The Design of Automatic Chicken Feeders Machine Controlled by a Smartphone

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Abstract

This paper presents the design of an automatic chicken feeder machine controlled by a smartphone. The DC gear motor was applied to control the flow of chicken feed operated via the ESP-8266 board. When the conveyor thread reaches the last head of the chicken feed pan, the infrared photoelectric switch sensor will immediately cut off the motor. A timer can operate the chicken feeder to turn it on and off. A test run at a speed of 100 rpm shows that the feeder machine can fully feed the chickens in 3:45 minutes, using a power of 11.20 W. The chicken feeders' machine can help provide convenience to chicken farmers. The chicken feeder can be adjusted the feeding time via the smartphone application at any time. The Internet of Things was used for the connection between the smartphone and the chicken feeder, which can control the operation of the machine anywhere. This research can also apply the knowledge to other animal feeding applications.

Keywords: Automatic chicken feeders machine, DC motor drive, Internet of things

Introduction

Nowadays, pets are popular as companions, playmates, companions when lonely, watch over the house in lodges or dormitories or even keep them for sports games such as gamecocks, or fighting chicken. The problem with adopting pets is that they often forget to feed, forget to water, or at times forget to check that the food or water is exhausted. If you have to work outside the home or have to go to work in other provinces or are on a mission to leave the house for several days, causing inconvenience to take care of their pets. There may be a charge if the pet has to be placed in a pet care center that offers temporary pet care (Thaenthong et al., 2019). Conventional feeding involves setting up food and water and adding it from time to time when food and water run out, or the introduction of a convenient device such as a gravity-powered feeding pellet. Traditional feeding can cause problems with forgetting to add food and forgetting to add water when the food and water containers are empty (Vijaya Saraswathi et al., 2022). Although automatic feeders are available today that can be controlled via a mobile application, they are often expensive and not designed to handle proper feeding. Therefore, Smart Farming is playing an increasingly important role today in which technology is used to manage farms or houses (Maksri et al., 2021). It can save the cost and time that would have otherwise been spent on hiring less productive farm personnel. It may be bringing software to alert or bringing hardware to join the farm (Khluabwannarat et al., 2016).

Therefore, this article designs and builds a smartphone-controlled automatic chicken feeder using a microcontroller board and Arduino, which is a ready-made microcontroller board that is popularly applied

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to creating affordable electronic devices. This board is open-source software that most people can use to develop and apply to other devices that can be connected to a Wi-Fi module such as NodeMCU through the Internet of things. So, the objective of this research is to study the working principle of the automatic chicken feeder machine with an internet of things system; study the control of feeding chickens with a smartphone via a wireless network, and design an automatic chicken feeder with the Internet of Things system.

In this paper, Section 2 presents the research objectives; Section 3 presents the design of a smartphone-controlled automatic chicken feeder; Section 4 presents the experimental results and discusses a smartphone-controlled automatic chicken feeder and the last section is the summary of the paper.

Literature Review

Today's computer technology and Smart Phone technology have advanced far and wide, making it very easy to control various electrical devices easily. Smart Phone technology can be applied in a variety of farming operations, one of which is the popular use of Smart Phone technology in chicken farming (Sari et al., 2021). Internet of Things in Smart Farm is applied to set time with a timer to control on/off automatic feeder and water system in collective farm and to monitor and display agricultural data (Rehman et.al., 2022). The IoT is applied to the Automatic Fish Feeder Machine, fish farmers can raise fish efficiently while reducing the number of workers working on the farm, thereby reducing production costs (Olayanju et al., 2018). The Internet of Things is applied to crop management using aquaponics techniques via computer networks, mobile phones, or smartphones. It can connect to the Internet which can be connected to both LAN and Wi-Fi to increase ease of use and access to various devices that need to be operated (Wongsila, 2022). Implementing smart farming systems has increased agricultural productivity. The device collects data from modern sensors and electronics (Nishanthi et al., 2021). Farmers can check an agricultural parameter, including weather forecasts to turn on the water pump and switch on the bulbs to adjust the lighting of the plants in the greenhouse due to low light intensity (Mitouilli, 2022).

Research Methodology

The design of the Internet of Things automatic chicken feeder can be seen in Fig. 1, which consists of a power supply, control unit, and motor and sensor. Switching converts electricity from alternating current to direct current to supply the microcontroller, Wi-Fi signal module and motor control unit. The Blynk application in the smart phone is used as an on/off switch of the motor-controlled microcontroller and can also set the operating time. The feeding is divided into 2 times, morning and afternoon. When the motor is running, the spiral feeds the chicken feed to each feeding tray. When the sensor detects a certain amount of food in the final food tray, it shuts down the control unit of the microcontroller to stop the conveyor motor. Figure 2 shows the flow chart in the operation of the automatic chicken feeder controlled by a smartphone.

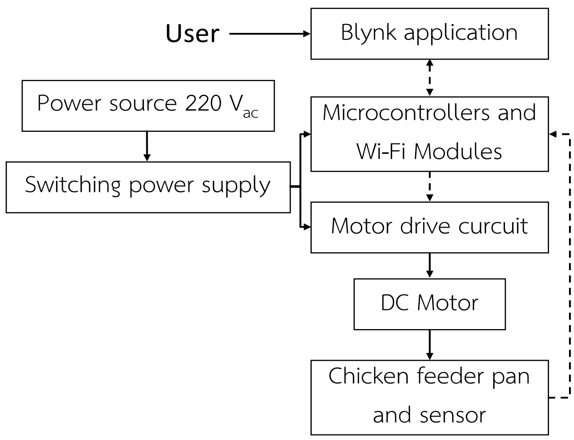

Figure 1. Structure design of an automatic chicken feeder controlled via a smart phone.

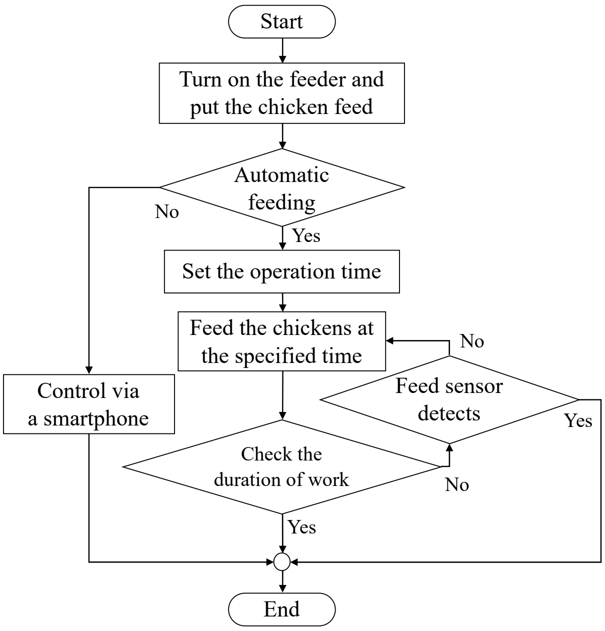

Figure 2. The operation of the automatic chicken feeder controlled by a smartphone.

A. Motor driver circuit design

The DC motor driver uses the PWM (Pulse with Modulation) principle to control the motor speed. PWM is a method of controlling the amplitude of a signal in the form of pulses over a period of time to obtain different average voltages (Faroqi et al., 2018). Which can control a DC motor with a maximum current of 30 A by using a 24 V power supply circuit. The motor speed can be adjusted from 0-100%. Figure 3 shows the motor speed control circuit.

A motor is another electrical device that serves to convert electrical energy into mechanical energy. In this research, gear motors are used to drive the spiral shaft. Gear motors are motors that rotate at a slower speed than normal speed to suit each type of application. Because some jobs can't take the speed of a motor with a speed of thousands of revolutions for some applications. Therefore, the speed must be adjusted accordingly. The DC gear motors are therefore widely used in industrial automation and in small electrical equipment. Figure 4 shows a 24 V 350 W DC gear motor with a ratio of 1: 6.6.

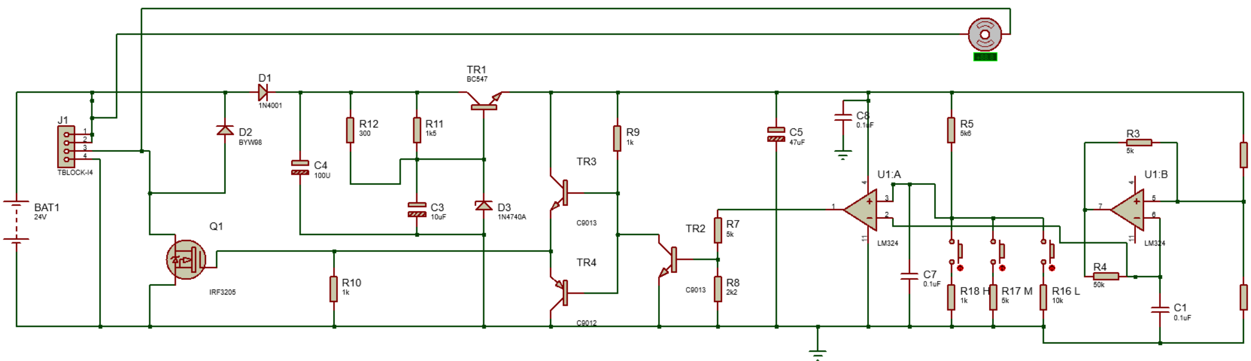

Figure 3. The motor speed control circuit.

Figure 4. DC gear motor 24 V 350 W.

B. Power supply design

The power supply converts from AC power to DC power by using a switching power supply to feed the motor drive circuit. The motor driver can adjust the speed depending on the needs of the application. A 220 V AC power supply is used with a 5 V DC power adapter to be used with the ESP-8266 board. The 220 V_{AC} 24 V_{DC} 20 A switching power supply is used to convert the 220 V_{AC} household voltage down to 24 V_{DC} for the motor drive. There is a cooling fan that can be used with a 24 V DC gear motor. Figure 5 shows the control circuit of the chicken feeder.

Figure 5. The control circuit of the chicken feeder machine.

C. Designing a circuit to control the operation via a smartphone

Node MCU (Node MCU ESP-8266) is a controller board that works according to instructions in C language, similar to Arduino, but has more special characteristics in that can connect to Wi-Fi. The operation can be controlled using the Arduino IDE program as well as the Arduino board. The Node MCU board contains the ESP-8266 (a Wi-Fi capable microcontroller) with conveniences such as a Micro USB port for powering program upload, a chip for uploading programs via a USB cable, a chip voltage converter and pins for connecting external devices.

Blynk application is a platform-based application running on IOS and Android operating systems to control Arduino, Raspberry Pi over the Internet. It is a digital control panel where users can create a graphical interface for their projects by dragging and dropping a wide selection of tools. The Blynk app connects to the Internet via a wireless (Wi-Fi) or wired Internet connection, keeping the device online and ready for use on the Internet of Things. An overview of the Network Blynk system is shown in Figure 6.

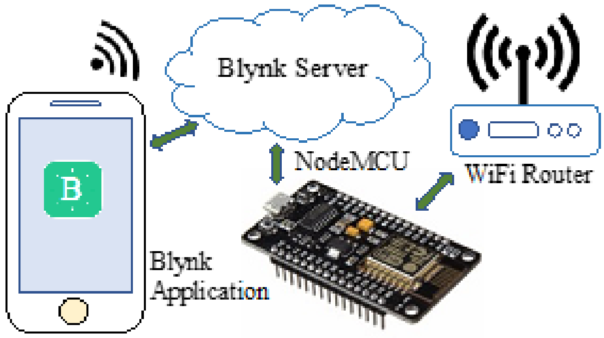

Figure 6. The overview of the Network Blynk system.

D. Designing the structure and components

The structure design has chosen the square tube box steel material to build the structure to attach to the motor. The design of the hopper tank was modified from a plastic water tank, with 20 liters capacity. PVC pipes are used as conveying pipes. Inside the PVC tubes are Auger screws transporting the chicken feed to each dispenser which is connected to the tray. Assemble the structure to a height of 180 cm., and a width of 50 cm, as shown in Figure 7.

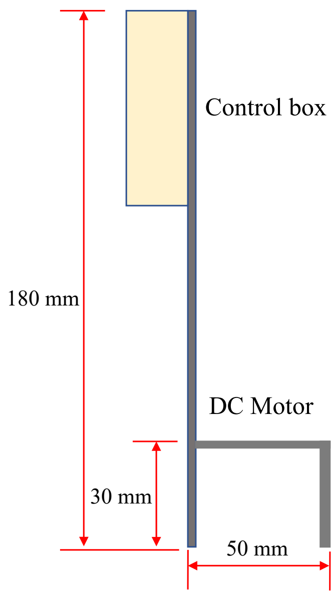

Figure 7. Dimensions of the chicken feeder structure.

Auger screw feeder is made of high-quality steel, flexible and spring-loaded. It can smoothly and quickly transport food through a 90-degree elbow without losing the amount of food during the conveying path. The Auger can be applied to all types of houses for its high conveying efficiency, easy to assemble and easy to operation. It can be driven by both belt and gear motors. The conveyor tube is 210 cm long as shown in Figure 8. Figure 9 shows the tube and screw conveyor model.

Figure 8. Screw conveyor.

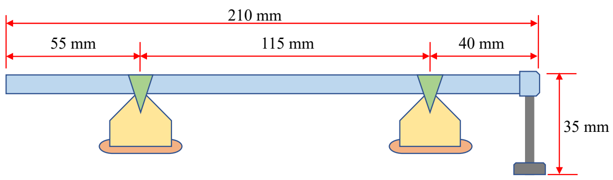

Figure 9. PVC Pipe and screw conveyor model.

The chicken feed pan is a container for an automatic system by receiving food from the arrangement of the screw auger, when it passes through the pan, the food will fall to the bottom of the pan. When the food is fully dropped, the food flows to the next pan as shown in Fig. 10. The dimensions of the chicken feed pan are 35 cm. height, 33 cm. width and 100 cm. distance between the chicken feed pans. Figure 11 shows a model of an automatic chicken feeder machine controlled by a smartphone.

Figure 10. Chicken feed pan.

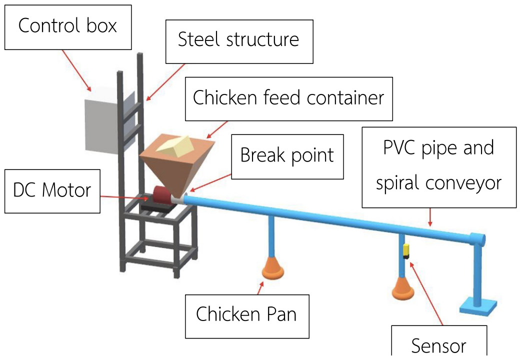

Figure 11. A model of an automatic chicken feeder controlled by a smartphone.

E. Evaluation of chicken feeder efficiency

This research is to design and build a chicken feeder that can be controlled via a smartphone. This chicken feeder can be operated via a smartphone, which can be turned on/off the system and can be set to work time. Therefore, the percent Error and the Accuracy index are used for performance monitoring (Petagon, et al., 2020) The basic equations are used to determine the percent Error as shown in Equation (1). From Equation (1), the Accuracy can be obtained according to Equation (2).

$$\%Error = [\frac{(Xt - Xn)}{X_t}]\ x\ 100 \qquad (1)$$

$$\%Accuracy = 100 - \%Error \qquad (2)$$

Where

X_n is the number of times the machine can work.

X_t is the total number of the test was performed.

Results and Discussions

After the construction of the automatic chicken feeder was completed, the researchers conducted a functional test by adjusting the motor speed and testing the operation of the ESP-8266 module. To check the operation of the Blynk application by programming and controlling it via a smartphone. The test is divided into two tests: 1). Function Test and 2). Machine Performance Test. Figure 12 shows an automatic chicken feeder with two feeding pans.

Figure 12. The automatic chicken feeder.

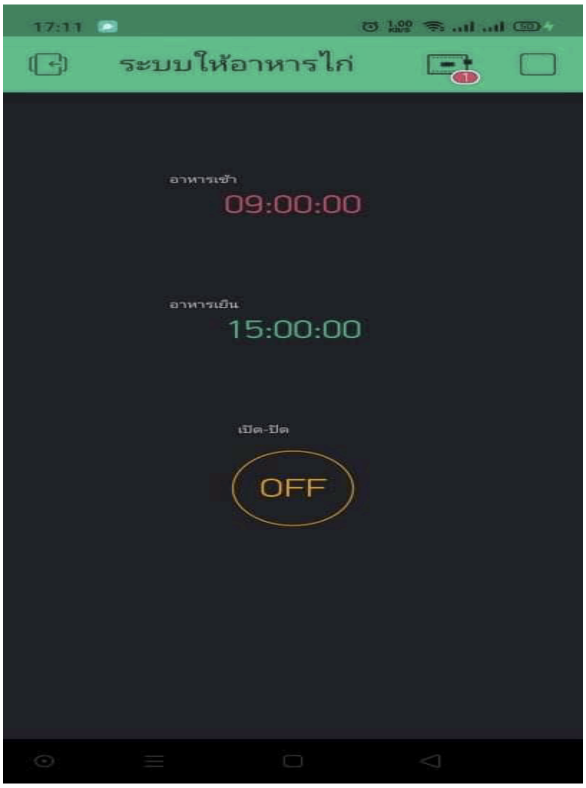

Figure 13. Blynk application display on mobile screen.

A. Function Test

The Blynk application was applied for this test and it has two feeding times, morning and afternoon, which can be switched on and off manually by pressing the ON-OFF button as shown in Fig. 13. Set the time for feeding in the morning from 9:00 am to 09:05 am. In the afternoon, the feeding time is from 3:00 pm to 3:05 pm, feeding time is 5 minutes. From the chicken feed test, if the chicken feed is full before 5 minutes, the sensor will switch off the control circuit and stop working. When a chicken comes to eat at the food pan, the feeder will continue feeding until the set amount of time has passed.

The researcher tested the efficiency of the machine using 1 kg of chicken feed. Test the machine to turn on-off the system on a smartphone and the results of the experiment are shown in Table 1. Table 2 shows a summary of the accuracy of the chicken feed machine Functional test.

Table 1. Functional test of the chicken feeder machine controlled via a smartphone.

No.	Functional test				
	Controlled via a smartphone		Automatic time setting		Stop working with the sensor
	On	Off	On	Off	
1	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓
3	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓
6	✓	✓	✓	✓	×
7	✓	✓	✓	✓	✓
8	×	✓	✓	✓	✓
9	✓	✓	✓	✓	✓
10	✓	✓	✓	✓	✓

Table 2 Accuracy values of the chicken feeder machine performance test controlled via a smartphone.

Case study		Total number of times tested	The number of the machine works accurately	Error (%)	Accuracy (%)
Controlled via a smartphone	On	10	9	10	90
	Off	10	10	0	100
Automatic time setting	On	10	10	0	100
	Off	10	10	0	100
Stop working with the sensor		10	9	10	90

Table 2 shows a summary of the accuracy of the performance test of the chicken feeder controlled via a smartphone. By dividing the work into 3 cases, when ordering the device to turn on via a smartphone, it was found that the device can work with an accuracy of 90%, and when ordering the device to turn off, it was found that the machine can work with an accuracy of 100%. In the case of setting the time for automatic operation, it was found that the machine can work with 100% accuracy. In the case of stop working with the sensor, the machine was found to be able to work with an accuracy of 90%. However, the reason why the device malfunctions are due to the internet signal of the mobile phone and the device's Wi-Fi network.

B. Chicken feeding performance test

The chicken feeding efficiency test was a test of the motor of the no-load and on load. In the no-load test, the motor shaft is not connected to the screw conveyor. On the other hand, when loaded the motor shaft is connected to the screw conveyor, which can be recorded as shown in Table 3. The experiment was conducted with the maximum speed of the motor at no-load (340 rpm), the voltage of 24 V, the current of 1.20 A, and the power of 29.05 W. While the motors are connected to the conveyor and chicken feeders, the chicken feeder uses the voltage of 24 V, the current of 4.10 A, and the power of 98.40 W.

Table 3. The motor experiments with No-load and loaded at maximum rpm (340 rpm).

Motor	Current (A)	Voltage (V)	Power (W)
No-load	1.20	24	29.05
Loaded	4.10	24	98.40

Table 4. The performance test of the chicken feeder with 1 kg of chicken feed.

Motor speed (rpm)	Power (W)	The food is full at 1st pan (min)	The food is full at 2nd pan (min)
100	11.20	1:36	3:45
200	18.56	1:05	2:48
300	30.20	0:43	2.01

From the Table 4 show the performance test of the chicken feeder with 1 kg of chicken feed. The experiment of connecting the spiral casing and the chicken feed pan at 100 rpm, is most suitable for use. The running at other speeds causes the machine to vibrate and consumes more electrical power. At a motor speed of 100 rpm, the chicken feeder consumes 11.20 W and takes 3:45 minutes to fill the 2^{nd} pan. Those who are interested in developing it may be able to improve the screw conveyor tube to allow for more food and faster feeding.

Conclusions

This paper presents the design of an automatic chicken feeder controlled by a smartphone. The DC motor is used to convey the food through a spiral shaft, which can adjust the motor speed and turn it on and off via a smartphone with the Blynk application. An experiment with a motor speed of 100 rpm showed that the chicken feeder used the power of 11.20 W, with a full pan feeding time of 3.45 min. The chicken feeders can help farmers to make their work easier and can also apply this knowledge to other animal feeding applications.

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