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Efficacious dialing of Fuzzy-PID Controller Assembled into Real Time Embedded Module for Controlling Sensible Parameters in Textile Industrial Boiler

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***Abstract*— Real Time Fuzzy-PID Embedded System (RTFES) underutilizes the concepts of Fuzzy Logic and PID Controller for measuring and controlling the textile industry boiler. The most advanced method to control the highly complex systems and exponential behavior of the physical parameters such as temperature, pressure, correlative amount of flow, liquid level, is Fuzzy Logic. In this design, the crisp values from the object are feedback to input of Fuzzy Logic controller, it translates into a Fuzzy values processed by IF….THEN rules to arrive at a single outcome value and defuzzified to get accurate values of kp, ki, kd which are used to auto tune the PID controller to control the physical parameters. The results show that the Fuzzy-PID scheme is able to control the oscillations more effectively in terms of steady- state error, rise time and settling time than that of PID controller. The capability of boiler should be tested prior they are used in real time applications. The Boiler Test Chamber must provide all the parametric conditions artificially. The theme of this project is to make a BTC which can analyses the feasibility of under those challenging parameters. The parameter oscillations which are to be analyzed inside the chamber and then the user can program the parameters (like Temperature, Pressure, Humidity, and Amount of flow) inside the chamber. Real time monitoring of the behavior of physical parameters at every instant is also recorded by using Serial Communication with a Personal Computer. In this project a simple and an attractive user interface is also created to represent the values numerically as well as graphically using Visual Basic. The data which are stored every instant can be retrieved at anytime.**

***Index Terms*— Boiler Test Chamber, LM 35 sensor, Pressure sensor, PIC microcontroller, Transducer independent interface, Monitoring display.**

I. INTRODUCTION

Now a day's The Tuning Parameter are increased exponentially in industrial applications, that can be used to many type of applications can be controlled by various driver emulator circuits. The driver's application mainly involves complex process (like modeling, control, simulation and parameters tuning etc). An expert knowledge is required for tuning the controller parameters to obtain the optimal response with respect to time. However, the conventional PID controller algorithm is simple lasting, easy adjustment and high safety, the industrial process with different degrees of non magnitude and guidelines variability, uncertainty of the mathematical model of the system [1].

Adapting the parameters of the conventional PID controller is quite onerous and poor meat, so difficult to achieve the goal of optimal resolution state under field condition in the definite production. For all the problems with the typical PID controller, fuzzy is the exceptional way to control systems. Fuzzy-PID controller method is superior method of controlling to the complex and confused model systems, it can give uncomplicated and effective control, play fuzzy control vigor, good dynamic feedback, rising time, overstrike temperament. FLC (fuzzy logic control) control has proven effective for complex non linear and estimated define process for which classic model based control techniques are impractical. Fuzzy logic deals with the problems that have ambiguousness anxiety and membership function (betwixt 0 to 1). i.e., if control system is too complex to acquire the required accord decrees, then some attempts have been made to solve these problems and restraint the task of tuning frameworks and developing rules for the controller.

II. PROPOSED APPROACH

With the aspiration of averting such accidents, it is nominated to develop a highly efficient and reliable of automatic measuring and controlling system for early detection of physical parameters like Temperature, Pressure, Water flow and Fuel flow by placing an embedded module along with sensor device. This device is capable of distinguishing whether the boiler pressure and temperature varied or not, if the continuous oscillations occur in the boiler uses of sensor is detected, a safety application named Fuzzy-PID will be automatically control the oscillations by

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change in temperature and change in pressure which helps in eliminating the risk of accidents from occurring, at the same time ensuring that the worker does not pull to any dangerous. The most advanced method to control the highly complex and nonlinear behavior of the closed loop temperature, is fuzzy logic. On the other hand, PID controllers are used in most of the linear control application due to its functional and structural simplicity. This report presents a method of controlling the boiler physical parameters like temperature, pressure by the combined action of both Fuzzy and PID controller shown in the Fig. 1 and Fig. 3 shows the block diagram of entire system application.

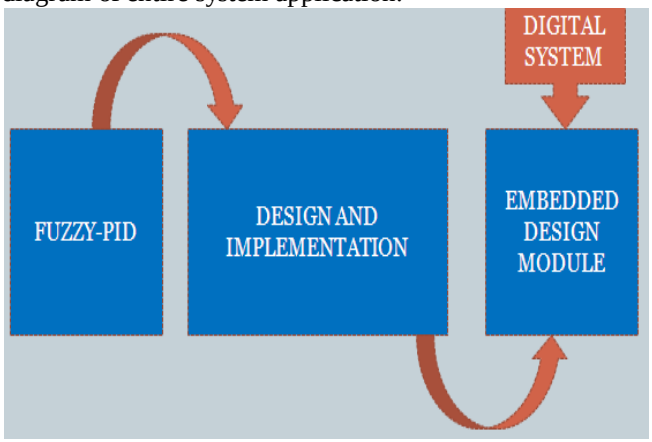

Fig. 1 Main concepts of this project

The research has been extended to show how far the system will help in preventing dangerous and to what extent this system will help in reducing the Indian economic loss incurred unnecessarily due to industry fatalities.

III. Real Time Embedded Module with Fuzzy-PID

The primitive Fuzzy inference system may take fuzzy inputs or crisp inputs based upon the process and its gains, in most of the cases, are fuzzy sets.

It can be called as an authentic fuzzy system due to the fact that it takes fuzzy sets as input and produces output that is fuzzy schedule. The Fuzzy rule base is the chunk culpable for storing all the rules of the system and hence it can also be called as the knowledge base of the fuzzy system.

Fuzzy inference system is responsible for significant decision making for cropping a required gain. Therefore a method of defuzzification is required in such case which converts the fuzzy values into corresponding crisp values.

Adaptive corrections can be made by the following methods,

$$KP = KP' + delKp$$

$$Ki = Ki' + delKi$$

$$Kd = Kd' + delkd$$

Here KP', Ki', and KD' refer to the previous value of the PID parameters whereas KP, Ki, and KD refer to the new corrected values of the criterions after a particular adapting step was completed shown in the Simulink diagram using MATLAB Fig. 2.

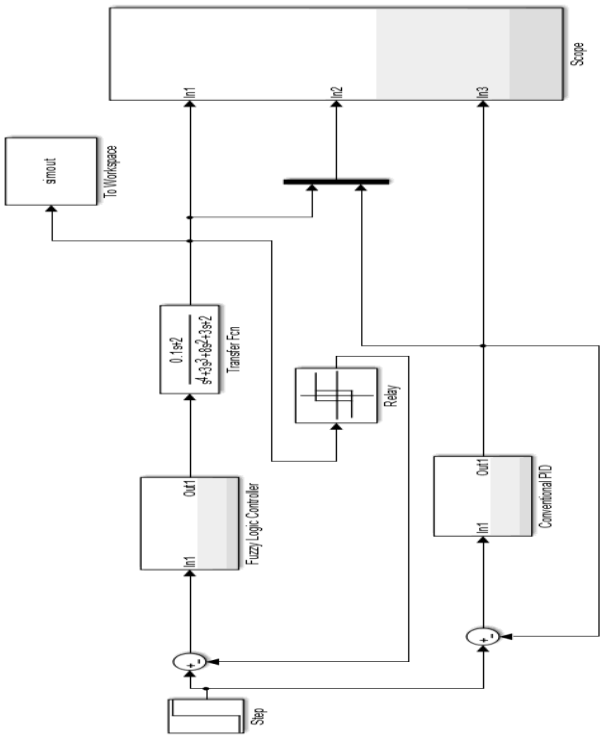

Fig. 2 Simulink Model of Fuzzy-PID

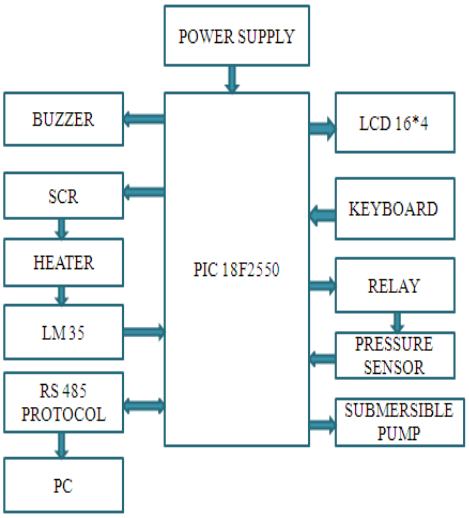

Fig. 3 Block Diagram

IV. Communication Device

The MAX232 is a unified circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits and it is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. This drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors which makes it useful for implementing RS-232 in devices that otherwise do not need any voltages farther the 0 V to + 5 V range, as

power supply design does not need to be made more complicated just for driving the RS-232 in this case. The receivers compress RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V with a typical hysteresis of 0.5 V. The MAX232A is backwards compatible with the authentic MAX232 but may operate at higher baud rates and can use smaller external capacitors – 0.1 µF in place of the 1.0 µF capacitors used with the original device.

V. System Implementation

A. Boiler Test Chamber

The Boiler Test Chamber (BTC) is thermally isolated from the external environment by using thermal desolation materials like silica fur, silica bricks etc. There are two sensors placed inside the chamber. Temperature sensor LM35 is located at the middle of the chamber wall from inside.

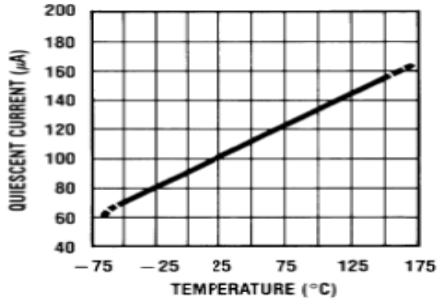

Fig. 4 Temperature Vs Quiescent Current

The pressure sensor MPS-2000 is shown in Fig. 5 also located near the temperature sensor. Feature of MPS-2000 be the cutthroat price dual in-line package, wide operating temperature field 40 to +85 degree, solid state reliability, easy to use, easily embedded in OEM equipment.

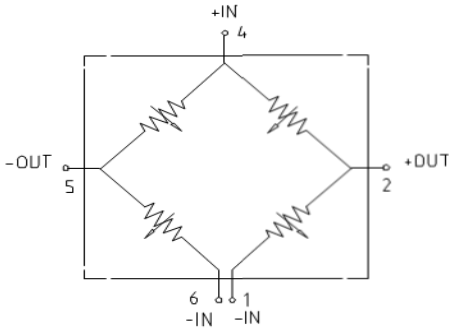

Fig. 5 Pressure Sensor Diagram

The location of the sensors selected so that the actual values of the parameters are read. Otherwise there may be error in reading the values.

B. Liquid Crystal Display

Liquid Crystal Displays (LCDs) have materials which merge the properties of both liquids and crystals. Without having a melting point and a temperature range within which the molecules are approximately as mobile as they would be in a liquid. They are grouped together in an ordered form similar to a crystal. The LCD is a flat panel display that uses the light modulating properties of the liquid crystals. The crystals do not emit light directly. LCDs are available to arbitrary images or fixed images which can be displayed or hidden and 7- segment displays as in digital clock.

C. SCR

A Silicon Controlled Rectifier is a four blanket solid state current controlling device. It acts as a switch with linear variation of physical parameters that is reasonable than a relay and is able to handle the large power bender that is expected in industries which consists of three layers namely Anode, Cathode and Gate.

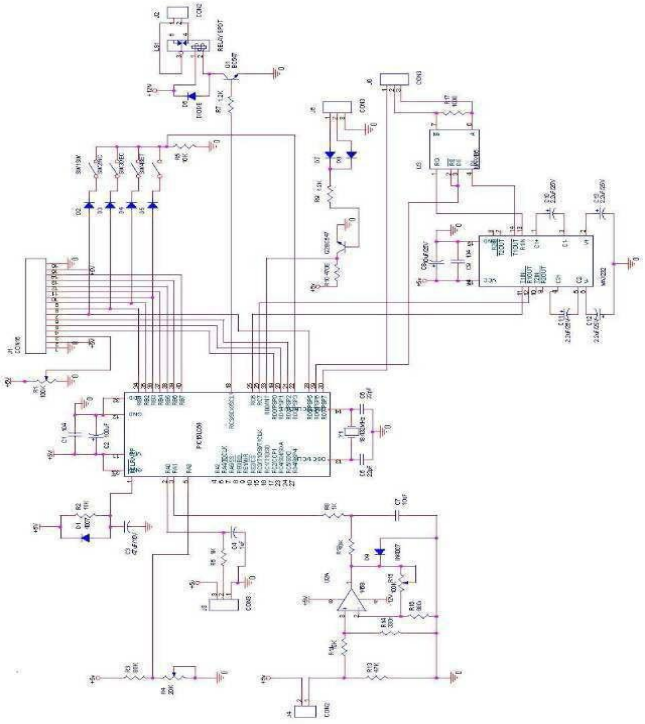

Fig. 6 Master Board Circuit

VI. Software Analysis

A. About Software

The main purpose of using the microcontroller in our project is because high- performance CMOS 8-bit microcontroller with 8K Bytes of insisting programmable Flash memory. Powerful microcontroller gives a highly flexible and cost-effective quick fix to many embedded control utilizations. The programs of the microcontroller have been written in Embedded C language and were compiled using MPLAB. A compiler used for microcontroller programming. The communication between PC and the microcontroller was entrenched MAX 232 classic and those programs were also done in C language.

B. *Proteus*

Proteus VSM is used to bridge the gap between schematic and PCB for embedded design, offering system level simulation of microcontroller based designs inside the simplified package itself.

C. *Visual Basic*

Visual Basic is a tool that allows you to evolve Windows (Graphic User Interface - GUI) applications. It has a familiar appearance to the user as shown below. Visual Basic is case driven; meaning code remains idle until called upon to respond to some event shown in the Fig. 7 and Fig. 8.

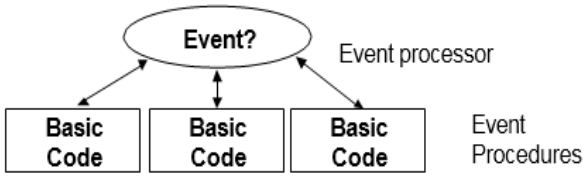

Fig.7 Block Diagram

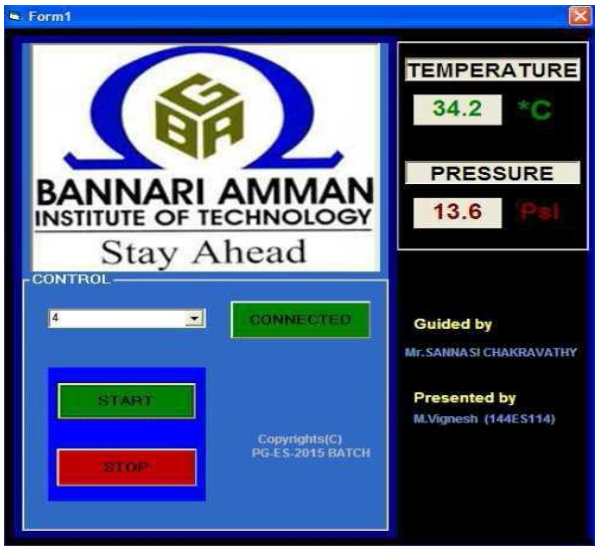

Fig. 8 Prototype

VII. Experimental Results

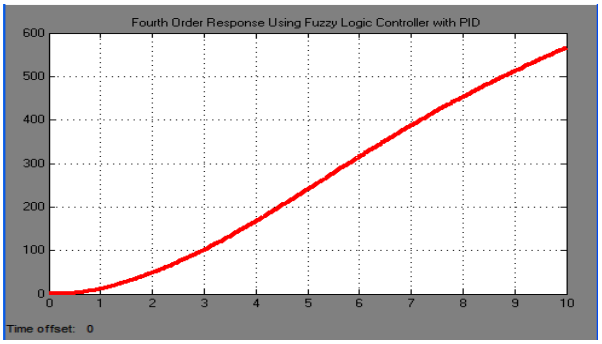

Fig. 9 Response of Fuzzy-PID

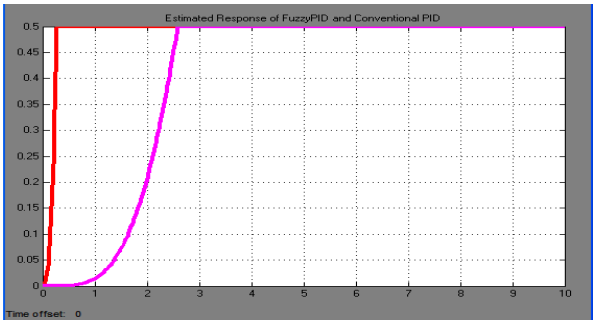

Fig. 10 Comparison of General PID and Fuzzy-PID

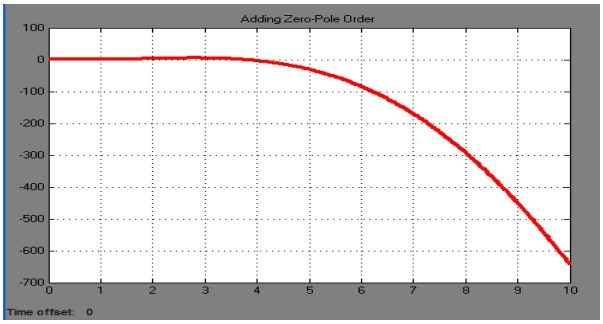

Fig. 11 Adding zero-pole order for compensating

The above MATLAB/Simulink results showcase the stability maintenance of the Fuzzy-PID and comparison betwixt conventional PID shown in Fig. 9 and 10. For compensating transfer function by adding pole-zero component response in system transfer function shown in the Fig. 11

VIII. Conclusion

To prevent the occurrence of dangerous situation due to exponential or sudden variations in boiler use by operators and pursuit has been made to provide a low- cost, non-invasive and small-size system. Sensing circuit is used to detect the parameter variation use of boiler, possessing the ability to auto-tune the PID controller using Fuzzy logic for correcting error occurrence in Boiler control system. The Real Time analysis produces a visual display of changing value of parameters. A user friendly graphical interface is provided using Visual Basic for recording and retrieving of data.

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BIOGRAPHY

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