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Improving PID Controller Using Neural Network Technique

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ABSTRACT

This research focuses on improving the quality of traditional Proportional integral derivative (PID) using neural network. A Reverence model approach was used to design a Neural Network NN controller and a proportional integral derivative PID controller. The purpose is to have a stable control systems in our industries that will help to improve and reduce waste during production in our industries that will be more flexible in the level of conversion, to be able to track set point change and reject load disturbance in our process industries. PID control scheme was used as a benchmark to study the performance of the PID controller at the same time with equivalent neural network. The proportional Integral derivative controller PID was modeled using Neural Network Technique NN and a MAT-LAB simulation was carried out and observation showed that there was a great improvement on the traditional PID controller as it started functioning like a digital controller. When connected to the Plant process control were all features of the traditional proportional integral derivative PID controller were retained and as well improved using Neural Network . The output was fantastic since the waste and loss encored by the process industries was drastically reduced to minimal.
Keywords : PID, NN, Simulation, MAT-LAB

I. INTRODUCTION

The setback of the traditional PID controller has it that it cannot get satisfied degree-especially for the time-varying objects and non-linear systems. The traditional PID controllers can do nothing to non-linear systems-the NN PID controller has a good controller effect in the non-line turning and optimizing. But the neural network PID controller can make both neural network and PID control into an organic which has the merit of any PID controller for its Simple construction and definite physical meaning of parameters, and also has the self-learning and adaptive functions of a neural network. This new NN PID controller has more advantage than the traditional one, such as more convenient in parameter regulating more independence and adaptability on the plant, etc. A neural auto tuner for PID controllers that is important for real-time plant operation applications achieved from this research. The neural auto tuner adaptive PID control scheme processes temporal patterns in real time and produces updated parameters for the PID controller. These and more are the main reasons why this research has been undertaken. This will be implemented on the simulated system

II. METHODS AND MATERIAL

1. Methodology, Design and Implementation

Design of PID Controller

A proportional-integral-derivative controller, known as a PID controller for short, is a type of device often used in control systems. These systems control other devices or systems and the PID controller helps regulate important variables within the control system. However, it is used in the industrial and manufacturing fields The P stands for proportional control, I for integral control and D for derivative control. This is also what is called a three term controller. The basic function of a controller is to execute an algorithm (electronic controller) based on the control engineer's input (tuning constants), the operators desired operating value (set point) and the current plant process value. In most cases, the requirement is for the controller to act so that the process value is as close to the set point as possible. The PID control algorithm is used for the control of almost all loops in the process industries,

How A PID Controller Works

The PID controller's job is to maintain the output at a level so that there is no difference (error) between the process variable (PV) and the set point (SP). In the diagram shown below are the structure of PID controller and A Modeled PID Controller. the valve could be controlling the gas going to a heater, the chilling of a cooler, the pressure in a pipe, the flow through a pipe, the level in a tank, or any other process control system.

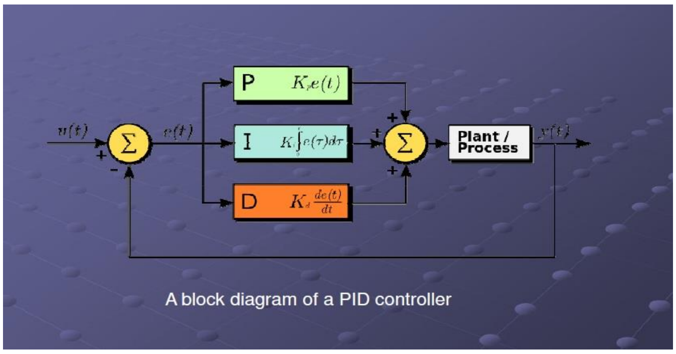

Figure 1. A Block Diagram of A PID Controller

2. A PID Controller Using Neural Network NN

The controller then calculates the control input that will optimize plant performance over a specified future time horizon.

1 The first step in model predictive control is to determine the neural network plant model (system identification).
2 Next, the plant model is used by the controller to predict future performance. Documentation for complete coverage of the application of various model predictive control strategies to linear systems.)

Using neural network PID controller to replace the ordinary PID controllers can make the error between the system output and expected values minimum. The structure of PID control system based on neural network as shown in fig, while the Developed Model of PID controller based on Neural Network is shown in figure 1.

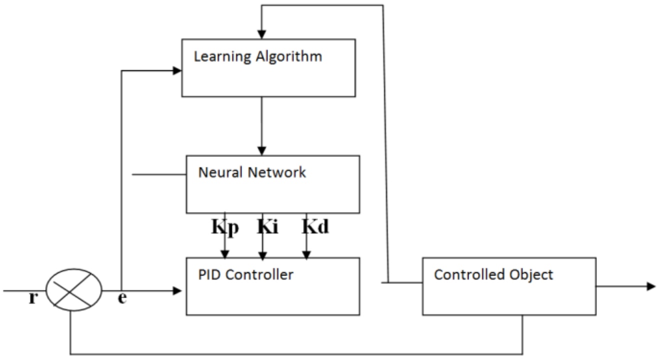

Figure 2. A structure of PID Controller Based on Neural Network

3. The Flow Charts

The specific implementation of PID control algorithm based on neural network is as shown on the following flow charts on the figures below which correspond to different simulated graphs shown

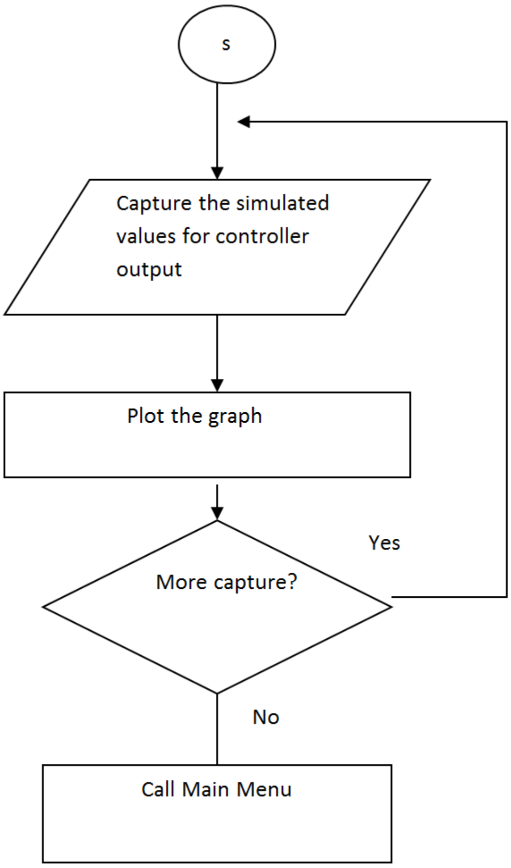

Figure 3. Time offset - Controller Output

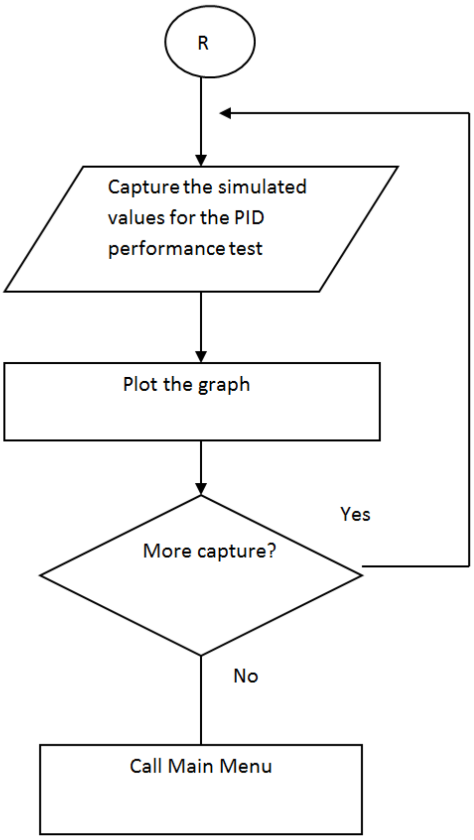

Figure 4. Performance Test

III. RESULTS AND DISCUSSION

1. Data Presentation

The data used in this simulated work were sourced from Nigeria breweries PIC, Aba were it was implemented on the processing plant.

The table is a time off set against the control output

TABLE 1 : Time offset-Controller Output

S/N	TIME OFFSET (SEC)	CONTROLLER OUTPUT (SEC)
1	100	2
2	200	4
3	300	6
4	400	8
5	500	9
6	600	10
7	700	11
8	800	12
9	900	14

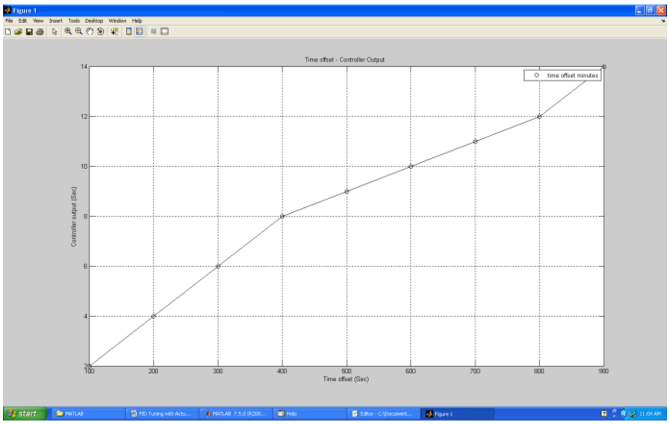

Figure 5. Time offset - Controller Output

The graph above represents a time offset of the control system. The system proceed in an arithmetical progression which shows that the system was properly controlled by NN programmed

Table 2. Performance Test Table

S/N	TIME OFFSET (SEC)	CONTROLLER OUTPUT (MS)
1	100	-1
2	200	-2
3	300	-3
4	400	-4
5	500	1
6	600	2
7	700	3
8	800	4
9	900	5

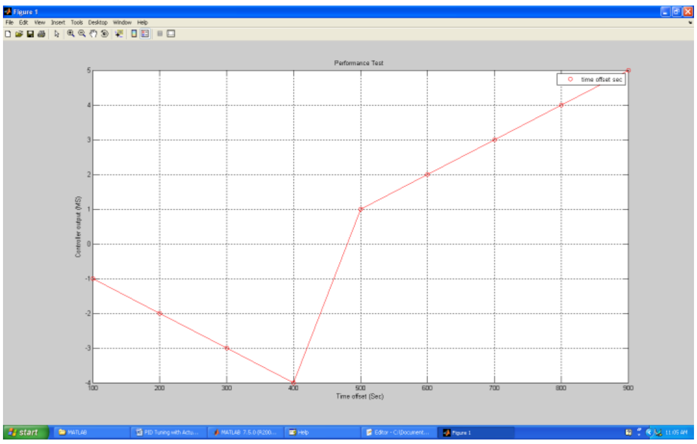

Figure 6. Performance Test Graph

2. Analysis

The fig above shows performance test both ANN and PID controller which makes a system setting that gives the best performance of overshoot which is very high and small inverse response. Also involved in tracking problem the offset point allowed a change in random fashion.

IV. CONCLUSION

The accuracy of PID controller was also improved by using a reasoning artificial intelligent (Neural Network). The flexibility offered by the neural network when the PID is remodeled was very great. Comparison of the operational characteristics between the PID and improved PID with neural network reviews the superiority of neural network controller. The neural network controller is more sensitive in equipment and the system parameters, unlike the conventional control design (PID) which often requires an improvement using artificial neural (ANN) for it to function effectively and start reasoning and waste incurred before reduced to the lowest minimum.

Finally, we will like to state that even though PID have a huge potential will get the best of them when they are integrated or improved with neural network control technology.

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