

SMART IOT – ENABLED MONITORING AND CONTROL SYSTEM FOR POULTRY FARM

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Poultry farming is a crucial sector in agriculture that significantly contributes to food production and economic development. Maintaining optimal environmental conditions such as temperature, humidity, air quality, and lighting is essential for ensuring bird health and productivity. However, traditional monitoring methods rely on manual supervision, which is inefficient, time-consuming, and prone to human error. To address these challenges, this project proposes an IoT-Based Poultry Farm Monitoring and Control System that automates environmental monitoring and enhances farm management efficiency.

The proposed system uses sensors such as DHT11 and MQ135 to continuously monitor environmental parameters within the poultry shed. An Arduino Uno microcontroller processes the collected data and controls actuators like exhaust fans and lighting systems based on predefined thresholds. The system also integrates a GSM module (SIM800L) to provide real-time SMS alerts, enabling remote monitoring even in areas with limited internet connectivity. Additionally, cloud integration through platforms like Blynk allows real-time data visualization and remote access. The system ensures continuous monitoring, rapid response to environmental changes, reduced manual intervention, and improved productivity, making it a cost-effective and scalable solution for modern poultry farming.

CHAPTER 1

INTRODUCTION

Poultry farming is one of the most significant sectors in modern agriculture, playing a vital role in ensuring food security and economic stability across the world. The demand for poultry products such as eggs and meat has been increasing rapidly due to population growth, urbanization, and changing dietary preferences. To meet this growing demand, poultry farms must maintain high standards of efficiency, hygiene, and productivity. Among the various factors influencing poultry production, environmental conditions such as temperature, humidity, air quality, and lighting are of paramount importance. These parameters directly affect the growth rate, health condition, and overall productivity of poultry birds. Even minor fluctuations in environmental conditions can lead to stress, disease outbreaks, reduced feed intake, and increased mortality rates, ultimately affecting farm profitability.

In traditional poultry farming practices, environmental monitoring and control are primarily carried out manually by farm workers. This approach involves periodic checking of temperature, humidity, and ventilation conditions, followed by manual adjustments such as turning fans on or off, opening windows, or adjusting lighting systems. While this method may be feasible for small-scale farms, it becomes highly inefficient and unreliable for large-scale operations. Manual monitoring is time-consuming and prone to human errors, which can result in delayed responses to critical environmental changes. Moreover, continuous monitoring is not possible, especially during nighttime or in remote locations, leading to inconsistent environmental conditions within the poultry shed. These limitations highlight the need for a more efficient and automated system capable of ensuring continuous monitoring and timely control actions. With the rapid advancement of technology, the concept of smart agriculture has emerged as a promising solution to overcome the limitations of traditional farming methods. Smart agriculture involves the use of modern technologies such as the Internet of Things (IoT), embedded systems, wireless communication, and cloud computing to improve agricultural productivity and efficiency. IoT, in particular, has gained significant attention due to its ability to connect physical devices and enable real-time data exchange. By integrating sensors, microcontrollers, and communication modules, IoT-based systems can continuously monitor environmental conditions and automatically control various processes without human intervention. This not only improves accuracy and efficiency but also reduces labor costs and enhances overall farm management.

In the context of poultry farming, IoT-based monitoring systems can play a crucial role in maintaining optimal environmental conditions. Sensors can be deployed within the poultry shed to measure parameters such as temperature, humidity, gas concentration, and light intensity. These sensors provide real-time data, which is processed by a microcontroller to determine appropriate control actions. For example, if the temperature rises above a certain threshold, ventilation systems such as exhaust fans can be automatically activated to reduce heat levels. Similarly, lighting conditions can be adjusted based on ambient light intensity to ensure proper growth and behavior of poultry birds. The use of automated control systems ensures quick response to environmental changes, thereby minimizing stress and improving bird welfare.

Another important aspect of modern poultry farm management is remote monitoring and control. Farmers may not always be physically present at the farm, especially in large-scale operations or rural areas. Therefore, it is essential to have a system that allows remote access to farm conditions and provides timely alerts in case of abnormal situations. Communication technologies such as GSM (Global System for Mobile Communication) enable the transmission of information through SMS alerts, making it possible to notify farmers about critical conditions such as high temperature or harmful gas levels. This ensures that necessary actions can be taken promptly, even from a remote location. Additionally, cloud-based platforms such as Blynk allow real-time data visualization and control through mobile applications, further enhancing user convenience and system accessibility.

The proposed project, titled “IoT-Based Poultry Farm Monitoring and Control System,” is designed to address the challenges associated with traditional poultry farming practices. The system integrates multiple sensors, including the DHT11 sensor for measuring temperature and humidity, and the MQ135 sensor for detecting harmful gases such as ammonia. These sensors continuously monitor the environmental conditions within the poultry shed and send data to an Arduino Uno microcontroller. The microcontroller processes the data and compares it with predefined threshold values to determine appropriate control actions. Based on the analysis, actuators such as exhaust fans and lighting systems are automatically controlled using relay modules to maintain optimal conditions.

In addition to automated control, the system incorporates a GSM module (SIM800L) to provide real-time communication with the user. Whenever abnormal environmental conditions are detected, the system sends SMS alerts to the farmer, enabling immediate response and corrective action. This feature is particularly beneficial in rural areas where internet connectivity may be limited or unreliable. Furthermore, the system supports cloud integration using the Blynk IoT platform, which allows users to monitor environmental parameters in real time through a mobile application. The cloud platform also enables data storage and analysis, helping farmers make informed decisions based on historical trends.

CHAPTER 2

LITERATURE REVIEW

2.1 IOT-BASED SMART POULTRY FARM MONITORING SYSTEM

TITLE: IoT-Based Smart Poultry Farm Monitoring System

AUTHOR: R. Rahman; M. S. R. Kohinoor; A. A. Sami

DESCRIPTION:

This study presents an IoT-based system for monitoring poultry farm conditions such as temperature, humidity, and air quality using sensors and a microcontroller. The collected data is transmitted to a cloud platform for real-time monitoring and analysis. The system includes automated control features, such as activating ventilation systems when temperature exceeds threshold values, thereby improving environmental stability and reducing manual effort.

The main advantage of this system is real-time monitoring and improved farm management through automation. However, it depends heavily on continuous internet connectivity, which may limit its effectiveness in rural areas. Additionally, the initial setup cost and system complexity can be challenging for small-scale farmers.

2.2 WIRELESS SENSOR NETWORK-BASED POULTRY FARM MONITORING

TITLE : Smart Poultry Farm Monitoring Using Wireless Sensor Networks

AUTHOR: J. P. Mondol; K. R. Mahmud; M. G. Kibria

DESCRIPTION:

This research focuses on the use of wireless sensor networks (WSN) for monitoring environmental conditions in poultry farms. Multiple sensor nodes are deployed across the farm to measure parameters such as temperature, humidity, and gas concentration, and transmit the data wirelessly to a central processing unit. This distributed approach allows efficient coverage of large farm areas and enables real-time monitoring of different zones within the poultry shed.

The system improves accuracy and reduces the need for extensive wiring, making installation easier and more flexible. It also supports data logging for analysis and better decision-making. However, challenges such as signal interference, limited communication range, and energy consumption of sensor nodes can affect performance. Regular maintenance and efficient power management are required to ensure reliable operation, especially in large-scale deployments.

2.3 GSM-BASED POULTRY FARM MONITORING AND ALERT SYSTEM

TITLE: GSM-Based Smart Agriculture Monitoring System

AUTHOR: S. R. Gaddam; K. S. Kumar

DESCRIPTION:

This study introduces a GSM-based monitoring system that provides real-time SMS alerts when environmental parameters exceed predefined limits. The system uses sensors and a microcontroller to monitor conditions and send notifications to the user through a GSM module. This approach is particularly useful for remote and rural areas where internet connectivity is limited or unavailable.

In addition to alert generation, the system can support basic automation by triggering actuators such as fans or alarms based on sensor readings. This reduces manual effort and ensures timely response to critical conditions. The simplicity and low cost of the system make it suitable for small-scale farmers. However, it lacks advanced features such as cloud-based data storage, graphical visualization, and remote control through applications. GSM communication may also introduce slight delays depending on network conditions.

2.4 IOT-BASED SMART AGRICULTURE AND ENVIRONMENTAL MONITORING

TITLE: IoT in Agriculture: Architectures, Protocols, and Applications

AUTHOR: P. Sethi; S. R. Sarangi

DESCRIPTION:

This paper provides an overview of IoT technologies and their applications in agriculture, focusing on real-time monitoring and automation. It explains how sensors, microcontrollers, and cloud platforms can be integrated to collect, process, and analyze environmental data. The use of mobile applications enables farmers to monitor conditions and control systems remotely, improving efficiency and convenience.

IoT-based systems help optimize resource utilization, such as water and energy, and support data-driven decision-making. They also enable continuous monitoring and predictive analysis, which can enhance productivity and reduce operational risks. However, challenges such as high initial cost, system complexity, and dependency on reliable network infrastructure remain significant. Security and data privacy are additional concerns that must be addressed when implementing IoT solutions in agriculture.

CHAPTER 3

SYSTEM IMPLEMENTATION

3.1 EXISTING SYSTEM

Traditional poultry farm management systems are primarily based on manual monitoring and control of environmental conditions. Farmers or workers regularly check parameters such as temperature, humidity, air quality, and lighting using basic instruments. Based on these observations, necessary actions such as switching on exhaust fans, adjusting ventilation, or controlling lighting systems are carried out manually. While this approach may work for small-scale farms, it becomes inefficient and unreliable in larger operations where continuous monitoring is required. The lack of automation increases the workload on farm workers and makes it difficult to maintain consistent environmental conditions throughout the day.

In some cases, semi-automated systems are used, where basic electronic components like thermostats and timers are employed. These systems can perform simple tasks such as activating fans when temperature exceeds a certain level or turning lights on and off at fixed intervals. However, these solutions are limited in scope and typically focus on controlling only one parameter at a time. They do not consider the combined effect of multiple environmental factors, which is crucial for maintaining optimal conditions inside the poultry shed. As a result, environmental imbalances may still occur, affecting the overall health and productivity of poultry birds.

A major limitation of existing systems is the lack of real-time monitoring and data recording capabilities. Environmental conditions are not continuously tracked, making it difficult to identify sudden changes or long-term trends. This absence of data analysis prevents farmers from making informed decisions to improve productivity and maintain consistent farm conditions. Additionally, without historical data, it becomes challenging to analyze patterns and optimize farm operations over time.

Another critical issue is the absence of remote monitoring and alert mechanisms. Farmers must be physically present at the farm to monitor conditions, which is not always possible. During nighttime or emergencies, delays in response can lead to serious consequences such as heat stress, poor ventilation, or accumulation of harmful gases. This can negatively impact bird health and increase mortality rates. Furthermore, unexpected environmental fluctuations may go unnoticed for long periods, causing significant losses.

The existing systems also involve several operational challenges:

- High dependency on manual labor for monitoring and control
- Delayed response to environmental changes
- Lack of integration between different environmental parameters
- No remote access or notification system
- Inconsistent environmental conditions affecting productivity
- Increased risk of human error and misjudgment

Overall, traditional and semi-automated poultry farm systems are not sufficient to meet the demands of modern agriculture. These limitations emphasize the need for a more advanced, automated, and intelligent system that can provide continuous monitoring, quick response, and efficient control of farm conditions. A smarter system can significantly improve farm management, reduce losses, and enhance overall productivity.

3.2 DISADVANTAGES

The existing poultry farm management systems, which are largely based on manual or semi-automated methods, suffer from several limitations that reduce their efficiency and reliability. These systems are highly dependent on human intervention for monitoring and controlling environmental conditions such as temperature, humidity, and air quality. As a result, there is a high possibility of human error, delayed responses, and inconsistent management practices. In large-scale poultry farms, it becomes extremely difficult to continuously monitor all environmental parameters, especially during nighttime or when manpower is limited. The absence of real-time monitoring and automation often leads to unfavorable conditions within the poultry shed, which can negatively impact bird health, growth, and productivity. Furthermore, traditional systems lack the capability to provide timely alerts or remote access, making it challenging for farmers to take immediate action during critical situations.

The major disadvantages of the existing systems are as follows:

- High dependency on manual labor for monitoring and control of environmental parameters
- Lack of continuous real-time monitoring, leading to delayed detection of critical changes
- Increased chances of human error and inaccurate decision-making
- Absence of automated control mechanisms for maintaining optimal conditions
- No remote monitoring or alert system to notify farmers during emergencies
- Difficulty in managing large-scale poultry farms efficiently
- Lack of data storage and analysis for improving long-term farm performance
- Inability to monitor multiple environmental parameters simultaneously
- Poor response time during sudden environmental fluctuations
- Increased risk of bird stress, disease outbreaks, and mortality

Need for Improvement

The limitations of existing systems highlight the urgent need for a more advanced and intelligent solution for poultry farm management. There is a requirement for a system that can continuously monitor environmental parameters in real time and automatically control farm conditions without human intervention. Such a system should integrate multiple sensors to track temperature, humidity, and gas levels simultaneously, ensuring a balanced environment within the poultry shed. Additionally, the system must provide remote monitoring capabilities so that farmers can access real-time data and control the system from any location.

An improved system should also include reliable alert mechanisms to notify users instantly when any parameter exceeds safe limits. The integration of communication technologies such as GSM or IoT platforms can ensure timely alerts and better accessibility. Furthermore, the system should support data storage and analysis, enabling farmers to study environmental trends and make informed decisions for improving productivity. Automation, accuracy, and scalability should be key features of the improved system, making it suitable for both small-scale and large-scale poultry farms.

Overall, there is a strong need to transition from traditional and semi-automated systems to a smart, IoT-based monitoring and control system that can enhance efficiency, reduce manual effort, and ensure optimal conditions for poultry farming.

3.3 PROPOSED SYSTEM

The proposed system, titled “IoT-Based Poultry Farm Monitoring and Control System,” is designed to overcome the limitations of traditional poultry farming methods by introducing automation, real-time monitoring, and intelligent control. The system integrates sensors, a microcontroller, communication modules, and actuators to create a smart environment within the poultry farm. By continuously monitoring key environmental parameters such as temperature, humidity, and gas concentration, the system ensures optimal conditions for poultry

growth and health. The implementation of this system significantly reduces manual effort, enhances accuracy, and improves overall farm productivity.

The system operates based on a closed-loop mechanism where environmental data is continuously collected, analyzed, and used to control various farm operations automatically. This ensures quick response to environmental changes and maintains stable conditions inside the poultry shed.

System Architecture

The overall architecture of the proposed system consists of sensing units, a processing unit, communication modules, and control units. The sensors are placed at appropriate locations within the poultry shed to capture real-time environmental data. These sensors are connected to a central microcontroller, which acts as the brain of the system.

The architecture includes the following components:

- Sensors for temperature, humidity, and gas detection
- Arduino Uno microcontroller for data processing
- GSM module (SIM800L) for communication
- Relay module for controlling electrical devices
- Actuators such as exhaust fans and lighting systems
- Cloud platform (Blynk) for remote monitoring and visualization

The system collects data from sensors and sends it to the microcontroller. The microcontroller processes this data and compares it with predefined threshold values. Based on the analysis, control signals are generated to operate the actuators. Simultaneously, the data is transmitted to the user through GSM alerts and cloud platforms for remote monitoring.

Hardware Design

The hardware design of the proposed system is based on cost-effective and easily available components, making it suitable for practical implementation. The central component of the system is the Arduino Uno microcontroller, which interfaces with all sensors and modules.

The key hardware components used in the system include:

- **DHT11 Sensor:** Measures temperature and humidity inside the poultry shed
- **MQ135 Gas Sensor:** Detects harmful gases such as ammonia that affect bird health
- **SIM800L GSM Module:** Sends SMS alerts to the user during abnormal conditions
- **Relay Module:** Controls high-power devices such as fans and lights
- **Exhaust Fan:** Maintains proper ventilation by reducing heat and gas concentration

- **Lighting System:** Provides appropriate lighting conditions for poultry growth
- **Power Supply Unit:** Provides stable voltage to all components

The hardware components are interconnected in such a way that sensor data flows into the microcontroller, and control signals are sent to actuators through relay modules. Proper circuit design ensures safe and reliable operation of the system.

Working Procedure

The working of the proposed system is based on continuous monitoring and automatic control of environmental parameters. The system operates in the following sequence:

- Sensors continuously monitor temperature, humidity, and gas levels
- The collected data is sent to the Arduino microcontroller
- The microcontroller processes the data and compares it with predefined threshold values
- If any parameter exceeds the safe limit:
 - The relay module is activated
 - Exhaust fans are turned ON to regulate temperature and air quality
 - Lighting system is adjusted if required
- At the same time, the GSM module sends SMS alerts to the user
- Data is also transmitted to the Blynk platform for real-time monitoring
- The system continues this cycle to maintain stable environmental conditions

This automated process ensures quick response to environmental changes and minimizes the need for human intervention. The continuous monitoring and feedback mechanism make the system highly efficient and reliable.

Features of Proposed System

The proposed system offers several advanced features that improve poultry farm management and efficiency:

- Real-time monitoring of environmental parameters
- Automatic control of temperature, humidity, and ventilation
- GSM-based SMS alert system for emergency notifications
- Remote monitoring using Blynk mobile application
- Continuous data collection and visualization
- Low-cost and easy-to-implement design

- Scalable architecture suitable for different farm sizes
- Reduced dependency on manual labor
- Improved accuracy and reliability

These features make the system suitable for modern smart agriculture applications and enhance overall farm performance.

Advantages

The implementation of the proposed system provides numerous advantages over traditional poultry farming methods:

- Ensures optimal environmental conditions for poultry growth
- Reduces manual effort and labor requirements
- Provides faster response to environmental changes
- Minimizes the risk of disease and mortality
- Enables remote monitoring and control
- Improves productivity and efficiency of the farm
- Supports data-driven decision-making
- Cost-effective and suitable for rural areas
- Enhances overall farm management and sustainability

In addition, the system helps farmers maintain consistent environmental conditions, which directly contributes to better bird health and increased production output.

Overall, the proposed IoT-based poultry farm monitoring and control system provides a comprehensive solution to the challenges faced in traditional farming. By integrating sensing, automation, and communication technologies, the system ensures efficient farm management, improved productivity, and sustainable agricultural practices. The flexibility and scalability of the system make it a practical solution for both small-scale and large-scale poultry farms.

Summary

The proposed IoT-Based Poultry Farm Monitoring and Control System automates the monitoring and management of environmental conditions within poultry farms. It uses sensors to continuously measure parameters such as temperature, humidity, and gas levels, and processes the data using an Arduino microcontroller. Based on predefined thresholds, the system automatically controls devices like exhaust fans and lighting to maintain optimal conditions. It also provides real-time alerts through GSM and enables remote monitoring via a cloud platform. This system improves efficiency, reduces manual effort, and enhances overall poultry farm productivity.

3.4 BLOCK DIAGRAM

The block diagram of the proposed IoT-Based Poultry Farm Monitoring and Control System illustrates the overall structure and interaction between various components. It shows how sensors, the microcontroller, communication modules, and actuators are interconnected to perform real-time monitoring and control. The system operates in a closed-loop manner, where environmental data is continuously collected, processed, and used to control farm conditions automatically.

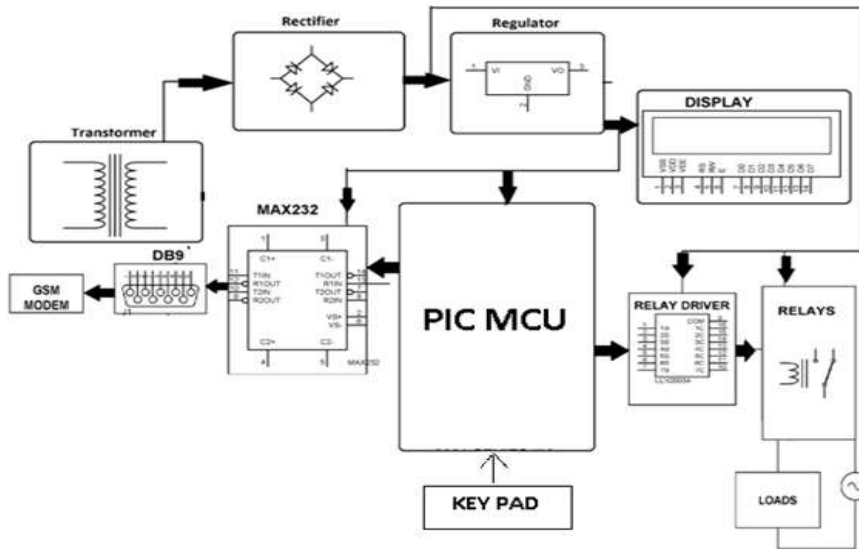


Figure 3.1 Block diagram of Proposed System

The system consists of several key functional blocks:

- Power supply unit
- Microcontroller unit
- Sensor modules
- Communication module (GSM)
- Display unit (optional)
- Relay driver and actuators

Each block plays a crucial role in ensuring efficient operation and maintaining optimal environmental conditions inside the poultry farm.

The **power supply unit** includes a transformer, rectifier, and voltage regulator to provide a stable DC supply to all components. The transformer reduces the input voltage, the rectifier converts AC to DC, and the regulator ensures a constant output voltage required for proper system functioning.

The **microcontroller unit (Arduino Uno)** acts as the central controller of the system. It receives input from sensors, processes the data, and makes decisions based on predefined threshold

values. The processed data is used to control output devices and communicate with external modules such as GSM.

The **sensor modules** are responsible for measuring environmental parameters such as temperature, humidity, and gas concentration. Sensors like DHT11 and MQ135 continuously send real-time data to the microcontroller, enabling accurate monitoring of the poultry farm environment.

The **GSM communication module** allows the system to send SMS alerts to the user when abnormal conditions are detected. This ensures that farmers are informed immediately, even in areas without internet connectivity, allowing quick corrective actions.

The **display unit (LCD)**, if included, shows real-time sensor values and system status. It provides a simple interface for users to monitor environmental conditions directly at the farm.

The **relay driver and actuators** are used to control high-power devices such as exhaust fans and lighting systems. The microcontroller sends signals to the relay driver, which activates the relays to control these devices. This enables automatic regulation of temperature, ventilation, and lighting conditions.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 HARDWARE REQUIREMENTS

The hardware components used in the proposed IoT-Based Poultry Farm Monitoring and Control System are carefully selected to ensure efficient performance, reliability, and cost-effectiveness. These components work together to monitor environmental parameters, process data, and control devices automatically. The hardware design focuses on simplicity, scalability, and ease of implementation, making it suitable for both small-scale and large-scale poultry farms.

The system consists of a microcontroller, sensors, communication modules, control units, and supporting components. Each hardware component plays a specific role in achieving real-time monitoring and automation of farm conditions.

The main hardware components used in the system include:

- Arduino Uno Microcontroller
- DHT11 Temperature and Humidity Sensor
- MQ135 Gas Sensor
- SIM800L GSM Module
- Relay Module
- Exhaust Fan and Lighting System

- Power Supply Unit

4.1.1 Arduino UNO Microcontroller

The Arduino Uno R3 is the main microcontroller used in the IoT-Based Poultry Farm Monitoring and Control System and acts as the central processing unit of the entire setup. It is based on the ATmega328P microcontroller and is widely used in embedded system applications due to its simplicity, flexibility, and reliability. In this project, the Arduino Uno is responsible for receiving input signals from environmental sensors, processing the data, and controlling output devices such as the exhaust fan and lighting system.



Figure 4.1 Arduino UNO R3 Microcontroller Board

The Arduino Uno board consists of 14 digital input/output pins, of which 6 can be used as PWM outputs, and 6 analog input pins. In this system, the sensors such as the MQ135 gas sensor provide analog output signals based on gas concentration, which are read through the analog pins of the Arduino. The Arduino uses its built-in Analog-to-Digital Converter (ADC) to convert these analog signals into digital values for processing. The DHT11 sensor provides digital output for temperature and humidity, which is directly read through a digital pin.

The digital pins of the Arduino are used to interface with output components such as the relay module, which controls devices like the exhaust fan and lighting system. When environmental parameters such as temperature, humidity, or gas levels exceed predefined threshold values, the Arduino sends control signals to activate the relay module. This results in automatic switching ON of the exhaust fan to regulate air quality and temperature inside the poultry farm.

The Arduino Uno operates at a voltage of 5V and can be powered either through a USB connection or an external power supply. It includes a voltage regulator that ensures stable power delivery to the board and connected components. The board runs at a clock speed of 16 MHz, which is sufficient for real-time monitoring and control operations in the system.

One of the key advantages of the Arduino Uno is its ease of programming. It can be programmed using the Arduino Integrated Development Environment (IDE), which supports Embedded C language. The IDE provides a user-friendly interface and various built-in libraries that simplify

coding. In this project, the Arduino is programmed to read sensor data continuously, compare it with threshold values, and control output devices accordingly. It also communicates with the GSM module to send alert messages to the user when abnormal conditions are detected.

The board also includes essential components such as a reset button, USB interface, power jack, crystal oscillator, and ICSP header. The reset button allows the system to restart the program, while the USB interface is used for uploading code and communication. The crystal oscillator ensures accurate timing for the microcontroller operations.

Another important feature of the Arduino Uno is its compatibility with a wide range of sensors and modules. It can easily interface with temperature sensors, humidity sensors, gas sensors, GSM modules, and relay circuits, making it highly suitable for IoT-based monitoring applications. The availability of extensive documentation and community support further enhances its usability.

In the proposed poultry farm system, the Arduino Uno plays a critical role by acting as the brain of the system. It continuously processes environmental data and ensures that appropriate actions are taken to maintain optimal conditions. Its reliability, flexibility, and ease of integration make it an ideal choice for implementing the system.

Overall, the Arduino Uno R3 provides an efficient and effective platform for building the IoT-based poultry monitoring system. Its ability to handle multiple inputs and outputs, combined with fast processing and simple programming, ensures smooth operation and quick response to environmental changes within the poultry farm.

4.1.2 DHT11 Temperature and Humidity Sensor

The DHT11 sensor is used in the proposed system to measure temperature and humidity levels inside the poultry farm. Maintaining proper temperature and humidity is essential for the healthy growth and productivity of poultry birds. Any variation beyond the optimal range can cause stress, reduced feed intake, and increased risk of diseases. The DHT11 sensor provides a simple and reliable solution for continuously monitoring these environmental parameters.

The DHT11 is a digital sensor that combines a temperature sensing component and a humidity sensing component in a single module. It provides calibrated digital output, which can be directly read by the Arduino microcontroller without the need for additional signal processing. This makes it easy to interface and use in embedded systems.

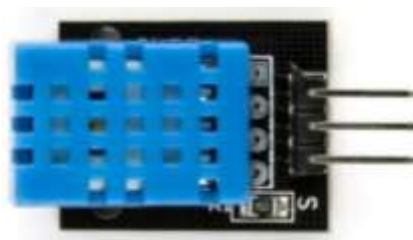


Figure 4.2 DHT11 Temperature and Humidity Sensor

The key features of the DHT11 sensor include:

- Measures temperature and relative humidity
- Temperature range: 0°C to 50°C
- Humidity range: 20% to 90% RH
- Digital output signal
- Low power consumption
- Simple and low-cost design
- Easy interface with microcontrollers

In the proposed system, the DHT11 sensor is placed inside the poultry shed to continuously monitor environmental conditions. It periodically sends temperature and humidity data to the Arduino microcontroller through a digital pin. The microcontroller processes this data and compares it with predefined threshold values. If the temperature or humidity exceeds safe limits, appropriate actions such as activating exhaust fans or adjusting ventilation are triggered automatically.

The DHT11 sensor plays a crucial role in maintaining a comfortable environment for poultry birds. By providing real-time data, it helps in preventing extreme conditions that could negatively affect bird health. The sensor's quick response and reliable performance ensure timely detection of environmental changes.

One of the main advantages of the DHT11 sensor is its ease of use. It requires minimal external components and can be easily integrated with Arduino using available libraries. Although it has moderate accuracy compared to advanced sensors, it is sufficient for practical poultry farm applications where cost-effectiveness is also an important factor.

Overall, the DHT11 temperature and humidity sensor is an essential component of the system, enabling continuous monitoring and helping maintain optimal environmental conditions for improved poultry productivity.

4.1.3 MQ135 Gas Sensor

The MQ135 gas sensor is an important component used in the IoT-Based Poultry Farm Monitoring and Control System for detecting harmful gases present in the poultry environment. In poultry farms, gases such as ammonia, carbon dioxide, and other pollutants are commonly produced due to waste decomposition. High concentrations of these gases can negatively affect the health of poultry birds, leading to respiratory problems, reduced growth, and increased mortality. Therefore, continuous monitoring of air quality is essential for maintaining a safe and healthy environment.



Figure 4.3 MQ135 Gas Sensor

The MQ135 sensor is designed to detect a wide range of gases including ammonia (NH_3), carbon dioxide (CO_2), benzene, smoke, and other harmful substances. It provides an analog output voltage that varies according to the concentration of gases present in the surrounding air. This analog signal is sent to the Arduino Uno microcontroller, where it is converted into digital form using the built-in Analog-to-Digital Converter (ADC) for further processing.

The key features of the MQ135 gas sensor include:

- Detects multiple harmful gases such as ammonia and carbon dioxide
- Provides analog output proportional to gas concentration
- High sensitivity to air quality changes
- Wide detection range
- Long operational life and stable performance
- Suitable for indoor air quality monitoring

In the proposed system, the MQ135 sensor is placed inside the poultry shed to continuously monitor air quality. The sensor detects the presence of harmful gases and sends real-time data to the Arduino microcontroller. The microcontroller compares the sensor readings with predefined threshold values. If the gas concentration exceeds safe limits, the system automatically activates the exhaust fan through the relay module to improve ventilation and reduce gas levels.

In addition to automatic control, the system also sends alert notifications to the user through the GSM module when high gas levels are detected. This ensures that the farmer is informed immediately and can take necessary actions if required. The combination of sensing, automation, and communication helps maintain a healthy environment for poultry birds.

One of the main advantages of the MQ135 sensor is its ability to detect multiple gases using a single device, making it cost-effective and efficient. It is easy to interface with the Arduino microcontroller and does not require complex circuitry. However, the sensor requires proper calibration for accurate readings, and its performance can be affected by environmental factors such as temperature and humidity.

Overall, the MQ135 gas sensor plays a crucial role in ensuring air quality within the poultry farm. By continuously monitoring harmful gases and enabling automatic control actions, it helps in maintaining a safe environment, improving bird health, and enhancing overall farm productivity.

4.1.4 SIM800L GSM Module

The SIM800L GSM module is an essential communication component used in the IoT-Based Poultry Farm Monitoring and Control System. It enables the system to send real-time alerts and notifications to the user through Short Message Service (SMS). This feature is particularly important in poultry farming, as it allows farmers to monitor environmental conditions remotely and take immediate action when abnormal situations occur, even in areas with limited or no internet connectivity.



Figure 4.4 SIM800L GSM Module

The SIM800L is a compact and efficient GSM/GPRS module that supports communication over cellular networks. It operates using a SIM card and communicates with the Arduino Uno microcontroller through serial communication (UART). The module receives commands from the microcontroller and sends SMS alerts to predefined mobile numbers based on environmental conditions.

The key features of the SIM800L GSM module include:

- Supports GSM/GPRS communication
- Enables SMS sending and receiving
- Compact size and low power consumption
- Operates on 3.7V to 4.2V supply
- Serial communication interface (UART)
- Wide network coverage

In the proposed system, the SIM800L module is connected to the Arduino microcontroller using TX and RX pins. The Arduino sends AT commands to the GSM module to control its operation. When the system detects abnormal conditions such as high temperature, excessive humidity, or increased gas levels, the Arduino triggers the GSM module to send an SMS alert to the farmer.

The key features of the relay module include:

- Allows control of high-voltage devices using low-voltage signals
- Provides electrical isolation between microcontroller and load
- Supports both AC and DC loads
- Fast switching operation
- Easy interfacing with Arduino
- Safe and reliable operation

In the proposed system, the relay module is connected to the digital output pins of the Arduino Uno. The microcontroller sends HIGH or LOW signals based on the environmental conditions detected by the sensors. When parameters such as temperature or gas levels exceed the predefined threshold, the Arduino activates the relay module.

The relay then switches ON the exhaust fan to improve ventilation and reduce heat or harmful gas concentration inside the poultry farm. Similarly, the relay can also be used to control the lighting system, ensuring proper illumination conditions for poultry growth. Once the environmental parameters return to safe levels, the relay is deactivated, and the devices are turned OFF automatically.

The relay module plays a crucial role in enabling automation within the system. It ensures that corrective actions are taken instantly without requiring manual intervention. This helps maintain stable environmental conditions and improves overall efficiency.

One of the major advantages of using a relay module is its ability to handle high-power loads safely while protecting the microcontroller from electrical damage. It is easy to install and does not require complex circuitry. However, proper wiring and insulation are necessary to ensure safe operation, especially when dealing with AC loads.

Overall, the relay module acts as a bridge between the control system and physical devices, enabling automatic operation of electrical equipment. Its use in the proposed system enhances reliability, safety, and efficiency in poultry farm management.

4.1.6 Exhaust Fan and Lighting System

The exhaust fan and lighting system are important output components in the IoT-Based Poultry Farm Monitoring and Control System. These components act as actuators that help in maintaining optimal environmental conditions inside the poultry farm. They are automatically controlled by the Arduino microcontroller through the relay module based on real-time sensor data.



Figure 4.6 Exhaust Fan

The **exhaust fan** is used to regulate temperature and air quality within the poultry shed. In poultry farms, heat and harmful gases such as ammonia tend to accumulate due to bird activity and waste decomposition. If not properly controlled, these conditions can negatively affect bird health and productivity. The exhaust fan helps in removing hot air and harmful gases while allowing fresh air to circulate inside the shed.

The **lighting system** is used to maintain proper illumination inside the poultry farm. Adequate lighting is essential for the growth, feeding behavior, and overall well-being of poultry birds. Controlled lighting conditions also help in regulating the biological cycle of birds, which directly influences productivity.

The key features of the exhaust fan and lighting system include:

- Automatic control based on sensor data
- Helps maintain proper temperature and ventilation
- Improves air quality by removing harmful gases
- Ensures optimal lighting conditions for poultry growth
- Reduces manual intervention
- Enhances overall farm efficiency

In the proposed system, the exhaust fan and lighting system are connected to the relay module, which is controlled by the Arduino microcontroller. When the temperature or gas levels exceed predefined threshold values, the microcontroller activates the relay, turning ON the exhaust fan to improve ventilation. Similarly, the lighting system can be controlled based on environmental conditions or predefined timing requirements.

The working process involves continuous monitoring of environmental parameters. The sensors send real-time data to the Arduino, which processes the information and determines whether action is required. If the conditions are not within the safe range, the system automatically switches ON the exhaust fan or adjusts the lighting system. Once the environment returns to normal conditions, the devices are turned OFF automatically.

One of the major advantages of this system is automation, which reduces the need for constant human supervision. It ensures quick response to environmental changes, thereby preventing stress and health issues in poultry birds. Additionally, it improves energy efficiency by operating devices only when required.

However, proper installation and maintenance are necessary to ensure effective operation. The exhaust fan should be positioned to allow efficient airflow, and the lighting system should be designed to provide uniform illumination across the poultry shed.

Overall, the exhaust fan and lighting system play a crucial role in maintaining a controlled environment within the poultry farm. Their integration with the automated system enhances efficiency, improves bird health, and contributes to increased productivity.

4.1.7 Power Supply

The power supply unit is a fundamental component of the IoT-Based Poultry Farm Monitoring and Control System, as it provides the necessary electrical energy required for the proper functioning of all hardware components. A stable and reliable power supply is essential to ensure continuous operation of the system, especially in real-time monitoring applications where interruptions can lead to incorrect readings or system failure.

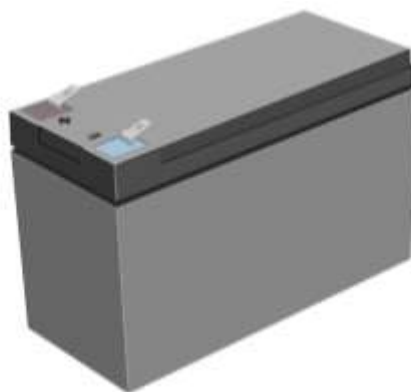


Figure 4.7 Power Supply Battery

The power supply unit is designed to convert the available input power into a regulated DC voltage suitable for electronic components such as the Arduino microcontroller, sensors, GSM module, and relay circuits. Typically, the system uses a step-down transformer to reduce the high-voltage AC input to a lower level, followed by a rectifier circuit to convert AC into DC. A voltage regulator is then used to maintain a constant output voltage, ensuring safe and stable operation of the connected devices.

The key features of the power supply unit include:

- Converts AC power to regulated DC supply
- Provides stable and constant voltage output
- Protects components from voltage fluctuations
- Supports continuous system operation
- Simple and reliable design
- Suitable for embedded system applications

In the proposed system, different components require different voltage levels. The Arduino Uno operates at 5V, while the SIM800L GSM module typically requires around 3.7V to 4.2V. Therefore, the power supply unit must be designed carefully to provide appropriate voltage levels for each component. Voltage regulators or DC-DC converters can be used to achieve this requirement.

The power supply is connected to all modules to ensure smooth functioning of the system. Any fluctuation or instability in power can affect sensor readings, communication, and control operations. Hence, proper filtering components such as capacitors are used to remove noise and maintain a steady output.

One of the key advantages of a well-designed power supply is improved system reliability. It ensures that all components receive the required power without interruption, allowing the system to operate continuously. This is particularly important in poultry farms where constant monitoring is necessary to maintain optimal environmental conditions.

However, improper power supply design can lead to issues such as overheating, voltage drops, or damage to sensitive components. Therefore, careful selection of components and proper circuit design are essential to ensure safety and efficiency.

Overall, the power supply unit plays a vital role in the proposed system by providing a stable and reliable source of energy. It supports the continuous operation of the monitoring and control system, ensuring accurate performance and long-term reliability.

4.2 SOFTWARE REQUIREMENTS

The software components play a crucial role in the implementation of the IoT-Based Poultry Farm Monitoring and Control System. They are responsible for programming the microcontroller, enabling communication between hardware components, and providing an interface for monitoring and control. The software ensures proper data processing, automation, and real-time response to environmental changes.

The system uses a combination of embedded programming and IoT-based platforms to achieve efficient monitoring and control. These software tools are selected based on ease of use, compatibility with hardware components, and reliability in real-time applications.

The main software requirements used in the system include:

- Arduino Integrated Development Environment (IDE)
- Embedded C Programming
- Blynk IoT Platform
- Serial Communication Protocols

The **Arduino IDE** is the primary software used for programming the Arduino Uno microcontroller. It provides a simple and user-friendly interface for writing, compiling, and uploading code to the microcontroller. The IDE supports Embedded C language and includes a wide range of built-in libraries that simplify the integration of sensors, GSM modules, and other components.

Embedded C programming is used to develop the logic required for system operation. The program is written to read sensor data, process it, and compare it with predefined threshold values. Based on these conditions, the microcontroller generates control signals to operate devices such as the exhaust fan and lighting system. It also sends commands to the GSM module to trigger alert messages.

The **Blynk IoT platform** is used for remote monitoring and visualization of environmental parameters. It allows users to view real-time data such as temperature, humidity, and gas levels through a mobile application. The platform provides a graphical interface with dashboards, making it easier for users to understand system status and performance.

Serial communication protocols are used for communication between the Arduino microcontroller and external modules such as the GSM module. The Arduino uses UART communication to send AT commands to the SIM800L module for sending SMS alerts. This ensures reliable and efficient data transmission between components.

The software works in coordination with the hardware to perform the following functions:

- Continuous monitoring of sensor data
- Data processing and threshold comparison
- Automatic control of actuators
- Sending alert notifications to users
- Displaying real-time data on IoT platforms

One of the major advantages of the software design is its simplicity and flexibility. The system can be easily modified or upgraded by updating the program code. Additional features such as more sensors or advanced analytics can be integrated without major changes to the existing system.

However, proper programming and testing are essential to ensure accurate performance. Errors in code or communication may lead to incorrect system behavior. Therefore, debugging and validation are important steps in the development process.

Overall, the software requirements provide the intelligence and control necessary for the system to function effectively. They enable automation, real-time monitoring, and communication, making the proposed system efficient and user-friendly.

4.2.1 Arduino IDE

The embedded software layer forms the core control unit of the proposed IoT-Based Poultry Farm Monitoring and Control System. While IoT platforms like Blynk are used for visualization and remote monitoring, the device-side intelligence is implemented using Embedded C programming through the Arduino Integrated Development Environment (IDE). This software is responsible for handling hardware components such as the Arduino Uno microcontroller, DHT11 sensor, MQ135 gas sensor, GSM module, relay module, and actuators like exhaust fans and lighting systems. It ensures continuous environmental monitoring, automatic control, and real-time alert generation.

Embedded programming enables direct interaction with hardware components and provides real-time execution with minimal delay. Since the system must respond quickly to environmental changes such as temperature rise or gas accumulation, a lightweight and efficient programming approach is essential. Embedded C is chosen due to its speed, reliability, and low memory usage. The Arduino IDE simplifies development by offering a user-friendly platform for coding, compiling, debugging, and uploading programs to the microcontroller.

Role of Embedded Software in the System

The embedded software acts as the brain of the system, coordinating all hardware components and operations. It continuously reads sensor data, processes environmental conditions, and controls actuators automatically.

The main responsibilities of the embedded program include:

- Reading temperature and humidity from the DHT11 sensor
- Monitoring gas levels using the MQ135 sensor
- Comparing sensor values with predefined threshold limits
- Controlling exhaust fan and lighting system through relay module
- Sending alert messages using GSM module
- Updating data to IoT platform for monitoring
- Managing overall system operation and stability

By integrating these functions, the system operates autonomously and maintains optimal environmental conditions without constant human supervision.

Arduino IDE Development Environment

The Arduino IDE is an open-source software platform used for developing microcontroller-based applications. It provides a simple interface that supports writing, compiling, and uploading code directly to the Arduino board. The IDE supports Embedded C/C++ programming and includes various built-in libraries that simplify integration with sensors and communication modules.

The development environment offers features such as syntax highlighting, serial monitor, debugging tools, and library management. These features help in testing the system and identifying errors during development. Libraries for sensors like DHT11 and modules like GSM reduce coding complexity and improve system reliability.

Another advantage of the Arduino IDE is its cross-platform compatibility, as it can run on Windows, Linux, and macOS. The simple structure of the code also makes it easy to modify or upgrade the system in the future.

Embedded C Programming Structure

The program for the poultry monitoring system is written using Embedded C and is structured into two main sections: setup and loop.

The setup section initializes all hardware components such as sensors, GSM module, relay module, and serial communication. It runs only once when the system is powered ON.

The loop section executes continuously. It reads sensor values, checks environmental conditions, and performs control actions based on predefined logic. This continuous execution ensures real-time monitoring and response.

Modular programming is used to improve code readability and maintainability. Separate functions are created for sensor reading, decision-making, communication, and control operations, making the system easy to debug and extend.

GPIO and Peripheral Interfacing

The Arduino Uno provides multiple General Purpose Input/Output (GPIO) pins for connecting external components. These pins are configured as input or output based on the application.

Input pins are used to read data from sensors such as DHT11 and MQ135. Output pins are used to control the relay module, which in turn operates devices like exhaust fans and lights. Serial communication pins (TX/RX) are used to interface with the GSM module.

Proper configuration of GPIO pins ensures smooth data flow and reliable operation of the system.

Sensor Data Acquisition

The embedded program continuously reads data from the DHT11 and MQ135 sensors. The DHT11 provides digital values for temperature and humidity, while the MQ135 provides analog signals representing gas concentration.

The Arduino processes these values and converts them into meaningful data. The readings are compared with predefined threshold values to determine whether the environment is safe or requires corrective action.

This continuous monitoring ensures accurate detection of environmental changes within the poultry farm.

GSM Communication Handling

The embedded software controls the SIM800L GSM module to send alert messages to the user. Communication is carried out using AT commands through serial communication.

When abnormal conditions such as high temperature or gas levels are detected, the system generates an alert message and sends it to the farmer. The message includes information about the detected condition, enabling quick action.

Error-handling mechanisms are included to ensure reliable message delivery, even under weak network conditions.

Automatic Control Mechanism

The system uses threshold-based logic to control actuators automatically. When sensor values exceed safe limits, the Arduino activates the relay module to turn ON the exhaust fan or adjust the lighting system.

Once the environmental conditions return to normal, the system automatically switches OFF the devices. This ensures energy efficiency and reduces manual intervention.

Power and System Management

The embedded program ensures stable operation of the system by managing all components efficiently. Although the Arduino does not have advanced sleep modes like ESP32, efficient coding practices help in reducing unnecessary processing and improving performance.

The system is designed to run continuously, ensuring uninterrupted monitoring and control of environmental conditions.

System Workflow

The overall working of the embedded program follows a continuous cycle. When the system is powered ON, all components are initialized. The sensors continuously monitor environmental parameters and send data to the Arduino. The microcontroller processes this data and compares

it with threshold values. If any abnormal condition is detected, appropriate actions such as activating fans or sending alerts are performed.

This workflow ensures real-time monitoring, quick response, and efficient control of the poultry farm environment.

4.2.2 Blynk IoT Platform

The Blynk IoT platform is used in the proposed IoT-Based Poultry Farm Monitoring and Control System for real-time monitoring and visualization of environmental parameters. It provides a user-friendly mobile application interface that allows farmers to access system data remotely and monitor the condition of the poultry farm from anywhere. The integration of Blynk enhances the system by adding IoT capabilities, making it more efficient and convenient to use.

Blynk is a cloud-based platform that connects hardware devices such as Arduino with mobile applications through the internet. It enables communication between the system and the user by transmitting sensor data to the cloud and displaying it on a dashboard. This allows users to observe real-time values such as temperature, humidity, and gas levels in an organized and graphical format.

Role of Blynk in the System

The Blynk platform acts as a bridge between the hardware system and the user interface. It collects data from the microcontroller and displays it on the mobile application.

The main functions of Blynk in the system include:

- Displaying real-time sensor data (temperature, humidity, gas levels)
- Providing a graphical dashboard for easy monitoring
- Enabling remote access to system information
- Allowing users to track environmental conditions continuously
- Supporting notifications and alerts (if configured)
- Enhancing user interaction with the system

By providing these features, Blynk simplifies monitoring and improves user convenience.

Working of Blynk Platform

The Blynk platform operates by connecting the Arduino system to a cloud server using an internet interface such as Wi-Fi. The sensor data collected by the Arduino is transmitted to the Blynk cloud, where it is processed and displayed on the mobile application.

The working process includes the following steps:

- Sensors collect environmental data from the poultry farm

- Arduino processes the data and sends it to the Blynk server
- The Blynk cloud stores and updates the data in real time
- The mobile application retrieves and displays the data on dashboards
- The user monitors system status remotely

This continuous data flow ensures real-time visibility of farm conditions.

Blynk Mobile Application

The Blynk mobile application provides a customizable dashboard where users can add widgets such as gauges, graphs, and value displays. These widgets are used to visualize sensor data in an easy-to-understand format.

Features of the Blynk mobile application include:

- Real-time data display using graphs and indicators
- Customizable user interface
- Easy setup and configuration
- Remote monitoring capability
- Support for multiple devices

The application allows farmers to quickly identify changes in environmental conditions and take necessary actions.

Advantages of Using Blynk

The use of the Blynk platform offers several advantages:

- Enables real-time remote monitoring
- Provides a simple and interactive user interface
- Reduces the need for physical presence at the farm
- Improves decision-making through continuous data access
- Easy integration with Arduino and other microcontrollers
- Supports scalability for future system expansion

4.2.3 Embedded C

Embedded C is the primary programming language used in the development of the IoT-Based Poultry Farm Monitoring and Control System. It is a specialized version of the C programming language designed for programming embedded systems and microcontrollers. In this project, Embedded C is used to write the firmware that controls the Arduino Uno microcontroller and manages all hardware operations.

Embedded C enables direct interaction with hardware components such as sensors, communication modules, and actuators. It provides efficient execution with minimal memory usage, making it suitable for real-time applications like environmental monitoring. Since the system requires continuous data processing and immediate response to changing conditions, Embedded C is an ideal choice due to its speed, reliability, and low-level hardware control capabilities.

Role of Embedded C in the System

The Embedded C program acts as the core logic of the system. It controls the overall functioning of the hardware and ensures smooth coordination between different components.

The main responsibilities of Embedded C programming include:

- Reading data from DHT11 temperature and humidity sensor
- Acquiring gas level data from MQ135 sensor
- Converting analog signals into digital values using ADC
- Comparing sensor values with predefined threshold limits
- Controlling relay module to operate exhaust fan and lighting system
- Sending commands to GSM module for alert notifications
- Managing system flow and continuous monitoring

Program Structure

The Embedded C program is organized into two main sections:

- **Initialization (Setup Section):**
 - This section runs once when the system is powered ON. It initializes all components such as sensors, serial communication, and input/output pins.
- **Execution (Loop Section):**
 - This section runs continuously. It reads sensor values, processes the data, checks conditions, and performs necessary control actions.

This structure ensures real-time monitoring and continuous operation of the system.

Sensor Data Processing

The embedded code continuously reads input data from sensors. The DHT11 sensor provides digital values for temperature and humidity, while the MQ135 sensor provides analog output corresponding to gas concentration.

The Arduino converts the analog signals into digital values using its built-in ADC. These values are then processed and compared with predefined threshold levels to determine whether the environment is safe or requires corrective action.

Control Logic Implementation

The system uses conditional statements (such as if-else) to implement decision-making logic. When sensor values exceed safe limits:

- The relay module is activated
- Exhaust fan is turned ON to improve ventilation
- Lighting system is adjusted if required
- GSM module is triggered to send alert messages

Once the conditions return to normal, the system automatically switches OFF the devices.

CHAPTER 5 CONNECTIONS

The connections in the IoT-Based Poultry Farm Monitoring and Control System represent the physical interfacing of all hardware components required for system operation. Proper connections are essential to ensure accurate data transfer, reliable communication, and safe functioning of the system. Instead of a circuit diagram, the system connections are described in a structured manner for better understanding and implementation.

The Arduino Uno microcontroller acts as the central unit to which all sensors, communication modules, and output devices are connected. Each component is interfaced using appropriate input/output pins based on its functionality.

The main connections in the system include:

- DHT11 sensor connected to a digital input pin of Arduino
- MQ135 gas sensor connected to an analog input pin
- SIM800L GSM module connected through serial communication (TX/RX)
- Relay module connected to digital output pins
- Exhaust fan and lighting system connected via relay module
- Power supply connected to all components

The **DHT11 temperature and humidity sensor** is connected to one of the digital pins of the Arduino. It provides digital output, which is read directly by the microcontroller to monitor environmental conditions inside the poultry farm.

The **MQ135 gas sensor** is connected to an analog input pin of the Arduino. It produces an analog voltage based on gas concentration, which is converted into digital values using the Arduino's built-in Analog-to-Digital Converter (ADC).

The **SIM800L GSM module** is interfaced with the Arduino using serial communication. The TX pin of the GSM module is connected to the RX pin of the Arduino, and the RX pin is connected to the TX pin of the Arduino. This allows the microcontroller to send AT commands and transmit alert messages to the user.

The **relay module** is connected to the digital output pins of the Arduino. It acts as a switching device that enables the microcontroller to control high-power devices safely.

The **exhaust fan and lighting system** are connected through the relay module. When environmental parameters exceed predefined limits, the Arduino activates the relay to turn ON the fan for ventilation and control lighting conditions. Once the environment returns to normal, the devices are turned OFF automatically.

The **power supply unit** provides the required voltage to all components. The Arduino operates at 5V, while the GSM module requires a lower voltage; therefore, proper voltage regulation is ensured. All components are connected to a common ground to maintain stable operation.

Overall, the connections in the system are designed to be simple, efficient, and reliable. Proper wiring and secure connections ensure smooth data flow and effective system performance, making the system suitable for practical implementation in poultry farms.

5.1 EXPLANATION

The **DHT11 temperature and humidity sensor** is connected to one of the digital input pins of the Arduino. It sends digital data representing temperature and humidity values, which are read by the microcontroller for processing.

The **MQ135 gas sensor** is connected to an analog input pin of the Arduino. It outputs analog voltage based on gas concentration, which is converted into digital values using the Arduino's ADC for further analysis.

The **SIM800L GSM module** is connected to the Arduino using serial communication. The TX pin of the GSM module is connected to the RX pin of the Arduino, and the RX pin of the module is connected to the TX pin of the Arduino. This allows the microcontroller to send AT commands and transmit alert messages.

The **relay module** is connected to the digital output pins of the Arduino. It acts as a switch to control high-power devices. When the Arduino sends a signal, the relay activates and turns ON or OFF the connected devices.

The **exhaust fan and lighting system** are connected to the relay module. These devices are automatically controlled based on environmental conditions. When temperature or gas levels exceed safe limits, the fan is turned ON, and lighting is adjusted accordingly.

The **power supply unit** provides the required voltage to all components. The Arduino operates at 5V, while the GSM module requires a lower voltage, so proper regulation is ensured. All components share a common ground to maintain stable operation.

5.2 HARDWARE KIT

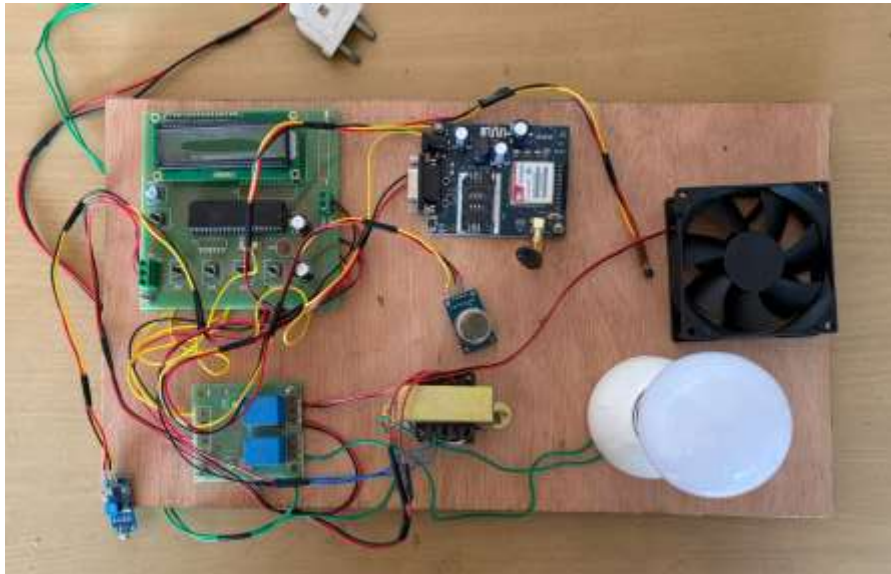


Figure 5.1 Hardware Kit

The hardware kit of the IoT-Based Poultry Farm Monitoring and Control System consists of all the physical components required to implement the system. It includes sensors, processing units, communication modules, control devices, and supporting components that work together to monitor and regulate environmental conditions within the poultry farm. The hardware kit is designed to be compact, cost-effective, and easy to assemble, making it suitable for practical deployment.

The components in the hardware kit are carefully selected to ensure reliable performance and efficient operation. Each component plays a specific role in sensing, processing, communication, and control, forming a complete integrated system.

The hardware kit includes the following components:

- Arduino Uno Microcontroller
- DHT11 Temperature and Humidity Sensor
- MQ135 Gas Sensor
- SIM800L GSM Module
- Relay Module
- Exhaust Fan
- Lighting System (LED/Bulb)

- Power Supply Unit
- Breadboard and Connecting Wires

The **Arduino Uno microcontroller** serves as the core component of the kit, controlling all operations and coordinating communication between sensors and actuators. The **DHT11 sensor** is used to measure temperature and humidity, while the **MQ135 sensor** detects harmful gases such as ammonia and carbon dioxide.

The **SIM800L GSM module** enables communication by sending alert messages to the user when abnormal conditions are detected. The **relay module** acts as a switching device to control high-power components like the exhaust fan and lighting system.

The **exhaust fan** is used to maintain proper ventilation and regulate temperature and air quality, while the **lighting system** ensures suitable illumination for poultry growth. The **power supply unit** provides stable voltage to all components, ensuring uninterrupted system operation.

The breadboard and connecting wires are used for assembling the circuit and establishing connections between components. They provide flexibility for testing and modifications during development.

The hardware kit is assembled in a systematic manner to ensure proper functioning and safety. All components are connected based on the circuit diagram, and care is taken to maintain proper voltage levels and secure connections. Proper insulation and arrangement of components help in avoiding short circuits and ensuring long-term reliability.

Overall, the hardware kit forms the foundation of the proposed system, enabling real-time monitoring, automatic control, and efficient management of poultry farm conditions. Its simple design and use of readily available components make it practical for real-world implementation.

CHAPTER 6

RESULTS AND DISCUSSION

Temperature and Humidity Monitoring Results

The temperature and humidity monitoring system was tested under different environmental conditions to evaluate its accuracy and performance. The DHT11 sensor was used to continuously measure temperature and humidity inside the poultry farm. The sensor readings were processed by the Arduino microcontroller and displayed through the system interface. The objective of this test was to verify whether the system can maintain optimal environmental conditions required for poultry health.

During the testing phase, the system was observed over different time intervals, including morning, afternoon, and evening conditions. The readings obtained from the sensor were compared with standard reference values to ensure accuracy. The system successfully monitored

variations in temperature and humidity and responded accordingly by activating the exhaust fan when required.

The following table shows the observed temperature and humidity values along with system response:

Table 6.1 Temperature and Humidity Monitoring Results

S. No	Time	Temperature (°C)	Humidity (%)	Threshold Status	System Action
1	Morning	26	60	Normal	No Action
2	Noon	34	55	High Temperature	Fan Activated
3	Afternoon	36	50	High Temperature	Fan Activated
4	Evening	29	65	Normal	No Action
5	Night	24	70	Normal	No Action

From the results, it is observed that the system effectively detects temperature variations and activates the exhaust fan when the temperature exceeds the predefined threshold. The humidity levels were also maintained within acceptable limits, ensuring a comfortable environment for poultry birds.

The system demonstrated reliable performance in maintaining environmental stability. The automatic control mechanism reduced the need for manual intervention and ensured timely response to changing conditions. This helps in preventing heat stress and improving overall poultry productivity.

GAS DETECTION AND ALERT RESPONSE TIME

The gas detection system was tested to evaluate its ability to detect harmful gases and respond quickly. The MQ135 gas sensor was used to monitor air quality inside the poultry farm. The sensor detects gases such as ammonia and carbon dioxide, which are commonly present due to waste accumulation.

During testing, different levels of gas concentration were simulated, and the response of the system was observed. The Arduino microcontroller continuously monitored the sensor values and compared them with predefined threshold levels. When the gas concentration exceeded the

safe limit, the system activated the exhaust fan and sent an alert message to the user through the GSM module.

The following table shows the gas detection results and system response time:

Table 6.2 Gas Detection and Alert Response Time

S. No	Gas Level (ppm)	Threshold Status	Fan Activation Time (sec)	SMS Alert Time (sec)	System Response
1	150	Normal	-	-	No Action
2	250	Moderate	2	5	Alert + Fan ON
3	350	High	1	4	Immediate Action
4	400	Very High	1	3	Rapid Response
5	200	Normal	-	-	No Action

From the results, it is evident that the system can quickly detect harmful gas levels and respond efficiently. The exhaust fan is activated within a few seconds, and alert messages are sent promptly to the user. This ensures that corrective action can be taken immediately, reducing the risk of health issues in poultry birds.

The response time of the system is minimal, which is a critical factor in preventing hazardous conditions. The GSM module effectively delivers alerts, ensuring that the farmer is informed in real time. The integration of gas sensing and alert mechanisms enhances the overall safety and reliability of the system.

Overall Discussion

The results demonstrate that the proposed system performs effectively in real-time monitoring and control of environmental conditions. The combination of temperature, humidity, and gas monitoring ensures a comprehensive solution for poultry farm management.

The system provides the following benefits:

- Accurate monitoring of environmental parameters
- Quick response to abnormal conditions
- Reduced manual effort and human error
- Improved safety and productivity
- Reliable communication through GSM alerts

The experimental results confirm that the system is capable of maintaining optimal conditions within the poultry farm. It ensures a stable environment, which is essential for the health and growth of poultry birds.

CHAPTER 7 CONCLUSION AND FUTURE SCOPE

Conclusion

The IoT-Based Poultry Farm Monitoring and Control System has been successfully designed and implemented to address the challenges faced in maintaining optimal environmental conditions in poultry farming. The system integrates sensors, microcontroller, communication modules, and control devices to provide an automated and efficient solution for monitoring temperature, humidity, and gas levels.

The use of the DHT11 sensor and MQ135 gas sensor enables continuous monitoring of environmental parameters, while the Arduino Uno microcontroller processes the data and controls the system accordingly. The integration of the relay module allows automatic operation of the exhaust fan and lighting system, ensuring proper ventilation and suitable conditions for poultry growth. Additionally, the GSM module provides real-time alert notifications to the user, enabling quick response to abnormal situations.

The system has demonstrated reliable performance during testing. It effectively detects variations in environmental conditions and takes appropriate actions without the need for manual intervention. The results show that the system can maintain a stable and healthy environment within the poultry farm, which is essential for improving poultry productivity and reducing risks.

One of the key advantages of the proposed system is its simplicity and cost-effectiveness. The use of easily available components and straightforward design makes it suitable for small and medium-scale poultry farms. The system also reduces labor effort and enhances efficiency through automation.

Overall, the project successfully achieves its objectives by providing a smart, reliable, and automated solution for poultry farm monitoring. It contributes to modern farming practices by integrating IoT technology and improving farm management.

Future Scope

Although the proposed system performs effectively, there are several opportunities for further improvement and enhancement. Future developments can focus on increasing system efficiency, scalability, and functionality.

Some possible future enhancements include:

- Integration of advanced sensors with higher accuracy for better monitoring
- Implementation of a mobile application with enhanced user interface
- Use of Wi-Fi or cloud-based systems for real-time data storage and analytics
- Addition of automated feeding and water management systems
- Implementation of machine learning algorithms for predictive analysis
- Solar-powered system for energy efficiency and sustainability
- Expansion of the system for large-scale poultry farms
- Integration of camera systems for visual monitoring

Future improvements can also include better data visualization and remote control features, allowing users to manage the system more effectively. The addition of cloud storage can help in maintaining historical data, which can be used for analysis and decision-making.

By incorporating these enhancements, the system can be transformed into a fully smart poultry farm management solution. This will further improve productivity, reduce operational costs, and ensure better health and safety for poultry birds.

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