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Prototype of Smart Poultry for Small-Scale Poultry Farmers at Ilocos Norte

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ABSTRACT

The poultry farm is a vital sector in the agricultural industry, both nationally and globally, for food production and supply. Monitoring and maintaining the optimum living conditions for poultry are essential steps that must be taken to produce poultry of the highest quality.To be able to provide quality poultry, the optimum environment must be maintained and monitored. If there are tools that can help notify the unique environment of the henhouse, it can help farmers solve the problems in monitoring methods conducted by the poultry farmers. Technology advancement plays a great role in the development of the development of the agricultural sector, including poultry farming. The study aims to create a prototype of smart poultry developed automatically to keep the area's ammonia gas content and temperature level in control. The humidity and temperature will be measured as well and will be controlled by a fan and heat lamp. In addition, the provision of food and water can be accomplished on a timely basis without manual intervention.

Keywords: henhouse, design thinking, small-scale, prototype, poultry.

INTRODUCTION

In the Philippines, the agriculture sector plays a major role in becoming one of the main sources of income for the country. According to the Philippine Statistics Authority (PSA), from 2009 to 2018, there was a 40% increase in the demand for dressed chicken—from 1 million MT to 1.4 million MT. According to the Organization for Economic Cooperation and Development—Food and Agricultural Organization, the aggregate chicken demand is projected to be about 1.8 million MT by 2023.

In the Ilocos Region, poultry raising has become an integral part of the lives of Ilocanos, especially in rural areas. Some chickens are raised in backyards to provide an ample source of meat and eggs for their meals. Based on PSA-Region 1, the total inventory of chicken in the Ilocos Region as of January 1, 2021, was 10.81 million birds. It increased by 1.29 percent from the previous year's inventory of 10.68 million birds. The inventory further increased to 11.22 million birds as of April 1, 2021. This was higher by 5.41 percent than last year's level of 10.64 million birds. Increases in inventory were noted in Ilocos Norte and La Union.

Poultry farming has a direct impact on farmers and has gained a notable attraction among entrepreneurs and women. Generally, it is the source of the poultry farmer's family income and protein. In this sector, women constitute the majority of poultry farmers, as they constitute over 80% of the farming population in Ilocos Norte.

Nowadays, a poultry farm uses computer technology. Using modern technology in poultry saves time and reduces dependency on labor, improves a healthy environment, and increases poultry production [3]. The system helps the farmer monitor and control the operations of the poultry farm. The system is a combination

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of wireless sensors and a mobile system to make managing and monitoring the poultry's work easier. The environmental parameters like temperature, light intensity, and ammonia gas are also monitored and controlled automatically [4].

PROBLEMS

Small-scalepoultry farmers are facing issues and challenges due to many factors, such as financial problems, diseases, errors in management, and others.

Objective

The main objective of the study is to determine the poultry farming strategies, techniques, and challenges faced by small-scale poultry farmers and design a prototype of smart poultry for small-scale poultry farmers.

REVIEW OF RELATED LITERATURE

Related Literature

Chicken Situation in Ilocos Region (1st Semester 2021)

Production

According to the Philippine Statistics Authority of Region 1, the total chicken production volume in the first semester of 2021 was 40,513 metric tons, which is lightweight. This was 7.53 percent lower than the 43,812 metric tons of live-weight chicken production in the same period of 2020. Chicken production for both the 1st and 2nd quarters decreased by 4.99 and 10.06 percent, respectively.

Inventory

The total inventory of chicken in the Ilocos Region as of January 1, 2021, was 10.81 million birds. It increased by 1.29 percent from the previous year's inventory of 10.68 million birds. The inventory further increased to 11.22 million birds as of April 1, 2021. This was higher by 5.41 percent than last year's level of 10.64 million birds. Increases in inventory were noted in Ilocos Norte and La Union.

By type of chicken, the inventory of broilers as of April 1, 2021, was 4.88 million birds. It was higher by 14.07 percent compared with 4.28 million birds in the same period of 2020. Likewise, the inventory of layers as of April 1, 2021, increased by 3.58 percent. On the other hand, the total population of native or improved chickens as of April 1 decreased from 5.21 million birds in 2020 to 5.14 million birds. The native chicken had the highest share of the total chicken inventory in the Ilocos Region as of April 1, 2021, with 45.84 percent, while broiler chicken and layers shared 43.53 percent and 10.63 percent, respectively.

Related WORK

e-Poultry: An IoT Poultry Management System for Small Farms

Presented the tackles of the Poultry Management System, an IOT system that automates the process of giving feeds and water to poultry animals.

Temperature and Humidity Control Algorithm for Poultry Farm Control Systems

The author aimed to propose an algorithm that harnesses the relationship between humidity and temperature

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to control their actuators for a more energy-efficient operation.

A Prototype Platform for Automated Chicken Feeding Control with an Embedded System

This prototype is an automated real-time chicken feeding mixing system that will help chicken farmers become more automated, which will be highly beneficial for the expansion of the chicken poultry farm in Phra Nakhon Si Ayutthaya, Thailand.

Smart Poultry Farm Automation and Monitoring System

The author presented the different sensors used to control temperature, water level, smoke, gas, and food dispensing. All these sensors are connected with the Raspberry Pi which can control and monitor all data.

A Poultry Farm Monitoring and Control System

A prototype has been developed using sensors, which are installed inside the poultry to monitor the factors. Based on the sensor data, the managing and controlling processes are automated.

Assessment of Conceptual Framework for Monitoring Poultry Farm's Temperature and Humidity

This paper highlighted the method of smart poultry farm monitoring systems with their types such as IoT, wireless sensor, and GPRS. These types have been designed based on their technique.

Poultry Monitoring and Controlling System using Arduino Uno

This system also helps farmers to monitor the poultry farm. It is a combination of Arduino Uno, gas sensor, LDR sensor, water sensor, and temperature sensor which makes the work easier.

Chicken Farm Monitoring System

This system is developed to solve several problems in the chicken farm which are many human workers needed to control the farm, high cost in maintenance, and inaccurate data collected at one point.

Smart Chicken Farm Monitoring System

Smart Chicken Farm Monitoring System has been developed to monitor and control the environment of the chicken coop by using sensors and the Internet of Things (IoT) platform.

Optimization Algorithm Applied to Environmental Control in Broiler Houses

The study aimed to apply the Simulated Annealing (SA) optimization algorithm to find the ideal control of the broiler housing rearing environment at 21, 28, 35, and 42 days of growth.

METHOD

To develop the project, it has to follow a few phases. There are four phases including research of the design, software development,hardware development, and software and hardware integration.

Research of project

This study was conducted among selected barangays in the City of Batac, Ilocos Norte, eliciting the respondents' knowledge and practices of poultry farming. The researchers used a descriptive type of

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research with a qualitative approach. The interview was utilized as the major data-gathering instrument. The purposefully chosen respondents of this study were residents of Barangay Baay, Camandingan, Palongpong, Payao, and Tabug. The poultry farmers in the different barangays were identified as being around 40–50 years old, and their main occupation is farming. On average, their poultry has been in operation for 3-5 years. The number of poultry houses ranged from 1 to 5 units. The starting stock for farmers to operate averaged 300 birds. The present stock of growers ranges from as low as 500 birds to as high as 1,000 birds.

Hardware development

The proposed prototype will display the status of the poultry house or cage at every instant and update the data by viewing the mobile application. The temperature sensor senses the ammonia gas content in the atmosphere and the temperature level prevailing over the cage at any instant. A weight sensor is attached to the food and water supply conveyor belt to detect the quantity of food and water fed to the chicken. Additionally, the prototype helps in identifying the status of all these parameters and automatically takes the necessary control actions. The farmers will also know about these actions, by using mobile apps. The diagram of the proposed prototype is shown in Fig. 1.

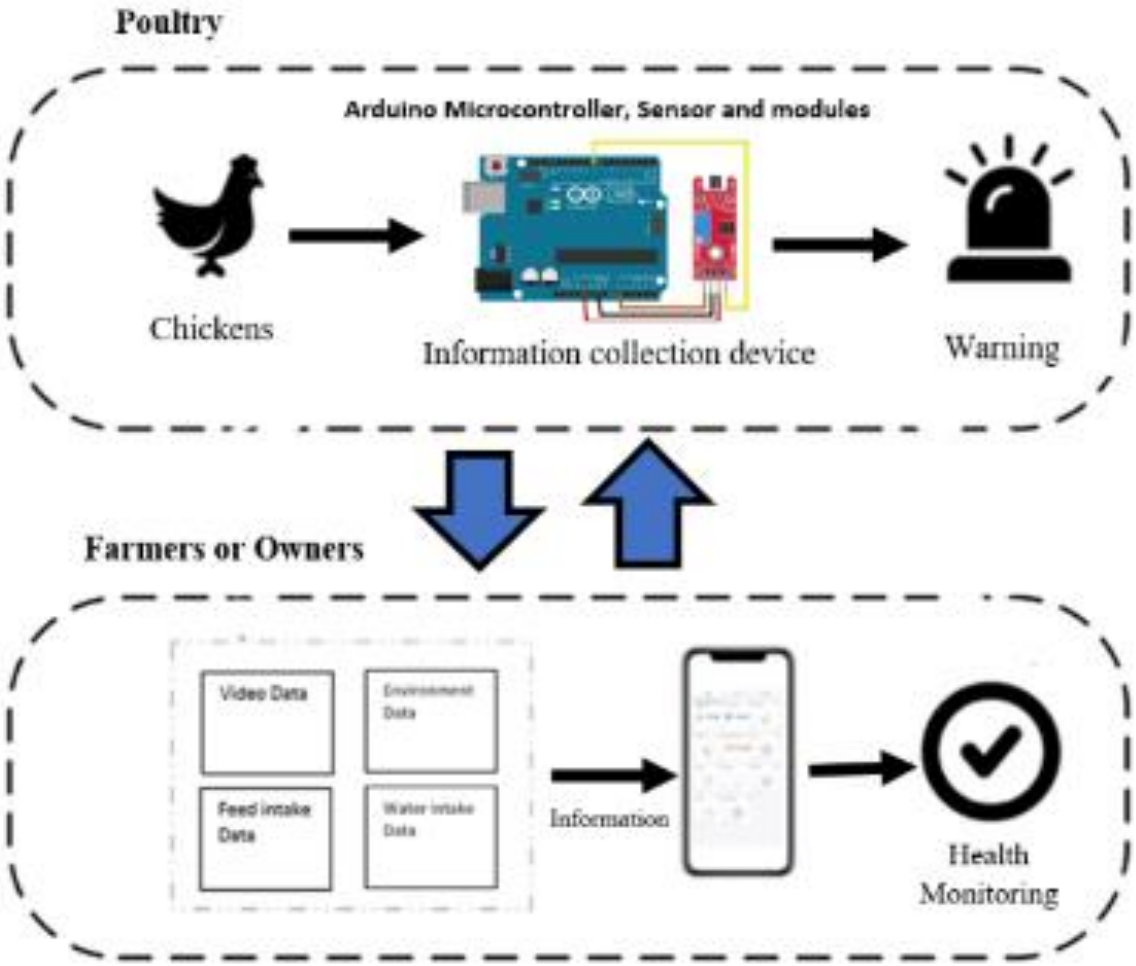

Figure 1. Diagram of the proposed prototype

Materials

The list of equipment and components used in this prototype are temperature and humidity sensors, waterlevel sensors, lamps, buzzers, fans, and servo for food and water. The prototype design of the

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chicken poultry cage is designed as shown in Figure 2.

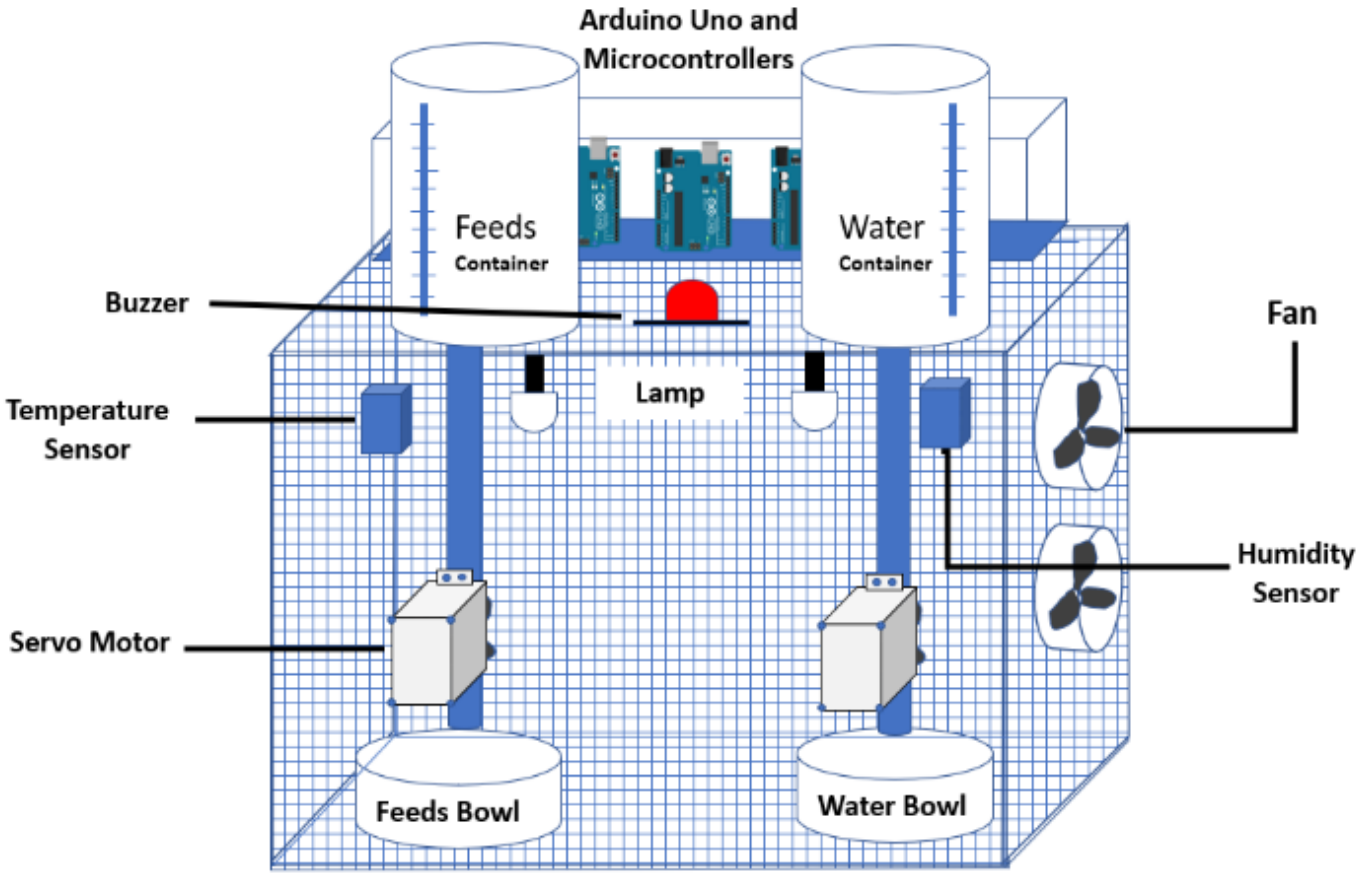

Figure 2: The conceptual 3D design of a prototype of smart poultry

The hardware setup uses sensors coupled with an Arduino board for controlling the parameters. The gas, humidity, temperature, and weighing sensors are connected to Arduino Uno via jumper wires. In the programming part, a threshold value has been set for each sensor. Whenever the values sensed exceed far or fall below the threshold value, suitable action is initiated automatically.

Software development

For the software development process of this project, the Arduino UNO microcontroller was programmed using embedded C++ programming language, thus the system was

implemented using embedded C++. It is to control the performance of the devices and system. The hardware usedare microcontroller Arduino UNO, humidity sensor, temperature sensor, bulb, and coolingfan. The Arduino UNO microcontroller acts as the main resource to conduct the working process.

Hardware and software integration

The testing procedure can be used to observe how hardware and software are combined. A project's testing phase typically takes a long time. One challenging aspect of the project was troubleshooting. The connection between the wires and the inoperable device sensors is the hardware component's constant source of trouble. In the software component, a compilation error occurred in the coding. This method provides difficult problem-solving experiences. The project can run automatically and the data cloud will function as

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intended if the testing phase is completed successfully.

Hardware design and description

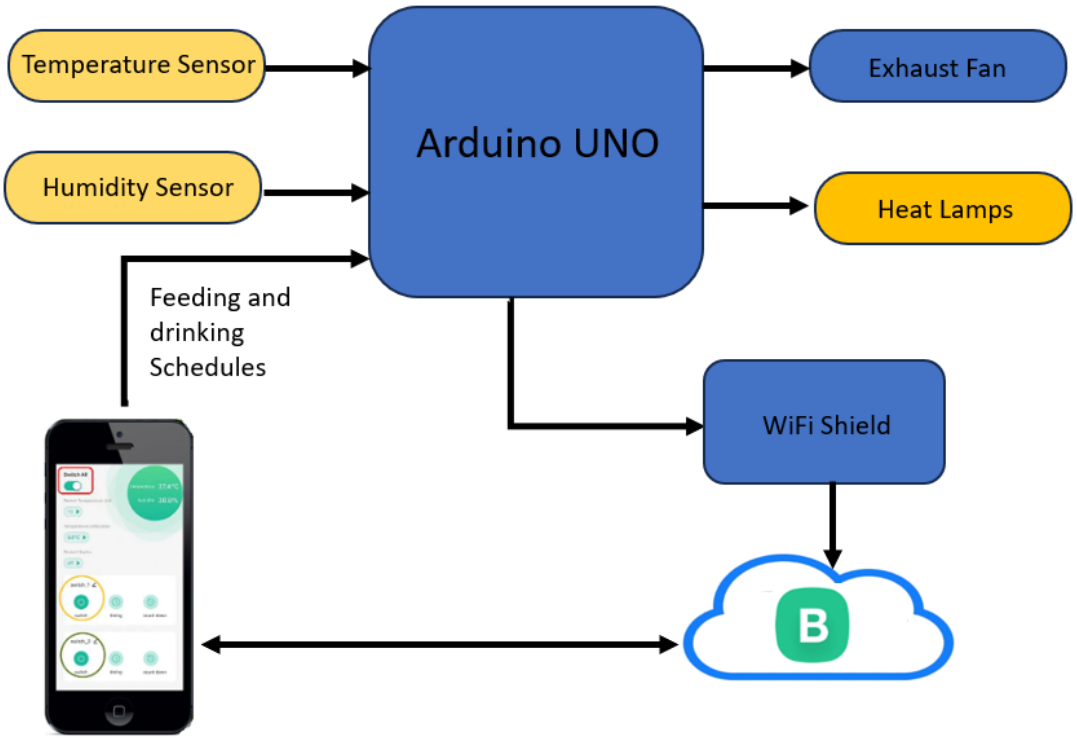

Figure 3. Block Diagram of Smart Chicken Poultry Farm

A. Arduino Uno

The Arduino UNO is a standard board of Arduino. UNO means 'one' in Italian. It was named UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered the powerful board used in various projects. Arduino developed the Arduino UNO board.

Arduino UNO is based on an A Tmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits [9].

B. Temperature Sensor

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record monitor or signal temperature changes. There are many different types of temperature sensors. Some temperature sensors require direct contact with the physical object that is being monitored (contact temperature sensors), while others indirectly measure the temperature of an object (non-contact temperature sensors) [10].

C. Humidity Sensor

Humidity sensors are used to measure and monitor the amount of water present in the surrounding air. These sensors are widely used in industries such as semiconductors, biomedical, textiles, food processing,

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pharmaceuticals, meteorology, microelectronics, agriculture, structural health monitoring, and environment monitoring [11].

D. Servo Motor

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision [12].

RESULT AND DISCUSSION

Temperature and humidity measurement

The measurement of temperature and humidity using a thermometer and humidity sensor in the Blynk interface. Table 1 shows the measurement readings of temperature and humidity taken for every 5 minutes. The thermometer serves as the actual reading reference for temperature and humidity in the coop. Based on the readings, it shows that the humidity sensor (DHT11) used in this project has high accuracy in measuring its reading near the thermometer reading.

Table 1: Result of thermometer and DHT11 readings

Thermometer		
Minutes	Temperature (^{O}C)	Humidity (%)
5	28.2	70
10	28.2	70
15	28.2	71
20	28.2	71
25	28.2	70
30	28.2	70

DHT11		
Minutes	Temperature (^{O}C)	Humidity (%)
5	29.7	73
10	29.7	73
15	29.7	72
20	29.7	72
25	29.7	72
30	29.7	72

Controlling parameters for temperature and humidity

The reading during the heating process of the chicken cage using a filament bulb. In this project, temperature and humidity have been set at 30˚C while humidity is between 60% -70%. The process of maintaining the temperature and humidity set in the chicken cage. If the temperature exceeds the threshold temperature, the bulb has been turned OFF and the cooling fan has been functioning to cool the temperature in the chicken cage. If the temperature in the coop is controlled and less than 30˚C, the bulb will light up

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again and the cooling fan will turn OFF.

Feed and drink water of the chicken in the cage

Chicken grows fast and healthy due to timely feeding. To ensure a proper feeding supply, an automatic feeding system can be included in our system. Pure water supply is a necessity at the poultry farm. To ensure a seamless purified water supply, sensors can be placed to confirm water flow, and water pump scans be been automated.

Using the mobile application the poultry farmer can create a schedule of feeding and drinking water for the chicken in the cage. The water tank and the feeder tank will be managed by the servo motor.

Temperature Test

The system was tested for its accuracy and reliability in measuring the temperature of the system. It was increased by switching ON the lamp, this in turn increases the temperature of the air inside the poultry house. The temperature rises from room temperature of 28.4°C to 32.9°C, at which point the bulb is turned OFF because the temperature is higher than required. This proves the system's capability of monitoring and regulating the temperature.

CONCLUSION

The objectives of this project have been successfully achieved. All sensors used have worked well in measuring the temperature, humidity, feeding, and drinking of the chicken in the cage. This is because, the formation of a good design circuit, has produced an orderly and functional system.

The platform that has been used in this project is the Blynk cloud system. With the use of this platform, poultry farmers can monitor all readings through devices such as Smartphones or Personal computers no matter where he or she is. As this objective has been achieved, the problem of poultry farmers monitoring has been overcome with this platform.

Lastly, a system has been developed that can control temperature, humidity, feeding, and drinking parameters automatically. Previously problems related to this objective, poultry farmers need the use of a large number of workers to control all processes involved such as monitoring temperature and humidity at all times to maintain temperature and humidity in a controlled state. With the achievement of this objective, poultry farmers can reduce the use of workers because all processes have been able to be controlled automatically.

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