Research Paper

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PLC Based Poultry Automation System

Engineering

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ABSTRACT

Poultry farming till now is done manually so farmers are incapable for getting the maximum benefits. Many years ago the feeding of whole cereals to chickens, as a scratch feed or part of a complete diet, was the normal accepted practice. With the growth of intensive poultry production, automatic feeding systems, employing for the most part full-fed complete diets, were adopted as the method of choice for feeding. We also have to ensure the environmental conditions like humidity and temperature control as required. Control and monitoring of environmental parameters inside a Poultry farm, so as to ensure complete care of chickens is one of the major objectives of the work. The objective is achieved through the use of sensor based technology. The Poultry Farming through automation using PLC has to form the Environmental Controlled Poultry sheds. These Environmental Controlled Poultry sheds are controlled 24 hours through automation. Due to automation wastage of time will be avoided. The feed to gain ratio is enhanced with precise nutrient feeding rather than a full-feeding program. It will provide optimum output with decreasing the human efforts and also human errors.

Introduction

Understanding the animal environment, air quality, feed and water requirement is a crucial first step in maintaining healthy and productive livestock. The foremost challenge in understanding the dynamic aerial indoor environment is overcoming the large scale and high concentration of commercial confined animal feeding and water supply operations. In conventional poultry farm monitoring system, feeding and water supply was done manually. Also the environmental parameters like temperature and humidity values can only be monitored. For providing the suitable environment, one has to manually switch on different devices like exhaust, air conditioner, fan etc. which is cumbersome for humans and now obsolete mechanism. It is possible to automate the monitoring of these environmental parameters instead of using the conventional monitoring methods and controlling the parameters automatically. Poultry farm monitoring and control can be divided into three main tasks: Measuring, calculating and adjusting. We have proposed and developed a Poultry Farm Monitoring and Control

System based on PLC control. Water, along with temperature management, good air quality, clean formulated feed and protection from disease are

The five basic needs of poultry to optimize bird performance. The PLC is programmed to provide feeding and water to poultry sheds as per bird's requirement.

The same PLC is integrated with commercial sensors capable of measuring environmental conditions. The measured values of the climate variables are first converted from analog to digital and then transmitted to the PLC. The output from the PLC is then transmitted to the control/actuator circuitry through a work station that controls local heating, ventilation or some other activity, which is acting on the poultry farm interior climate. These systems are usually equipped with the option of controlling zonal heat, ventilation and/or any other climatic aspect. Provision of these facilities is made possible by the automation system whose accuracy directly depends upon number of measured values. Increasing the accuracy and thus the number of measurement spots raises the cost. So, a compromise is to be made between the cost and accuracy. In automated poultry farms, multiple sensing spots are required to monitor the local climate variables in different zones of the large poultry farm to make the automation and control system work properly. We are going to control feed and water supply system, poultry environment such as temperature, humidity (which indirectly controls poultry odor) through PLC control.

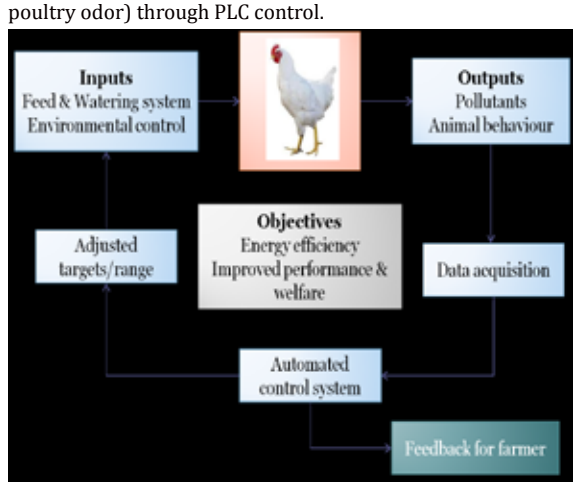

Fig 1. Precision livestock model (adapted from Wathes, 2007)

This paper presents an automated monitoring and control systems for poultry farms. In this system, we are going to control MAIN parameters like:

- FEED SYSTEM
- WATER SYSTEM

ENVIRONMENTAL parameters like:

- ODOUR CONTROL
- TEMPERATURE CONTROL
- HUMIDITY CONTROL

A main concern in humidity and temperature control of a poultry farm is to provide the best suited environment for poultry nourishment. And odor control is related with human comfort. Temperature and humidity are closely linked together in a poultry farm. Cold air has a lower moisture-holding capacity than warmer air, and therefore the decrease of the relative humidity is a sign of increased air temperature. One or many sensors can be an attractive, modular and inexpensive option in building the poultry farm monitoring system.

The poultry farm is mainly divided into four zones: hatchery,

feeding, egg production and multiplier breeder flocks zone which provides broiler hatching eggs. Depending upon zonal chicken population and distribution, each zone has its own local climate.

Water system

The poultry farm water system should be checked on a regular basis to ensure that adequate quantity and quality water is available. Water and feed consumption are directly correlated, meaning that if one decreases, they both decrease. So if water consumption drops for a few days, then feed consumption will decrease as well. While water is an important nutrient, it is also a critical component of the environmental control system when using evaporative cooling to keep the birds cool in hot weather. Water volume and availability are important. Water management of the water system at the house water panel involves monitoring water pressure or flow at several locations. Totally enclosed water systems have been adopted by the poultry industry. One of the biggest benefits from this type of system is the cleanliness and ability to prevent bacteria and other foreign materials from entering the drinking water. Birds obtain the water directly from the water system on demand. Mediator pumps are a normal component of most poultry house water systems and are used to deliver vaccines, medications, water treatment and sanitation products.

The regulator, water pipe, nipple and standpipe are all components of the water line that should be examined and maintained. One of the simplest things to do in the process is routine flushing of the water lines.

Application of treatments to control microbial growth, such as chlorine, can cause precipitants to form in water that has high iron or manganese concentrations. This will clog filters and possibly result in leaky drinkers neither of which will be good for bird performance.

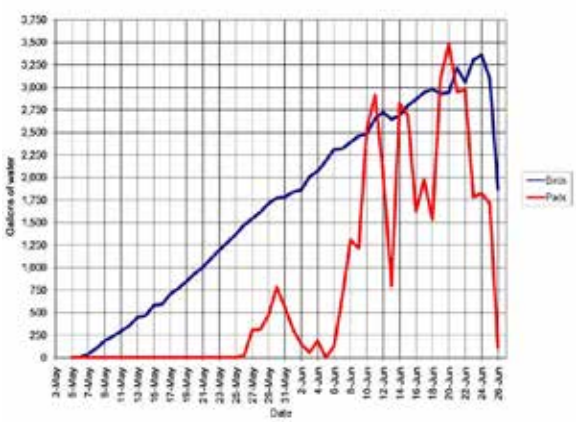

Fig2: Daily bird and evaporative cooling system water usage.

Feed System

As the present feeding devices used in the chicken farm are mostly simple and less automated, an intelligent feeding system is established by comprehensive technological means like sensor detection, data processing and to control the feeding quantity accurately and monitor the feed intake in real time. Upon testing, the feeding efficiency is 1.4-1.9 times higher than that of traditional machine. Users can set the feeding parameters based on the chicken age, type of chicken and other information through the interface of the upper computer, and monitor the situation of the chicken farm, to achieve the requirement of intelligent feeding. There are main things chickens need nutritionally to be healthy: Protein, Grains, Greens, Calcium, Vitamin A and Vitamin D, Salt, etc. Using automated feeding system, appropriate amount of nutrition can be provided. The main advantage of this system is that we ensure the equal distribution of feed throughout the poultry farm.

Temperature

The system features automatic control of air temperature. The temperature sensor placement can have a significant effect on both bird performance as well as energy usage. When placing fan temperature sensors/thermostats in broiler-breeder houses it is important to realize that the environment on the slats can be very different than that in the scratch area, especially during hot weather Though placing fan thermostats/sensors on the slats will tend to have the greatest effect on how fans operate during the day when the greatest temperature differences tend to occur between the scratch and slat areas, it will also prove beneficial in early morning. During feeding a significant amount of heat is generated by the birds, especially on the slats where the majority of the birds are located. If there are thermostat/sensors on the slats, the fans will respond to the surge in heat, helping to quickly cool the birds. Placing thermostat/sensors on the slats will also tend to cause fans to operate a little later into the evening insuring that all the birds are adequately cooled, not just those in the scratch area, so all the birds will be willing to eat the next morning. If placed too high or too close to a brooder, bird chilling can occur. If placed too close to a side wall, brood curtain, and end wall or in the vicinity of where the air entering through an inlet moves to the floor excessive fuel usage can occur.

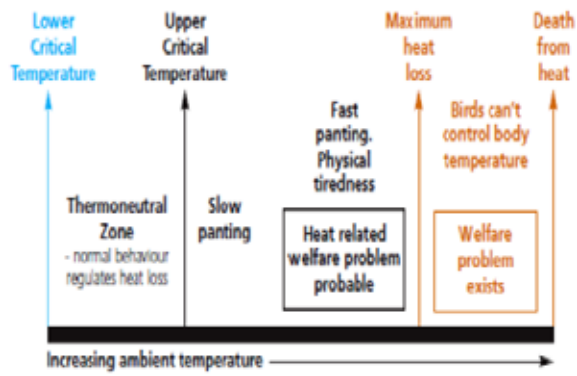

Fig.3 ThermoNeutal Zone

The heating purpose achieved using a LED smart lighting control system applying to poultry farms. There are disadvantages of the conventional system adjusting incandescent bulbs of illumination, of which energy efficiency is very low. In order to solve this drawback, a smart control system is applied to poultry farms. The proposed smart control system has several advantages as follows. First, the energy efficiency can be increased in comparison to the existing system. The maximum illumination is improved by 10 times more than that of the existing system.

Cooling system in poultry environmental control is done using tunnel or circulation type of fans. From a fan performance and overall air-velocity-distribution standpoint, the fact is that tunnel fans can be placed in the end walls, side walls, or a combination of the two; depends on the architecture of poultry shed. The only area that tunnel fans placement affects air velocity distribution is near the tunnel fan end wall. Placing tunnel fans in the end wall can reduce the size of triangular dead spot near the end wall that tends to occur in houses where the tunnel fans are placed solely on the side walls. Another type of fan is the circulation fans, which have proven to be very effective in reducing fuel usage, promoting drier litter, and minimizing hot and cold spots in broiler houses during cold weather. We should install circulation fans in such a way so they work together as a unit to thoroughly, yet gently, mix the air in the house not only from ceiling to floor but from end to end, on a continuous basis, without producing excessive air movement at floor level.

Humidity

Fresh air is required to transport excess moisture from inside the house to outside the house. Heat is needed to increase the temperature as well as the moisture holding capacity of the cool

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incoming air, and air movement helps to extract the moisture from the litter so it can be exhausted from the house. A moisture control system in a poultry house consists of timer fans to exchange the air,

Figure 4. Circulation fan system

How do we know 'how much should be operating timer fans?' Since we are trying to control moisture, one way is to use a minimum ventilation chart based on bird water consumption (Table 1). The more water the birds drink, the more water we need to remove, the more the timer fans we need to operate. Though Table 1 provides a good starting point, in reality the best method of determining how much timer fans should be operated is to simply monitor the relative humidity of the air in a house. The optimal humidity is between 50 and 60%. Though there is not an exact correlation among relative humidity, ammonia and carbon dioxide the relationships are consistent enough to indicate that when a relative humidity of 60% or lower is maintained air quality tends to be within acceptable limits. Conversely, a relative humidity of 70% or higher tends to be a fairly accurate indicator of poor air quality. Humidity control is an important tool to prevent the spread of broiler diseases in poultry farms. Normally, the range of healthy relative humidity for the broilers is from 30% to 60%. The favorable poultry farm climate adjustments especially during the summer and winter seasons can help to improve the productivity of the farm and economize the energy usage. In advanced poultry farms, various measurement spots are used to record the parameters defining the local climate in different parts of the large poultry farm to make the automation and control system work efficiently.

If the humidity is too high we should increase fan run time, if too low runtime should be decreased.

Inside temperature	Two - 36" fans	Four - 36" fans
90°F	5 seconds	3 seconds
80°F	10 seconds	5 seconds
70°F	15 seconds	8 seconds
60°F	20 seconds	10 seconds

Table 1. Fan runtime (out of 300 seconds) for every 100 gallons of water consumed.

Though at times controlling litter moisture may seem like an impossible task, with proper management of incoming air and house relative humidity, it can be done. Proper litter management will result in better environment for the birds and ultimately better health and performance.

Odour

Odour is one of the important parameter to be reduced. Preventative actions include minimizing the number of people that may be affected by appropriate site selection and shed orientation (including fan direction), purchasing additional buffer lands, or using effective land use planning controls to prevent encroachment. But sometimes it may be difficult and costly. Where such options are no longer relevant, the most effective strategy is to manage odour-generating processes at the source and maintain positive communication with neighbours.Odour impacts can also be reduced by dispersing (diluting) odours before they reach potential receivers. How well this works depends on the relative separation distance and the number and direction of sensitive receivers. The frequency, intensity, duration and offensiveness of the odours are also critical. Remain ineffective. For example, installing air conditioning in odour-affected houses does not control odour outside the treated building and is expensive if there are multiple houses to treat.

Though it is basically impossible to eliminate all odors there are a number of things farm managers can do that will help to minimize odor emissions from their poultry houses. Planting trees, for instance, around a poultry house has been shown to reduce odor. In some cases, producers have found constructing a wall around exhaust fans to direct air upward has diminished odor. The best way of minimizing odor emissions is through proper ventilation system management. The fact is the better a poultry house is ventilated, lower the odor emissions from a house will be. Keep birds evenly distributed throughout the house. Even bird distribution increases bird cooling by allowing more air to get between the birds. Along with proper ventilation system management houses' watering systems need to be carefully managed and maintained to help insure proper litter conditions and therefore keep odors to a minimum.

Application

Using the system, a study was performed to:

- Reduce the feed waste and using optimum water quantity
- Chemical dosage to birds with least human efforts.
- Determine water evaporation rate from poultry and finding efficient method ;
- Quantify physiological responses of the chicken to the selected thermal conditions.

Future Scope

By detail study of available system and our future assuming one can implement the following to get more efficient system.

- Multilayer poultry farming is possible
- Time-base controls can be replaced by sensor technology.
- Other control loops like egg separation, waste removal, etc. can be included.

Conclusion

The paper suggests various important benefits related to the poultry owner and bird's health. PLC based poultry automation system can be used to provide feed & water to the poultry farm appropriately and nourishment to its optimum level. A control and measurement system was developed for studying interactive effects of thermal conditions on physiological responses of small animals. The system features control of air temperatures (35 to 41 °C), relative humidity (33 to 63%), and velocity (0 to 1.5 m·s–1) at the animal occupied zone; continuous, measurement of poultry area temperature. In the current situation of indigenous chicken production, there is a potential to increase the production from 20-30% to 50-60% by ways of minimum impact on the farmers' production. Reducing the chicken mortality rate by vaccination or adding chemicals in the drinking system(Fowl Pox, New Castle and Fowl Cholera). Supporting and educating the farmers in order to employ agricultural by-products and insect pests as indigenous chicken feeds instead of commercial rations. Herbs should also be used for parasite prevention.

To increase the chickens' growth rate, selection and breeding

might be a better method compared to by way of feed improvement. This is to maintain the chickens' good characteristic that is meat texture

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