant growth and productivity. [4]

"IoT-Based Smart Greenhouse: Monitoring the Plant Growth Using Wireless Sensor Network" (2017) by Haras, K. I., & Hameed, S.: This research focuses on an IoT-based smart greenhouse system that employs wireless sensor networks to monitor and analyze plant growth, facilitating optimal conditions for cultivation. It discusses the use of sensors for monitoring environmental factors and the integration of IoT technologies for improved greenhouse management [5]

III. FLOW CHART

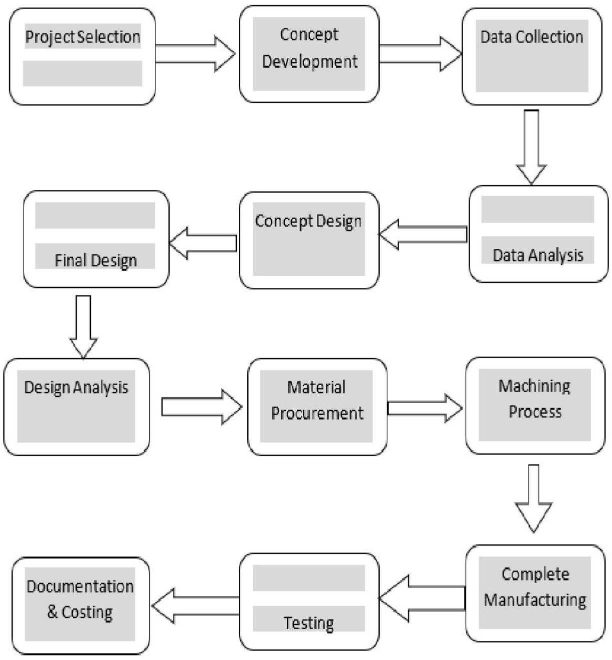

Fig 1

IV. CONDITIONED MAINTAIN IN POLYHOUSE

4.1 Temperature

To ensure the healthy and optimal growth of flowers and vegetables in a polyhouse, maintaining the right temperature is crucial [13]. During the daytime, the temperature requirement typically ranges from 26°C to 30°C, while during the night, it should be between 15°C to 18°C. However, due to the polythene covering on the steel framework of the polyhouse, the internal temperature can rise up to 40°C. To regulate the temperature inside the polyhouse, ventilation, cooling pads, and fans are employed. These measures allow for continuous and high-quality production of herbs throughout the year.

4.2 Light

Light is a critical factor in polyhouse farming [14]. The brightness of light is measured in LUX, and for healthy crop growth, a minimum of 50,000 to 60,000 LUX is required. In regions like Maharashtra, Karnataka, and M.P. in India, where sunlight is bright, it needs to be controlled using shed nets. Commonly, 50% shade nets are used in India to reduce sunlight. Along with LUX, the wavelength of light also plays a vital role. Plants primarily utilize visible light with wavelengths ranging from 400 to 700nm for photosynthesis. In polyhouse technology, light is carefully managed to maximize the plant's exposure to visible light while reflecting the excess light outside the polyhouse.

4.3 Humidity

Proper humidity levels are essential for the healthy growth of flowers and vegetables [15]. For flower production, humidity requirements range from 65% to 80%, while for vegetables, it is around 60% to 65%. Maintaining appropriate humidity levels ensures continuous plant growth, vibrant flower colors, and increased shelf life after harvesting. Humidity also contributes to the color development of herbs, vegetables, and flowers.

4.4 Air Flow

Excessive humidity in the polyhouse can lead to an increased risk of diseases and pests [16]. To mitigate this, the side vents of the polyhouse are opened to promote air circulation. The movement of air helps reduce humidity levels and minimizes the likelihood of diseases and pests affecting the plants.

V. SELECTION OF SITE FOR POLYHOUSE

1. The site should be free from pollution to ensure the quality and purity of the crops grown in the polyhouse.
2. Regular availability of water is crucial for irrigation purposes. Therefore, selecting a site with a reliable water source is important.
3. A stable and regular supply of electricity, preferably three-phase power, is necessary to operate various equipment and systems within the polyhouse.
4. The soil at the site should be properly leveled and well-drained to prevent waterlogging and ensure optimal growing conditions for the crops.
5. The polyhouse should be located near a road or have proper accessibility to facilitate transportation of produce and supplies to and from the polyhouse
6. It is advisable to select a site that allows for potential future expansion of the polyhouse if needed.
7. Availability of skilled expertise and labor is essential for the successful management and operation of the polyhouse, so selecting a site where such resources are accessible is beneficial.
8. Sunlight Exposure: Adequate sunlight is crucial for plant growth in a polyhouse. Select a site that receives maximum sunlight exposure throughout the day, preferably facing south to maximize solar radiation.
9. Wind Protection: Assess the site's exposure to strong winds and consider natural windbreaks such as trees or hills. Planting windbreakers around the polyhouse can help protect the crops from wind damage and maintain a stable growing environment.
10. Soil Quality: Conduct a soil analysis to determine the soil's fertility, nutrient composition, and pH levels. Select a site with fertile soil that is suitable for the specific crops you intend to grow. Proper soil preparation and amendment can enhance crop productivity and overall plant health.

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VI. STRUCTURE DIAGRAM

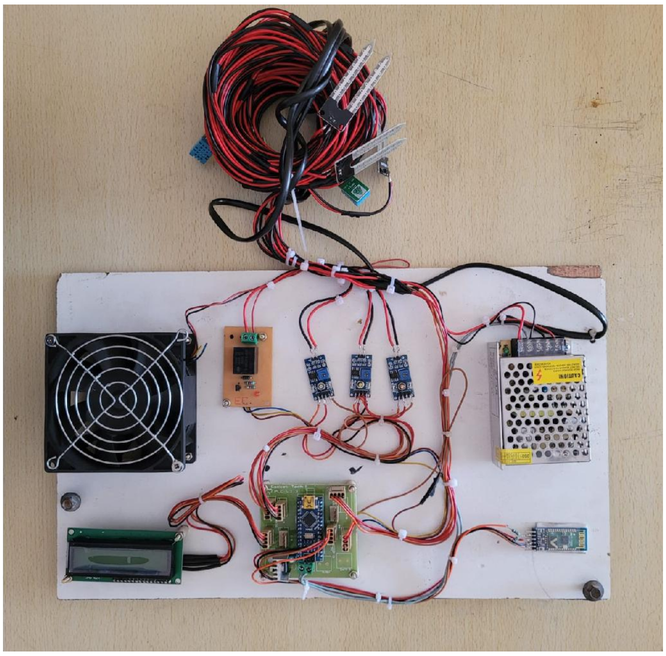

Fig 2

VII.COMPONENTS

Arduino Nano Datasheet

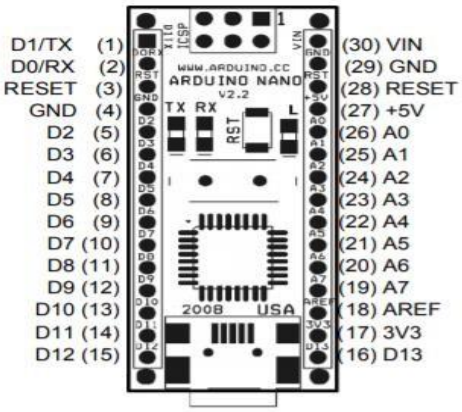

Fig 3

The Arduino Nano is a compact microcontroller board based on the ATmega328P. It offers 14 digital input/output pins, 8 analog inputs, and 6 PWM outputs. With its small form factor and low power consumption, the Arduino Nano is ideal for projects requiring embedded control and sensor integration. It can be easily programmed using the Arduino Software (IDE) and supports a wide range of applications in robotics, automation, and IoT projects.

Soil moisture sensor

A soil moisture sensor is a device designed to measure the water content in the soil. Its primary purpose is to assist farmers in effectively managing their irrigation systems. The sensor consists of two probes that are inserted into the soil to measure the volumetric water content. By passing a current through the soil, the sensor obtains resistance values, which are then used to determine the moisture level. When the soil contains more water, it conducts electricity more efficiently, resulting in lower resistance and indicating higher moisture levels. Conversely, dry soil exhibits poor electrical conductivity, leading to higher resistance and indicating lower moisture levels. The sensor provides valuable information to farmers, enabling them to make informed decisions regarding irrigation to ensure optimal soil moisture levels for plant growth.

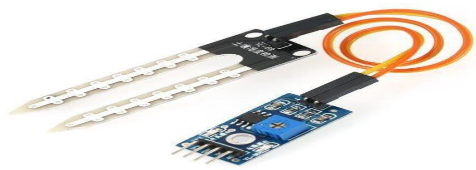

Fig 4

Temperature & Humidity Sensor

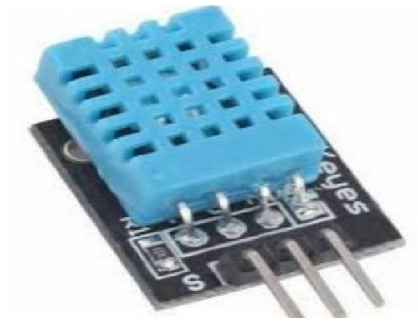

Fig 5

A temperature sensor is a device designed to measure and provide accurate temperature readings. It utilizes a resistance temperature detector (RTD) to detect changes in temperature. The sensor offers high-quality and prompt temperature measurements. Additionally, it is a hybrid sensor that can also provide humidity values. The sensor produces a digital signal output, ensuring enhanced stability and reliability. Specifically, the DHT11 Module temperature and humidity sensor module is commonly used. This sensor is an affordable option that incorporates a capacitive humidity sensor and a thermistor to measure the ambient air. It outputs the temperature and humidity data digitally through its data pin. The DHT11 sensor is straightforward to use, making it a popular choice for temperature and humidity monitoring applications.

LCD Display

Fig 6

An LCD (Liquid Crystal Display) is a flat-panel display technology commonly used in electronic devices. It consists of a layer of liquid crystals sandwiched between two transparent electrodes. When an electric current is applied, the liquid crystals align to control the passage of light, producing visible images or text. LCD displays are widely used in devices like televisions, computer monitors, smartphones, and digital watches. They offer high-resolution visuals, low power consumption, and compact size, making them versatile and practical for various applications. LCD displays are commonly used for information display, user interfaces, and visual feedback in electronic devices.

Bluetooth module (HCO5)

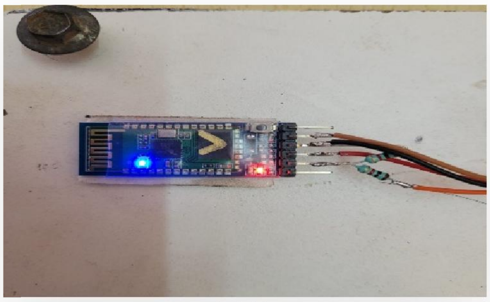

Fig7

The Bluetooth module HC-05 is a popular wireless communication module used for establishing Bluetooth connections between devices. It operates on the Bluetooth version 2.0 and supports the Serial Port Profile (SPP). The HC-05 module is easy to use, cost-effective, and offers reliable communication with a range of up to 10 meters. It is commonly used in projects requiring wireless data transmission, such as connecting microcontrollers or Arduino boards to smartphones, tablets, or other Bluetooth-enabled devices.

VIII. TESTING ON PLANT

8.1 Tomatoes

Fig8

The tomato, scientifically known as Lycopersicon esculentum, is a popular fruit belonging to the Solanaceae family. It thrives in temperatures ranging from 10°C to 30°C, with an optimum range of 21°C to 24°C. A minimum temperature below 10°C and maximum temperature above 38°C negatively affect plant tissues and slow down physiological activities. Tomatoes require at least 8 hours of direct sunlight per day for healthy growth, and they prefer fertile, well-drained soil with a pH between 6.0 and 6.8. While they need adequate moisture, it's important to avoid waterlogged or excessively wet soil to prevent issues like blossom-end rot. Overall, tomatoes are versatile crops that flourish in moderate temperatures, ample sunlight, and well-drained soil conditions.

8.2 Green gram

Fig 9

Green gram, also known as mung bean, is a versatile leguminous crop consumed for its high-quality protein and nutritional content. It thrives in temperatures ranging from 28 to 30 degrees Celsius and requires a hot and warm climate. Green gram is a hardy crop that can tolerate drought and adverse conditions, making it suitable for cultivation in drought-prone areas during the Kharif season. The crop requires full sunlight or at least 8 to 10 hours of sunlight daily for optimal growth. It can be grown in various soil types with good drainage capacity, but saline and alkaline soils should be avoided. Green gram is sensitive to waterlogging and frost conditions. Overall, green gram is a resilient crop with significant agricultural and nutritional value.

IX. EXPERIMENTAL ANALYSIS TABLE

PLANTS	Atmospheric conditions required		
	Temperature (In ^{0}C)	Soil moisture	Light intensity
Tomatoes	21-23	1-1.5 inches of Water	8-hour sunlight
Green gram	28-30	Optimum	8–10-hour sunlight

Table 1

X. CONCLUSION

The conclusion highlights the benefits and opportunities of an IoT-based polyhouse system using the Virtuino 6 application with Bluetooth technology. It emphasizes how this system addresses challenges faced by farmers, such as weather variations and water scarcity, by providing continuous monitoring of climatic parameters. The integration of IoT devices and sensors enables remote control and management of environmental factors, leading to increased crop cultivation and efficient resource utilization. The user-friendly Virtuino 6 application allows farmers to access real-time data, set thresholds, and receive alerts, reducing manual effort and optimizing operations. The automation provided by this system results in higher crop yields, improved quality, and cost savings. The data collected over time offers valuable insights for informed decision-making and enhancing overall agricultural practices.

FUTURE SCOPE

The future scope of polyhouse farming includes several advancements and possibilities. First, there is a focus on disease recognition and prevention, where the controller will not only provide optimal climatic conditions but also identify and address plant diseases. Additionally, the use of Raspberry Pi instead of Arduino is suggested for improved performance. IoT capabilities can be integrated to provide real-time information to farmers about the conditions inside the polyhouse. Water level monitoring and conditioning of available reservoirs can enhance water management. Furthermore, the integration of AI and robotics has the potential to revolutionize polyhouse farming. AI-powered systems can automate tasks such as plant monitoring, pest detection, and crop harvesting. Robots equipped with sensors and actuators can navigate the polyhouse environment, reducing labor requirements and increasing overall efficiency. These advancements hold promise for increased productivity, reduced labor, and improved crop management in the future of polyhouse farming

REFERENCES

[1]. Arduino Uno software & programs (www.arduino.cc)
[2]. "Smart Greenhouse: An IoT-Based Monitoring System for Crop Cultivation": Link: https://www.researchgate.net/publication/319364979_Smart_Greenhouse_An_IoT-Based_Monitoring_System_for_Crop_Cultivation

[3]. Simulation software “Fritzing” (www.Fritzing.co)
[4]. "Automated Smart Greenhouse Using IoT": Link: https://www.electronicshub.org/automated-smart-greenhouse-iot/
[5]. Online Simulation tools “Thinker CAD” (www.ThinkerCAD.co) and “Circuitio” (www.Circuitio.io).
[6]. "IoT-based smart greenhouse for optimized crop cultivation" - [Link:https://www.researchgate.net/publication/331862628_IoT-based_smart_greenhouse_for_optimized_crop_cultivation]
[7]. "IoT-enabled Greenhouse Farming for Sustainable Agriculture" - [Link: https://www.researchgate.net/publication/334125062_IoT-enabled_Greenhouse_Farming_for_Sustainable_Agriculture]
[8]. "IoT-based Greenhouse Monitoring System" - [Link: https://www.electronicsforu.com/electronics-projects/hardware-diy/iot-based-greenhouse-monitoring-system]
[9]. "Smart Greenhouse Management System using IoT" - [Link: https://ieeexplore.ieee.org/document/8274876]
[10]. "IoT-based Intelligent Greenhouse for Smart Agriculture" - [Link: https://www.sciencedirect.com/science/article/pii/S221201731630042X]