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Artificial Intellligence And Energy Optimization In Thermal Industries

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ABSTRACT
In the thermal industry today, optimization of energy cannot be put aside regarding the state of the environment as well as the energy production level. Today, in this industrial sector, the type of control system applied in the control machinery is of the classical type (the Proportional-Integral-Derivative (PID) controllers) and this control system in the phase of non-linearity, that is when the process becomes too complex to be described by analytical models, it becomes inefficiently controlled by this classical approach, To forestall this energy waste and bring about energy optimization in the system operation, an automated operator's task which employs an artificial intelligence control system is required. This will result in an automated control system that will delist the classical control inability, thereby making efficient the thermally induced machinery control and bring about the optimization of energy. In a nutshell, this work is meant to optimize energy in the thermal industry by using the artificial intelligent control in its system control of machinery. This work finds application in the thermal industry.

Keywords-- Artificial Intelligence, Classical Control, Energy Optimization, Thermal Industry

INTRODUCTION

In the thermal industry today, optimization of energy cannot be put aside regarding the state of the environment as well as the energy production level. Today, in this industrial sector, the type of control system applied in the control machinery is of the classical type (the Proportional-Integral-Derivative (PID) controllers) and this control system in the phase of non-linearity, that is when the process becomes too complex to be described by analytical models, it becomes inefficiently controlled by this classical approach. In this case, a classical control method can in many cases simplify the plant model, but not provide good performance, since it requires an operator to manually tune its parameters. This control method is vulnerable, and very dependent on an operator's experience and qualifications, and as a result, many PID controllers are poorly tuned in practice (Wang et al., 1999).

This causes a delay in system functionality, thereby leading to much energy being consumed in the process of production in this industry. To forestall this energy waste and bring about energy optimization in the system operation, an automated operator's task which employs an artificial intelligence (AI) control system, with the subset of fuzzy logic control (FLC), neural network (NN), etc, is required. This will result in an automated control system that will delist the classical control inability, thereby making efficient the thermally induced machinery control and bring about the optimization of energy [1]. Almost every application, including embedded control applications, could reap some benefits from fuzzy logic. Its incorporation in embedded systems could lead to enhanced performance, increased simplicity and productivity, reduced cost and time-to-market, along with other benefits (Ibrahim, 2003). In a nutshell, this work is meant to optimize energy in the thermal industry by using the artificial intelligent control in its system control.

LITERATURE REVIEW

Artificial intelligence (AI) is an area of computer science that has been around for some time. In fact, the conceptual design of AI was first developed in the early 1960s. The definition of artificial intelligence varies among people in the computer industry, making the concept somewhat difficult to perceive and understand (Bryan and Bryan, 1998).

According to the survey of the Japanese control technology industry conducted by the Japanese Society of Instrument and Control Engineering (Takatsu and Itoh, 1999), fuzzy and neural control (AI subset) constitute one of the fastest-growing areas of control technology development, and have even better prospects for the future [2]. The attraction of a fuzzy controller (FC) from the process-control point of view can be explained by the fact that an FC provides good support for translating both the heuristic knowledge about the process of a skilled operator, and control procedures (expressed in imprecise linguistic sentences), into numerical algorithms. In a typical PID controller design for industry, the controller parameters are initially determined and then tuned manually to achieve the desired plant response. In the approach described in (Copeland and Rattan, 1994), manual tuning can be replaced with an FC supervising a tuning process. The resulting improvements in the system response are accomplished by making on-line adjustments to the parameters of the FC.

METHODOLOGY

This section deals with the procedures employed in carrying out this research work. The steps used to gather material, the problems involved and the reliability of the results [3]. A thematic approach of analysis of site research and e-book was adopted for the study to achieve the aim of this work.

Artificial intelligence Design

Generally speaking, AI can be defined as the subfield of computer science that encompasses the creation of computer programs to solve tasks requiring extensive knowledge.
In designing the AI system, it will be divided into three parts, namely;

- Diagnostic.
- Knowledge.
- Expert.

The Diagnostic AI systems

It is the lowest level of artificial intelligence implementation. It functions to troubleshoots and detect faults within an application, but they do not try to solve them. It reaches a fault conclusion through inferring techniques through known facts (knowledge) introduced into its detection system.

The Knowledge AI system

This is an enhanced diagnostic system. It detects faults and process behaviors based on resident knowledge, and also makes decisions about the process including the probable cause of a fault.

It gives suggestions about probable faulty devices, and in some cases, if the fault is complex, may suggest the shutdown of the device to allow for rectification; otherwise, the system may be working and repairs carried out.

The expert AI system

In the design and applications of the AI system, the expert AI system constitutes the batch; it possesses all of the capabilities of a knowledge system and more. This system gives the additional capability for examining process data using statistical analysis, which allows it to predict outcomes based on current process assessments. The outcome prediction may be a decision to continue a process despite fault detection [4]. This decision requires more sophisticated software programming, since their decision trees involve more options and attributes; therefore, must be endowed with more hardware capability.

In general, the AI system has a simple rule-based system, which formulates a simple diagnostic rule, such as:
IF, THEN.

For instance, IF the count is 20, THEN rotate system clockwise; otherwise rotate anticlockwise.

RESULT

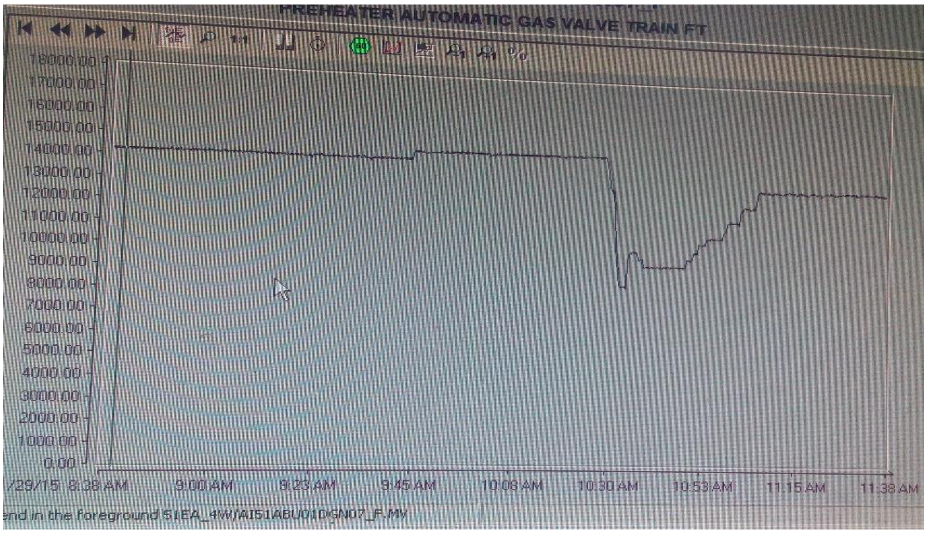

Figure 1: *Classical Control (PID) Output in Production Line.*
Source: Dangote Cement, Ibese (2017)

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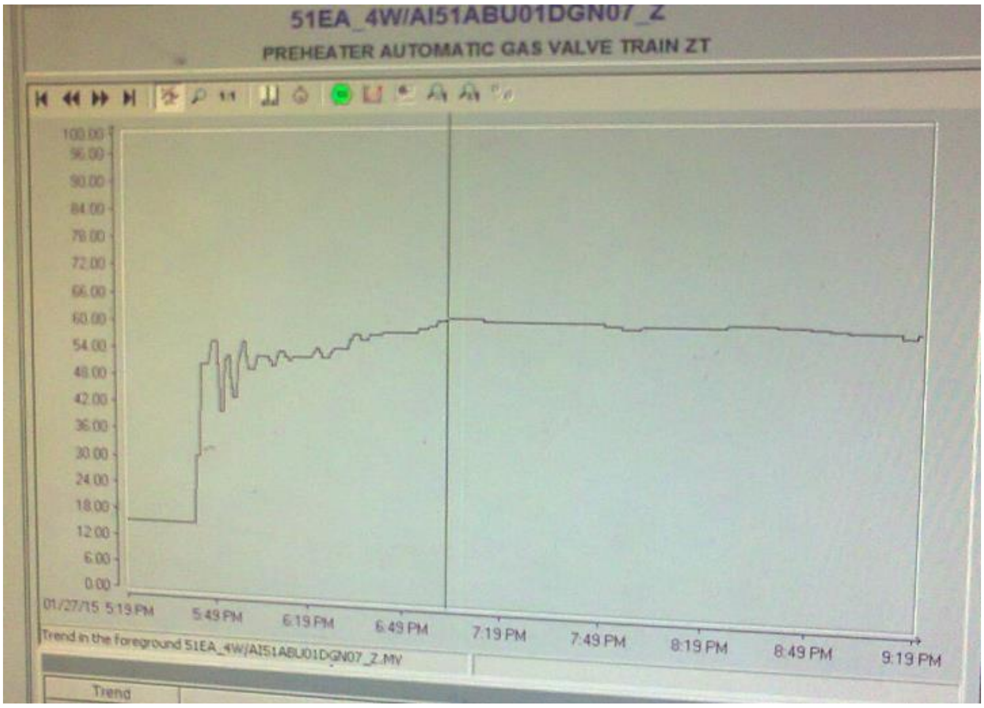

Figure 2: *Classical Control (PID) Output in Production Line.*
Source: Dangote Cement, Ibese (2017)

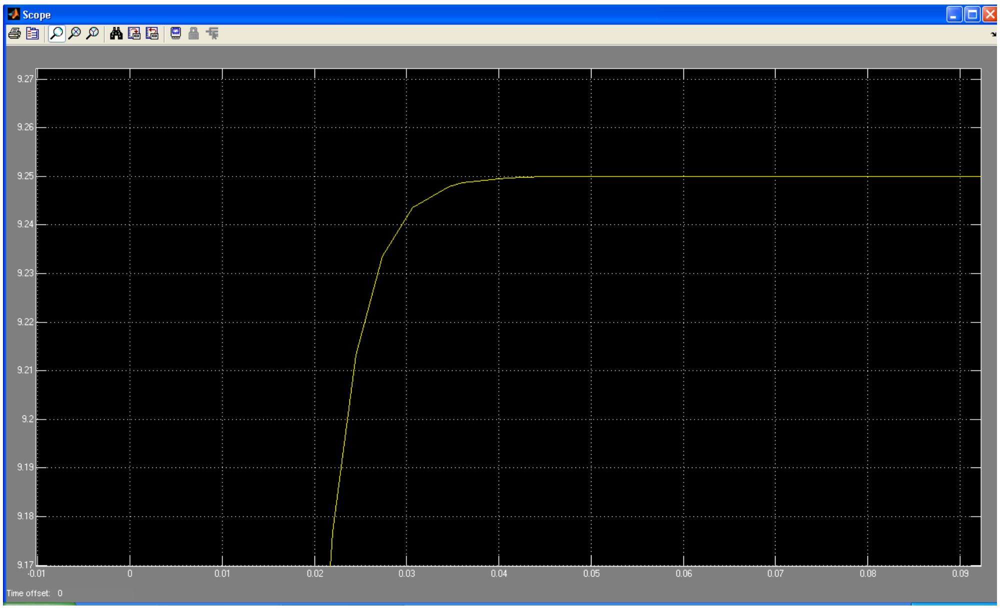

Figure 3: *Artificial Intelligent (FLC) Chart in Prroduction Line.*
Source: Simulation

DISCUSSION

Figure 1 and Figure 2 show the charts of the production line being controlled by the classical controller (PID), these were monitored in the control room of the production at Dangote cement, Ibese [5]. In Figure 1, the large undershoot depicts a delay in system operation caused by system complexity due to non-linearity. This delay leads to high energy being consumed, hence, energy lost. In Figure 2, the overshoot and undershoot in the form of sine waves in the chart depict delays, amounting from system non-linearity, which amounts to energy overconsumption. This concludes that there was no energy optimization in Figures 1 and 2.

Figure 3 is a specific chart gotten from system simulation. The chart shows a smooth curve, which interprets system viability. It could be seeing that no overshoot or undershoot in the chart of the system operation, hence, no time delay takes place and hence, the energy was optimized.

CONCLUSION

To avoid energy waste and bring about energy optimization in an industrial thermal production line, an automated operator's task which employs an artificial intelligence control system is required. This will result in an automated control system that will delist the classical control (PID) inability, thereby making efficient the thermally induced machinery control and bring about the optimization of energy.

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