

# Design and Development of an IoT-Based Monitoring System for Ammonia Gas, Temperature, and Humidity in Poultry Houses with Automatic Control via Blynk

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## Article Info

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## ABSTRACT

Clean air is crucial in poultry farming as it significantly affects the health and productivity of chickens, as well as the surrounding environment. One of the serious issues often encountered is the odor originating from waste or leftover feed, which produces ammonia gas (NH<sub>3</sub>). If not properly managed, this gas can cause stress or even death in chickens and pollute the environment. In response to this problem, this study aims to design an Internet of Things (IoT)-based monitoring system for ammonia gas, temperature, and humidity in chicken coops, featuring automatic control through Blynk in real-time. The system uses an MQ135 sensor to detect ammonia gas and a DHT22 sensor to measure temperature and humidity. Sensor data is periodically transmitted through Blynk for remote monitoring. If ammonia levels exceed the safe threshold (>20 ppm), the system automatically activates an indicator LED, an exhaust fan for air circulation, a pump to spray an ammonia-neutralizing liquid, and a servo to dispose of chicken waste. This system also allows users to manually activate the devices via virtual buttons on Blynk and sends real-time notifications on Blynk when ammonia levels rise or when devices are activated. The test results show that the system effectively monitors coop air conditions and performs actions based on needs. It is expected that this system will enable farmers to more optimally control air quality in chicken coops, thereby improving the health of both chickens and farmers, and achieving better farming efficiency.

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## INTRODUCTION

Maintaining air quality in poultry farms is a crucial factor that strongly influences the health and productivity of livestock, as well as the well being of farmers. One of the most common hazardous gases found in poultry house environments is ammonia, which is generated from the decomposition of manure and feed residues. High concentrations of ammonia cause severe air pollution characterized by strong and unpleasant odors, leading to stress,

respiratory disorders, and even mortality in chickens, while also contaminating the surrounding environment. Air contaminated with ammonia gas around poultry farms poses serious health risks to humans, particularly farm workers and nearby communities. According to Brotosusilo and colleagues, poor air quality is mainly caused by elevated concentrations of ammonia, carbon monoxide, and carbon dioxide, where higher ammonia levels are directly associated with increased humidity around accumulated poultry waste, resulting in strong offensive odors.

Research conducted by Pendriadi and colleagues highlights that ammonia gas is highly dangerous to both poultry and farmers. Exposure to ammonia concentrations exceeding the occupational threshold can disrupt chicken health and negatively affect the surrounding environment, especially the farmers themselves. Previous studies indicate that ammonia levels inside poultry houses should remain very low, as elevated concentrations can lead to respiratory problems in chickens. This study measures ammonia levels using an MQ series gas sensor to analyze its impact on poultry conditions, while temperature and humidity are monitored using a digital environmental sensor to examine their relationship with optimal poultry production.

Unpleasant odors in poultry houses are primarily caused by high ammonia concentrations, although poultry manure can also decompose into other harmful gases such as carbon dioxide, hydrogen sulfide, and methane. Among these gases, ammonia is considered the most significant contributor to health problems affecting both poultry and farmers. Chickens are highly sensitive organisms that require precisely controlled environmental conditions, making continuous regulation of ammonia emissions essential in poultry farming. High ammonia exposure also poses serious risks to human health. Based on the regulation issued by the Indonesian Ministry of Manpower, ammonia exposure limits are strictly defined for workplace safety.

Studies by Jarot and Yuli demonstrate that Internet of Things technology plays a significant role in modernizing poultry farming systems, including environmental monitoring and automation. The implementation of IoT based air quality monitoring systems has been proven to improve data accuracy, enhance poultry health, increase operational efficiency, and enable remote monitoring and control. Excessive ammonia levels clearly affect poultry health, farmer safety, and environmental quality. Therefore, the application of IoT based monitoring systems enables farmers to continuously observe ammonia levels and air quality conditions, helping prevent disease, optimize livestock productivity, and safeguard farmer health.

## METHODS

This study on ammonia monitoring in poultry houses falls under engineering research, which is an approach focused on the design, development, and testing of technological system prototypes to address practical problems encountered in real-world settings. In this study, the problem addressed is the lack of an automated monitoring system capable of continuously measuring ammonia gas concentration, temperature, and humidity in poultry houses in real

time, with the aim of improving production efficiency and preventing health issues, including risks to farmers' health.

This research can also be categorized as development research, as it goes beyond theoretical discussion by encompassing the processes of system design, implementation, testing, and evaluation of a prototype developed in a simplified form.



**Figure 1.** Design of the Miniature Poultry House Device

### System Design

This system is designed based on the Internet of Things (IoT) concept to provide ease of remote monitoring and control. The system design in this study utilizes the NodeMCU ESP8266 as the main control unit responsible for reading sensor data, processing information, and transmitting it to the cloud as well as to the Blynk application in real time. The system is designed to automatically respond to environmental conditions in the poultry house at all times and to facilitate remote monitoring of ammonia levels via internet connectivity.

The MQ135 sensor is employed to detect ammonia gas ( $\text{NH}_3$ ) and is first calibrated in clean air to obtain a reference resistance value. The calibration results indicate that lower  $R_s/R_o$  values correspond to higher  $\text{NH}_3$  concentrations. This relationship forms the basis of the system logic for activating the neutralizing liquid sprayer and the ventilation fan. Measurement data are displayed on the LCD and transmitted to the Blynk platform and Google Sheets for monitoring and data logging purposes.

### Block Diagram

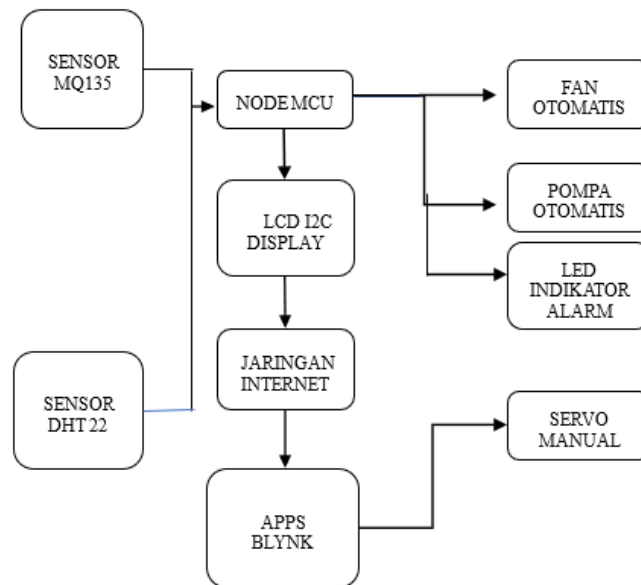


Figure 2. Block Diagram

### System Block Diagram

The block diagram of the designed ammonia gas monitoring system consists of five main components: input, control, output, display, and IoT communication. The input section employs an MQ135 sensor to detect ammonia gas and a DHT22 sensor to measure temperature and humidity. Sensor data are processed by the ESP8266 NodeMCU microcontroller, which also automatically controls actuators such as an exhaust fan, pump, servo motor, and LED indicators. The monitoring results are displayed locally via an I2C LCD and transmitted to the Blynk application for remote monitoring and control through a smartphone. In addition, the data are periodically sent to Google Sheets as a cloud-based logging medium that can be accessed at any time.

### Research Concept

The research concept implements a simple Internet of Things (IoT)-based monitoring system capable of automatically observing and controlling environmental conditions in a poultry house. The primary focus of the system is to detect high ammonia gas concentrations and to measure ambient temperature and humidity in real time. A key advantage of the proposed system is its ability to actively respond to unfavorable environmental conditions. For instance, when the MQ135 sensor detects ammonia levels exceeding the safe threshold, the system automatically activates the exhaust fan to improve air circulation and turns on the neutralizing liquid pump to reduce ammonia gas, particularly in waste areas. Simultaneously, data and notifications are transmitted in real time to the farmer's smartphone via the Blynk application. The system also allows manual control of the servo motor, which drives the poultry waste disposal mechanism, through virtual buttons available in the Blynk application. It is expected that this system will enhance the efficiency of poultry farm management, control

the risks associated with high ammonia levels, and help maintain farmers' health through automation and remote monitoring.

## RESULTS AND DISCUSSION

To analyze the performance of the developed ammonia monitoring system in the poultry house, observations were conducted using Blynk graphs and real time sensor data recorded in Google Sheets. The graphs illustrate changes in ammonia concentration, temperature, and humidity during nighttime conditions. The overall system performance is interpreted based on these graphical observations.

**Table 1.** Sensor Data Readings During Nighttime

Date	Time	Amonia (ppm)	Suhu (°C)	Humadity (%)
22/06/2025	23.19.47	22,2	30,9	81,5
22/06/2025	23.20.52	24,57	30,9	81,5
22/06/2025	23.21.51	21,29	30,9	81,5
22/06/2025	23.22.55	23,23	30,8	81,5
22/06/2025	23.23.57	23,48	30,8	81,5
22/06/2025	23.25.00	20,93	30,9	81,6
22/06/2025	23.26.09	24,47	30,8	81,6
22/06/2025	23.28.09	21,4	30,8	81,6
22/06/2025	23.29.13	24,82	30,9	81,6
22/06/2025	23.30.15	21,87	30,8	81,7
22/06/2025	23.31.17	22,5	30,8	81,6
22/06/2025	23.32.20	24,13	30,8	81,7
22/06/2025	23.34.25	23,1	30,8	81,8
22/06/2025	23.35.28	23,57	30,8	81,8
22/06/2025	23.36.31	20,93	30,8	81,7
22/06/2025	23.37.37	24,52	30,8	81,8
22/06/2025	23.38.37	22,51	30,9	81,8
22/06/2025	23.39.39	22,03	30,9	81,8
22/06/2025	23.40.41	24,5	30,8	81,8
22/06/2025	23.41.44	20,86	30,8	81,7
22/06/2025	23.42.57	23,63	30,8	81,7
22/06/2025	23.43.50	23,64	30,8	81,8

During nighttime conditions, the monitoring graph shows a significant increase in ammonia concentration reaching high levels due to inactive air circulation inside the poultry house. The absence of ventilation causes ammonia gas from manure decomposition to accumulate, resulting in elevated concentrations. The system automatically detects this condition when the ammonia level exceeds the predefined safety threshold and activates the exhaust fan and neutralizing pump. The fan expels contaminated air and draws in fresh air, while the pump disperses a neutralizing solution to reduce ammonia concentration.

At the same time, sensor data are transmitted in real time to the Blynk platform, allowing users to monitor environmental changes through a smartphone interface and receive notifications when critical conditions occur. All sensor readings are also automatically stored in cloud based spreadsheets, enabling historical data analysis and performance evaluation. Shortly after the actuators are activated, the ammonia level gradually decreases to a safe range, indicating that the system operates effectively in controlling hazardous gas levels and maintaining a safe and healthy poultry house environment during nighttime conditions.

**Table 2.** Sensor Data Readings During Daytime

Date	Time	Amonia (ppm)	Suhu (°C)	Humadity (%)
23/06/2025	13.22.10	11,68	35,6	58,8
23/06/2025	13.23.13	12,97	35,1	60
23/06/2025	13.24.17	14,54	34,7	61,6
23/06/2025	13.25.19	13,92	34,4	63
23/06/2025	13.27.23	11,27	34,2	62
23/06/2025	13.31.31	10,32	34,2	63,3
23/06/2025	13.32.33	11,87	34,1	63,7
23/06/2025	13.33.36	13,54	34	63,8
23/06/2025	13.35.41	13,81	33,9	63,2
23/06/2025	13.36.42	12,27	33,8	63,5
23/06/2025	13.37.43	10,75	33,7	63,1
23/06/2025	13.43.52	13,91	34	63,1
23/06/2025	13.44.54	14,64	33,9	63,4
23/06/2025	13.45.57	13,02	33,8	63,8

During daytime conditions, ammonia levels tend to be lower and more stable, ranging between ten and fifteen parts per million. This condition is likely influenced by better natural ventilation through open poultry house vents and higher temperatures that enhance air circulation. However, the temperature approaches the upper comfort limit for broiler chickens, indicating that temperature control remains an important aspect of the system. During this period, the system does not activate any actuators because all environmental parameters remain within safe limits.

## CONCLUSION

This study successfully demonstrates the design and implementation of an Internet of Things based monitoring system for ammonia gas, temperature, and humidity in a poultry house environment. The developed system is capable of continuously observing critical environmental parameters and providing real time information that supports effective poultry house management. By integrating environmental sensors, wireless communication, and a mobile monitoring platform, the system enables farmers to maintain better awareness of air quality conditions without requiring constant physical presence at the farm. The automatic control mechanism embedded in the system plays an essential role in maintaining a safe and

healthy environment. When ammonia concentration exceeds the predefined safety threshold, the system responds promptly by activating ventilation and neutralization devices, thereby reducing harmful gas accumulation. This automated response helps minimize health risks for chickens and farmers, particularly during periods when natural ventilation is limited. At the same time, the availability of manual control through a mobile application offers additional flexibility in managing environmental conditions. The use of cloud based data storage further enhances the system's value by allowing historical data analysis and performance evaluation. Continuous data recording supports better decision making and provides insight into environmental trends over time. Overall, the proposed system proves to be effective, practical, and suitable for real world poultry farming applications. Its implementation has the potential to improve animal welfare, increase operational efficiency, and support sustainable livestock management through the application of modern digital technology.

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