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Temperature Control and Scheduled Feeding for Quail with Optional Control

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Abstract: Quail chicks are delicate and require careful attention, as they tend to die easily, particularly in their first 1-2 weeks of life. Therefore, the purpose of this project was to develop a monitoring and controlling product for quail food and temperature prototype. The development process utilises the design thinking model, which consists of five stages namely, Empathize, Define, Ideate, Prototype, and Test. The prototype uses temperature, food and water level detectors, and utilizes an Arduino uno microcontroller and NodeMCU to connect to the Blynk apps as a display for remote monitoring. The prototype is designed to control the temperature in the quail cage by using a DHT11 temperature detector with a heating bulb. The food quantity is detected with a load cell, which indicates the food quantity. The waterlevel detector uses a float switch sensor to detect the drinking water level in the quailcage. The functionality and usability test indicates an encouraging finding for further exploration and for future product improvement.

Keywords: Quail, Temperature Control, Automatic Feeding, Blynk Application, Arduino Uno, Wi-Fi Module NodeMCU ESP8266, DHT11 Sensor, Load cell, Float Switch

1. Introduction

Quail is a species of poultry found across Europe, America, Africa, Australia, and Asia (Woodard et al., 1973). In 2020, Malaysia had 301 quail farms among 2,483,308 poultry farms, making it the most abundant poultry species (Malaysian Livestock Statistics, 2020). This highlight the high demand and importance of quail breeding in Malaysia. Quail meat and eggs are in high demand due to their benefits to human health, as they contain protein, nutrients, and healthy fats essential for growth and development. Quail eggs are a good source of protein and have been shown to reduce the risk of anemia due to their iron content.The future of Japanese quail for research and production (2019). Thus, quail eggs offer high benefits to the human body.

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Female quails start laying eggs at 35 days old, usually at 40 days, and reach full egg production at 50 days. They can lay an average of 250 eggs per year and produce 3-4 generations annually. The future of Japanese quail for research and production. (2019). Ovum production and thus egg production is influenced by sufficient nutrient intake. The future of Japanese quail for research and production. Males grow faster than females, but females reach sexual maturity earlier and may lay eggs at 42 days old. The high quality of quail drives the demand and market for the species; however, the supply of quail must be increased to meet the demand. Every day, the demand for quail eggs reaches 200,000, according to Mustafa (2019). This high demand requires a significant increase in quail breeding to quickly produce many eggs. As demand for quail continues to grow, breeders must raise and produce more quail to meet the demand.

2. Methodology

The Design Thinking Model was chosen as the methodology to develop prototypes for temperature control and scheduled feeding for quail with optional control. This model is a practical approach, especially for developing products and services that aim to solve problems creatively. Furthermore, the model also strives to discover innovative solutions to problems by focusing on the genuine needs of users. The Design Thinking Model will be used to execute the development process for this project, which consists of five (5) primary phases for product development: empathy phase, defining phase, ideation phase, prototyping phase, and testing phase.

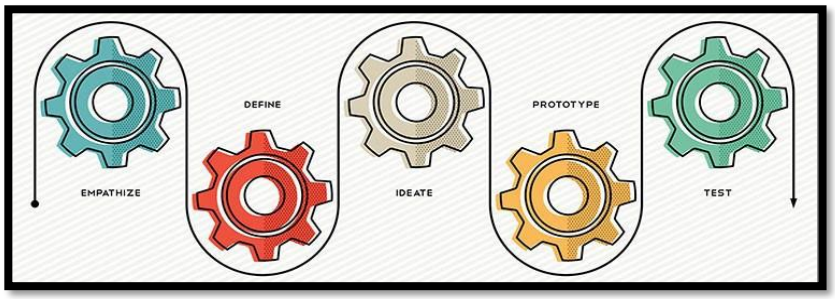

Figure 1: Design Thinking Process (Scott Timer, 2018)

2.1 Empathy Phases

At the start of this study, an unstructured interview was conducted with quail farmers to gather information about the problems they face while farming. This is to further understand the problems faced by the farmers. The scope of the study was determined first. This is to ensure that the project developed can be simplified and produced in a systematic manner, that is organized and makesthe project have a defined focus and focused emphasis in line with the initial set topic and objectives of the project. At the beginning, it was found that quails are birds that require careful care based on the unstructured interview conducted at the quail farm.

2.2 Define Phases

After completing the unstructured interviews with the quail breeders, the define phase can now begin to determine the causes and causes of the observed problems which are:

i. Quails Sensitive to temperature.
ii. Quails need to be fed on time.
iii. Quails need enough water for good health.

2.3 Ideate Phases

During this phase, the focus is on designing a prototype for temperature control and scheduled feeding for quail. This also includes identifying the means to solve the problem, as well as selecting the components that will be used.

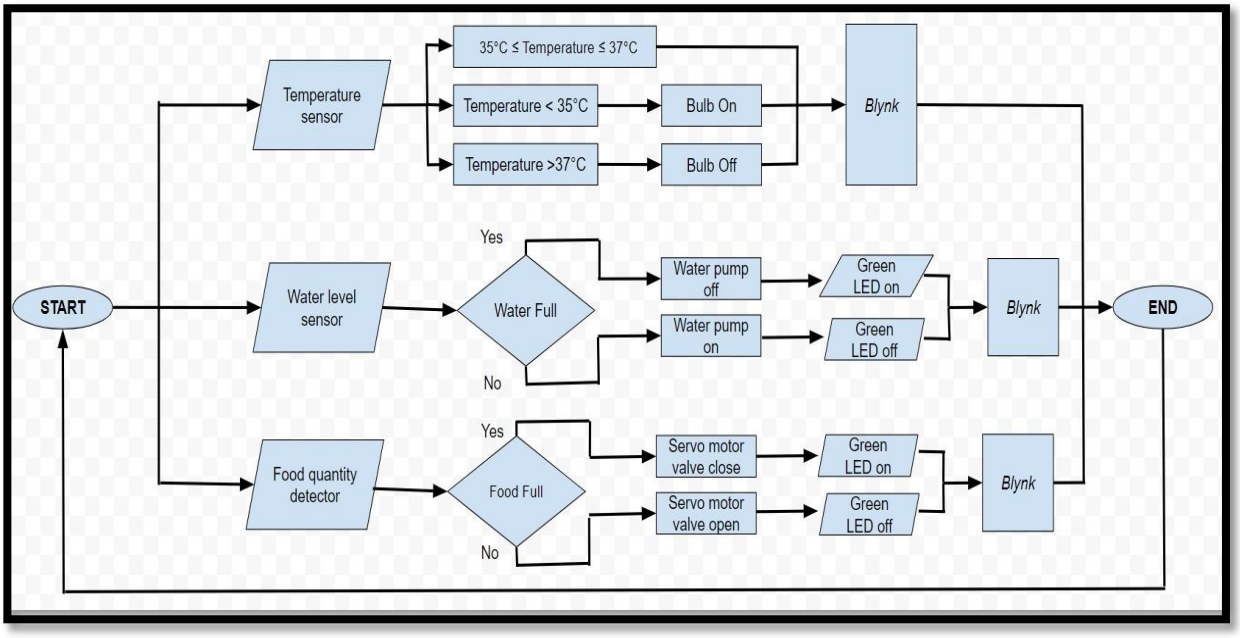

Figure 2: Prototype flow chart

Figure 2 shows the operation of three different detectors in a device that serves food and drinks. The first detector is a temperature detector that reads the temperature of the food and displays it on the Blynk application. If the temperature is within the normal range of 35°C to 37°C, the display will show the reading. However, if the temperature is below 35°C, a bulb will light up indicating low temperature, and if the temperature is above 37°C, the bulb will go out, indicating high temperature. The second detector is a water level detector that monitors the water level in the drink tray. If the water level is sufficient, the water pump will stop, and a green LED indicator will light up. The drink indicator on the Blynk app will also light up, indicating enough drink. However, if the water level is insufficient, the water pump will start pumping water into the tray, and the green LED indicator will not light up, indicating insufficient drinking.

The third detector is a food quantity detector that monitors the amount of food in the food tray. If the quantity of food is sufficient, a servo motor will close the food valve, and a green LED indicator will light up. The food indicator on the Blynk application will also light up, indicating sufficient food. However, if the amount of food is not enough, the servo motor will open the food valve, the green LED indicator will not light up, and the food indicator on the Blynk application will not be lit, indicating insufficient food.

2.4 Prototype Phases.

In this phase, a product prototype will be constructed based on the system design that has been developed. The Blynk application, as shown in Figure 3, will display all the data on a mobile phone.

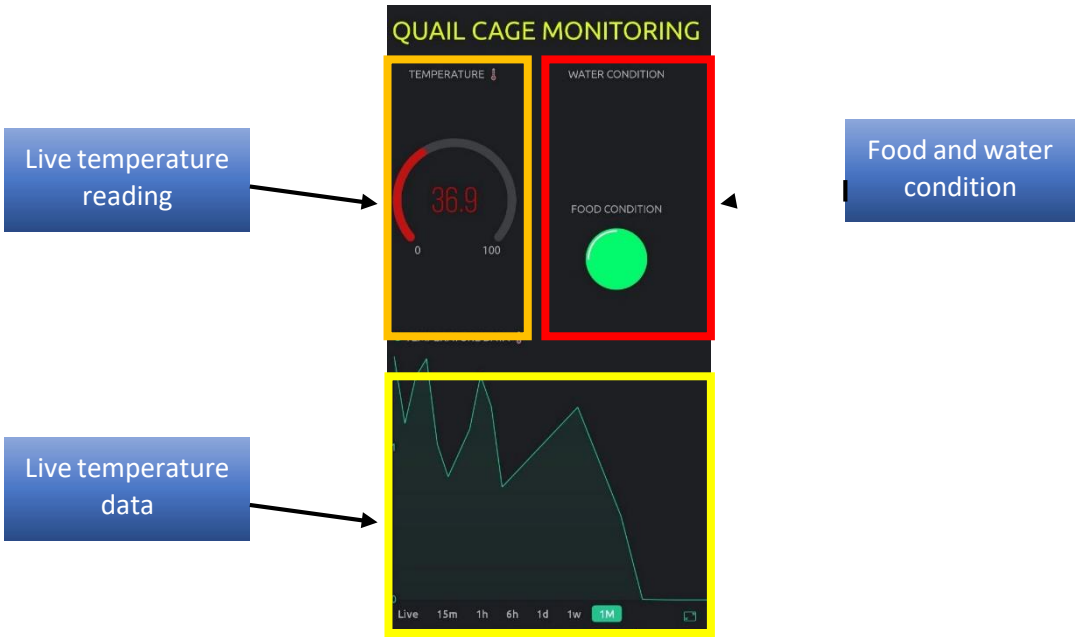

Figure 3: Blynk application display

Figure 4 shows the overall positioning of the components used in this prototype, including the temperature sensor (DHT11) for detecting the ambient temperature, the water level sensor for detectingthe level of drinking water, and the food quantity sensor for detecting the amount of food.

Figure 4: Prototype temperature control and scheduled feeding for quail with optional control

2.5Testing Phases

In this section, various tests were conducted on the developed product. These tests included data analysis covering design analysis, circuit analysis, functionality analysis, safety analysis, and cost analysis. In addition, expert analysis was performed to determine the functionality of this prototype.

3. Results and Discussion

The results and discussion section presents the data and analysis of the system, with all the data and results presented in tabular form. The analysis of all the data was performed by testing each input and sensor used in the prototype.

3.1 Analysis Temperature Sensor Reading

Table 1: Result from temperature sensor (DHT11) reading

Reading	DHT 11	Thermometer
1	37.0℃	36.8℃
2	34.0℃	34.0℃
3	29.0℃	29.0℃
4	29.0℃	29.2℃
5	32.0℃	32.1℃

The sensor readings are highly accurate, and the error that occurs is relatively close to the readings from the thermometer. Based on the accuracy of the temperature readings obtained from the temperature sensor (DHT11), it can be concluded that this sensor is capable of effectively determining the temperature conditions within the cage.

3.2 Analysis Bulb Heat

Table 2: Result bulb temperature

Reading	Bulb on (minute)	Thermometer
1	1	30.0℃
2	2	32.0℃
3	3	33.0℃
4	4	34.0℃
5	5	35.0℃

The result of the reading showed that the bulb is overheating when it is left on for an extended period. The 60-watt bulb can heat up the quail cage. The longer the bulb remains on, the higher the temperature reading will be for the heat produced by the bulb.

3.3 Analysis Load Cell Reading

Table 3: Result reading load cell

Reading	Food quantities(spoon)	Load cell reading (gram)
1	1 scoop	10g
2	2 scoops	15g
3	3 scoops	23g
4	4 scoops	30g
5	5 scoops	46g

The results of the reading indicate that the load cell can accurately measure the weight of foodas it increases or decreases. The load cell functions effectively.

3.4 Analysis Water Level Sensor

Table 4: Result response of water pump

No	Full water	Low water
1	Water pump off	Water pump on
2	Water pump off	Water pump on
3	Water pump off	Water pump on
4	Water pump off	Water pump on
5	Water pump off	Water pump on

The results of the analysis showed that the water level detector can measure the water level both when it is full and when it has decreased, and it can also control the water pump accordingly.The water level detector and water pump function properly/correctly

3.5 Analysis Design

After expert confirmation, it has been determined that this prototype design is unique and original, as it was conceived entirely by the researcher. Additionally, the prototype was produced using readily available materials that were appropriate for its construction.

4. Conclusion

This prototype was developed to simplify quail breeding for breeders by remotely monitoring the environmental conditions of the quails using the Blynk application. The prototype utilizes an Arduino Uno and NodeMCU as a microcontroller to detect the temperature (DHT11), heat the cage (bulb), measure the food (HX711), monitor the water level (float switch), and control the food output (servo motor) and water supply (DC water pump). The prototype has successfully met its objectives.

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