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Humidity Control Scheme for Chicken Chick Banda for Improved Performance using Particle Swarm Optimization

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Abstract*: The research is about developing of prototype Humidity control unit of a chicken chick Banda for maximum reduction in energy wastage and ensuring conducive environmental condition for bird's growth and development using the proportional integral differential (PID) controller and the particle swarm optimization (PSO) technique for comparison purposes. The PSO stated here in is a stochastic optimization method working on the movement of swarm so as to achieve convergence. The study is achieved through designing of a prototype of the humidity environment controller to achieve two states or conditions that is for the controlled case and for the uncontrolled case. Environmental humidity control is achieved using a programmed Arduino and the DC FAN. The process is then designed using the MATLAB simulation software operating at the Simulink model designing platform. The same design is connected to the PID controller and then also tuned using the PID tuning platform on the Matlab. The same design is implemented on the workspace using particle swarm optimization method and it is then run to see the system behavior in terms of settling time, rising time and peak overshoot. The major reason of the study is to demystify the myth that one can only use conventional PID controller techniques in performance improvement and that there is a better method which can similarly be used with better results and cheaper. Most poultry farmers are stack with their old ways of achieving good performance therefore the results of this work will be an eye opener for them to embrace new techniques in the market The presented particle swarm optimization techniques shows impressive performance in terms of the settling time, rise time and over shoot.

Keywords: MATLAB Simulink, PID controllers, Overshoot controller, stochastic, Particle swarm optimization

I. INTRODUCTION

Fundamental objective of the Chicken Chick Banda Humidity control is to ensure reliability through maintaining a rigorous balance between external and internal humidity A DC FAN unit is responsible to supply the right humid condition by switching the FAN ON and OFF demanding on the percentage humidity fluctuations.

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There are multiple researches that focused on monitoring and controlling of temperature. For example [1] had researched on controlling temperature by fan speed using Pulse Width Modulation Technique; Singh [2] works is on temperature control fan system based on 8051 microcontroller while [3] study on smart electric fan using PIC. All the mentioned works are focused on creating an automatic system that maintains a desired environmental condition. Besides temperature, another common environmental parameter that is frequently monitored is humidity.

Common humidity measurement is relative humidity which is the percentage of saturation humidity, calculated in relation to saturated vapor density [4]. Humidity is an important factor because too high a humidity will promotes condensation and corrosion. On the other hand, low humidity will affect the birds by causing static electricity and feeling of discomfort hence the relative humidity to be fully controlled.is is an International reputed journal that published research articles globally.

II. LITERATURE REVIEW AND MATHEMATICAL MODELLING

A. Literature review

A system for control of temperature and humidity was undertaken by [5] - [18] however for improvement [7] - [8] did the same control of humidity with little progress. The authors [10], [19] - [21] studied the influence of energy and humidity control but did not come out effectively on the performance aspect.

The system that I am working on utilizes the fan speed to control humidity of the chicken chick Banda that is driven using Arduino. It is designed in such a way that when room temperature is low, fan will automatically switch OFF and when room temperature is high, fan will switch ON.

This research involve both hardware and software programming. Hardware section will require building a circuit that will consist of microcontroller, input block and output block.

The input block of the circuit to consist of temperature sensor, relative humidity sensor and also a graphic user interface (GUI) for user to interact with the circuit. The output block of the circuit is consisting of LCD, heater and fan. The LCD will display the current room temperature, relative humidity percentage as described in Fig 2

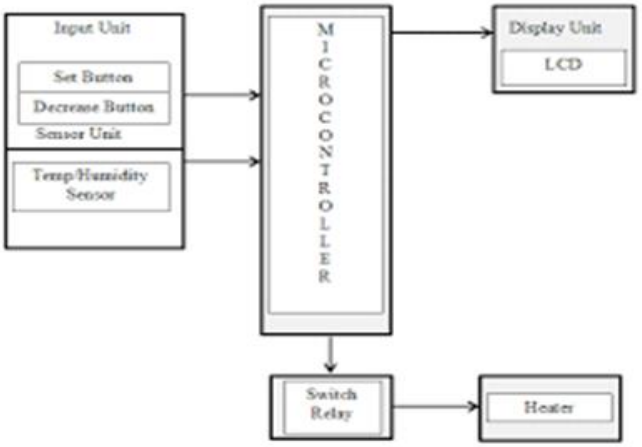

Fig: 1 Circuit layout

DHT11 is a composite sensor to measure both parameters with digital signal calibration. The LCD display output consist of the controller and communication interface

B. Mathematical Modeling of the process

The moisture balance of the chicken chick Banda can be calculated using the indoor humidity from outdoor practically measured data from reliable boundary conditions as per the model discussed in equation 1 to 4.The following nomenclature is used.

$$dWi/dt = Qsource/\rho\gamma - I(Wi - Wo) - (\alpha Wi - \beta Wsat) \quad (1)$$

Where

Wi = Indoor degree of dampness (Kg/Kg)

W_o = outdoor degree of dampness (Kg/Kg)

W_{sat} = saturation moisture content of indoor air (Kg/Kg)

I = Air exchange rate

γ = Volume of the space m^3

Q_{source} = General moisture content (Kg/h)

α / β = Moisture admittance h^{-1}

ρ = Density of air 1.22Kg/m^3

For some other conditions the following equation 2 is utilized

$$Pi = IPo/(I+\alpha) + Qsource\ Ptotal/0.622\rho\gamma(I+\alpha) + \beta Psat/(I+\alpha) \quad (2)$$

Where by the following describe the connotations

P_i = Indoor air pressure (vapor) (Pa)

P_o = outdoor pressure (vapor) (pa)

P_{sat} = Saturated vapor pressure of indoor air pressure (pa)

P_{total}= Total atmospheric pressure (pa)

At steady state condition we let α = β = 0

Hence equation 2 becomes

$$Pi = Po + Qsource\ Ptotal/0.622\rho\gamma I \quad (3)$$

Which can be further reduced to

$$Pi = Po + CQsource\ Ptotal/Qventillation \quad (4)$$

Where from the above equations the humidity content can be realized from the Q_{source} which stand for general humidity content.

III. MATERIALS & METHODS

The components that are used to accomplish the paper objectives are: - DC FAN, Composite sensor DH111, Heater (40Watts bulb), Microcontroller unit, Matlab Simulink software, Data transfer cable and finally stop watch. The prototype of the humidity environment controller to achieve two states or conditions that is for the controlled case and for the uncontrolled case is connected as in Fig 1 Environmental humidity control achieved using programmed Arduino and the DC FAN. The process is then designed using the MATLAB simulation software operating at the Simulink model designing platform. The same design is connected to the PID controller and then also tuned using the PID tuning platform on the Matlab. The same design is implemented on the workspace using particle swarm optimization method and it is then run to see the system behavior in terms of settling time, rising time and peak overshoot.

Fig: 2 Circuit layout

IV. RESULTS & DISCUSIONS

When the proto type is connected and displayed as in Fig 1 and Fig 2 respectively the variation of time with humidity is summarized on table I

TABLE I: Humidity analysis

Time (s)	Humidity	
	Controlled %	Uncontrolled %
0	45.2	45.3
50	47.4	47.4
100	49.5	49.5
150	46.6	51.1
200	46.7	53.1
250	47.1	55.1
300	46.95	56.1
350	47.65	56.6
400	47.75	57.1

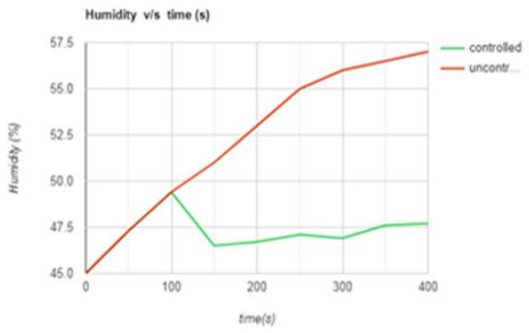

Fig: 3. Humidity curve

The graph in Fig 3 shows that the control of humidity is achieved in the green curve and for the uncontrolled the process can go on forever hence wasting energy and resources.

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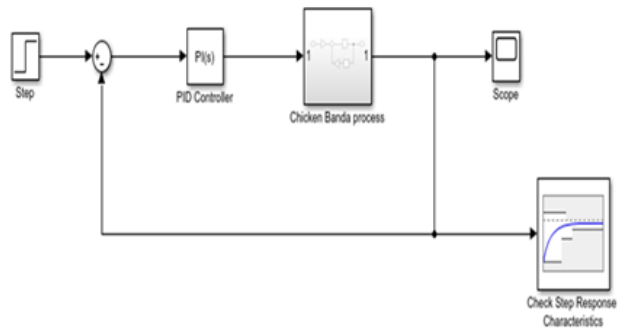

Fig. 4 PID and PSO optimized block diagram.

When the circuit is connected as in Fig 4 PID and PSO optimized, where the scope indicated the PID response while Optimized system is checked by the step response characteristics.

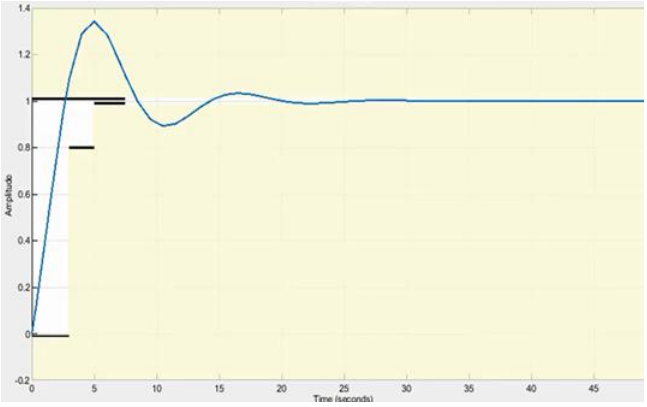

Fig. 5 PID optimized response

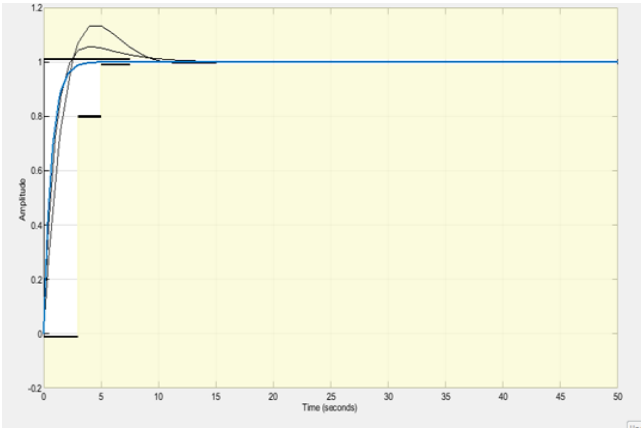

Fig.6. PSO optimized response

The results are tabulated in Table 11 which shows that the PID has overshoot of 38. settling time of 28 seconds and the rise time of 3 seconds while the PSO has better performance of 0% over shoot ,5seconds settling time and)seconds rise time. The effect of PSO to the overall effect in the performance can be well observed as far as the parameters are concerned.

TABLE II. Response of PSO and PID analysis

Method	Overshoot %	Settling time (seconds)	Rise time (seconds)
PID	38	28	3
PSO	0	5	0

V. CONCLUSION

The humidity system was studied and the paper found out that the energy saving for the controlled and controlled system respectively which shows a remarkable improvement in energy management for optimum performance of the chicken chick Banda. The paper has convincingly proved that the particle swarm optimization is better in optimization compared to the conventional PID controller. The paper resulted into an energy efficient system with major emphasis in achieving very healthy chick's hence sufficient food supply to our republic.

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REFERENCES

1. V.Bhatia, "Room Temperature Based on fan speed control," International Journal of computer Applications, pp. 35-40, 2014. [CrossRef]
2. B.S.Waraich, Micro controller Based Temperature control fan system, 2014.
3. Z.Rizman, "Design and Automatic Temperature control system for smart electric fan," International Journal of science and research, vol. 2, no. 9, pp. 1-4, 2014.
4. C.R.Nave, "Hyper Physics," on line, 2014.
5. A.Solemanzadeh, "Designing fuzzy controller for air conditioning system in order to save energy consumption," Journal of Artificial intelligence for Electrical Engineering, vol. 3, no. 11, pp. 11-18, 2014.
6. M.Hamadi, "A fuzzy control system based on the human sensation of thermal comfort," in IEEE world conference of computational intelligence, 1998.
7. V.J.Nandeshwar, "Design of room cooler using fuzzy logic control system," International Journal of computer application, vol. 975, no. 3, pp. 88-87, 2015.
8. M.Abbas, "Autonmous room air cooler using fuzzy logic controller system," International Journal of science Engineering and research, vol. 2, no. 5, pp. 74-81, 2011.
9. S.Mohamed, "Developing of fuzzy logic controller for air conditioning system," Journal of computer Application, vol. 126, no. 15, pp. 1-8, 2015. [CrossRef]
10. S.A.U.R>Omer, "Design of intelligent air conditioning using fuzzy logic," International conference of Electrical Eng and computer Technology, pp. 1-5, 2017.
11. K.B.Uplenchwar, "Design of fuzzy inference system for autonomous air conditioning," International Journal of computer application, vol. 975, no. 1, pp. 85-87, 2015.
12. M.S.Islam, "Development of a fuzzy logic controller algorithm for air conditioning system," in IEEE international conference on semi-conductor elecron, 2006. [CrossRef]
13. N.U.Ahamed, "Fuzzy logic controller for intelligent air conditioning," in 2nd international conference on control system Engineering, 2016. [CrossRef]
14. S.Gokilaveni, "Energy conservation possibilities in heating ventilation air conditioning using fuzzy logic," in IEEE 9th International conference of intelligent system control, 2015. [CrossRef]
15. M.Z.Sarker, "A proposed air conditioning system using fuzzy algorithm for industrial applications," in TENCIN-IEEE Region 10th Conference , 2005.
16. S.Saha, "Designing of air conditioning system using fuzzy logic with advantage of energy saving," in International conference information technology and electronics, 2014. [CrossRef]
17. W.Batayneh, "Fuzzy logic approach to provide safe and comfortable indoor environment," International Journal of Engineering Science and Technology, vol. 2, no. 7, pp. 65-72, 2010.
18. S.Dash, "Intelligent air conditioning system using fuzzy logic," International Journal of science Engineering and Research, vol. 3, no. 12, pp. 1-6, 2012.

19. Z.M.Zain, "Micro controller based energy saving for air conditioning system using fuzzy logic," 4th student conference on research and development, pp. 246-249, 2006. [CrossRef]
20. R.N.Lea, "An HVAC fuzzy logic Zone control system and performance results," IEEE 5th conference of fuzzy system, vol. 3, pp. 2175-2180, 1996.
21. A.Pregles, "Energy efficient fuzzy model based Multi variable predictive control of HVAC system," vol. 82, pp. 520-533, 2014. [CrossRef]

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