Automatic Cleaning System of Chicken Coop

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ABSTRACT

This study aims to develop an automated cleaning system for chicken coops using Internet of Things (IoT) technology. The system utilizes IoT technology to monitor and control the condition of the coop in real-time and provide notifications to the farmer via a mobile application. The main specifications of the system include scheduled feeding, system status monitoring, alarm notifications and database real-time. The system utilizes Arduino Mega 2560 + Wi-Fi built in Esp8266 as the microcontroller, if there is a differences in system status, such as low food or water capacity, the system triggers an alarm or sends a notification to the mobile application. Additionally, the system operates continuously for 24 hours and maintains communication with the database to ensure up-to-date information. It also features an automated cleaning function that can schedule regular cleaning of the coop using water. The farmer can control the cleaning process through buttons located near the coop. During the system verification, the scheduled Cleaning, status alert feature, system uptime, communication between the system and the database, and automated cleaning functionality were tested and verified according to the specified requirements. This research provides a practical and efficient solution for managing broiler chicken coops. The system allows real-time monitoring of coop conditions, improves cleaning efficiency, and enhances coop cleanliness. Implementing this system can boost farm productivity and facilitate overall chicken coop management.

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1. INTRODUCTION

The growth of the poultry farming industry has presented new challenges in the management and maintenance of chicken coops. One crucial aspect of chicken coop maintenance is scheduled and effective cleaning [1]. Proper cleaning ensures environmental hygiene, the health of the chickens, and prevent the spread of the diseases. To improve the efficiency and reliability of the chicken coop cleaning processes, the utilization of Internet of Things (IoT) technology has emerged as a promising solution.

In this context, this research aims to develop an automated chicken coop cleaning system using IoT [2]. Additionally, the system is designed to communicate with a database and perform data backups to address any potential technical issues. It is expected that the development of this automated chicken coop cleaning system will provide significant benefits in enhancing efficiency, reliability, and cleanliness of chicken coops [3]. The implementation of IoT technology in poultry farming management can reduce manual workload, increase productivity, and optimize animal health and welfare.

2. THEORETICAL BASIC

IoT (Internet of Things) is a concept that refers to a network of physical objects that are connected and interact with each other through the internet. In the context of IoT, these physical objects can be electronic devices, sensors, vehicles, household appliances, or even animals or humans that can collect and exchange data [4]. The internet is experiencing rapid growth in terms of human engagement, leading to significant changes in the way people work. Thanks to the internet's assistance, various aspects of human workflow have become much more convenient. The emergence and advancement of the Internet of Things (IoT) have greatly contributed to enhancing everyday tasks and activities. With the integration of IoT into daily life, individuals now can effortlessly control and remotely access a wide range of devices and systems [5].

An example of IoT application is a scheduled and remotely controllable automated cleaning system for chicken coops[6]. Through internet-connected sensors and devices, the coop owner can monitor and control the cleaning process in real-time [7]. Notifications and alerts can also be received in case of any issues. This improves efficiency, maintains cleanliness in the coop, and prevents the spread of diseases among broiler chickens [8].

A microcontroller is a small-sized chip that serves as the main control unit in an electronic system. It consists of memory, communication pins, input, and output pins, as well as analog-to-digital conversion systems [9]. Over time, microcontrollers have been developed alongside development boards, making it easier to program them. Arduino is a type of microcontroller that operates on a 10-bit memory capacity, equivalent to 1023 [10]. Arduino Mega 2560 is one of the microcontroller models produced by the Arduino Company, which has a higher number of digital and analog pins compared to other Arduino models such as Arduino Micro, Nano, and Uno.

Firebase, a NoSQL-based service database offered by Google, provides developers with a convenient platform to build their applications. By utilizing Firebase, developers can reduce the amount of effort required to handle backend issues [11]. The specific Firebase service discussed in this paper is the Firebase Realtime Database. This database service is hosted in the cloud and allows data to be stored in JSON format. It enables real-time synchronization with users who are connected to mobile or web applications.

3. METHOD

The purpose of this IoT-based automated chicken coop cleaning system is to improve efficiency and cleanliness of the coop. The system utilizes sensors and internet-connected devices that enable real-time monitoring and control of the cleaning process. With this system, coop owners can schedule and automate the cleaning process, specifically after the feeding period. Additionally, the system can provide notifications and alerts in case of any issues. The implementation of IoT in chicken coop cleaning is expected to reduce manual workload, increase productivity, and enhance the health and welfare of broiler chickens.

The system incorporates several components, including the Arduino Mega 2560 as the main control unit, a servo-motor for opening and closing the chicken manure holder, and a water valve for regulating the water supply. The Arduino Mega 2560 functions as the primary operating system for data processing. The servo-motor acts as a like door lock to access and secure the chicken manure holder. The water valve controls the water supply used in the cleaning process. With these components, the system can operate automatically and efficiently in cleaning the chicken coop.

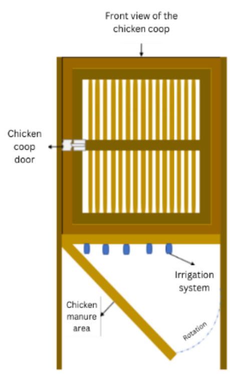

Figure 1. Tool Illustration

Figure 1 shows an illustration in the chicken manure holder cleaning system, the servo motor is employed to operate the chicken manure holder. Its purpose is to shift or lift the chicken manure holder from its position. Once the waste receptacle is opened, the next step involves watering the chicken manure holder using a control system with a water valve module that is connected to the Arduino Mega 2560 microcontroller with built-in Wi-Fi.

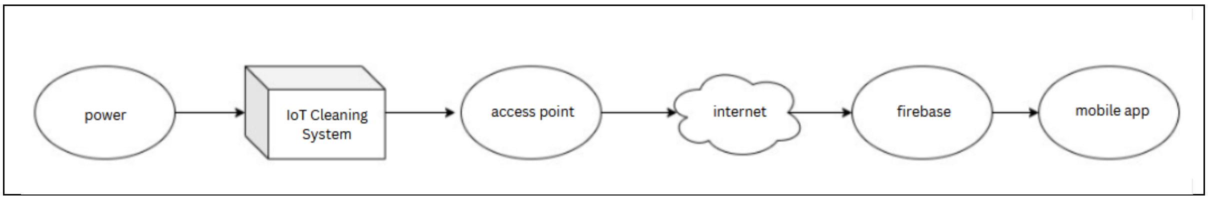

Figure 2. System Design

Figure 2 shows an illustration of the system design starting from the power for the data sent to the database.

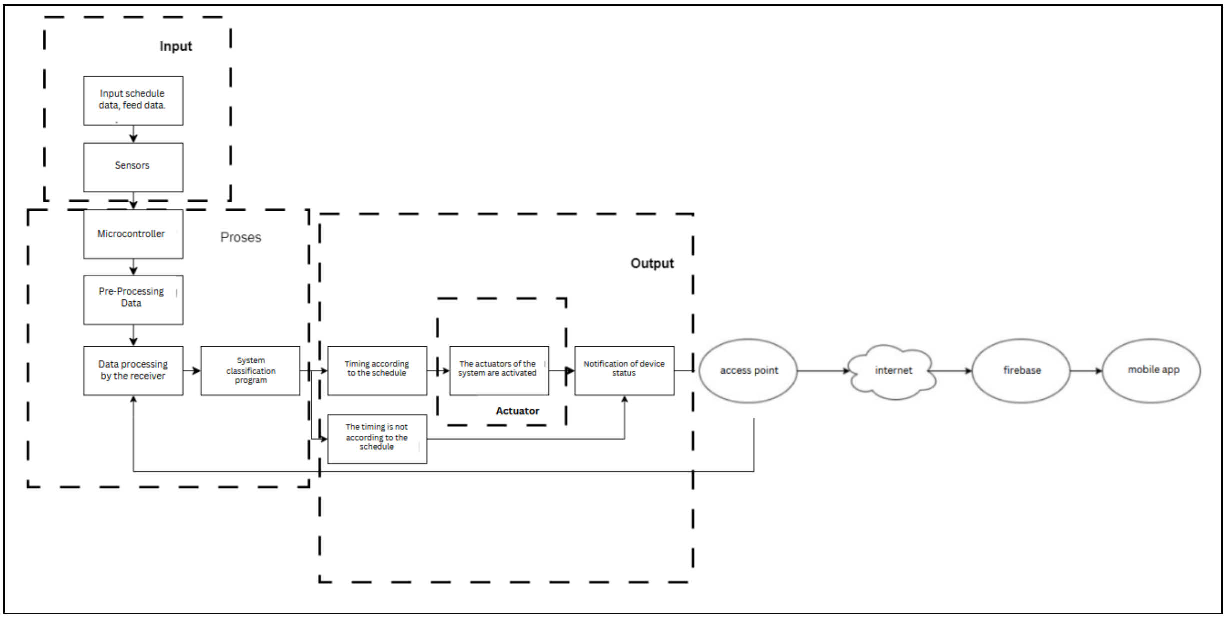

Figure 3. System Architecture

The block diagram in Figure 3 illustrates the chicken coop cleaning system, which consists of interconnected components. The system is divided into input, processing, and output subsystems. The input subsystem collects data from sensors and sets the program timing for further processing in the processing subsystem. The microcontroller processes the data, including parameters such as chicken feed capacity, feeding schedule, and coop cleaning schedule, which serve as output indicators. The output subsystem uses actuators to make decisions based on the processed data. The output is sent to the database through data connectivity with the application interface. Actuators provide physical warnings through a buzzer sensor, and users receive notifications through the application interface.

Users can set schedules and preferences through the application, which are then sent to the database via the application programming interface (API). The microcontroller reads the scheduled time and system settings from the database, ensuring timely operations and scheduling of the chicken coop cleaning system.

In summary, the chicken coop cleaning system comprises interconnected subsystems. The input subsystem collects and sets program timing, the processing subsystem classifies and processes data, and the output subsystem uses actuators for decision-making and warnings. Users interact with the system through the application interface, setting schedules and receiving notifications. The microcontroller reads settings from the database to ensure the system operates according to user-defined schedules and preferences. The Design is illustrated in Figure 4.

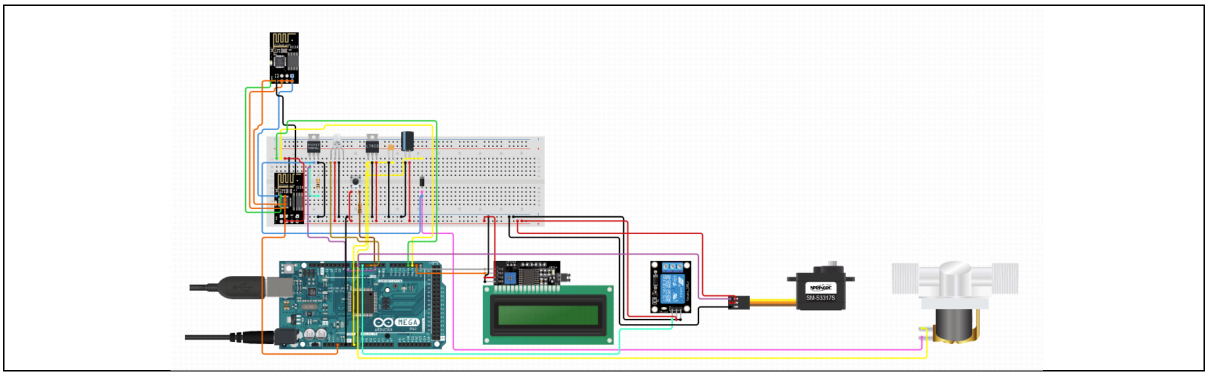

Figure 4. Hardware Design

Figure 5 shows the flow of the system follows the flowchart diagram for its operation. Once the microcontroller receives data and schedule inputs, it proceeds with the cleaning process based on the designated time. Subsequently, it verifies whether the current time corresponds to the scheduled time. If there is a match, the system's actuators and status alerts are activated, resulting in on-site or application notifications sent to the user. The cleaning process involves opening the waste receptacle and initiating water flow for effective cleaning. Consequently, regardless of the time alignment, the system's output data is forwarded to the microcontroller for transmission to the database and the Android application via connectivity.

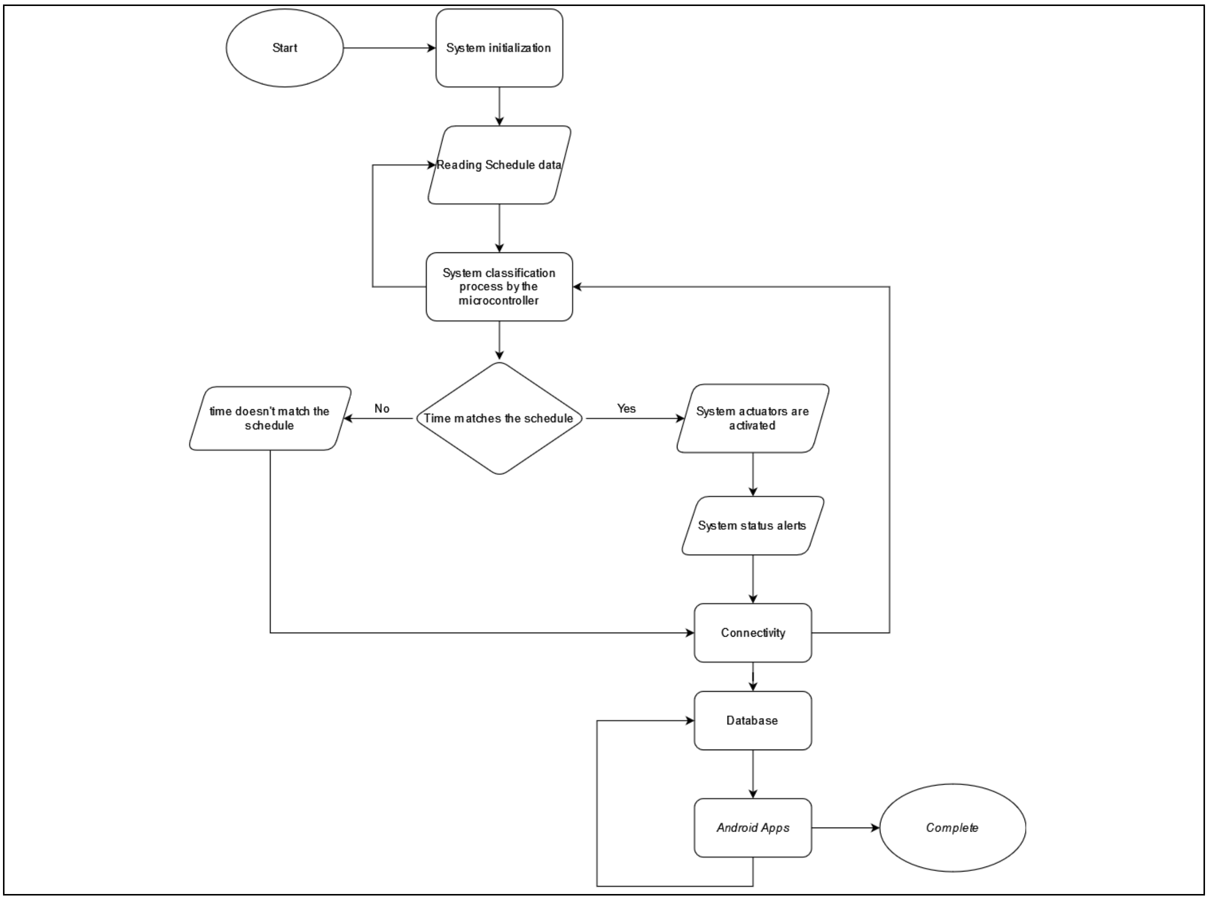

Figure 5. Cleaning Operation Flow

Data processing involves receiving data from the user and converting it into JSON format using the Firebase 8266 library. The converted data is then transmitted to the Firebase real-time database. This flow is pictured in Figure 6.

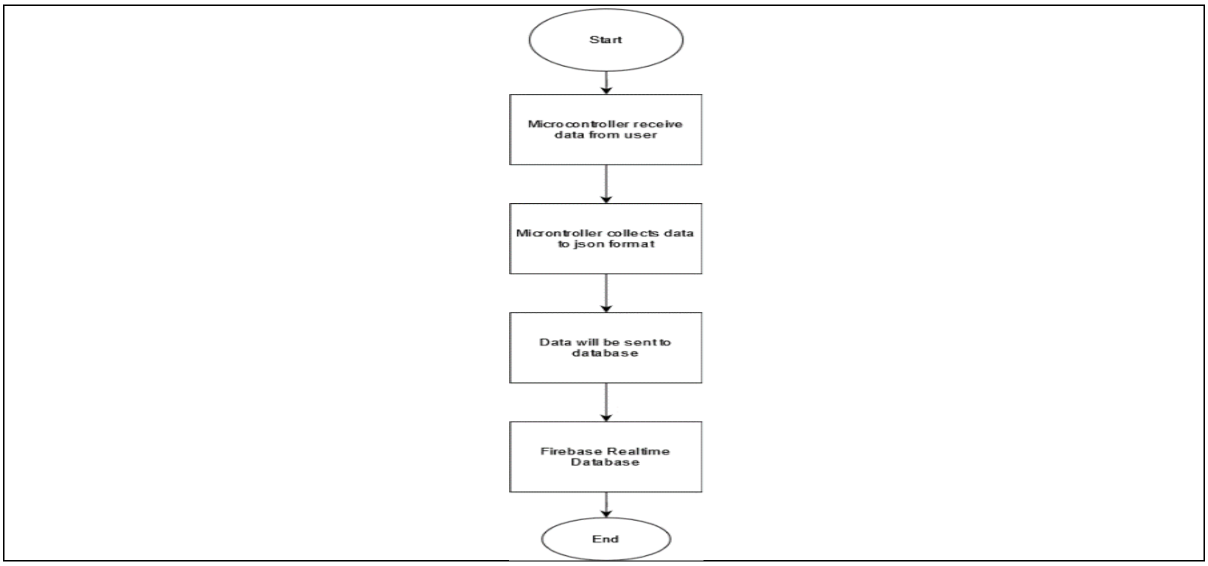

Figure 6. Data Processing Flowchart

4. RESULTS AND DISCUSSION

4.1 Led Value Test

The functionality of the Led was tested by input when cleaning of chicken coop running. The purpose of this testing was to determine if the Led produces at On and Off. Then the result can be seen in Table 1.

Table 1. Led Value Tests

Test	Input	Result
Test 1	On	High
Test 2	Off	Low
Test 3	On	High
Test 4	Off	Low

For manual testing, if push button 2, the system will open the chicken manure holder using a servo that is already wound with a string to unwind the roll when the system needs to open it. The same applies in reverse. Then, the water valve solenoid connected to a water source will flow water. The pipe direction, which has been set inside the chicken coop, will irrigate the open chicken waste area for 5-10 minutes, after which the holder will naturally fall. The system will also turn on a white Led during this process. When released, the system will stop the irrigation, and the chicken manure holder will return to its initial position (servo at 0 degrees). The rolling position will take 10 times the amount of the initial condition, so if 1 rotation is equal to 360 degrees, the chicken manure holder system will use rotations up to 3600 degrees.

Based on the results, it can be observed that the Led will high while the cleaning process was running, and led will off when cleaning process was stop.

4.2 Chicken Manure Holder, Water Flow, and Cleanliness Accuracy Test

In this test, the aim is to measure the accuracy of the chicken manure holder being opened and closed properly, the water flow, and the cleanliness level. The tests cleaning of chicken coop is shown in Table 2.

Table 2. Chicken Manure Holder, Water Flow, and Cleanliness Accuracy Tests

Test	Chicken Manure Holder Result	Water Flow Result	Cleanliness Level
Open Chicken Manure Holder, Water Flow and Closed	full open - full closed	good water flow	high
Open Chicken Manure Holder, Water Flow and Closed	partially open - full closed	good water flow	medium
Open Chicken Manure Holder, Water Flow and Closed	full open - partially closed	bad water flow	medium
Open Chicken Manure Holder, Water Flow and Closed	full open - full closed	good water flow	high
Open Chicken Manure Holder, Water Flow and Closed	partially open - full closed	bad water flow	low
Open Chicken Manure Holder, Water Flow and Closed	full open – full closed	good water flow	high

In the open chicken manure holder and water flow test, the results indicate whether the chicken manure holder is full or not and whether the water flow is good or not. The cleanliness level is also recorded for each test. The tests that show a full open chicken manure holder and good water flow indicate high levels of cleanliness, However, if the chicken manure holder is not full open or water flow is bad, its results are a low cleanliness level. These tests are important to ensure that the automated chicken coop cleaning system functions as expected and meets the desired cleanliness standards.

5. CONCLUSION

The system can be successfully made according to the design. The Led value test confirmed the proper functioning of the Led during the cleaning process. The accuracy test of the chicken manure holder, water flow, and cleanliness level provided valuable insights into the system's performance. By evaluating these parameters, it is possible to ensure the effective operation of the automated cleaning system and maintain a high level of cleanliness in the chicken coop.

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