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IoT Based Automated Sericulture System

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Abstract: *Sericulture denotes to the rearing of silkworm to produce silk. Parameters like Temperature, Humidity and Light intensity are the important factors in the progression of silkworms and suitable encouraging must to be done according to the requisites in every stage. Environmental variations assume as the important part in the growth and development of silkworm. Sericulture is the important occupation in India and the techniques used by the agriculturists are yet outdated. Hereafter there is the need of developing modernization in sericulture cultivate. This endeavour gives a thought of providing automation in sericulture cultivate. The model goals at making use of developing technology that is IOT and smart Sericulture using automation. Observing environmental parameters of the silkworm rearing house is the most important aspect to improve vintage of the silk. The specialty of this model comprises enhancement of a system which can observe temperature, humidity, light power through sensors using Node MCU and in case of any variations in the parameters send a notification on the user mobile application using internet connection.*

Keywords*:* IoT, Sensors, Sericulture

I. INTRODUCTION

Sericulture, the cultivation of silkworms for the production of silk, is an age old activity with economic significance across the world. The processing condition gives rise to a particular quality of silk, which also depends on how the silkworms are reared and their environmental factors. Optimal temperature, humidity, and light intensity levels are crucial to the health and productivity of silkworms. Therefore, constant monitoring is needed. Management of these environmental factors has historically been tedious and demanding in terms of time and effort, requiring hands-on attention from the sericulturists. Each factor needed adjustment and continuous checking which took a great amount of time, while causing human blunders that would lessen silk production. Technological improvements including the Internet of Things have given us the option to \(automate\) these tasks.

This project goal is to create an IoT based sericulture system where environment conditioning and monitoring takes place automatically. We will be able to collect large amounts of data in regards to temperature, humidity, and light which will be PI Pico microcontroller enabled.

II. METHODOLOGY

The proposed system is an IoT-based solution designed to automate the monitoring and control of environmental conditions crucial for sericulture. The system aims to provide a consistent and optimized environment for silkworms by leveraging modern sensor technology, microcontrollers, and IoT platforms is shown in figure 1. The following sections outline the key components and functionalities of the proposed system.

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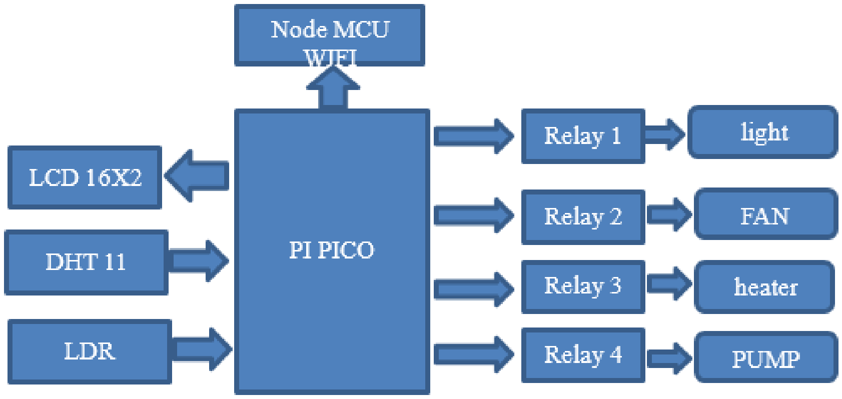

Figure 1 : Block diagram of the model

➢ The sericulture environmental monitoring and control system integrates various sensors, microcontrollers, actuators, and an IoT platform to maintain optimal conditions for silkworm cultivation. A DHT11 temperature and humidity sensor continuously measures ambient temperature and humidity, while a Light Dependent Resistor (LDR) monitors the light intensity within the environment.

➢ These sensors feed data to a Raspberry Pi Pico microcontroller, which processes the inputs and implements control logic to manage key actuators such as a fan, heater, and water pump. The fan is activated when temperatures rise above a defined threshold, the heater is triggered when temperatures drop too low, and the water pump is used to maintain ideal humidity levels or can be manually controlled remotely.

➢ For connectivity, a Node MCU (ESP8266) microcontroller interfaces with the Blynk IoT platform, enabling remote monitoring and control via a mobile application. This allows users to view real-time data, receive alerts, and control the water pump from anywhere. Additionally, a 16x2 LCD display is used for local monitoring, showing real-time temperature and humidity values to assist sericulturists in maintaining optimal rearing conditions.

System Implementation

• The hardware setup for the sericulture monitoring and control system involves connecting the DHT11 sensor, LDR sensor, and relays to the Raspberry Pi Pico, which serves as the central processing unit. A 16x2 LCD display is interfaced with the Pi Pico to provide local, real-time readings of temperature and humidity.

• The actuators, including the fan, heater, and water pump, are connected to relays that are controlled by the Pi Pico based on the sensor data. Additionally, a Node MCU (ESP8266) is configured for Wi-Fi connectivity and integrated with the Blynk IoT platform, enabling remote access and control.

• In the software development phase, code is written for the Pi Pico to read data from the sensors, display this information on the LCD, and control the actuators based on predefined temperature and humidity thresholds. Separate code is developed for the Node MCU to facilitate communication with the Blynk platform, allowing it to transmit sensor data and receive control commands from the mobile application.

• The Blynk app is configured to display real-time environmental data and provide an intuitive interface for users to remotely monitor conditions and control the water pump as needed.

III. COMPONENTS REQUIRED

1. Raspberry Pi Pico

The Raspberry Pi Pico is a low-cost, high-performance microcontroller board developed by the Raspberry Pi Foundation. Unlike other Raspberry Pi models, which are full Linux-based computers, the Pico is a microcontroller designed for embedded applications such as automation, robotics, and IoT The Raspberry Pi only utilises 26 out of 30 GPIOs the RP2040 has to offer, 26 pins are exposed and an additional 27th pin can only be used for the onboard LED. The Raspberry Pi Pico's

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GPIO is powered from the on-board 3.3V rail and is therefore fixed at 3.3V. GPIO0 to GPIO22 are digital only and GPIO 26-28 are able to be used either as digital GPIO or as an ADC input which can be done through software.

Figure 2 : Raspberry Pi Pico

2. Node MCU

Node MCU is a firmware and development board based on open-source Lua, primarily designed for IoT applications. It features a SoC (System on a Chip) ESP8266 with Wi-Fi developed by Egresses systems and a compatible hardware module which is based on ESP-12 as shown in figure 3.3. The Node MCU ESP8266 development board also integrate the ESP-12E module which possess the ESP8266 chip, And A TensilicaXtensa 32-bit LX106 RISC microprocessor, describbed in table 3.1.This microprocessor runs an RTOS SoC clock frequency of 80MHz to 160Mhz adjustable.
Node MCU has 128 KB of RAM and 4MB Flash memory. Its processing capability together with integrate Wi-Fi / Bluetooth, Deep Sleep Operating features make it ideal for IoT projects

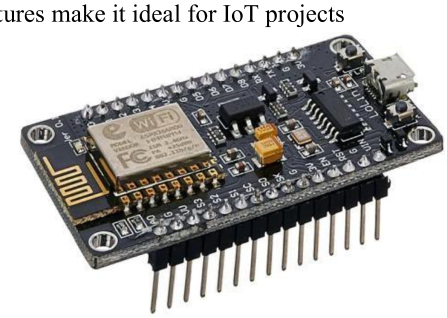

Figure 3 :Node MCU

3. 5V4-Channel Relay Module

The four-channel relay module houses four 5V relays and their respective galvanic relay switching and separating elements, so that the microcontroller or sensor can be connected with minimum peripheral components and wiring. The contacts on each relay are rated for 250VAC and 30VDC at 10A, which is the limit that is marked on the body of the relays The four-channel relay module contains four 5V relays and the associated switching and isolating components that make interfacing with a microcontroller or sensor east with minimum components and connections

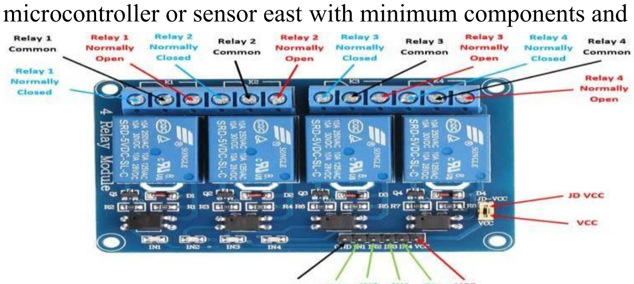

Figure 4 : Relay module

4. 16x2 LCD Module

16x2 LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability, programmer friendly and available educational resources. 16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. but the most used one is the 16×2 LCD is shown in table 3.3. So, it will have (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dots. A Single character with all its Pixels.

Figure 5 : LCD module

5. LDR(Light Dependent Registor)

The Light dependent resistor, or LDR, also known as photoresistor, is another unique type of resistor which has no polarity so they can be connected in any direction. They are very easy to work with on a perf board as well. The symbol for LDR in circuit diagrams is almost the same as Resistor but contains inward arrows as shown above at LDR pinout diagram. The arrows denote the light sign signals.

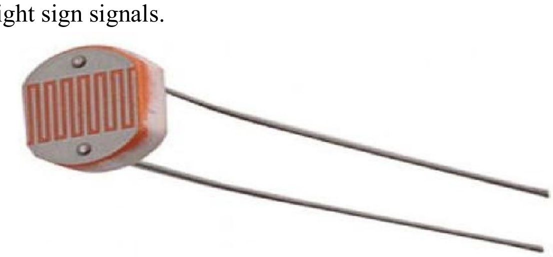

Figure 6: LDR Sensor

6. DTH11-Tempature and Humidity Sensor

DHT11 is a rather popular sensor of temperature and humidity which incorporates a dedicated NTC for temperature measurement and an 8-bit microcontroller for serial output of temperature and humidity data.Like all DHT series sensors, the DHT11 is a rather popular sensor of temperature and humidity. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data which is displayed . The sensor is also easy to work with other microcontrollers since it comes factory calibrated.

Figure 7 : DTH11 Sensor

7. Blynk IoT

The Blynk platform serves as the IoT interface between the user—typically the agriculturist—and the hardware system, enabling remote monitoring and control. It communicates with the NodeMCU (ESP8266), which acts as a bridge between the sensors and actuators managed by the Raspberry Pi Pico and the cloud. The NodeMCU uploads real-time environmental data such as temperature, humidity, and light intensity to the Blynk cloud, making it accessible through the Blynk mobile application. Additionally, it receives control commands from the user via the app, allowing actions such as remotely activating the water pump, thereby enhancing convenience and responsiveness in managing sericulture conditions.

IV. RESULTS AND CONCLUSION RESULTS

The variation in the parameters such as temperature and humidity of silk worm rearing house is sensed by the sensors and is shown on LED and is sent in the agriculturist mobile application and planned important changes will be completed. In case if the temperature increases then the fan will be turned on and if it decreases the heater will be turned on, if light intensity is low then light will on by leveraging IoT technology, the system offers automated monitoring, precise control, and remote accessibility, thereby enhancing the efficiency, productivity, and quality of silk production.

CONCLUSION

The development of an IoT-based environmental monitoring and control system for sericulture presents a transformative approach to improving silk production through automation, precision, and remote accessibility. By integrating sensors with microcontrollers like the Raspberry Pi Pico and NodeMCU, the system effectively monitors key environmental parameters such as temperature, humidity, and light intensity. Automated actuation of fans, heaters, and water pumps ensures optimal rearing conditions for silkworms, significantly reducing the need for manual labor and minimizing human error.

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