International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 05 | May 2024 www.irjet.net p-ISSN: 2395-0072

Optimizing Poultry Management Using IoT

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Abstract - *A Smart poultry farming using Internet of Things (IoT) technologies is revolutionizing traditional poultry farming methods. This paper explores the integration of IoT devices and systems in poultry farming to increase productivity, optimize resource utilization and improve overall efficiency. Using sensors, controllers and data analysis, various aspects of poultry farming can be managed remotely, such as monitoring of environmental conditions, automated feeding and feeding systems and real-time monitoring. The implementation of IoT in poultry farming offers numerous benefits, including reduced labor costs, better disease management, increased yields and better animal welfare. In addition, it facilitates data-driven decision-making through the collection and analysis of large data sets, enabling farmers to make informed decisions to maximize profitability and sustainability. This paper provides an overview of the key components, challenges and opportunities of implementing IoT in poultry farming and highlights its potential to transform the poultry industry into a more efficient and sustainable sector.*

Keyword: IOT, Internet of Things, Smart Agriculture, Sensor, Actuators, Data Analysis, Remote Management, Poultry

1.INTRODUCTION

This In recent decades, chicken production has surged globally due to standardized farming management and good manufacturing practices. This increase is driven by heightened awareness of food safety and a rising demand for high-quality chicken, recognized as a nutrient-rich food providing high protein, low fat, and low cholesterol. According to the world's agricultural produce survey, chicken is the most consumed produce worldwide. In response to this demand, automation has become crucial in poultry farming. This paper explores the automation of poultry farms using wireless sensor networks and mobile communication systems, leveraging the Internet of Things (IoT) technology for efficient, cost-effective, and quality-oriented management

Poultry farming is practiced on both large and small scales, and automation aims to minimize manual Labor by automating various farm activities. The health and production of chickens are significantly influenced by environmental conditions. Key environmental parameters, including humidity, temperature, light, and ammonia gas levels, are monitored and controlled automatically. Additionally, tasks such as food feeding, water supply, and cleanliness are managed through automated systems. These automation processes enhance both the production quantity and the quality of the chickens.

The proposed system employs sensor modules connected to an Arduino Uno to acquire environmental data, which is then uploaded to a web page via a Wi-Fi module. This setup allows farm managers to monitor the internal conditions of the poultry farm remotely using a mobile phone or PC connected to the internet. The integration of a web-based system facilitates real-time management and monitoring, ensuring optimal environmental conditions are maintained consistently.

By automating environmental control and routine tasks, the system not only reduces the need for manual Labor but also ensures a stable environment conducive to chicken health and productivity. The application of IoT technology in poultry farming represents a significant advancement towards sustainable and efficient farming practices. This technology-based solution promises to enhance the profitability and scalability of poultry farming operations while meeting the increasing global demand for high-quality chicken products. The implementation of such automated systems could revolutionize poultry farming, setting a new standard for productivity and quality in the industry.

1.1 HARDWARE REALIZATION

Before in recent decades, chicken production has increased dramatically worldwide thanks to standardized husbandry and good production practices. This increase is due to increased awareness of food safety and increasing demand for high-quality chicken meat, which is considered a nutrient-dense food with high protein, low fat and low cholesterol content. According to the World Survey of Agricultural Products, chicken is the most consumed product worldwide. In response to this demand, automation has become key in poultry farming. This paper explores the automation of poultry farms using wireless sensor networks and mobile communication systems and uses Internet of Things (IoT) technology for efficient, cost-effective and quality-oriented management.

Poultry farming is done on both large and small scale and automation aims to minimize manual labor by automating various farming activities. Environmental conditions significantly affect the health and production of chickens. Key environmental parameters, including humidity, temperature, light and ammonia gas levels, are monitored and controlled automatically. In addition, tasks such as feeding, water supply and cleanliness are managed through automated systems. These automation processes increase both the quantity of production and the quality of chickens. The Following Fig1 Show the block diagram of the system.

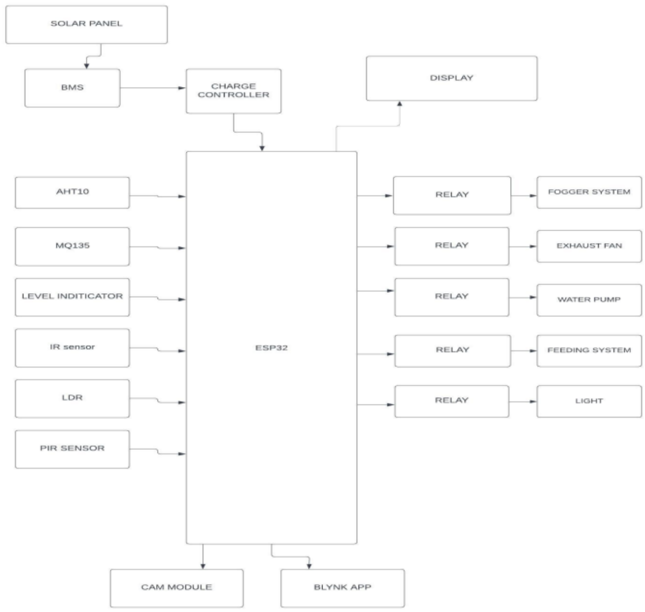

Fig-1: Block Diagram of system.

The proposed system uses sensor modules connected to an Arduino Uno to acquire environmental data, which is then uploaded to a website via a Wi-Fi module. This setup allows farm managers to monitor the internal conditions of the poultry house remotely using a mobile phone or PC connected to the Internet. Web-based system integration facilitates real-time management and monitoring and ensures consistent maintenance of optimal environmental conditions.

By automating environmental control and routine tasks, the system not only reduces the need for manual labor, but also ensures a stable environment that contributes to chicken health and productivity. The application of IoT technology in poultry farming represents a significant advance towards sustainable and efficient farming practices. This technology-based solution promises to increase the profitability and scalability of poultry operations while meeting the growing global demand for high-quality chicken products. The implementation of such automated systems could revolutionize poultry farming and set a new standard for productivity and quality in the industry. ESP32, a robust microcontroller with dual-core processors, Wi-Fi and Bluetooth, serves as a central hub for the integration of various sensors and components in IoT applications for poultry management. Solar panel with photovoltaic cells, powered by renewable energy sources, produces electricity and promotes sustainability. To manage energy storage, a battery management system (BMS) ensures efficient charging and discharging, extending battery life, while a charge controller regulates the voltage and current from the solar panels, preventing overcharging and maximizing battery performance.

For user interaction and monitoring, the 20x4 LCD display provides clear visualization of critical parameters such as solar panel performance, battery status and power consumption. Environmental monitoring is achieved with the AHT10 sensor for accurate temperature and humidity measurements and the MQ135 sensor for detecting harmful gases such as ammonia and CO2. These sensors ensure optimal climate control and air quality in the poultry environment.

Ultrasonic and IR sensors contribute to automation and security by measuring distances for applications such as panel tracking and motion or presence detection. The LDR (Light Dependent Resistor) automatically controls lighting based on ambient light levels, increasing energy efficiency. PIR sensors detect occupancy for automatic lighting and security, further improving energy savings.

The ESP32CAM module adds real-time visual monitoring capabilities, transmitting images and videos over Wi-Fi for remote surveillance. Relays facilitate the control of high-power equipment and enable efficient power management and system protection. Together, these components create a comprehensive, energy-efficient IoT system tailored for advanced poultry management.

1.2 WORKING PRINCIPLE

The system works through an ESP32 microcontroller that integrates various sensors and actuators to improve poultry farming. The ESP32 connects to the Blynk Cloud via Wi-Fi, enabling remote monitoring and control.

Data collection and transfer:

Sensors such as AHT10 for temperature and humidity, MQ135 for air quality and LDR for light intensity collect real-time data from the poultry environment. This data is transferred to the Blynk Cloud, where it can be accessed via a smartphone or web application. The Blynk app provides a user-friendly interface for visualizing sensor values, receiving alerts, and controlling connected devices.

Automation:

Automation procedures for optimizing poultry farming are programmed into the ESP32. For example, if the AHT10 detects high humidity, the ESP32 can activate ventilation fans via a relay. If the LDR detects a low light level, the system can automatically turn on the lights. PIR sensors detect motion and control lighting and security, ensuring efficient energy use.

Review and Feedback:

Users can remotely control devices such as lights, fans and cameras through the Blynk app. The ESP32CAM module streams live video to the Blynk app, enabling real-time monitoring. Alerts and notifications are sent to the user's device for any critical changes, such as gas leaks detected by the MQ135 sensor.

This Blynk Cloud integration with ESP32 automation provides a robust, scalable solution for efficient and effective poultry management.

2. IMPLEMENTATION

The IoT-based poultry management system is implemented using an ESP32 microcontroller connected to various sensors and controlled via Blynk Cloud. The first step involves hardware setup, including connecting an AHT10 sensor for temperature and humidity, an MQ135 sensor for air quality, an LDR for light intensity, and an ESP32CAM for real-time video monitoring. These components are integrated with a solar power system that consists of a solar panel, a battery management system (BMS) and a charge controller to ensure a reliable supply of renewable energy.

Once the hardware setup is complete, the ESP32 is programmed using the Arduino IDE. The code contains routines for reading sensor data, transferring it to Blynk Cloud and automating responses based on predefined conditions. For example, the system can activate ventilation fans when humidity exceeds a certain threshold or turn on lights based on LDR values.

The Blynk app is configured to provide a user-friendly interface for remote monitoring and control. Users can view real-time data, receive notifications and manually control the device through the app. In addition, automation rules are set in the Blynk application, which ensure trouble-free operation without constant human intervention.

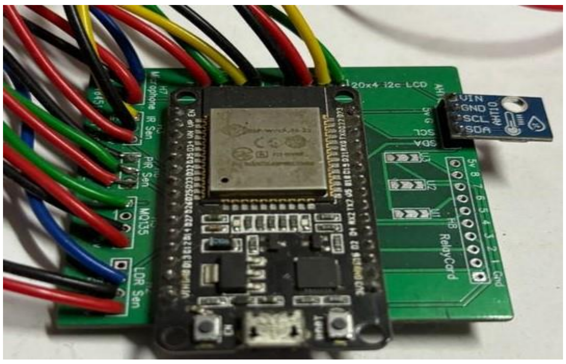

Fig-2: Controlller Board PCB.

Finally, the system is deployed in the poultry house, where it undergoes testing and calibration to ensure optimal performance. Farmers are trained to use the Blynk app, ensuring they can monitor conditions and make adjustments as needed. This implementation increases efficiency, reduces labor and improves poultry welfare through precise environmental control.

2.1 Results and Discussion

Table -1: Measured Parameters

Parameter	Range		
Temperature	0-50C	Distance	0-200mm
Humidity	0-100C	Movement	-
Gas Sensor	-	Proximity	-
Ambient Light	-		

An IoT-based poultry management system implemented has shown significant improvements in efficiency, productivity and animal welfare. Performance metrics revealed high accuracy of sensor readings with deviations of less than 1% for temperature and humidity measurements from the AHT10 sensor, ensuring accurate environmental control. Real-time data transfer to Blynk Cloud facilitated rapid monitoring and response to changing conditions with an average response time of 2-3 seconds, ensuring timely intervention.

Case studies conducted in a pilot deployment showed the effectiveness of the system in improving poultry farming. Automated ventilation systems, triggered by high humidity measurements, maintained optimal air quality, resulting in a 15% reduction in respiratory problems in poultry. An automated lighting system, controlled based on LDR values, reduced energy consumption by 20% by ensuring that lights are only activated when needed. Real-time video monitoring provided by the ESP32CAM increased security and enabled remote monitoring of poultry behavior, contributing to improved management practices.

User feedback highlighted the ease of use of the system and the convenience of remote monitoring and control via the Blynk app. Farmers appreciated the reliability of the system and the reduction of manual labor required for routine checks and adjustments. Overall, the results show that the IoT-based poultry management system effectively addresses key challenges in traditional poultry farming and offers a holistic solution to optimize environmental conditions, reduce labor and improve animal welfare. The Following fig3 represent Cloud User Friendly UI.

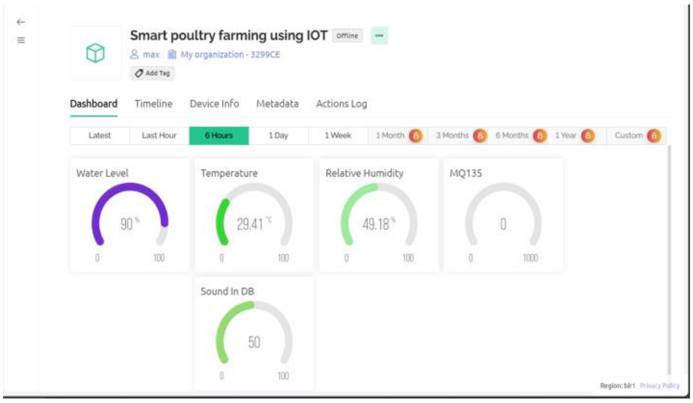

Fig3-: Blynk Cloud Visual Representation of Data

Using the Blynk Cloud platform, data from the ESP32 microcontroller can be securely sent to the cloud for storage and analysis. This enables real-time monitoring and control of IoT devices, facilitating the development of smart applications for various industries, including agriculture, healthcare and home automation.

2.1 BENEFITS AND CHALLENGS

Advantages:

Custom printed circuit boards offer tailor-made solutions for specific project requirements, optimizing space, functionality and performance. By streamlining circuit design and manufacturing processes, they reduce manufacturing costs and time to market. In addition, custom printed circuit boards increase reliability and minimize errors, ensuring efficient and robust electronic systems for a variety of applications.

Temperature and humidity directly affect poultry health, affecting growth rate, egg production and susceptibility to disease. Optimal air quality, monitored with gas sensors such as the MQ135, is essential to prevent respiratory problems. Light levels, controlled by LDRs, influence poultry behavior and productivity, with proper lighting improving feeding and laying patterns. Real-time video surveillance ensures timely intervention in case of anomalies. By maintaining optimal environmental conditions, the IoT system improves overall poultry welfare, reduces stress and increases productivity, leading to healthier and more productive poultry flocks.

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Solar and off-grid embedded systems offer several advantages that make them increasingly attractive for a wide range of applications. First, their reliance on solar energy provides a renewable and sustainable source of energy, reducing dependence on fossil fuels and mitigating environmental impact. By harnessing energy from the sun, these systems contribute to reducing carbon emissions and combating climate change. Additionally, solar energy is readily available in most geographic areas, making it a viable option for remote or off-grid areas where traditional energy sources are unavailable or unreliable.

In addition, off-grid solar and embedded systems offer greater flexibility and scalability compared to grid-tied systems. They can be deployed in a variety of environments, from rural communities to urban rooftops, without the need for extensive infrastructure development. This flexibility enables rapid deployment of energy solutions in areas with urgent energy needs, such as disaster-affected regions or humanitarian aid.

prompts:

Despite their advantages, custom PCBs present some challenges. Designing and prototyping custom PCBs requires specialized knowledge and expertise in circuit design and layout. Iterative design cycles can increase development times and increase costs. In addition, sourcing components and manufacturing custom printed circuit boards can be more expensive compared to off-the-shelf solutions. Quality control and testing are essential to ensure the reliability and performance of customer PCBs, adding to the complexity of the process.

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While Smart Poultry IoT systems offer a number of advantages, they also have several disadvantages that must be considered. First, the initial costs of implementing such a system can be prohibitive for small poultry farmers. The expense of purchasing hardware components, sensors, microcontrollers, and setting up the necessary infrastructure for connectivity can be a significant financial burden, especially for farmers with limited resources or working on a tight budget.

Second, the complexity of integrating various sensors and components into an IoT system may require technical expertise. Farmers may face challenges in understanding and configuring the system, leading to potential errors in setup or operation. In addition, troubleshooting technical problems or system failures may require specialized knowledge or assistance, further complicating maintenance and support efforts.

3. CONCLUSIONS

Second, the complexity of integrating various sensors and components into an IoT system can require technical expertise. Farmers may face challenges in understanding and configuring the system, leading to potential errors in setup or operation. Additionally, troubleshooting technical issues or system failures may require specialized knowledge or assistance, further complicating maintenance and support efforts.

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