POULTRY AUTOMATION

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Abstract

The paper presents the system design and development of poultry automation. The proposedsystem presents the automation of three fundamental necessities of poultry farm. They are: theautomation of feeding system, temperature automation and the automation of the light illumination. To achieve these three funadamental automation, Arduino microcontroller is used with various input sensors. Temperature sensor LM35 is used as an input sensor to detect the temperature range and passive light dependent resistor (LDR) is used to detect the intensity of the light. The developed poultry system is of size 2 by 4 by 3 cubic feet well equipped with heater, fan and incandescent bulb to provide ideal living environment for chickens. The feeding automation is controlled usinga DC motor and a solenoid valve. The proposed system eliminates the need of manual feeding and offers the means to increase the poultry production by providing ideal and automated environment for chickens. The application of the proposed system also enhances the quality of the product to a great extend. The design and development has considered it's practical suitability in both cold and warm places. In addition the proposed system is designed to be flexible providing the ease to change to desired setting as per the requirement..

***Key Words** :PoutryAutomation, Microcontroller, Arduino,Temperature sensor, Light dependent resistor,Illumination.*

INTRODUCTION

Poultry farming in Bhutan is raising of chickens aiming egg production for domestic purpose or for business purpose. The whole management is labour intensive and complex due to uncontrolled environment conditions. The environmental conditions and the temperature are required to be monitored manually by the farmers. This would require the farmer to have expertise in the poultry farming and there would be a need to hire additional helpers which would just increase the expenditure. The temperature would be controlled by the farmers manually based on their approximate assumptions. Maintaining appropriate temperature throughout the day is very important for the health of the chickens and for the egg production as well. The cold weather would increase the appetite of the layer in order to substitute the energy required to combat with the cold weather. Ziyun and Phil(2005) reported that for every 10C drop in temperature from the optimum, a chicken would need an extra of 4.2 calories. But increase in temperature would, especially in summer, reduce the egg weight and the shell thickness due to a cutback in energy and protein intake(Jacob,2003). Exposing young chicks to either very low temperature or extremely high temperaturemay cause some permanent damage to their health and may even lead to death in some serious conditions. The ideal temperature is from 24^{o}C to 28^{o}C for a healthy chicken and proficient eggproduction(Gates,2001). And also,fluctuation in temperature affects the egg production.

The illuminating process in a poultry house would require a person to put ON the bulb when it gets dark and remains ON throughout the night but the required amount of bright hours by the chickens is only 17hrs which means the energy is just being wasted. Moreover, the absence of dark hours makes the chicken agitated and affects their immune system. Incandescent bulb which emits orangish-reddish light stimulates egg production (Phil,1999) and the bulb will emit certain percentage of heat along with the radiation which would be useful during cold weather.

Feeding of chicken demands a huge magnitude and careful attention by the feeder because not only the quality of the feed matters, but also the quantity and the time of the feed play an important role. A person has to be present most of the time and has to feed the chicken manually at specific time which makes his presence inevitable making the person unable to do any other work. Ziyun and Phil(2005) found out that on an average amount, a laying hen requires 0.11kg of feeds per day . Now if the feeds have been given at irregular times or the amounts have not been maintained, the production of eggs drop, the rate of egg production reduces, the size of the eggs become smaller and leads to unhealthy chickens in the poultry. Thus, birds eat when they are hungry and drink when they are thirsty and are not required to await a visit by personnel to provide feed and water, or to fight with their neighbours for a share.

Water is a crucial but usually unnoticednutrient. Chickens will survive longer without food but not without water. Water is a vital element for chickens for regulation of temperature, digestion of food and elimination of wastes. The amountof water has to be double the quantity of waterwith a cooler temperature at certain intervals(Jacob,2003). Kumar and Basnet found out that it may lead to dehydration, undue fatigue, deficiency diseases and reduction in rate and production of eggs.

SYSTEM DEVELOPMENT

The complete block diagram of the proposed system for the “Poultry Automation” using the Arduino UNO with Temperature sensor LM35, Light Dependent Resistor, DC motor, Solenoid valve, Fan and Bulb is shown;

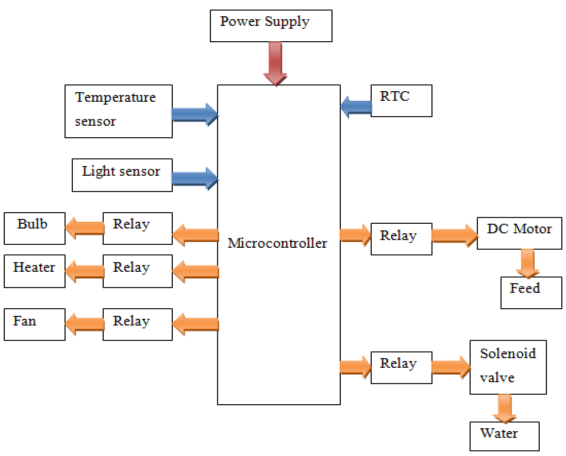

Fig. 1 System Block Diagram.

When the temperature in the poultry house drops below the favourable points, temperature sensor in the design system will sense the temperature and then maintain the temperature with the necessary heating up of the room with infrared heater or cooling down the temperature with help of electric fan attached. In case if the temperature is within the favourable range then both fan and heater remains inactive which helps in reducing the power consumption.

An LDR sensor will regulate the light in the room and to limit the unnecessary wastage of light energy, also to maintain the dark hours which is very important for the better egg production. If the light intensity is above the set threshold value then the bulb remains OFF and if it happens to be below the threshold value then bulb will be put ON automatically.

This proposed system will deliver feed and water for chicken at a given time set. This is done with help of RTC, which will keep track of the current/local time. Feed and water are delivered by DC motor and the solenoid valve respectively.

In the proposed system the most important component that controls all other components is the Arduino UNO.

METHODOLOGY

For the design of the model following methods are adopted:

3 Research on poultry farm locally and internationally.
4 Detailed study of automated feeding system.
5 Study of temperature control system.
6 Study of light control system.

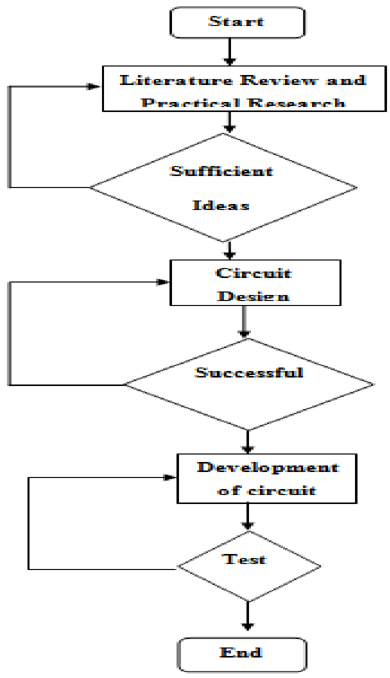

Fig.2Project Methodology.

1 For the design of circuit.
2 Conceptual block diagram.
3 Feeding system circuit designing.
4 Temperature control circuit.
5 Light control circuit.
6 Simulation of all the circuits.
7 Testing of the circuits on breadboard.

SYSTEM DESIGN

The design of the system has been done first on software basis and then on hardware.

7.1 4.1.Software Design

The design of system has included two software programs and they are Arduino and Proteus.

7.1.1 4.1.1.Arduino

Using this software, all the required conditions are programmed and uploaded in the Arduino UNO.

7.1.2 4.1.2.Proteus

The Proteus software is used to test the complete working of the designed circuit of the proposed system. The Proteus software is used especially because it has all the components we need in our project. It allows uploading program into the Arduino UNO in itself and simulating as it was required.

The circuit of the proposed system is developed in the Proteus software.

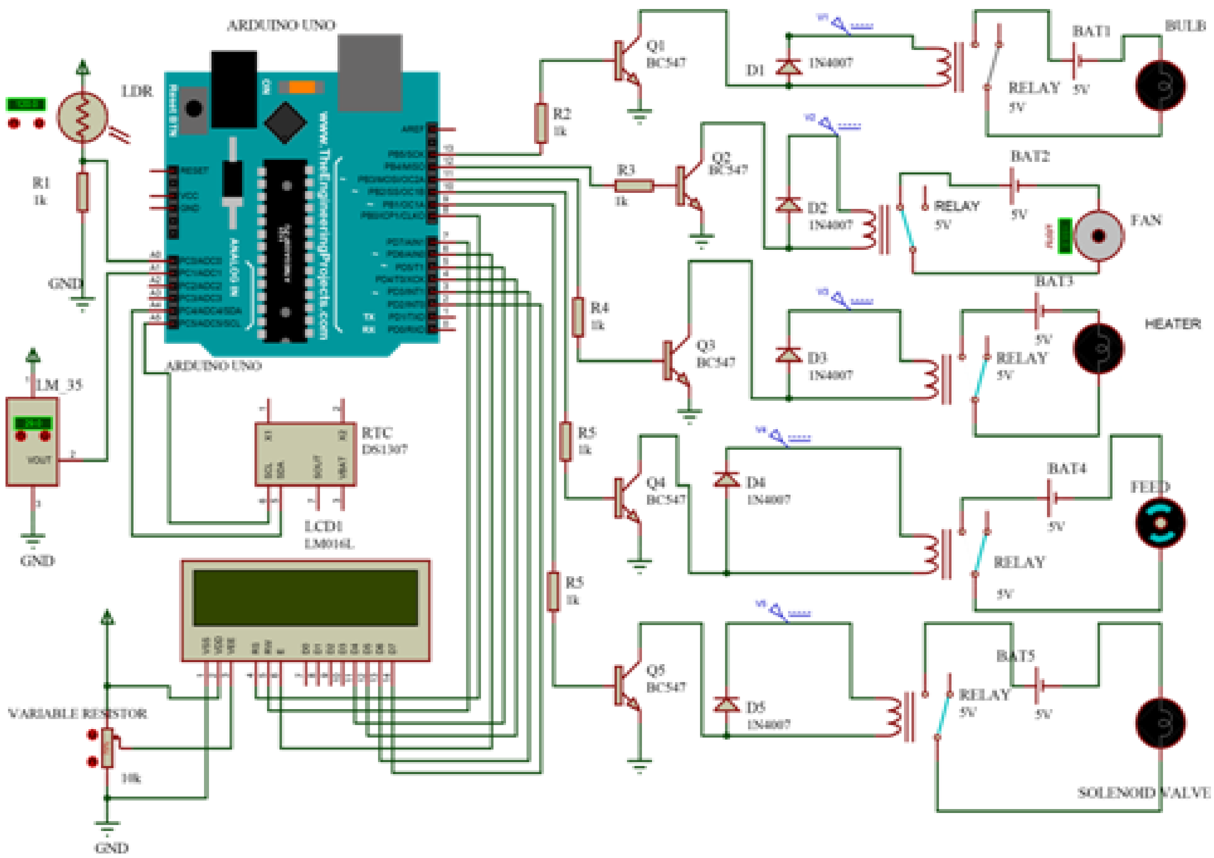

Fig.3 Simulation Design of the Proposed System.

4.2. Hardware Design

The schematic diagram for the proposed system is shown below:

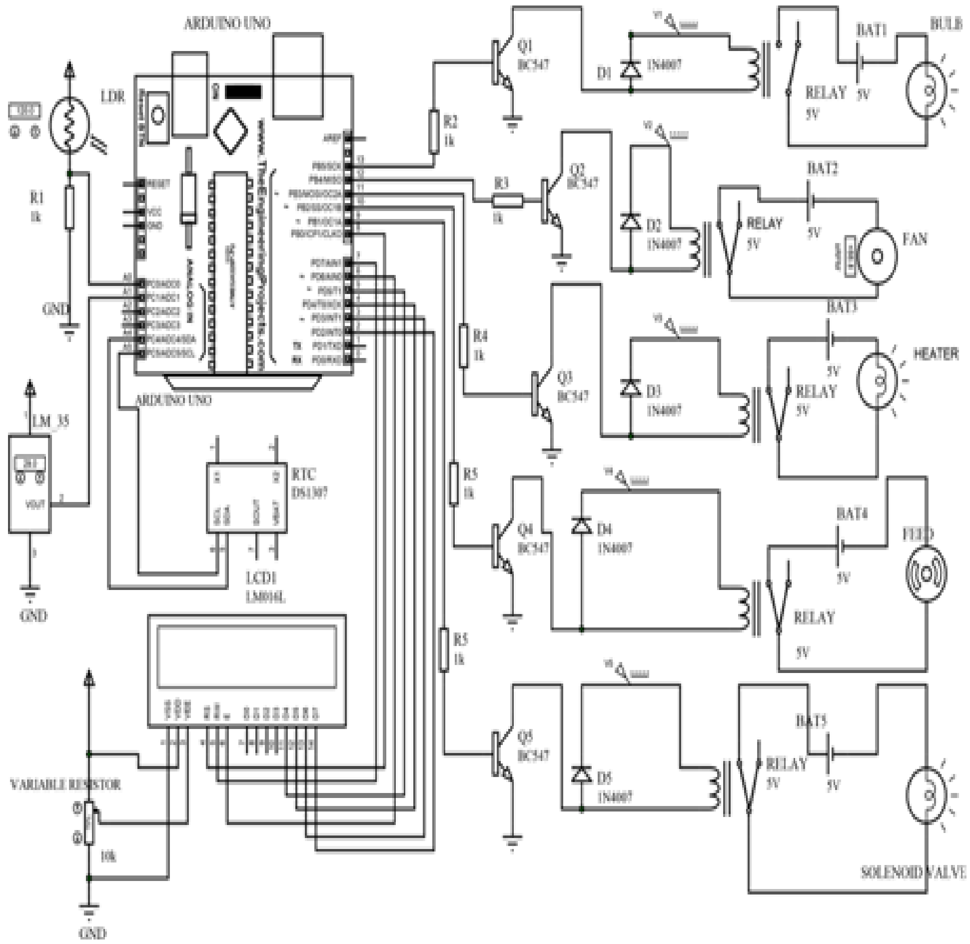

Fig.4Circuit Diagram

The Figure shows the main circuit diagram for the proposed system. A temperature sensor, light sensor, and DS3231 RTC module are connected to the Arduino UNO analog pins A0, A1 and SDA, SCL respectively. The digital IO pins D13, D12, D11, D10, and D9 are used for output bulb, fan, heater, feeding motor and solenoid valve respectively. The main component of the system is the Arduino UNO which stores the program to read inputs and control all the outputs.

7.1.3 3.2.1.Light Control

For the purpose of light control, a 10K ohm LDR (Light Dependent Resistor), which senses the intensity of light, is used. A1K ohm resistor used in series with the LDR forms a potential divider. Aconstant 5V dc is applied to the LDR whose resistance changes with the amount of light intensity falling on it. Thus the output voltage is given to the pin A0 of the Arduino UNO which converts it into digital value within range of 0-1023. DS3231 RTC module is used to provide real time and date for the system, so as to provide the feed and water on time and also to maintain 7 hours of darkness (turn off the light for 7 hours to let the chickens sleep/rest). According to the LDR value in the Arduino UNO, along with the real time from RTC module, the bulb connected to digital I/O pin D13 of Arduino UNO, is either switched ON or OFF. DS3231 RTC module SDA and SCL pins are connected to pin A4 and A5 on Arduino UNOrespectively.

7.1.4 3.2.2.Temperature Control

LM35 sensor is connected to Arduino UNO pin A1. An output voltage linearly-proportional to the centigrade temperature from the LM35 is converted to a digital value within the range of 0-1023. The output voltage from LM35 is converted to temperature as:

$$\text{Temperature} = VoltagefromLM35 \times 0.48828125$$

Where,

$$0.48828125 = [5V(supply\ voltage\ to\ LM35) \times 1000(convert\ volt\ to\ mV)] \div [1024(2^{10}, values\ represented\ by\ Arduino) \times 10(each\ 10mV\ equals\ 1^{0}C)]$$

According to temperature read from LM35, the Arduino UNO turns ON the fan or heater, connected to digital I/O pin D12 and D11 respectively, if the temperature goes above or falls below the defined range, or turns both OFF if the temperature is in the defined range.

7.1.5 3.2.3 Feeding and Water Control

With the real time and date provided by the DS3231 RTC module, the feeding motor and solenoid valve of water is switched ON for the amount of time required for the feeding and then turned OFF.

CRITICAL ANALYSIS

If the prototyped poultry house was not automatic then in a month,if the generated income from the poultry house is about Nu.1500 (raising 5 hens), hiring a labour for a month will costs about Nu.7020 per month (minimum wage rate of Nu. 234 per day), electricity bill of about Nu.50 (using a 100W bulb, 12hours a day) and then including additional costs of feed for 5 chicken about Nu.500 (0.11kg per chicken daily and Nu.1400 per 50kg bag) and other required materials in the poultry house, the poutltry house will run under huge loss.
Theproposed automatic system would only require to spent on power consumption about Nu.500 and on feedabout Nu.500 for 5 hens (0.11kg per chicken daily and Nu.1400 per 50kg bag). If the income generated is Nu.1500 per month with 5 hens, there can be actual profit of about more than 30% (about Nu.500).

The proposed prototype is solely working on electricity. In times of power shortage the system will fail to operate. The cost of electricity is about Nu.500 per month which is huge for a small farm. In larger dimensional poultry the cost will increase further with more power consumption. With the power source from the grid there is lack of opportunity for the system where there is no electricity. Therefore there is provision to make the whole system work on power obtained from solar energy which willallow the poultry farm work independent and sustainable. The current system does not include egg collection functions. Further work can be done to design automatic egg collection techniques.

RESULTS

The final prototype is developed, which is of size 2 by 4 by 3 cubic feet. It presents the automation of fundamental necessities of poultryfarm. The house has the capacity to accommodate about 5 birds.Figure 5 shows the interior of the prototype poultry house. They are: the automation of feeding and water system, temperature automation (heater and fan) and the automation of the light illumination (bulb).

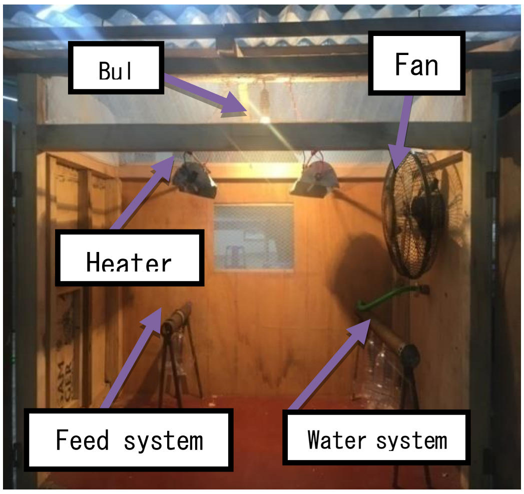

Fig. 5 Interior of designed poultry house.

The temperature range of 26 to 30 degree celcius is maintained by the house, and has the availability to change the temperature range to desired range from the Arduino program. The feed is provided twice and water thrice daily by the system. According to what time the feed needs to be given, it can be set from the Arduino program.

CONCLUSION

The proposed project aims to provide an automated based system for poultry houses in Bhutan with the automatic optimization of temperature for the chickens, automated control of lighting system with the reference to the situation and duration, and then an automated feeding system on a timely basis. This system not only provides an easier life to the poultry farmersbut also increases the production and overall the economy of the farmer. The system is cost efficient and the application it provides are also effiecient in terms of power cost since everything is programmed, so the particular system would function only when it is required. Sustainability and cost efficiency also comes in to picture when the required help from hired people gets done by the system itself.

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