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IoT Based Smart Monitoring and Controlling Automated Sericulture System

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A B S T R A C T :

This project aims to design a smart system using IoT technology to monitor and control the environmental conditions necessary for silk production, known as sericulture. As a key rural occupation, sericulture plays a significant role in the livelihoods of many communities, particularly in India, a leading producer of raw silk globally.

The system integrates two main microcontrollers: the Raspberry Pi Pico and the NodeMCU (ESP8266). The Raspberry Pi Pico gathers real-time environmental data using sensors—specifically, a DHT11 sensor for measuring temperature and humidity, and an LDR for detecting light intensity. This data is displayed live on a 16x2 LCD screen for easy viewing.

To maintain ideal conditions for silkworm rearing, the system uses relay-operated devices such as a fan, heater, and water pump connected to a sprinkler. Based on the sensor readings, the Pi Pico automatically controls these devices to keep the environment within set limits.

For IoT connectivity, the NodeMCU links the system to the Blynk platform, enabling users to remotely monitor the data and operate the water pump via a smartphone app. This adds convenience and flexibility, making it easier to manage the silk farming environment from any location.

Keywords: Sericulture, Silk worms, IoT.

INTRODUCTION

Sericulture, the cultivation of silkworms for producing silk, is a traditional agricultural practice that contributes significantly to the rural economy in many countries. The productivity and quality of silk depend heavily on maintaining suitable environmental conditions, such as temperature, humidity, and light. Traditionally, these factors are managed manually, requiring constant supervision by sericulturists. However, this method is labor-intensive, time- consuming, and can result in inconsistent outcomes due to human error.

With the rapid advancement of technology, particularly in the field of the Internet of Things (IoT), it has become possible to modernize sericulture practices. IoT allows the integration of sensors, microcontrollers, and wireless communication to create systems that can monitor and control environmental conditions in real-time. An IoT-based automated sericulture system helps maintain optimal conditions for silkworm growth by collecting data continuously and making necessary adjustments automatically. This not only reduces human effort but also increases accuracy, efficiency, and overall silk production.
By implementing such smart systems, sericulture can become more reliable and scalable, benefiting both small-scale and commercial silk producers.

LITERATURE REVIEW

[1] " Arduino based automated sericulture system" Manjunath et al. proposed an automated sericulture system based on the Arduino microcontroller. This project combines the ARDUINO microcontroller with GSM-based technology to provide mechanization and supervisory control for sericulture cultivates. In order to keep the climate conditions in a growing state, this model controls and faculties them. The actuators are small and simple to access, and they are only turned on when needed. Financial and resource resources are effectively utilized in the proposed design. The model can be used to gradually monitor the ranch's natural surroundings, according to a pilot test. The Seri cultivator is now farther away from the raising unit. The framework is user- friendly. Future projects will all make use of the Internet, Wi-Fi, and the Internet of Things. IOT). The interior of the ranch was found to be in its natural state during the initial test. The rearing unit and Seri culturist no longer interact

closely. The framework is easy to use. Future ventures will use the Web, Wi-Fi, and the Web of Things (IOT) to control correspondence and safeguard information..

[2] "IOT based automated sericulture system.", Khaja Moinuddin and co. 4] proposed an Internet of Things-based automated sericulture system. This essay goes into great detail about how humidity and temperature affect the growth and development of silkworms, as well as recent research on heat shock protein. In addition, it discusses the effects of light and air on silkworm development. The growth of the embryo in a silkworm egg, the nutritional status of the larval stage, and the moth's capacity for reproduction are allexamined in this study as well. It focuses on how temperature and humidity affect silkworm post-cocoon parameters and the importance of caution when spinning silkworms. The study looked into different ways to control the climate so that cocoon harvests were successful. Advantages: Sensor based cascade control of physical parameters thus improve the quality of silk farm with less human intervention.

[3] "Automated sericulture system." R. Arun et al. developed a smart, automatic sericulture system [3]. A smart monitoring and automated actuation sericulture system based on the Internet of Things (IoT) will be described in detail in this essay. Through the use of the internet, the sericulture will make it possible for the end user to control and monitor the system in real time. The implemented prototype successfully controls the deployed environment's state and keeps an eye on its parameters in real time. There are a number of advantages to remote monitoring, which is automated to the appropriate system state. The prototype will operate in real time for the purpose of system control and monitoring

METHODOLOGY

The development of the lo T-based automatic sericulture system involves a step-by-step approach combining hardware integration, software development, and system testing. The project The Internet of Things (IoT)-based automated sericulture system leverages a combination of IoT devices, sensors, and automation technologies to optimize and monitor the silk production process. Sericulture refers to the practice of breeding silkworms for silk production, and an automated system can help in optimizing the rearing conditions, improving production efficiency, reducing human labor, and ensuring better quality control throughout the process. The methodology is divided into the following phases:

1. **Requirement Analysis**

   Identified the key environmental parameters critical to silkworm growth primarily temperature, humidity, and light intensity

2. **System Design**

   An IoT-based automated sericulture system integrates smart sensors, actuators, and data processing modules to monitor and control the environmental And operational conditions required for efficient silkworm rearing. The system also includes a centralized information platform to share common data among farmers, researchers, and authorities.

3. **Hardware Implementation**

   Connect the DHT11 sensor, LDR sensor, and relays to the PI Pico. Interface the 16x2 LCD with the PI Pico for local data display. Connect the actuators (fan, heater, and water pump) to the relays controlled by the PI Pico. Set up the NodeMCU for Wi-Fi connectivity and interface it with the Blynk platform.

4. **Software Development**

   Embedded Code: Program the microcontroller to read sensor values, compare with predefined thresholds, and trigger actuators accordingly. Mobile/Web Interface: Develop a simple UI using platforms like Blynk, Firebase, or a custom app to allow real-time monitoring and control. Data Logging: Implement cloud integration to log environmental data for future analysis and alerting.

5. **Integration & Testing**

   Assemble all components and install the system in a controlled rearing environment. Ensure secure and clean wiring, and proper placement of sensors for accurate readings. Run the system under different conditions to test accuracy and responsiveness.

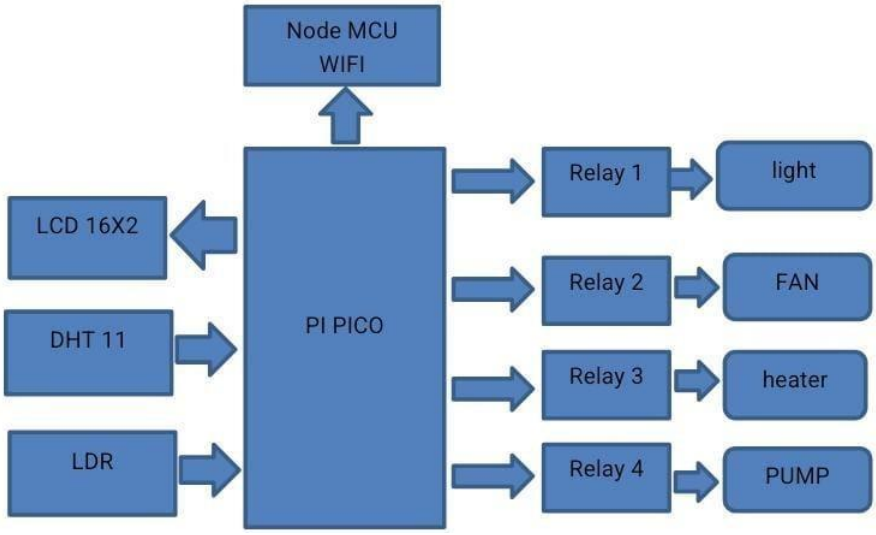

Fig 1: Design Methodology

RESULTS AND DISCUSSION

The IoT-based automatic sericulture system was successfully developed and tested in a controlled environment. The system effectively monitored and maintained the required temperature, humidity, and light conditions for silkworm rearing.The key results observed include: Accurate Monitoring: Real-time temperature and humidity data were accurately sensed and displayed through the IoT dashboard/mobile app. Automated Control: The system automatically activated fans, heaters, and humidifiers based on threshold values, maintaining optimal environmental conditions. Remote Access: Users were able to monitor and control the system remotely via a smartphone interface using platforms like Blynk or Thing Speak. Data Logging: Environmental data was continuously recorded and stored on the cloud for analysis and performance evaluation. Energy Efficiency: Automatic operation reduced unnecessary energy usage by activating devices only when needed. Improved Cocoon Quality: Test batches showed more uniform cocoon development under stable conditions compared to traditional manual methods.When environmental thresholds were crossed, actuators responded accordingly:

Sericulture, or silk farming, is a traditional agricultural activity that involves raising silkworms to produce silk. The success of sericulture depends heavily on maintaining the right environmental conditions, such as temperature, humidity, and cleanliness. In recent years, the use of Internet of Things (IoT) technology has emerged as a helpful tool to automate and improve sericulture practices. An IoT-based sericulture system includes various sensors and devices that work together to monitor and control the rearing environment. These sensors can measure temperature, humidity, air quality, and light levels inside the rearing house. The data collected is sent to a central control unit, like a microcontroller or a small computer. This information can then be accessed by farmers using a mobile phone or computer, either through a special app or website. The system can also include automatic devices like fans, humidifiers, or heaters that turn on or off based on sensor readings. For example, if the temperature goes too high, the system can turn on a fan automatically to cool the area. This helps in keeping the environment ideal for silkworm growth, which leads to better silk production. Another useful feature of this system is that it can send alerts to the farmer if any condition goes beyond the safe limit. This allows quick action and prevents the loss of silkworms due to sudden changes in the environment. Overall, using IoT in sericulture offers many advantages. It reduces the need for manual monitoring, helps in maintaining a stable environment, and increases the chances of a successful silk harvest. However, it also has some challenges, such as the cost of the equipment and the need for internet connectivity, which may not always be available in rural areas. Despite these challenges, IoT-based systems have great potential to modernize sericulture and support farmers by making the process more efficient and less labor-intensive.

REFERENCES

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2. Carvalho, R., Kima, M., Fonseca, M., & Bastos, J. (2021). A Low-Cost IoT-Based System for Environmental Monitoring and Control in Greenhouses. Computers and Electronics in Agriculture,

3. Numerous studies have highlighted the potential of IoT in transforming traditional farming and sericulture practices. Patel et al. (2022) developed a real-time monitoring system using IoT to track environmental conditions in agriculture, showing that continuous data collection improves decision-making. Mulla and Patil (2017) proposed a smart agriculture framework integrating sensors and wireless communication to enhance crop management.

4. Specifically for sericulture, Srinivas et al. (2019) presented an automated system that monitors critical parameters like temperature and humidity using IoT devices, significantly reducing manual labor. Similarly, Nagaveni et al. (2019) designed a smart monitoring system tailored for sericulture, demonstrating improved productivity and healthier silkworm development.

5. In greenhouse environments, Kaur and Singh (2020) implemented a real-time IoT solution using NodeMCU and the Blynk platform, emphasizing its usefulness in remote control and monitoring. Khan and Al-Fuqaha (2019) provided a comprehensive survey on enabling technologies for smart agriculture, highlighting the growing importance of IoT, cloud computing, and automation.

6. Further supporting research by Rao and Mahalakshmi (2018) and Patil et al. (2018) explored the integration of wireless sensor networks in precision agriculture, enhancing efficiency through real-time alerts and automation. Sharma and Tomar (2021) also reinforced the benefits of IoT in smart farming by emphasizing its role in optimizing environmental parameters critical for crop and livestock health.