Mobile Collaborative Smart Farm: Proposed Poultry IoT Solution for Indonesia Farming

Faisal SYAFAR
Computing and Information Systems Research Centre, Department of Electronics, Universitas Negeri Makassar, Makassar, Indonesia, email: faisal.syafar@unm.ac.id

Misita ANWAR
Computing and Information Systems Research Centre, Department of Electronics, Universitas Negeri Makassar, Makassar, Indonesia, email: misita.anwar@unm.ac.id

Ridwansyah
Computing and Information Systems Research Centre, Department of Electronics, Universitas Negeri Makassar, Makassar, Indonesia, email: ridwansyah@unm.ac.id

Abstract

Over the past five years, Indonesia's chicken production in Indonesia has increased by an average of 4.63% per year due to improvements in the management of the livestock industry, leading to more chicken consumption and an increase in the number of exports both domestically and internationally. The lack of labor in production processes affects fresh chicken exports, becoming a significant problem. The increasing number of populations also harms chickens, humans, and the environment due to the increasing amount of chicken *feces (feces)* in the house. The research aims to develop a system that will be applied to chicken farms known as Smart *Farming*, IoT-based. *Smart Farm,* based on IoT, can be accessed through *mobile phones,* either alone or in groups (collaboration) among breeders. The specific purpose of this study was to design a system to monitor the temperature, humidity, harmful gases, and weights of broiler chickens in real-time.

Introduction

Research's farm partner is the largest farm in the city of Soppeng, South Sulawesi. Partners revealed that temperature and humidity are factors that affect broiler chicken cultivation. If the temperature and humidity of the house are high, then the broiler will potentially be exposed to stress and heat so dehydrated. Conversely, if the temperature and humidity conditions of the house are low, the broiler is cold, which will cause the broiler to scramble to approach the incandescent lamp so that some broilers suffer broken legs and even die from clustering. The broiler death rate is about 20-30%, with total losses ranging from 200 - 400 million IDR per 20 days. High humidity leads to microbial growth that will increase the formation of ammonia gas (NH3) and carbon dioxide (CO2). High levels of carbon dioxide will cause chicks to be lethargic and decrease in chicken weight.

The research problems are, (1) chicken manure collected in houses and accumulated for days in large quantities can produce a variety of harmful gases, including ammonia, methane, carbon dioxide; (2) temperatures that are too high or too low, and (3) aabnormal humidity will cause a reduced appetite for chickens and cause chickens to drink more often than eat. This condition will have an impact on (4) the reduced weight of the chicken produced. Lack of ventilation can also affect the house's temperature that makes the house feel hot for chickens.

Therefore, it is seen as urgent to develop a helpful system to help improve crop yields and interest in chicken cultivation without being constrained by changes in temperature and humidity. With good house management, the weight of chickens will be good when weighed during harvest. The study designed a *real-time monitoring* system of temperature, humidity, hazardous gases, and IoT-based broiler hens.

Cite this Article as: Faisal SYAFAR, Misita ANWAR and Ridwansyah "Mobile Collaborative Smart Farm: Proposed Poultry IoT Solution for Indonesia Farming" Proceedings of the 38th International Business Information Management Association (IBIMA), 23-24 November 2021, Seville, Spain, ISBN: 978-0-9998551-7-1, ISSN: 2767-9640

Theoretical Foundations

Internet of Things (IoT) technology is a very social impact that is defined as solving the problems that exist today. Technically, IoT standardization describes the global infrastructure of meeting people's information needs based on ICT development that allows physical things to be physically connected.

The Internet of Things is defined from two words: "internet" and "Things." "Internet" means a computer network of internet protocols (TCP/ IP) as information in a specific scope to communicate. "Things" means an object taken from the physical world through sensors sent over the internet. The results of the submitted object are expected to be easier to understand by *the stack holder* in performing the restatement. Therefore, the three supporting components are the internet, things, and semantics as the embodiment of the *internet of things.*

State of the Art
Applied research using IoT technology has been extensively conducted for temperature and humidity monitoring (Barik, 2019, Baeta, 2020, Neves et al., 2020). However, the application of IoT to also monitor various harmful gases such as ammonia gas, methane, and carbonation, and chicken weight is the first study to be carried out.

Web Server
Web browsers known as web servers accept clients from requests in the form of web pages over HTTP or HTTPS of software on the server and send back the results in HTML documents on standard web pages (Solochin, 2016). To design a website, several elements are needed, namely HTML, PHP, and MySQL HTML is the basis for displaying web pages that stand for HyperText Markup Language. PHP is a development site used in conjunction with HTML extensively to handle creation, which stands for Hypertext Processor. MySQL is a user application interface of the results of a running database. Data that is stored and that is well integrated with a computer is called a database. The need for a DBMS *(Database Management System)* as a database manager (Meher, 2019).

Thingspeak
Thinspeak is a web-based open API IoT *source information platform* that is comprehensive in variety and conspiracy as a store of data from IoT applications, the resulting output of the web level in form. Communication with the help of an internet connection is called thingspeak, which acts as a carrier between interconnected sensors, analyzing, storing, and observing a microcontroller's perceived data from a sensor.

Sensor DHT22
DHT22 sensor is a temperature and humidity gauge sensor. DHT22 is a digital signal that is already calibrated and can be ascertained that the sensor is more stable because the sensor calibration program is stored in the type of program in OTP *(One Time Programmable) memory*. When the sensor detects, it will read the coefficient values already stored in memory (Kusharga, 2019).

Software Arduino IDE
Arduino software is used using a simple program that is C language that is facilitated with *libraries.* IDE*(Integrated Development Environment)* works to write programs, *compile* and *upload* programs to Arduino microcontroller *boards.*

Broiler Chicken Rearing
Broiler chicken is a type of chicken breed that is the flagship breed of crossbreeding from chicken nations that have high productivity power, especially in producing meat. Chicken broiler has its advantages and disadvantages. The advantages of broiler chickens are tender meat, large body size, wide chest shape, dense and contained, the efficiency of feed is relatively high. Most of the feed is converted into meat, and weight gain is speedy. The disadvantage is that it requires intensive and careful maintenance, is relatively more sensitive to an infectious disease, is challenging to adapt, and is very sensitive to changes in environmental temperature. According to Baeta (2020), chicken maintenance includes many factors such as preparation, arrival of DOC, feed and drinking water, temperature, floor mat system. The ideal temperature for broiler chickens is 23-26°C. The provision of feed and drinking water must be adjusted to the number of chickens so that each chicken gets the opportunity to drink and eat. The color of the critical feed place is considered, especially where the feed is round or tray-shaped for *chicks (chick feeder tray)* made of plastic and usually red (Neves et al., 2020).

Research Method

The study applies a design model developed by Dick and Carey (1985), namely ADDIE, as shown in Figure 1. The research design consists of five *stages:* Need Analysis, Planning and *Design, Development, Implementation,* and System *Trials (Evaluation).*).

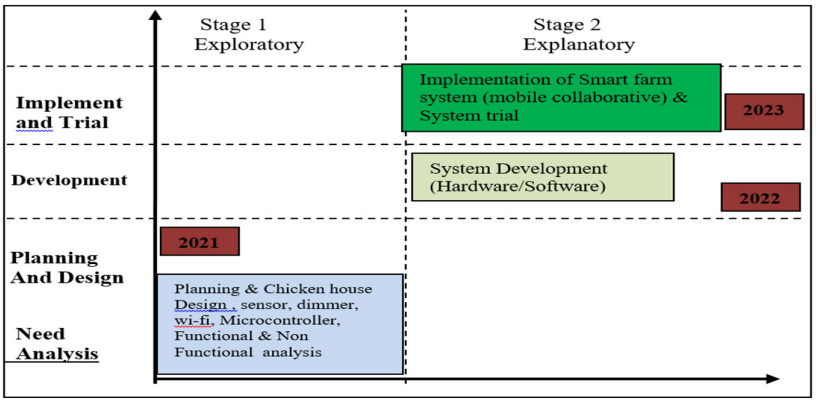

Figure 1: Research flow diagram

Stages of Needs Analysis

At this stage, data collection is done in several ways, namely, literature studies and observations. This literature study aims to look for data on temperature and humidity control in broiler chickens and information related to the design and manufacture of tools.

Collection and Analysis of System Needs

Functional and non-functional analyses are needed to analyze more straightforward. The data analyzed for system design are as follows:

1) Size of broiler house
2) Sensor placement
3) Temperature sensor
4) Humidity Sensor
5) Incandescent lamps (heaters)
6) Fan (cooler)
7) *Mist Maker*
8) *Ac Dimmer Circuit*
9) Relay,
10) Microcontroller
11) Wifi Module

System Planning Stages

The activities carried out at the planning stage are:

1) System Illustration
   It is a stage that is done to describe the design model of the temperature and humidity arrangement tool in the broiler house that suits the needs of the house.
2) System Diagram Block
   Know what components the system needs, then describe the whole system diagram block.

System Design Stages

1) Wiring plan
   Determine the components that follow the system's needs, then design the *wiring* scheme of all the components used.
2) Mechanical System Design
   Design and describe the construction of the system design and document the construction of the system created.
3) Program Planning

Design an algorithm that matches the characteristics of the sensor to be used. It then designs a controlling algorithm that will be used to control the tool to work as expected.

4) System Performance Parameters

Design and determine the methods used to analyze and formulate data processing that will be carried out to support the analysis process.

5) Formulation of System Relatedness

Select and determine the product using the tool created, logically identifying the selection of product users.

Development Stages

Developing a temperature and humidity regulation system in a broiler chicken coop consists of an interconnected system so that the hardware can be controlled by software.

A. Hardware Development

In this stage of hardware development, all the components used will be explained individually, including the circuit scheme of each component, pin mapping table, and overall circuit scheme.

1) **ESP8266 Wifi Module**

The ESP8266 wifi module is used as a sender of information. The wifi module works when the temperature and humidity measurement readings received are sent to the *interface.*

2) **DS18B20 sensor**

The development of a temperature control system uses only one sensor, the DS18B20 sensor. Readings from the DS18B20 sensor cover the entire chicken coop.

3) **16X2 LCD module**

LCD circuits are used as a media *interface* to provide information and display the updated value of temperature and humidity in broiler houses.

4) **Overall Development of Hardware Systems**

The entire series of modules is composed of several components into a system, in which there is a series of *inputs,* process circuits, and output *circuits.*

B. Software Development

The stages of programming temperature control, humidity, harmful gases, and chicken broiler weights by utilizing *the Internet of Things.*

1) **Development of Temperature Control *Software,* Humidity, Hazardous Gases, and Chicken Weights**

Sensor control programming aims to determine the temperature state in the house. The working principle reads the temperature, humidity, harmful gases around the coop, and the condition of the chicken is transformed into a specific weight displayed on the LCD.

2) ***Thingspeak Web* Development**

The central development of *software* is web *thingspeak.* This research aims to be able to connect esp8266 to the web *thingspeak,* which is expected to *monitor* the temperature, humidity, harmful gases, and weights of chickens remotely that can be accessed anywhere through an internet connection mobile phones (*mobile phones).*).

B. Broiler Chicken Coop

The broiler chicken coop that will be made on this system is made of triplet material for its walls, while the pillars are from wood beams, the floor is of small wood with a distance of 1 cm, and on the front is made of net wire.

System Implementation and Testing Stages

1) Implementation of Smart Farming system

After all systems, both hardware and software, are developed, the system is applied to the boiler chicken coop developed itself. The next step following the system's application in the artificial house is to analyze the data and

conduct *software testing, hardware* and test how much the tool performs. The tests will be carried out in three stages: Functionality, Connectivity, and Delay in software, hardware, and houses, as follows:

2) **Software Testing**

Software *testing* will be conducted using a microcontroller pin configuration evaluation. This is done to find out if the hardware configuration through Arduino pins can run well and smoothly. As well as making sure the *hardware* has worked following the design of how tools and programming work.

3) **Hardware testing**

Hardware testing (microcontrollers, sensors, LCDs, lights, fans, mist makers) is done to ascertain whether the I/O pin can function correctly. In this test, all Arduino pins in the program become *output* pins and measured *output voltage*.

4) **Broiler house performance testing**

The tests conducted on this study are testing for temperature control, humidity, harmful gases (ammonia, methane, carbon dioxide) and the weight of broiler chickens in empty house conditions or without broilers, and the condition of houses containing broilers. This test aims to know the overall performance of the system without interruptions and with interference during the testing process. The system is operated for a full day and is observed and captured data displayed on LCDs and web *things.*

Conclusion

It is expected that the research finding will obtain a greater control of broiler flock's condition through the visualization of all kinds of essential information, including immediate situation and equipment setting, which can be accessed from the internet, smartphone, or even a PC.

References

- Baeta, FC, 2020, 'Thermal comfort temperature update for broiler chickens up to 21 days of age' Engineering Agriculture, Vol. 33, No. 1.
- Barik, L., 2019, 'IoT based Temperature and Humidity Controlling using Arduino and Raspberry Pi,' International Journal of Advanced Computer and Applications, Vol. 10, No. 9.
- Dick & Carrey, L. 1985,'The systematic design instruction. Second Edition. Blennview. Illonois: Scott, Foreman and Company.
- Kusharga, 2019,'Digital-output relative humidity & temperature sensor/module DHT22. https://www.sparkfun.com/datasheet/sensors/temperature/DHT22.pdf
- Meher Sibananda, 2019,'Database Management System', https://www.academia.edu/35634140/Database_Management_System_Tutorial
- Neves, DP, Banhazi, TM. And Naas IA., 2020,'Feeding Behaviour of Broiler Chickens: a Review on the Biomechanical Characteristics' Rev Bras Cienc Avic, Vol. 16, No. 2.
- Solichin. "*Pemrograman web dengan PHP dan MySQL".* Universitas Budi Luhur : Jakarta, 2016.