IoT-BASED TEMPERATURE MONITORING AND AUTOMATED VENTILATION FOR POULTRY FARMS

A PROJECT REPORT

Submitted By

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In partial fulfilment for the award of the degree

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SRI SHANMUGHA COLLEGE OF ENGINEERING AND TECHNOLOGY

SALEM – 637 304 (AUTONOMOUS)

MAY 2025

BONAFIDE CERTIFICATE

Certified that this project **"IoT-BASED TEMPERATURE MONITORING AND AUTOMATED VENTILATION FOR POULTRY FARMS"** is the bonafide work of **BHARATHKUMAR M (732721106005), SALINTH D (732721106030), SARAVANAN N (732721106032), VINOTH V (732721106040)** who carried out the project work under my supervision.

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Internal Examiner **External Examiner**

DECLARATION

We affirm that the project work titled **"IoT-BASED TEMPERATURE MONITORING AND AUTOMATED VENTILATION FOR POULTRY FARMS"** being submitted in partial fulfilment for the award of **BACHELOR OF ENGINEERING (ELECTRONICS AND COMMUNICATION ENGINEERING)** is the original work carried out by us. It has not formed the part of any other project work submitted for award of any degree or diploma either in this or any other University.

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ABSTRACT

This project presents the design and implementation of an IoT-based temperature monitoring and automated ventilation system specifically developed to enhance environmental control in poultry farms. In modern poultry farming, maintaining a stable thermal environment is critical, as extreme temperatures can severely impact the health, growth rate, and productivity of birds. The proposed system continuously monitors ambient temperature and humidity using a DHT11 sensor, with data processed by a Node MCU ESP8266 microcontroller. When the measured temperature exceeds a predefined threshold of 35°C, the system automatically activates a fogger-based cooling mechanism through a relay-controlled 12V solenoid valve. The system provides dual output displays—one on a 16x2 I2C LCD for local monitoring, and another through the Blynk IoT platform that allows real-time remote access via smartphone. An intelligent alert system is integrated to notify the farm owner immediately through mobile push notifications with audible warnings and email alerts, ensuring timely intervention even when the user is off-site. This smart automation minimizes the need for constant manual supervision, reduces labor, and promotes a healthier poultry environment. Designed to be cost-effective, energy-efficient, and scalable, the system is ideal for small to medium-scale farms, especially in rural or under-resourced areas. Overall, the project demonstrates how affordable IoT technologies can be effectively leveraged to transform traditional poultry farming into a smart, sustainable, and responsive system that ensures better livestock management and improved operational efficiency.

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LIST OF ABBREVIATIONS

IoT	-	**I**NTERNET **O**F **T**HINGS
IDE	-	**I**NTEGRATED **D**EVELOPMENT **E**NVIRONMENT
ESP	-	**ESP**RESSIF (MANUFACTURER OF ESP8266)
MCU	-	**M**ICROCONTROLLER **U**NIT
DC	-	**D**IRECT **C**URRENT
AC	-	**A**LTERNATING **C**URRENT
LCD	-	**L**IQUID **C**RYSTAL **D**ISPLAY
I2C	-	**I**NTER**-I**NTEGRATED **C**IRCUIT
GPIO	-	**G**ENERAL **P**URPOSE **I**NPUT / **O**UTPUT
DHT11	-	**D**IGITAL **H**UMIDITY AND **T**EMPERATURE SENSOR
RH	-	**R**ELATIVE **H**UMIDITY
Wi-Fi	-	**W**IRELESS **F**IDELITY
VCC	-	**V**OLTAGE **C**OMMON **C**OLLECTOR
GND	-	**G**ROUND
SMS	-	**S**HORT **M**ESSAGE **S**ERVICE
API	-	**A**PPLICATION **P**ROGRAMMING **I**NTERFACE

CHAPTER – 1
INTRODUCTION

Poultry farming is essential to supplying the world's food needs, particularly in developing nations where it offers a significant source of money and protein. However, preserving ideal environmental conditions is essential to guaranteeing poultry welfare, production, and health.

Temperature control is a key component of these settings. Heat stress, slower growth rates, poor feed conversion, and in severe situations, death, can all result from excessive heat.

Farmers have historically relied on manual techniques to chill the poultry area, such as turning on fans, pulling curtains, or employing water sprays. These techniques are time-consuming, prone to mistakes, and unreliable. Real-time monitoring and control of many parameters, such as temperature, humidity, and ventilation, is now possible because to the development of Internet of Things (IoT) technology.

The goal of this project is to use IoT to create an automated ventilation and temperature monitoring system for chicken farms. With the help of sensors, microcontrollers, and cloud-based dashboards, the system guarantees the birds a stable environment with little assistance from humans.

1.1. NEED FOR THE STUDY

For modern poultry farming to maximize productivity and guarantee animal welfare, accuracy and automation are essential. The following are the main factors that make this study necessary:

- **Poultry Heat Sensitivity:** In tropical regions, birds are especially vulnerable to high temperatures. Lower production of eggs or meat can result from extreme stress caused by temperatures above 35°C.
- **Labor-intensive Methods:** Farmers must put in more effort and produce uneven outcomes when monitoring and controlling by hand.
- **Cost Restrictions:** Small and medium-sized farms sometimes cannot afford the commercial automated systems.
- **Need for Scalability:** There is a gap in affordable and scalable solutions that cater to farms of various sizes.

Thus, an IoT-based automated solution can offer a smart, scalable, and reasonably priced method of controlling ventilation and temperature in chicken habitats.

1.2. OBJECTIVE

The goal of this project is to use Internet of Things technology to create an automated, cost-effective temperature monitoring and control system for chicken farms. By monitoring outside conditions with real-time sensor data, the system will make sure the inside temperature stays at or below 35°C. Fogger misters and other cooling equipment will be automatically activated when temperatures beyond the ideal threshold. Additionally, the technology will enable remote monitoring using mobile applications and real-time alerts, enabling farm operators to oversee conditions from any location. This guarantees a steady temperature environment that supports the health and welfare of birds while lowering physical work and operating expenses. The system is a flexible and effective solution for contemporary poultry farming operations since it is made to be scalable and adjustable to accommodate different farm sizes and environmental circumstances.

1.3. SCOPE OF THE PROJECT

The design, installation, and testing of an intelligent temperature management system for chicken farms are all included in the project's scope. The system is made up of:

- **Sensor Nodes:** DHT11 sensors are used as sensor nodes to measure humidity and temperature.
- **Microcontroller:** ESP8266 microcontroller for Internet of Things connectivity and processing.
- **Actuators:** Solenoid valves with relay control that run a water misting system.
- **User Interface:** Blynk mobile app dashboard and LCD real-time display.
- **Alert System:** Email and smartphone notifications in the event of a temperature breach.

Small and medium-sized chicken farms are the target audience for this initiative, especially those in areas with poor access to sophisticated technology. The architecture of the original prototype permits future extensions such as light control, feeding automation, and intruder detection, even though it is intended for temperature monitoring and cooling

CHAPTER – 2
LITERATURE SURVEY

2.1. IoT-BASED TEMPERATURE REGULATION SYSTEM FOR POULTRY FARMS

AUTHORS:

Prof. K. Ramanan, Naveen J, Silambarasan A, Vimal M (2025) Department of Computer Science and Engineering, Paavai Engineering College (Autonomous), Pachal, Namakkal, Tamil Nadu, India.

METHODOLOGY:

- Sensors like DHT22, MQ135, and PIR are used to monitor temperature, gas, and motion.
- ESP32 controls fans and water misters based on sensor data.
- Cloud platforms (Firebase/ThingsBoard) are used for remote access.

LIMITATION:

Involves multiple sensors and cloud setup, increasing system cost and complexity, making it unsuitable for small farms.

2.2. A SMART POULTRY FARM: AUTOMATED TEMPERATURE AND LIGHTING CONTROL

AUTHORS:

Dr. N. Sivashankar, Naveen Kumar M, Priyadharshini K , Pugazhenthi J (2025) Mechanical Engineering, Kongunadu College of Engineering and Technology, Trichy, Tamil Nadu, India.

METHODOLOGY:

- DHT11 and LDR sensors control fans and lighting automatically.
- ESP32 transmits real-time data to Blynk mobile app.

LIMITATION:

Focuses on basic automation only and lacks alert mechanisms like email/SMS when temperature exceeds threshold.

2.3. MONITORING AND CONTROLLING OF TEMPERATURE IN POULTRY FARMS

AUTHORS:

P. Prakash, Rathish S, Mohammedshah K, Mohan Raj S, Sabareeswaran V (2024) Department of Electrical and Electronics Engineering, P. A. College of Engineering and Technology, Pollachi, Coimbatore, Tamilnadu, India.

METHODOLOGY:

- Automatic heater or fan based on temperature levels.
- Uses simple sensors with on/off control logic.

LIMITATION:

The system doesn't have IoT monitoring or a user interface. It only works locally and can't be accessed from a distance.

2.4. SMART POULTRY FARM AUTOMATION

AUTHORS:

Mr. Pratik Landge, Ms. Gloria Kiplinger, Ms. Vaishnavi Sakhare, Prof. Omprakash Rajankar, Prof. Bhausaheb Shinde (2024) Department of ECE, Dhole Patil College of Engineering, Pune, India

METHODOLOGY:

- Monitors temperature, humidity, and automates feeding and watering.
- Data collected for analysis to improve bird health.

LIMITATION:

This system is complex and covers multiple modules, which increases initial cost and setup complexity for small-scale farms.

2.5. AUTOMATION OF POULTRY FARM

AUTHORS:

Dr. Suma, Ashwin S, Chitty Babu S, Deepak R, Kushal GS (2023) Department of ECE, Vidya Vikas Institute of Engineering and Technology, Mysore, India

METHODOLOGY:

- Overview of poultry farm automation using sensors, AI, and robotics.
- Discussed productivity, cost savings, and efficiency improvements.

LIMITATION:

Focus is theoretical with no specific low-cost practical implementation or IoT integration for temperature control.

CHAPTER – 3

METHODOLOGY

3.1. EXISTING SYSTEM

Current automation technologies, though beneficial in many agricultural settings, often fall short when it comes to small-scale farms. These systems tend to be expensive, technically complex, and difficult to scale down. Most are designed with large industrial farms in mind, requiring specialized knowledge to install and operate. As a result, they are not well-suited for smaller farms, particularly those in rural or low-resource areas, where access to funding, technical expertise, and infrastructure may be limited. This creates a gap in accessibility and effectiveness for small-scale farmers seeking to adopt modern automation solutions.

Fig. 3.1: Existing Poultry Farm Monitoring System

3.2. COMPARISON OF EXISTING METHODOLOGIES

S.No	Paper Title	Automation	Remote Monitoring	Alert System	Cost	Scalability
1	IoT-Based Temperature Regulation	Full	Yes	Yes	High	Low (complex setup)
2	Smart Poultry Farm	Flexible	Yes	No	Medium	Medium
3	Automation of Poultry Farm	Conceptual	No	No	Not Defined	Not Defined
4	Monitoring & Control of Temp	Semi-Automation	No	No	Low	Low
5	Monitoring & Control of Temp	Semi-Automation	No	No	Low	Low
6	Proposed System (This Project)	Full	Yes	Yes	Low	High

Fig. 3.2: Comparison Table for Existing Methodologies

This comparison shows that most existing systems are either complex or expensive, making them unfit for small farms. The proposed system stands out by offering:

- Full automation
- Low cost
- IoT-based remote monitoring
- Instant alerts
- High scalability

3.3. PROPOSED SYSTEM

The proposed system is designed to offer a cost-effective and scalable automation solution tailored specifically for small and medium-sized poultry farms. It leverages IoT technology to automate temperature regulation and provide remote monitoring capabilities. At the core of the system is the ESP8266 microcontroller, known for its low cost, low power consumption, and built-in Wi-Fi support. Environmental data is gathered using the DHT11 sensor, which accurately measures both temperature and humidity levels within the poultry house.

When the temperature exceeds the optimal threshold of 35°C, the system automatically activates a fogger misting setup through a solenoid valve to cool the environment efficiently. The collected sensor data is continuously transmitted to the Blynk IoT platform, where users can view real-time readings through a mobile dashboard. The system also features a notification mechanism that alerts users immediately when temperature or humidity crosses predefined limits, ensuring prompt corrective action and improved bird welfare.

3.3.1. FLOW CHART

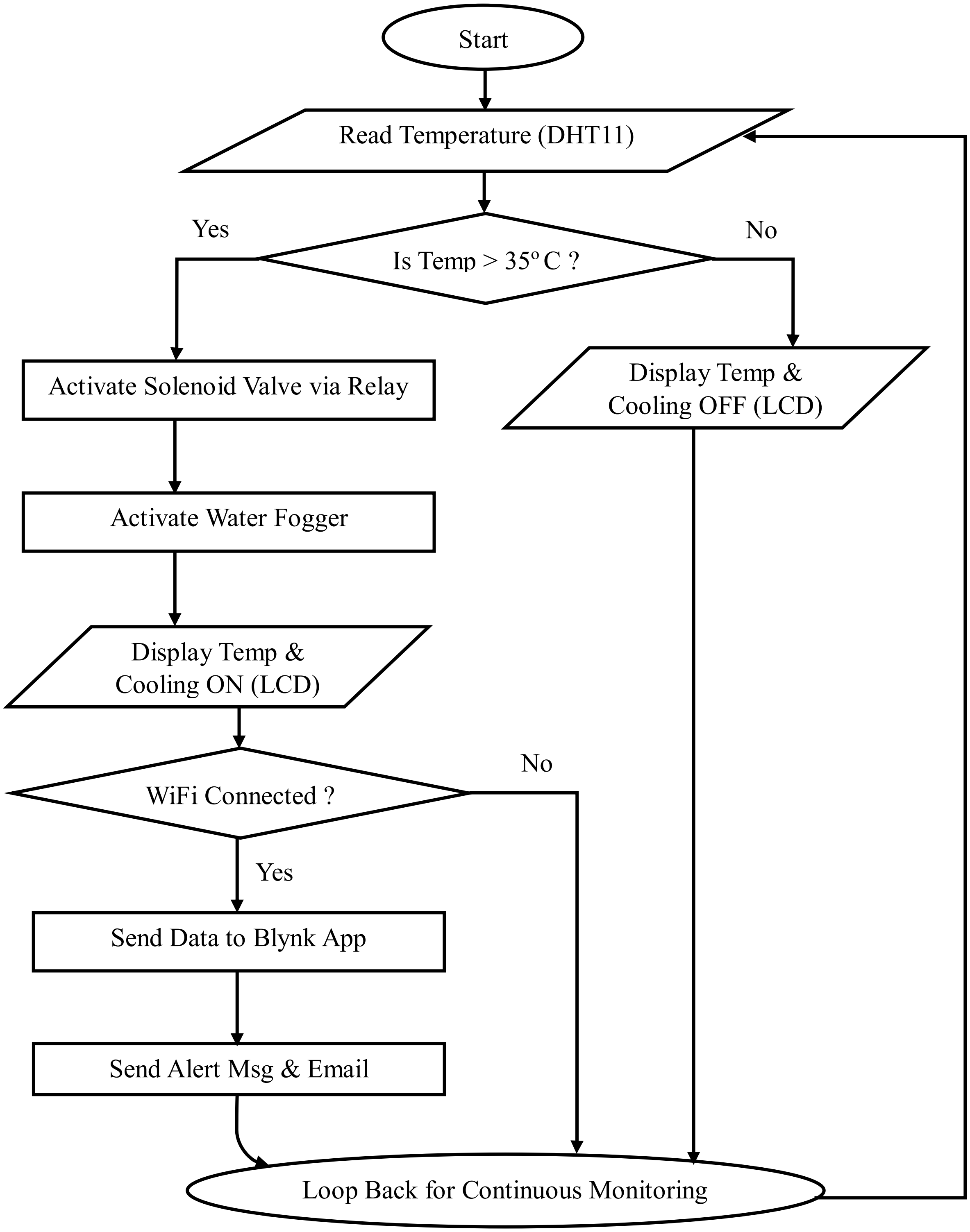

Fig. 3.3.1: Flow Chart

3.3.2. ALGORITHM

Step 1: Start the system and initialize all components.

Step 2: Read the temperature from the DHT11 sensor.

Step 3: If temperature > 35°C:

- a. Turn ON the solenoid valve using the relay
- b. Activate fogger/misting system
- c. Display temperature and "Cooling ON" on LCD
- d. If Wi-Fi is connected:
  - i. Send data to Blynk app
  - ii. Send alert message and email

Step 4: If temperature ≤ 35°C:

- a. Turn OFF the solenoid valve
- b. Display temperature and "Cooling OFF" on LCD

Step 5: Repeat from Step 2 continuously.

3.3.3. BLOCK DIAGRAM

The proposed poultry farm automation system is designed to maintain a stable and healthy environment by continuously monitoring and controlling temperature and humidity levels. At the core of this system is the DHT11 sensor, a reliable and cost-effective digital sensor that provides real-time measurements of ambient temperature and humidity within the poultry housing. These environmental readings are critical, as poultry are highly sensitive to changes in climate.

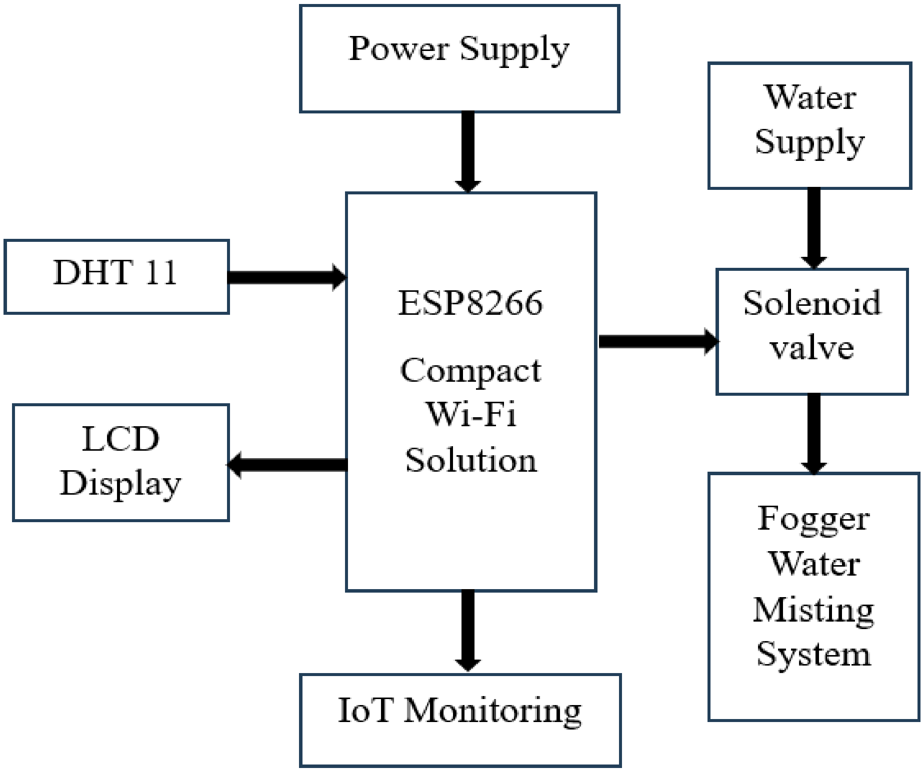

Fig. 3.3.3: Block Diagram of Proposed Methodology

Once data is collected, it is transmitted to the ESP8266 NodeMCU, a compact and low-cost microcontroller equipped with built-in Wi-Fi capabilities. This microcontroller processes the incoming data and evaluates whether the temperature exceeds a predefined safety threshold of 35°C. If the threshold is breached, the ESP8266 triggers a 5V relay module connected to a solenoid valve, which in turn activates a fogger misting system. When engaged, the valve opens to allow water to flow to the foggers, which spray a fine mist into the environment. This mist promotes evaporative cooling, effectively reducing the ambient temperature without directly spraying the birds, thus minimizing stress and maintaining bird welfare.

To ensure real-time local feedback, a 16x2 LCD display is included in the system. This display continuously shows the current temperature, humidity, and system status messages such as “Cooling ON” or “Normal,” providing visibility even when internet access is unavailable. This feature is particularly valuable in remote or rural locations.

Furthermore, the system is enhanced with IoT capabilities through integration with the Blynk platform. The ESP8266 sends live sensor data to a mobile dashboard, allowing farmers to monitor conditions from their smartphones. If temperatures continue to rise beyond safe levels, the system automatically sends push notifications and email alerts, enabling the farmer to respond promptly from any location.

This automated climate control system significantly reduces the need for manual intervention, increases responsiveness, and ensures that the poultry environment remains within optimal thermal conditions. The design is modular and scalable, making it suitable for both small and large farms. By using affordable, energy-efficient components and incorporating smart connectivity, this system provides a practical, modern solution tailored to the challenges of contemporary poultry farming.

Advantages of Proposed System:

- Low cost and easy to set up
- Compact design using ESP8266 microcontroller
- Cloud-integrated with email/SMS alerts
- Scalable for farms of different sizes

CHAPTER – 4

HARDWARE REQUIREMENTS

The IoT-based temperature monitoring and automated ventilation system for poultry farms is built using a set of carefully selected hardware components. Each component serves a specific function and contributes to the overall performance, reliability, and affordability of the system. This chapter discusses each component in detail, including its working principle, specifications, and role within the project.

4.1. ESP8266 NODE MCU MICROCONTROLLER

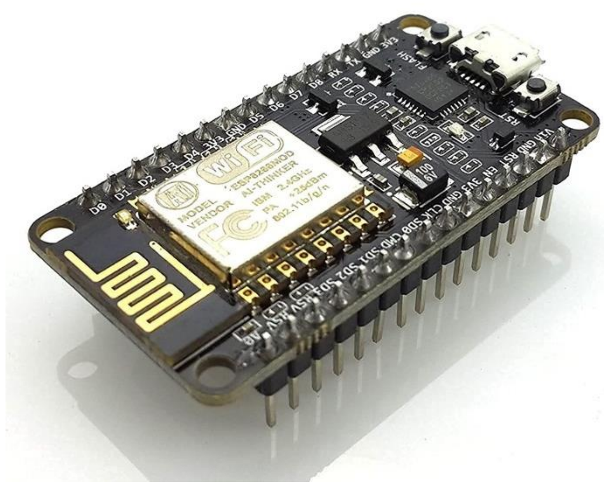

Fig. 4.1: ESP8266 Node MCU

The ESP8266 Node MCU is the central processing unit and communication module of the project. It is a powerful, low-cost microcontroller developed by Espressif Systems, equipped with built-in Wi-Fi capabilities that make it ideal for Internet of Things (IoT) applications. The Node MCU development board simplifies the prototyping process by integrating essential components like voltage regulators, USB interfaces, and easy-to-use pin layouts.

Working Principle:

The ESP8266 reads temperature and humidity data from the DHT11 sensor through its GPIO pins. It processes this data and makes logical decisions based on pre-programmed conditions. For example, if the temperature exceeds a threshold (35°C), the microcontroller triggers a digital output signal to activate the relay module, which then powers the cooling system. Simultaneously, the ESP8266 connects to the internet via Wi-Fi and sends data to the Blynk IoT platform. This enables remote monitoring and control via a smartphone application. The microcontroller also updates the LCD display with real-time environmental data.

Specifications:

- Microcontroller: Tensilica L106 32-bit processor
- Operating Voltage: 3.3V to 5V
- Flash Memory: 4MB
- Clock Speed: 80 MHz (up to 160 MHz)
- Wi-Fi: 802.11 b/g/n
- GPIO Pins: 11 (can be used for digital I/O, PWM, I2C, SPI, UART)
- USB Interface: Micro-USB for programming

Role in the System:

The ESP8266 acts as the brain of the system. It coordinates data acquisition, logical decision-making, device control, and communication with the IoT cloud platform. Its small size, low power consumption, and wireless capabilities make it a perfect fit for automated farming systems.

4.1.1. NODE MCU PIN DIAGRAM

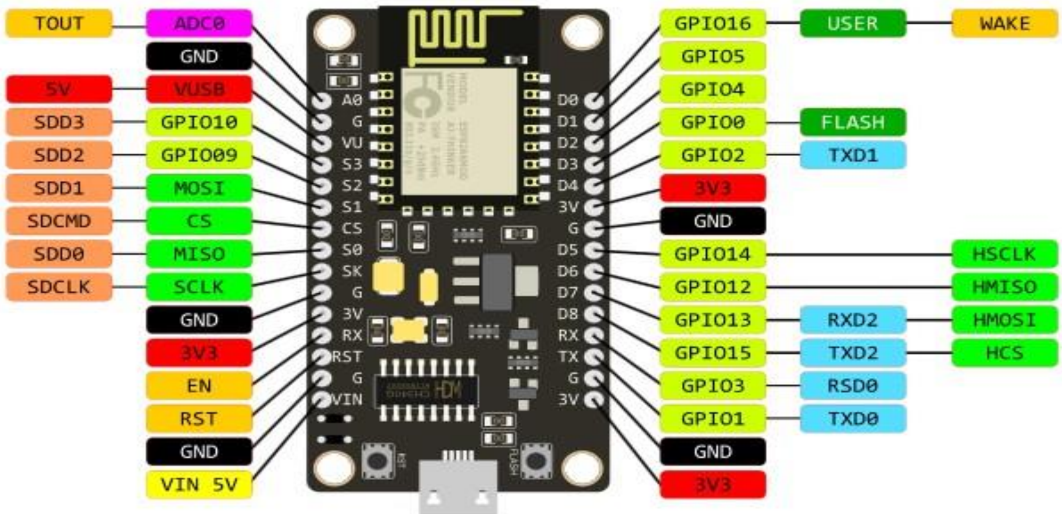

Fig. 4.1.1: Node MCU Pin Diagram

4.2. DHT11 TEMPERATURE AND HUMIDITY SENSOR

The DHT11 is a digital sensor used for measuring ambient temperature and relative humidity. It is cost-effective, easy to use, and commonly found in weather monitoring and environmental control systems. It combines a thermistor and a capacitive humidity sensor, both pre-calibrated to deliver accurate measurements.

Working Principle:

The sensor continuously monitors the environment for temperature and humidity changes. It outputs the readings in a digital format using a single-wire communication protocol. The data is read periodically by the ESP8266, which evaluates whether environmental conditions fall within acceptable limits. If the temperature crosses the defined threshold, the system takes corrective actions such as activating the fogger.

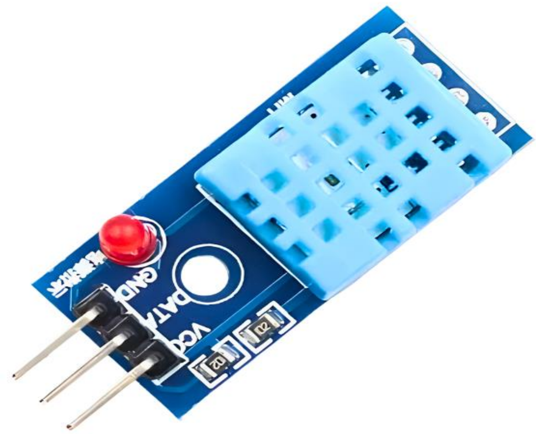

Fig. 4.2: DHT11 Temperature and Humidity Sensor

Specifications:

- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90% RH
- Temperature Accuracy: ±2°C
- Humidity Accuracy: ±5% RH
- Operating Voltage: 3.3V to 5V
- Signal Type: Digital output

Role in the System:

The DHT11 is the primary sensor responsible for detecting critical environmental parameters. Accurate data from this sensor enables the system to make intelligent decisions, ensuring the poultry environment remains within optimal temperature and humidity levels.

4.3. RELAY MODULE (5V)

A relay is an electrically operated switch used to control high-voltage or high-current devices with a low-power signal. The 5V relay module used in this project is crucial for controlling the 12V solenoid valve that regulates water flow to the misting system.

Working Principle:

The relay module operates based on electromagnetic induction. When the ESP8266 sends a HIGH signal (or LOW depending on the relay type) to the relay input pin, the coil inside the relay energizes, generating a magnetic field. This magnetic field pulls a switch, completing the circuit and allowing 12V current to flow to the solenoid valve. When the signal is turned off, the magnetic field collapses, and the switch returns to its normal position, cutting off power to the valve.

Specifications:

- Operating Voltage: 5V DC
- Trigger Current: 20mA
- Switching Voltage: Up to 250V AC / 30V DC
- Switching Current: Up to 10A
- Channels: Single-channel used
- Isolation: Opto-isolator for safety

Fig. 4.3: Relay Module

Role in the System:

The relay acts as a mediator between the low-voltage ESP8266 and the high-power solenoid valve. It ensures safe operation by isolating the control circuit from the power circuit and allows the system to physically activate cooling based on sensor inputs.

4.4. SOLENOID VALVE (12V)

The solenoid valve is a critical electromechanical device that controls the flow of water to the fogging nozzles. It is normally closed, meaning it remains shut unless powered by a voltage source. When activated, it opens to allow water to pass through the misting system.

Working Principle:

When the relay is energized, it allows 12V DC to flow to the solenoid valve. The electric current generates a magnetic field inside the valve coil, which moves a plunger or armature to open the valve. This allows pressurized water to flow through the connected piping to the fogger nozzles. When the power is turned off, the spring mechanism inside the valve pushes the plunger back, closing the valve and stopping the water flow.

Specifications:

- Voltage Rating: 12V DC
- Current Consumption: ~0.5A
- Pipe Size: ½ x ½ (20mm)
- Material: Brass or plastic (depends on type)
- Dimensions: L=7cm, B=6.5cm, H=4cm
- Connection: Hose or pipe thread compatible
- Type: Normally closed

Fig. 4.4: Solenoid Valve

Role in the System:

The solenoid valve physically regulates the misting process. It plays a key role in environmental cooling by enabling or disabling water flow based on microcontroller instructions, contributing to the automation of temperature control.

4.5. WATER MISTING FOGGER SYSTEM

The water misting system consists of a network of ultra-fine nozzles that disperse water as a mist to reduce ambient temperature through evaporative cooling. It is a passive yet highly effective cooling mechanism widely used in greenhouses and poultry farms.

Fig. 4.5: Water Misting Fogger

Working Principle:

When water flows through the solenoid valve, it reaches the fogger nozzles, which break it into fine droplets due to high pressure and small nozzle diameter. As the mist evaporates in the air, it absorbs heat energy from the environment, resulting in a noticeable drop in temperature.

Specifications:

- Nozzle Diameter: ~0.3 mm
- Spray Coverage: 2-5 square meters per nozzle
- Water Usage: 5-30 liters/hour depending on pressure
- Operating Pressure: 2-4 bar (low-pressure system)

Role in the System:

The fogger system provides the actual cooling mechanism. It enables rapid and efficient temperature reduction in the poultry shed without over-wetting the floor or birds, thereby maintaining hygiene and comfort.

4.6. 16x2 LCD DISPLAY (I2C ENABLED)

The 16x2 character LCD with an I2C interface is used for displaying real-time data and system status. It simplifies wiring and code by using only two data lines (SCL and SDA) to communicate with the microcontroller.

Working Principle:

The ESP8266 sends data to the I2C LCD driver, which interprets it and displays it on the LCD screen. This display is continuously updated to show the current temperature, humidity, and whether the cooling system is ON or OFF. The I2C interface significantly reduces the number of required GPIO pins, making it ideal for small microcontroller boards.

Fig. 4.6: 16x2 LCD Display with I2C Module

Specifications:

- Display Size: 16 columns × 2 rows
- Interface: I2C (2-pin)
- Operating Voltage: 5V
- Backlight: LED with adjustable contrast
- Character Size: 2.95mm
- Current Consumption: ~2mA

Role in the System:

The LCD provides immediate visual feedback to local users. Even if internet connectivity fails, users can still monitor critical environmental data directly from the device.

4.7. POWER SUPPLY UNIT AND VOLTAGE REGULATION

The power system ensures safe and reliable voltage supply to all components. It uses a 12V DC adapter and an AMS1117 voltage regulator to step down voltage for the ESP8266 and other low-power modules. An MB102 breadboard power module provides convenient 3.3V and 5V outputs during prototyping and testing.

Working Principle:

The 12V adapter supplies power to both the solenoid valve and the input of the AMS1117 regulator. The regulator outputs a stable 5V, which is used to power the ESP8266, relay module, DHT11 sensor, and LCD display. For prototyping purposes, the MB102 module can be connected directly to a breadboard and offers dual output options. The MB102 contains an onboard AMS1117 regulator and jumper switches to select between 5V and 3.3V outputs for each rail. This provides flexibility for powering different components simultaneously.

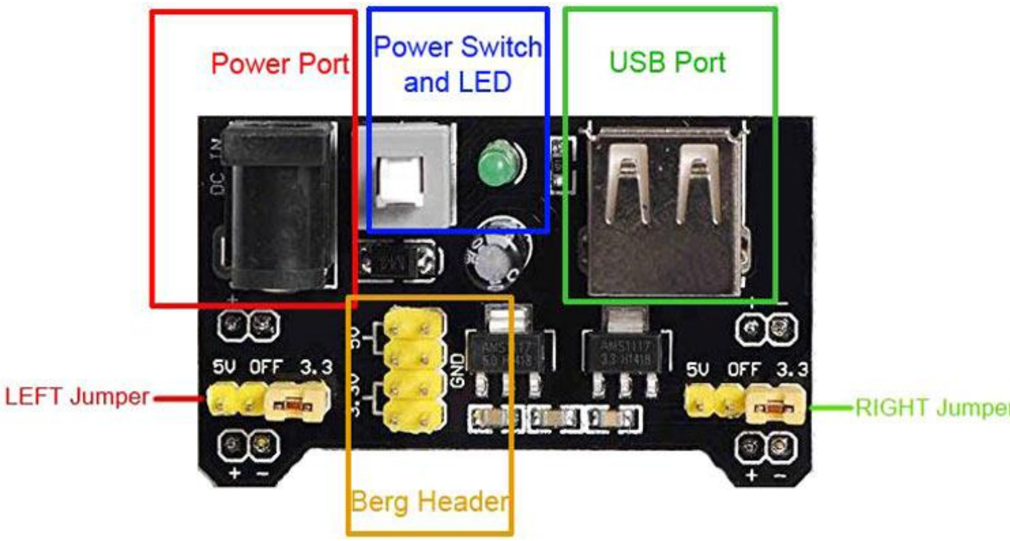

Fig. 4.7: MB102 Module

Specifications:

- Adapter Output: 12V DC, 2A
- AMS1117 Output: 5V DC, 800mA
- MB102 Input: 6.5V to 12V via DC jack or USB
- MB102 Output: Selectable 3.3V/5V
- Current Capacity: Up to 700mA per rail
- Features: Dual power rails, power indicator LED, reset button

Role in the System:

The power supply unit ensures stable and safe system operation. The MB102 module simplifies development by providing selectable 3.3V and 5V outputs, supporting both the ESP8266 and peripheral components without external converters, thus reducing complexity.

CHAPTER – 5

SOFTWARE REQUIREMENTS

5.1. INTRODUCTION

Software plays a crucial role in embedded systems, transforming basic hardware into an intelligent and automated solution. In this IoT-based temperature monitoring and ventilation system for poultry farms, the software controls the interaction between sensors, actuators, and communication modules, enabling real-time monitoring, automated responses, and remote notifications. Without software, the system would lack the intelligence required for autonomous operation and timely decision-making.

The core of the software is written in Embedded C using the Arduino IDE and is uploaded to the ESP8266 Node MCU microcontroller. This embedded code is responsible for acquiring sensor data, evaluating temperature conditions, activating cooling mechanisms, and communicating with cloud services. The system integrates with the Blynk IoT platform, which offers a user-friendly mobile dashboard for live data visualization and alert notifications. To support smooth operation, various software libraries are utilized to interface efficiently with each hardware component, ensuring reliability and responsiveness in real-time conditions.

5.2. EMBEDDED C PROGRAMMING

Embedded C is the primary programming language used to develop the firmware for the ESP8266 microcontroller. It is a subset of the C language tailored for embedded systems, providing direct control over hardware with minimal overhead. It is highly efficient, lightweight, and ideal for real-time applications where precise control over input/output pins and timing is required.

Working Principle:

Embedded C code is written to initialize hardware components such as sensors, relay modules, and LCD displays. Logical conditions are defined to compare sensor readings against predefined thresholds. If the temperature exceeds 35°C, the relay is activated to power the solenoid valve and start the fogging system. The code also includes communication protocols to update the LCD and send data to the Blynk platform. Additional routines manage system timing, error handling, and loop execution to ensure continuous and stable operation.

Key Features:

- Low-level hardware control
- Efficient memory usage
- Real-time execution
- Compatibility with Arduino IDE and ESP8266 libraries
- Enables modular and reusable coding practices

Role in the System:

Embedded C provides the real-time logic required for temperature sensing, decision-making, device control, and data communication, ensuring seamless automation of the cooling system. It serves as the foundation for all intelligent behavior exhibited by the system.

5.3. ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is used to write, compile, and upload Embedded C code to the ESP8266 microcontroller. It simplifies the programming process and provides a user-friendly interface for developers of all skill levels.

Working Principle:

The Arduino IDE provides a simple interface to write code and manage libraries. The ESP8266 board package is installed to support the specific microcontroller. Code is uploaded via a USB connection. The IDE includes built-in serial monitor and debugging tools that help monitor sensor readings, debug logic errors, and validate system behavior.

Specifications:

- **Platform:** Windows, macOS, Linux
- **Language Support:** Embedded C/C++
- **Board Support:** ESP8266, Arduino Uno, Nano, Mega, etc.
- **Library Management:** DHT sensor, LCD, Blynk, ESP8266WiFi, etc.
- **Features:** Sketch management, code auto-formatting, and serial communication tools

Role in the System:

The Arduino IDE serves as the primary development tool for firmware creation, testing, and uploading to the ESP8266. It enables quick code compilation, debugging, and deployment, accelerating the development cycle.

5.4. BLYNK IoT PLATFORM

Blynk is a cloud-based Internet of Things platform used for real-time remote monitoring and control of the system. It enables users to build customized mobile interfaces without extensive programming and supports a wide range of microcontrollers.

Working Principle:

The ESP8266 communicates with the Blynk cloud server over Wi-Fi. Sensor readings such as temperature and humidity are sent to virtual pins in the Blynk app. The app displays this data through widgets like LCD displays, gauges, and LED indicators. Alerts are configured to trigger notifications and emails when temperature thresholds are exceeded. The user can receive push alerts and even trigger manual actions remotely if desired.

Key Features:

- Real-time data visualization
- Push notifications and email alerts
- Customizable mobile dashboard
- Virtual pin mapping for hardware interaction
- Secure data transfer with token-based authentication

Role in the System:

Blynk is used as the user interface so farmers can easily check sensor data, get alerts, and see how the system is working. It connects the hardware to the user through a simple mobile app. This visual interface makes it easier for farmers to use, especially in rural areas with limited resources.

CHAPTER – 6

RESULTS AND DISCUSSION

This chapter presents the outcomes of implementing the IoT-based temperature monitoring and automated ventilation system for poultry farms. The results are analyzed based on functionality, responsiveness, and usability.

6.1. REAL-TIME TEMPERATURE AND HUMIDITY MONITORING

The system effectively monitored ambient temperature and humidity using the DHT11 sensor. Data was displayed locally on a 16x2 I2C LCD and remotely via the Blynk app.

- **LCD Display:** Shows temperature and cooling system status (ON/OFF).
- **Blynk App:** Displays temperature and humidity values in real-time using gauges and value widgets.

This dual interface ensured users could monitor conditions both on-site and remotely.

6.2. AUTOMATED COOLING SYSTEM RESPONSE

The system automatically activated the cooling mechanism when the temperature exceeded 35°C.

- **Temp > 35°C:** Relay activates → Solenoid opens → Fogger ON
- **Temp < 35°C:** Relay deactivates → Solenoid closes → Fogger OFF

This ensured a stable environment for poultry during hot periods.

6.3. ALERT NOTIFICATION SYSTEM

If temperature exceeded 35°C:

- **Blynk App:** Sends a warning message with an alert sound.
- **Email Alert:** Sent to the farm owner with a message: "Warning! Temp > 35°C. Cooling system activated."

These alerts ensured timely awareness and action.

6.4. REMOTE MONITORING VIA BLYNK IoT

Using the Blynk app, farmers could:

- Monitor temperature and humidity
- View cooling system status
- Receive alerts

Even without internet, the system continued local operation via the LCD and relay.

6.5. DISCUSSIONS

The implemented system successfully automated temperature regulation in poultry farms, improving bird comfort and reducing manual intervention. Real-time data monitoring and alert notifications enabled timely responses to temperature changes, helping maintain a stable thermal environment.

The solution is both affordable and scalable, making it well-suited for small to mid-sized poultry farms. Minor issues, such as occasional Wi-Fi instability, were effectively addressed through code adjustments and optimal hardware placement, ensuring reliable system performance.

Real-Time System Response and Hardware Integration Results

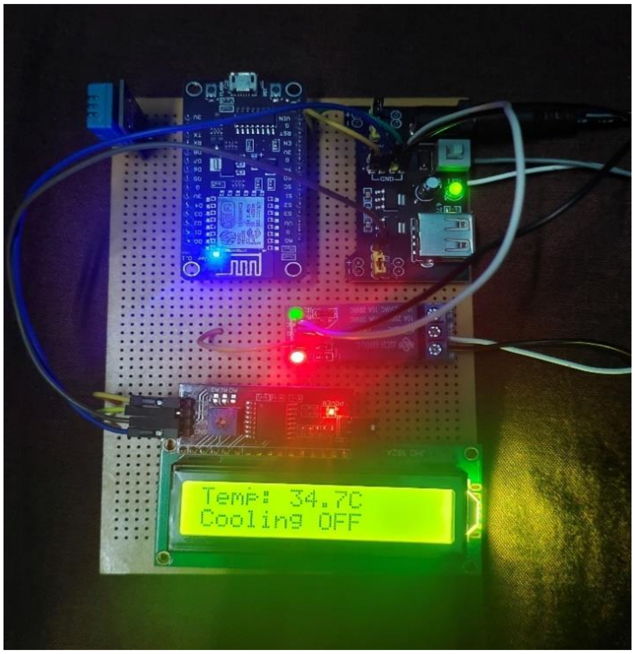

Fig. 6.5.1: Temperature Controller with LCD Display Monitoring

Fig. 6.5.2: Solenoid Valve Controller with Fogger Misting System

Cloud-Based Monitoring and IoT Data Visualization

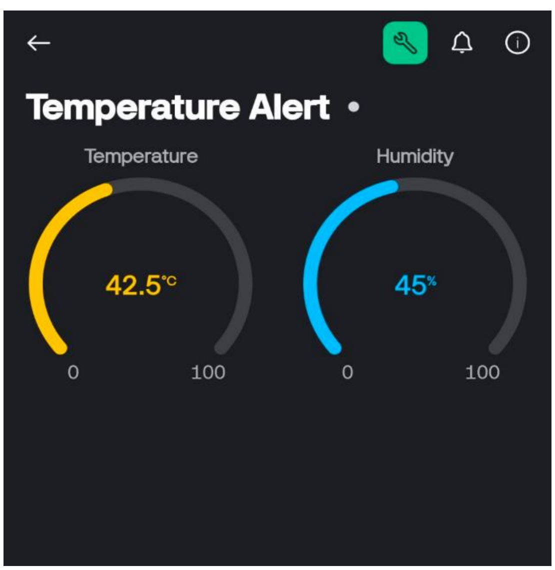

Fig. 6.5.3: Blynk Mobile App Custom Dashboard Display Monitoring

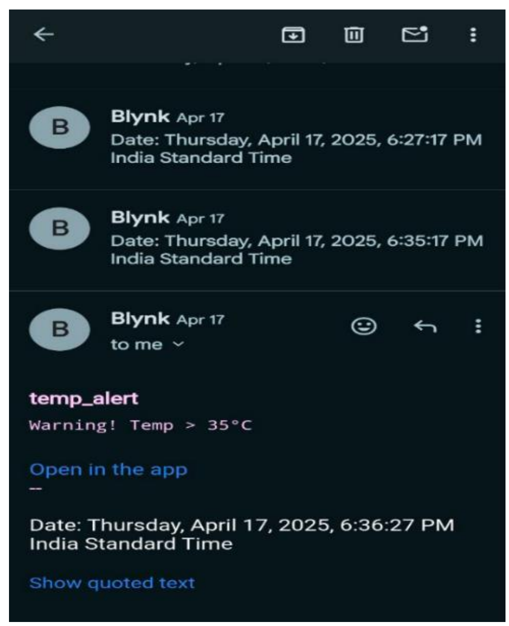

Fig. 6.5.4: Alert message through email (When Temperature > 30ºC)

Area Size (sq. ft)	No. of Birds	Water/1°C Drop	Time (min)
200–500	100–300	5–7 liters	5–7
800–1500	500–1000	12–15 liters	10–12
2000+	1500–3000	25–30 liters	15–18

Fig. 6.5.5: Water Efficiency in Poultry Farm

This table highlights how the size of the poultry farm and bird population directly influence the water consumption and time required to reduce the ambient temperature by 1°C. As the area and number of birds increase, so do the heat load and the resources needed for effective cooling. This underlines the importance of scalable misting solutions and efficient control systems to maintain optimal poultry house conditions across different farm sizes.

CHAPTER – 7

CONCLUSION AND FUTURE WORK

7.1. CONCLUSION

This project successfully demonstrated the design and implementation of an IoT-based temperature monitoring and automated ventilation system tailored for poultry farms. By integrating low-cost hardware components like the DHT11 sensor, ESP8266 microcontroller, relay module, solenoid valve, and fogger misting system, the system was able to monitor and regulate ambient temperature efficiently. Real-time data was displayed both locally via an LCD and remotely through the Blynk IoT platform, allowing farmers to supervise environmental conditions even from distant locations.

One of the major strengths of the system is its automated decision-making capability, which activates the cooling system without human intervention whenever the temperature crosses a critical threshold (35°C). Additionally, the system is equipped with an effective alert mechanism that notifies the user via mobile push notification and email in case of abnormal temperature conditions. This ensures a rapid response, reducing the risk of heat stress and improving poultry health and productivity.

The modularity, affordability, and scalability of the design make it suitable for small to mid-sized farms in developing regions where expensive automation solutions are not feasible. The system also performed reliably during testing, with high uptime and minimal power or connectivity issues.

7.2. FUTURE ENHANCEMENTS

To improve functionality and adaptability, several enhancements can be integrated into the existing system:

- **Machine Learning for Predictive Control:**

  Implementing machine learning algorithms would enable the system to analyze historical data and predict temperature trends, allowing proactive control of the cooling system for improved efficiency.

- **Solar Power Integration:**

  Adding solar power support would enhance sustainability and reduce dependence on conventional energy sources, especially beneficial for farms in rural or off-grid areas.

- **Data Analytics and Reporting:**

  Integrating a cloud-based analytics platform would allow farmers to track environmental data, identify trends, and make informed decisions to optimize farm operations.

- **Multizone Monitoring:**

  Supporting multizone monitoring would enable precise environmental control across different sections of larger farms, accommodating varied microclimates more effectively.

These enhancements would transform the system into a more intelligent, energy-efficient, and scalable smart farming solution, supporting broader agricultural needs beyond temperature control.

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APPENDIX I

Source Code (ESP8266 - Embedded C using Arduino IDE)

```
#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>

#include <BlynkSimpleEsp8266.h>

#include <LiquidCrystal_I2C.h>

#include <DHT.h>


// WiFi & Blynk credentials

char auth[] = BLYNK_AUTH_TOKEN;

char ssid[] = "Enter_Wifi_Name";

char pass[] = "Enter_Wifi_Pass";


// DHT sensor setup

#define DHTPIN D5

#define DHTTYPE DHT11

DHT dht(DHTPIN, DHTTYPE);


// LCD setup

LiquidCrystal_I2C lcd(0x27, 16, 2);
```

```
// Relay setup
#define RELAY_PIN D4
#define ALERT_TEMP 35

// Timers
unsigned long lastSensorRead = 0;
unsigned long lastWiFiCheck = 0;
const unsigned long sensorInterval = 2000;  // 2 seconds
const unsigned long wifiInterval = 5000;    // 5 seconds

bool wifiConnected = false;

void setup() {
  Serial.begin(9600);
  lcd.init();
  lcd.backlight();
  lcd.setCursor(0, 0);
  lcd.print("System Booting...");
  delay(1500);
```

```
  lcd.clear();
  dht.begin();
  pinMode(RELAY_PIN, OUTPUT);
  digitalWrite(RELAY_PIN, LOW);

  WiFi.begin(ssid, pass);
}
void loop() {
  // === Handle WiFi every 5 seconds ===
  if (millis() - lastWiFiCheck >= wifiInterval) {
    lastWiFiCheck = millis();

    if (WiFi.status() != WL_CONNECTED) {
      Serial.println("WiFi disconnected, retrying...");
      WiFi.begin(ssid, pass);
      wifiConnected = false;
    } else if (!wifiConnected) {
      Serial.println("WiFi connected.");
      Blynk.config(auth);
      Blynk.connect(1000);
```

```
    wifiConnected = true;
  }
}
  if (wifiConnected) {
  Blynk.run();
}
// === Sensor + LCD update every 2 seconds ===
if (millis() - lastSensorRead >= sensorInterval) {
  lastSensorRead = millis();

  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();
  if (isnan(temperature) || isnan(humidity)) {
    lcd.setCursor(0, 0);
    lcd.print("Sensor Error    ");
    return;
  }
  lcd.setCursor(0, 0);
  lcd.print("Temp: ");
  lcd.print(temperature, 1);
```

```
    lcd.print("C   ");

    if (temperature > ALERT_TEMP) {
      digitalWrite(RELAY_PIN, HIGH);
      lcd.setCursor(0, 1);
      lcd.print("Cooling ON ");
      if (wifiConnected && Blynk.connected()) {
        Blynk.logEvent("temp_alert", "Warning! Temp > 35°C");
      }
    } else {
      digitalWrite(RELAY_PIN, LOW);
      lcd.setCursor(0, 1);
      lcd.print("Cooling OFF");
    }
    if (wifiConnected && Blynk.connected()) {
      Blynk.virtualWrite(V5, temperature);
      Blynk.virtualWrite(V6, humidity);
    }
  }
}
```

APPENDIX II

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