DESIGN AND FABRICATION OF A TIMER BASED CONTROL SYSTEM FOR WATERING AND LIGHTING IN AN AUTOMATED POULTRY SYSTEM

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Abstract: In order to satisfy the rising demand for premium poultry products around the world, the poultry industry is essential. Automation technology integration has become crucial for improving the productivity and welfare of chicken farm. The goal of this research is to design and build a timer-based control system specifically for automated poultry system that will handle lighting and watering. In order to optimize resource consumption, ensure the welfare of poultry, and reduce labor demands, the suggested method intends to address critical difficulties faced by poultry producers. To accomplish these objectives, the control system combined elements from the hardware and software world. The hardware consists of sensors, solenoid valve, precise timers and lighting fixtures. To ensure that chickens always have access to clean water, solenoid valves are used to regulate the flow of water to drinking stations. An interface between the hardware components and software is provided by a microcontroller-based system. Given information about the age, breed and environment condition of the fowl, the microcontroller is programmed to carry out a predefined schedule for watering and lighting.

Keyword: Automation, Microcontroller, Poultry, Lighting, Watering.

Introduction

The Poultry industry is rapidly growing and highly sought-after in numerous countries worldwide. It can be found in various regions where human settlements exist (Dennis *et* al., 2020). This is primarily due to the rising demand for poultry meat and egg products, which has led to the expansion of large-scale commercial poultry production. As a result, confinement housing for poultry has become more prevalent, posing a challenge for ensuring adequate feeding and relying on manual feeding techniques in poultry farming (Alders *et al*., 2019). Poultry farming plays a vital role in protein production for human consumption, generating employment opportunities and revenue for those involved in the industry. Therefore, it is crucial to prioritize effective management practices (Barcho, 2019). Proper management of poultry nutrition has been identified as a significant factor in the success of poultry businesses. According to (Olumide and Ajayi, 2019) feeding alone accounts for 75% of the production costs in poultry farms. Additionally, the extensive reliance on human labor in various daily operations of the farm increases production costs. The current deep litter system of poultry farming is associated with issues such as improper feed administration, feed wastage, unfavorable weather conditions, labor-related stress, and increased risk of disease outbreaks, fatigue, and stress. (Shamshiri *et al*., 2021).

To address these challenges, technologies have been developed to automate different aspects of poultry farming over time. However, many of the existing systems designed to automate feed dispensing in poultry farms have proven to be inefficient and unstable, leading to malnutrition and an elevated risk of disease outbreaks in numerous farms. Therefore, the present study aims to develop an automated feeding system for poultry farms that effectively addresses these challenges. This system is found very simple and useful for farmers, as they can effectively control the poultry farm at any time and from anywhere. (Ojo *et al*., 2019).

Materials and Method

The complete circuitry is been analyzed with different modules in focus.

Power supply

This is the circuit that supplies power to the full system. It obtains its power source from a 220 volts AC power supply source, to deliver a volt DC output. The circuit diagram is shown in fig 1.

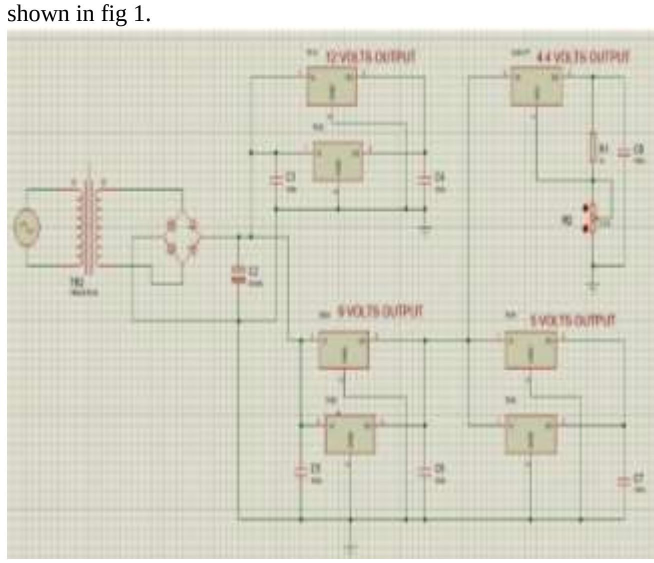

Fig. 1: Power Supply

TR2: This is the step down transformer. A transformer voltage of 12Vac or above is required. The current should be enough to supply the requirement of the circuit.
The transformer (T1) chosen is 12Vac at 300mA.

D1-D4: These are the rectifier circuit. The diodes chosen must have a peak inverse voltage (PIV) that must be able to withstand twice the peak voltage (Vp) of the transformers output and a forward current (Dc) of 1.5 times the output current of the transformer.

C1-C8: This is the filters capacitor. Electrolytic capacitors come with a capacitance and a voltage rating.

LEDS AND BUTTONS

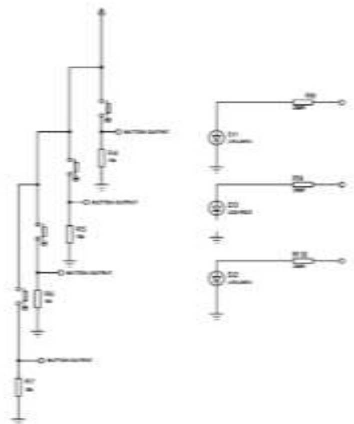

Fig. 2: Button and LED Circuit

The led and button setup is shown is the diagram above. For the button the multimeter probes were connected between the terminal to the microcontroller and the ground terminal by connecting the positive probe of the multimeter to the positive end of the 10k resistor, while the negative probe of the multimeter was connected to ground. When the button was not pressed or pushed the multimeter measures 0v when means it was an open circuit. As soon as the button was pressed the voltage measured by the multimeter becomes 4.98V which is close to the 5.00V voltage source the button circuit was connected. This sudden increase in voltage is what allowed the controller pin that will later be connected to this circuit detect that a button has been pressed.
Testing the LED circuit was straight forward. A 5V voltage source from the power supply circuit was connect to the led, with a 200 ohms resistor and the LED light up, when this voltage source was removed the LED light went off. The brightness of the LED can be was changed by changing the resistor value used.

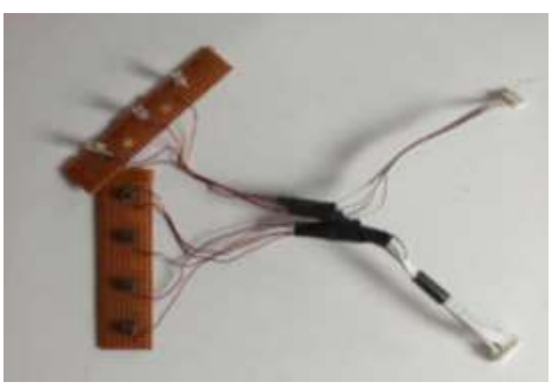

Fig. 3: Button and LED Setup

The setup for the Light Emitting Diodes (LED) and buttons circuit is show in the figure 3.11 above. The setup consists of 4 push buttons, four 10k ohms resistors and a 5volts power input for the Button section. And 3 red LEDs and three 200 ohms resistor for the LED section.
The button circuit uses a pull-up button configuration (ACTIVE HIGH) where the button is active when its output measures a high signal (2.5V -5.5V). Before a button is pressed or pushed, the output measured is 0.00 V (LOW). When the button is pressed or pushed, the momentary voltage measured at the output is 4.98 V (HIGH), Therefore this configuration is considered pull-up or active high configuration. The 10k ohms resistor connected between output and ground is to prevent direction current flow from power to ground (SHORT CIRCUIT).

LED RESISTOR CALCULATION

From Ohm's law;

$$V = IR \quad \text{----------------------------------} \quad 1$$

$$Ve = Vs - Vled \quad \text{---------------------------} \quad 1.1$$

$$Ve = V \quad \text{------------------------------------} \quad 1.2$$

Substituting 1.2 into 1

$$Ve = IR \quad \text{----------------------------------} \quad 1.3$$

Substituting 1.1 into 1.3

$$Vs - Vled = IR \quad \text{--------------------------} \quad 1.4$$

Make R the subject of formula

$$R = \frac{Vs - Vled}{I} \quad \text{-----------------------------------} \quad 1.5$$

$$Iled = I \quad \text{-----------------------------------} \quad 1.6$$

Substituting 1.6 into 1.5

$$R = \frac{Vs - Vled}{Iled} \quad \text{----------------------------------} \quad k1.7$$

Where;
V = Voltage
Ve = Effective Voltage
Vs = Supply Voltage
Vled = Led Forward Voltage
Iled = Led Forward Current
R = Resistance
From the Equation 1.7 above;

$$R = \frac{5 - 2}{20x10^{-3}}$$

Vs = 5v
Vled = 2v for red LED
Iled = 20mA – 50mA

R = 150 ohms.

Working Principle of the Complete Circuit

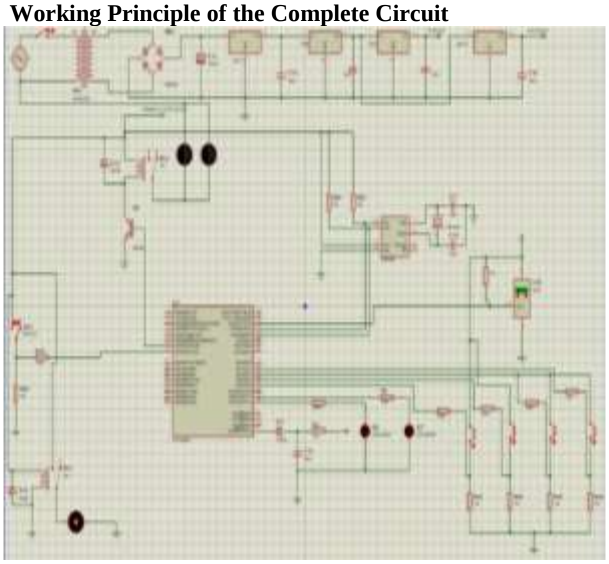

Fig. 4: Complete Circuit Diagram

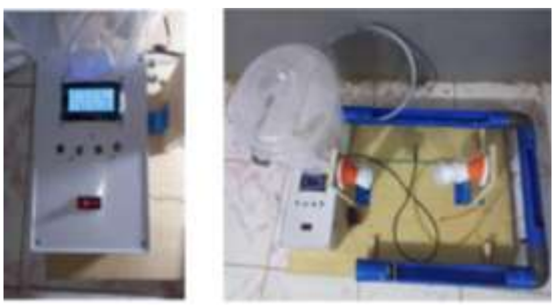

Plate 1: Packaging of the final project

Mode of Operation

The project entry point is the power supply which is made up of a linear power supply topology. The power supply produces 12V, 9V and 5V. The 12 volt is used to power the 12V relay, the 9V used to power the DC pump while the 5V is used to power the microcontroller unit, 5V relay the temperature sensor and other modules. When the system comes on, the microcontroller configures the device and set every necessary data, like the time set, the temperature set and so on. The controller (microcontroller) continuously checks the two sets time against the current time with the help of the RTC module connected to it. If the current time is more than the first time the water pumps and record that the water has pumped for the first time. Also, when the current time is more the second time the water also pumps and record that the water has pumped for the second time. The system has a contact circuit to detect when the water is full and signal the controller to cutoff supply to the DC pump.

The control of the light is done by comparing the current room temperature obtain through a temperature sensor connected to the device, with the two pre-set temperatures. When the current temperature drops below the low temperature value the light comes ON and stays ON until the current temperature goes above the pre-set high temperature. The times and temperatures can always be set multiple times to allow more water being pumped, also the system can be reset to achieve multiple scenarios to pump the water.

Conclusion

The design and fabrication of a timer-based control system for watering in an automated poultry farms offers numerous benefits for efficient and effective poultry management. The developed system also improves power management in the farm and by incorporating such a system it can significantly enhance efficiency, water management, and overall poultry health. The system controls the dispensing of poultry feed (liquid) through a program written on Microcontroller (PIC18F4620). Compared with other conventional methods, this system shows excellent performance with its advanced digital technology and by addressing potential challenges and ensuring consistent maintenance, farmers can reap the benefits of this technology to achieve more sustainable and profitable poultry operations.

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