

Smart Poultry Farming with ESP8266: A Comprehensive Review of Monitoring and Automation Approaches

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Abstract: *Poultry farming is a significant component of the agricultural sector, contributing to food security and rural income generation. However, maintaining the health of poultry birds requires constant monitoring of their living conditions, which is challenging with traditional manual methods. These methods are often time-consuming, inconsistent, and prone to human error.*

This project presents a Smart Poultry Monitoring System based on Arduino microcontroller technology. The system utilizes various sensors, including temperature, humidity, and gas (ammonia) sensors, to monitor the poultry environment in real-time. These sensors are interfaced with an Arduino board, which processes the sensor data and displays it on an LCD screen for easy visibility. Additionally, the system features a buzzer or LED alert mechanism to notify the farmer when any environmental parameter crosses predefined threshold levels.

The primary objective of this project is to automate the monitoring process, reduce manual effort, and help maintain a healthy and safe environment for poultry birds. The system is cost-effective, user-friendly, and suitable for small to medium-sized poultry farms, especially in rural areas where advanced solutions like GSM or IoT may not be accessible or affordable.

This smart monitoring approach enhances poultry farm management by enabling timely corrective actions, thereby improving bird health, reducing mortality, and increasing overall productivity.

Keywords: *Health monitoring, Disease alert, Sensors, Temperature and humidity*

I. INTRODUCTION

Poultry farming is a vital branch of agriculture that contributes significantly to food production and rural employment. With the rising global demand for poultry products, farmers are increasingly expected to maintain healthy environments that ensure the welfare and productivity of their flocks. The health and growth of poultry birds are strongly influenced by environmental conditions inside the shed, particularly temperature, humidity, and overall activity levels. Poorly managed conditions can lead to stress, diseases, reduced egg production, and increased mortality, making continuous monitoring an essential part of poultry management. Traditionally, farmers rely on manual inspections to check these environmental parameters and observe bird activity. However, this approach is time-consuming, prone to error, and often unable to respond quickly enough to sudden changes. Modern automated systems exist, but they typically depend on costly IoT infrastructures, cloud connectivity, or GSM modules, which are not always practical for small and medium-scale farmers, especially in rural areas. To address these challenges, this work proposes a Smart Poultry Health Monitoring System built using affordable embedded hardware. The system integrates an ESP8266 microcontroller, a DHT11 sensor to measure temperature and humidity, and a PIR sensor to detect poultry movement or activity within the shed. Real-time sensor data is displayed on an LCD module, allowing farmers to instantly monitor the current conditions. The use of the ESP8266 ensures efficient data processing and the potential for future wireless communication, while keeping the system low-cost



and user-friendly. The proposed system eliminates the need for complex IoT platforms or internet connectivity, making it highly suitable for small-scale poultry farms. By providing real-time updates on environmental conditions and bird activity, it helps farmers take timely actions to ensure bird welfare, reduce labor efforts, and improve productivity. In addition, the design is scalable and can be expanded with other sensors or actuators if required in the future. The rest of this paper is structured as follows: a review of related work is provided in the next section, followed by details of the methodology and system design. The experimental results are then discussed, and finally, the conclusion highlights the main contributions and possible future improvements.

II. LITERATURE SURVEY

Rao et al. [1] (2025) introduced a smart poultry monitoring and management system integrating embedded systems with IoT, enabling real-time data collection and environmental control. Nanjo et al. [2] (2025) developed an IoT-driven health monitoring system for broiler and noiler chickens, highlighting smart precision farming applications. Balthazar et al. [3] (2025) designed and validated a rapid-prototyping IoT-based sensor system for poultry house microclimate monitoring, focusing on accuracy and reliability. Klasner et al. [4] (2025) presented an autonomous robotic system for managing basic technological processes at poultry farms, contributing to automation in large-scale operations. Rajesh et al. [5,6] (2025) proposed advanced smart systems using CNN and SVM algorithms to detect and mitigate aggression among poultry, improving animal welfare through AI-based monitoring. Barbosa et al. [7] (2024) evaluated the dependability of a smart poultry monitoring system and introduced a disaster recovery mechanism to enhance resilience. Ferrozine et al. [8] (2024) integrated random forest models with IoT-based sensors for efficient poultry farm monitoring, enabling data-driven decision-making. Etikasari et al. [9] (2024) developed an IoT-based water quality monitoring system for laying hens, focusing on pH detection to ensure optimal drinking water conditions.

Yu et al. [10] (2024) emphasized climate-smart agriculture by enhancing global agricultural monitoring systems, providing insights applicable to poultry farming. Cabajes et al. [11] (2024) designed an IoT-enabled egg incubator system to improve hatching outcomes through automated control and monitoring. Parampara bath et al. [12] (2024) introduced a colorimetric sensor for nitrite detection in poultry packaging, enhancing food safety across the value chain. Sangeetha et al. [13] (2022) implemented a wireless sensor network for poultry farm management, demonstrating scalability and real-time control. Otari and Amuhaya [14] (2022) explored mechatronic and automation technologies for sustainable farming in Kenya, offering approaches that can be adapted to poultry production. Wahyuni et al. [15] (2024) proposed an IoT- and AI-based smart egg incubator, improving hatchability and precision farming practices.

P. et al. [16] (2024) designed a line-guided robotic car for precision monitoring in poultry farms, showcasing automation in physical inspection. N. et al. [17] (2024) implemented an embedded system-based poultry feeding trolley, reducing labour in feed distribution. Sasirekha et al. [18] (2023) proposed an IoT-based poultry house monitoring system to maintain optimal environmental conditions. Saputras et al. [19] (2023) combined IoT and automated feeder control in smart poultry farms, enhancing efficiency in daily operations. Edgar et al. [20] (2023) designed a smart incubator to empower poultry farmers by maximizing hatching success. Joshi et al. [21] (2023) integrated AI and IoT technologies for smart poultry health monitoring, enabling early detection of health issues.

Manohar [22] (2022) presented a general IoT-based smart poultry farming model, establishing a baseline for further innovations. Halim et al. [23] (2023) focused on post-harvest monitoring with performance dashboards, which can be adapted for poultry logistics. Wingiest et al. [24] (2023) demonstrated a real-time crowd monitoring system using Wi-Fi infrastructure, offering adaptable insights for poultry farm management. Zhang and Zhi [25] (2021) developed an IoT-based environment monitoring system for intelligent breeding bases, improving real-time climate regulation. Ezema et al. [26] (2021) designed an ESP32-based embedded poultry monitoring system, emphasizing scalability and automation. Liu et al. [27] (2021) proposed an IoT-enabled intelligent rabbit culture system, with methodologies relevant to broader livestock farming.

Sekar [28] (2019) presented an early IoT-based poultry farm monitoring system, laying groundwork for later smart farm models. Gunawan et al. [29] (2019) applied RTOS on Arduino for poultry farm automation, ensuring real-time operation and stability. Mahalakshmi et al. [30] (2019) introduced an IoT sensor-based smart agricultural system, contributing to broader smart farming frameworks with direct applications in poultry.



Table1: Comparative review of smart poultry monitoring system.

Paper / Project	System Architecture	Cost	Ease of Implementation	Performance	User Experience	Limitations
Rao [1]	Embedded + IoT poultry monitoring & management	Low–Moderate (<\$50)	Moderate (IoT integration)	Real-time monitoring & control	Improves farm efficiency	Requires reliable internet
Nanjo et al. [2]	IoT-driven health monitoring for broiler/noiler chickens	Moderate (~\$60)	Moderate (sensor setup & calibration)	Effective health data tracking	Supports precision farming	Limited to specific breeds
Balthazar et al. [3]	IoT-based rapid-prototyping sensor for microclimate	Moderate (<\$70)	Easy (prototype-friendly)	Accurate microclimate sensing	Reliable & adaptable	Still at prototype stage
Klasner et al. [4]	Autonomous robotic system for poultry farm operations	High (> \$100)	Complex (robotics integration)	Automates farm processes	Reduces manual labor	Costly, high maintenance
Rajesh et al. [5,6]	AI system (CNN + SVM) for aggression detection	Moderate–High (~\$80)	Complex (ML training required)	Detects & mitigates aggression	Enhances animal welfare	Needs large datasets & compute
Barbosa et al. [7]	Smart monitoring system w/ disaster recovery	Moderate (~\$70)	Moderate (network config)	High dependability & resilience	Robust & secure	Extra cost for redundancy
Fahrurrozi et al. [8]	IoT + Random Forest model for monitoring	Moderate (~\$60)	Moderate (requires ML integration)	Data-driven accurate monitoring	Adaptive & intelligent	Dependent on training data
Etikasari et al. [9]	IoT-based pH monitoring for drinking water	Low (<\$40)	Easy (sensor-based setup)	Effective pH & water quality detection	Ensures poultry health	Narrow scope (water only)

III. PROPOSED METHODOLOGY

The design and implementation of the Smart Real-Time Poultry Health Monitoring System follow a systematic methodology that integrates embedded hardware, sensor technologies, and communication modules to achieve a cost-effective and intelligent solution for poultry farm management.

Figure 1 shows block diagram of proposed methodology



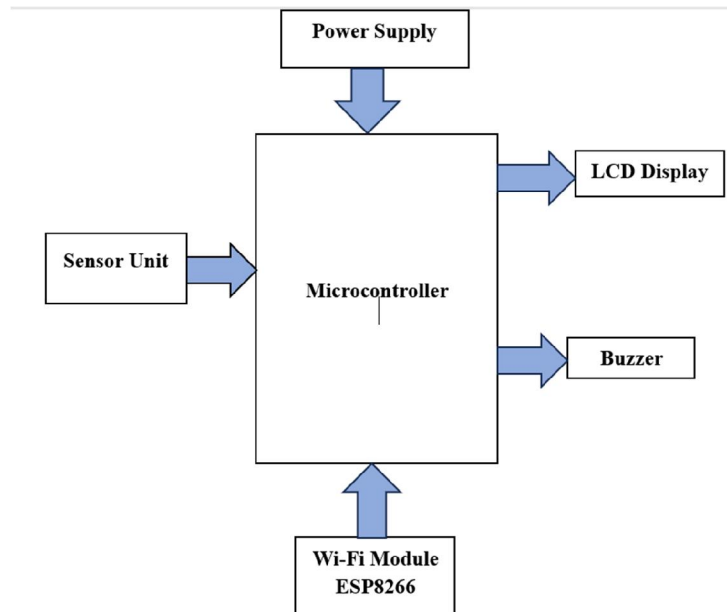


Figure1: Block Diagram of Proposed System

The proposed poultry farm automation system is a comprehensive smart farming solution that integrates sensors, microcontrollers, and IoT technology to ensure optimal bird health, efficient management, and reduced manual intervention. It is powered by a regulated DC supply that delivers stable voltage to all components, safeguarding sensitive electronics such as the microcontroller, sensors, and communication modules from voltage fluctuations. The system's sensor unit continuously collects real-time data on environmental and activity conditions inside the poultry house. A DHT11 sensor measures temperature (0–50 °C) and humidity (20–90% RH), ensuring that birds remain within their comfort zone, since extreme heat or dryness can cause stress, reduced egg production, or mortality. The MQ135 gas sensor monitors ammonia levels (10–1000 ppm), and when concentrations exceed 300 ppm, the system automatically activates ventilation fans to reduce toxic buildup, protecting the birds' respiratory health. A PIR sensor detects motion and activity, enabling the monitoring of flock movement patterns, which can indicate whether birds are healthy, overcrowded, or inactive due to illness, while the IR sensor provides flexibility by being used for bird counting, feed and water level detection, or object monitoring based on placement.

At the core, a microcontroller acts as the decision-making unit, processing sensor inputs, comparing them with pre-set thresholds, and sending commands to actuators such as fans, sprinklers, heaters, or alarms. IoT connectivity is enabled by the ESP8266 Wi-Fi module, which uploads processed data to cloud platforms, dashboards, or mobile applications. This allows farmers to remotely monitor temperature, humidity, gas levels, and bird activity in real time, while also receiving instant alerts via SMS, email, or mobile notifications in emergencies. For on-site visibility, an LCD display shows live sensor readings, and a buzzer with LED indicators provides immediate audio-visual alerts in abnormal situations such as dangerous gas concentration, extreme temperatures, or lack of bird activity. The system can also be expanded with automated lighting to simulate natural day-night cycles, water pumps to maintain hydration levels, or smart feeders to regulate diet and prevent wastage.

Beyond monitoring and control, the system offers long-term benefits by storing sensor data for trend analysis and predictive maintenance. Historical data on temperature, humidity, and flock activity can be analysed to optimize farm operations, prevent disease outbreaks, and improve feed-to-growth ratios. The system's modular design makes it scalable for both small farms and large commercial poultry houses, while its integration with renewable energy sources such as solar panels can make it cost-effective and sustainable. Ultimately, this automation system reduces manual labour, minimizes risks associated with environmental fluctuations, improves poultry welfare, and enhances overall productivity, making it a vital step toward modern, technology-driven poultry farming.



IV. CONCLUSION

The Smart Poultry Monitoring System is expected to provide an affordable, reliable, and easy-to-use solution for poultry farmers. By continuously monitoring important parameters like temperature, humidity, air quality, and bird activity, the system helps farmers detect problems early and take quick action.

It reduces bird sickness and death, improves their living conditions, and increases farm productivity. The system also saves time and effort by sending alerts automatically and keeping records of farm data.

In short, this project will make poultry farming smarter, safer, and more profitable, especially for small and medium-scale farmers.

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