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Design and Implementation of PV Poultry Incubator Using PLC

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Abstract

It is very much important to have an improved meathod of poultry incubation because of the increase in demand for chicken. But in conventional meathod of poultry incubation it consumes much power and this power is taken from the grid. In short conventional meathod of egg hatching requires countioous supply of power. Weknow about the increasing demand In this paper a new meathod of solar poultry incubator design is suggested which could be used to hatch eggs from solar pv and hence could reduce the usage of power and can maximize the usage of solar power which is a renewable source of energy.By implementing this meathod of solar poultry incubator we will be able to reduce the power consumption of the incubator by 75% and the cost involved in the design also yields profit and hence could bring out a reveloution in this field.

Keywords*: Battery, Charge Controller, Hatching, PV panel*, *PLC*

1. Introduction

One of the main problems faced in the incubation process of chicken is the necessity of power from grid. Because of this many farmers mainly in rural areas struggle to survive with this business due to lack of power available from grid. Yet another problem is that conventional meathod of power generation is not going to last for more than few decades. So it is very much important and high time for us to move to renewable energy based power generation and utilization so that we can conserve our resources. In this paper a new meathod which involves solar Photovoltaic panels to produce electric power and this power is used to meet the demand in a poultry incubator. Because of this farmers in poultry incubation business can make use of this without depending power from grid and is having many other advantages also like economics. In this paper the controlling mechanism is done with the help of PLC. Siemens Logo was the PLC used as the controller. The main advantage of using PLC as the controller is that it is user-friendly. We can implement the program using ladder logic, which is very simple and yet another advantage is that we can make necessary changes if required.

2. Design of Solar Poultry Incubator

The block diagram of the proposed solar poultry incubator is given below in figure 1. It consists of a PV panel which is used to produce DC power from sunlight and the output power from the panel is fed into the charge controller and from there to the battery. The charge controller is used so as to prevent the battery from getting overcharged and it has got a blocing diode inside which prevents the flow of current from battery to panel when the panel is not produciong any power. From the battery it is connected to an inverter. The role of the inverter is to convert DC-AC. It is very much important because the PLC which is employed only works on AC.

Relay is employed to interface the circuit with the grid.It is essential to have grid supply so as to continue the incubation process even when the panel is not able to produce power due to lack of solar irradiation. It is very essential to control the temperature inside the incubator.If the temperature is less or more it will affect the hatching efficiency. Similerly it is important to maintain the humidity inside the incubator. So as to perform these actions we had employed two sensors namely Temperature sensor (TS) and Humidity sensor (HS). This could be seen clearly

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from the block diagram of the poultry incubator. So the PLC receives these sensed outputs from the sensors and will activate the fan, heater or the water sprinkler accordingly. If the sensed temperature is more then the controller will activate the fan so as to control the temperature and if the temperature is less then it will activate the heater so as to maintain the required temperature.If the humidity inside the incubator is to be maintained then the controller will activate the water sprinkler so as to control the humidity inside the incubator.

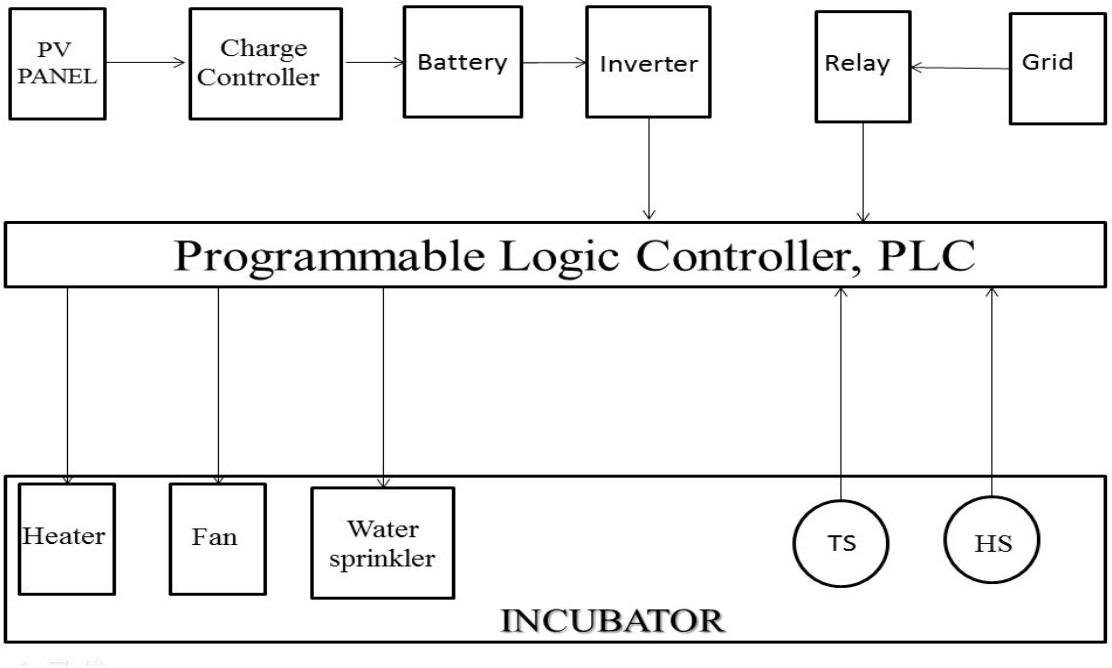

Figure 1. Block diagram of solar poultry incubator

The flowchart of the project development is given in figure 2. It gives the complete idea about the various steps achieved, checked in the development of the whole project from the starting to the end.

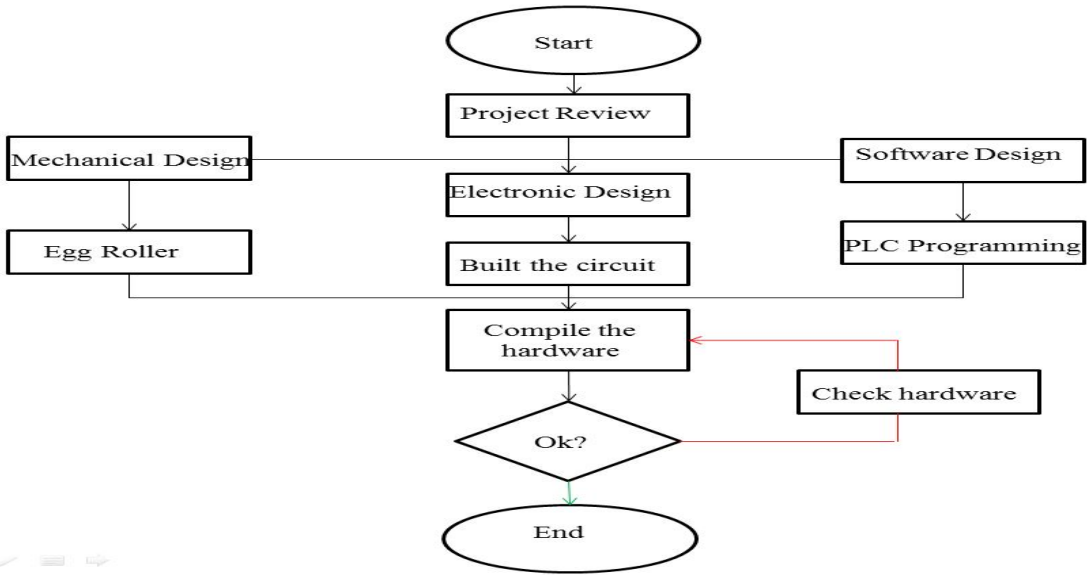

Figure 2. Flowchart of the project development

3. Materials Required

The main body of the incubator is made using wood and insulation material so as to prevent heat losses and to have a safe environment for the hatching of eggs. It is very important to maintain the temperature and humidity inside the incubator, so we keep on checking the temperature and humidity and thereby keep these values on a desired range which is perfectly suitable for the incubation of eggs. It is also important to turn the egg racket so that we can prevent sticking of the egg yoke to the shell and hence we can supply uniform heat to the egg. Usually the egg racket should be turned 3-4 times a day. So because of this the embryo will get centered in the egg. The proposed incubator is designed in such a manner that turning off egg racket is done manually. It could also be done in an automated manner. While placing the egg we should mark the egg so that we can identify the two sides and this will help in placing the egg after turning egg racket in the correct position. Under any circumstances we should never open the incubator until hatching process is completed. This is very important so as to have high incubation efficiency. The last 3 days of the complete cycle we should not turn the egg racket.

Four factors are of major importance in incubating eggs artificially: temperature, humidity, ventilation and turning. Of these factors, temperature is the most critical. However, humidity tends to be overlooked and causes many hatching problems. Extensive research has shown that the optimum incubator temperature is 100°F when relative humidity is 60 percent. Concentrations of oxygen should be above 20 percent, carbon dioxide should be below 0.5 percent, and air movement past the egg should be 12 cubic feet per minute.

4. Heat load of the poultry incubator

In determining the heat load of the PV poultry egg incubator, the following assumptions were made: steady state condition exists, one dimensional heat flow prevails, incubator materials have constant thermal conductivity, the incubator is a closed system at constant temperature.Table 1 shows the wet bulb reading at various incubator temperature.

The heat balance equation of the incubator chamber was estimated by

$$\mathbf{Qload = Qpv + Qegg – Qcnd – Qcnv}$$

Qload = Heat load of the incubator, W
Qpv = Heat supplied by PV panels, W
Qegg = Heat supplies due to metabolic actions of egg, W
Qcnd = Heat loss by conduction through incubator walls
Qcnv = Heat loss through air convection

Table 1. Wet bulb reading at various temperatures

Incubator Temperature	Wet Bulb Readings					
100^0F	81.3	83.3	85.3	87.3	89.0	90.7
101^0F	82.2	84.2	86.2	88.2	90.0	91.7
102^0F	83.0	85.0	87.0	89.0	91.0	92.7
Percent Relative Humidity	45%	50%	55%	60%	65%	70%

Estimation of battery size is calculated. An operating voltage of 220V was selected for the design.

$$I_d = \frac{Q_{load}}{V_{op}}$$

I_d =Design current, A

Off-Sunshine period of 16 hours of duty cycle of 7 days was considered. The ampere-hour discharge rate of battery was calculated using the following equation.

$$\boldsymbol{Current\ load * Duty\ cycle = I_d * 16\ hr}$$

Corrected ampere-hour per day taking into consideration the lossed through wire and efficiency of battery was calculated as

$$\boldsymbol{Corrected\ ampere - hour\ per\ day = \frac{I_d * 16hr}{0.87 * 0.925}}$$

The capacity of energy storage battery was then determined by

$$\boldsymbol{Required\ battery\ capacity = \frac{Corrected\ amp - hour\ per\ day * storage\ days}{maximum\ depth\ of\ discharge * temp\ derate\ factor}}$$

4. Results and Discussions

The performance evaluation of the photovoltaic (PV) powered incubator was conducted. The incubator was initially run empty without eggs. This was done so as to ensure that the level of the operating micro elements- temperature and relative humidity of the incubation chamber were right. The incubator was then loaded with fertilised poultry eggs for a period of twenty one days and replicated three times.

The eggs were turned periodically and manually. This was to no sticking of the egg yoks on the shell. Before loading the eggs candling was conducted to ascertian the condition of the eggs.This was repeated on the seventh, fourtenth and eighteenth days of the incubation period. At two days towards the end of the twenty one days incubation period the eggs started hatching. The hatched day old chicks are Fig 3 as shown the incubator chamber.

Figure 2. Solar hatched day old chicks inside incubator

Table 2 gives the incubation period required for hatching eggs of other species.Energy has always been an important issue among scientists and policy makers.Seeking a viable alternative energy source has always been the centre of attention particularly in the agricultural sector.Harnessing solar energy has been gaining significance as a new and continuous supply of alternative power source, which seems to have an answer to frequent power constraints faced by farmers. Continuous power supply is a boon to ryots, especially in regions affected with frequent electricity failure.So far solar energy has been used for lighting lamps and for cooking food. Recently it has also been utilised in the poultry sector. The cost of these incubators may vary between Rs.50, 000 and Rs. 60,000.

Table 2. Incubation periods of other species

Incubation Periods (species and days required to hatch)			
Bobwhite Quail	(24)	Guinea	(37)
Chicken	(21)	Muscovy Duck	(31)
Chukar Partridge	(28)	Pheasants	(30)
Coturnix Quail	(18)	Ostrich	(40)
Ducks	(28)	Swan	(38)

4. Conclusion

A solar poultry incubator design which is automated using PLC is proposed in this paper which will make a reveloution in the poultry incubation field and will reduce the usage of power from convetional method of generation and this model could be used mainly by farmers in rural areas where grid supply is not available all the time. This model reduces the power usage from 75 % compared to conventional grid fed poultry incubator.

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