



MICROCONTROLLER BASED LEVEL MONITORING AND CONTROLLING SYSTEM IN THE COAL BUNKER

Hemalatha.D, Praveena.M, Sowmiya.K -Student, Dept of EEE, Vel Tech Multi Tech Dr. Rangarajan
Dr. Sakunthala Engineering College, Chennai.

K.Vidya, Assistant Professor, Dept of EEE, Vel Tech Multi Tech Dr. Rangarajan Dr. Sakunthala
Engineering College, Chennai

ABSTRACT

Raw coal, dry ash is stored in a range of bunker, storage tower, and hoppers in thermal power station. A measurement system is need to know the accurate level inside the bunker or storage tower which is useful for both controlling of solid material and monitoring of inventory level, There are many different technologies available today for solid level measurement and it is important to consider these technologies which is suitable for our application. The level sensor service sometime interrupted due to the dusty atmosphere inside the bunker or storage tower due to continuous process of material handling like coal or dry ash. It requires frequent maintenance. The alternate method of continuous level measurement is load cell or strain gauge based measurement which can be more reliable, accurate and maintenance free.

Keyword - Microcontroller, Coal, Bunker.

I. INTRODUCTION

In developing countries like India, world power generation is achieved using fossil fuels. The new technologies for handling coal as a result of the most provide i.e. fuel for generating power. Sometimes in thermal power plants use coal because the main supply i.e. fuel for generating power. A coal handling plant (CHP) is prepared in every station to handle the coal

safely. The mine from underground must be sized, processed and handled effectively and with efficiency coal is keep in bins or storage towers in plants and conjointly in outside areas. Little plants sometimes store coal in storage towers and bunkers directly provide the furnaces for sooner or later operation. Coal reserves for big plant area unit store outdoors next to the plants by stock pilling strategies.

Continuous level measurement may be a necessary method in coal - fired power plants. The amount of coal should be measured in bunkers. Unpredictable levels of coal among the bunkers will interrupt electricity generation and cause disturbance in condition.

Coal should be maintained properly within the bunkers will be a challenging one. When the coal is at the highest of the bunkers using mechanical switches alarm was given. Several coal plants have operators to measure the coal in the bunkers. Several times the bunkers would run barren of coal that could cause a disturbance results in loss of generation.

II. EXISTING METHODOLOGY

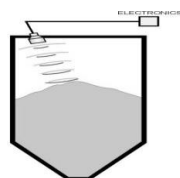


Fig: 1 Ultrasonic level measurement

In this paper we made a detailed study in boiler particularly in milling system and we have implemented a continuous level monitoring system which will be available in control room for boiler operator. Sensors cannot be used inside coal bunkers due to dusty surroundings. The coal is measured using load cell that is placed under the bottom of the bunker. Therefore the measured signal is regenerate into an electrical signal using the signal conditioner. The

In ultrasonic level measurement methodology, high frequency sound waves are used to measure the coal in the bunker.

Less than 5 KHz frequency is used for solid materials and frequencies at thirty kilocycle per second or higher area unit are used for short range. If the storage tower is pneumatically fed, the soiled environment might stop a come back indication to the sensing element. Heat materials will modify the transmission speed, resulting in accuracy issues.

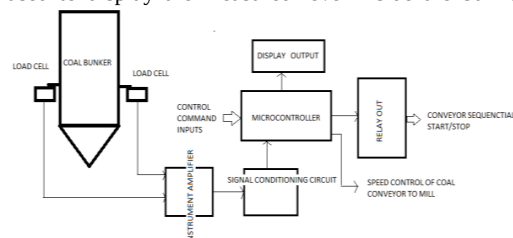
The material echo also a challenge while measuring the level monitoring; aslant surface might causes an indirect reflective resulting in weak or split echoes.

ISSUES OF EXISTING METHODOLOGY

- i. Faulty measurements of bunker level due to coal dust inside the bunker.
- ii. The sensor system gets damaged under high temperature which in turn causes failure of boiler and tripping of entire generation unit.
- iii. Consequently, there is no special feature to encourage its usage.

III. PROPOSED METHODOLOGY

signal received might be a weak at some cause hence it is amplified using amplifier. Finally the amplifier signal is proceed using PIC microcontroller, which is used to display the measured level inside the bunker



through the display units and it also provide the control signal for the chain feeder for the smooth variation of the chain. Feeder speed, that provides the continuous flow of coal to the boiler. Thus there is no manual management chain feeder is needed underneath this technique.

In the proposed system, the load cell is placed at high corners in the coal bunkers. The load cell will give an output voltage in the range of milli volts with respect to the weight of the coal bunker. At the starting condition, the weight of the coal bunker is zero, and the load cell output is zero, the chain feeder drive of coal rotates at maximum speed and large amount of coal is powered and hold in PF bunker.

When the weight of bunker gets increased, the local cell will produce around 0.3mV to 1.3mV output. Load cell output is given to the instrumentation amplifier circuit and so given to best amplifier circuit. The amplifier circuits amplify the output of load cell around 5V and it is connected to the PIC16F877 micro-controller. The level display is interfaced with the PIC micro controller to display the level of the bunker. The chain feeder drive is connected to the PIC microcontroller with the help of opto-coupler for speed control. So when the bunker gets loaded to 30% the load cell output is increased so the bunker gets loaded slowly. When the bunker gets fully loaded the chain feeder speed will be zero. So the coal will not be pulverized to avoid the over flow of PF bunker.

IV. PF BUNKER

PF bunker is a pulverized Fuel bunker. It is a storage space of a coal fired power station. In NCTPS, the PF bunker incorporates a capability of tones/hour and also the speed is concerning 8rpm. It is derived by eddy current drive.

V. AMPLIFIER CIRCUIT

Amplifier circuit is used to amplify the output of the load cell. Due to the strain gauge deformation, there will be a modification in electrical resistance that causes the bridge output to be modified. A change in output voltage that is directly proportional to the applied force. The type of amplifier used here is instrumentation amplifier.

$$\text{i.e., } e_0 a F(t) \text{ -----(1)}$$

VI. MICROCONTROLLER

PIC 16F877A Microcontroller is used for level monitoring and continuous level monitoring can be in control room for Operator.

VII. COMPONENTS DESCRIPTION

a. LOAD CELL

A load cell is used to convert a force into an electrical signal. Every weighing machine which shows weight has a load cell as sensing element. The type of load cell used here is strain gauge load cell.

$$GF = \frac{\frac{\Delta R}{R}}{\epsilon} = \frac{\frac{\Delta \rho}{\rho}}{\epsilon} + 1 + 2\nu$$

Or

Gf = change in resistance / (resistance * strain)

Where

- $\epsilon = \text{strain} = \Delta L / L_0$
 - ΔL = absolute change in length
 - L_0 = original length
- ν = Poisson's ratio
- ρ = Resistivity
- ΔR = change in strain gauge resistance
- R = unstrained resistance of strain gauge

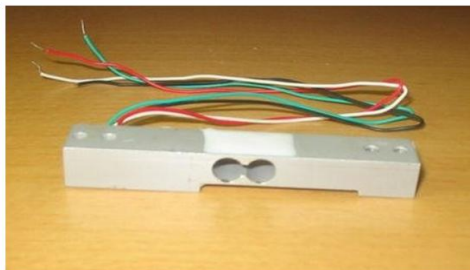


Fig: 3 Load Cell

b. LIQUID CRYSTAL DISPLAY

16 characters x 2 line displays are used in this module. This pin is used to control whether you are reading or writing to the display. There are minimum wait times between operations.



Fig 4: LCD Display

HARDWARE MODEL

The microcontroller measures the load cell signal and converts it into level and display in the LCD. Then the level is compared with set values for conveyor controlling purpose.



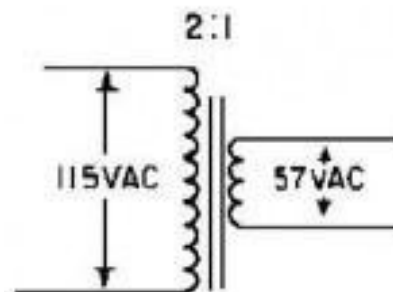
Fig: 6 Hardware Model

SIMULATION DESCRIPTION

Simulation is carried out in **Proteus (Processor for Text Easy to Use)** software. The four statuses maintained are:

- 0 - 40% - Empty
- 41 - 60% - Low
- 61 - 80% - Normal

c. STEP DOWN TRANSFORMER



A step down transformer is used to step down the voltage from 115V to 57V.

SERIAL NUMBER	BUNKER LEVEL (%)	DRIVER SPEED (%)
1.	0 - 40	100
2.	41 - 60	75
3.	61 - 80	50
4.	81 - 99	25
5.	LEVEL > 99	0

SIMULATION OUTPUT

The above shown output is the simulation result obtained in proteus software where the simulation waveform is varied when the level of coal gets varied in accordance with the feed of the bunker.

- 81 - 99% - High
- Level > 99% - Full

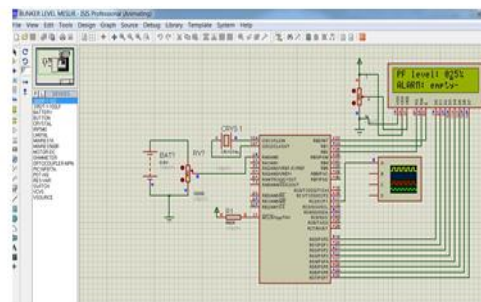


Fig: 7 Simulation Waveform for Full Level (99%)

If the bunker is stuffed with the range of (99%) that is taken into account as full level, the extent of coal is measured and therefore the simulation output voltage waveform is obtained as shown in the figure above.

HARDWARE OUTPUT

A hardware model is created with the previously described components, and the results are compared with the simulation output. The following table shows the hardware output.

ADVANTAGES OF PROPOSED METHOD

- Load cell primarily based level monitoring system is a closed loop control system, wherever variation of the load directly

- controls the speed of the raw coal chain feeder.
- Automated bunker level measurement.
- Continuous level monitoring can be in carried out in control room itself.
- Driver will be directly coupled to the raw coal feeder instead of eddy current clutch.

VIII.CONCLUSION

The importance of automatic coal flow control using load cell is the method of control has many advantages over the other system and is very cost effective. Since when the coal flow is very low or very high it may leads to loss of power generation and in addition paves way to spend amount in lakhs to establish the system again.

We tend to conclude that there is no need of manual control of raw coal chain feeder speed using this methodology. The real time monitoring of the level of coal is observed along with the alarm signals that facilitate to improve safety standards.

REFERENCES

1. Haiming Zheng and Tieqiao Guo (2010) titled "Technique study of measuring system of the coa powder storage tower with level meter" published in "Environment science and information application technology (ESIAT,2010) International Conference on (Volume:4)".
2. Morsalin .S ,Mahmud.K, Halim.M.R,Saha.O and Jamil.I.A (2014) "Freighter fuel level detection and overload alarming system with safety notification via GSM" published in "Informatics, electronics & vision (ICIEV),2014 International Conference".
3. Muller .I,de Brito.R, Pereira.C.E and Brusamarello.V (2010) "Load cells in force sensing analysis – theory anda novel application" published in "Instrumentation & measurement magazine.IEEE(Volume:13,Issue:1)"
4. Zhong .H.Y, Behera.A.K and Rashid .M.H (1991) "8096 microcontroller based field acceleration method control for induction motor with new digital PWM inverter technique"
5. Taylor.R and Shirvaikar.M (2010) titled "Performance analysis of range sensors for a real-time power plant coal level sensing system" published in "system theory (SSST),2010 42nd Southeastern Symposium"
6. Krithiga .s and Ammasai Gounden.N (2011) "A Micocontroller based power electronic controller for PV assisted DC motor control" published in 6th IEEE International conference on Industrial and Information systems (ICIIS),2011".
7. Longbottom.F and Eren.H (1994) "Ultrasonic multiple – sensor solid level measuerements" published in "Instrumentation and measurement technology conference, 1994. IMTC/94. Confrence proceedings .10th anniversary.advanced technologies in i& amp: m,1994 IEEE".
8. Makabe .m and Hrada.s (2006) "Research of protection equipment for the load cell receiving a large impact load" published in "SICE – ICASE,2006. International Joint Conference".
9. Manavaalan Gunasekaran and Ramprasad Potluri (2012) "Low – Cost Undergraduate Control Systems Experiments Using Microcontroller – Based Control of a DC Motor" published in "Education, IEEE Transactions on (Volume; 55, Issue:4)".

