

IoT based Smart Management of Poultry Farm and Electricity Generation

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Abstract— Poultry is one of the most important growing economic segments of agricultural sector in India today. Nowadays because of standardized farming management and good manufacturing practices, chicken production in the world has been increasing gradually. In contemporary world automation plays a vital role and concept of Internet of Things (IoT) is also emerging very fast, there is an approach to convert traditional systems into automated systems. The paper focuses on automation of poultry farm using IoT technology to perform various management related things. The environmental factors which affect the health of chicken such as temperature, humidity, light and Ammonia gas are monitored and the manual jobs like food feeding, water supply system, cleanliness are managed. If all these parameters are maintained, the production and quality of chicken increases. Along with this, electricity is generated from the methane gas which is produced from the chicken manure and stored in battery. The management and monitoring of the farm can also be done through a web based system. Which keeps track of the management of poultry farm from anywhere and at any time.

Keywords— *Arduino uno; Automation; GPRS module; Sensors; RTC module.*

I. INTRODUCTION

From last few decades, there has been an increase in the chicken production across the world because of standardized farming management and good manufacturing practices and also there has been an increased level of awareness regarding the safety of food products like chickens and there has been a huge demand for good quality chicken food. According to world's agricultural produce survey, chicken is the most consumed produce, as it is a nutrient rich food providing high protein, low fat and low cholesterol.

In the today's world, automation plays a very important role. This paper focuses on an automation of poultry farm by using wireless sensor network and mobile communication system. Internet of Things (IoT) technology is used for automation. A technology-based solution for low cost, asset

saving, quality oriented and productive management of chicken farming is proposed. Poultry business is practiced on large as well as small scale. There is an approach to minimize the manual work by performing automation to various activities performed in a poultry farm. The health and production of the chicken depends on the environmental conditions. The environmental parameters such as humidity, temperature light and ammonia gas are controlled and manual jobs like food feeding, water supply and cleanliness are managed automatically. The management and monitoring of the farm can also be done through a web-based system. If all these parameters are maintained, the production and quality of chicken increases. All the sensor modules are connected to the Arduino Uno and sensor values are acquired, then the data is uploaded to the web page using GPRS module. Thus, the person-in-charge of the poultry farm can monitor the internal environmental situation of poultry farm through mobile phone or PC using the internet.

II. EXISTING SYSTEM

Most of the businessmen and farmers use traditional poultry farming methods. The traditional poultry farms lack proper and effective management to maintain health and growth of chicken. All the poultry activities like filling the water tank, time to time feeding of chicken, cleaning the chicken waste and light control in the farm are done manually. Hence a large manpower is required. Some of the factors in the existing system are considered, which are as follow:

A. Ammonia Gas:

There is no proper system for management of ammonia gas. Ammonia gas is hazardous to the health of chicken. Hence due to excess of ammonia gas in poultry environment, diseases are caused. It is important to control the ammonia gas in farm.

B. Temperature and Humidity:

Temperature and humidity is controlled naturally. Special measures are not taken to control the temperature and humidity. Rise in environmental temperature and humidity is also dangerous for chicken.

C. Food Feeding and Water Supply:

In traditional farms, food is provided and water is supplied to the chicken from time to time, manually. Sometimes the workers may fail to provide feed or water on time which causes bad effect on the growth and production of chicken. Also more manpower is needed. So there is need of automated system.

D. Cleanliness System:

Cleaning of chicken waste is done manually in traditional poultry farm. The chicken manure contains gases like Nitrogen, Ammonia and a good amount of Potassium and Phosphorus which are hazardous to the health of chicken as well as for the workers. Hence poultry farm owners need a proper cleanliness system for managing chicken waste.

By considering only the above-mentioned factors, the chicken health is not maintained. In this paper, to increase productivity and get healthy chicken, along with the above parameters, others parameters like manual work should be considered. In the existing system, PIC microcontroller and raspberry Pi 2 is used. [1] It increases the cost, and designing of the system is also complicated. In the proposed system Arduino microcontroller is used. It makes the system comparatively simple and cost-effective. For monitoring purpose, the ESP8266 Wi-Fi module is used to transmit data on a designed webpage. [2] In the proposed system, the ESP8266 module is replaced by a GPRS module. In existing system, managing chicken waste is difficult, so a model is designed to clean the chicken waste and utilize it for the electricity generation. The electricity generated in poultry farm is sufficient for farm activities.

III. PREPOSED SYSTEM

In the proposed system, almost all factors including environmental parameters such as temperature, humidity, ammonia gas, light and manual works like food feeding, water supply system and cleaning chicken waste are monitored and a fully automated system is designed to perform these activities. This system reduces manpower, improves health and growth of chicken and increases eggs production also website is developed which is used for monitoring farm activities and internal environment. In addition to this, electricity is generated from chicken waste which makes poultry farm self-reliable for electricity.

A. Ammonia Gas level Control System:

The ammonia gas in the poultry farm environment is sensed with sensor and the data is sent to Arduino. A

threshold value is set. When the ammonia gas level crosses the threshold value, relay gets activated and exhaust fan is ON. [1]

B. Temperature and Humidity Control System:

The sensor is placed in the poultry farm to sense the temperature and humidity in the poultry farm. Exhaust fan and ventilation window will get ON when the temperature and humidity level crosses the threshold value. [1]

C. Water Supply System:

Water supply system is designed for cage system to supply water from time to time. [2] Ultrasonic sensor is used for this purpose. It will determine the water level. When the water level will decrease than the specified level, the water pump will start and fill water tank again. When the water tank is filled, it will stop automatically, thus water will not be wasted.

D. Feeding System:

A food feeding system is designed to provide feed to the chicken from time to time. This system reduces the manpower and wastage of feed is also avoided.

E. Cleanliness System:

Cleanliness plays a vital role in the health of chicken. The cleanliness module will prove to be the most useful module to all the poultry owners as cleaning chicken waste is major problem faced by the workers. The chicken manure is converted into liquid form and it can be used to generate electricity.

F. Light System:

Research says that, for maximum egg production, enough light needs to be provided to the chicken. 16 hours of light is essential to the chicken; Part of required light is obtained in the form of sunlight (approx. 12 hours), and remaining part of the light is provided by an electric bulb. So automation is done.

G. Electricity Generation:

In proposed system, electricity generated from chicken waste is important innovation. Half of the electricity required of poultry farm is satisfied by this model. In the cleanliness system chicken waste is converted in liquid form. Controlled fragmentation of biomass in biogas plants produce a gas that can be used to produce electrical thermal energy on account of its higher percentage of methane.

H. Web Based System:

In proposed system, web based system keeps track of all the activities of the poultry farm and notifies the owner.

IV. SYSTEM DESIGN

Fig. 1 shows a general block diagram of the Internet of things based system which includes remote sensors and Arduino UNO microcontroller. Arduino Uno has been used as a controller and GSM SIM800L is used as GPRS module. Arduino Uno collects data from different sensors which placed in a poultry farm. Such as Temperature and humidity sensor, Ammonia gas sensor, IR sensor, light sensor and Ultrasonic

sensor etc. and communicate with the web-based system over the GPRS network.

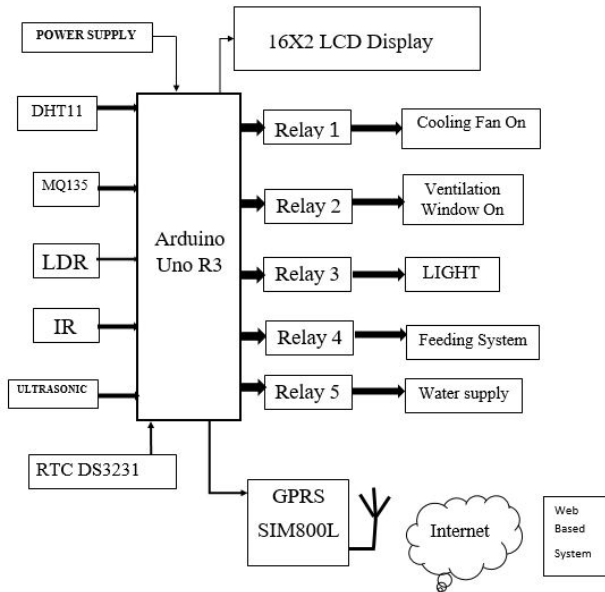


Fig. 1. General Block diagram

V. METHODOLOGY

A. Arduino Uno

Arduino Uno is a microcontroller. It is used to control the sensors and related electrical equipments that are considered for automation of related factors. In proposed project Arduino Uno plays most important role in automation to poultry farm. It requires 5V power supply. Arduino Uno is used because it is in low cost, easy to use and programming language is simple.

B. Sensor modules :

1) *DHT 11*: DHT 11 is Temperature and Humidity Sensor. This sensor is used to measure the temperature and humidity level in poultry farm.

2) *MQ 135*: MQ 135 is an air quality sensor. It is used to detect ammonia level in a poultry farm. [5]

3) *IR Sensor*: Infrared sensor measures the heat of an object as well as detects the motion. It is used for feeding system which is placed on top of the poultry feeder. It detects whether the feed is present in the feeder or not. If IR detects feeder as empty then specified action is performed and feeder is filled again.

4) *Ultrasonic Sensor*: Ultrasonic sensor HC-SR04 is used in the water supply system to check the water level in a water tank in a poultry farm. It is used for the measure distance in between sensor and object in front of the sensor.

5) *LDR Sensor*: Light Dependent Resistor (LDR) is used when there is a need to sense the absence and presence of the light. It is used in light system in poultry farm only during critical conditions like darkness in the rainy season, etc. LDR

detects darkness present in farm and sends the analog signal to Arduino.

C. RTC DS 3231:

A real-time clock (RTC) is a computer clock, it keeps track of the current time. RTC DS 3231 is used for following systems in which required work is done from time to time.

1) *In Light Model*: In existing system the lights are controlled manually. In proposed system, RTC module is used to automatically switch On/Off the lights in poultry farm.

2) *In Cleanliness Model*: A model for cleaning the chicken manure is designed. By using the RTC module, the water pump is activated and water is supplied forcefully for cleaning purpose.

D. Relays:

All the sensors which are used are 5V sensors and the electrical components are of high voltage. Therefore here relay circuit is used which is capable of handling and switching high voltage circuits.

E. LCD:

The 16 x 2 LCD display is used to display the current status of considered parameters. It is used mainly for testing purpose.

F. GPRS SIM 800L

Arduino collects all the data from sensors and controls required actions and sends collected data to the GPRS module. That data and information about the activities of poultry farm are sent to the owner, for this purpose the GPRS SIM 800L is used which is connected to Arduino. The GPRS SIM 800L transmits and decodes all the data it receives from Arduino over a cellular network. The owner can access that data on the web-based system by using website.

G. Electricity Generation using Cumbustion Engine:

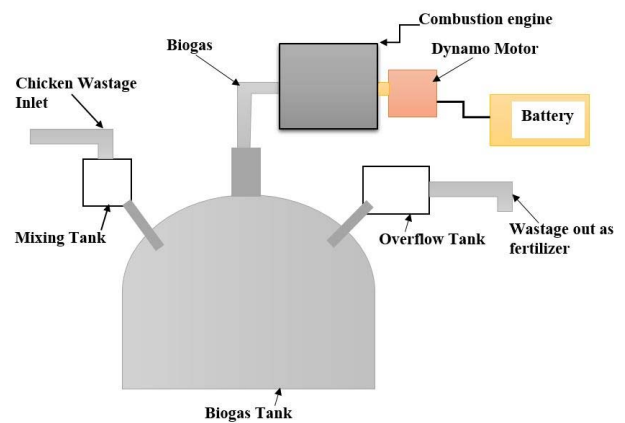


Fig. 2. Electricity Generation System

Fig. 2 shows the process for electricity generation from chicken manure. The chicken waste (manure) in liquid form is used as raw material (substrate) in this biogas plant. After short interim storage, the manure gets transferred to the

mixing tank and it is blended before fermentation. After this, the substrate is transferred to the biogas unit where it undergoes fermentation and biogas is generated, which has a higher percentage of methane gas. The generated gas is inducted into the combustion engine which produces kinetic energy. Dynamo is used to convert kinetic energy into electrical energy which can be stored in a battery for further usage. The remains of the substrate can be used as fertilizer in agriculture-farm.

H. Web Based System:

In the web-based system, a website is designed on which owner can access data sent by GPRS module. Through this website, the owner can monitor the internal environment and keep track of poultry farm activities at anytime and anywhere [2].

I. Parameters and their Threshold values:

The environmental parameters which are considered for automation are controlled on the basis of threshold values [2]. These values are obtained through detail studies about particular factor required in a poultry farm and through professional guidance. Table I shows the parameters and their respective threshold values.

TABLE I. PARAMETERS AND THEIR THRESHOLD VALUES

Parameter	Threshold Value
Temperature	40-41 degree Celsius
Humidity	<40% or 100ppm
Ammonia gas	<40%
Water level	One litter

VI. FLOW-GRAPH FOR ARDUINO PROGRAMMING

Fig. 3 shows, the functionality of the working model. The system sensors read all environmental parameters in a poultry farm. Real-time is initialized in the RTC module. Arduino is used to monitor the values received from sensors and perform corresponding actions. If input value is greater than the threshold values, send high output to the port else if the input values are less than threshold values then again the parameters will be read. Four environmental parameters such as temperature, humidity, ammonia gas and light, and activities like water level system, food feeding system and cleanliness system are monitored. If humidity increases, the exhaust fan will be ON. If temperature crosses its threshold value, the cooling fan will be ON. If ammonia gas level increases, ventilation window will be ON. Similarly, if the water level decreases, and if the feeder gets empty, the water pump and DC motor will be ON respectively. When the RTC module gets activated the light and DC motor (used for cleanliness system) will be ON at the specified time. In critical conditions, when darkness is detected by LDR, the bulb is ON. The current status is displayed on LCD and important notifications are sent to the webpage.

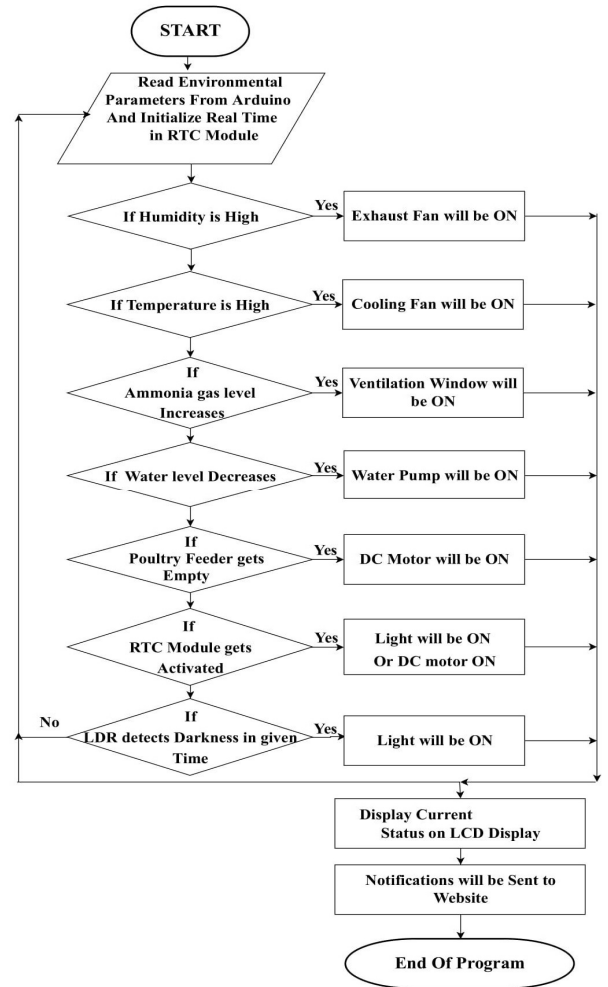


Fig. 3. Flow-Graph for Arduino Programming

VII. PERFORMANCE ANALYSIS

In this paper, we have discussed various parameters that affect directly the health of chicken. As water and feed are provided on time, the proper growth of chicken is observed and there is an increase in the production of eggs. Also, the wastage of water and feed is prevented. In the existing system, due to lack of luminosity, irregularity in egg size was observed, but due to the properly designed light system, the required amount of light is supplied to the farm because of which, the egg size is maintained. Because of electricity generation, half of the electricity needed in the farm is generated in the farm itself. The owner can keep track of the activities in the farm from anywhere and anytime with the help of web based system.

VIII. ADVANTAGES

- The proposed system converts traditional farm into a smart farm.
- It provides quicker and accurate information about different parameters to Poultry owner.

- The System is less expensive and affordable for not only poultry owners but also all those who look up for poultry farming as their side business.
- The smart monitoring of different parameters like temperature, light, humidity, gas etc. by using wireless sensor network.
- Production and health of poultry product improves.
- Cleanliness of the farm becomes easier.
- Sufficient electricity is generated itself in the farm.

IX. CONCLUSION AND FUTURE PLAN

Poultry farming is practiced from very long time not only in India but across whole world. But from last few years, it has been practiced in a scientific manner. The backyard poultry has turned in to commercial poultry farming and a gainful and dignified business enterprise in India and elsewhere in the world. Since the poultry farming can be practiced as a supplementary or second income-generating mechanism, the landless labours and small farmers find a support in this business. In fact, poultry farming has become an indispensable component of the agricultural industry in India. Thus the proposed project design provides an efficiently automated monitoring system. Traditional poultry farm can be converted into modern and automatic poultry farm using IoT. This automated poultry farm is used to improve the health and growth of the chicken. So poultry owner can make a huge profit and good earning from poultry farming business.

In future, the fire alarm system can be added and automated fire extinguisher system can be designed and we can add more information about poultry farm like reminders for vaccination of the chicken, information about workers, etc. on the web page. The same system can be referred for Poly house and food preserver.

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