SMART POULTRY MANAGEMENT SYSTEM

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Abstract: Many poultry farmers are performing diverse operations in their farms manually. Therefore, they experience a huge financial loss due to inability to properly automate the monitoring and to detect fire accidents and control of environmental factors such as temperature, humidity, light and air quality and to ensure an adequate supply of feed and water. These factors adversely affect the chicks and leaving them uncontrolled might cause health problems for the chicks. This affects the chicks' feed intake and leads to an increase in mortality rate and increases chances of diseases. Therefore, this paper seeks to address automating those factors by developing an smart poultry farm. The system consists of a microcontroller, actuators, and sensors as major components. We display data collected from the sensors to the operators of the farm. The system is able to detect fire accidents before or after it happens and informs to the users immediately and system is able to sense environmental parameter status and responds accordingly to regulate and maintain an optimum condition for improved health conditions for the chicks. The smart system reduces the fire accidents and improves productivity and environmental or climatic conditions in the poultry farm, making it conducive for the broiler chicks.

Keywords: Smart poultry farm, Arduino, Microcontroller, IoT, Temperature, Humidity, Ammonia gases, Fire.

1. Introduction

Our project is based on poultry chickens. Smart poultry farm has a great impact on increasing growth of chicken in order to provide better quality food. In contemporary world automation plays a vital role. Automation of poultry farm by using microcontroller, actuators, sensors and Internet of Things and Global System for Mobile Communication. Chicken is the most favourite produce in today's world because it is a nutrient rich food with high protein, low fat and low cholesterol than other poultries. Environmental parameters of a poultry farm such as temperature, humidity, ammonia gas and intensity of light are monitored and controlled automatically to increase the productivity of chicken. Food valve also controlled and monitored with the help of servo motor without human interference. By connecting all the sensor modules to the Arduino all sensor values are acquired then using Wi-Fi module it will be uploaded to the web page. The person in-charge of the poultry farm can get the internal environmental situation of poultry farm through PC or mobile phone using internet.

This system will detect fire accidents before or after it happens control temperature, humidity, ammonia gas and intensity of light with the help of respectively cooling fan and light ON/OFF without human interference. Based on the threshold values it will switch ON/OFF the devices. System design provides automated poultry, reduces man power and increases production of healthy chicken. From the last few decades, around the globe, there has been an increased level of awareness regarding the food safety and there has been a high demand for better quality food. This has forced many countries to adopt new protocols to change all manual farms into automated farm. In this way, smart poultry farm has a great impact on increasing productivity of chicken.

This paper focused on modern technologies for a poultry farming to control all environmental parameters which effects on the growth of the chickens and detecting of fire accidents immediately. If environmental condition is

not up to the mark then there may be harmful for digestive, respiratory and behavioural change in the chickens. If chickens may get suitable atmosphere and proper water then it may grow rapidly and health of chickens will be good so the weight of the chickens will be increases. In the growth of the chicken climate plays a vital role. Smart poultry farm is designed in such a way that the climate can be changed by cooling fan and bulb. Environmental parameters are monitored and controlled with the help of Arduino. Monitored sensor values can know the internal environment of poultry farm are stored in the cloud and monitor by IoT.

In [1], the chicken farming management is done using Embedded system and smart phone, with problem solving by Raspberry Pi and Arduino Uno. This intelligent system has been developed and tested in a sample chicken farm in this study. It is found that, it could sense the surrounding weather conditions and the filter fan switch is controlled based on the sensed data. Though this system was found to be comfortable for farmers, it faced problems in terms of integration of embedded system with various sensors and it is not cost efficient because of using both Arduino and Raspberry Pi. This system is unable to detect fire accidents

.[2] has used Free Real Time Operating System (RTOS) and the whole system is controlled by using Arduino only which is cost efficient more accruable than the system[1]. Arduino with Free RTOS library provide a real- time sensing, monitoring, and control of the farm environment, including ammonia, carbon dioxide, temperature and humidity. This system prototype is developed and implemented. It is found that experiments showed that this system has better monitoring and control compared to the traditional Arduino system. Though this system is showing better results but using of RTOS makes the system somewhat complicate and this system has no fire detection techniques and auto feeding and watering.

[3] This system will warn the person in-charge about the various environmental parameters like temperature, humidity, etc. by sending message to the registered mobile number. The person in charge can initiate a required action by sending a message back and when the system doesn't receive a command in a particular time period it will initiate the action automatically.

[4] is able control environmental parameters and detect fire accidents and share the data to the person in charge through GSM and Wi Fi module. This system is showing the best results but it has no auto feeding and watering.

[5] using wireless sensor network, GPRS, IoT, Artificial Intelligence, Computer Vision Technology, Machine Learning and Image processing developed a system that can monitor the poultry farm and share the information to the user. But this is very difficult to implement this system because of using advanced technology and hardware used to implement is also costly.

[6] has implemented system using Arduino Uno, GSM, ESP-12E NODEMCU, RTC. This system is cost efficient and it is able to work in real time by using Real Time Clock(RTC) module. This system is able to control the environmental parameters, auto feeding and detect fire accidents. Due to the maximum controllability and best results [6] is using to implement our project.

2. Materials and Methods

A. Arduino

Arduino is an open-source microcontroller compatible with developed platforms. The controller appears not to be expensive and uses low electrical power, 5.5 volts. C and C++ were employed for this development. Arduino can connect to a computer via the Universal Serial Bus (USB) and perform with compatible connected accessories in both analog signal and digital signal. The Arduino is a microcontroller platform, mounted on a board that plugs easily into most computers. It allows the user to program the onboard Atmega chip to do various things with programming language.

B. ESP8266

The ESP8266 is a low cost Wi Fi with a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi Fi networking functions from another application processor.

C. GSM

A customized Global System for Mobile communication (GSM) module is designed for wireless radiation monitoring through Short Messaging Service (SMS). This module is able to receive serial data from radiation monitoring devices such as survey meter or area monitor and transmit the data as text SMS to a host server.

D. DHT11

Environmental conditions directly affect animal livelihood contributing to some chronic epidemics such as Bird Flu and Hand Foot and Mouth Disease. Therefore, DHT11 is use as a censor for measuring temperature (for both Fahrenheit and Celsius value) and humidity. The measurement unit will be demonstrated in a digital signal form.

E. Gas Sensor Module

The module works as a Air Quality Detection Gas Sensor, this is sensitive to gas dangerous to human, applied to measure NH3, NOx, Alcohol, Benzene, CO, and CO2. The module is also used for controlling weather conditions and air cleaners in buildings. The measurement unit is presented in a Analog signal. In this research, three censor forms were used, consisting of MQ-2 and MQ-135 because of its gas measurement differences.

F. Flame Sensor Module

The flame sensor module consists of an IR receiver, resistor, capacitor, potentiometer, and a comparator LM393 in an integrated circuit. It can detect infrared light with a wavelength ranging from 700nm to 1000nm. The flame probe converts the light detected into the form of infrared light into current changes. This type of flame detector works by detecting the UV radiation at the point of ignition. Almost entirely all fires emit UV radiations, so in case of the flame, the sensor would become aware of it and produce a series of the pulses that are converted by detector electronics into an analog or digital output.

G. Photosensitive sensor module (LDR)

A light sensor was used for measurement of light intensity especially for naked eye light. Light Dependent Resistor (LDR) is a light sensitive resistance changing electronic resistance when there is a light incidence, called Photo Resistor or Photo Conductor. The resistor was made from Semiconductor, Cadmium Sulfide or Cadmium Selenide. These two substances are semiconductors coated in a ceramic sheet as a base

H. Relay Module

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

F. Ultrasonic Sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. They work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. This is similar to how radar measures the time it takes a radio wave to return after hitting an object.

I. Water Level Indicator

Water Level Depth Sensor Module for Arduino is an easy-to-use, cost-effective high level/drop recognition sensor, which is obtained by having a series of parallel wires exposed traces measured droplets/water volume in order to determine the water level. Used to measure the depth of the water.

J. DC Motor

A DC motor is an electrical machine that converts electrical energy into mechanical energy. In a DC motor, the input electrical energy is the direct current which is transformed into the mechanical rotation. DC motors use electrical current to produce rotating magnetic fields that, in turn, generate rotational mechanical force in the armature located on the rotor or stator around the shaft.

K. Hardware connection

The Arduino, ESP8266 and GSM were connected via UART. The connection was a serial communication as Full Duplex since there was two-ways that data could be transmitted via pins TX and RX. A direct connection between the Arduino, ESP8266 and GSM was prohibited, because of its electrical potential differences. Arduino operating voltage is 5v for ESP8266 operating voltage is 3.3v and for GSM SIM900a is 12v. Bi-directional Logic Level Converter should be used to separate Arduino and ESP8266.For powering the GSM a 12v adapter is used.

All sensors would be connected via Board Arduino and the data would be transmitted from UART to Board ESP8266. Arduino works as a controller and notify the working condition to the smart phone via ESP8266 and GSM.

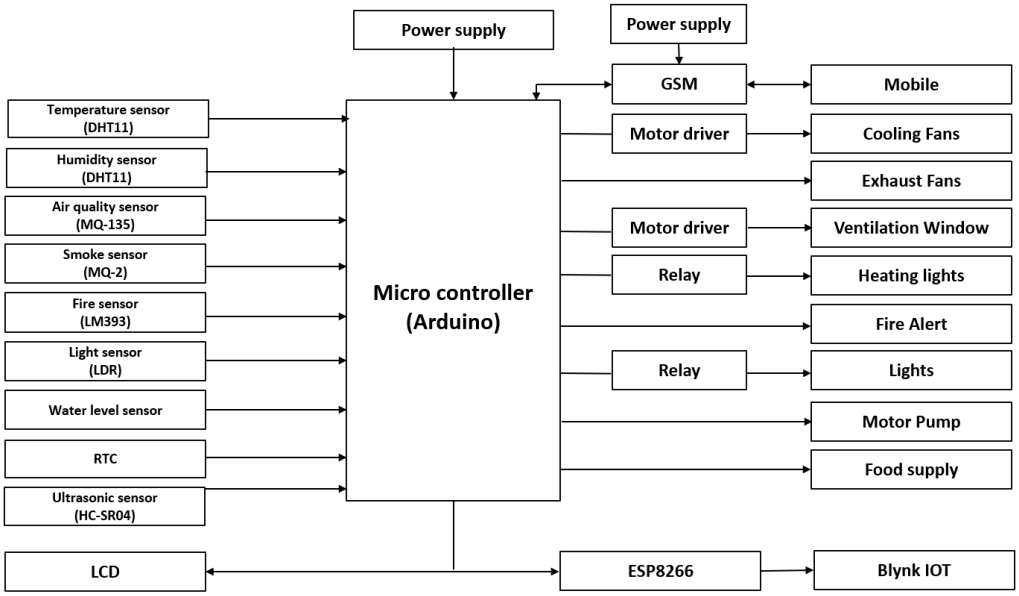

Figure 1: Block Diagram of Hardware Design

Figure 1 shows the block diagram of Hardware Design of the proposed smart poultry management system using Arduino. Arduino Mega is the main microcontroller unit which connects to sensors and other output for data logging. For the proper date and time stamp of the data logging, an RTC (real time clock) module is utilized. Temperature sensor (DHT11) will sense the surrounding temperature continuously and always comparing with the desired value in the chicken hall. If there is a sudden increasing of heat from the surrounding, an exhaust fan will blow out the heat and cooling fan will blow to stabilize the temperature in the chicken hall. If the surrounding temperature is too low than desired, heat lamp will be turned on until it reaches an optimum temperature between 28°C – 32°C for baby chicks. The humidity sensor (DHT11) will sense the level of moisture from surrounding either it too high or low. The gas sensor (MQ135) will be used to detect two different harmful gasses, i.e. ammonia and carbon dioxide. An exhaust fan and ventilators will be used to regulate both gas concentration. The gas sensor (MQ2) will be used to detect different flammable gases, i.e. Methane, butane, LPG, Smoke, etc. Alarm buzzer alert and notification is given to the user, all the windows and ventilators will be opened. The fire sensor (LM393) is used to detect fire and warns the user through notification and alarm. The Photoresistor sensor (LDR) is used to measure the light intensity in the farm. If light intensity is low then lights in the farm will turn on else lights will be turn off. Water level depth sensor is used to measure the water depth in the watering trays and if water level in trays is empty then motor pump will be turn on until again the tray is filled. The Ultrasonic sensor (HC-SR04) is used to detect the water level by measuring distance of water in the water tank, if water level is low then motor pump will be turn on until the water tank is filled. Motor Driver (L2N8) is used to control the speed of cooling fans and ventilator fans.

All the sensor data is displayed in farm by using an LCD and the data is shared with the person in charge by using ESP8266 and GSM.

Figure 2 shows the prototype design of smart poultry management system cage using various sensors, heat lamps, exhaust fans, feeding system ,watering system, Esp8266, GSM and Arduino microcontroller. Broiler chickens are the main group of chicken that will be focused on. Different ages of chicken have a variety of environment condition needed such as size of hall and surrounding temperature and different quantity of food and water. Maintaining temperature is very important to produce a good quality of chicken. Broiler chickens need around 28°C - 32°C to grow

healthily. Advanced chicken farming nowadays has used enclosed barns in order to keep the birds safe from extreme weather, insects, predators and diseases. Normally some food dropping and watering techniques were used in poultry farms. The food will drop continuously if bowls were empty without any limit because of eating more food also chickens would face some problems so we are using a technique that will drop required amount only. For this we are using rotatory blower that will blow the food at certain interval of time only. Watering is continuously given in the by checking the sensor values.

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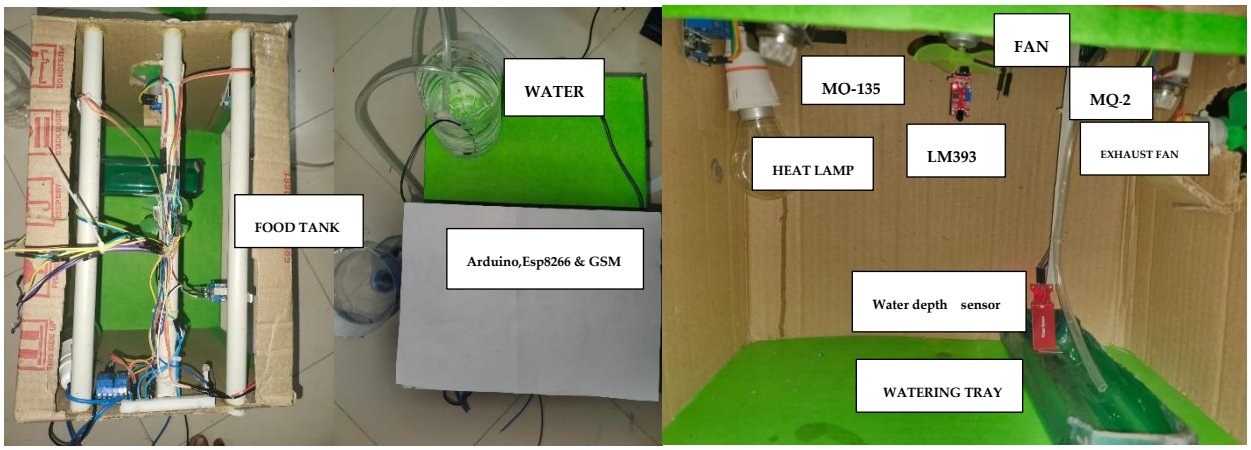


Figure 2: Prototype Design of Smart Poultry system

L. Software Design

For software programming of the hardware the Arduino IDE software is used. **Arduino IDE** is the Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. **Figure 3** shows the starting window of the Arduino IDE software. In starting window we see to buit in finctions **void setup() and void loop().** The code that we put in void setup() will only run once, and that will be at the beginning of the programm. The code that we put in the void loop() will run continously until the Arduino is turned off.

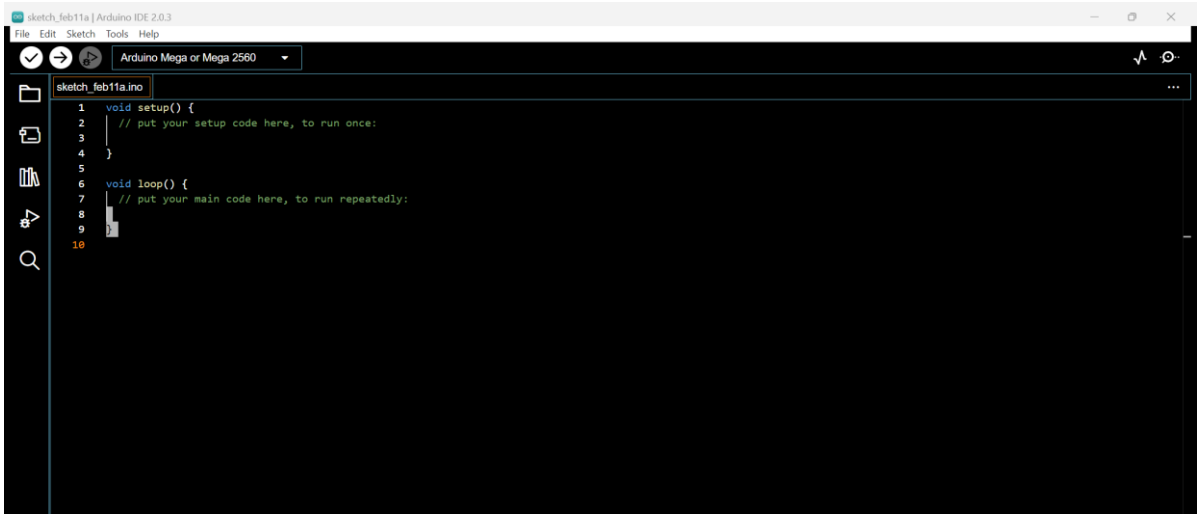


Figure 3 Starting window of Arduino IDE Software

Figure 4 shows the flowchart of the proposed system. The Arduino will acquire data from the temperature sensor, humidity sensor, LDR sensor and gas sensors. Then the data is compared with the assigned threshhold values that suitable in the chicken farm. If the actual value is the same with the desired value, the Arduino will keep read data from the sensor. If the temperature value is lower than the optimum value, the heat lamp will be activated. If the temperature value is higher or the gas concentration is high, the exhaust fans will be activated. If the humidity is greater than desired value then Exhaust fan will be activated. If Flamme is detected then alert alarm will activated cetain remedies were taken. If smoke is detected then fire warning alarm will be activated. Watering of chicken is activated if water level in the trays is low. If water in the tank is low then motor pump will be activated. Food is given based on the given time delays.

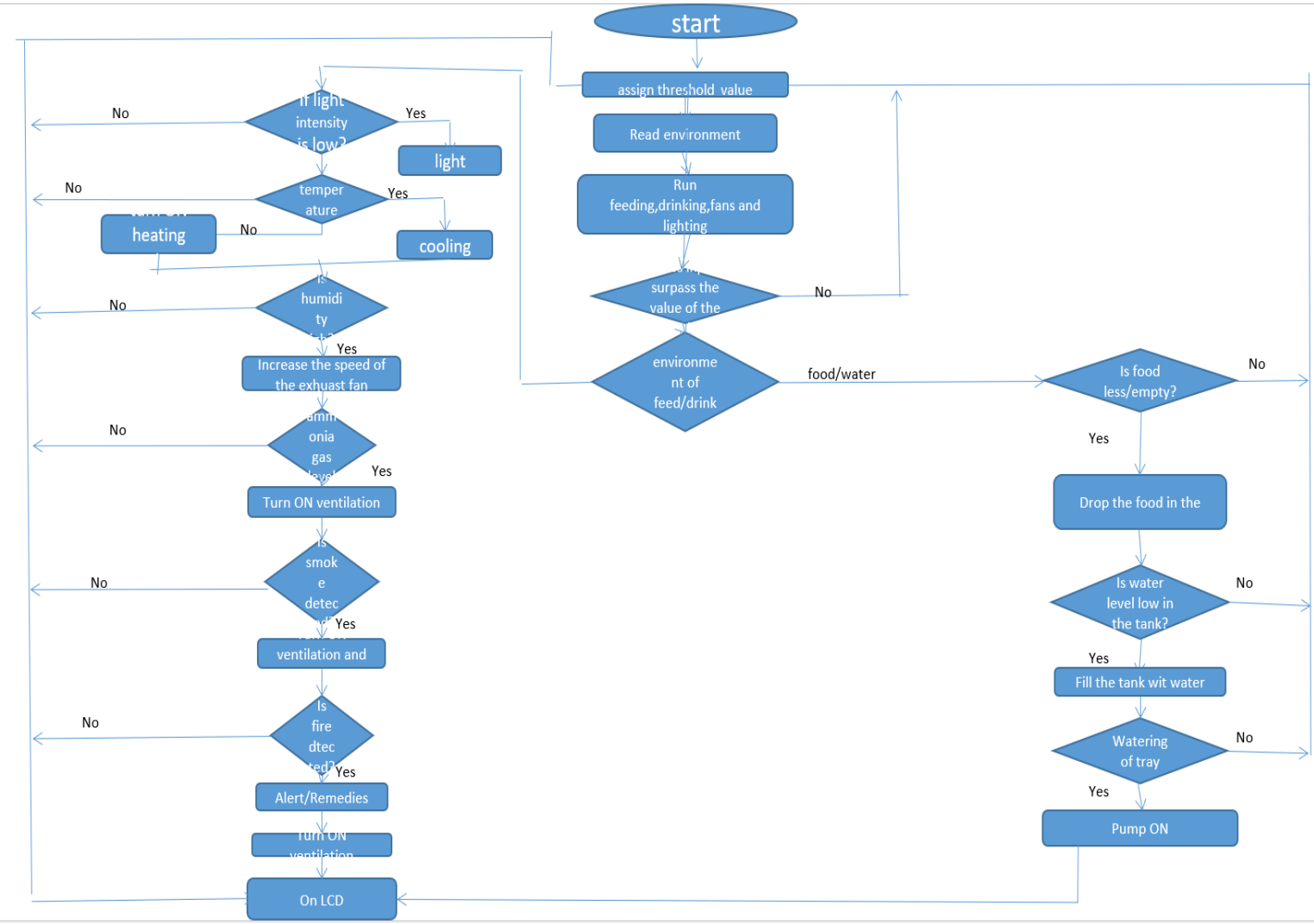


Figure 4: Flowchart of the Smart poultry Management system

3.Result

In this paper, the model developed has led to a trial in the environment and climate of a chicken farm, using the default configurationvalues and the outcomes were displayed to user through LCD, Text Message and IoT cloud. **Table 1** shows the given thresh hold values.

TEMPERATURE	**28-32 Celsius**
HUMIDITY	**30-50%**
AMMONIUM GAS	**>25ppm**
LDR	**>200Kohms**

Table 1: Threshold values

Figure 5 shows the results the observed in the serial monitor of Arduino IDE software. We can observe that in serial monitor the temperature and humidity values are shown and the status os the other sensor was also showed. Even we can observe every sensor value can be observed if required in the serial monitor.

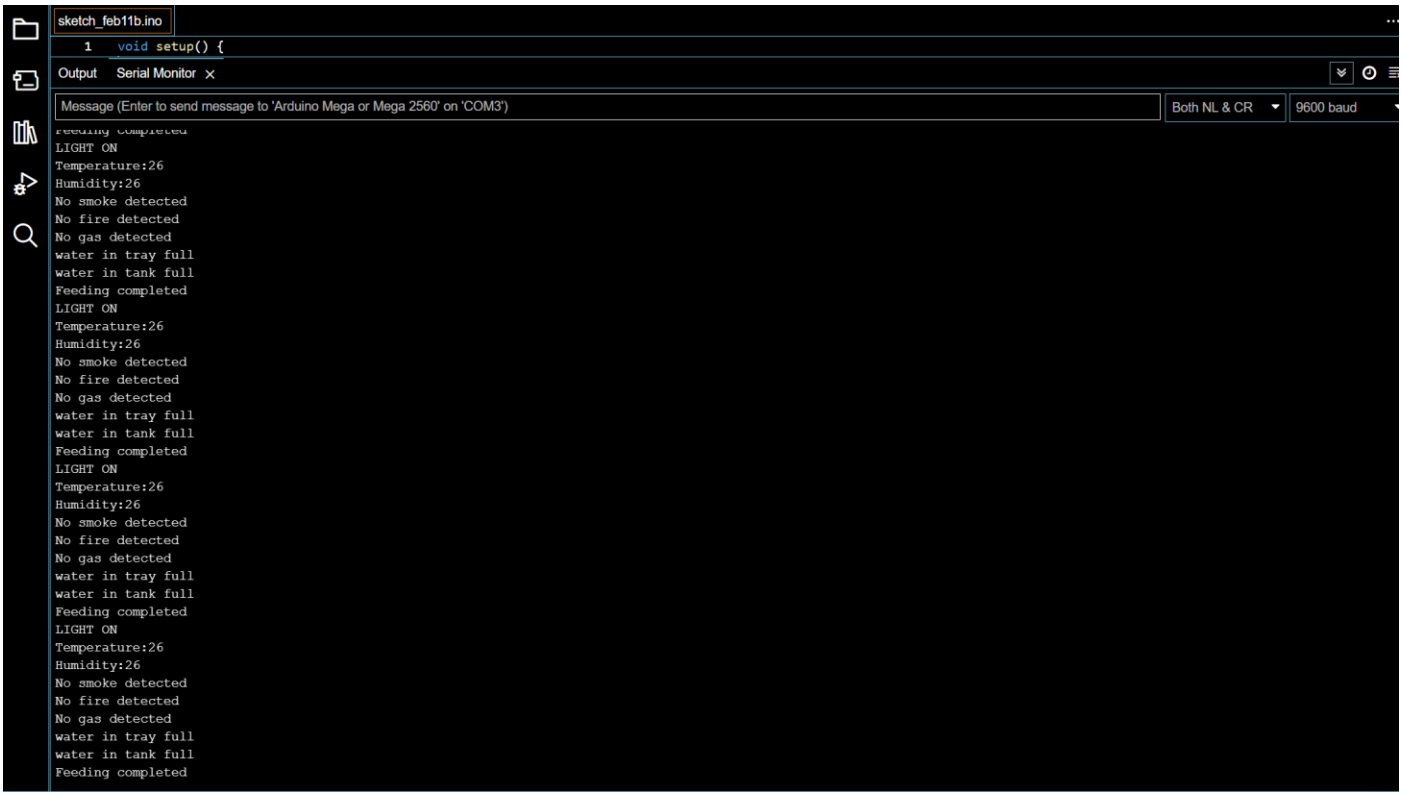
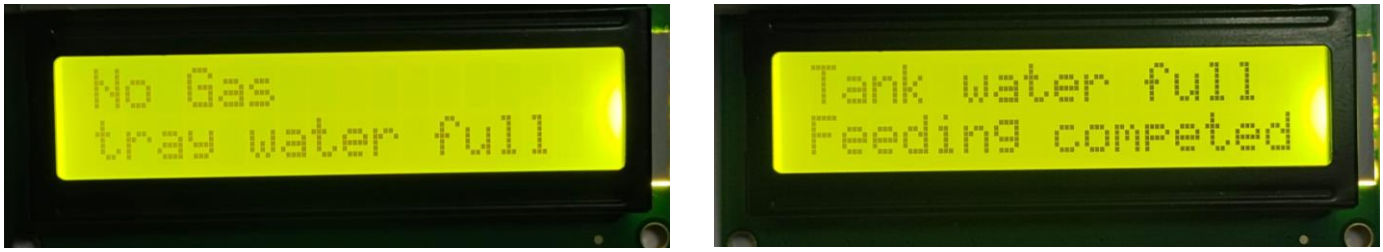


Figure 5: Results observed in Arduino IDE serial monitor

Figure 6a, 6b, 6c &6d shows the farm monitoring through LCD which placed inside the poultry farm and it is used by the workers working in the farm.

6a

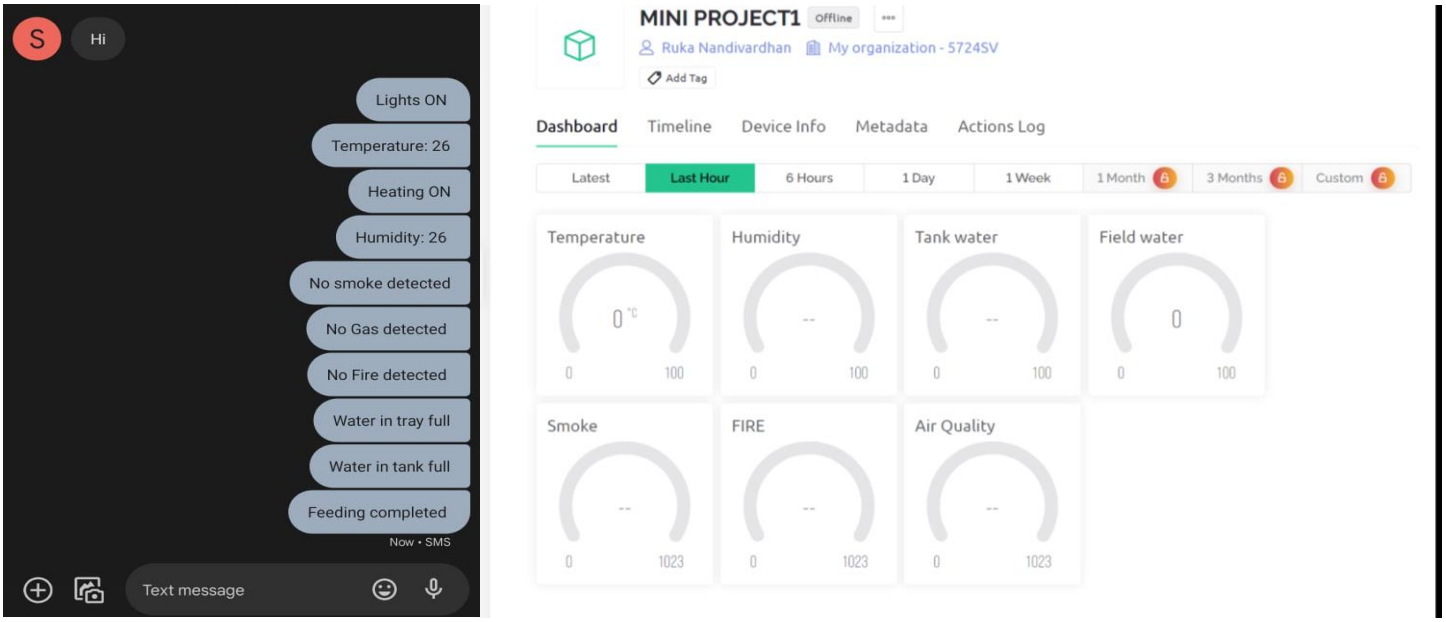
6b



6c **6d**

Figure 6: Farm monitoring through LCD

Figure 7a and **7b** shows the monitoring of farm by the user via mobile and IoT cloud. In figure 6a shows the data send by the GSM to the user mobile phone and figure 6b shows the farm monitoring through IoT cloud which sent by the Esp8266 module. Our system allows user to monitor the farm in different ways.



7a **7b**

Figure 7: Monitoring through Text message and IoT

4. Discussion

Our system shows better results when compared to the previous/other systems because of automated feeding and watering. Because of giving required amount of food the growth of chickens is very good. Compared other system our system can able to predict fire accidents by detecting flammable gases. This system can be used in all type of poultry forms, i.e. small, medium and large poultry farms because of it's cost efficiency. In future an advanced system can be implemented by using this system by adding advanced systems like cleaning, controlling through IoT, Livestock monitoring, Disease monitoring and other advanced systems

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5. Conclusions

This paper has presented the development of smart poultry management system. Arduino with a realtime sensing, monitoring, and control of the farm environment, including ammonia, carbon dioxide, temperature and humidity.Successfully this system is also able to feed and water the chicken automatically. Experiments showed that our proposed system has better monitoring and control compared to the traditional Arduino system.

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