

Implementation and Testing of an Intelligent Control System for Sericulture Using IOT

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ABSTRACT

Sericulture is an important agro-based activity in which environmental conditions have a significant influence on the growth of silkworms and the quality of silk production. Conventional silkworm-rearing methods require continuous manual monitoring of parameters such as temperature, humidity, and light intensity, resulting in increased labor requirements and possible variations in the rearing environment. This paper presents the implementation and testing of an Internet of Things (IoT)-based intelligent control system for automated monitoring and regulation of environmental conditions in sericulture. The proposed system employs a NodeMCU controller integrated with temperature and humidity sensing, light sensing, an LCD, electromechanical relays, a water pump, cooler, heater, and lighting system. Sensor information is processed by the controller, which activates the appropriate actuators whenever the monitored parameters deviate from the required range. Wi-Fi connectivity and a cloud-based interface enable remote monitoring and notification of environmental conditions. The developed system provides continuous environmental supervision while reducing manual intervention and improving resource utilization. The proposed approach demonstrates the potential of IoT-based automation for creating controlled and efficient silkworm-rearing environments.

Keywords— Internet of Things (IoT), Sericulture, NodeMCU, Silkworm, Environmental Monitoring, DHT11, Automation, Blynk.

INTRODUCTION

Sericulture is the process of rearing silkworms, particularly *Bombyx mori*, for silk production. The growth and development of silkworms are strongly influenced by environmental factors such as temperature, humidity, airflow, and light intensity. Maintaining suitable environmental conditions throughout the different stages of the silkworm life cycle is therefore essential for obtaining good-quality silk and improving production yield. Conventional sericulture practices depend considerably on manual observation and regulation of these parameters, making the process labor-intensive and susceptible to human error.

The Internet of Things provides an effective approach for overcoming these limitations through continuous sensing, communication, and automated control. IoT-enabled sensors can continuously collect environmental information and transmit it to a controller or cloud platform for monitoring and analysis. When the measured conditions exceed predefined limits, actuators such as heaters, coolers, water pumps, and lighting systems can be operated automatically to restore suitable conditions. Such automation can reduce manual intervention while providing a more stable environment for silkworm cultivation.

The present work develops an intelligent IoT-based sericulture control system using NodeMCU as the primary controller. Temperature, humidity, and light conditions are monitored using appropriate sensors, while electromechanical relays control the water pump, cooler, heater, and lighting system. The integration of Wi-Fi/cloud communication further enables remote observation of the rearing environment.

LITERATURE SURVEY

Rakesh Sharma and Rohit RM [1] investigated IoT-based hazard detection and monitoring for sericulture and demonstrated the importance of continuously monitoring temperature, humidity, air quality, pests, and other environmental conditions. Their approach showed that real-time sensor information can enable farmers to identify unfavorable conditions rapidly while reducing human error. Goverdhan Reddy *et al.* [2] presented an automated environmental control approach employing NodeMCU and IoT. Their system integrated environmental sensors for monitoring temperature, humidity, and light intensity and used the collected information to maintain suitable conditions for silkworm rearing.

Dinesh Kumar and Soundarya [3] combined IoT-based environmental monitoring with image-processing techniques for detecting different stages of the silkworm life cycle. Their work demonstrated that environmental sensing and automated life-cycle identification could improve decision-making in sericulture. Saikia and Saikia [4] investigated the integration of AI and IoT for modernizing sericulture, emphasizing real-time monitoring and predictive analysis. Jambukar and Dawande [5] further investigated predictive analytics using IoT, Oracle, and machine-learning techniques to predict environmental conditions and potential risks associated with silkworm cultivation.

These studies indicate that IoT-based monitoring can significantly improve sericulture management. The present project focuses on implementing a practical NodeMCU-based system capable of sensing important environmental parameters and automatically controlling associated devices.

PROBLEM STATEMENT

Traditional sericulture requires continuous manual monitoring of environmental conditions. Variations in temperature, humidity, and light can adversely affect silkworm development and consequently reduce silk quality and production. Therefore, an automated system capable of continuously sensing environmental parameters and initiating corrective actions is required.

OBJECTIVES

1. To develop an IoT-based system for continuous monitoring of temperature, humidity, and light intensity in the silkworm-rearing environment.
2. To automatically regulate environmental conditions using suitable actuators and provide remote monitoring through IoT connectivity.

PROPOSED SYSTEM

The proposed system consists of sensors, a NodeMCU controller, electromechanical relays, actuators, Wi-Fi communication, cloud connectivity, and a user interface. The DHT11 sensor measures temperature and humidity, while an LDR-based light sensor determines the surrounding light intensity. The sensed information is supplied to the NodeMCU, which serves as the main processing and control unit.

Depending on the sensor readings and predefined operating conditions, the NodeMCU controls devices such as the water pump, cooler, heater, and LED lighting through electromechanical relays. Wi-Fi communication enables environmental information to be transmitted to the cloud and accessed remotely through the Blynk application. The LCD provides local indication of system parameters. The project report identifies NodeMCU, water pump, LCD, light sensor, cooler, heater, DHT11 sensor, and electromechanical relay among the principal hardware components.

BLOCK DIAGRAM

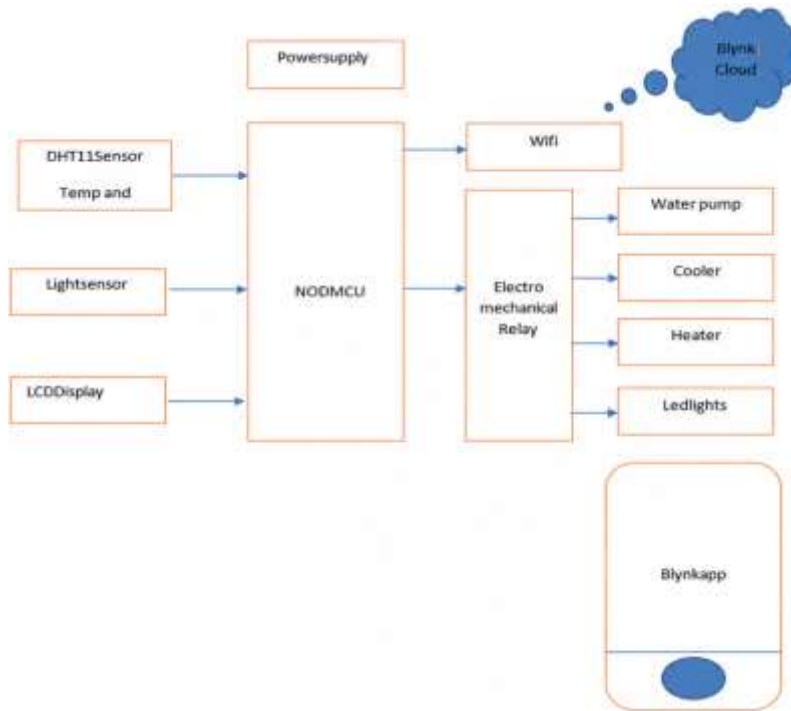


Fig 1 block diagram

CIRCUIT DIAGRAM

Fig. 2 shows the circuit diagram of the IoT-based intelligent sericulture control system, where the ESP32 MCU receives inputs from the LDR and DHT11 sensors and displays data on the LCD. The 4-channel relay controls the pump, heater, cooler, and light according to the sensed environmental conditions.

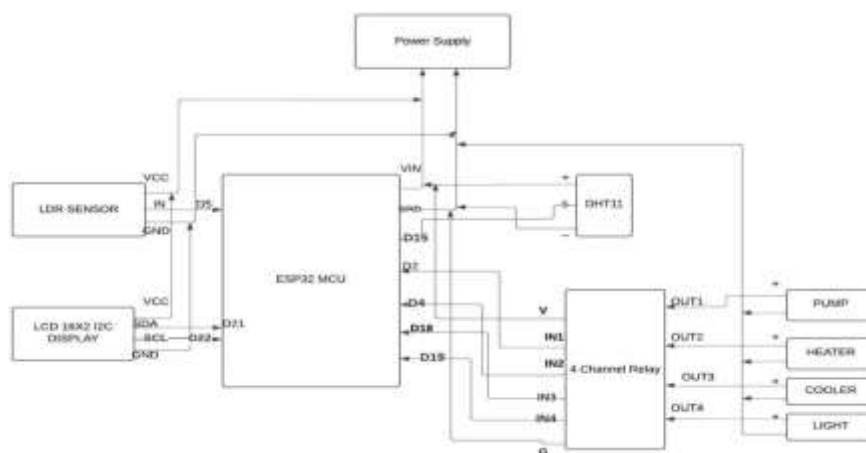


Fig 2 circuit diagram

METHODOLOGY

The methodology begins with continuous acquisition of environmental data from the sensors installed in the silkworm-rearing environment. Temperature and humidity measurements are obtained from the corresponding sensor, while the light sensor measures the available illumination. The NodeMCU receives these measurements and compares them

with predetermined operating ranges. The report identifies approximately **25–30 °C** as the required temperature range and **60–80%** as the humidity range considered in the system design.

When a monitored parameter moves outside the specified range, the NodeMCU generates the appropriate control signal. The relay interface subsequently switches the required actuator, such as the heater, cooler, water pump, or lighting system. Sensor data can also be transmitted through Wi-Fi to a cloud platform, allowing farmers to monitor environmental conditions remotely. The interface can provide alerts when parameters exceed their predefined limits and permits intervention when necessary.

RESULTS AND DISCUSSION

Fig. 3 shows the developed prototype of the IoT-based intelligent control system for automated sericulture monitoring, integrating environmental sensors, NodeMCU-based processing, relay-controlled actuators, and IoT communication into a single functional system. The prototype continuously monitors important environmental parameters such as temperature, humidity, and light intensity and processes the collected sensor data through the NodeMCU. Whenever the measured values deviate from the predefined operating limits, the controller automatically activates the appropriate actuators, including the water pump, heater, cooler, and lighting system, through the relay module to restore suitable environmental conditions for silkworm growth. The IoT communication facility further enables remote monitoring of system parameters and operating conditions, while the overall implementation demonstrates effective sensor operation, actuator response, automatic environmental control, and reliable system performance for improving sericulture management.

The IoT interface allows the monitored information to be accessed remotely and provides notifications when abnormal conditions are detected. For example, the documented system design considers alerts when temperature exceeds approximately **30 °C** or humidity falls below approximately **60%**. The implementation consequently demonstrates how IoT-based control can reduce the requirement for continuous manual monitoring while maintaining more consistent environmental conditions for silkworm development.

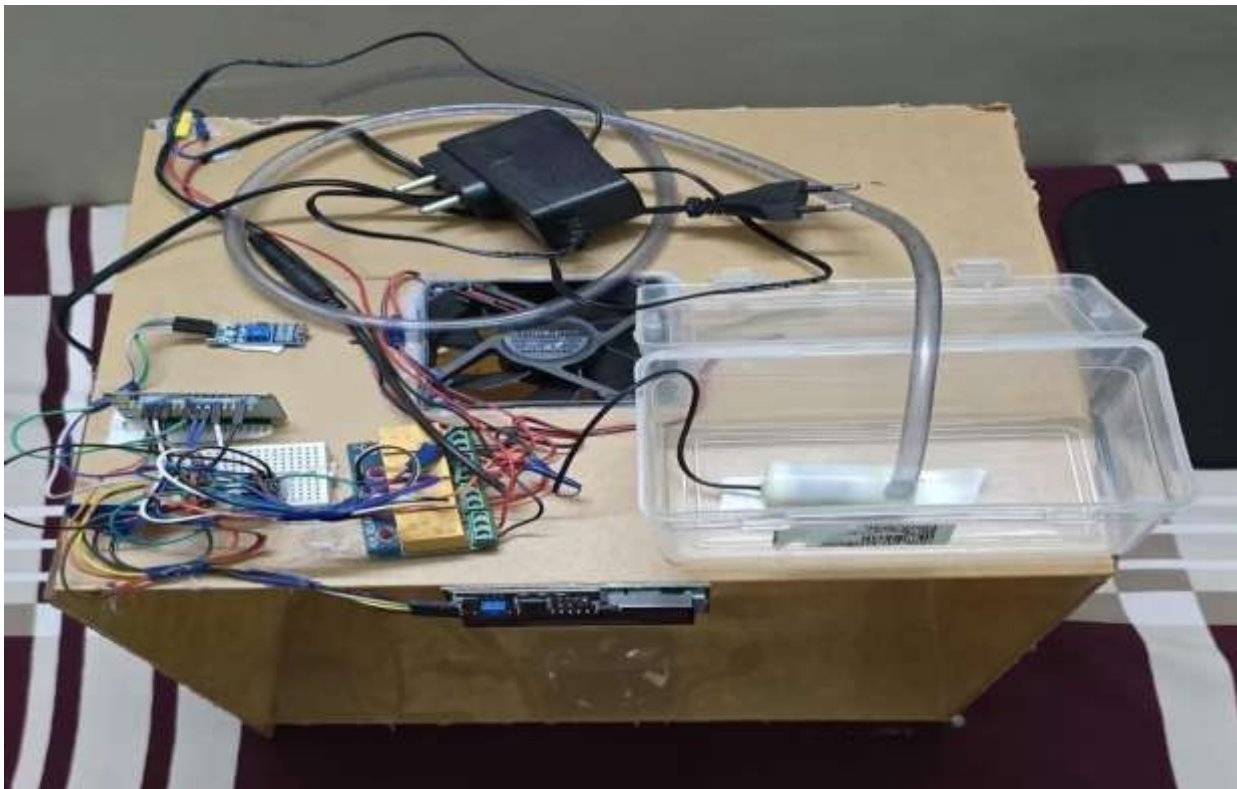


Fig 3 hardware setup

CONCLUSION

The implementation and testing of an IoT-based intelligent control system demonstrate the potential of automation for improving environmental management in sericulture. By continuously monitoring temperature, humidity, and light conditions and automatically operating the associated actuators, the system can provide a more stable environment for silkworm cultivation. IoT connectivity further enables remote supervision and timely notification of variations in operating conditions.

The proposed approach can reduce manual intervention, improve resource utilization, and contribute to improved productivity and silk quality. Future integration of advanced IoT sensors, predictive analytics, and artificial intelligence could further enhance the scalability, efficiency, and adaptability of intelligent sericulture systems.

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