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Design of a Mechatronic Device that Increases the Efficiency of Hatching Eggs in an Incubator

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Abstract:

The present research uses wireless sensor networks (WSN) to create a smart watering system. The system’s ability to perform real-time monitoring and management of irrigation makes sure that crops get the right quantity of water depending on their unique needs. The suggested method boosts agricultural yields, decreases labor costs, and improves water usage efficiency. The system uses a fielddeployed network of inexpensive wireless sensors to track the soil moisture levels in real time. The central controller utilizes the wirelessly sent sensor data to decide when and how much water should be applied to the crops. Utilizing wireless protocols like Zigbee, these nodes connect to a central gateway, where the data is processed and examined to establish the ideal watering needs for each crop. The technology is scalable and simple to install in larger agricultural fields. The study’s findings indicate that the system can boost crop yields by up to 30% while boosting water usage efficiency by up to 60%. Farmers may decrease their water use, save time and money, and enhance their profitability by adopting the smart irrigation monitoring service powered by WSN.

Keywords: Poultry; Incubator, egg.

Entrance: Four independent factors play a key role in the incubation process for optimal quality and quantity of chicks.

These factors are temperature, humidity, ventilation, and egg rotation. Incubator manufacturers have designed their machines to best utilize these four factors to provide the most stable environment for the embryos to be encased within the egg mass throughout the incubation period[1]. Only a perfect combination of temperature, humidity, ventilation, and rotation systems can control the gas exchange and heat/cold transfer required for maximum environmental stability and provide the macro and micro environments to meet the ever-changing needs of the developing embryos.

In a field experiment, a hatchery reported poor hatchability and quality of chicks. The incubation team's first thought was that their ventilation system was faulty. The results showed high late mortality and misplacement rates of up to 10%, resulting in a 15% lower than normal fertilization rate[2]. After a thorough inspection, it was found that although their egg rotation system was working, according to the computer monitoring system, their rotation system was actually only working in two positions, one side and the other. This was a turning problem, and with regular inspections, the quality and quantity of chicks could be saved from loss[3].

Advantages:

Lower cost

Manual incubators are relatively inexpensive and ideal for farmers with limited budgets. Especially for small family farmers, manual incubators can provide basic incubation functions with less initial investment[4].

Simple operation

Manual incubators are not complicated to operate, and even users without technical knowledge can easily get started. Follow the simple instructions, and farmers can start the incubation process without complex technical knowledge or high-tech equipment[5].

High freedom of control

Since manual incubators require farmers to personally control the incubation conditions, this equipment provides more flexibility for experienced farmers. They can adjust the temperature, humidity and egg rotation frequency at any time according to actual conditions and personal experience, which can better meet the incubation needs of specific egg types[5].

Disadvantages:

Reliance on manual operation:

One of the main disadvantages of manual egg incubators is their high dependence on manual operation. Farmers need to frequently adjust the temperature and humidity manually and turn the eggs regularly, which can be inconvenient in daily life, especially when the incubation volume is large[6].

Lower incubation success rate

Manual operation can lead to human errors such as temperature fluctuations, unstable humidity, or not turning the eggs in time, which will lead to unsatisfactory incubation conditions, thereby affecting the incubation success rate. This risk always exists during the incubation period, requiring farmers to work carefully and carefully.

Time-consuming and labor-intensive

Using a manual egg incubator requires a lot of time and effort, especially when the incubation volume is large, the difficulty of management and operation and the workload will increase significantly[7].

Figure 1. Small family farms.

EGG SELECTION:

Incubate only CLEAN eggs. Floor and system eggs will not hatch. This selection must be done on the farm, so never put ir egg into the box.

Incubate only eggs with normal shape and good shell quality (discard eggs with hairline cracks).

To evaluate the procedures, it is necessary to monitor the quality of egg selection: regularly inspect 60 to 90 eggs and count the % of dirty, upside down, hail, etc. Record the result[8].

EGG DISINFECTION:

Disinfect the eggs as soon as they are collected, while they are still warm (within 2 hours of laying).

Only use the product labeled for use on incubation eggs.

Always follow the instructions: dosage, exposure time and method of application.

It is best to test the fumigation method when early mortality is high (<24 hours).

NEST MANAGEMENT:

Good nest: improves nesting behavior, keeps eggs clean, and prevents damage to eggshells.

Keep nests clean. Always have clean, deep enough (2.5 cm / 1 inch) and good quality bedding material in the manual nest[9].

Daily nest inspection is essential. In manual nests, change the bedding material and/or sanitize the nest in a timely manner (in automatic nests: every two weeks, daily and before starting egg collection

All nests should be checked for condition (e.g. if they are 100% open). Check for infertile females hiding inside the nests.

Close the nest 2-3 hours before the lights go out and open them again before the lights come on. Never leave nests open at night[10].

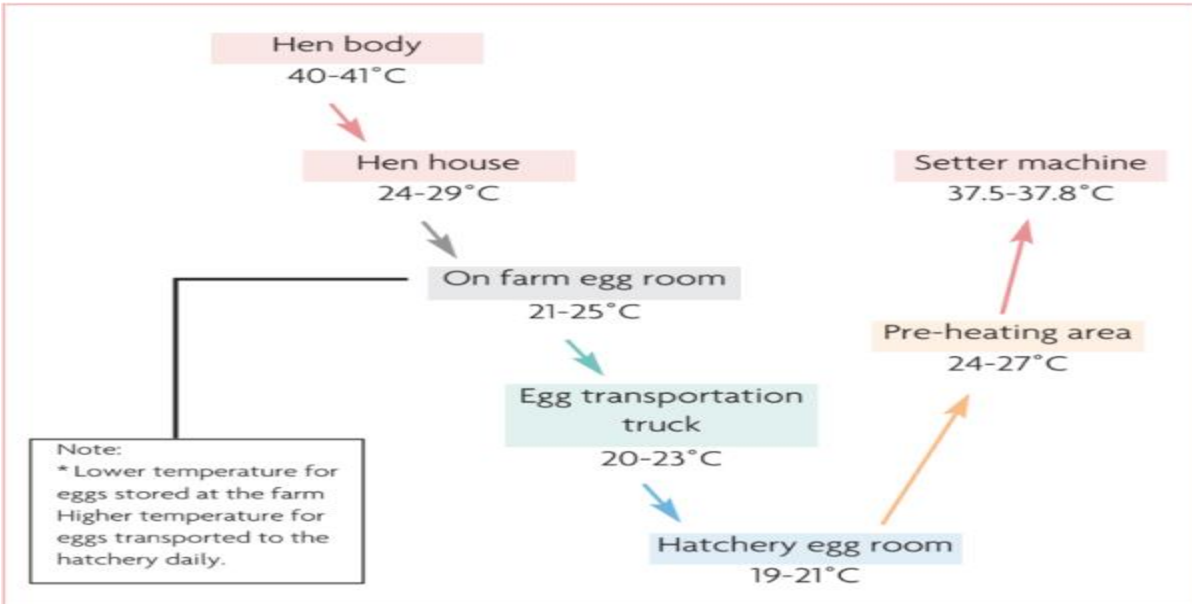

Figure 2. Egg temperature flow chart (for fresh eggs).

EGG COLLECTION:

Collect eggs as often as possible. Prevent eggs from accumulating in the nests and belts.

In a manual nest, at least 4 times a day at normal temperature (18-25 ° C). More often in summer/hot climates. Remember that the goal is to collect more than 90% of the eggs within the first 7 hours after the light is turned on.

In an automatic nest, do not wait more than 3 hours since the start of the light period and do it continuously for the first 4 hours to avoid hairline cracks.

It is better to collect the eggs in disinfected plastic or trays. Always use trolleys that allow good air circulation between the eggs. Place the eggs in the trays with the air cell facing up (rounded end)[11].

Never leave the eggs in the nests or belts overnight.

EGG STORAGE:

After disinfection, store the incubation eggs quickly in optimal conditions (within 5 hours of laying).

Always avoid temperature fluctuations and condensation.

It is important to have good air circulation to create a uniform environment.

Always monitor temperature and humidity. Use a min/max thermometer and a digital thermometer/hygrometer. Data loggers are recommended.

If eggs are left in the farm storage room for more than 3 days, monitoring is necessary (75-85% RH)[12].

Always monitor temperature and humidity. Use a min/max thermometer and a digital thermometer/hygrometer. Data loggers are recommended.

Do not place controllers or sensors in direct air flow from AC equipment.

If it is not possible to have rooms with different temperatures, a general rule of thumb is to keep eggs between 15 and 17°C (59 to 62.6°F) and a relative humidity of 75 to 85%[13].

Conclusion:

All these major and minor factors, if observed, play a role in ensuring the best incubation performance and ensuring healthy chick quality. Of course, there are other factors that have a great influence on the embryo development process: room temperature adjustment, room ventilation, oxygen supply, cooling and removal of heat and CO^2 (it is recommended not to exceed 0.4%). and air pressure. The challenge for incubator manufacturers is to ensure the correct air exchange and air flow for each egg in the turner at each position during the turning process. Some incubators claim that in order to increase the efficiency of ventilation, the angle of rotation should be reduced to 15-20 ° to provide more space for ventilation inside the incubator. Some have reduced the distance between egg racks and increased the frequency of rotation to 96 times per day to compensate for the reduction in the angle of rotation. All of these trials have not yet resulted in improved incubation and chick quality. On the contrary, chick quality has been found to be reduced and embryo mortality and embryo malposition have increased.

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