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UTILIZATION OF TELEMETRY SYSTEMS IN QUAIL FARMING USING THE IOT CONCEPT

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ABSTRAK

Unggas salah satu sektor yang tumbuh secara signifikan khususnya di Negara Indonesia, karena dalam peternakan unggas khususnya puyuh dapat memberikan hasil panen berupa daging dan telur yang bergizi. Dalam informasi yang didapat produksi daging puyuh mengalami peningkatan sebesar 26.86% dan pada telurnya mengalami penuruan sebesar 4.69%. Dalam studi literatur yang didapat, ketika beternak unggas terkadang mengalami kondisi yang dinamakan *heat stress* yang disebabkan oleh temperatur udara dan kelembapan ruangan atau kandang melebihi batas zona nyaman pada tubuh puyuh. Untuk mengatasi hal tersebut sehingga dibuatlah produk penelitian ini dengan memanfaatkan teknologi IoT. Tidak cukup disitu, dalam penelitian ini diimplementasikan juga system telemetri dalam menentukan nilai – nilai *set point* untuk mengatasi suhu dan kelembapan yang ekstrem, serta memberikan nilai *set point* pada waktu makan supaya tepat waktu. Hasil data pembahasan ketika diimplementasikan produk penelitian didapatkan rata – rata suhu dan kelembapan sebesar 29°C dan 72.1%, kemudian untuk hasil data nilai tanpa implementasi produk penelitian didapatkan dengan nilai suhu dan kelembapan sebesar 32.5°C dan 57.2%. Selisih suhu dan kelembapan sebesar 3.5 dan 14.9, cukup siginifikan. Hal tersebut dapat dikatakan bahwa implementasi produk penelitian kedalam kandang puyuh dapat meminimalisir suhu ekstrem didalamnya. Selain itu dalam penelitian ini juga diimbau pada kurun waktu yang ditentukan agar memberikan vitamin yang dicampur kedalam minum puyuh dengan dosis yang sesuai, agar puyuh tetap sehat.

Kata kunci: Unggas, puyuh, IoT, system telemetri.

ABSTRACT

Poultry is one of the sectors that has grown significantly, especially in Indonesia, because poultry farms, especially quail, can provide crops in the form of nutritious meat and eggs. In the information obtained, quail meat production increased by 26.86%, and eggs decreased by 4.69%. In the literature study obtained, when raising poultry, sometimes they experience a condition called heat stress caused by the room's air temperature and humidity or cage exceeding the comfort zone limits on the quail's body. To overcome this, this research product was made by utilizing IoT technology. There needs to be more there. In this study, a telemetry system was also implemented to determine set point values to deal with extreme temperatures and humidity and provide set point values at mealtimes so that they were on time. The results of the discussion data when the research product was implemented obtained an average temperature and humidity of 29°C and 72.1%, then for the results of the value data without implementing the research product it was obtained with a temperature and humidity value of 32.5°C and 57.2%. The difference in temperature and humidity is 3.5 and 14.9, which is quite significant. It can be said that the implementation of research products into quail cages can minimize extreme temperatures in them. Apart from that, in this study, it was also advised to provide vitamins mixed into the quail drink at the appropriate dose so that the quails stay healthy during the specified period.

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***Keywords**: Poultry, quail, IoT, telemetry system.*

INTRODUCTION

Raising poultry is a common thing that some people do. Sometimes raising animals has obstacles due to our need for more focus as owners to look after these animals (Ananda, Saragih, & Hidayat, 2022). So we need a technology that can help livestock activities (especially quail farming) and, of course, aims to make it easier for humans to raise poultry.

Poultry is an agricultural sector that has grown significantly (Yalviolita & Hendayani, 2022). The poultry industry provides meat and eggs that are liked by almost all cultures, are affordable, and are of good quality (Daryanto, 2019). Some of the things that can be conveyed in this journal are information obtained from the 2021 Livestock and Animal Health Statistics Book. The book explains that there are categories of livestock groups, including various types of livestock, namely rabbits and quail. In 2020 quail meat production will increase by 26.86%, and quail eggs will decrease by 4.69% (Directorate General of Livestock and Animal Health, 2021).

Quail is one of the livestock that has advantages as a producer of eggs and meat (Widjadtuti & Sujana, 2022). Producing quality quail meat and eggs is related to external factors such as temperature and humidity in the area around quail livestock. Indonesia is a country that is on the equator, which also makes Indonesia a tropical climate country (Wijaya, 2019). According to research from Lela Nurpulaela et al. in 2021, it was explained that especially in tropical areas with high air temperatures, it would affect the continuity of poultry development because birds can only control their body temperature in the range of 16°C-26°C (Nurpulaela et al., 2021).

It should be noted that poultry has a condition called heat stress. Heat stress is a condition caused by temperature and humidity exceeding livestock's comfort zone limits (especially quail). Reasonable temperature, humidity, and feeding and drinking (accompanied by vitamins) can minimize heat stress. Of course, suppose the phenomenon of heat stress occurs in poultry, especially quail. In that case, it can significantly affect livestock yields that are not good, so a particular technology is needed to overcome this.

Then after doing a literature study, the next step is to do an initial field trial, namely with a closed quail cage without implementing the product made. This aims to find out the initial problems when raising quail-type poultry.

Figure 1. Initial Fields Trial.

The initial field trials still needed to improve, especially in producing less than optimal temperature and humidity in the cage. The feed and drink were also still manual, so sometimes they needed to be given on time. Sometimes quail are also close to each other or clustered for a long time, and this is due to exposure to extreme temperatures. Initial field trials are included in our background in this research in the form of technology we want to implement into quail-type poultry cages.

The problem that can be concluded based on initial field observations and information from literature studies is that in raising quail to produce good quality quail, a technology is needed that can control the temperature and humidity of the cage automatically and continuously, as well as automatic feeding and drinking based on a predetermined time. This is done to minimize the occurrence of heat stress on the quail. Then in the initial field test, there was no monitoring of temperature and humidity in the cage, so the indicator values for temperature and humidity in the quail cage were not known during the initial field test.

The purpose of this research is to provide convenience, overcome problems often experienced by the community when raising quail types of poultry, and produce better quail

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livestock. Then other research objectives are to minimize heat stress when raising quails and also to be able to provide food and drink promptly. Then, of course, this research product aims to monitor temperature and humidity and control other features in the quail cage remotely with a device that can be installed and accessed by the Telegram application.

This research will make a product that can regulate the temperature and humidity in the quail cage, then to regulate the temperature and humidity in the cage continuously, it needs to be applied to a system technology that can work automatically and continuously, so a microcontroller, sensor, and supporting output device. The microcontrollers used are NodeMCU and Arduino Uno, and the sensors used are DHT22 and supporting output devices such as bulbs, DC fans, and DC 5V water pumps. The remote control and monitoring of the telemetry system will rely on IoT technology based on the Telegram bot.

RESEARCH METHODS

This research uses a quantitative approach with a descriptive method (Yuliani, Nurpulaela, & Latifa, 2021). This research was conducted utilizing initial field test observations, literature studies, and documentation of product trial results in stages. After that, data analysis was carried out, and the conclusions on the research topics were summarized.

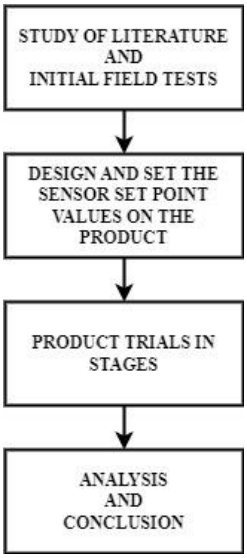

Figure 2. Research flow block diagram.

The research flow begins with a literature study and then conducts an initial field test. Then proceed with product design and determine the DHT22 sensor set point value and the time of feeding quail on the DS3231 RTC module. So that product trials can be carried out immediately and analyzed and conclusions are drawn.

The 12V DC fan functions into two functions, the first as a fan and the second as an exhaust. The fan provides fresh air from the outside to the inside of the cage, then exhaust to suck moist air from inside to outside the quail cage.

The set point value in this study was adjusted according to the average temperature in the study area. The research was conducted in Karawang City, Klari Pancawati District. Based on the information observed from Weatherspark, Karawang weather is in July with daily highs of around 32°C, rarely dropping below 30°C or exceeding 33°C. The highest average daily low was 32°C on July 13 (Cuaca Juli di Karawang Indonesia. 2022). So with the implementation of this research product, maximum efforts have been made to minimize extreme temperatures and humidity in the research area.

Table 1. Set point value set

Temperature	Humidity	Feed
When the temperature is above 29° the fan turns on.	When the humidity is above 74%, the exhaust turns on.	Feed was regulated as needed, in this study the feed was regulated three times a day, namely morning (07.00WIB), afternoon (13.00WIB), and evening (20.00WIB).
When the temperature is below 25°, the bulb will light up	When the humidity is below 71% then the fan turns on.	

In designing this research by relying on IoT technology and telemetry systems. IoT is accessed via the NodeMCU microcontroller then telemetry systems are accessed via the Arduino Uno microcontroller. The IoT platform has the advantage of easier data management because all rely on cloud storage (Rustami et al., 2022). So, with IoT technology, monitoring and control can be

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done remotely and must use the internet as an access medium. Then the product concept for further research uses a telemetry system. It could have been combined using one NodeMCU microcontroller. However, this study was deliberately separated into two microcontrollers for the first reason to minimize delay and the second to facilitate wiring in research products.

Basic Theory

There are three main theoretical bases in this research's focus: the internet of things (IoT), intelligent systems, and set points. These three foci of research are being tested to get results and conclusions in this study. Especially in the set point, in the set point it is necessary to pay special attention to the value that will be given because when you give the set point value to the sensor and module, the system will run automatically and continuously, without any touch or control when the product is continuously lit. Explanation of the three constituents of the basic theory of this research can be briefly explained as follows:

a. Internet of Things (IoT)
   In the new era of networking technology, we cannot deny the greatness of the Internet of Things (IoT) (Manshor, Rahiman, & Yazed, 2019). IoT is a set of things connected through the internet (Saragih et al., 2020). Like how to process data obtained from electronic equipment through an interface between the user and the equipment (Rahmadhani & Arum, 2022). So an effort has been taken to provide a reliable and user-friendly application for easy use and monitoring of electrical devices (Gupta & Johari, 2019). IoT is undoubtedly beneficial for human activities, for example, the implementation of IoT in this research. IoT can be accessed using LoRa microcontrollers, ESP32, NodeMCU, etc.
b. Telemetry System
   Telemetry is a measurement technology carried out remotely and reporting information to the system designer or operator. The word telemetry comes from the Greek word telemetry, meaning distance, and metron meaning measurement. In terms of telemetry is defined as a field of engineering that utilizes instruments to measure heat, radiation, speed, or other properties and sends the measured data to recipients who are physically far away, out of reach of observers or users.
c. Set point
   Based on this research's theme, the set point is a sensor or module reading value variable set to achieve the desired value. For example, if a set point is given at a temperature of 25°C below, the bulb will light up. The concept of the set point here is that when the reading value of the sensor reaches a temperature value of 25°C below, the sensor will give a signal to the microcontroller and then send it to the Normally Open (NO) relay, and the relay will provide a voltage to the output device (bulb) where previously the output device (bulb) is in the off position so that when the relay gives voltage, the bulb will light up when the temperature value is below 25°C

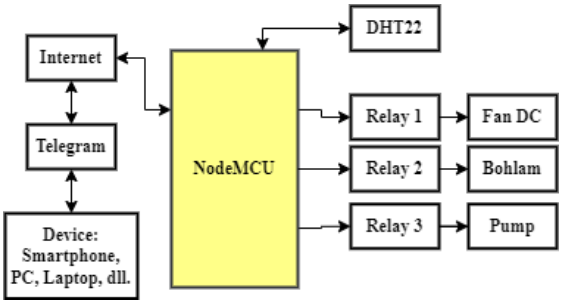

Figure 3. IoT hardware block diagram.

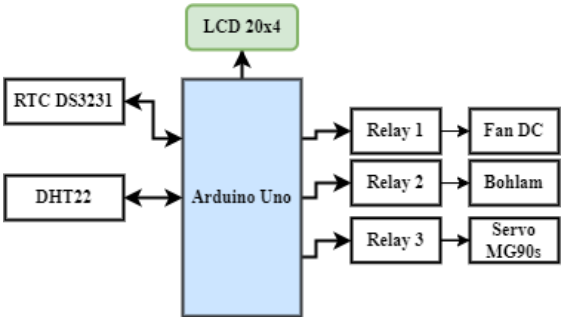

Figure 4. Telemetry system hardware block diagram.

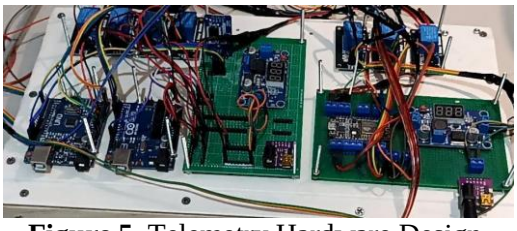

Figure 5. Telemetry Hardware Design.

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Figure 6. Quail Cage Prototype.

RESULTS AND DISCUSSION

Implementation of IoT and telemetry systems in quail cages went well, as expected. Combining the two can minimize the problems summarized in the research background. The features contained in this research product are as follows:

Table 2. Parameters Controlled Using a Telemetry System

No	Fiture	Description
1	Manual control and monitoring of temperature and humidity	For IoT-based remote use a smartphone that has the Telegram application installed, then this product can also be monitored by looking at indicators via a 20x4 LCD.
2	Automatic control of temperature and humidity	By setting it through a telemetry system based on the sensor and module set point values that have been set in Table 3.
3	Drinking control	Can be controlled via a Telegram Bot-based device.
4	Automatic Feed	Set based on the set point value in Table 3, the automatic feed works continuously when the tool is on. When the time reaches the set point value, the servo will open the feed valve and the food will come out into the quail feed container.

Then an analysis of the reading value of the sensor is carried out to find out whether this product can overcome the problem of temperature and humidity that are too extreme for quail. Testing is carried out in stages to obtain sensor reading value data. The value that will be displayed is the reading value of the sensor originating from the telemetry system (Figure 4), please note that the IoT system is made for the sole purpose of remote control and monitoring which functions to check temperature and humidity as well as on and off controls on bulbs, fans and waterpump. So that Table 3 is data from telemetry systems only for the block diagram of the system as shown in Figure 4.

Table 3. Data from sensor reading values through research products

No	Temp (°C)	humidity (%)	Explanation
1	30	71	Fan on
2	30	72	Fan on
3	30	72	Fan on
4	30	72	Fan on
5	29	74	Exhaust on
6	29	75	Exhaust on
7	29	75	Exhaust on
8	28	72	-
9	28	72	-
10	28	72	-
11	28	72	-
12	28	72	-
13	28	72	-
14	30	69	Fan on
15	30	69	Fan on
Average :	29	72,1	

Figure 7. Weather monitoring results during research

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As with other temperature and humidity comparison data, sensor testing was carried out using Arduino.IDE serial monitor without implementing the sensor set point value for supporting output devices (such as bulbs, fans, and exhaust). The data is presented in Table 4..

Table 4. Data from sensor reading values via serial monitor as a comparison

No	Temp (°C)	Humidity (%)
1	32	57
2	33	56
3	33	57
4	33	57
5	33	56
6	33	57
7	33	57
8	33	56
9	32	57
10	32	58
11	32	58
12	32	58
13	32	58
14	32	58
15	32	58
Average:	32.5	57.2

The results of product implementation in telemetry system testing based on setting the sensor and module set point values (Table 1) have been successful because they can minimize the air in the quail cage, it is said to be successful because the air in the cage has been minimized by the research product, where the air in the area around the study is higher than in the quail cage, at the air temperature around the research that was reviewed first using Google Weather, Serial Monitor and Weatherspark where the forecast for the weather around is in the range of 31°C to 33°C. Then the results in Table 4 are obtained with an average temperature of 32.5°C and humidity of 57.2% (RH units). Table 4 is the result of testing using a serial monitor. This is done to compare sensors to data results in Table 3. In the data results, Table 4 obtained an average temperature that is slightly higher and very low humidity. It can be concluded that the test data in Table 4 for the implementation of the set point for the output device is very influential on the temperature and humidity conditions of the cage without a set point that provides on or off access to the output device, the conditions in the quail cage cannot provide the best air quality for the continuity of quail activity, of course, Unfavorable temperature and humidity as in the average results of Table 4 will result in unwanted things for quail. Then on the average experimental data collection in Table 3, the average temperature obtained is 29°C, and the humidity is 72.1% (RH units). Of course, with these results, it can be said that product implementation has been successfully carried out based on the results of research product testing data in Table 3.

It should also be noted that there is a difference in the average values obtained between the two research data. The average value obtained from Table 3 is a temperature of 29°C and a humidity of 72.1%, then in Table 4, it is obtained with an average temperature value of 32.5°C and a humidity of 57.2%. So that the difference between the two is at an average temperature value of 3.5 and humidity of 14.9. Thus the difference between the two is quite significant. In the data in Table 4, it can be said that the temperature and humidity are unstable or can be said to be extreme because, in the results of the test data, Table 4 does not use the implementation of control monitoring and is not given a sensor and module set point value in the system so that the value the data obtained is extreme, this is different from the results in Table 3 which have implemented the full features of this research product. It can be said that the difference is quite significant because, in Table 4, the data for the temperature and humidity values are pretty extreme.

Then to give the quail good quality, the quail drinking container is mixed with poultry vitamins at the appropriate dosage. The quail drinking feature can be controlled through the PUMP feature in Figure 9. So with all the efforts in discussing the results of this research with full hope, it can give good results in the quail livestock that will be obtained.

Figure 8. Quail activity in research takes place

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Figure 9. IoT on the Telegram application uses a telemetry system

CONCLUSION

From the data that has been obtained in the results and discussion, two points of conclusion will be given in this study, namely:

a. The creation of this research product can provide convenience in quail-raising activities by providing a technology that can be controlled and monitored using IoT. Then there is also a telemetry system that can minimize temperature and humidity and provide food and drink. All of these features have been successfully tested.
b. Determination of the set point value has been carried out optimally. Given the set point value on the telemetry system, it has succeeded in minimizing extreme air. This is seen from the difference in the average data obtained from Tables 3 and 4.
c. Several things must be done by paying attention to excellent and timely food and drink. The feed based on the telemetry system is regulated once every three days, as shown in Table 2. Feeding quails is by giving our yellow poultry. Drinking can be controlled through Telegram bots, and drinking is occasionally mixed with vitamins in sufficient quantities. This effort is carried out to help the development of quail in order to produce livestock with the best results.

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