Sensor Based Effective Monitoring of Coal Handling System (CHS)

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ABSTRACT: **Coal level detection is an important aspect to assess the performance of a coal-fired power plant. Coal has to be transported, via a coal handling system. The fuel in a coal-fired power plant is stored in silos, bunkers or stock piles. Coal is stored in silos in a small plant, Bunkers for handling a day's operation and Stock piling methods for large plants. So, fuel handling had to done efficiently. To accurately sense the coal height, Real-time feedback is deployed within the bunker or stock pile. The real time range information is then fedback to the control system. Of the different types of ranging sensors, radar based system is used. Also a real-time temperature monitoring system is developed to protect the coal. The range and temperature data from sensors are sent to the main system through GSM modem by means of SMS. The range information is used to start the conveyor belt to draw the coal from coal yard. If the temperature exceeds the limit, the SMS will be sent through the software or it will call the respective person to monitor the process. A fire sensor is also used to extinguish the fire by initiating the water spraying system. A PIC Microcontroller is interfaced all the sensors for effective handling of thermal power plant.**

I. INTRODUCTION

A. General:

Commonly thermal power plants uses coal as the main source i.e. fuel for generating power. A coal handling plant (CHP) is set in every power station to handle the coal safely. The coal mined from underground has to be sized, processed, and handled effectively and efficiently. Coal is stored in bins or Silos in plants and also in outdoor areas [1]. Small plants usually store coal in Silos and Bunkers directly supply the furnaces for one day operation. Coal reserves for large plants are stored outdoors next to the plant by Stock piling methods.

B. Overview of Conveyor Control System:

Different kinds of systems are used to move the coal to either storage or to the furnace. So, fuel handling has to be done efficiently. A Number of Conveyors are used in the CHP. The conveyors control systems are important for the working of the plant more efficiently. Initially the conveyors are silent; at once the conveyor is fitted with a suitable control system they start giving effective plant operation [10]. Electronic intelligent conveyor control is used when conveying task is difficult. Earlier in CHP, a simple on/off switches or speed switches are used to control the conveyor system. On adding a range based sensor to this CHS, the best kind of fully automated system shall be made operational.

II. LITERATURE SURVEY

A.Coal Handling System (CHS):

The economic development of the emerging economies like India is based on the use of coal for power generation. So, the development of new technologies for handling of coal can thus contribute to making the coal more efficient and sustainable [8]. Handling, transportation and storage of materials is an integral part of a range of different industries. Materials come in a variety of sizes, shapes density and flow characteristics. Depending upon the application and the material to be handled, the conveying rates and distance vary. Storage is also an important aspect of dealing with materials. Handling of coal and fly ash are a major challenge to the engineer in the thermal power plants. An efficient coal handling system is the key for optimum utilization [2].

B. Conveyor System:

Efficiency of CHS depends heavily upon working of conveyor system. Each conveyor shall be made to run close to 100% reliability. The conveyor system's reliability depends mainly on the control system especially if the number of conveyor increases [10]. Hence the design of the control system should be taken care of. Though the existing system were designed to be concerned only with the conveyor stoppage which happens due to the occurrence of sequential operation and zero speed. If the coal transported is also done automatically by using sensing device, it can be made very productive by deploying a microcontroller based intelligent conveyor control system.

III. EXISTING SYSTEM

A. Operating Principle:

To set the conveyor on it is needed to set the receiving conveyor system first before starting the feeding conveyor i.e. the operation logic is to be from downstream to upstream. To stop the conveyor, the operation will be reversed i.e. from upstream towards downstream. So if the conveyor is stopped, the upstream conveyors should stop automatically. This is the conveyor sequential operation. Also it is necessary to stop the conveyor if the rotation of the conveyor becomes slow which is known as zero speed protection. The Existing system will stop the conveyor and additionally it stops the upstream system serially.

B. Range sensor-based systems:

According to Carl Bergmann, "sensor-based sorting is still a developing technology that is rapidly evolving". He also said that Improvements are continually made and a very wide range of sensors are now available [9].

The coal height is sensed by means of real-time feedback sensors and the data is sent to downstream systems for further processing. The height of the coal is measured in silos, bunkers, or stock pile done using the range sensor based systems.

Three different types of sensors used in coal level detection are ultrasonic, radar and laser based systems [3]. These systems determine the coal height and data range is fedback into the particular control systems in real-time. In this manner, process, environmental and safety needs are assisted in real time.

C. Ultrasound systems:

The ultrasonic based systems mounted on the top of coal silos. One such representative system is E.g. Siemens Milltronics XLT Air Ranger systems [4]. 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.

D. Radar based systems:

In the top section of the coal receiving hoppers, radar probes are fixed. These are also non-contact technologies. 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. A 4-wire 24 GHz FMCW (Frequency Modulated Continuous Wave) radar level transmitter with extremely high signal-to-noise ratio is used and it continuously monitors solids up to 100 meters (328 ft) [5].

E. Laser based systems:

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 [6]. 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 [7].

F. Outcome of the Survey:

Hence, a convenient CHS built with sensors (range, temperature, fire) was thought of to enhance the efficiency. A PIC microcontroller based effective CHS to improve the existing system was proposed, designed and implemented.

IV.PROPOSED SYSTEM

A sensor based effective monitoring and controlling of Coal Handling System (CHS) has been developed. In this system, a PIC microcontroller is used to do the coordinating functions along with different kinds of sensors. Two sensors are used for range prediction, for lower and upper level of coal in storage units. The sensor activates the conveyor system depending upon the data received from the coal storage unit. A GSM based temperature sensor is also deployed for controlling the temperature of the coal stored. The cooling fans are activated based on the input from sensor. In addition, a fire sensor is also used to activate the water spraying system. In this way, most of the fire hazards are taken care of. Hence, the proposed system increases the efficiency of the CHS with all the added features.

V. EXPERIMENTAL METHODOLOGY

The project is designed with a PIC Microcontroller. A Temperature sensor, Relay and GSM modem are interfaced with the PIC microcontroller.

Fig.1. shows the overall block diagram of sensor based effective monitoring of coal handling system (CHS).

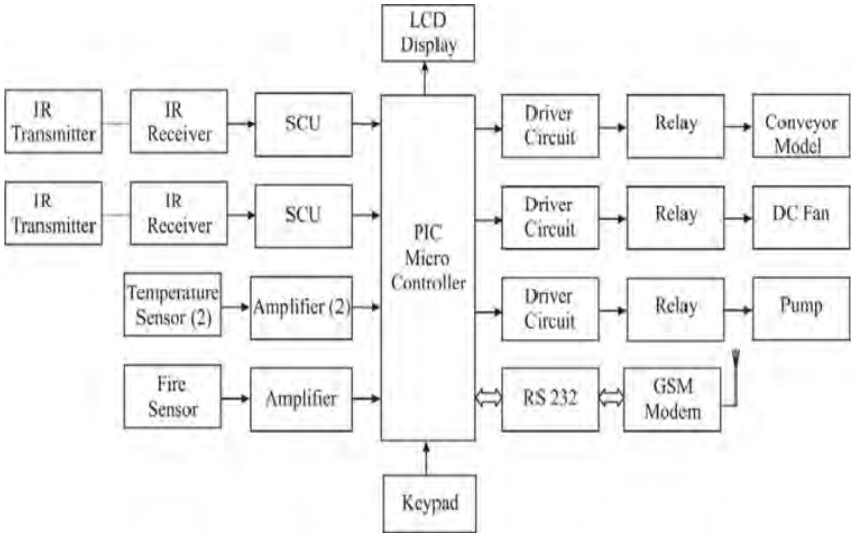

Fig.1. Block diagram of the proposed system

The output of Thermistor is given to ADC which is then processed and displayed in LCD. It is used to monitor the boiler temperature and when the particular temperature is reached, the microcontroller activates the driver circuit for the relay. Also microcontroller updates the temperature value to the mobile, where the mobile phone monitors and if temperature exceeds the value, then, SMSes are sent to two mobile phones continuously.

The frequency and amplitude of a signal output of the Fire sensor and the number of pulses generated during a predetermined period of time are computed. The flames and smoke are detected with a high accuracy on the basis of the duration of the signal.

In any coal fired power plant the desired level of automation could be achieved by this project. As, the coal is the vital fuel in any thermal power plant, the level of coal can be maintained in the silos (coal tank). As and when the level becomes lower than the predetermined level, it automatically activates the conveyor system which in turn draws the coal from the storage yard. When the level raises the upper predetermined level, the conveyor system stops.

Apart from maintaining the coal level, its temperature level can also be monitored. When the temperature raises the predetermined value it automatically sends messages to two pre-programmed GSM based mobile numbers. The cooling systems such as industrial fans can be activated through the GSM mobile system. In addition to the above temperature sensing system, a fire sensing system also monitors the silos. In case of fire in the coal tank, it automatically activates the water spraying system.

When the above systems are incorporated in any thermal based power plant, the efficiency of the plant improves as any untoward incident such as fire has been adequately addressed. The following are the advantages of the system designed: Low cost, Low power consumption, No manual work, Reliable, Compatible size and easy to implement.

The experimental setup for the sensor based Coal Handling System (CHS) is shown in fig.2. and fig.3.

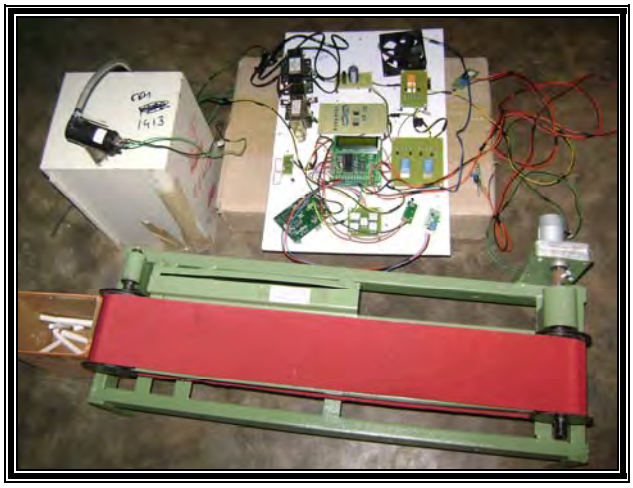

Fig.2.Hardware Setup of CHS

Fig.3. Display Showing the Message sent to the mobile

VI.CONCLUSION

With the progress in technology, the proposed system based on PIC microcontroller [micro chip] is found to be more compact, user friendly and less complex, which can readily be used in order to perform several tedious and repetitive tasks. Though it is designed keeping in mind about the need for industry, it can be extended for other purposes such as commercial & research applications. The system is fully software controlled with less hardware circuit. This feature makes this system as the base for future systems.

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