Electronics Design of an Automated Surveillance and Control System for Aviaries

Farjad Khan[1], Rimsha Ali[1], Bilal Haider[2], Iqra Perveen[3], Abdul Samad Danish[3], Agha Muhammad Yar Khan[4]

[1] Department of Computer Engineering, HITEC University Taxila
[2] Department of Mechanical Engineering, HITEC University Taxila
[3] Department of Computer Science, HITEC University Taxila
[4] Department of Software Engineering, HITEC University Taxila

Abstract- Advancements in technology have recently led to increased automation and management of bird houses in poultry farming, with the goal of improving efficiency and welfare. The automated bird house system is created by employing an ESP32 microcontroller and a range of sensors. The system monitors and controls essential variables like as feeding, watering, temperature, humidity, rain detection, lighting, and general surveillance. An automated feeding device dispenses feed at predetermined intervals, guaranteeing that birds receive consistent and regulated nourishment. Likewise, a watering system regulates water levels by utilizing sensors and the ESP32. The ESP32 and a DHT11 sensor are utilized to manage temperature and humidity, making necessary adjustments to heating or cooling systems. A rain sensing module triggers precautionary steps during adverse weather conditions, while an autonomous lighting system adapts illumination intensities to replicate natural cycles. The ESP32-CAM module enables remote monitoring through live video streams that can be accessed via a mobile application or online interface. To summarize, this project showcases the efficacy of the ESP32 microcontroller and sensors in the automation and surveillance of bird houses. Poultry growers can advance sustainable and profitable bird farming operations by effectively controlling important factors, allowing for remote management. This can lead to increased output, decreased labor costs, improved bird welfare, and overall enhanced efficiency.

Index Terms- Automation, ESP32 Control System, Bird Welfare Monitoring, Sustainable Farming

I. Introduction

Each year, millions of birds are bred for meat and eggs, making the poultry business a key global economic sector. Farmers strive to enhance their operations to fulfill the growing demand for chicken products. Automation of monitoring and control systems has substantially improved poultry farming [1]. Bird farming utilizes automated monitoring and control systems to maintain shed conditions including temperature, humidity, ventilation, and lighting. These systems aim to enhance bird health and welfare by mimicking their natural habitat. The adoption of automated systems is increasing due to their numerous benefits [2]. One major benefit of automated monitoring and control methods is their ability to promptly identify and resolve issues. Real-time data on bird health and well-being helps farmers spot difficulties and avert undesirable effects. A shift in temperature or humidity can signal a ventilation issue, leading to poor air quality and danger to birds. Automated monitoring systems can help farmers identify and resolve issues before they escalate [3]. Automated monitoring and control can improve avian welfare. Birds are highly sensitive to their environment, which directly affects their overall health. Farmers can improve bird health by mimicking their natural habitat by managing temperature, humidity, and lighting [4]. The Food and Agriculture Organization of the United Nations studied the importance of automated monitoring and control techniques to reduce avian mortality and disease prevalence [5]. These systems play a critical role in improving the health and wellbeing of birds. Bird farming, sometimes known as poultry farming, involves raising birds for various purposes, including meat or egg production. It plays a vital role in the agricultural sector and supplies the world's chicken product need. Chickens, turkeys, ducks, and geese are common farm birds [20]. Raising birds has evolved over time due to advancements in technology and farming techniques. It is today a specialized and efficient company providing nutritious meat and eggs to meet the needs of the growing global population [20]. Achieving production efficiency, animal care, and farmer profitability are essential objectives in bird farming. Modern bird farming emphasizes optimal nutrition, living conditions, disease prevention, and management systems to achieve goals [21]. Commercial bird farming includes breed selection, hatchery operations, brooding, growth, egg production, and meat processing. To ensure birds' health, development, and well-being, each stage requires constant monitoring and supervision [22]. Recent technological breakthroughs have changed bird farming. Automation and automated systems enhance efficiency, output, and animal care. Farmers can remotely monitor and manage temperature, humidity, lighting, ventilation, and feeding systems using automated monitoring and control mechanisms. Innovating in farm management can optimize output, reduce overhead, and improve overall management [24]. The growing demand for eco-friendly and sustainable farming practices has led to the introduction of alternative strategies including organic farming and free-range systems. These methods prioritize animal comfort, reduce pharmaceutical and poison use, and promote natural avian behavior. Sustainable bird husbandry is crucial for meeting the global demand for chicken products. We will continue to develop, adopt new technologies, and implement new methods to maintain ethical and effective production while keeping animal welfare standards. In conclusion, global meat and egg production is vital to the agriculture industry. To meet demand for chicken products, the industry prioritizes efficient production, animal care, and sustainable practices through technology advancements and agricultural changes.

II. Literature Review

Recent years have seen a surge in interest in automated bird monitoring and control systems in poultry production. These devices allow farmers to remotely monitor and manage bird shed conditions such as temperature, humidity, ventilation, and lighting. Technology breakthroughs like IoT, sensors, and AI have enabled this. The combination of these technologies has led to greater bird care, efficiency, and lower operational costs for farmers. Remote monitoring of bird shed conditions is a major benefit of automated monitoring and control systems. Farmers may monitor temperature and humidity levels in real-time to maintain optimal conditions for bird health and productivity. Automated systems can alter shed characteristics to offer a suitable environment for birds, especially in adverse weather situations. Monitoring systems can inform farmers of any deviations from intended conditions, enabling them to take rapid action to correct the issue. Several research have examined the application of IoT-based monitoring and control systems in chicken farming. A study [6] indicated that IoT-based solutions enhanced growth rates, feed conversion ratios, and reduced death rates in broiler chickens. Automation has a positive impact on bird health and overall performance. Automatic control systems are essential for maintaining optimal conditions in bird sheds, in addition to monitoring. AI algorithms have been used to create intelligent ventilation control systems for layer houses, utilizing real-time sensor data to adjust ventilation rates based on factors like temperature, humidity, and bird density [7]. The deployment of these technologies has led to increased ventilation efficiency and energy savings, promoting sustainable and cost-effective chicken production. Another important feature of automated monitoring and control systems is automated lighting. Bird behavior, production, and welfare depend on proper lighting. Research indicates that automated lighting schemes significantly affect bird performance. A study [8] found that automated lighting systems enhanced egg output and reduced stress in laying hens. Automation of lighting cycles promotes consistent and optimal light exposure for birds, enhancing their health and productivity. Machine learning algorithms have been used to develop adaptive lighting systems that adapt to birds' behavior and needs, improving performance [9]. Farmers can gain significant insights into bird health and behavior through automated monitoring and control systems. Analyzing real-time environmental and avian behavior data can detect anomalies or indicators of distress. In research [10], an IoT-based monitoring system gave farmers real-time updates on temperature, humidity, and bird activity. This provided early diagnosis of anomalous behavior or environmental conditions, enabling farmers to address health hazards or welfare concerns promptly. Although automated monitoring and control technologies have clear benefits for bird farming, they also present limitations and obstacles. To implement these systems, initial investment is needed in hardware, sensors, and networking infrastructure. Farmers face technical problems in integrating and guaranteeing compatibility of various technology. Automated systems require regular maintenance, calibration, and troubleshooting to ensure dependable and accurate operation. Farmers require proper training to efficiently use and analyze the system's data. The introduction of automated monitoring and control technologies has transformed the bird farming sector. These devices allow farmers to remotely monitor and manage parameters, resulting in greater bird welfare, increased productivity, and lower operational costs. The use of IoT, sensors, and AI has enabled farmers to access real-time data on environmental conditions, bird behavior, and performance, enabling educated decisions and rapid problem resolution. Though challenging to install, automated monitoring and control systems offer considerable benefits for bird farming operations, making them a crucial tool for sustainable and efficient poultry production. Modern technology, scientific research, and an emphasis on sustainability and animal welfare have revolutionized poultry farming. The chicken production revolution has led to enhanced productivity, efficiency, and bird welfare, while also changing old methods. This post will analyze the key elements of the revolution and its impact on chicken farming. Automation and technology have revolutionized poultry farming by integrating them into production processes. Automated technologies have altered chicken farm management by controlling feeding, watering, temperature, ventilation, and lighting. These systems use complex algorithms, sensors, microcontrollers, and microprocessors to monitor and control critical elements for optimal bird environment. Automated feeders now give accurate volumes of feed at predetermined times, replacing manual feeders in feeding systems. The birds' food is regulated and consistent, reducing the need for manual feeding. Automated feeders can administer feed formulations at certain growth stages, promoting healthy development and maximizing feed efficiency. Significant advances in watering systems, including automatic dispensers, ensure consistent bird water delivery. These devices monitor water levels and replenish as needed, preventing dehydration and shortages. Access to clean, readily available water is essential for avian health, digestion, and overall well-being. Automated climate control methods enhance temperature accuracy and efficiency. These programs adjust ventilation, heating, and cooling based on temperature and humidity conditions in the chicken house. This creates a comfortable and optimal environment for birds regardless of the weather outside. To maintain air quality and prevent ammonia buildup in chicken houses, ventilation systems are crucial. Automated ventilation systems monitor air quality and adjust fan speeds and airflow patterns for optimal ventilation. Improved respiratory health reduces the risk of illnesses associated to poor air quality. Lighting systems have also improved. Farmers may mimic natural day-night cycles and adjust lighting intensity as needed. Controller-programmable LED lights. A well-lit habitat promotes feeding, avian activity, and egg production in laying hens. The revolution in chicken farming includes data-driven decision-making using advanced analytics and machine learning algorithms. Farmers collect and analyze data on bird health, performance, and environment. This data-driven system enables proactive management, early problem identification, and targeted interventions, leading to greater output and efficiency. The poultry farming sector is changing across the supply chain, not only during production. RFID-based traceability systems can follow birds from hatchery to market, ensuring transparency and quality control. Improved storage, transportation, and shelf life of chicken products have led to less waste and fresher products. The revolution in chicken farming has had profound effects on both producers and consumers. By utilizing automated technologies and data-driven management, farmers may boost output, reduce labor expenses, and enhance animal care. Consumers benefit from a reliable supply of high-quality, secure, and responsibly produced poultry products. In conclusion, automation, technology, and data-driven management have transformed chicken farming. Modern poultry producers may enhance efficiency, productivity, and animal welfare using automated feeding, watering, temperature management, lighting, and data analytics.2.3 Farming Issues The poultry industry is complex and faced with many issues. Problems may arise from disease outbreaks, biosecurity concerns, environmental sustainability, animal welfare, and market demands. This article will discuss main issues faced by poultry farmers and possible solutions. Outbreaks of disease One major challenge in chicken production is the risk of disease outbreaks. Diseases like avian influenza, Newcastle disease, and infectious bronchitis can rapidly spread within flocks, leading to high mortality and financial losses. Controlling and preventing disease outbreaks requires strict biosecurity measures, including controlled access, cleaning procedures, and vaccination campaigns. Effective infection control on poultry farms requires regular monitoring, early diagnosis, and prompt reaction to indicators of illness. Maintaining high biosecurity standards is crucial to prevent disease introduction and spread. Biosecurity measures include restricting farm access, cleaning equipment, separating age groups, and ensuring proper waste disposal. Farm staff and visitors must be instructed on biosecurity protocols to prevent disease spread. Additionally, using monitoring measures and participating in disease monitoring initiatives can help identify and manage biosecurity issues. Environmental Sustainability: Poultry farming may impact the environment through waste generation, greenhouse gas emissions, and water/air pollution. Managing and mitigating these effects is crucial for the industry's long-term success. Poultry farms can minimize environmental impact by employing eco-friendly techniques like waste management, water conservation, and renewable energy. Sustainable chicken production can benefit from sustainable feed supply, feed efficiency optimization, and reduced antibiotic and chemical usage. Protecting bird welfare is a key ethical and consumer-driven concern. Poultry farmers face challenges in providing adequate room, ventilation, clean water, feed, and disease prevention. To solve bird welfare issues, farmers might use housing solutions including free-range or enriched cage systems. To increase animal welfare in poultry farms, recommended techniques include optimum lighting, temperature control, encouraging natural behavior, and monitoring bird behavior and health. The poultry industry must adapt to shifting consumer preferences and market expectations. Consumers are increasingly concerned about food production, animal care, and antibiotic/hormone use. Ensuring transparency, correct labeling, and quality standards are essential for meeting these needs. Introducing new product categories, such as organic or antibiotic-free options, might target certain consumer groups. Poultry farmers can better adapt production methods to consumer desires by cooperating with merchants and staying abreast of market changes. Challenges economically: In the competitive poultry farming industry, producers face challenges such as uncertain markets, rising production costs, and shifting feed prices. Implementing efficient manufacturing methods, boosting feed conversion rates, and using economical technology helps mitigate these challenges. Stability and fair market value for chicken products can be accomplished through strategic partnerships with suppliers, processors, and retailers. In summary, poultry farming faces challenges such disease outbreaks, biosecurity concerns, environmental sustainability, animal welfare, and evolving customer demands. Addressing these concerns requires a holistic approach that includes biosecurity controls, eco-friendly production methods, animal welfare, market knowledge, and financial efficiency. Collaboration between industry players, research institutes, and government agencies is essential for developing and implementing innovative ideas for the long-term viability and sustainability of chicken farming.

III. Methodology

In order to monitor and manage the environment that is present within the bird shed, the Automated Monitoring and Controlled Mechanism for Birds is comprised of a number of various components that are connected to one another. These components are designed to fulfill the purpose of monitoring and controlling the environment. These components include sensors that monitor temperature, humidity, and other environmental factors. The ESP32 Microcontroller, which serves as the central processing unit, is also included in this group of components. In addition, the ESP32 Microcontroller is accountable for the transmission of commands and the collection of data from the sensors. An additional component of the system is automatic lighting, which entails the adjustment of LED lights in line with the light levels that are measured by an LDR sensor. This is done in order to ensure consistency throughout the system. In addition, an automated watering system makes use of a water pump in order to regulate the amount of water that is present in the system. A monitoring camera that is activated by an ESP32-CAM module enables the user to remotely watch the shed. This allows the user to keep an eye on the shed from a distance. This allows the user to view content in real time. A web interface or a mobile application can be used to access the user interface, which makes it possible to perform real-time data monitoring and remote management of the environment of the shed. Both of these chances are made available by the user interface. To summarize, the purpose of an alarm system is to provide the user with notification in the event that there is a departure from the environmental criteria that have been defined. When these integrated components are brought together, they provide a regulated and automated habitat for the birds. This not only enhances the birds' well-being, but it also adds to increased productivity in chicken farming. In order to achieve this goal, it is necessary to effectively manage environmental elements such as temperature, humidity, and illumination.

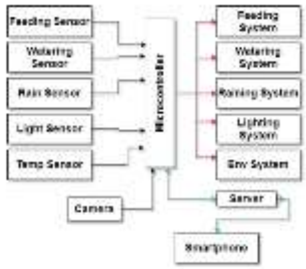

Figure 1 Block Diagram

In the illustration of the system architecture of the automated and controlled bird shed that makes use of ESP32 technology. This architecture incorporates a wide variety of components and subsystems that work together to monitor and control the environment of the shed. The ESP32 microcontroller is the major control unit that is responsible for data processing, actuator control, and communication with sensors and other external devices. It is located at the center of the architecture and serves as the principal control unit. There are a number of sensors that are needed for environmental monitoring and control that are included in the Sensors Subsystem. These sensors include the Temperature and Humidity Sensor, the Light Sensor, and the Rain Sensor. These sensors give data that is necessary for regulating temperature, humidity, lighting conditions, and responding to rainfall. Ventilation, Heating, Cooling, Lighting, and Watering are some of the systems that are included in the Actuator Subsystem. Each of these systems is responsible for performing a certain activity in order to guarantee that the circumstances within the shed are optimal. Utilizing platforms such as Blynk or MQTT for real-time data transmission and control, the Communication Subsystem makes it possible for the ESP32 to interface with cloud services, mobile applications, and remote monitoring systems. This is made possible by the Communication Subsystem's ability to support communication by Ethernet or Wi-Fi. All of the system's components receive the direct current (DC) power that they require from the Power Supply subsystem. Users have the option to get notifications, make adjustments to settings, and remotely monitor and modify shed parameters through the User Interface, which includes both a mobile application and a web dashboard. Last but not least, the Data Storage and Analysis subsystem makes use of cloud storage to store sensor data and monitoring logs. This makes it possible to do subsequent analysis and historical tracking. Additionally, data analytics tools make it possible to visualize and analyze the shed environment in order to detect patterns, trends, and abnormalities. Individually, these integrated components and subsystems come together to form a robust and complex system architecture. This architecture ensures effective monitoring, control, and management of the environment within the bird shed, which in turn improves the welfare of the birds and maximizes the production of poultry farming.

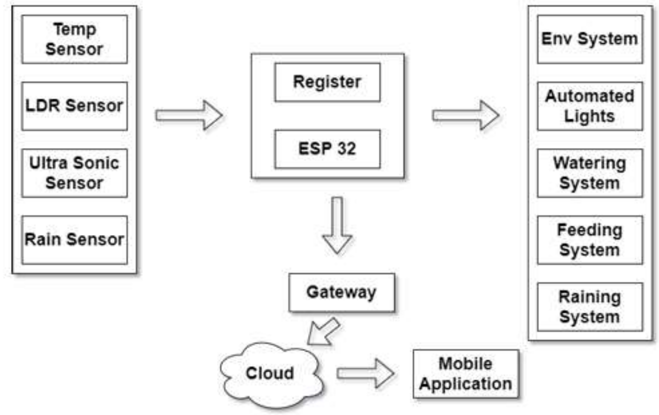

Figure 2 System Architecture Diagram

There are a number of sequential processes involved in the process of putting into action the automated and controlled bird shed mechanism. Following the completion of the Requirement Analysis, the procedure comprises gaining an understanding of the particular requirements of the bird shed and determining the primary variables that need to be monitored and managed. These variables include temperature, humidity, lighting, and ventilation. After the requirements analysis has been completed, the next step is to begin the System Design process, which involves the creation of an all-encompassing proposal. During this stage, you will select the right hardware components such as sensors, controllers, and actuators. Additionally, you will design software algorithms in order to efficiently regulate and monitor a variety of factors. Following this step is the Hardware Implementation process, which involves the assembly and incorporation of the selected hardware components into the birdhouse. This process includes the installation of actuators for lighting and ventilation, as well as sensors for measuring the quality of the surrounding environment. Concurrently, Software Development takes place, which involves the construction of software algorithms for the purpose of controlling and monitoring parameters, as well as the development of a user interface for the purpose of observing the system and receiving warnings in the event of anything out of the ordinary. Afterwards, testing and validation are carried out in order to guarantee that the system is capable of satisfying the requirements of the bird shed. This process includes doing stringent tests on the performance of software algorithms, sensors, and actuators of the system. After the system has been validated, it will go on to the Deployment phase, during which it will be installed in the bird shed for the purpose of continuous monitoring and management of parameters. Maintenance and upgrades are carried out on a regular basis to ensure that the system continues to function properly and is kept current with the latest technical breakthroughs. This ensures that the system will continue to perform at its highest level over time.

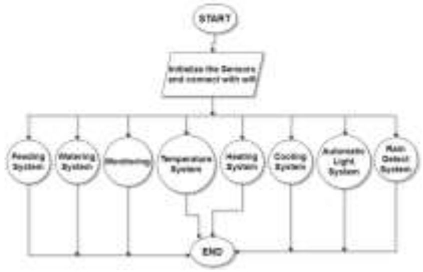

Figure 3 Flow of system

The execution of the workflow is broken down into a number of discrete stages. In the first step of the Data Gathering process, sensors are strategically placed inside the bird shed in order to collect information on a variety of parameters, including temperature, humidity, CO2 concentrations, and lighting conditions. Finally, during the Data Transmission phase, the microcontroller unit (MCU) is responsible for receiving the data that was gathered by the sensors. This can be accomplished by wired or wireless communication protocols such as Bluetooth and Wi-Fi. After this, the MCU will proceed to the Data Processing phase, where it will process the data that it has received and use predetermined algorithms in order to arrive at well-informed judgments. Control Actions are the result of these decisions, in which the microcontroller unit (MCU) delivers control signals to a wide variety of actuators, such as heaters, ventilation fans, and lighting fixtures, in order to keep the bird shed at the ideal temperature and humidity level. In addition, the MCU is responsible for monitoring tasks, which include evaluating the health state of the birds on a regular basis and monitoring the conditions of the environment. It also notifies the farmer immediately of any irregularities that are discovered.

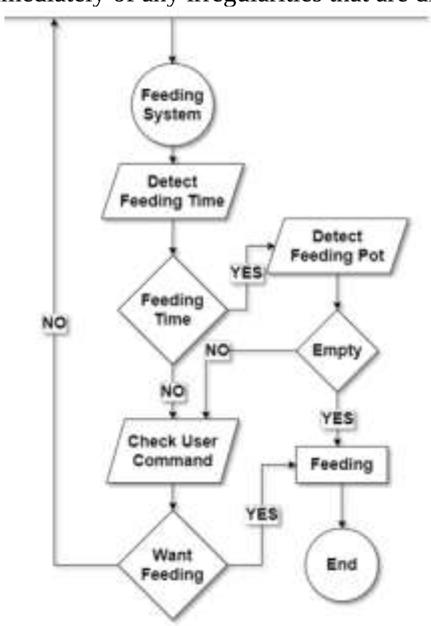

Figure 4 Feed System Flow

This flowchart is initiated by the system initializing the ESP32 microcontroller and DS1302 real-time clock module. The current time is then obtained using the DS1302 module. In order to determine the appropriate period for feeding, the system refers to the feeding schedule. In that case, the feeding mechanism remains operational for the duration required to deliver the food. Following each feeding, the system updates the feeding journal or record. The system maintains a timekeeping function notwithstanding the absence of feeding time. The flowchart also incorporates a verification process for any manual overrides or alterations that the user may request. In that case, the system modifies the feeding schedule or parameters as required to reflect the user's input and updates the schedule accordingly. When no requests for manual modifications are received, the system maintains a record of matters. Also included in the flowchart is a check for sensor or system errors. If faults or malfunctions are detected, the system generates an alert or message and commences the required remedial actions. The system continues to verify that there are no bugs or issues discovered. Subsequently, the process is replicated with meticulous monitoring of the passage of time, the feeding schedule, user adjustments, and vigilant inspection for defects or malfunctions. The illustrated process flowchart demonstrates how the system executes automated avian feeding in accordance with the user's inputs and the pre-established schedule.

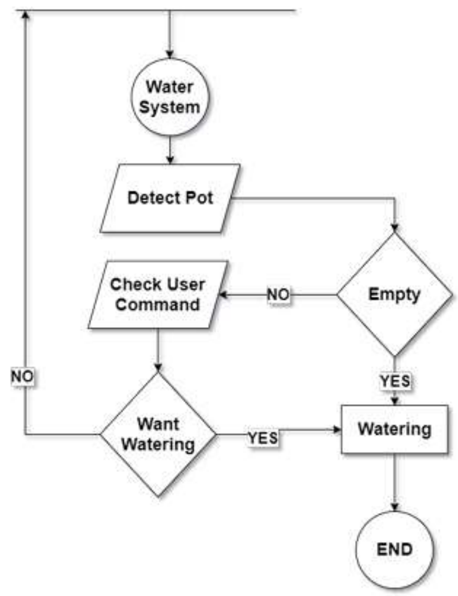

Figure 5 Watering System Flow

The flowchart commences with the initialization of the ESP32 microcontroller and the ultrasonic sensor. Afterwards, the water level is ascertained by means of the ultrasonic sensor. The water level is monitored by the system if it falls below the minimum threshold. Signaling the necessity for irrigation, the water pump or valve is activated for a predetermined duration to restock the reservoir. Following irrigation, the system updates the water level status or log. The water level is monitored by the system in the event that it exceeds the minimum threshold. The flowchart also incorporates a verification process for any manual overrides or alterations that the user may request. In the event that this is the case, the system modifies the watering schedule, or parameters as required to reflect the user's input. When no requests for manual modifications are received, the system maintains a record of matters. Also included in the flowchart is a check for sensor or system errors. If faults or malfunctions are detected, the system generates an alert or message and commences the required remedial actions. The system continues to verify that there are no bugs or issues discovered. Following this, the procedure is repeated while monitoring for faults, verifying user adjustments, and monitoring the water level. The system utilizes the user inputs, the predetermined timetable, and the water level readings from the ultrasonic sensor to automate the process of hydrating the birds in accordance with the steps outlined in this flowchart.

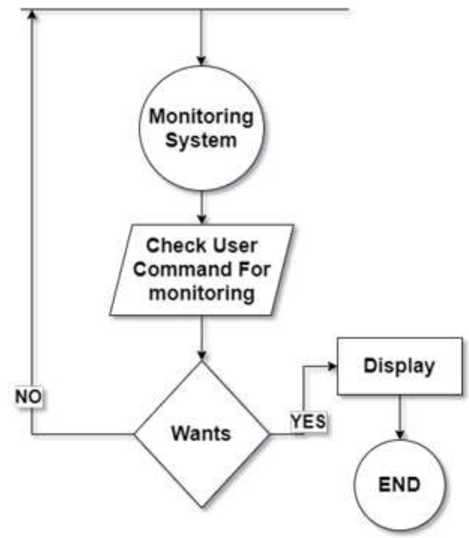

Figure 6 Monitoring System Flowchart

Initialization of the ESP32-CAM module occurs at the beginning of the flowchart. Following this, the camera is employed to capture an image. Following this, the gathered image is examined for signs of avian activity. Should a bird be detected in the image attempting to access the screening area, the screening system is activated and the requisite measures are executed to prevent bird admission. The detection event is additionally documented for future reference by the system. The system continues to monitor the area until it detects the absence of any birds in the image. A verification for user-requested manual overrides or adjustments is incorporated into the flowchart. In such a case, the system modifies the screening parameters or settings in accordance with user input and updates the configuration. Without any explicit requests for manual modifications, the system maintains a record of all transactions. Additionally, the flowchart incorporates a verification process to identify any system or camera malfunctions. If faults or malfunctions are detected, the system generates an alert or message and commences the required remedial actions. The system continues to verify that there are no bugs or issues discovered. Photographs are iterated through the following processes: identification of animals, verification of human alterations, and inspection for defects or malfunctions. This flowchart illustrates how the system safeguards the designated area from avian ingress by automating the bird screening process using ESP32-CAM.

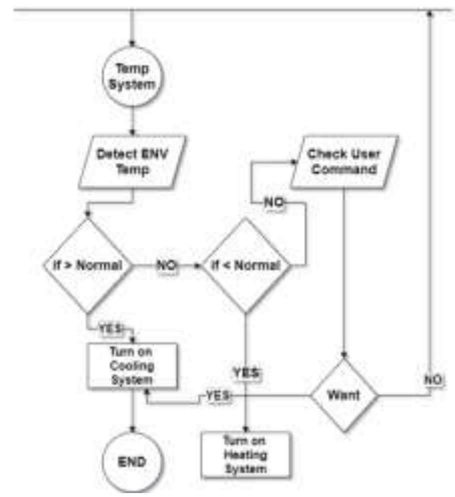

Figure 7 Temp System Flowchart

The system initiates this flowchart by configuring the DHT11 temperature and humidity sensor and the ESP32 microcontroller. The sensor is subsequently employed to acquire data on temperature and humidity. The temperature is monitored by the system if it falls outside the specified range. If necessary, the cooling or heating system is activated to bring the temperature within the specified range; otherwise, an indication of a temperature change is received. The temperature and humidity are monitored by the system, which updates the temperature status or record as required. Constantly, the system verifies that the temperature remains within the specified range. The flowchart also incorporates a verification process for any manual overrides or alterations that the user may request. When this occurs, the system modifies the temperature parameters or settings in accordance with the user's input and updates the configuration. When not explicitly requested for manual modifications, the system maintains a record of all transactions. Also included in the flowchart is a check for sensor or system errors. If faults or malfunctions are detected, the system generates an alert or message and commences the required remedial actions. The system continues to verify that there are no bugs or issues discovered.

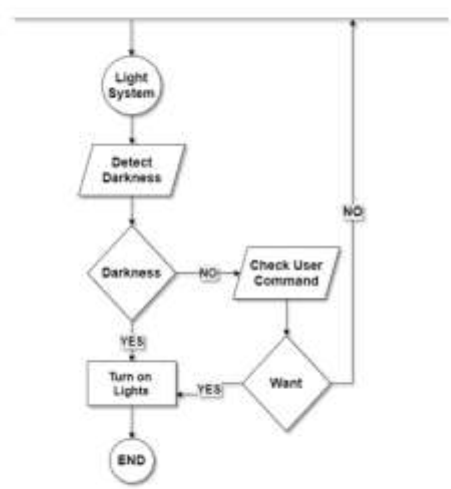

Figure 8 Light System Flowchart

This flowchart is initiated by the system initializing the ESP32 microcontroller and the LDR sensor. The light intensity is subsequently measured by the LDR sensor. Subsequent to the threshold being reached, the system ascertains that additional illumination is necessary. If so, the lights are activated to provide sufficient illumination for the animals. The light output is monitored by the system, which makes any required adjustments to the illumination status or log. If the illumination level surpasses the predetermined threshold, the system continues to monitor. The flowchart also incorporates a verification process for any manual overrides or alterations that the user may request. In such a case, the illumination parameters or settings are modified by the system in accordance with the user's input. When not explicitly requested for manual modifications, the system maintains a record of all transactions. Also included in the flowchart is a check for sensor or system errors. If faults or malfunctions are detected, the system generates an alert or message and commences the required remedial actions. The system continues to verify that there are no bugs or issues discovered. The process is subsequently iterated while concurrently examining for user modifications, scrutinizing for malfunctions, and monitoring the intensity of the light. The system automates the lighting system for birds using the ESP32 microcontroller and LDR sensor, thereby assuring that the birds have optimal lighting conditions for their health.

IV. HARDWARE

Within the domain of hardware tools, the ESP32 stands out as a preferred selection for Internet of Things (IoT) applications due to its efficient energy usage and flexible networking capabilities, such as Wi-Fi and Bluetooth. With its dual-core processor and extensive selection of peripherals, this device provides a strong base for a wide range of projects, including wearable technology and industrial automation. With its support for many programming languages such as C++, Python, and Micro Python, this platform accommodates a wide spectrum of developers, including both experts and enthusiasts. The ESP32-CAM is a noteworthy hardware tool that is specifically developed for embedded applications that require both wireless capability and camera integration. Equipped with the OV2640 camera module and Wi-Fi/Bluetooth connectivity, this device is suitable for many applications such as video streaming, security systems, and remote monitoring. The LDR, also known as the Light Dependent Resistor, is an essential element in light-sensitive circuits. It provides resistance that changes depending on the amount of light in the environment. The uses of this technology span from controlling lighting automatically to making exposure adjustments in cameras, showcasing its adaptability in various contexts. Similarly, the Servo Motor is notable for its exceptional precision in controlling movement, rendering it essential in the fields of robotics, CNC machines, and radio-controlled models. The inclusion of an integrated feedback system allows for precise control over positioning, speed, and torque, making it ideal for applications that require a high level of accuracy. The hardware toolbox is enhanced by the inclusion of relay modules, which provide solutions for controlling high-voltage circuits, and ultrasonic sensors, which are used for object identification. Relay modules serve as a means to connect low voltage control signals with high voltage circuits, and are commonly used in automation systems in many sectors such as automotive, industrial, and residential. Conversely, ultrasonic sensors utilize high-frequency sound waves to detect objects, making them extremely valuable in robotics, parking assistance systems, and industrial automation. The Arduino IDE is a widely used software tool for coding on Arduino boards. It is known for its user-friendly interface and its ability to integrate with the Processing platform, which is used for generating visuals and interactive media. The software offers fundamental functionalities such as a text editor, code library, and compiler, designed to meet the needs of both beginners and advanced users in the Arduino community. Proteus is a highly adaptable tool for designing and simulating electronic circuits. It provides a full set of features for circuit design, simulation, and PCB layout. The tool's intuitive interface and comprehensive collection of components make it a preferred choice for both experts and enthusiasts in a wide range of fields, including electronics, engineering, and education. Lynk is a robust platform for IoT development, offering a smooth interface for constructing IoT projects and apps. Blynk streamlines the prototype and development of IoT solutions by offering an intuitive mobile app interface, a cloud-based architecture, and a wide range of libraries for common hardware platforms. The flexible architecture of this technology supports a wide range of Internet of Things (IoT) applications, including smart agriculture and home automation. It enables enthusiasts, hobbyists, and specialists to easily create linked goods.

V. IMPLEMENTATION

The circuit diagram for creating an automatic light using esp32:

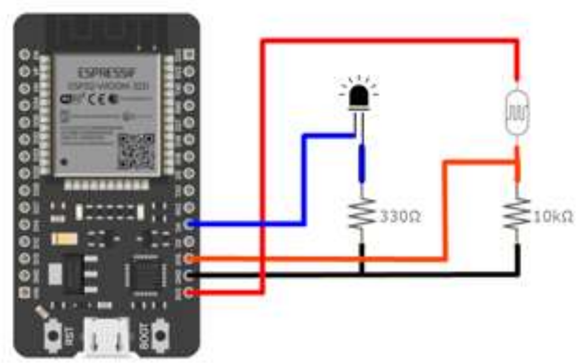

Figure 9 Automatic Light Circuit Diagram

- GPIO pins are used to link the relay module to the ESP32 microcontroller.
- To regulate the current for a light bulb, a 330-ohm resistor is employed.
- The ESP32 and resistors are connected to the power supply's 5V and GND lines.
- The ESP32's analogue input pin and a 10K Ohm resistor are connected to the LDR (Light Dependent Resistor).
- The 330-ohm resistor is attached to the light bulb.

The circuit diagram for creating an automatic watering using esp32:

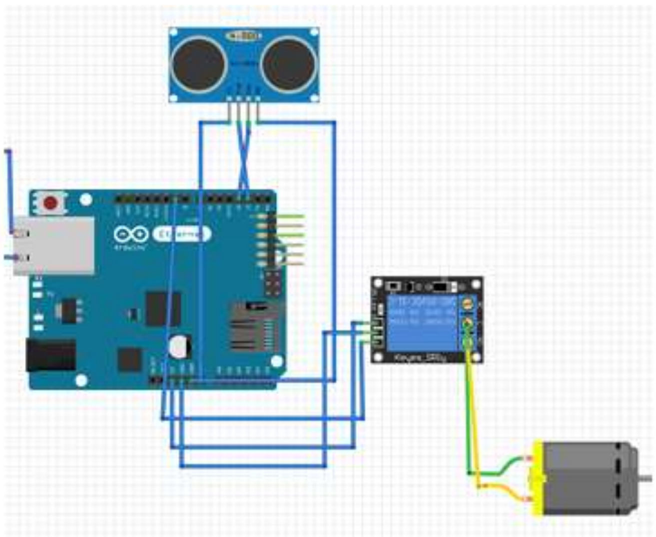

Figure 10 Watering System Circuit Diagram

• GPIO pins are used to link the relay module to the ESP32 microcontroller.
• The water pump is managed by the relay module.
• Water is pumped into the bird's water tank using the water pump from a water
supply.
•The power source provides 5V and GND connections to the ESP32 and relay module. The ultrasonic sensor is used to measure the water level in the bird's water tank.

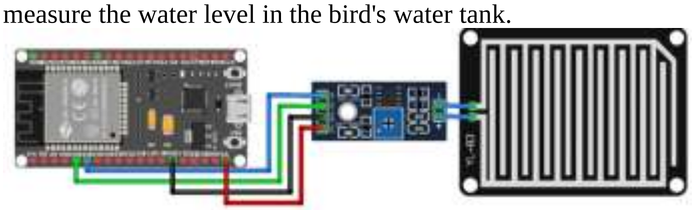

Figure 11 Rain Detection Circuit Diagram

• Analogue pins on the ESP32 microcontroller are used to connect it to a rain sensor.
• Outside, where it will be exposed to the rain, the rain sensor is positioned. The sensor detects rain by sending a signal to the ESP32 whenever raindrops touch it.
• The rain sensor's signal is read by the ESP32, which then determines whether rain has been seen.
• The ESP32 can be programmed to carry out a task if rain is detected, such as alerting the user or opening curtains.

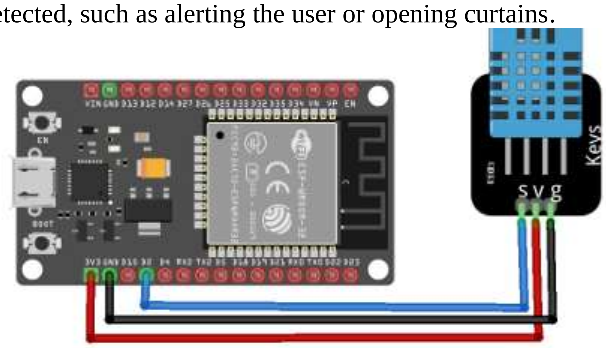

Figure 12 Temperature Detection Circuit Diagram

• Connect the temperature sensor's data line to an ESP32 digital GPIO pin.
• To supply power, attach the temperature sensor's VCC and GND pins to the ESP32's 3.3V and GND pins, respectively.
• Connect the LCD display module's SDA and SCL pins to the ESP32's corresponding I2C pins, which are typically GPIO 21 and GPIO 22.
• To supply power, join the ESP32's 5V and GND pins with the VCC and GND pins of the LCD display module, respectively.
• If the LCD display module does not already have the necessary pull-up resistors for the I2C bus lines (SDA and SCL), make sure to install them.

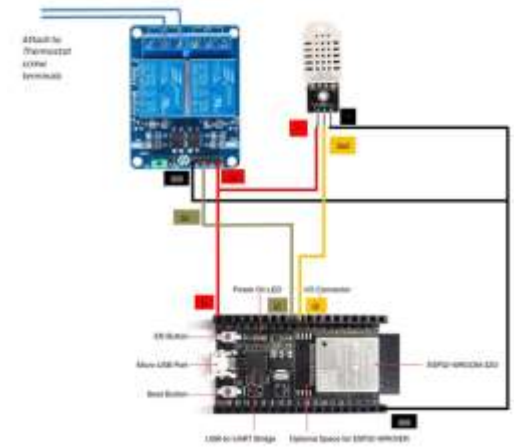

Figure 13 Heating System Circuit Diagram

• Connect the ESP32's VCC and GND pins, respectively, to a 3.3V power source
and ground.
• Connect the control pin of the relay module to a digital GPIO pin of the ESP32.
The relay can be turned on or off using this pin.
• Connect the temperature sensor's input pin to an ESP32 digital GPIO pin. The
sensor's temperature data will be read via this pin.
• To supply power, attach the temperature sensor's VCC and GND pins to the
ESP32's 3.3V and GND pins, respectively.
• Connect the relay module's output pins to the heating system's power source.
The heating system's on/off state will be managed using this link.

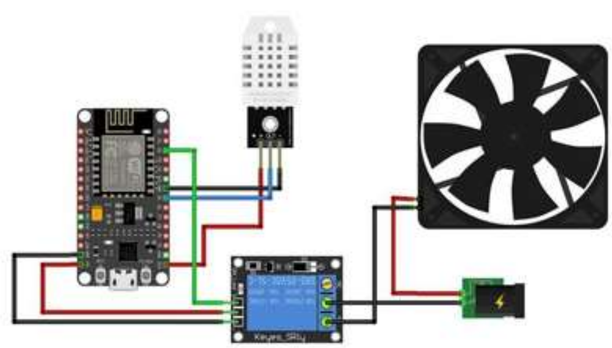

Figure 14 Cooling System Circuit Diagram

• Connect the ESP32's VCC and GND pins, respectively, to a 3.3V power source
and ground.
• Connect the control pin of the relay module to a digital GPIO pin of the ESP32.
The relay can be turned on or off using this pin.
• Connect the temperature sensor's input pin to an ESP32 digital GPIO pin. The
sensor's temperature data will be read via this pin.
• To supply power, attach the ESP32's 3.3V and GND pins to the VCC and GND
pins of the relay module and temperature sensor, respectively.
• Relay module output pins should be connected to the cooling system's power
supply. The cooling system's on/off state will be managed using this link.

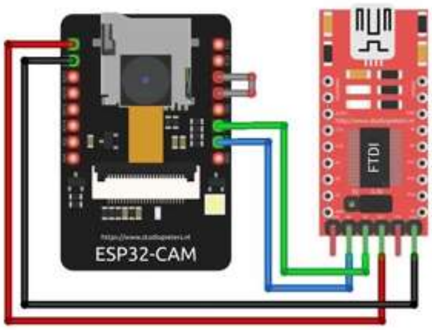

Figure 15 Monitoring System Circuit Diagram

• ESP32 with camera module connected:
Connect the necessary headers on the ESP32 board to the ESP32-CAM module.
As stated in the documentation or pinout diagram, make sure the camera module's pins are connected properly.
• The development environment should be set up:
Install the development tools and libraries required for ESP32 programming.
Set up the ESP32 development environment board.
• Assemble and analyses camera data:
Configure the camera module's settings (such as resolution and frame
rate) after initializing it.
To take pictures or video frames, use the given libraries or APIs.
As required, process the collected data (apply filters or transformations, conduct picture analysis, etc.).
• Transmit the data via a network:
By utilizing the ESP32 to create a network connection, such as Wi-Fi.
To communicate the camera data, use the proper protocols (such as HTTP, TCP/IP, and MQTT).
For effective transmission, encode the data in an appropriate format (e.g., JPEG for photos, H.264 for video).
• Watch or save the images from the camera:
On a computer, smartphone, or other device that can receive and show camera data, set up a monitoring system.
Create the client-side programmed or interfaces required to receive and handle the transmitted camera data.
For recording and subsequent retrieval, you can opportunistically save the camera data on a server or in the cloud.

• Manage any supplementary features:
As required by the project, provide functionality like motion detection, object recognition, or notifications.
If necessary, integrate with other services or systems (such home automation or security systems).

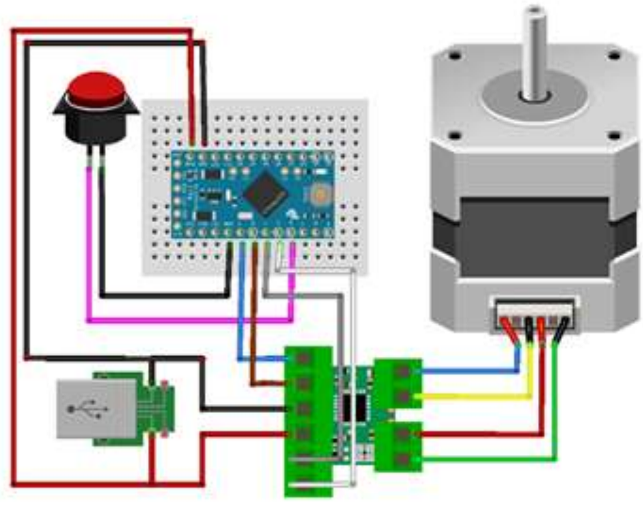

Figure 16 Feeding System Circuit Diagram

• Connect the DS1302 module to the ESP32 as follows:
Connect the DS1302 module's VCC and GND pins to the appropriate power supply.
Connect the DS1302 module's CLK, DAT, and RST pins to the ESP32's appropriate GPIO pins.
• Configure the development environment:
Install the ESP32 programming library and development tools.
In the development environment, configure the ESP32 board.
• Initialize and configure the DS1302 module as follows:
To initialize the DS1302 module's settings, use the given library or API.
To ensure accurate timekeeping, set the current time and date on the
DS1302 module.
• Create a feeding schedule:
Feeding intervals and times should be determined based on your needs. Create a schedule with the ESP32 code to specify the feeding times and frequencies.

VI. CONCLUSION

The implementation of automated surveillance and control systems in poultry sheds offers numerous benefits for poultry farming enterprises. It is worth noting that these systems effectively optimize the efficiency of poultry husbandry procedures while simultaneously mitigating operational expenditures. Through the use of contemporary technology, agricultural practitioners are able to remotely monitor and control a multitude of vital elements within the shed setting, encompassing temperature, humidity, ventilation, and illumination. The ability to access information remotely not only facilitates the administration process but also encourages more accurate adjustments to be made in real-time, thereby guaranteeing ideal conditions for the birds' welfare. Furthermore, the integration of automated systems positively impacts the birds' overall well-being. Real-time monitoring of health and well-being empowers producers to expeditiously identify and resolve any potential issues. By adopting a proactive stance towards avian management, the likelihood of potential health complications is not only reduced, but the overall standard of care given to the birds is also elevated. In addition, by employing sophisticated sensors and data analytics, agricultural practitioners are able to acquire more profound understandings of the conditions transpiring within the enclosures. This empowers them to make well-informed decisions and consistently enhance their farming methodologies. In anticipation of forthcoming developments, automated monitoring and control systems present auspicious prospects for the continued optimization and enhancement of poultry farming operations. Potential areas of concentration encompass the incorporation of artificial intelligence and machine learning algorithms to enhance comprehension and adjustment to the unique requirements of avian species. Additionally, the deployment of energy-efficient technology and renewable energy sources to advocate for environmental stewardship and sustainability could be considered. Furthermore, the establishment of alliances with fellow poultry farmers, researchers, and industry professionals can promote collaborative knowledge acquisition and the sharing of optimal methodologies, thereby stimulating advancements and novelty in the poultry farming domain. Our endeavor is to address the changing demands and obstacles of the poultry husbandry sector by giving precedence to these prospective domains of future research. The primary objective is to create an innovative, functional, and environmentally conscious resolution that not only improves the well-being of birds and agricultural processes but also promotes ecological accountability. By means of sustained collaboration and innovation, our objective is to make a positive contribution to the global progress and success of poultry husbandry methodologies.

REFERENCES

[1] Tullo, E., Fontana, I. and Guarino, M., 2013. Precision livestock farming: an overview of image and sound labelling. Precision Livestock Farming'13, pp.30-38.

[2] Abdulwahab, M.M., Waled, M., Osman, A.A. and Al-Tahir, A., 2022. Wireless sensor networks for real-time monitoring and controlling of poultry farm. Journal of Telecommunication, Electronic and Computer Engineering (JTEC), 14(1), pp.21-26.

[3] Kashiha, M.A., Bahr, C., Vranken, E., Hong, S.W. and Berckmans, D., 2014, July. Monitoring system to detect problems in broiler houses based on image processing. In Proceedings International Conference of Agricultural Engineering (pp. 6-10).

[4] Zhang, L., Dabipi, I.K. and Brown Jr, W.L., 2018. Internet of Things applications for agriculture. Internet of things A to Z: technologies and applications, pp.507-528.

[5] Revanth, M., Kumar, K.S., Srinivasan, M., Stonier, A.A. and Vanaja, D.S., 2021, October. Design and Development of an IoT Based Smart Poultry Farm. In 2021 International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA) (pp. 1-4). IEEE.

[6] Zheng, H., Zhang, T., Fang, C., Zeng, J. and Yang, X., 2021. Design and implementation of poultry farming information management system based on cloud database. Animals, 11(3), p.900.

[7] Lashari, M.H., Memon, A.A., Shah, S.A.A., Nenwani, K. and Shafqat, F., 2018, November. Iot based poultry environment monitoring system. In 2018 IEEE International Conference on Internet of Things and Intelligence System (IOTAIS) (pp. 1-5). IEEE.

[8] Jácome, I.M.T.D., Rossi, L.A. and Borille, R., 2014. Influence of artificial lighting on the performance and egg quality of commercial layers: a review. Brazilian Journal of Poultry Science, 16, pp.337-344.

[9] Sparagano, O.A. and Ho, J., 2020. Parasitic mite fauna in Asian poultry farming systems. Frontiers in Veterinary Science, 7, p.400.

[10] Appleby, M.C., Hughes, B.O. and Elson, H.A., 1992. Poultry production systems. Behaviour, management and welfare. CAB international.

[11] Samad, A., 2022. Antibiotics Resistance in Poultry and its Solution. Devotion Journal of Community Service, 3(10), pp.999-1020.

[12] Mitkari, S., Pingle, A., Sonawane, Y., Walunj, S. and Shirsath, A., 2019. IOT based smart poultry farm. system, 6(03).

[13] Neethirajan, S., 2022. Automated tracking systems for the assessment of farmed poultry. Animals, 12(3), p.232.

[14] Wan, Y., Yu, S., Huang, J., Yang, J. and Tsai, C., 2008. Automation integration for taiwan country chicken farm management using field server. Proceedings of the IAALD AFITA WCCA.

[15] Naphade, S.T. and Badhe, S.G., 2021. Study of smart management system in poultry farming. Journal of Scientific Research, 65(6), pp.153-156.

[16] Astill, J., Dara, R.A., Fraser, E.D., Roberts, B. and Sharif, S., 2020. Smart poultry management: Smart sensors, big data, and the internet of things. Computers and Electronics in Agriculture, 170, p.105291.

[17] Hu, X., Sun, L., Zhou, Y. and Ruan, J., 2020. Review of operational management in intelligent agriculture based on the Internet of Things. Frontiers of Engineering Management, 7(3), pp.309-322.

[18] Ayaz, M., Ammad-Uddin, M., Sharif, Z., Mansour, A. and Aggoune, E.H.M., 2019. Internet-of-Things (IoT)-based smart agriculture: Toward making the fields talk. IEEE access, 7, pp.129551-129583.

[19] Ahmadi, M.R., Hussien, N.A., Smaisim, G.F. and Falai, N.M., 2018. A survey of smart control system for poultry farm techniques. In International Conference on Distributed Computing and High Performance Computing (DCHPC2018). Iran: 25th–28th November.

[20] Kijlstra, A., & Eijck, I. A. J. M. (2006). Animal health in organic livestock production systems: a review. NJAS-Wageningen Journal of Life Sciences, 54(1), 77-94.

[21] Oladeji, J. O. (2011). Sources and utilization of poultry production information among poultry farmers in Oyo State. International Journal of livestock production, 2(2), 011-016.

[22] Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M. S., & Bernabucci, U. (2010). Effects of climate changes on animal production and sustainability of livestock systems. Livestock Science, 130(1-3), 57-69.

[23] Soni, R. P., Katoch, M., & Ladohia, R. (2014). Integrated farming systems-a review. IOSR Journal of Agriculture and Veterinary Science, 7(10), 36-42.

AUTHORS

First Author – Farjad Khan, qualifications, HITEC University Taxila.

Second Author – Rimsha Ali, Student, HITEC University Taxila.

Third Author – Bilal Haider, Student, HITEC University Taxila.

Fourth Author – Iqra Perveen, Student, HITEC University Taxila.

Fifth Author – Abdul Samad Danish, Lecturer, HITEC University Taxila.

Sixth Author – Agha Muhammad Yar Khan, Student, HITEC University Taxila.

Correspondence Author – Abdul Samad Danish