Journal of Telecommunication, Electronic and Computer Engineering
ISSN: 2180 – 1843 e-ISSN: 2289-8131 Vol. 14 No. 1
jtec.utem.edu.my

Wireless Sensor Networks for Real-Time Monitoring and Controlling of Poultry Farm

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Article Info

Article history:
Received Nov 21st, 2020
Revised Sept 25th, 2021
Accepted Dec 2nd, 2021

Index Terms:
Arduino
XBee
Sensor
Monitoring System

Abstract

Modern technology exists to improve the quality and the quantity of the productions in many fields. It plays an important role in increasing production and reducing costs in poultry farming. Many factors affect the poultry farm's amount of production, such as temperature, light, and water. Those factors must be monitored and controlled to achieve high production. This paper provides a real-time design of monitoring and controlling poultry farms which aimed to replace the traditional manual system with an advanced system. The design aimed to assist in raising the poultry farming production to satisfy the increasing demand for chicken products by providing a completely automatic system. The design is based on an Arduino controller and uses an XBee module to provide a wireless connection between the basic monitoring page and the hardware. The hardware connects a network of chicken houses. The hardware monitors and controls the temperature, light, and water supply system to avoid dryness problems. The design also ensures the gate security of the chicken corps by providing wireless monitoring of the gate status and firing an alarm when the gate is opened. The system was examined in different cases, and the simulation results were exact.

I. INTRODUCTION

Recently, poultry has become an important economic activity of agriculture in any country around the world, which helps push the wheel of the economy [1]. Nowadays, the demand for chicken production is rapidly increased because it is considered healthy food due to its high rate of protein and fewer amounts of fat and cholesterol [2]. Using advanced monitoring and controlling techniques in managing chicken corps helps reduce the workforce and the death rate of the chicken. On the other side, it increases the production levels. Many environmental parameters directly affect chicken health, such as temperature and light. The benefits of using innovative technology rather than the traditional managing and monitoring system encourage many farmers to obtain this technology [3]. The poultry farming production is either eggs or meat and the amount of production in both types affected by the previously mentioned parameters [4]. The proposed design used the visual basic language to create a monitoring page that provides new monitoring improvements because, unlike other programming languages, the visual basic based on frames is considered easier for users than other languages[5]. The communication between this page and the sensors on the chicken houses is done via the XBee module, which uses the IEEE 802.15.4 ZigBee standard protocol [6]. A group of sensors is connected wirelessly to form a wireless sensor network (WSN). The main goal of the WSN is to create an efficient and inexpensive system. As with most WSNs, this design was included with actuators to provide direct control[7].

II. SURVEY OF RELATED WORKS

The proposed paper differs from most of the published papers in this field. The difference is shown in the type of monitoring page, which is designed to simplify the monitoring and controlling the corps environment. Also, this paper differs in the functions achieved by monitoring and controlling the poultry. Monitoring the door and the water level is required in the poultry farm industry, which provides security and reduces the probability of death due to thirst. Most of the related papers did not include secure doors, and some ignored the control of water level, which is required to avoid the thirst. The system of Mitkari [4] shows a design to control food containing temperature and remove gases. In Ghazal [3], wireless control is achieved using ZigBee technology; it controls temperature, humidity, light and air in the poultry farm and is based on a PIC microcontroller. Mahale [8] shows the advantages of using an embedded system and smartphone in the monitoring and controlling system of the poultry farms. The poultry farm system of Li [9] presented only a monitoring system of the environmental parameters, and the system used a web page to monitor these parameters wirelessly. Amir et al. [10] presented a design of wireless monitoring system, which can be used in a poultry farm, the monitoring function in this design was temperature, humidity, light and water level, and the design was based on Arduino. It also did not include gate monitoring and did not provide a specific monitoring page. Valerio et al. [11] designed a temperature control system for chicken egg farms controlled using SMS or a microcontroller connected to a computer. It aimed to increase the production of eggs and is considered a low-cost system. Ezema et al. [12] developed an automated microcontroller system to monitor and control environmental parameters such as temperature and humidity. Neither a wireless connection nor a monitoring page is stated in the paper.

III. METHODOLOGY

The design circuit of the chicken poultry monitoring system is shown in Figure 1. The design circuit included the following specifications:

- Water level circuit
- Temperature Circuit
- Arduino and XBee
- LCD 20X4
- Light control circuit
- L293D ICs Driver
- Door circuit

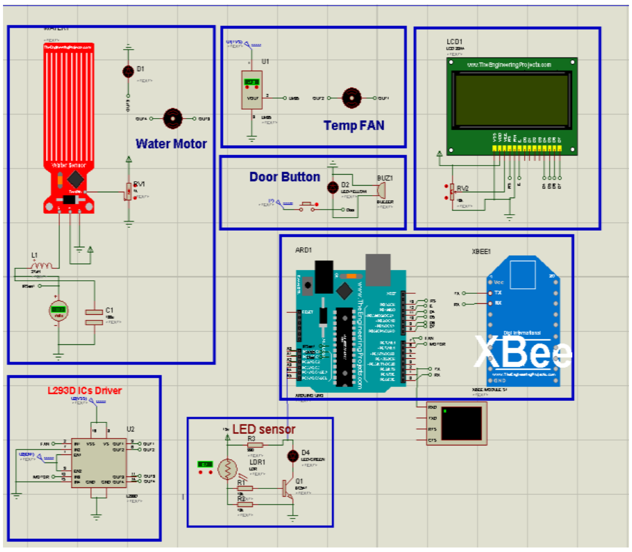

Figure 1. Circuit Schematic

When the system is turned on, the circuit reads the temperature value via the LM35 and is compared with the specified temperature of 30° (reference value selected for simulation purpose). If it is less than 30°, the system rereads the temperature, but it automatically runs the FAN when the temperature is greater than 30°. As for the water, the motor works continuously to save water. When the state is HIGH, the water level sensor reads the water level in the drink. If the water level is above the required level, the Arduino sends a LOW command to the motor to stop working. The door's status is displayed whether it is open or closed, and a buzzer will be activated if it is open. The system sends all readings coming from the sensors to the receiver section in the monitoring room using XBee. The receiver circuit is shown in Figure 2. It receives data wirelessly from the control circuit and displays it on the graphic interfaces designed using visual basic.

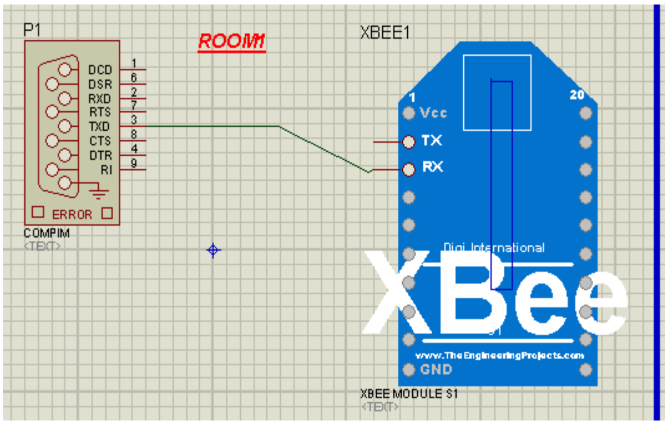

Figure 2. Receiver circuit

The connection between the graphic interface and the receiving circuit is made using the serial port COMPIM, as shown in Figure 2. This port received the serial communication data and transmitted it to the CPU as digital signals[12]

IV. SYSTEM DESIGN

There are three algorithms designed can be distinguished through this implementation:

- Temperature sensor Circuit
- Water level sensor Circuit
- Light control circuit

The system also takes care of the security so it provided with a monitoring system of the gate. The status of the gate (open/closed) is shown in the designed monitoring page opening the gate will fired the buzzer.

A. Temperature Circuit

The temperature sensor as shown in Figure 3 reads the temperature in the room and is sent to the Arduino to compare it with the specified temperature (30 degrees). If the temperature value is equal to or less than the specified value, the situation in the circuit is normal. If it is greater than it, the fan is switched on. This function can be achieved using the following code:

```
int LM35 = A1;
void setup () {
    pinMode (FAN, OUTPUT);}
void loop () {
    int T = analog Read (LM35);
    if (Temp >= 30) {
            digitalWrite (FAN, HIGH);
            }
    }
```

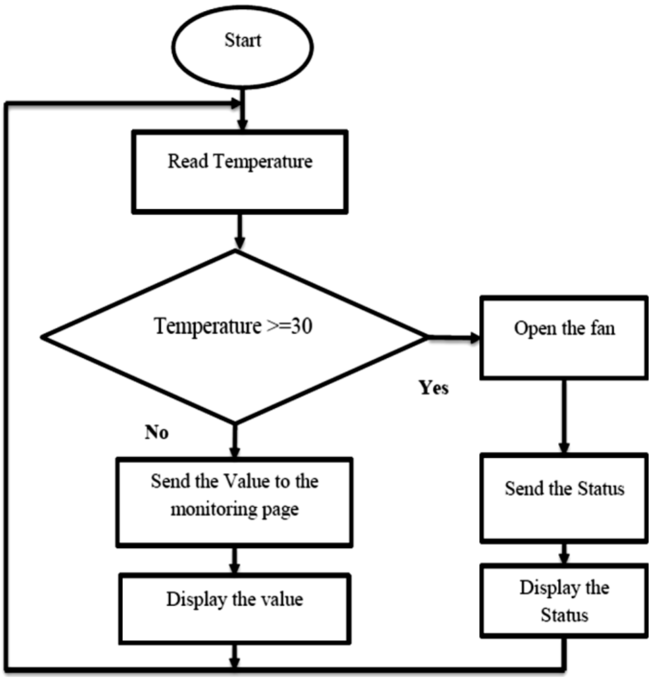

Figure 3. Temperature flow chart

The basic formula which used in the temperature sensor is given by calculating the current through a resistive temperature detector:

$$V = IR \quad (1)$$

$$\Delta V/\Delta I = \Delta R \quad (2)$$

where:

V: is the voltage

R: Resistive temperature

B. Water Level Circuit

The water level algorithm is shown in Figure 4. the system works continuously until the basins are filled with water, and when the water level reaches the maximum 1000 litres (reference value selected for simulation purpose), then the system will stop filling water; this function can be shown in the following code:

```
define Motor 6
int Sensor Pin = A0 ;
void setup () {
        pinMode (Motor, OUTPUT);
void loop () {
        if (Water >= 1000) {
        digitalWrite(Motor, LOW);
        }
}
```

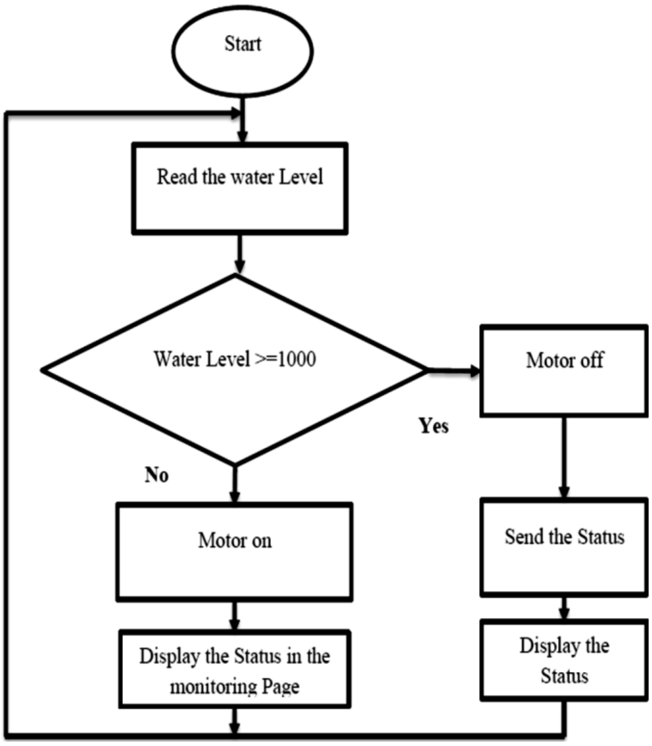

Figure 4. Water Level Flow Chart

The mechanism of the water sensor is straightforward. It consists of five electric wires in addition to five sensor wires. These wires are connected through the water level [13].

C. Light Control Circuit

The designed electronic circuit used to control the light system of the chicken house is shown in Figure 5. The circuit is straightforward; it contains a light sensor and electronic switch (transistor).

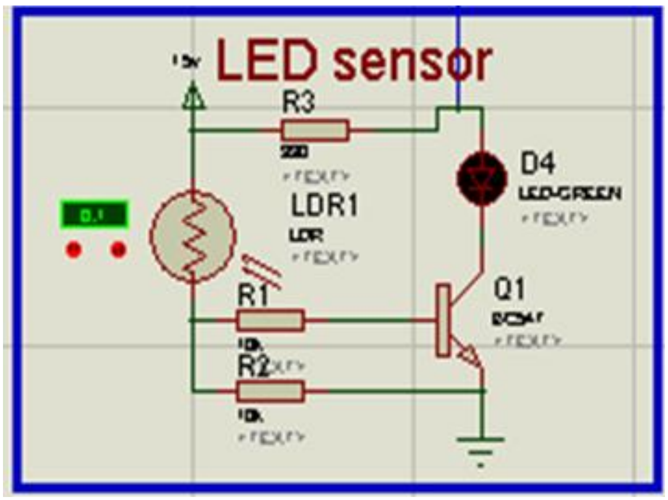

Figure 5. Light control Circuit

The operation algorithm of the tight control circuit is shown in Figure 6. The lighting turns on when the intensity of the incident light decreases on the sensitive resistance to light and stops working when the intensity of the incident lights increases the light-sensitive resistance.

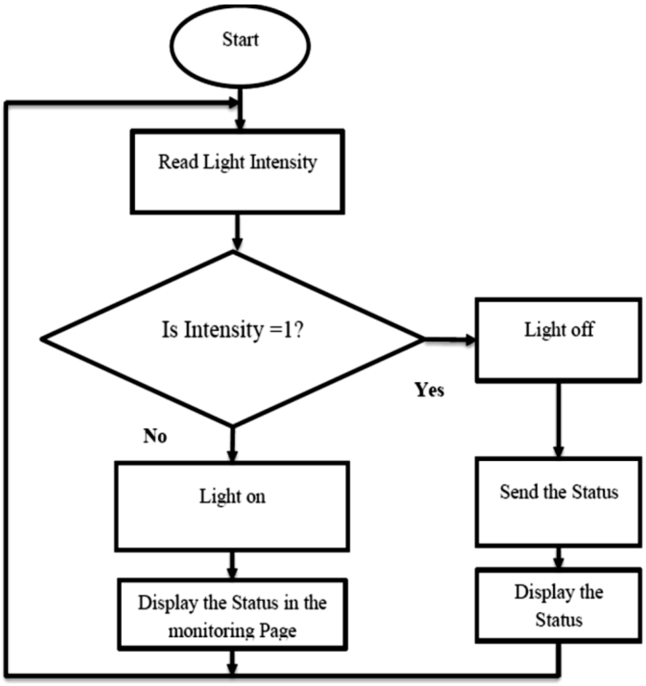

Figure 6. Light control Circuit flow chart

The general formula of light intensity is given by:

$$I = n\,h\,f/At \qquad (3)$$

where:

I: intensity of light
n: the number of photons
h: Planck's constant
A: incident area
t: time.

V. MONITORING PAGE

The monitoring page was designed using visual basic and connected to the electronic circuit wirelessly via the XBee module. The page is secured, and only the password owner can access the page. The first step of operating the system is to enter the access information, as shown in Figure 7.

Figure 7. First step of the operation

If the username and the password are correct, a message will appear and be directly entered into the main page, as shown in Figure 8.

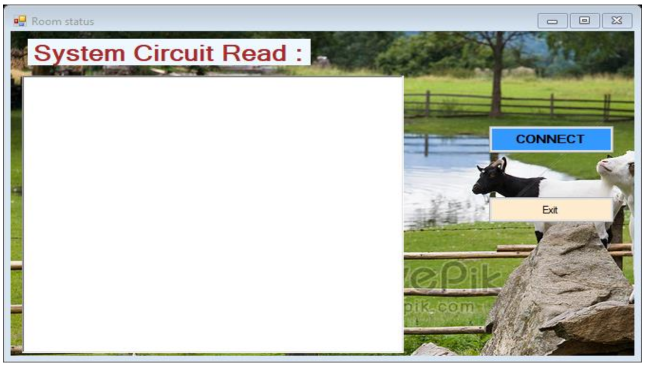

Figure 8. Main page

Once the user pushes the connect button on the right corner of the page, the received data will be shown on each chicken house page, as shown in Figure 9.

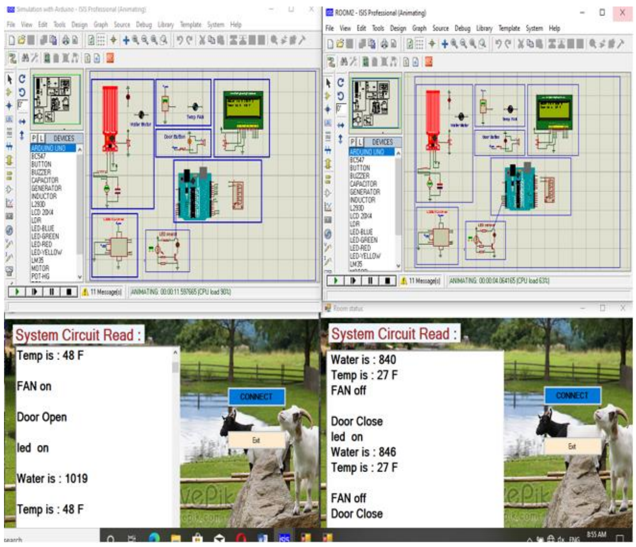

Figure 9. Main page of two chicken house

VI. RESULTS AND DISCUSSION

The received results of this system are shown in three forms:

- Monitoring page
- LCD
- Virtual terminal

A. Temperature Circuit Results

The normal case is shown in Fig 10. It occurs when the temperature is in the normal position of 30° or less (FAN off). In this case, the cooling fan will not work.

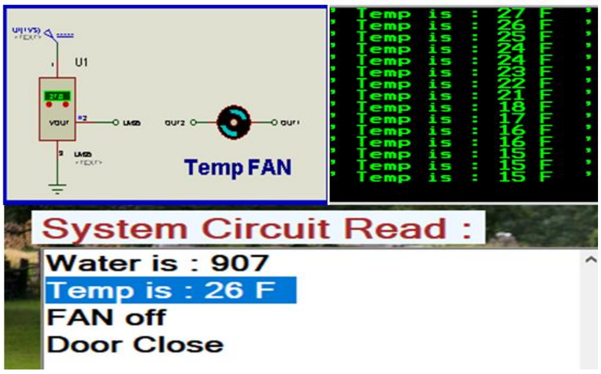

Figure 10. Normal Temperature

The second case is shown in Figure 11. It happens when the temperature exceeds the reference range 30°. The control circuit directly turns on the fan to return the temperature to the normal range.

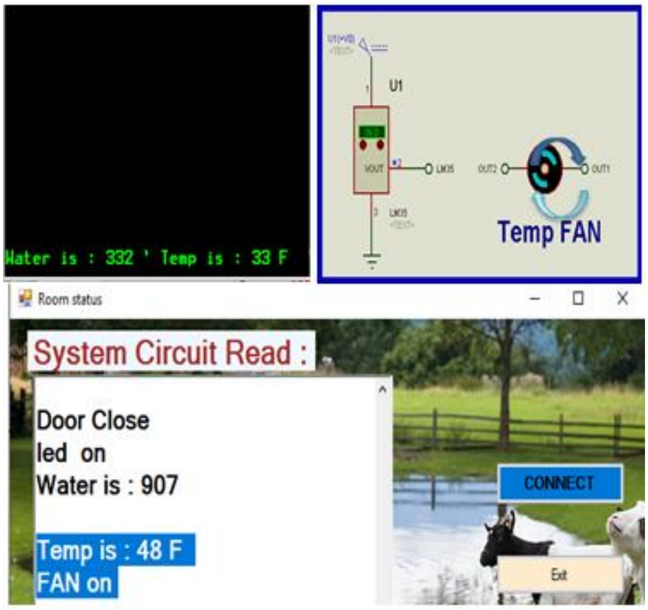

Figure 11. High Temperature

B. Water Level Circuit

This circuit is essential to improve the poultry system because it is used to supply water in the drinks. The circuit drives a pump to keep water into the drinks. This circuit was simulated in the typical case and the low-level case. The first condition is when the water level is less than the reference value (1000 litres), as shown in Figure 12. The indicator LED will turn on, and the control circuit turned on the pump in this case.

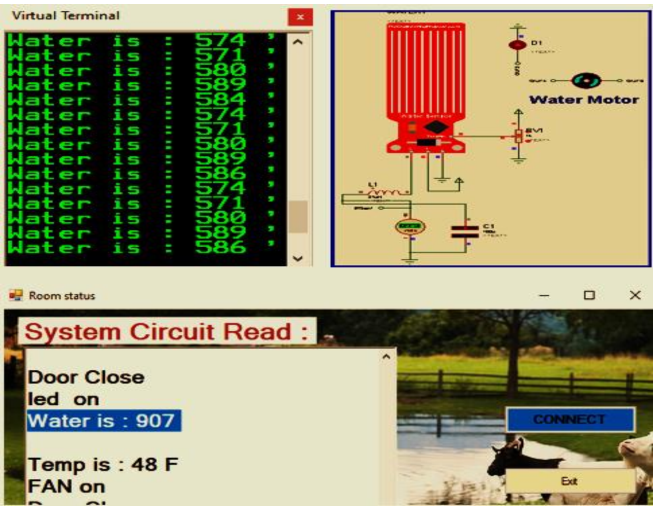

Figure 12. Low Level of Water

The second simulation case is done when the water level becomes higher than the reference level, as shown in Figure 12. The indicator LED will turn off, and the control circuit will turn off the pump.

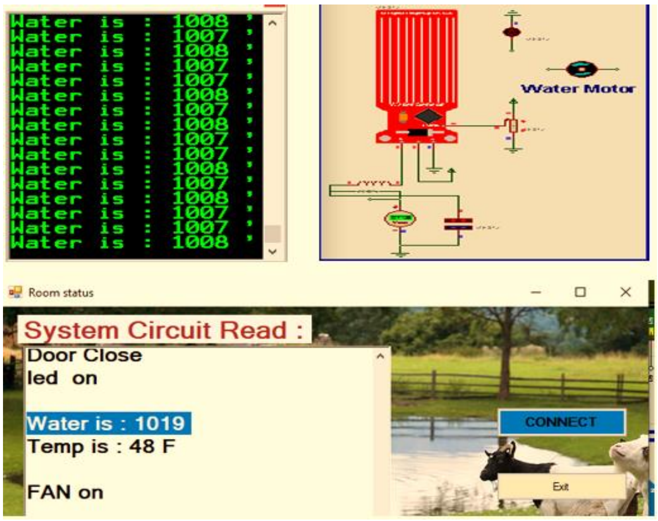

Figure 12. High level

The temperature and water level results can be shown in the LCD unit, as shown in Figure 13.

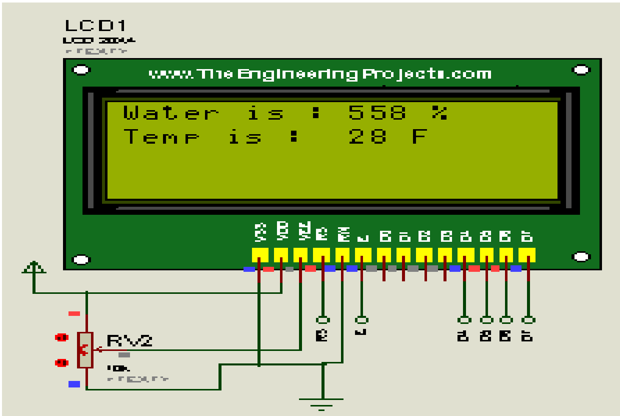

Figure 13. LCD Results

VII. GATE CONTROL CIRCUIT

The gate circuit contained an LED indicator, alarm device and push button. It is a circuit used to send the door's status (open or close). A push-button is used to simulate the gate status. As shown in Figure 14, the status appears on the screen as (door open) when it was closed. In this case, a yellow indicator was turned on.

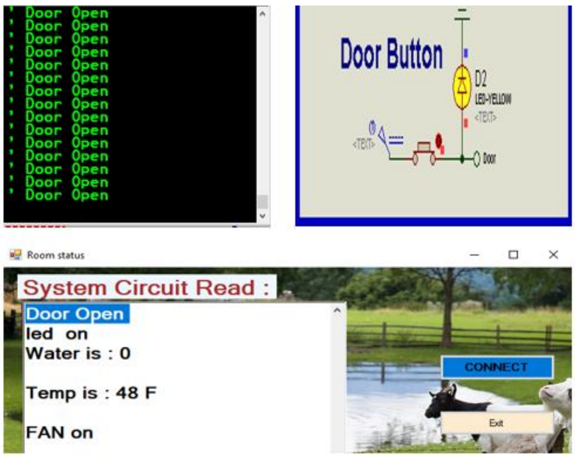

Figure 14. Open Status

The status of the gate changed to be (door open), and the yellow LED turned off. The push-button status will open when the door is closed, as shown in Figure 15. The alarm will fire once the gate is opened.

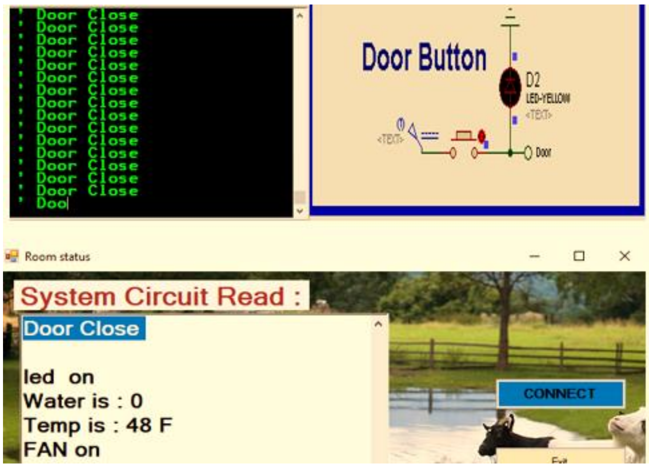

Figure 15. Close Gate

VIII. CONCLUSION

This paper proposed an intelligent design of chicken corps consisting of a wireless monitoring system and control unit. The system is designed to monitor the corps environment. The design was tested in different cases to ensure that all the required parameters such as temperature, gate, light system and water level are always in the normal state. The results were shown in different display units. The overall simulation results give that the system works correctly as planned in the objective of the design. Based on the monitoring results, it is evident that the system is easy to use.

ACKNOWLEDGMENT

This work is done under the supervision of college of Alnour College of Science and Technology.

REFERENCES

[1] Prof. Shruthi B Gowda, Rashmitha K, Rakshitha K, Vijaylaxmi" A witted-management-of-poultry-farm-using-IOT "International Journal of Engineering Research & Technology (IJERT),Vol(8),issue(15), ISSN:2278-0181,2020.

[2] Mustafa Metin Donma1*, Orkide Donma "Beneficial Effects of Poultry Meat Consumption on Cardiovascular Health and the Prevention of Childhood Obesity" Med One 2017

[3] G. Bilal, A.-K. Khaled and C. Khaled, "A Poultry Farming Control System Using a ZigBee-based Wireless Sensor Network," International Journal of Control and Automation, vol. 10, no. 9, pp. 191-198, 2017.

[4] S. Mitkari, A. Pingle , Y.Sonawane, S. Walunj, A. Shirsath " IOT Based Smart Poultry Farm", International Research Journal of Engineering and Technology (IRJET) Vol(6),No03,pp:2380-2384, 2019 e-ISSN: 2395-0056.

[5] S.Sentance.S.Johnston, S. Hodges, J. Kučera, J. Scott,S.S.Grocsche, "Learning To Program With Visual Basic And .Net Gadgeteer", Creative Commons,2013

[6] Agus Kurniawan XBee ZigBee Development Workshop Kindle Edition PE Press; 1st edition (July 7, 2017).

[7] W. Dargie and C. Poellabauer" Fundamentals of Wireless Sensor Networks-Theory and Practice) John Wiley and sons ltd first edition ,2o10.

[8] Rupali B. Mahale, S. S. Sonavane "Smart Poultry Farm Monitoring Using IOT and Wireless Sensor Networks ,international Journal of Advanced Research in Computer Science, Volume 7, No. 3, 2016,E-ISSN:0976-5697..

[9] H. Li, H. Wang, W. Yin *, Y. Li, Y. Qian and F. Hu" Development of a Remote Monitoring System for Henhouse Environment Based on IoT Technology", 2015..

[10] N.S.Amir , A.Abass, ,A.Azmi,Z.Abid,A.Shaie," Chicken Farm Monitoring System", IEEE International Conference on Computer and Communication Engineering (ICCCE16) ,PP:132-137, Kua Lambor, Malaysa,2016.

[11] A .S. Valreio, N .R Juco, M.Plisent, P.Benard "Controlled Environment and SMS Monitoring System for Pampanga Agricultural College Chicken Egg Farm Coop",2nd International Conference on Chemical Ecology and Environmental Sciences(IEES2013),PP:251-254,London,2013.

[12] L. S. Ezema, M. C. Nnabuko, C .B.Opara "Design and Implementation of an Embedded Poultry Farm",2019 IEEE 1st International Conference on Mechatronics, Automation and Cyber-Physical Computer System,PP:187-192,(2019), Nigeria,

[13] https://www.virtual-serial-port.org/article/com-port-in-proteus [online-Accessed 2019].

[14] Jan.R,Sincclair" Sensors and Transducers",Third edition,Newnes,2001.