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Popular Article

Smart Hatchery Management

Dr Mendu Mounika[1], Dr T.Srilatha [2], Dr Mojarla Raghavendar[3]
[1,3]PG Scholars, Dept of poultry science, college of veterinary science, Hyderabad
[2]Assistant professor, Dept of poultry science, college of veterinary science, Hyderabad
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Smart hatchery management involves using advanced technology and data driven approaches to optimize the breeding and hatching processes in poultry

- Implementing automated systems and using Internet of Things (IoT) devices and sensors to monitor environmental conditions like temperature, humidity, air quality, and egg turning frequency in real-time. This data helps in making timely adjustments for optimal hatch rates.
- Use of data analytics and predictive algorithms to analyze the collected data and identify patterns that can enhance hatchery conditions and predict potential issues.
- Utilizing remote monitoring systems that allow hatchery managers to oversee operations from anywhere, enabling prompt responses to deviations or emergencies.
- Implementing systems to track and trace eggs and chicks, ensuring quality control throughout the hatchery process and enabling better management of inventory and logistics.
- Utilizing AI and machine learning algorithms to optimize incubation conditions based on historical data, leading to improved hatch rates and better overall performance.
- Using specialized hatchery management software that integrates all aspects of the hatchery process, from incubation to chick placement, to streamline operations and facilitate decision-making.
- Implementing strict biosecurity measures to prevent the spread of diseases and maintain a healthy hatchery environment.

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- Providing training and continuous education to hatchery staff to ensure they are proficient in operating and maintaining the smart technologies effectively.

Technologies that have been developed for hatchery management

1. Real time remote monitoring:

Smart Real time remote monitoring solutions for poultry hatcheries must be followed for increasing the productivity by using artificial intelligence and Internet of things over the mobile or web. Real time monitoring of temperature, humidity, rack turning, door condition, power supply and fan functioning. Any abnormal changes in these anomalies can be detected and local alarm alerts along with notifications in the mobile app will be shown.

2. Use of temperature calibration probes:

Temperature calibration probes are used to check and calibrate the temperature sensors in setters and hatchers regularly. Using a calibration probe which is accurate to 0.2°F, and readable to 0.1°F is beneficial. To achieve a proper calibration, the calibration probe has to be placed at a location which is consistently within 0.2°F points of the air temperature at the machine probe. Best accuracy can be obtained when probe is placed next to machine probe. When the machine probe and calibration probe readings are similar (less than ±0.2°F difference), drill a hole in the wall or roof to allow the calibration sensor to be inserted at that point. Once the best position in one machine is detected, the same location can be used for all the other machines of similar type and capacity.

3. Control and Monitoring System of Chicken Eggs Incubator Using Raspberry Pi (micro controller):

Microcontroller Raspberry Pi technology which is combined with temperature and humidity sensors, light sensor, motor servo, webcam, and relay to produce control and monitoring system of chicken eggs incubator machine which can be accessed through website. ***Monitoring of Temperature, Humidity, and Light:*** This feature is used to monitor the condition of the temperature, humidity, and light in chicken eggs incubator space. Raspberry Pi gets temperature data through temperature and humidity sensor, and also the light sensor. After those data obtained then send it to the server and save it in the database. If the data obtained is empty, it have to do retrieve the data. Website application provides a graphical user interface (GUI) to access that data. Sending data to the server is done every 5 minutes until the incubation process finish**.**

Automatic Control of Temperature and Humidity: This feature works as the Raspberry Pi receives temperature data through temperature and humidity sensor. If the temperature is 38°C

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or up to that, it is called high temperature, SET GPIO. LOW process in Raspberry Pi pin that is connected to relay is done, so that the bulb will turn off. Temperature of 37°C or less than that is called low temperature, it means SET GPIO.HIGH process in Raspberry Pi pin that is connected to the relay is done, and the bulb will turn on. The data of humidity is received by checking the condition of the humidity itself. If the humidity is 51-60% is called normal. If it up to 60%, it is called a high humidity, then the SET GPOI. HIGH in Raspberry Pi pin process which is connected to the relay is done, so the water pump and air fan will turn off. If the humidity is only 50% or less than that, it means the humidity is very low, then the SET GPIO.LOW in Raspberry Pi pin process which is connected to the relay is done, so that the water pump and air fan will turn on.

Automatic Turning of Egg Shelf: This feature is used to turn the egg shelf automatically in order to spread the temperature evenly on all sides and also to make the egg embryo not stick to one side of the egg shell. How the feature works is the turning of egg shelf is done every six hours. First position of the egg shelf faces to the centre, then Raspberry Pi moves the step motor which is set to the fore with approximately 45° degree angle and remains in this position for six hours. After those six hours, the egg shelf will be moved by the step motor facing backward with approximately 45° degree angle and remains in this position for six hours and then back to the first position in the centre. It happens repeatedly until incubator process stopped.

Taking Images: This feature is used to monitor condition inside the incubator space by taking images using USB Web Camera.

a. Taking Images through User Request: This feature works by taking and sending the images after user does request process on the website.

b. Taking Images Automatically: This feature works by taking and sending the images every once hour which is done automatically after incubation process is started.

Control and monitoring system of chicken eggs incubator machine by applying “internet of things” technology using Raspberry Pi has succeed to be conducted. By using this system, they can control and monitor through their own incubator machine anywhere and anytime. Using website application as graphical user interface (GUI) gives an easiness to use this system because it can be accessed through internet browser from various devices, such as smartphone, tablet, desktop computer, and others.

4. Application of I2C SHT11 Sensors on Automatic Egg Hatching Machines Application of I2C SHT11 Sensors on Automatic Egg Hatching Machines

Automatic Egg Hatching Machine utilizing I2C SHT11 Sensor and Real Time Clock DS1307 has been successfully designed. As the control center used Arduino Uno

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microcontroller and output devices in the form of DC fans, incandescent lamps, liquid crystal displays, and linear actuators to drive the egg shelf. Electronic technology Inter Integrated Circuit (I2C) temperature and humidity sensors SHT11 is a single chip temperature and relative humidity sensor with multi sensor modules whose output has been digitally calibrated so that a good output signal, fast response time, and resistance from interference outside. While Real Time Clock (RTC) is an I2C chip that has the function of storing time and date.

Temperature and humidity control: The software design (program) from the design of temperature and humidity control includes 3 (three) main parts, namely

1) Programs for SHT11 sensors
2) Programs for display on display
3) Programs for lights and fans

The ideal temperature required in the hatching process is 37 ° C - 40.5 ° C, so if the SHT11 sensor reads the temperature less than 37 ° C then the microcontroller will give the light command to on. This situation will cause the temperature to increase slowly. When the SHT11 sensor reads a temperature of more than 40.5 ° C, the microcontroller will instruct the lamp to turn off and this condition will cause the temperature to slowly decrease. The same thing applies in the design of humidity control, and this cycle will continue to repeat during the hatching period.

Control of Egg Shelf Playback: Software design from the design of egg rack playback controls also includes 3 (three) main parts, namely

1) Program for DS1307 RTC
2) Program for display on display
3) Program for linear actuator.

The programs in all of these sections are designed to follow the egg screening requirements needed in the hatching process and what activities the actuator will do as an output device in response to changes in the time given by the DS1307 RTC. When the clock shows 04.00 for example, the microcontroller will give an order to the linear actuator to move the sloping shelf to the right with a certain slope. The same thing happens when the clock shows 8:00 a.m., the microcontroller will give an order to the linear actuator to move the egg shelf tilted to the left with a certain slope, and this cycle will continue to repeat during the hatching period.

5. Egg hatching incubator using conveyor rotation system:

The temperature and humidity adjustment were set automatically according to the specifications determined by the users on the display monitor. Eggs were placed into the

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incubator once the temperature and humidity are consistent. Eggs were turned by the conveyor system at least 2-3 times daily to ensure a high percentage of hatching. The entire system was controlled by the microcontroller. This incubator consists of three elements that need to be controlled which are movement, temperature and humidity. Coil heaters were used to supply the appropriate temperature to the eggs. The percentage of moisture inside the incubator was controlled consistently by the exhaust fan and water. It is to ensure that the moisture and ventilation are in good condition. Nevertheless, sufficient moisture is needed to ensure the embryo eggs do not stick together with the egg shell. Geared motor was placed on the tray of eggs to change the position of the eggs with mechanical system. In addition, microcontroller was used to monitor and control all of these elements. This controller processed the data from sensors and changed the temperature as well as the humidity conditions in the incubation machine.

6. Solar Powered Poultry Egg Incubator:

The utilization of solar incubator would offer a solution to a major constraint of power inadequacy for commercial poultry egg incubation in Nigeria. A solar powered poultry egg incubator was developed and the main components included incubating chamber, control system and solar powered system. The turning of the eggs was automated using crank and connecting bar mechanism and powered by an electric motor. The electric motor serves as the mechanical power source or energy converter. The switching on and off of the electric motor were accomplished using on and off relay timer with contactor. However, for automated system it is recommended that the turner should be set to operate few seconds after every one hour. The electric motor with a speed reducer was used for the turning. The power of the electric motor was 1hp. A low-speed electric motor is required to prevent cracking of the eggs due to vibration, collision and continuous agitation of the egg. The inner temperature of the incubator was monitored using a thermostat and thermometer while the ambient temperature and relative humidity were monitored using the hygrothermometer clock.

6. Advanced technology for assessing live and dead embryos during transfer of eggs from setter to hatcher: Machines developed for this purpose check the heartbeat of embryo and display the condition of embryo by the display of different colors on the screen.

Green dots- fertile eggs with viable embryo

Blue dots –infertile eggs with no embryo

Yellow – non viable embryos

Transfer system picks up only the fertile viable eggs and shuffles them into specialized hatching trays. The other infertile or non-viable eggs are left in the trays and are later

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decomposed to prevent the exposure to harmful bacteria.

Conclusion

Smart hatchery management offers a transformative approach to poultry farming, revolutionizing the industry with its technological advancements and data-driven strategies. By integrating automation, AI-powered monitoring, internet of things and precise analytics, it optimizes every aspect of hatchery operations. This comprehensive system not only enhances productivity and efficiency but also ensures higher hatch rates, improved animal welfare, and better resource utilization. The future of hatcheries lies in this intelligent fusion of technology and expertise, promising sustainable, higher-yield production while minimizing environmental impact.

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