AUTOMATED SERICULTURE SMARTGRID REVOLUTIONIZING SILK FARMING WITH TECHNOLOGY

A PROJECT REPORT

(Project Work II Phase I)

Submitted By

MEIPRASAANTH V

(21ECR116)

JEGAN M

(21ECR089)

JEGAN P

(21ECR090)

In partial fulfilment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Estd : 1984

KONGU ENGINEERING COLLEGE

(Autonomous)

PERUNDURAI ERODE – 638 060

OCTOBER 2024

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

KONGU ENGINEERING COLLEGE
(Autonomous)

PERUNDURAI ERODE – 638060

OCTOBER 2024

BONAFIDE CERTIFICATE

This is to certify that the project work II phase I report entitled **AUTOMTED SERICULTURE SMARTGRID – REVOLUTIONIZING SILK FARMING WITH TECHNOLOGY** is the bonafide record of project work done by **MEIPRASAANTH V (21ECR116), JEGAN M (21ECR089), JEGAN P (21ECR090)** in partial fulfilment of the requirements for the award of the Degree of Bachelor of Engineering in Electronics and Communication of Anna University, Chennai during the year 2024-2025.

SUPERVISOR	**HEAD OF THE DEPARTMENT**
Ms. V. MEKALA,	**Dr. N. KASTHURI M.E., Ph.D.,**
Assistant Professor (Sr.G),	Professor & Head,
Department of ECE,	Department of ECE,
Kongu Engineering College,	Kongu Engineering College,
Perundurai - 638 060.	Perundurai - 638 060.

Date:

Submitted for the end semester viva voce examination held on _____________

INTERNAL EXAMINER **EXTERNAL EXAMINER**

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

KONGU ENGINEERING COLLEGE
(Autonomous)

PERUNDURAI ERODE – 638060
OCTOBER 2024

DECLARATION

We affirm that the project work II phase I report titled **AUTOMATED SERICULTURE SMARTGRID – REVOLUTIONIZING SILK FARMING WITH TECHNOLOGY** being submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering is the original work carried out by us. It has not formed the part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

(Signature of the candidate)

Date: **NAME OF THE CANDIDATE**

MEIPRASAANTH V
(21ECR116)

JEGAN M
(21ECR089)

JEGAN P
(21ECR090)

I certify that the declaration made by the above candidates is true to the best of my knowledge.

Name & Signature of the supervisor with seal

Date:

ABSTRACT

The Automated Sericulture Smart Grid harnesses the power of the Arduino Uno as its central control unit, orchestrating various components to create optimal conditions for silkworm farming. This system consists of humidity and temperature sensor continuously monitor the environmental parameters essential for silkworm growth. The Arduino Uno is responsible for managing a relay module that powers high-demand devices, such as heaters for temperature regulation, coolers to prevent overheating, and a solenoid valve for the regular spraying of lime powder, which is crucial for maintaining the health of the silkworms. Additionally, the system incorporates a blower for waste removal and a servo motor that automates the feeding of mulberry leaves. By integrating these functionalities, the Automated Sericulture Smart Grid streamlines operational processes, significantly reduces manual labour, and enhances both productivity and silk quality, leading to a more efficient sericulture industry.

Furthermore, the design of this automated system incorporates user-friendly features aimed at simplifying operation and monitoring, making it accessible to farmers with varying levels of technical expertise. In addition to this, two digital displays are integrated into the system to provide real-time feedback on environmental conditions, allowing farmers to make informed decisions regarding their silkworms. Such flexibility significantly enhances the management of the sericulture process, allowing for prompt responses to any emerging challenges. By integrating modern technology into sericulture practices, this innovative system not only improves productivity but also plays a vital role in securing the livelihoods of rural communities that depend on silk farming, ultimately contributing to the preservation and growth of this traditional yet economically significant industry.

ACKNOWLEDGEMENT

First and foremost, we acknowledge the abundant grace and presence of the almighty throughout different phases of the project and its successful completion.

We wish to express our hearty gratitude to our honourable Correspondent **THIRU A.K. ILANGO B.Com., M.B.A., LLB.,** and other trust members for having provided us with all necessary infrastructures to undertake this project.

We express our hearty gratitude to our honourable Principal **Dr. V. BALUSAMY B.E.(Hons)., MTech., Ph.D.,** for his consistent encouragement throughout our college days.

We would like to express our profound interest and sincere gratitude to our respected Head of the department **Dr. N. KASTHURI M.E., Ph.D.,** for her valuable guidance.

A special debt is owed to the project coordinator **Dr.S.MAHESWARAN,M.E.,Ph.D,** Associate Professor and **Mr.S.SUTHAGAR, M.Tech**, Assistant Professor Department of Electronics and Communication Engineering, for their encouragement and valuable advice that helped us to carry out the project successfully.

We express our sincere gratitude to our beloved guide **Ms.V.MEKALA, M.E.,** Assistant Professor(Sr.G), Department of Electronics and Communication Engineering, for her ideas and suggestions, which have been very helpful to complete the project.

We are grateful to review members, all the faculty members and staff of the Department of Electronics and Communication Engineering and those who had directly and indirectly supported this project.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ADC	Analog to Digital Converter
ATmega328P	Atmel mega 328 Plastic dual in-line package
DAC	Digital to Analog Converter
DHT	Digital Temperature and Humidity Sensor
GPIO	General Purpose Input/Output
I2C	Inter-Integrated Circuit
IDE	Integrated Development Environment
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCU	Microcontroller Unit
PID	Proportional-Integral-Derivative
PWM	Pulse Width Modulation
RTC	Real-Time Clock
RTD	Real-Time Display
SCL	Serial Clock Line
SDA	Serial Data Access
VCC	Voltage Common Collector
VSS	Voltage Source Supply

CHAPTER 1

INTRODUCTION

Sericulture, the cultivation of silkworms for silk production, has been a vital part of the textile industry for thousands of years. Despite the luxury associated with silk, traditional sericulture remains labour intensive, relying heavily on manual processes. Silkworms, particularly the Bombyx mori species, are reared on a strict diet of mulberry leaves, progressing through various developmental stages before they spin their silk cocoons. The success of this process depends on maintaining precise environmental conditions, particularly temperature, humidity, and hygiene, which are critical for the health of the silkworms and the quality of the silk produced.

Traditional methods of sericulture require continuous monitoring of environmental factors like temperature and humidity, with manual adjustments to equipment such as heaters, fans, and humidifiers. Waste management is another crucial aspect, as accumulated waste from silkworm excreta and leftover leaves can compromise hygiene, leading to potential disease outbreaks that can affect silk yield and quality. These manual, labor-heavy tasks make sericulture time-consuming and prone to human error, reducing overall productivity and quality.

The Automated Sericulture Smart Grid project seeks to modernize and revolutionize the sericulture process by automating key elements such as environmental control, feeding, and waste management. In this system, temperature and humidity sensors constantly monitor the rearing environment, automatically activating heaters, coolers, and humidifiers to maintain the ideal conditions for silkworm development. This eliminates the need for frequent manual adjustments, ensuring consistent and precise environmental control. Additionally, an automated feeding system replaces the traditional manual method, where a hopper driven by a stepper motor distributes mulberry leaves evenly and at regular intervals, ensuring that the silkworms receive timely and adequate nourishment. To maintain hygiene, the system also automates waste collection, using trays and air blowers to efficiently remove waste material, reducing the risk of disease and minimizing labour requirements.

The introduction of automation not only reduces the reliance on manual labor but also ensures that conditions are optimized for silkworm health, ultimately leading to higher productivity and improved silk quality. Furthermore, the system integrates cloud-based data storage, allowing for real-time monitoring, data logging, and remote control, enabling farmers to track and manage conditions efficiently. The Automated Sericulture Smart Grid represents a significant leap forward in silk farming, bringing technological precision to a centuries-old practice, improving efficiency, scalability, and productivity, and enhancing the overall quality of silk produced.

1.1 OBJECTIVE

The project aims to modernize sericulture through automation. It focuses on three main areas are automating environmental control using temperature and humidity sensors with heaters and coolers, and optimizing feeding and waste management with a hopper setup through servo motor and an efficient waste collection system.

1.2 SCOPE

The scope of this project encompasses the automation of key processes in sericulture, focusing on environmental control, feeding, and waste management. It involves the installation of sensors to continuously monitor temperature and humidity, with automated adjustments made using heaters, coolers, and humidifiers to maintain optimal conditions for silkworm rearing. Additionally, a hopper-based feeding system, driven by a stepper motor, will automate the distribution of mulberry leaves, ensuring consistent and timely feeding. The waste management system will automate the collection of silkworm waste using air blowers and trays, ensuring a clean rearing environment. Furthermore, the system will integrate with cloud-based data storage, enabling remote monitoring, real-time data logging, and timely alerts for system adjustments. This comprehensive approach will significantly enhance the efficiency, reduce the labour involved, and modernize silk farming by leveraging automation and data-driven management.

CHAPTER 2

LITERATURE SURVEY

Arun et al (2019) explores the second-largest global producer, contributing 15% of the world's silk output alongside China. It plays a significant role in India's socio-economic, cultural, and political development, particularly in rural areas where it serves as a major livelihood. The successful rearing of silkworms is highly dependent on environmental factors like temperature and humidity, especially during the larval stage. Disinfection is also critical to ensure the health of the silkworms. This gap underscores the urgent need for the adoption of modern technologies in sericulture to enhance productivity, improve silk quality, and ultimately uplift the rural economy.

Poornima G R et al (2018) examines Sericulture and the science of rearing silkworms for silk production, is vital to rural livelihoods in India, driving financial, social, and intellectual progress. Silk, often referred to as the "queen of textiles," is prized for its ulster, softness, and durability. The primary species used in sericulture is *Bombyx mori*, a domesticated silkworm that produces silk by consuming mulberry leaves during its larval stage. To address this challenge, the paper proposes an automation system using Arduino technology to regulate these conditions, helping farmers improve the efficiency and quality of silk production by ensuring a more controlled environment throughout the rearing process.

Ahyeong lee et al (2023) states that Image recognition methods classify objects by extracting key features and are widely used in agriculture for quality assessment. With advancements in AI, deep learning techniques like convolutional neural networks (CNNs) have become essential for image recognition, automatically identifying relevant features. This study aimed to automate dead cocoon detection in sericulture using RGB images and various algorithms, including k-nearest neighbour, support vector machine, and deep learning models like VGG16 and ResNet50.

Seita Nojiri et al (2023) introduces a soft robotic device with a flexible body that switches between air blowing and suction using a single airflow control. Suction is created by jet flow entraining surrounding air, while blowing is achieved by reversing the flow. A thin flap gate controls this switching by either blocking or allowing airflow, with its operation managed by inflatable chambers that expand based on upstream pressure. The gate's dimensions affect blowing and suction performance. The device is demonstrated for use in variable friction systems and as an end effector for handling thin objects covered in dust.

Sunardi et al (2023) examines the Internet of Things (IoT) to control a fan and monitor room temperature and humidity through a mobile app. The system, which uses an ESP32 microcontroller with WIFI allows remote fan operation and ensures a comfortable environment. Room conditions are measured by a DHT22 sensor and managed using Tsukamoto's Fuzzy Inference System to adjust fan speed. The findings showed that the fan could not significantly cool a closed room, with temperatures increasing by 0.3°C to 0.5°C over 40-75 minutes. Future studies should explore incorporating cooling devices such as exhaust fans or air conditioners for better temperature control

Jyothi et al (2019) examines that sericulture is the process of producing silk from silkworms, with India being the second-largest producer globally, trailing China, which leads with 85% compared to India's 15%. This disparity is largely due to the limited use of automation in Indian sericulture. Quality silk production requires precise control of environmental factors like temperature, humidity, light, and gases. The Internet of Things (IoT) can enhance this process by providing real-time monitoring and control through interconnected sensors and network systems. This paper reviews research on implementing IoT-based smart automation techniques to improve efficiency and quality in sericulture.

Zhangzhi dong et al(2020) discuss about the temperature control for aircraft electronic equipment's liquid cooling system. A numerical model was developed to analyse heat transfer in key components, such as liquid storage tanks and radiators, under various temperature conditions (40°C-50°C). Using AMESim software, the study assessed the cold plate's thermal characteristics and compared different cooling control schemes. Results showed that the system generally meets the cold plate inlet temperature requirements (5°C-30°C). For low temperatures, an electric heater efficiently warms the cold plate, while at high temperatures, opening the ram airport is more effective than increasing fan speed but requires careful management to avoid exceeding temperature limits.

Simone Vasta et al (2023) reviews the Cocoon sorting is a labour-intensive process essential for silk quality, and automating this step is crucial for reducing costs and standardizing Fiber quality, especially in the context of a potential European sericulture revival. This research developed a prototype machine to address this challenge, using three cameras and imaging algorithms to assess cocoon shape, size, and stains, along with a custom light sensor and AI model to identify and discard dead cocoons. The prototype sorts approximately 80 cocoons per minute. The study highlights the integration of traditional sensors with a new design for detecting live versus dead pupae, showcasing the prototype's efficiency in improving sorting processes.

Yogesh raj N S et al (2022) introduces Sericulture in the cultivation of silkworms for silk production, is vital to India's economy and development, with India being the world's second-largest silk producer. Key to healthy silkworm growth are optimal temperature and humidity, especially during larval development. Our study employs a webcam and image processing techniques to monitor silkworm health. By analysing colour changes in the silkworms, we can identify infections, diseases, and developmental issues such as black worms and swallow worms. This approach enables the detection of non-identical phases and health problems, helping improve overall silk production quality.

Nivaashini M et al (2018) explores the Sericulture, the cultivation of silkworms for silk production, is crucial in India, the world's second-largest silk producer. This industry supports various advancements in the country. The proposed system uses an Internet of Things (IoT)-enabled Wireless Personal Area Network (WPAN) for continuous monitoring. It integrates Arduino software with environmental sensors and a camera to track and analyse temperature, humidity, and silkworm development stages. Image processing techniques help identify different life cycle phases, aiming to enhance the efficiency and effectiveness of sericulture practices.

Ahmed Farooq & (2021) explores the integration of IoT and image processing technologies in sericulture, transforming silk production. The research demonstrates that these technologies turn traditional silk farms into intelligent ecosystems, enhancing efficiency and productivity, while predictive analytics help sericulturists anticipate issues and optimize resources for a more sustainable future.

C. Manoharan et al (2022) investigates how Silkworms are reared in sericulture to produce raw silk, involving tasks such as growing food plants, spinning cocoons, and reeling silk for processing and weaving. It presents systems and strategies to enhance silk quality and production efficiency, focusing on monitoring environmental factors like humidity, temperature, and rainfall, as well as silkworm health. These advancements aim to optimize rearing conditions and boost productivity in sericulture.

Swetha Rohde et al (2021) explores technological innovations aimed at enhancing sericulture, a sector often underperforming in agriculture. It details a system that uses Arduino-based IoT, image processing, and smart sensors to monitor key environmental parameters—humidity, temperature, and rainfall—along with silkworm health. By controlling these factors and optimizing cocoon aggregation, the system aims to improve silk quality and productivity. Farmers receive real-time data through a user-friendly cloud interface implemented via REST API

Mohan Eshwari G P et al(2023) explores about the advancement of automated silkworm incubator that integrates modern technology with traditional sericulture practices. Utilizing an ESP32 microcontroller, the incubator controls key variables such as temperature, humidity, and air quality to ensure optimal conditions for silkworms. It uses DHT11 and MQ135 sensors to monitor these parameters, maintaining ideal conditions at 24-28°C and 70-85% humidity. A DC motor handles leaf cutting and storage, while an exhaust fan regulates temperature. Real-time data is displayed on a 16x2 LCD, and a buzzer alerts for emergencies. This innovation enhances productivity and sustainability, representing a significant advancement in silk farming.

Alejandra Duque-Torres et al (2022) explores Silk, known for its softness and durability, is produced from silkworm cocoons. Proper temperature and humidity are crucial for silkworm growth and cocoon quality. This paper introduces a prototype silkworm incubator using a Raspberry Pi, chosen for its capabilities and cost-effectiveness. The prototype monitors temperature, humidity, and luminosity, with data stored on Google Drive for analysis. Preliminary tests were conducted at the University of Cauca, Colombia, showcasing the prototype's ability to maintain optimal conditions for silk production.

2.2 SUMMARY OF LITERATURE SURVEY

Sericulture, the cultivation of silkworms for silk production, is a vital industry in countries like India, which ranks second globally in silk output, contributing significantly to the economy and rural livelihoods. However, the industry faces numerous challenges, primarily stemming from the limited adoption of modern technologies. Several studies emphasize the importance of controlling environmental factors, particularly temperature and humidity, which are critical for successful silkworm rearing. For instance, research by Poornima G. R. et al. (2018) highlights the development of IoT and Arduino-based automation systems that monitor and regulate these environmental conditions, helping farmers enhance silk quality and improve overall farming efficiency. Similarly, Sunardi et al. (2023) demonstrate how these technologies facilitate real-time monitoring and remote control, enabling farmers to maintain optimal conditions for silkworms throughout their developmental stages. By integrating modern technology, farmers can better manage their resources, resulting in improved productivity and economic sustainability.

Innovations in image recognition and artificial intelligence also present significant opportunities for automating labor-intensive tasks in sericulture, further enhancing operational efficiency. Research by Ahyeong Lee et al. (2023) explores the use of deep learning models to detect dead cocoons and sort them based on quality, thereby reducing labor costs and improving overall productivity. This automation is further supported by the work of Simone Vasta et al. (2023), which developed a prototype machine employing imaging algorithms to assess cocoon characteristics and discard non-viable specimens efficiently. The integration of IoT with image processing, as demonstrated in studies by Ahmed Farooq & C. Manoharan et al. (2022), is transforming traditional silk farms into smart ecosystems. These advancements not only enhance operational efficiency but also provide predictive analytics that help sericulturists anticipate potential issues, ensuring more sustainable and high-quality silk production. Overall, these technological innovations pave the way for a more resilient sericulture industry, capable of meeting the growing global demand for silk while also improving the livelihoods of those involved in its production.

CHAPTER 3

METHODOLOGY

3.1 EXISTING METHOD

3.1.1 Environmental Control:

In traditional sericulture, environmental control is managed manually, where workers frequently monitor the temperature and humidity levels in the rearing environment. Heaters, fans, humidifiers, and ventilation systems are adjusted manually to maintain optimal conditions. The ideal temperature for silkworm rearing ranges between 25-29°C, and the humidity level should be around 70-80%. This manual process is labour-intensive and can be prone to human error, which may result in suboptimal conditions that negatively impact silkworm health and silk quality.

Challenges:

- Labor-intensive monitoring and adjustments.
- Prone to human error, leading to inconsistent temperature and humidity control.
- Suboptimal conditions may lead to lower silk yield or affect the quality of the silk produced.

3.1.2 Feeding Silkworms:

Feeding the silkworms with mulberry leaves is another critical part of the sericulture process. Workers manually collect and distribute fresh mulberry leaves multiple times a day to ensure the silkworms are fed consistently. The feeding schedule and number of leaves given directly impact the growth of silkworms and their ability to spin cocoons.

Challenges:

- Requires significant labour to feed the silkworms consistently throughout the day.
- Inconsistencies in the amount or timing of feeding may affect silkworm health and development.
- Delayed or missed feedings can result in malnourished silkworms, affecting the quality of silk.

3.1.3 Waste Management:

In traditional sericulture, waste management is handled manually, where workers remove the silkworm waste (excreta and leftover leaves) from the rearing trays. Improper waste disposal can result in the accumulation of waste, leading to unhygienic conditions, which increase the risk of diseases and infections among the silkworms. A clean environment is essential to maintain the health of the silkworms and ensure high-quality silk production.

Challenges:

- Manual cleaning is labour-intensive and time-consuming.
- Accumulation of waste due to inadequate cleaning can lead to poor hygiene and increase the risk of disease outbreaks.
- Unclean rearing environments may negatively affect the growth and health of the silkworms, impacting silk yield and quality.

3.2 PROPOSED METHOD

3.2.1Automated Environmental Control:

The proposed system introduces automation in the control of environmental factors to ensure optimal conditions for silkworm rearing. Sensors and Actuators: Temperature and humidity sensors continuously monitor the rearing environment. Based on real-time data from the sensors, automated heaters, coolers, and humidifiers are activated to maintain the desired temperature range of 25-29°C and humidity levels between 70-85%. This removes the need for manual adjustments and ensures consistent environmental control.lime Powder Spraying: To prevent diseases and maintain silkworm health, an automated lime powder spraying system is deployed. The system sprays lime powder at regular intervals, minimizing human intervention and ensuring silkworm welfare.

3.2.2 Automated Feeding System:

The traditional manual feeding process is replaced with an automated mechanism to ensure the silkworms receive a consistent and even distribution of food.hopper and Stepper Motor: A hopper is mounted on a stepper motor that moves along one axis via a rack and pinion system. This allows precise control over the distribution of mulberry leaves, ensuring that the silkworms are fed evenly. The automation reduces labour requirements and ensures timely and adequate feeding, which is critical for the growth and health of the silkworms.

3.2.3 Automated Waste Management:

To maintain a clean and hygienic environment, the proposed system automates the waste collection process, preventing the buildup of waste material and reducing the risk of disease air blowing system: A tray is placed under the silkworm rearing trays to collect waste such as excreta and leftover mulberry leaves. This waste is removed through a powerful air-blowing system, ensuring that the trays remain clean and minimizing manual intervention in waste disposal. This automation helps maintain a healthy rearing environment and reduces labour-intensive cleaning processes.

3.3 BLOCK DIAGRAM

The block diagram showcases the architecture of the automated sericulture system, with Arduino Uno as the central controller. The input module includes a humidity sensor that monitors environmental conditions and sends data to the Arduino for processing. Based on the input, the Arduino controls various components through relays and drivers: a heater/cooler mechanism for temperature regulation, an automated feeding system for dispensing mulberry leaves, a lime powder sprayer for maintaining hygiene, and an air blower for waste management. The system also features an LCD display to show real-time data and supports cloud storage for logging and remote monitoring of system operations. The diagram highlights a fully automated setup for optimizing sericulture environments.

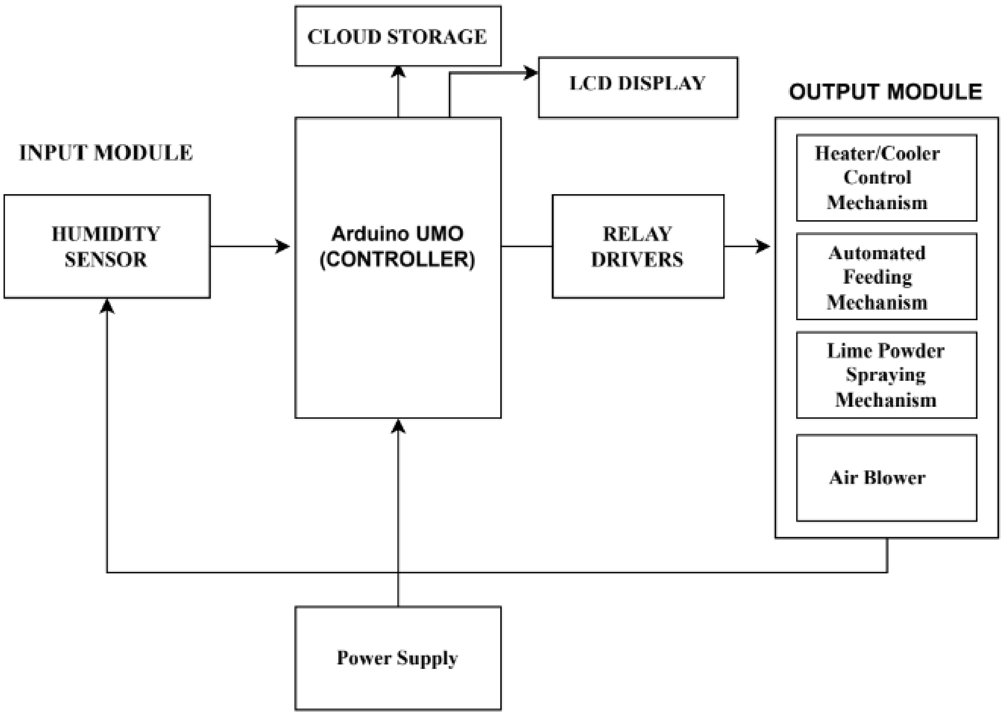

Figure 3.1 Block Diagram of Automated Sericulture Smart grid

Figure 3.1 illustrates the Block Diagram of the Automated Sericulture Smart Grid. This system employs an Arduino Uno to control various components essential for maintaining optimal conditions in silkworm farming. It incorporates a humidity and temperature sensor for real-time environmental monitoring and an I2C module for task scheduling. The system manages a relay module that powers devices like heaters, coolers, a solenoid valve for spraying lime powder, a blower for waste removal, and a stepper motor for automated feeding. This automation significantly enhances operational efficiency, reduces manual labour, and ultimately improves both productivity and silk quality, enabling a more sustainable approach to silk production.

3.4 PIN CONFIGURATION

Understanding the pin assignments and voltage requirements ensures seamless integration of sensors, facilitating precise monitoring of hazard.

Table 3.1 Components PIN Configuration on Arduino Uno

COMPONENTS	ANALOG/DIGITAL PINS	VOLTAGE
DHT 11	D2	5V
SERVO MOTOR	D3	5V
LCD – I2C (SDA, SCL)	A4, A5	5V
4 – CHANNEL RELAY	D4, D5, D6	5V
SOLENOID VALVE	RELAY 1	12V
AIR BLOWER	RELAY 2	12 V

Table 3.1 displays the pin configuration of all the components that is connected to Arduino Uno. It details the analog and digital pins on the Arduino Uno to which each sensor is connected, along with the voltage supplied to each component. This information is crucial for understanding the hardware setup and interfacing of components with Arduino Uno in automated sericulture smart grid.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 SOFTWARE REQUIREMENTS

For the proposed hazard prevention system, the software requirements include

- Proteus 8 Professional for simulation.
- Arduino IDE for coding.

4.1.1 PROTEUS 8 PROFESSIONAL

Proteus 8 Professional is a powerful simulation software commonly used for designingand testing electronic circuits. It allows engineers to simulate the behavior of electronic components and circuits before actual implementation, which is crucial for ensuring the functionality and reliability of the system. With Proteus, engineers can model various scenarios, test different configurations, and troubleshoot potential issues in a virtual environment, saving time and resources during the development process.

4.1.2 ARDUINO IDE

Arduino IDE, on the other hand, is an integrated development environment specificallydesigned for programming Arduino microcontrollers. It provides a user-friendly platform forwriting, compiling, and uploading code to Arduino boards. Arduino IDE supports the Arduinoprogramming language, which is based on C/C++, making it accessible to both beginners and experienced programmers. With Arduino IDE, developers can write code to control sensors, process data, and communicate with other components of the hazard prevention system. Additionally, Arduino IDE offers a range of libraries and examples to streamline the development process and facilitate rapid prototyping of electronic projects.

4.2 HARDWARE REQUIREMENTS

Arduino The hardware requirements encompass a suite of specialized sensor for monitoring the environment 24/7 and to provide real time data, complemented by a core controller for data processing and transmission. This setup facilitates real time data collectionand analysis to ensure effective monitoring to detect any hazard from the industry.

- Arduino UNO Development Board
- Temperature and humidity Sensor (DHT11)
- Servo Motor
- Relays
- Solenoid Valve
- LCD Display

4.3 HARDWARE DESCRIPTION

4.3.1 ARDUINO UNO

Arduino Uno is a popular microcontroller board based on the ATmega328P microcontroller. It is widely used in electronics projects due to its simplicity, versatility, andease of use. The Arduino Uno board features digital input/output pins, analog input pins, power pins, and a USB interface for programming and communication with a computer. It is compatible with various sensors, actuators, and other electronic components, making it suitable for a wide range of applications, including hobbyist projects, prototyping, and educational purposes.

Figure 4.1 Pin Diagram of Arduino UNO

Figure 4.1 represents the Pin Diagram of the Arduino UNO, which functions as the central controller in the automated environmental control system for sericulture. It plays a critical role in processing data from various sensors, including the humidity sensor and the I2C module used for tracking day and time. The Arduino also manages the operations of connected components, such as relays that control high-power devices, a solenoid valve for spraying lime powder, and a stepper motor for feeding mulberry leaves. By integrating these diverse functionalities, the Arduino facilitates seamless communication and coordination among the system's elements, ensuring optimal environmental conditions crucial for the health and productivity of silkworms.

4.3.2 HUMIDITY SENSOR DHT11

The DHT11 is a low-cost digital sensor used to measure both temperature and humidity. It consists of a resistive humidity sensor and a thermistor to measure the surrounding air, providing output in digital format. The sensor operates on a simple communication protocol, making it easy to interface with microcontrollers like Arduino and Raspberry Pi. It can measure humidity in the range of 20-90% RH with an accuracy of ±5%, and temperature from 0-50°C with an accuracy of ±2°C. Though not the most accurate sensor, its affordability and ease of use make it ideal for basic applications like home automation, weather stations, and educational projects.

Figure 4.2 Humidity Sensor DHT11

Figure 4.2 represents the humidity sensor, which is connected to the digital pin 2 (D2) of the Arduino, receiving power from it while providing real-time readings of temperature and humidity. These readings are displayed on the LCD, enabling effective monitoring of the environmental conditions in the silk farming setup. This integration ensures that the system can maintain optimal conditions for silkworm health and productivity.

4.3.3 SERVO MOTOR

The servo motor typically features a torque of 4.0 kg·cm, a speed of 0.15 sec per 60 degrees, and operates within a voltage range of 4.8V to 6V. Servo motor plays a crucial role in automating the feeding process by precisely controlling the movement of a hopper or feeding tray. The basic function of a servo motor is to provide accurate position control through a feedback mechanism, allowing it to rotate to specific angles based on control signals. Using Pulse Width Modulation (PWM), the servo motor ensures accurate and consistent distribution of mulberry leaves to the silkworms at scheduled intervals. This automation reduces manual labor, ensures timely feeding, and contributes to the overall health and productivity of the silkworms, ultimately enhancing silk quality.

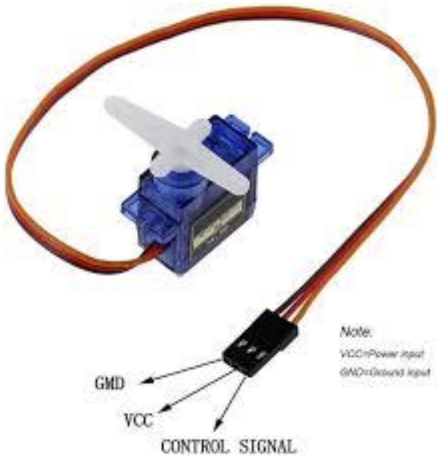

Figure 4.3 Pin Diagram of Servo Motor

Figure 4.3 represents the stepper motor, which is connected to the digital pin 3 (D3) of the Arduino. This setup is used to automate the feeding of chopped mulberry leaves to the silkworms. By controlling the stepper motor through the relay, the Arduino can precisely manage the delivery of leaves, ensuring that the silkworms receive a consistent and adequate supply of food, thereby promoting their health and enhancing silk production.

4.3.4 RELAYS

A relay is an electrically operated switch that allows low-power circuits to control high-power devices. It works by using an electromagnet to mechanically operate a switch. When current flows through the relay's coil, it generates a magnetic field that moves an armature, opening or closing the contacts within the relay. This enables the control of circuits that handle high voltages or currents, such as motors, heaters, or lighting systems, from low-power control systems like microcontrollers. Relays are commonly used in automation, industrial controls, and home appliances to isolate and switch between different circuits safety.

Figure 4.4 Pin Diagram of Relay

Figure 4.4 displays a relay, which serves as the brain of this circuit, coordinating various components such as the feeding system, cooling system, lime powder spraying mechanism, and blower. By interfacing with the Arduino, the relay allows for precise control over these systems, enabling seamless operation. This centralized control ensures that all functions work harmoniously to maintain optimal conditions for silkworm health and productivity, ultimately enhancing silk production efficiency.

4.3.5 SOLENOID VALVE

A solenoid valve is an electromechanical device used to control the flow of fluids or gases in a system. It consists of a solenoid (a coil of wire that acts as an electromagnet when energized) and a valve that opens or closes based on the magnetic field generated by the solenoid.

When electricity is applied to the solenoid, the magnetic field pulls a plunger or piston inside the valve, either allowing fluid to pass through or stopping its flow. Solenoid valves are widely used in automation systems, irrigation, HVAC, fluid control, and industrial processes, providing precise, reliable control over fluid flow. They come in various configurations, such as normally open (NO) or normally closed (NC), depending on the application needs.

Figure 4.5 Pin Diagram of Solenoid Valve

Figure 4.5 represents a solenoid valve, which is connected to the digital pin 4 (D4) of a relay and it is controlled by a relay that is powered by the Arduino. This configuration allows the Arduino to manage the operation of the solenoid valve, enabling precise control over the spraying of lime powder. By utilizing the relay, the system ensures consistent and accurate application, contributing to the overall health of the silkworms.

4.3.6 LCD DISPLAY

An LCD (Liquid Crystal Display) is a flat-panel display technology commonly used in devices such as monitors, televisions, and digital instruments. It operates by using liquid crystals sandwiched between layers of glass or plastic. When an electric current is applied, the liquid crystals align in such a way that they either block or allow light to pass through, forming images or text on the screen. LCDs are energy-efficient, producing clear and sharp images while consuming minimal power.

Figure 4.6 Pin Diagram of LCD Display

Figure 4.6 represents the LCD display where the output from humidity sensor is transmitted via the I2C module, which displays real-time readings of temperature, humidity, day, and time. This setup allows for efficient communication between the components, ensuring that farmers have access to critical environmental data immediately. By consolidating this information on the LCD, the system enhances monitoring capabilities, facilitating better management of conditions necessary for silkworm health and productivity.

4.3.7 I2C MODULE

An I2C (Inter-Integrated Circuit) module is a communication interface commonly used to connect low-speed peripherals to microcontrollers or processors. It allows multiple devices to communicate over a short distance using just two wires: SDA (Serial Data) and SCL (Serial Clock). The I2C protocol is a master-slave communication model, where the master device controls the clock and initiates communication with the slave devices, which each have unique addresses.

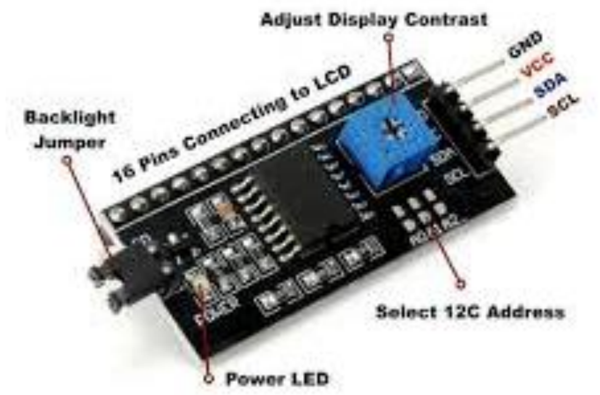

Figure 4.7 Pin Diagram of I2C Module

Figure 4.7 represents the SDA and SCL pins of the I2C, which is connected to the analog pin A4 and A5 if the Arduino uno. The I2C module, powered by the Arduino and controlled by a relay, measures the day and time. This setup enables accurate tracking of time-related data, which is crucial for managing the silkworm farming process.

By integrating the I2C module with the Arduino, the system ensures that the date and time information is readily available for display on the LCD, enhancing the overall functionality and monitoring capabilities of the automated environmental control system.

4.3.8 AIR BLOWER

In sericulture, air blowers are used to efficiently remove silk worm waste (frass) from rearing trays or beds. As silkworms consume mulberry leaves, they produce waste, which needs to be regularly cleaned to maintain a healthy environment and prevent disease. The air blower helps by blowing away the lightweight waste material, making the cleaning process faster and more hygienic. This method minimizes disturbance to the worms and reduces manual labour, allowing for better maintenance of the optimal conditions necessary for the silkworms' growth and health.

Figure 4.8 Pin Diagram Air Blower

Figure 4.8 represents an air blower, which is controlled by the relay which in turn controlled by the digital pin 5 (D5) of the Arduino. The battery-powered air blower system is used to remove waste after silkworm harvesting, helping to control diseases in the farming environment. By efficiently clearing organic waste, it reduces the risk of pathogen buildup, promoting a cleaner habitat essential for silkworm health and optimal silk production.

4.3.9 POWER SUPPLY

A 12V DC battery is a power storage device that supplies 12 volts of direct current, commonly used in cars, solar systems, and backup power. Available in types like lead-acid and lithium-ion, it is known for its portability and reliability in powering low-voltage devices.

Figure 4.9 Figure of Power Supply

Figure 4.9 represents a battery, which is used to power both the solenoid valve, which sprays lime powder to support silkworm health, and the vacuum mechanism for efficient waste removal. This battery-operated setup ensures that these essential functions operate independently, providing flexibility and reliability in maintaining optimal conditions for silk farming.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 3D MODEL DESIGN

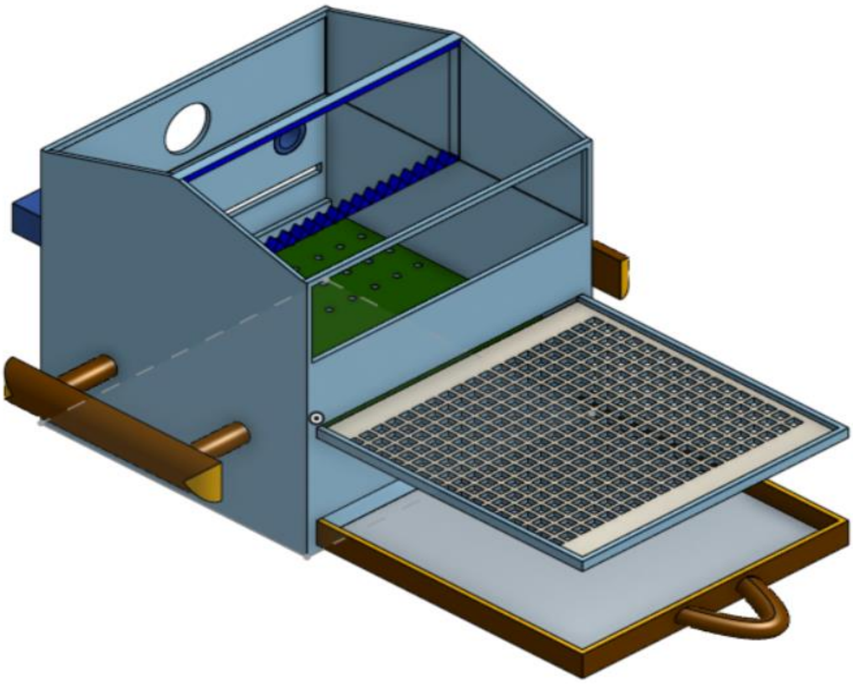

Figure 5.1 Figure of 3D Model Design

Figure 5.1 represents a prototype design for an automated sericulture system. It includes multiple compartments for different functionalities, likely for the processes involved in silk farming. The upper section seems to house a feeding system, with a hopper mechanism that dispenses mulberry leaves, essential for feeding silkworms. The slotted tray in the middle allows for waste segregation and air circulation, supporting hygiene and optimal conditions for silkworms. Below this, a drawer system is likely designed for collecting waste or for cleaning purposes. The handles on the sides provide mobility and ease of handling. The overall design reflects an integrated, user-friendly solution for automating and improving traditional silk farming practices.

5.1.1 SOFTWARE USED FOR 3D MODELLING

Onshape is a cloud-based 3D modelling software designed for product development and engineering, offering powerful tools for design, collaboration, and data management. Unlike traditional CAD programs, Onshape operates entirely online, enabling users to access their projects from any device with an internet connection. This flexibility facilitates real-time collaboration among team members, as multiple users can work on the same model simultaneously, making it ideal for remote teams. Onshape features a comprehensive suite of modelling tools, including parametric design capabilities, assemblies, and advanced simulations, allowing users to create complex geometries and analyse designs efficiently. Additionally, its version control and data management systems ensure that users can track changes, manage revisions, and maintain a centralized repository of project data, enhancing productivity and streamlining workflows in the design process.

5.2 SIMULATION RESULTS

In this simulation, the Arduino Uno reads temperature and humidity data from the DHT11 sensor and displays the real-time values on LCD1. Based on these readings, the system controls environmental conditions by activating various devices. The heater turns on if the temperature falls below the set threshold, indicated by an orange LED, while the cooler is activated when the temperature exceeds the limit, with a purple LED signalling its operation.

To maintain optimal humidity, the water sprayer is triggered when the humidity drops, shown by a yellow LED. The lime powder sprayer operates at regular intervals, with a red LED confirming its activation. A motor driver (L298, U3) controls the lime powder sprayer's motor, managing its speed and direction for even distribution.

Two LCDs are used: LCD1 shows the temperature and humidity data, while LCD2 displays the status of the heater, cooler, water sprayer, and lime powder sprayer. Users can adjust the temperature and humidity thresholds via two variable resistors (RV1 and RV2). Additionally, the DS3232 real-time clock (RTC) module ensures that time-based operations, such as the lime powder sprayer, are executed accurately. LEDs provide visual feedback for each device's activation, ensuring the system's performance is easy to monitor.

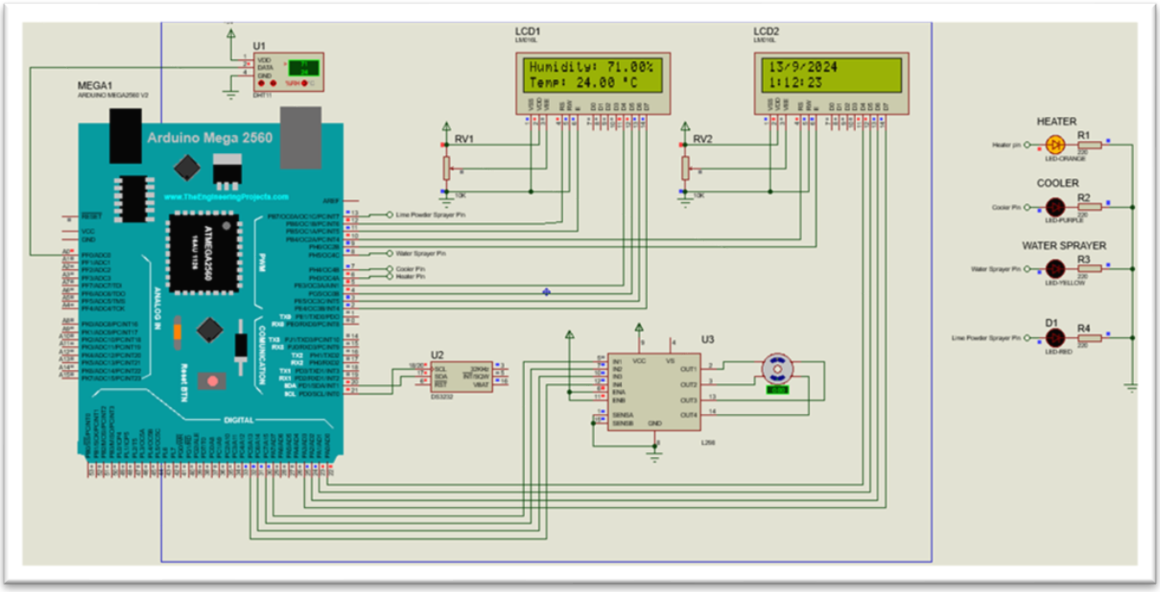

Figure 5.2 Heater is turned ON when temperature < 25 degree C

Figure 5.1 represents the automated environmental control system for silk farming has been meticulously designed in Proteus, featuring an integrated setup that revolves around an Arduino Uno. This design includes a DHT11 humidity sensor for accurate measurement of temperature and humidity, complemented by a 16x2 LCD display for real-time monitoring of environmental conditions. Control mechanisms such as relays regulate high-power devices, while a solenoid valve is utilized for spraying lime powder to promote silkworm health. The system also incorporates a vacuum mechanism for efficient waste removal, a stepper motor for automating the feeding of mulberry leaves, and an air blower to ensure optimal air circulation. Communication between components is streamlined through an I2C module, and a stable power supply supports the entire setup. This comprehensive Proteus design effectively visualizes the interaction between components, highlighting its potential to enhance silk production efficiency.

5.3 DEMO PROTOTYPE

The Arduino Uno is programmed to monitor and control the environment using temperature and humidity data from the DHT11 sensor, displayed in real-time on LCD1. The prototype showcases how different devices respond to changing environmental conditions. When the temperature drops below a specified threshold, the heater is activated, with an orange LED providing visual feedback. Conversely, when the temperature rises above the limit, the cooler turns on, and the purple LED lights up to indicate this.

Humidity control is demonstrated by activating the water sprayer whenever the humidity falls below a set value. A yellow LED illuminates to show the sprayer is functioning. Additionally, the lime powder sprayer operates at preset intervals, with a red LED indicating its activity. A motor driver is integrated to control the sprayer motor, managing both its speed and direction for effective lime powder distribution.

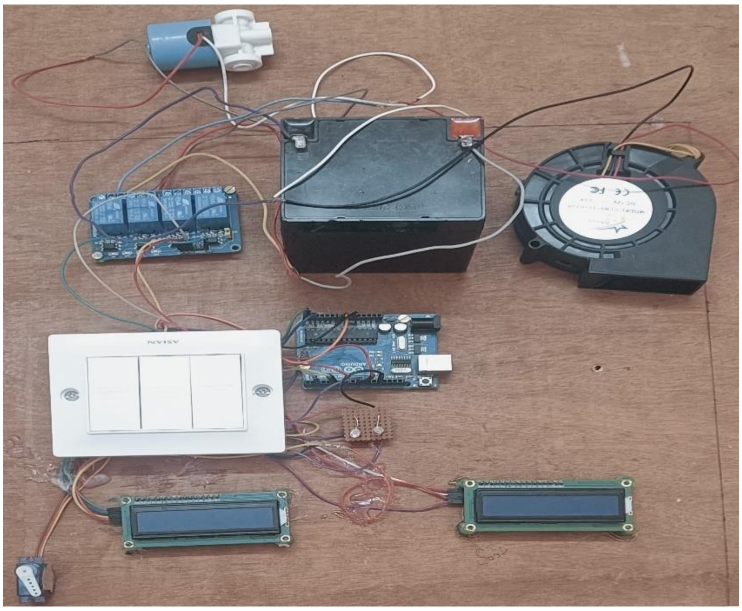

Figure 5.3 Hardware Connections

The demo Figure 5.1 represents a two LCDs. LCD1 displays real-time temperature and humidity readings, while LCD2 provides information about the status of the heater, cooler, water sprayer, and lime powder sprayer. The LEDs visually confirm each device's activation, making it easy to track the system's performance during the process.

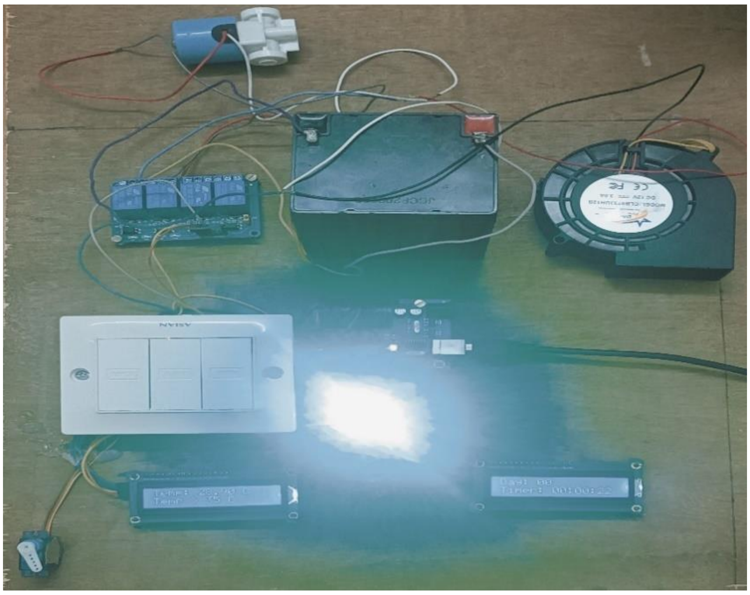

Figure 5.4 LED is turned ON when temperature is not maintained between 25 – 29 degrees Celsius.

The Figure 5.4 illustrates the automated environmental control system for silk farming, centred around an Arduino Uno, which processes data from various components and manages control mechanisms. Key elements include the DHT11 humidity sensor, which measures temperature and humidity levels, and a 16x2 LCD display that provides real-time feedback on these environmental conditions.

Control mechanisms consist of relays for managing high-power devices like heaters and coolers, a solenoid valve for spraying lime powder to maintain silkworm health, and a vacuum system designed to remove waste effectively. Additionally, a stepper motor automates the feeding of mulberry leaves, while an air blower circulates air to maintain optimal temperature and humidity. Communication between the Arduino and the LCD is simplified by an I2C module, and a stable power supply ensures reliable operation for the entire system. This comprehensive setup facilitates precise monitoring and control, essential for enhancing silk production efficiency.

Figure 5.5 LCD 1-Displays temperature

This project uses a temperature sensor connected to a microcontroller to monitor the room temperature. The readings are displayed on a 16x2 LCD, with a potentiometer for contrast control. This allows real-time monitoring of environmental conditions, crucial for effective sericulture.

Figure 5.6 LCD 1-Displays humidity

This project uses a temperature sensor connected to a microcontroller to monitor the room temperature. The readings are displayed represents on Figure 5.6 a 16x2 LCD, with a potentiometer for contrast control. This allows real-time monitoring of environmental conditions, crucial for effective sericulture.

Figure 5.7 LCD 2-Displays Day and time

The readings are displayed on a 16x2 LCD, which shows both the temperature and the clock data simultaneously. This system ensures continuous monitoring of environmental conditions, helping maintain the ideal settings for sericulture operations.

Figure 5.8 Interfacing the hardware and software to the design model

The figure 5.8 illustrates the prototype of the Automated Sericulture SmartGrid. It consists of a wooden enclosure equipped with sensors and electronic components for controlling temperature and humidity. LCD screens display real-time data, while the control system manages environmental conditions for silkworms. The slatted panels below support trays for feeding mulberry leaves, and the system incorporates waste collection features. This setup aims to automate key aspects of silk farming, improving efficiency and productivity.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

This project successfully developed an automated environmental control system using Arduino Uno to optimize temperature, humidity, and lime powder distribution for silk farming. The system ensures a controlled environment, which is crucial for the health and productivity of silkworms, leading to better silk yields. The real-time monitoring via LCDs and visual indicators through LEDs provide an intuitive interface for farmers. This prototype demonstrates the potential for a cost-effective and scalable solution for silk farming, with precise control over the essential environmental factors.

Looking ahead, the system can be further enhanced by integrating it with IoT platforms for remote monitoring and control via mobile apps. Incorporating machine learning could enable predictive maintenance, optimizing performance by analysing historical data. An automated mulberry leaf feeding mechanism could complement the environmental control system, making the setup even more autonomous. Additionally, integrating image processing for silkworm health monitoring could detect diseases early, improving farm management. Energy efficiency could also be improved by incorporating renewable energy sources like solar power. These future enhancements would make the system more versatile, automated, and sustainable, revolutionizing the sericulture industry.

REFERENCE

Arun, R., Sandhya, P., Kiran, D.L., Monika, S.G., and Chiranjeevi, S. (2019). 'Automated Smart Sericulture System.' Journal of Engineering Technologies and Innovative Research, Vol. 6, No. 5, pp. 682-685.

Poornima, G.R., Taj, F., Gavinya, T.M., Madhu, G., and Madhubala, B.N. (2018, May). 'Arduino Based Automated Sericulture System.' In 2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), pp. 2504-2507. IEEE.

Lee, A., Kim, G., Hong, S.J., Kim, S.W., and Kim, G. (2023). 'Classification of Dead Cocoons Using Convolutional Neural Networks and Machine Learning Methods.' IEEE Access, Vol. 11, pp. 137317-137327.

Nojiri, S., Nishimura, T., Tadakuma, K., and Watanabe, T. (2023). 'Flexible and Slim Device Switching Air Blowing and Suction by a Single Airflow Control.' IEEE Robotics and Automation Letters, Vol. 8, No. 5, pp. 2637-2644.

Yudhana, A. (2023). 'Tsukamoto Fuzzy Inference System on Internet of Things-Based Room Temperature and Humidity Control.' IEEE Access, Vol. 11, pp. 6209-6227.

Jyothi, S., Mamatha, D.M., Raju, P.J., Sultana, S., and Seetharamulu, J. (2021). 'A Study on the Sericulture Farm Automation System Using the Internet of Things (IoT).' In Proceedings of the 2nd International Conference on Computational and Bio Engineering: CBE 2020, pp. 403-415. Springer Singapore.

Dong, Z., Li, X., Li, Z., and Hou, Y. (2020). 'Modeling Simulation and Temperature Control on Thermal Characteristics of Airborne Liquid Cooling System.' IEEE Access, Vol. 8, pp. 113112-113120.

Vasta, S., Figorilli, S., Ortenzi, L., Violino, S., Costa, C., Moscovini, L., and Tocci, F. (2023). 'Automated Prototype for Bombyx mori Cocoon Sorting: Improving Silk Quality and Production Efficiency through a Multi-Step Approach and Machine Learning Algorithms.' Sensors, Vol. 23, No. 2, p. 868.

Nivaashini, M., Soundariya, R.S., and Dinesh Kumar, A. (2018). 'Silkworm Growth Monitoring Smart Sericulture System Based on Internet of Things (IoT) and Image Processing.' International Journal of Computer Applications, Vol. 975, p. 8887.

Farooq, A. (2023). 'The Convergence of IoT and Image Processing in Sericulture: An Overview of Innovative Applications.' International Journal of Social Analytics, Vol. 8, No. 6, pp. 16-35.

Devi, S.S., Gadde, S., Harish, K., Manoharan, C., Mehta, R., and Renukadevi, S. (2022). 'IoT and Image Processing Techniques-Based Smart Sericulture Nature System'. Indian Journal of Applied & Pure Biology, Vol. 37, No. 3, pp. 678-683.

Rokhade, S., Guruprasad, M.K., Mallesh, M.S., Banu, S., Jyoti, S.N., and Thippesha, D. (2021, January). 'Smart Sericulture System Based on IoT and Image Processing Technique.' In 2021 International Conference on Computer Communication and Informatics (ICCCI), pp. 1-4. IEEE.

Thilagavathy, R., Mohaneshwari, G.P., Nisarga, M.J., Pruthvi, S., and Puneetha, B.P. (2024). 'Automated Silkworm Incubator.' International Journal of Trendy Research in Engineering and Technology, Vol. 8, Proceedings of NCCDS-24. ISSN: 2582-0958.

Duque-Torres, A., Rodriguez-Pabon, C., Ruiz-Rosero, J., Zambrano-Gonzalez, G., and Almanza-Pinzon, M.C., Caicedo Rendon, O.M. (2018). 'A New Environmental Monitoring System for Silkworm Incubators.' F1000Research, Vol. 7, p. 248.

Dixit, M.A., Kulkarni, A., Raste, N., and Bhandari, G. (2015, January). 'Intelligent Control System for Sericulture.' In 2015 International Conference on Pervasive Computing (ICPC), pp. 1-5. IEEE.