

# PLC BASED POWER PLANT COAL LEVEL SENSING SYSTEM USING ULTRASONIC SENSOR

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## *Abstract-*

Coal level detection is an important aspect to assess the performance of coal-fired power plants. The inventory of coal powder in the silos needs to be monitored continuously to allow efficient operation of the power plant. For this, Real-time feedback sensors are utilized to sense the coal height so that data can be sent to downstream systems for further processing. These sensors are required to accurately sense the height of coal within the bunker or stockpile. There are many types of ranging sensors available in the market of which the ultrasonic, radar and laser sensors are used to determine the height of coal stockpiles in various sites in coal-fired power plants.

Our project uses an Ultrasonic sensor which is used for sensing presence or absence of material within a coal storage tank. The Ultrasonic sensor will sense the level condition which will be further used to calculate the volume of coal in the tank and the volume will be indicated with the help of LEDs. Depending upon the volume of coal the control action will take place which means for a low volume condition the system input will be On and for a high volume condition system input will be Off. In the core of the project we will use Programmable logic controller (PLC) to drive the motors. We use two DC motors for two conveyor belts and a stepper motor for the Ultrasonic circuit. The output of LED display is connected to PLC for controlling action.

It is an industrial automation based application. It helps to maintain the sufficient level of powdered coal in the silos and prevents damaging events such as blow-backs which hamper the entire process of coal-fired power plants.

## I. INTRODUCTION

A coal-fired power plant typically has silos, bunkers or stockpiles in which the fuel is placed for storage purposes. Real-time feedback sensors are utilized to sense the coal height so data can be sent to downstream systems for further processing. These systems are required to accurately sense the height of coal within the bunker or stockpile. The coal-fired power plant application is especially daunting due to the particularly harsh operating conditions and reliability requirements. There are many types of ranging sensors available in the marketplace. The performance of ultrasonic, radar, and laser rangefinder sensors was investigated to determine the height of coal stockpiles in various sites in a coal-fired power plant. Coal-fired power plants are commonplace around the world. In order for these power generating stations to create huge amounts of electricity the turbines need to be feed with steam and the steam created by boilers are fired by coal. The inventory of coal powder in the silos needs to be monitored continuously to allow efficient operation of the power plant. If the level of powdered coal in these silos reaches minimum levels then it may hamper the

entire process of coal-fired power plants. It is necessary to maintain sufficient coal height which will prevent damaging event such as blow-backs from occurring. Hence it becomes very essential to maintain and monitor the coal level in silos.

## II. METHODOLOGY

### A) ULTRASONIC BASED SYSTEM

The ultrasonic based systems mounted on the top of coal silos. One such representative system is E.g. Siemens Milltronics XLT Air Ranger systems. It consists of two main components: an ultrasonic signal transducer and a remotely mounted electronic transceiver. A continuous series of ultrasonic pulses are sent from a transducer and the reflected echoes from the liquid or solid surface are monitored. In the transceiver part, a microprocessor converts these signals into distance, level or volume and displays these data in an LCD.

### B) RADAR BASED SYSTEM

In the top section of the coal receiving hoppers, radar probes are fixed. These are also non-contact technologies. Micro-pulses at the speed of light are transmitted and reach the material surface and reflect back to the radar. Time is calculated and it is converted into level of the solid surface. No accuracy problems arise but may have difficulties with respect to inert materials. E.g. Siemens LR 460 radar system is an industry standard for detecting bulk materials such as coal.

### C) LASER BASED SYSTEM

Laser systems improve the correctness of the level of coal sensing system range. The transmitter is made up of semiconductor diode laser which transmit the infrared light pulses, which are grouped by means of transmitter lens and the target reflects the part of the echo signal back which hits a photodiode and generates an electrical receiver signal. The duration between the pulses is calculated with the help of quartz. The counted value is sent to a microcomputer in which the measured data is processed and makes it ready for data output, for range and speed display.

## III. RESULTS

The inventory of coal powder in the silos needs to be monitored continuously to allow efficient operation of the power plant. It is very essential to maintain and monitor the coal level in silos. The Ultrasonic sensor is used for sensing the presence or absence of material within a coal storage tank. The Ultrasonic sensor senses the level condition of coal in the silo. The level condition will be indicated with the help of LEDs. The average obtained from the readings given by the Ultrasonic sensor will be further used to calculate the volume. Depending upon the volume of coal the control action will take place which means for a low volume condition the system input will be On and for a high volume condition system input will be Off. The controlling action is performed by Programmable Logic Controller.

## IV. BLOCK DIAGRAM

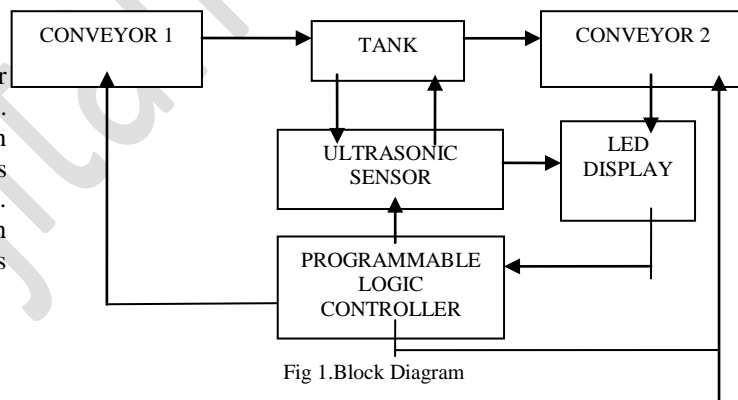


Fig 1. Block Diagram

The project uses an Ultrasonic sensor which is used for sensing presence or absence of material within a coal storage tank. The Ultrasonic sensor will sense the level condition which will be further used to calculate the volume of coal in the tank and the volume will be indicated with the help of LEDs. Depending upon the volume of coal the control action will take place which means for a low volume condition the system input will be On and for a high volume condition system input will be Off. In the core of the project we will use Programmable logic controller (PLC) to drive the motors. We use two DC motors for two conveyor belts and a stepper motor for the Ultrasonic circuit. The output of LED display is connected to PLC for controlling action.

#### V. APPLICATIONS

- A) Coal level sensing system is basically used to sense the level of coal in coal-fired power plants.
- B) It can also be applied to various other solid level sensing systems.
- C) It can also be implemented to overcome the drawback of high cost of the Radar based and Laser based systems in solid level measurement.
- D) The same circuit is also used to measure the liquid level in various process industry.
- E) Used in Food process industry where different solid levels can be measured.

#### VI. CONCLUSION

Thus, we sense the level of coal in the tank with which we control input and output flow of powdered coal in the system. With the progress in technology, the proposed system based on PLC is found to be more compact, user friendly and less complex. Though it is designed keeping in mind about the need for industry, it can be extended for research applications as well.

#### VII. ACKNOWLEDGEMENT

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