Industrial Burner Automation based on PLC HMI & SCADA

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Abstract—In this paper the basic concepts of HMI (Human Machine Interface) & SCADA (Supervisory Control and Data Acquisition) systems is studied, and then interfacing it with PLC system. Industrial Burner Automation is being done which is based on PLC,HMI & SCADA with remote monitoring and energy conservation. Remote monitoring of field devices is being done with the Scada software and it gathers all the data from Plc module. Here HMI is being used to primarily control and monitor the industrial wood pellet burner. Variable Frequency Drive (VFD) is being used to control the speed of motor by PID control logic.. A P&I screen will be designed to be used for easy monitoring for the burner operator. A Process Trend and Data log will be available for finding the previous and current value of parameters. By Data Logging in SCADA all the data which will be gathered from data logging will be saved to a computer system.

Key words: PLC, HMI, SCADA, VFD, Automation, Controls Logic

I. INTRODUCTION

In recent time, Programmable Logic Controller (PLC) has been widely accepted in various types of process and control industries which perform different logical functions and operation. Different features of PLC includes low power consumption, flexibility, reliability, and easy to expand [11]. The Ladder Diagrams are taken from electrical field and they inherit certain names and representations from this field. The base elements of the ladder diagrams are the contacts and coils [1]. The software programming used for Plc reduces the wiring logic and easily reconfigured. Supervisory control and data acquisition system (SCADA) which offers graphical and visual representation of process parameters from different remote places. Scada Software Vijeo Citect is used for operating and monitoring components and is made up of a several configuration tools and a runtime section[5].A Variable Frequency Drive is used for applications wherein speed control is of an essential importance due to load changes wherein the speed needs to be increased or decreased accordingly[8][12].

A. Industial Wood Pellet Burner:

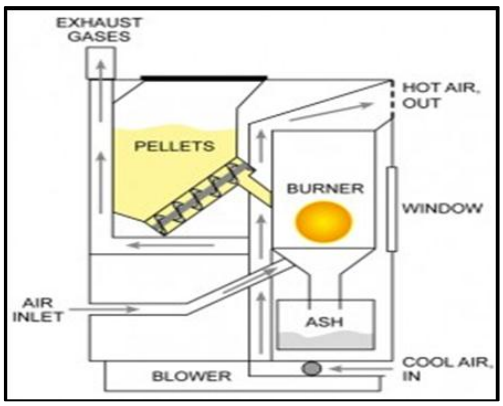


Fig. 1: Basic Wood Pallet Burner

The wood pellet burner is a type of biomass combustion device which takes the wood pellets as the fuel. It is systemized equipment which can easily

Substitute the traditional fuel (oil, coal or gas) to obtain and provide heat sources for boilers or drying machines.

B. Wood Pellet Burner Features and Benefits:

1) Energy-efficient: the Industrial wood pellet burner takes ecological biomass wooden pellets as the energy source, decrease in cost by 30%-60% compared to the fuel oil or gas.
2) Low carbon and environmental protection: the biomass pellet burning is with low emissions of smoke, sulfur nitrogen, dust and no emission of carbon dioxide; measured up to the emission standard of air pollutants [13].
3) Labor Saving: the pellet burner is with automatic feeding design, easy to operate; one person can finish the operation.

C. Pellet Burner Application

The biomass wood pellet burner is being used widely in various Industries which demands for heat energy, such as painting lines, electroplating, food drying ,paper oven-dry, steam boiler, hot-water boiler, industry furnace, die-casting aluminum, die-casting coppers and melting furnace etc.

II. PROCESS AND LOGIC DESCRIPTION

Automation of Industrial burner is being done by developing logic in plc and controlling whole process using hmi and scada. Vfd controls the motor speed by chamber tempreture which works with PID control logic. A VFD can reduce energy consumption of a motor by as much as 60% by speed control [10]. The basic purpose of control systems is to keep system behavior on the desired value.In industry two common classes of control systems are used which are open loop and closed loop control systems [2]. PID controller structure is simple and it can satisfy the requirements of many industrial processes [3].

A. Block Diagram of Work

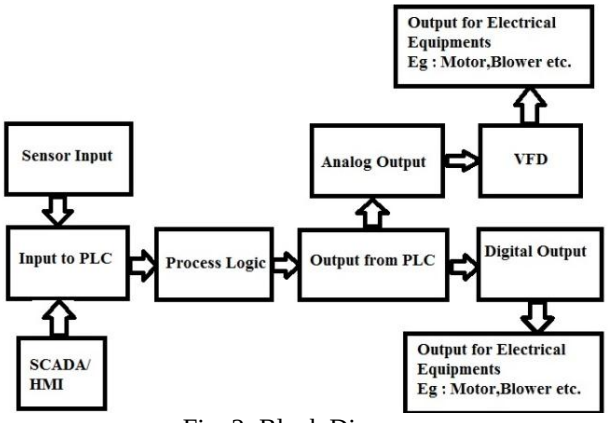


Fig. 2: Block Diagram

B. Logic Flow Chart For Burner Automation

Flow Diagram of logic being programmed in Plc for burner automation.It works in Three mode Auto,Manual and Test.In Test mode Individual output can be energized.Auto and Man mode works together, by Man mode Frequency to Vfd can be manually entered.

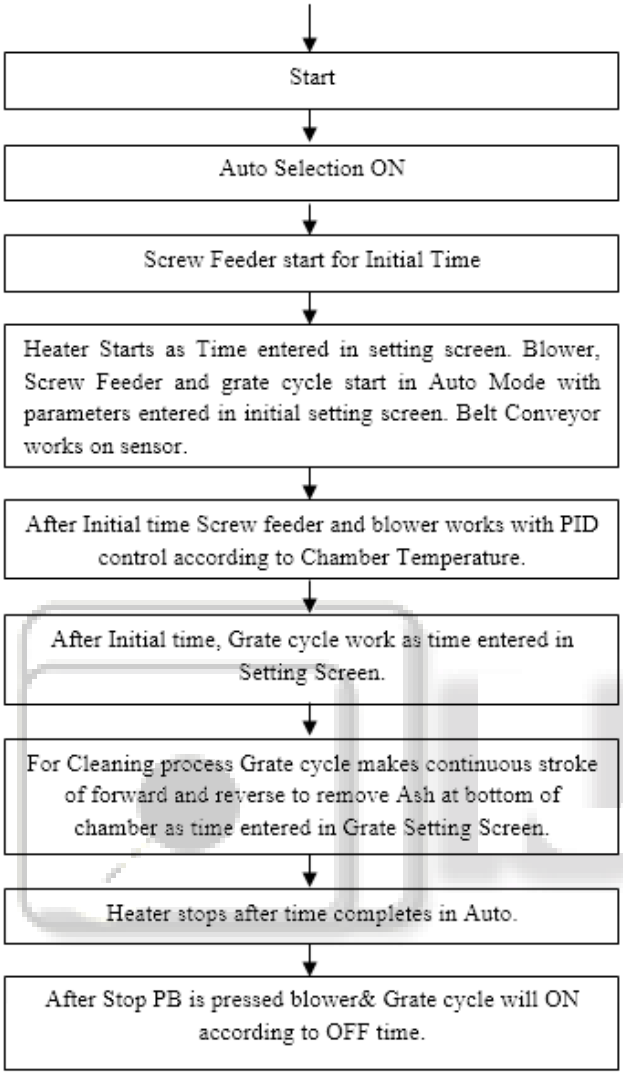


Fig. 3: Flowchart of Burner Logic

C. Burner Working Principle

The biomass pellets enter into the chamber through the auto-feeding system. Initially pellets enter into the gasification chamber and the after few seconds Heater attached at the bottom of the chamber starts.

As heater start heating the chamber with the pellet fuel present in the chamber. Then after few minutes Blower starts and air start entering into the chamber.

As the fuel all are heated up gets fired as air start entering into chamber. After the required minutes to completely fired up the fuel heater stop and automatically fuel start entering into the chamber as per requirement. Grate cycle works as per time entered on setting screen. For Cleaning Process grate cycle makes continuous stroke of forward and reverse for few minutes to remove Ash of burnt fuel which is set from grate screen. Blower will remain continuously ON until the Flame is required for the process.

No.	Input	Output	Volts
1	Burner Start	Blower	24vdc
2	Burner Stop	Heater	24vdc
3	Emergency stop	Screw Feeder	24vdc
4	Flame Indication	Grate Forward	24vdc
5	Hooper Level High	Grate Reverse	24vdc
6	Hooper Level Low	Belt Conveyor	24vdc
7	Screw Feeder Trip	Hooter	24vdc
8	Blower Trip	Burner On	24vdc

Table 1. Inputs And Outpus For Burner

III. EXPERIMENTAL RESULT AND ANALYSIS

A. Setting and Initial Setting:

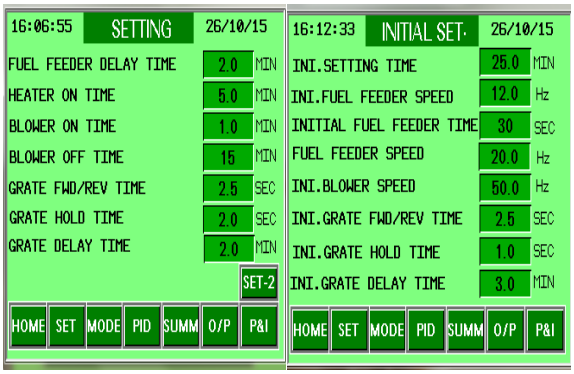


Fig. 4: Setting and Initial Setting Screen

In setting screen different parameter ON and OFF time is being entered for Auto mode and in Initial setting Initial time for Auto mode is entered.

B. Grate Setting and Mode Selection:

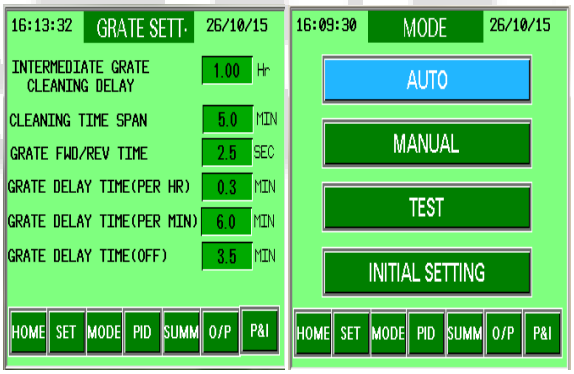


Fig. 5: Grate setting and Mode Selection

In Grate setting screen Grate cycle parameter time is being entered for Auto mode which is used for cleaning process and in Mode Screen Mode Selection is done for Auto Manual and Test.

C. VFD Feeder and Blower:

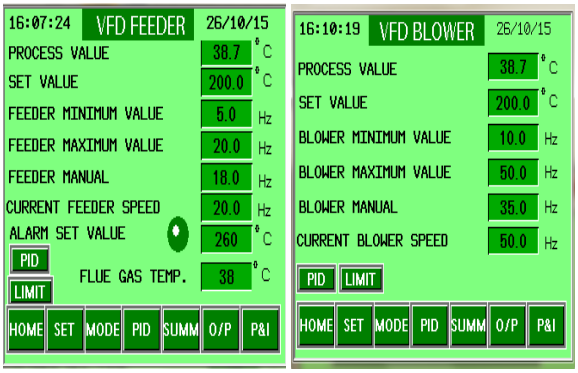


Fig. 6: VFD Parameters for Screw Feeder & Blower

In both the screen different parameter required for PID operation is being entered by controlling with minimum and maximum speed and control action with P, I and D operation parameter

D. Test Mode and Output States:

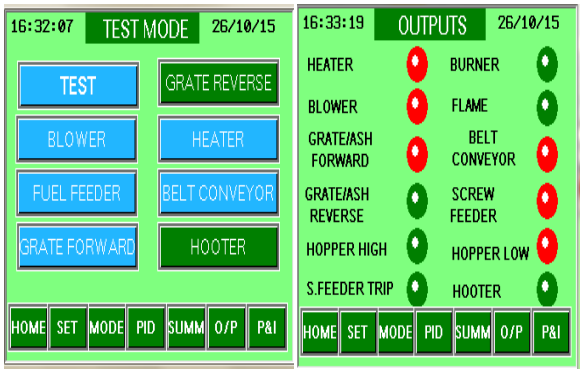


Fig 7: Test Mode and Outputs in Test Mode

In test mode individual output can be change to ON/OFF using individual buttons and output is shown respective to Test mode

E. Fuel Consumption and Setting:

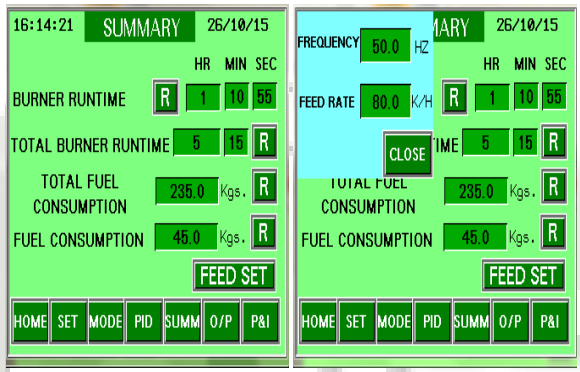


Fig 8: Fuel Consumption Calculation and Feed rate Setting

In Summary screen Burner Runtime and Total Fuel consumed for Burner operation is calculated and feed rate is selected according to motor speed and fuel consumed per hour.

F. Auto Mode Output & Field View:

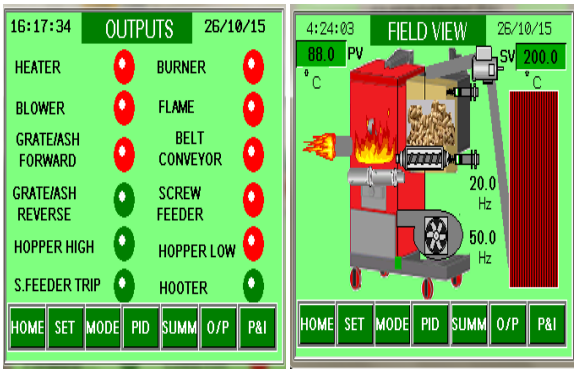


Fig 9: Auto Mode Output and P&I Screen

In output screen Auto mode output states is being shown and P&I screen shows the Graphical field view of Industrial burner.

G. Parameter Trend Graph:

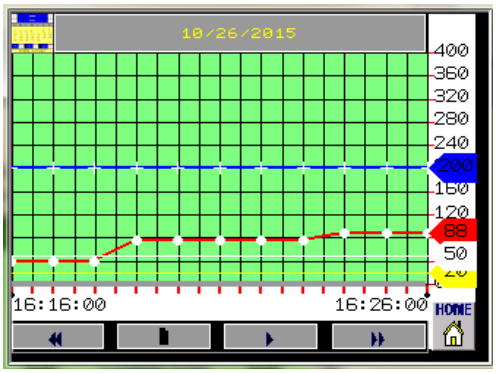


Fig 10: Parameter Trend

Parameter Trend display graphical representation of different parameter which includes Temperature Process value, Set point, Screw Feeder Output, Blower Output.

H. Parameters in Scada System:

In this screen Scada system is shown with Screw feeder and blower setting parameter, Input and output states is being displayed in Scada.

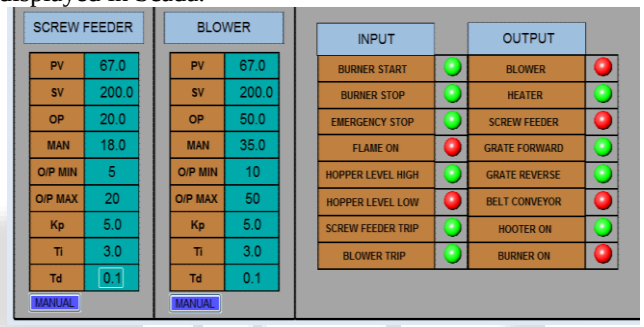
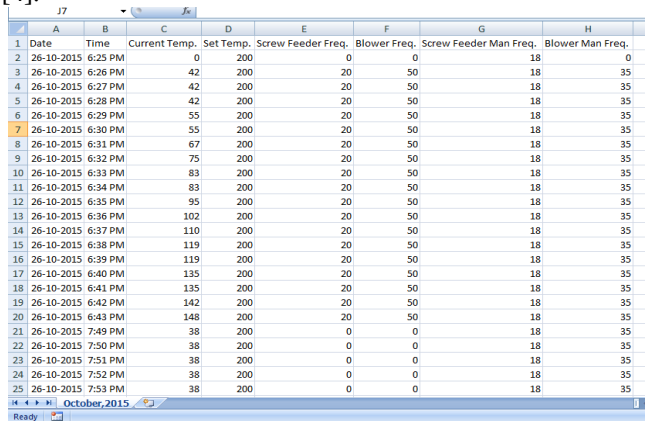


Fig. 11: Parameters in Scada System

I. Scada Data Logging In CSV:

Data log file created using vijeo citect scada of schneider electric and it is stored in scada computer in csv format .It is updated every minute of vijeo citect if its runtime is started. Data historians in process environment gathers vast amount of information on the process over a long period of times [4].



Date	Time	Current Temp.	Set Temp.	Screw Feeder Freq.	Blower Freq.	Screw Feeder Man Freq.	Blower Man Freq.
26-10-2015	6:25 PM	0	200	0	0	18	0
26-10-2015	6:26 PM	42	200	20	50	18	35
26-10-2015	6:27 PM	42	200	20	50	18	35
26-10-2015	6:28 PM	42	200	20	50	18	35
26-10-2015	6:29 PM	55	200	20	50	18	35
26-10-2015	6:30 PM	55	200	20	50	18	35
26-10-2015	6:31 PM	67	200	20	50	18	35
26-10-2015	6:32 PM	75	200	20	50	18	35
26-10-2015	6:33 PM	83	200	20	50	18	35
26-10-2015	6:34 PM	83	200	20	50	18	35
26-10-2015	6:35 PM	95	200	20	50	18	35
26-10-2015	6:36 PM	102	200	20	50	18	35
26-10-2015	6:37 PM	110	200	20	50	18	35
26-10-2015	6:38 PM	119	200	20	50	18	35
26-10-2015	6:39 PM	119	200	20	50	18	35
26-10-2015	6:40 PM	135	200	20	50	18	35
26-10-2015	6:41 PM	135	200	20	50	18	35
26-10-2015	6:42 PM	142	200	20	50	18	35
26-10-2015	6:43 PM	148	200	20	50	18	35
26-10-2015	7:49 PM	38	200	0	0	18	35
26-10-2015	7:50 PM	38	200	0	0	18	35
26-10-2015	7:51 PM	38	200	0	0	18	35
26-10-2015	7:52 PM	38	200	0	0	18	35
26-10-2015	7:53 PM	38	200	0	0	18	35

Fig. 12: Data logging using Scada in csv file

IV. CONCLUSION AND FUTURE SCOPE

In this work, Plc Logic is being developed using schneider electric software Somachine and Hmi, Scada system is studied through software of schneider electric Vijeo Designer and Vijeo citect by configuring all the required

parameters for developing the process plant. Industrial Pellet burner system is being used for process plant and complete design and development of Industrial Burner is being done in the vijeo designer & citect. Trend is being generated which shows Graphical representation of different parameter. A study related to variable frequency drive is being done for energy consumption and thus using vfd energy is being saved with it. A Data Log is being created using Scada of required parameters and Output states which is being stored in Computer. PLC is being used to control the system with HMI & Scada and Vfd. The whole system is being used for energy conservation and fully controlling the plant.

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