

Smart Farming: IoT-Based Monitoring and Automated Ventilation in Poultry

Jayapoorani S¹, Srinivasan J², Saravanan N³

Submitted: 02/11/2024

Revised: 14/12/2024

Accepted: 26/12/2024

Abstract: This proposal presents a cost-effective automated system to maintain optimal temperatures in poultry farms. The system ensures a stable temperature of 35°C by continuously monitoring conditions and controlling cooling mechanisms such as fans and misting systems. It utilizes an affordable temperature sensor and a Wi-Fi-enabled microcontroller to automate the process, reducing the need for manual intervention. Additionally, the system connects to an Internet of Things (IoT) platform, allowing real-time remote monitoring and control. This feature enhances efficiency, minimizes labor costs, and ensures quick responses to temperature fluctuations. The system improves poultry health, increases productivity, and optimizes energy use by providing a stable environment. The affordability and scalability of this solution make it suitable for small- and medium-sized farms, particularly in developing regions where expensive alternatives are impractical. Ultimately, this automated system offers a reliable, user-friendly approach to temperature regulation, benefiting both farmers and poultry production.

Keywords: smart farming, microcontroller, temperature monitoring, automated ventilation, poultry farming, Internet of Things, and remote monitoring.

INTRODUCTION

Poultry farming plays a critical role in the global food supply, but maintaining optimal environmental conditions is essential to ensuring bird health and maximizing productivity. Temperature control is particularly important in poultry production, as excessive heat can lead to heat stress and increased bird mortality. Traditionally, farmers have relied on manual methods to monitor and regulate temperature, a process that is not only time-consuming but also susceptible to human error.

However, with the advent of automation technologies and the Internet of Things (IoT), more

efficient and reliable methods for environmental control are being developed. This paper aims to review various approaches and technologies used in poultry farms for ventilation and temperature management. It also proposes an innovative IoT-based automated system for real-time temperature monitoring, which enhances productivity and integrates intruder detection mechanisms. The system continuously monitors critical environmental parameters, alleviating the burden on farmers. By utilizing smart sensors, microcontrollers, and IoT platforms, this project seeks to optimize the poultry farming process, improving bird health and farm productivity through intelligent automation.

OVERVIEW OF THE PROJECT

Importance of Temperature Control in Poultry Farming

Maintaining a stable and controlled temperature is vital in poultry farming for several reasons:

Bird Health: Poultry, especially chickens, are sensitive to temperature variations. Proper temperature control ensures that the birds remain healthy, reducing stress-related illnesses and

1 Professor, Department of ECE, Excel Engineering college, Komarapalayam

2 Associate Professor, Cyber security, Sri Shanmugha College of Engineering and Technology, Sankari, Salem

3 UG student, Department of ECE, Sri Shanmugha College of Engineering and Technology, Sankari, Salem.

jayapoorani@yahoo.com, srinijayakumar@gmail.com, nsaravanan146@gmail.com

improving overall immunity.

Productivity: Birds exposed to optimal temperature ranges grow faster, consume more feed, and produce

more eggs. Consistent temperature regulation enhances the overall productivity of the farm.



Figure 1: architecture of the study

Economic Benefits: Effective temperature control minimizes bird mortality and health issues, leading to reduced veterinary costs and higher profitability for the farm. (figure 1)

The Impact of Heat Stress

High temperatures can have severe consequences on poultry farming, including:

Reduced Feed Intake: Birds tend to eat less when the temperature rises, leading to stunted growth and poor weight gain.

Lower Egg Production: Heat stress can negatively affect egg production, with birds laying fewer eggs or eggs of lower quality.

Higher Mortality Rates: In extreme cases, high temperatures can lead to bird fatalities, resulting in significant financial losses for farmers.

Limitations of Traditional Temperature Control Methods

Traditional methods for managing temperature in poultry farms have significant drawbacks:

Manual Labor: Techniques like water spraying, ventilation, and fan-based cooling require continuous manual intervention, making them labor-intensive and time-consuming.

- **Inconsistency:** These manual methods often lack precision, leading to inconsistent temperature control throughout the day.
- **Human Error:** Farmers are prone to missing temperature fluctuations, which can result in delayed corrective actions and poor environmental management.

Challenges with Existing Automated Systems

While automated systems are available, they are not always practical for small to medium-sized farms:

- **High Cost:** Many existing automated systems are expensive, making them inaccessible for small-scale farmers.
- **Complexity:** These systems often require advanced technical knowledge to install, operate, and maintain.
- **Suitability:** Most available solutions are designed for large industrial farms, limiting their usefulness in smaller setups, particularly in developing regions where resources are limited.

Need for an Affordable and Scalable Solution

- **Low-Cost Solution:** A low-cost, energy-efficient system would make automated temperature control feasible for small and medium-sized poultry farms.
- **Ease of Use:** The system should be simple to install and operate, requiring minimal technical expertise, making it ideal for farmers with limited resources.
- **Scalability:** The system should be adaptable to farms of different sizes, ensuring that it can be implemented across a range of farming operations.

Ideal Features of the Proposed System

To address these challenges, an IoT-based automated system for real-time temperature monitoring is proposed:

- **Temperature Control:** The system should automatically maintain the farm temperature at or below 35°C to prevent heat stress and enhance bird welfare.
- **Real-Time Alerts:** These should include real-time monitoring and instant alert systems to notify farmers when the temperature exceeds the threshold, allowing for immediate corrective action.
- **Energy Efficiency:** The system should be designed to minimize energy consumption, making it cost-effective and sustainable.

- **Scalability and Flexibility:** It should be customizable to accommodate various farm sizes, ensuring accessibility to both small- scale and large-scale poultry operations.

This proposed solution aims to combine smart sensors, microcontrollers, and IoT platforms to create an effective and affordable temperature control system that enhances farm productivity while reducing manual labor and operational costs.

SYSTEM COMPONENTS AND WORKING PRINCIPLE

Hardware Components

Temperature Sensor (DHT11): Used to continuously monitor the temperature inside the poultry farm.

Wi-Fi-enabled Microcontroller (ESP32): Acts as the central unit, controlling the cooling mechanisms and transmitting data to the IoT platform.

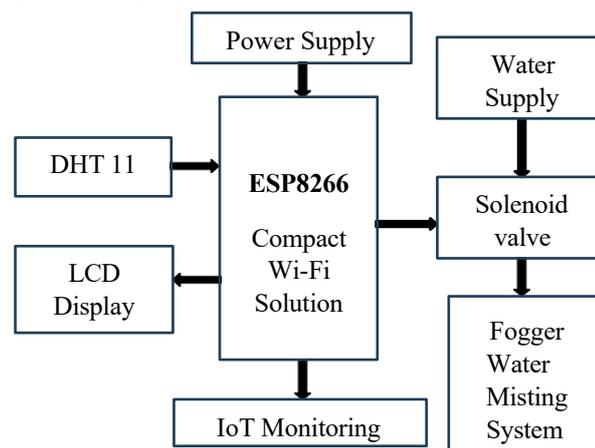
Cooling Mechanisms (Misting System): Automated components that regulate temperature

logging for better farm management. And sends alert messages to the mail

Working Principle

The system continuously monitors the temperature inside the chicken farm using sensors like the DHT11. These sensors send real-time data to the microcontroller (ESP32), which checks if the temperature goes above 35°C. When it does, the microcontroller automatically turns on a cooling system, such as a Water Misting Fogger System, that sprays a fine mist of water to cool the area. This helps lower the temperature quickly and efficiently without disturbing the birds (Figure 2).

If the temperature continues to rise above the safe level, the system also sends alert messages to the farmer’s mobile. This allows the farmer to be aware of the situation and take action if needed. The system works automatically, helping to reduce the workload on the farmer while keeping the chickens safe from overheating. It’s also scalable, meaning it can be



based on sensor input.

IoT Platform: Enables remote monitoring and data

used on farms of different sizes to ensure a stable and healthy environment for the poultry.

Figure 2: system architecture

LITERATURE REVIEW

Introduction to IoT-Based Temperature Monitoring Systems:

Traditional poultry farming relies on manual labor to control temperature, humidity, and feeding, which can be time-consuming and inconsistent. Farmers must constantly monitor conditions, and any delays in adjusting them can lead to poor poultry health, reduced growth, and higher mortality rates. Without real-time monitoring, responding to sudden environmental changes becomes difficult, affecting farm productivity.

To solve these challenges, modern poultry farms are adopting Internet of Things (IoT) technology. IoT systems use devices like ESP8266, Raspberry Pi, and AT89C51 microcontrollers, along with sensors such as DHT11 and SHT11, to automate temperature and humidity control. Wireless networks, including XBee and GPRS, allow real-time monitoring and adjustments, reducing manual work. These systems can automatically turn on sprinklers, ventilation, or lighting based on sensor readings to maintain optimal conditions for poultry.

With IoT, farmers can monitor and manage their farms remotely through cloud-based dashboards and

mobile apps. Automation also improves feeding efficiency, predicts poultry health trends, and enhances overall farm management. This literature review explores the shift from manual poultry farming to IoT-based

automation, highlighting advancements in monitoring, control, and efficiency.

Review of Existing Systems:

[1] This study uses the AT89C51 microprocessor and PROTEUS software to simulate a temperature and humidity management system. To preserve environmental stability, it highlights the usage of the SHT11 sensor for data collection and comparison with predetermined normal values. [2] This study monitors and controls environmental conditions in chicken farms using Raspberry Pi and Arduino. Farmers can use a smartphone to remotely monitor temperature, humidity, and other critical elements, which lowers costs and increases output. [3] This study suggests using a GPRS network in conjunction with a wireless sensor network to track temperature, humidity, and ammonia levels. With automated controls that guarantee the maintenance of predetermined environmental conditions, the system enables farm operators to access data through a web page.

[4] This study monitors and controls temperature and humidity in chicken farms using a wireless sensor network (WSN). The system's sensors ensure precision within a 1.51% error margin. The use of XBee communication shows versatility in both indoor and outdoor environments. [5] This study introduces an innovative IoT-based poultry farm management system that integrates electricity generation from poultry waste. The system monitors temperature, humidity, and ammonia levels while utilizing a biogas plant to power IoT-based automation, creating a self-sustainable model. [6] This study presents a temperature and humidity management approach using an ATmega328p microcontroller, an AM2302 sensor, an LCD, and keypad interface. Conditions at the chicken farm are maintained between 20°C and 25°C and 60% to 80% humidity, reducing manual effort.

[7] This study emphasizes the use of IoT to monitor environmental factors in broiler farms, including temperature, humidity, ammonia, and air quality. The technology automates control mechanisms to maintain ideal conditions and reduce manual labor. [8] This study focuses on developing an IoT-based smart poultry farm that automates environmental regulation using temperature and humidity sensors. An Arduino-based controller and cloud storage allow remote data access. An AI-driven analytics module predicts poultry health trends to improve productivity and reduce mortality.

[9] This study explores the integration of Raspberry Pi and Arduino Uno to develop a smart poultry monitoring system. The system automates feeding, lighting, and climate control, with real-time sensor data sent to a cloud dashboard for proactive farm management. [10] This study investigates the use of IoT to automate temperature, humidity, and feeding processes in broiler farming. Real-time sensor data is used to optimize environmental conditions, and operators can access data remotely via a web interface.

[11] This study introduces a comprehensive system incorporating the MQ135 gas sensor, DHT11 sensor, PIR motion sensor, and ESP32 microcontroller. It enables automated temperature, humidity, and air quality monitoring with remote control via WiFi. [12] This study addresses IoT-based temperature and humidity monitoring in broiler farms, with emphasis on automatic light activation for temperature control. The system adjusts lighting to maintain optimal growth conditions for the chickens. [13] This study highlights the use of the DHT11 sensor with an ESP8266 microcontroller to control temperature and moisture in poultry farms. When thresholds are exceeded, the system activates sprinklers automatically, reducing manual labor and improving bird health and farm productivity.

[14] This study presents an IoT-based poultry management system that automates temperature and humidity control along with real-time livestock monitoring. It uses sensors and actuators integrated with a cloud platform to deliver alerts and enable remote farm management. [15] This study presents a smart poultry farming system featuring real-time environmental and security monitoring using IoT. It integrates biometric-based access control with temperature, humidity, and air quality sensors. Data is stored in the cloud for predictive analytics, enhancing poultry health and farm security.

CONCLUSION

Summary of the Project

This project developed an IoT-based automated temperature monitoring and control system for poultry farms. The system utilizes temperature sensors (DHT11) to gather real-time data, a microcontroller (ESP32) to process this data, and a cooling mechanism (Water Misting Fogger System) to regulate the temperature when it rises above 35°C. Alerts are sent to farmers when critical temperature limits are reached, ensuring immediate response and efficient farm management. This system is designed to optimize poultry farming by reducing manual intervention, improving bird health, and increasing farm productivity.

Challenges Faced During Implementation

During the development and implementation of this system, several challenges were encountered, including:

Sensor Placement: Identifying the optimal locations for the temperature sensors was crucial to ensure accurate readings of the farm environment, but it was challenging to find spots that avoid interference from localized heat sources like equipment or sunlight.

System Calibration: Fine-tuning the system to ensure it responded accurately to temperature changes required extensive calibration. The sensitivity of the sensors had to be adjusted to avoid false alerts while still maintaining precise temperature control.

Power Management: As the system is designed to run autonomously, power efficiency is critical. Ensuring that the cooling mechanisms and sensors operated without consuming excessive energy required testing and optimization.

Alert Integration: Ensuring that the alert system was reliable and timely posed challenges, particularly in integrating GSM or Wi-Fi modules for sending notifications without delay, especially in remote farm areas with limited connectivity.

Future Enhancements

The system can be further improved by

incorporating additional features and technologies:

Advanced Cooling Systems: Exploring more efficient cooling mechanisms, such as solar-powered cooling fans, can enhance energy efficiency, making the system more sustainable for long-term use.

Data Analytics: By integrating a data analytics platform, the system could provide farmers with detailed insights into temperature trends, allowing them to make more informed decisions about farm management and planning.

Mobile Application: Developing a dedicated mobile app could provide real-time updates and control options for farmers, enabling remote access to system settings, manual overrides, and data reports.

Final Conclusion

This project successfully developed an IoT-based automated temperature monitoring and control system tailored for poultry farms (Figure 3 and Table 4). The system effectively monitors the temperature in real-time, activates cooling mechanisms to maintain a healthy environment for the birds, and sends timely alerts to farmers when critical thresholds are reached.

The challenges faced during implementation highlighted the importance of system accuracy, power efficiency, and reliable communication.

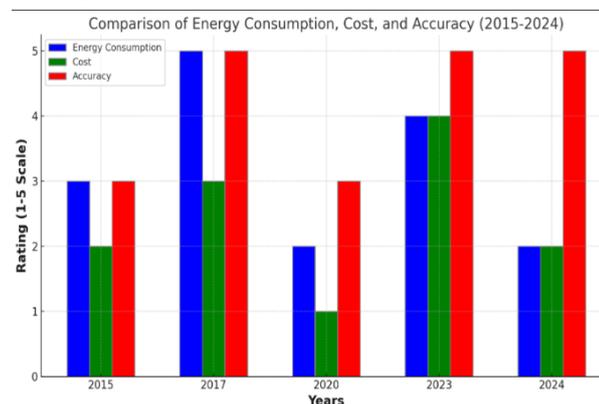


Figure 3: Comparison of energy consumption and accuracy

Moving forward, the proposed enhancements would make the system even more robust, efficient, and adaptable to various farm sizes. Overall, this solution has the potential to significantly improve farm

productivity and bird health, reduce the need for manual intervention, and provide a scalable, affordable option for poultry farmers, particularly in regions where access to advanced technology is limited.

RESULTS AND DISCUSSIONS

Table 1: relevent study of cost and accuracy

Study & Year	Methodology	Energy Consumption	Cost	Remote Monitoring	Accuracy
darat, et al. (2015)	pberry Pi & Arduino	Moderate	Low	Yes	Moderate
aksono, et al. (2017)	WSN & XBee Communication	High	Moderate	Yes	High
eyad, et al. (2020)	ATmega328p & AM2302 sensor	Low	Low	No	Moderate
asanto, et al. (2023)	IoT & Light Control	Moderate	oderate- High	Yes	High
agyam, et al. (2024)	IoT & ESP8266	Low	Low	Yes	High

Numerous studies have shown how temperature and humidity management systems in chicken farms have significantly changed between 2015 and 2024. What started out as manual labor and simple automation has evolved into complex Internet of Things-based systems. By reducing human work, increasing accuracy, and preserving ideal environmental conditions for the healthy growth of chickens, these innovative technologies seek to improve the overall efficiency of poultry farming. Every study emphasizes the main goal, which is to use technology innovation to improve productivity and streamline processes.

REFERENCES

[1] X. Xiumei and P. Jinfeng, "The simulation of temperature and humidity control system based on PROTEUS," Proc. 2011 Int. Conf. Mechatronic Sci., Elect. Eng. and Comput. (MEC), Jilin, China, 2011, pp. 1896–1898, doi: 10.1109/MEC.2011.6025856.

[2] S. Jindarat and P. Wuttidittachotti, "Smart farm monitoring using Raspberry Pi and Arduino," Proc. 2015 Int. Conf. Comput. Commun. and Control Technol. (I4CT), Kuching, Malaysia, 2015, pp. 284–288, doi: 10.1109/I4CT.2015.7219582.

[3] G. A. Choukidar and N. A. Dawande, "Smart Poultry Farm Automation and Monitoring System," Proc. 2017 Int. Conf. Comput., Commun., Control and Autom. (ICCUBEA), Pune, India, 2017, pp. 1–5, doi: 10.1109/ICCUBEA.2017.8463953.

[4] D. Wicaksono et al., "Design and analysis automatic temperature control in the broiler poultry farm based on wireless sensor network," Proc. 2017 2nd Int. Conf. Inf. Technol., Inf. Syst. and Elect. Eng. (ICITISEE), Yogyakarta, Indonesia, 2017, pp. 450–455, doi: 10.1109/ICITISEE.2017.8285549.

[5] S. Mitkari, P. Pingle, S. Bhosale, and P. Patil, "IoT-Based Smart Management of Poultry Farm and Electricity Generation," Proc. ICICICT, 2019, doi: 10.1109/ICICICT1.2019.8782308.

[6] M. Zeyad et al., "Design and Implementation of Temperature & Relative Humidity Control System for Poultry Farm," Proc. 2020 Int. Conf. Comput. Perform. Eval. (ComPE), Shillong, India, 2020, pp. 189–193, doi: 10.1109/ComPE49325.2020.9200032.

[7] M. Revanth et al., "Design and Development of an IoT Based Smart Poultry Farm," Proc. 2021 Int. Conf. Adv. Elect., Electron., Commun., Comput. and Autom. (ICAECA), Coimbatore, India, 2021, pp. 1–4, doi: 10.1109/ICAECA52838.2021.9675553.

[8] S. A. Alexander et al., "Design and Development of an IoT-Based Smart Poultry Farm," Proc. 2021 Int. Conf. Comput. Intell. and Comput. (ICCIC), 2021, doi: 10.1109/ICCIC.2021.9675553.

[9] S. K. Sahoo, S. K. Dash, and S. K. Mohapatra, "IoT-Based Smart Poultry Farm Monitoring and Controlling Using Raspberry Pi and Arduino Uno," Proc. IEMTRONICS, 2021, doi: 10.1109/IEMTRONICS.2021.9422591.

[10] S. Debdas et al., "Automation Of Temperature, Humidity Regulation And Feeding System In Broiler Farming using IOT," Proc. 2022 IEEE 2nd Int. Conf. Sustain. Energy and Future Elect. Transp. (SeFeT), Hyderabad, India, 2022, pp. 1–6, doi: 10.1109/SeFeT55524.2022.9909494.

[11] S. I. Orakwue, H. M. R. Al-Khafaji, and M. Z. Chabuk, "IoT Based Smart Monitoring System for Efficient Poultry Farming," Webology, vol. 19, 2022, pp. 4105–4112, doi: 10.14704/WEB/V19I1/WEB19270.

[12] A. Susanto et al., "Design of a Temperature and

- Humidity Monitoring System in Broiler Farms Using Internet of Things-Based Thingspeak,” 2023.
- [13] L. N. Bagyam et al., “Implementation of Temperature and Moisture Controller in Poultry Using IoT,” Proc. 2024 2nd Int. Conf. Intell. Data Commun. Technol. and IoT (IDCIoT), Bengaluru, India, 2024, pp. 126–130.
- [14] K. K. C. et al., “IoT-Based Smart Poultry Management System,” J. Inf. Syst. and Manag., 2024, doi: 10.36548/jismac.2024.1.004.
- [15] J. N. Padua et al., “IoT-Based Smart Poultry Farming: Enhancing Security and Monitoring for High-Quality Production,” Proc. ICICTA, 2024, doi: 10.1109/ICICTA.2024.11141.
- [16] Q. Tong et al., “Edge AI-Enabled Chicken Health Detection Based on Enhanced FCOS-Lite and Knowledge Distillation,” arXiv, 2024, doi: 10.48550/arXiv.2407.09562.
- [17] T. Z. Ehsan and S. M. Mohtavipour, “Broiler-Net: A Deep Convolutional Framework for Broiler Behavior Analysis in Poultry Houses,” arXiv, 2024, doi: 10.48550/arXiv.2401.12176.