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Automated Sericulture System based on IoT

Rakesh A B[*1], *Supriya K S*[*2], *Suman H M*[*3], *Dr.Divakara S S*[4]

B.E. Student, [1, 2*], Assistant Professor [3*], Head of Department [4]

[1,2]Department of Electronics and Communication Engineering, Coorg Institute of Technology, Ponnampet-571216

ABSTRACT :

Sericulture refers to the rearing of silkworms for the production of silk. Critical environmental parameters such as temperature, humidity, and light intensity significantly influence the growth and development of silkworms. Maintaining optimal conditions at each stage of silkworm development is essential for high-quality silk production. Despite its importance as a traditional occupation in India, many sericulture practices remain outdated. Hence, there is a need to modernize sericulture through the adoption of advanced technologies.

This project proposes an automated and smart sericulture system leveraging the Internet of Things (IoT). The system monitors environmental parameters in the silkworm rearing house using sensors integrated with a Node MCU microcontroller. Real-time data on temperature, humidity, and light intensity is collected, and any deviation from the optimal range triggers notifications to the user via a mobile application. This allows timely intervention and improved environmental control. The system is developed and programmed using the Arduino IDE, enabling efficient monitoring, data analysis, and automated scheduling. The proposed model aims to enhance productivity and quality in sericulture through intelligent automation.

Keywords: : Sericulture, Silkworm Rearing, IoT, Automation, Environmental Monitoring, Temperature, Humidity, Light Intensity, NodeMCU, Arduino IDE, Smart Farming, Mobile Notification System

Introduction

According to the Central Silk Board, India ranks as the world's second-largest silk producer, contributing approximately 15% to global output, while China dominates the market with 85%. Sericulture, the practice of cultivating silkworms for silk production, is a labor-intensive process requiring careful attention to environmental conditions. Silkworms, especially during the larval stage, consume mulberry leaves and spin cocoons composed of silk fiber. One of the major challenges in Indian sericulture is the limited adoption of mechanization, which affects both cocoon quality and the cocoon-to-shell weight ratio. Seasonal changes and inconsistent environmental conditions within the silkworm-rearing houses can significantly impact the development of the larvae and, ultimately, the quality of the silk produced. This project proposes the integration of automation in sericulture to enhance silk yield and improve thread quality. Research highlights the critical role of maintaining optimal environmental parameters—such as temperature, humidity, and light intensity—throughout the silkworm's growth stages. Each moulting phase of the silkworm requires specific environmental settings, and adhering to these requirements is essential for achieving superior silk production.

Sericulture, or silkworm farming, is a time-honored practice centered around the cultivation of Bombyx mori for silk production. For centuries, this activity has played a vital role in supporting the textile industry and sustaining agricultural livelihoods. The successful rearing of silkworms hinges on their sensitivity to environmental variables, with factors like temperature, humidity, and light significantly influencing their development and the quality of silk produced. Silkworms thrive in a controlled temperature range of 23°C to 28°C for optimal silk output, with 26°C to 28°C and relative humidity around 90% being ideal for uninterrupted growth. Additionally, ambient CO_2 levels serve as an indicator of air quality, where concentrations exceeding 2% can inhibit larval development. These insects are also photosensitive, favoring low light environments of about 15–20 lux, while avoiding both complete darkness and bright illumination

Literature Review

one of the most prominent domesticated insects, makes silk thread by consuming mulberry leaves from the mulberry plant [1]. Unlike other insects, the silkworm has a highly different capacity for adjusting to environmental changes. The silkworm is particularly sensitive to environmental changes and cannot tolerate a wide range of alterations because of its specific distinctions from other insects. One of the most significant domesticated insects is the mulberry silkworm, which uses mulberry leaves as a casing to manufacture silk string [2]. The silkworm differs from other creepy crawlies in its capacity to adapt to shifting ecological variables. Silkworms are very different from other creepy crawlies, which makes them incredibly sensitive to environmental changes and unable to thrive in a variety of species. India is only second to China in the world in terms of total silk production, according to a Central Silk Board report. India, on the other hand, only contributes modestly. China produces 85% of the world's silk, while India only makes up 15%. The sericulture process's lack of automation is the primary cause of this significant gap [3]. Sericulture is a rural agro-based industry

that is ideal for countries with agricultural economies and a shortage of rural labor. It is primarily a rural sector of the economy [4], with high labor costs
that necessitate some earnings in foreign currency.

III. Methodology:

1. *Sensors and Data Collection*:
   - *Temperature and Humidity Sensor (DHT11)*: Measures the ambient temperature and humidity levels.
   - *Light Intensity Sensor (LDR - Light Dependent Resistor)*: Measures the light intensity in the sericulture environment.
2. *Microcontrollers*:
   - *Pi pico*: Collects data from the sensors and processes it. Implements control logic to manage actuators (fan, heater, and water pump) based on sensor readings.
   - *NodeMCU (ESP8266)*: Provides Wi-Fi connectivity to the Blynk IoT platform, enabling remote monitoring and control.
3. *Actuators*:
   - *Fan*: Used to cool down the environment when the temperature exceeds a certain threshold.
   - *Heater*: Used to warm up the environment when the temperature falls below a certain threshold.
   - *Water Pump*: Sprinkles water to maintain optimal humidity levels and can also be controlled remotely.
4. *Display*:
   - *16x2 LCD Display*: Shows real-time temperature and humidity readings locally for easy monitoring by sericulturists.
5. *IoT Platform*:
   - *Blynk*: An IoT platform that provides a mobile app interface for remote monitoring and control. Users can view real-time data, receive notifications, and control the water pump from anywhere.

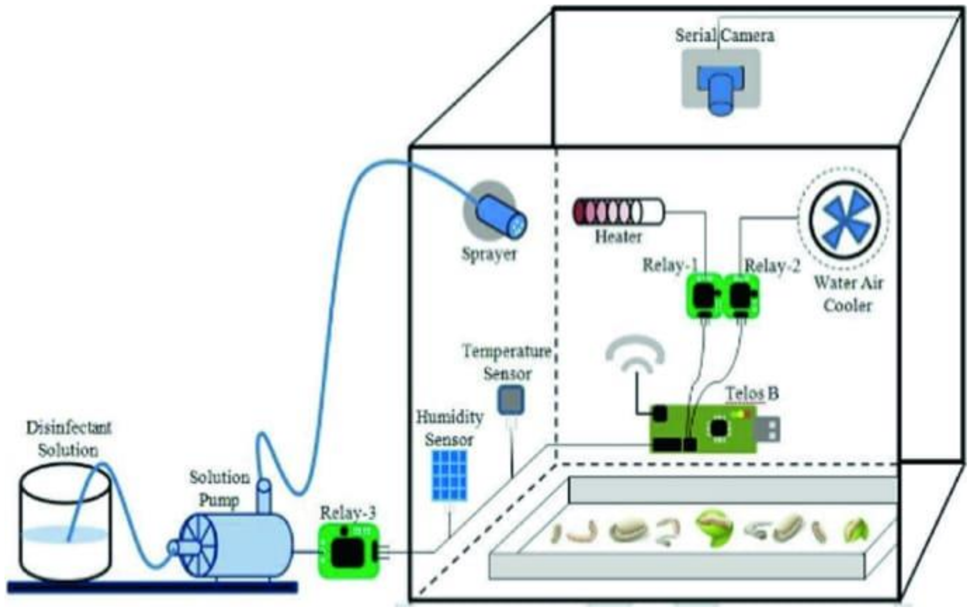

Fig 1: Sericulture farm automation system

Result analysis

The developed system was effectively implemented and tested within a simulated sericulture setup. The DHT11 sensor provided accurate readings of temperature and humidity, while the LDR reliably tracked ambient light levels. Sensor data was displayed in real time both locally on a 16x2 LCD and remotely via the Blynk IoT mobile application. When environmental conditions crossed preset thresholds, the system triggered appropriate actuator responses:

- The fan was activated if the temperature rose above 30°C.
- The heater switched on when the temperature dropped below 22°C.
- Thwater pump operated when humidity levels fell below 65%.
  Additionally, all actuators could be manually controlled through the Blynk app interface.

Users received instant smartphone notifications in response to significant environmental fluctuations. The system proved to be stable and dependable during continuous operation, showing consistent accuracy in sensor readings and prompt actuator response.

This project presents a cost-effective, scalable, and efficient IoT-based automation solution tailored for sericulture. Leveraging the Raspberry Pi Pico for local control and the NodeMCU ESP8266 for cloud connectivity via Blynk, the system maintains ideal rearing conditions for silkworms. It reduces the need for constant human supervision, minimizes errors, and enhances overall productivity in silk production.

Looking ahead, several enhancements can further improve the system's utility:

- GSM Module Integration: Enables SMS notifications in areas with limited internet access.
- AI-based Image Processing: For monitoring cocoon quality and early disease detection.
- Data Logging & Analytics: Utilizing SD cards or cloud platforms like Firebase for long-term environmental tracking and analysis.
- Solar Power Supply: Facilitates off-grid operation and improves system sustainability.
- Voice Assistant Integration: Enhances accessibility, especially for elderly or less tech-savvy farmers.

This system holds great potential to transform traditional sericulture practices, offering meaningful support to rural silk farmers and contributing to the growth of India's silk industry.

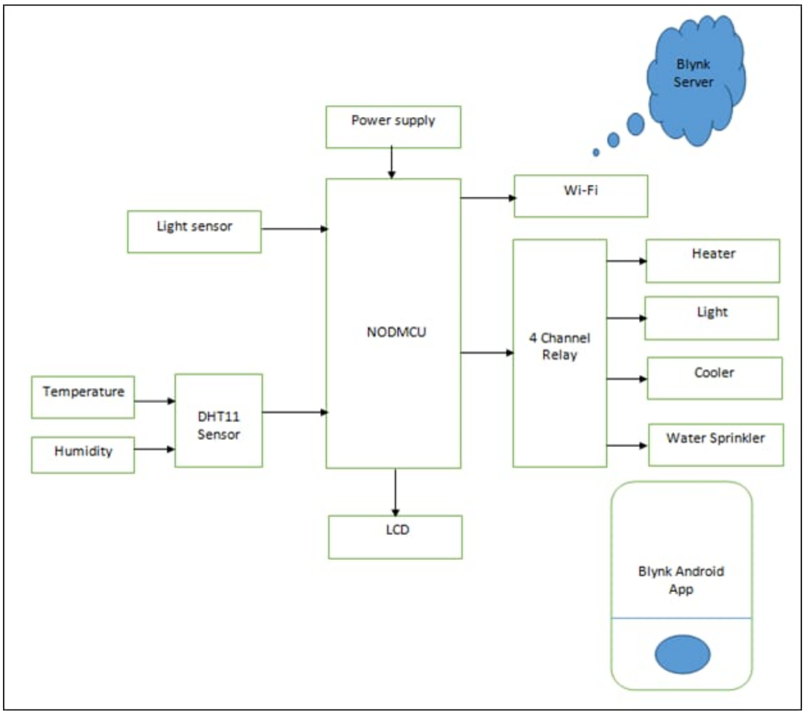

Fig 2 : Block diagram

Conclusion

The IoT-based automated sericulture system successfully demonstrates how smart technology can enhance traditional silk farming practices. By integrating sensors, actuators, and IoT platforms like Blynk, the system maintains optimal environmental conditions for silkworm rearing with minimal human intervention. It ensures real-time monitoring, automated control, and remote accessibility, leading to improved efficiency, reduced labor, and higher productivity. With future enhancements like GSM alerts, AI-driven disease detection, and solar power integration, this scalable and cost-effective
solution has strong potential to modernize sericulture, especially in rural areas, and significantly contribute to the growth of India's silk industry.

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