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IoT based Smart Poultry Farm Monitoring System

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Abstract - This project focuses on improving poultry farming efficiency by creating a smart monitoring and automation system that ensures optimal environmental conditions and reduces manual intervention. The system integrates a camera module with real-time video streaming and disease detection capabilities to identify abnormalities in poultry. A Raspberry Pi-based IoT system monitors critical parameters such as temperature, humidity, and ammonia levels using appropriate sensors. It also automates food and water dispensing using servo motors and DC motors, ensuring timely nourishment. A web-based interface provides real-time feedback on environmental conditions and system performance, enhancing user convenience and allowing remote monitoring. The system's automated responses help maintain ideal conditions, reducing poultry mortality and improving overall farm productivity. By combining IoT and machine learning, the solution enhances farm management, promotes animal welfare, and maximizes resource efficiency. This approach aligns with global efforts to optimize agricultural practices through smart technologies, ensuring sustainable poultry farming.
***Key Words*:** Food Waste Reduction, Smart Food Hubs, Iot based systems, Web based Platform, Servo motors, Weight sensors.

1.INTRODUCTION

Ensuring proper environmental conditions and poultry health is vital in modern farming to reduce mortality rates and enhance productivity. This project introduces a smart poultry farming system that leverages IoT and automation to monitor environmental factors, detect diseases, and automate key farm operations efficiently.

The system involves a centralized setup where environmental parameters such as temperature, humidity, and ammonia levels are continuously monitored. To prevent potential issues, a camera module powered by Raspberry Pi is used for real-time disease detection and surveillance. Food and water distribution is automated using servo motors and DC motors, ensuring that poultry receive timely nourishment.

Additionally, a web-based interface provides real-time updates on farm conditions, enabling remote monitoring and immediate alerts for abnormal situations. Administrators receive notifications regarding changes in environmental parameters and system performance, ensuring timely intervention. Through the integration of IoT, automation, and real-time analytics, this solution improves farm management, enhances animal welfare, and supports sustainable poultry farming practices, aligning with global agricultural advancements.

2. METHODOLOGY

The proposed smart poultry farming system aims to enhance farm management by ensuring optimal environmental control, automating essential operations, and enabling real-time monitoring using IoT and image processing technologies. The system consists of three main components: an environmental monitoring unit, an automated food and water dispensing mechanism, and a web-based control interface. By integrating these technologies, the system ensures improved poultry

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welfare, prevents disease outbreaks, and boosts overall farm productivity.

1.Camera Module: The Raspberry Pi Camera Module is a compact, high-resolution camera designed specifically for Raspberry Pi boards to capture photos and videos. It connects to the Raspberry Pi's CSI (Camera Serial Interface) port using a ribbon cable. The module features an image sensor that detects light and converts it into digital signals. These signals are processed by the Raspberry Pi's GPU (Graphics Processing Unit), enabling efficient image and video processing.

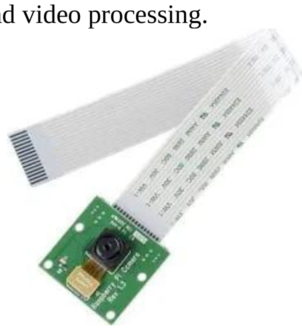

Fig -1: Camera Module

2.Raspberry Pi: Raspberry Pi is a small, affordable, single-board computer designed for embedded systems, education, and prototyping. It features an ARM-based processor with memory and storage managed through a microSD card. The device runs an operating system like Raspberry Pi OS, allowing user interaction through a connected display, keyboard, or remotely via SSH. Equipped with USB ports, HDMI output, Wi-Fi, Bluetooth, and GPIO pins, it supports various peripherals and sensors, making it ideal for IoT, robotics, and automation projects.

Fig -2: Raspberry Pi

3.Temperature Sensor: A temperature sensor operates by detecting changes in temperature and converting them into an electrical signal for processing. It typically uses a thermistor, thermocouple, or semiconductor-based component that alters its resistance or voltage based on the surrounding temperature. This change is then converted into an analog signal, which is processed by an analog-to-digital converter (ADC) to generate accurate temperature readings. The data can be used to regulate environmental conditions effectively.

Fig-3: Temperature Sensor

4.Mechanical Servo: A servo motor, also known as a mechanical servo, is an electromechanical device designed for precise control of angular or linear motion. It comprises a DC or AC motor, a control circuit, a position sensor (usually a potentiometer), and a feedback mechanism to ensure accurate positioning and motion control.

Fig-4: Servo Motor

5.Gas Sensor: A gas sensor detects and measures the concentration of gases in the surrounding environment. It works by identifying changes in gas levels and converting them into an electrical signal for further processing. In poultry farms, gas sensors play a vital role in monitoring harmful gases like ammonia, ensuring a safe and healthy environment for the birds. The system responds to elevated gas levels by triggering corrective actions, preventing hazardous conditions and maintaining optimal air quality in the farm.

Fig-5: Gas Sensor

6.DC Motor: A DC motor is an electromechanical device that converts direct current (DC) electrical energy into mechanical motion. In the poultry farming system, the DC motor is used to automate food and water dispensing by controlling the movement of dispensers. When triggered by the Raspberry Pi, the motor operates to ensure timely and consistent supply to the poultry. This automation reduces manual labor, maintains a regular feeding schedule, and ensures that the birds receive adequate nourishment at appropriate intervals, contributing to improved growth and health. The motor's efficiency in controlling the dispenser mechanism enhances system reliability and reduces operational errors, ensuring seamless farm management.

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Fig-6: Gas Sensor

In this project, the servo motor automates the feeding system by controlling the opening and closing of dispensers to ensure consistent food and water supply for poultry. A camera module integrated with the Raspberry Pi monitors poultry health through real-time video analysis. The captured images are processed to detect abnormalities or diseases. Based on environmental data, the Raspberry Pi sends a signal to the servo motor, allowing precise operation of the dispensers.

A camera module is integrated with the Raspberry Pi to monitor poultry health through real-time video analysis. The captured images are processed to detect abnormalities or diseases. The system enhances poultry farm management by ensuring optimal conditions, reducing mortality, and improving overall productivity.

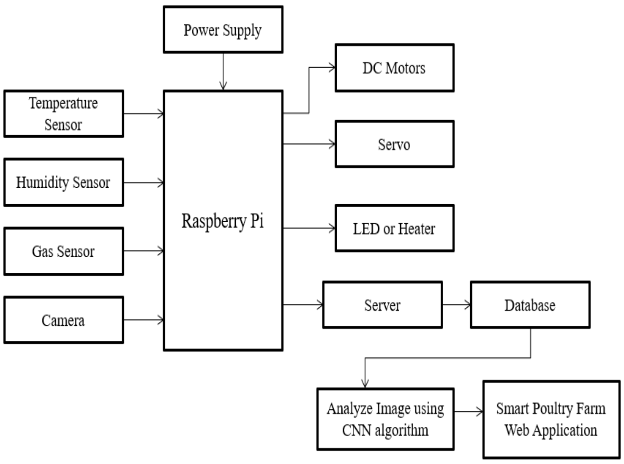

Fig-5: Block Diagram

It runs on a Raspberry Pi, serving as the CPU, managing disease detection, environmental monitoring, and servo motor control. The camera module captures real-time video streams to detect abnormalities in poultry, ensuring prompt intervention. The servo motor automates food and water dispensing, ensuring consistent nourishment.

A web-based platform, developed using HTML, CSS, and JavaScript, displays real-time data on environmental conditions and system performance. All monitored data, including disease detection results and dispenser status, are stored in a cloud database (Firebase/AWS) for real-time updates and remote monitoring. The platform enhances accessibility by allowing users to remotely track poultry health and receive instant notifications of system anomalies or maintenance requirements. It helps administrators monitor the farm’s condition effectively and ensures that the environment remains optimal for poultry.

3. RESULTS AND DISCUSSIONS

The smart poultry farming system was successfully implemented using a Raspberry Pi, a camera module, and a servo motor. The system efficiently managed automated feeding and watering by integrating real-time monitoring and disease detection. The web platform provided accurate updates on environmental conditions and system performance, ensuring optimal farm management.

The Raspberry Pi camera module captured real-time video streams to monitor poultry health and detect abnormalities. The disease detection model achieved an 80% success rate in identifying affected birds, allowing timely intervention. System performance was evaluated based on detection accuracy and response time, with improvements made to enhance reliability in different lighting conditions. The servo motor automated the food and water dispensers, ensuring consistent nourishment. The platform’s real-time monitoring and alert system helped administrators maintain a healthy environment, ensuring the welfare of poultry while reducing manual labor and operational inefficiencies.

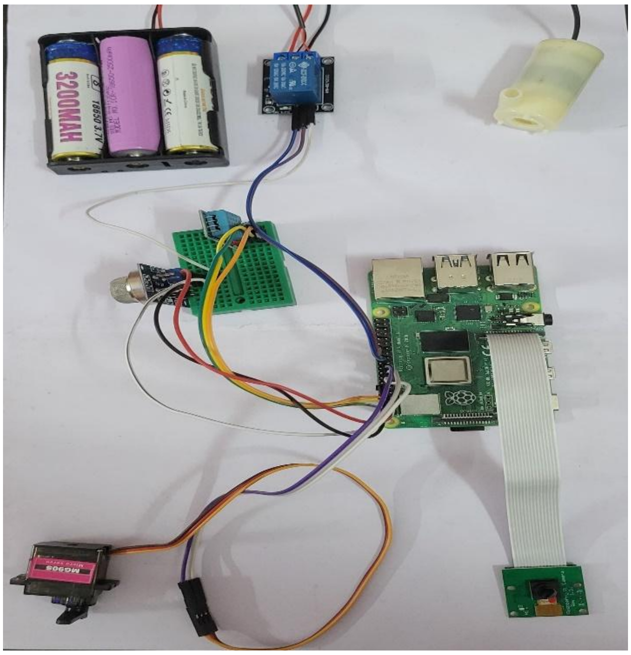

Fig-6: System Setup

The system consistently monitored environmental factors like temperature and humidity with an error margin of ±8%, enabling real-time updates through the web platform. Users and administrators could remotely

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track and analyze environmental parameters, ensuring effective control and maintenance of optimal farm conditions. By integrating sensor data with the web interface, the system enhanced decision-making, reduced manual oversight, and minimized risks of disease or environmental stress. Real-time updates improved poultry welfare, operational efficiency, and overall farm productivity by allowing timely adjustments and preventive measures to address changing environmental conditions effectively.

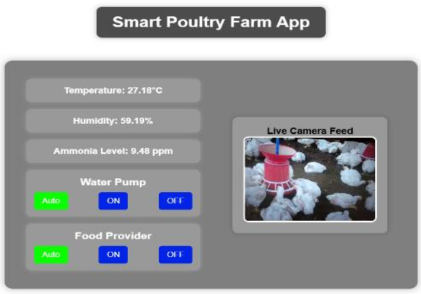

Fig-7: Web Application

The web application efficiently provided real-time updates on environmental conditions and system performance in the poultry farm. Users could easily monitor temperature, humidity, and dispenser status remotely. Alerts for abnormal conditions allowed administrators to take timely corrective actions, ensuring optimal farm management. However, occasional delays in data updates were observed due to network connectivity issues. Future improvements will focus on optimizing data transmission, enhancing system responsiveness, and ensuring seamless real-time monitoring and control.

4. CONCLUSION

This paper presents a smart poultry farming system based on Raspberry Pi, a camera module, various sensors, and a servo motor to automate environmental monitoring, disease detection, and food and water dispensing. The system integrates real-time video analysis for disease identification, sensor data for environmental monitoring, and a web platform for remote tracking and management. Experimental results validate that the system effectively detects abnormalities in poultry, maintains optimal environmental conditions, and automates essential farm operations, ensuring improved poultry welfare and farm efficiency.

5.FUTURE WORK

The proposed smart poultry farming system has already shown great potential in automating farm management, enhancing disease detection, and ensuring optimal environmental conditions. However, several enhancements can be implemented to improve its efficiency, scalability, and reliability. Future developments will focus on improving disease detection accuracy, optimizing dispenser control, strengthening data management, and integrating renewable energy sources.

One of the most critical areas for improvement is the accuracy of disease detection. Although the current system effectively identifies abnormalities, variations in lighting conditions, camera angles, or subtle changes in poultry appearance can affect detection accuracy. Future versions will incorporate advanced deep learning models to enhance detection reliability and robustness. Additionally, integrating thermal imaging with real-time video analysis can improve accuracy in identifying diseases and abnormal behaviors. As a backup system, RFID or weight-based tracking can be employed to ensure accurate monitoring and management of poultry health.

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