



International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Special Issue 4, May 2014

Belt Conveyor Monitoring and Fault Detecting Using PLC and SCADA

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ABSTRACT- In order to ensure the belt conveyor operation safe and reliable, centralised monitoring and control is very necessary. The main objective of this proposal is to monitor and detect the fault occurring in the coal conveyor using delta series PLC and SCADA. Faults such as belt tear up faults, oil level reduction fault, fire occurrence faults in the belt conveyor are not identified properly and thus leading to serious damage to the belt conveyor. In order to avoid this type of serious conditions, we are applying here various types of sensors in their operations using PLC and SCADA to provide proper protection for the belt conveyor in Thermal Power Plant. Manual control at present is more disadvantageous and is being the major reasons for frequent accidents. In order to reduce these accidents and for increasing further enhancements, automation is used. All parameters will be processed, controlled, and managed in the coal conveyor with help of sensors and plc.

KEYWORDS: Coal conveyor, Delta series PLC, Sensors, SCADA

I.INTRODUCTION

The project mainly tells about the identification of belt conveyor faults by sensing the conveyor by means of providing three types of sensors for (i)identifying the tear up of belt conveyor which can be occurred during overload condition and any other causes,(ii)identifying the oil level reduction which can be occurred when there is a decrease in oil level in the tank which is placed in low tension motor,(iii)sensing the temperature level which can be occurred during overheating of conveyor motor, sudden fire occurrence in the conveyor. The automation will strongly enhance the safety, speed and control characteristics of belt conveyor in real time without requiring manpower. Due to the advent of PLC automation can be done efficiently to satisfy flexibility, reliability and efficiency of conveyor. A Delta's DVP series programmable logic controllers offer high-speed, stable and highly reliable applications in all kinds of industrial automation machines. In addition to fast logic operation, bountiful instructions and multiple function cards, the cost-effective DVP-PLC also supports various communication protocols, connecting Delta's AC motor drive, servo, human machine interface and temperature controller through the industrial network in to a complete "Delta Solution" for all users.

II.LITERATURE REVIEW

A. Existing Methods

Fire can be found in belt conveyor after happened in it. It is one of the major disadvantages in present system. Fireaccidents occurs in the belt conveyor is identified only by the human working on conveyor sometimes this will lead to severe damage to the conveyor. The tear up in the conveyor is identified only by the speed variation. Speed will show variation only when the tear up is big. Thus conveyor leads to severe damage. There is no monitoring system for the oil level in the fluid coupling of LT conveyor motor. Reduction in the oil level leads to OFF the conveyor in all the conditions. These are main drawbacks in the present system.

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B. Proposal System

This proposed system gives the efficient way of automating the belt conveyor using delta series plc along with SCADA for high reliability, and fast operation without delay. It consists of hardware and software modules to identify the belt conveyor faults.

a) System Architecture

The system consists of many functional units such as ultrasonic flaw detector, LM35, capacitive type level sensor. Figure1. Shows block diagram Representation of Proposed System. Here delta series PLC plays vital role i.e. it is heart of this proposed system. The plc is burnt with program that is necessary to control the sensors and relays interfaced to it. The interfaced units are controlled by the PLC in an efficient and faster manner, thus providing the system to be reliable than the existing ones.

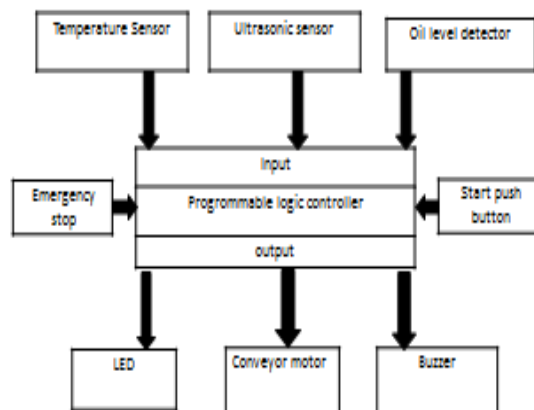


Fig1:Block Diagram

C. Need for Automation

Belt conveyor automation will strongly enhance the safety, fault identification, and control characteristics of conveyor in real time without requiring physical man power. Due to advent of wireless communication technologies and high speed powerful processors, automation will be done to satisfy flexibility, reliability and efficiency of belt conveyor. Generally, delta series plc is a ladder logic based system for enhanced performance, reduced power consumption and more efficient simultaneous processing of multiple tasks. Wireless sensor network consists of spatially distributed autonomous sensors to cooperatively monitor physical or environmental conditions such as temperature, smoke, level, pressure etc., Utterly the coal conveyor automation could be done for conveyor protection and assurance, and communication.

III.COMPONENTS OF PROPOSED SYSTEM

A. PLC

Programmable logic controller (PLC) is a control system using electronic operations. Its easy storing procedures, handy extending principles, functions of sequential/position control, timed counting and input/output control are widely applied to the field of industrial automation control.

B. Delta series PLC

Delta's DVP series programmable logic controllers offer high-speed, stable and highly reliable applications in all kinds of industrial automation machines. In addition to fast logic operation, bountiful instructions and multiple function cards, the cost-effective DVP-PLC also supports various communication protocols, connecting Delta's AC motor drive, servo, human machine interface and temperature controller through the industrial network in to a complete "Delta Solution" for all users.

C. LM35



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The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μ A from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a –55° to +150°C temperature range. Once it reaches the specified temperature range, which is meant for fire accident, the belt conveyor will give indication and stopped immediately and fire is extinguished, thus protecting fire accidents without time delay.

D. Ultrasonic sensors

The ultrasonic sensor works on the principal of reflected signal. The high frequency sound waves are made to pass through an object continuously by which the tear up is to be determined. If belt present on the conveyor the ultrasonic sensor continuously transmit and receive the signal when any tear up in the belt, the conveyor get automatically stopped and the transmitted signal will not return back. It is more efficient and accurate monitoring is done to prevent errors.

E. Oil level detector

In industry, liquids such as water, chemicals, and solvents are used in various processes. The amount of such liquid stored can be found by measuring level of the liquid in a container or vessel. In this project, capacitive type of level sensor is used. The principle of capacitive level measurement is based on change of capacitance. An insulated electrode acts as one plate of capacitor and the tank wall (or reference electrode in a non-metallic vessel) acts as the other plate. The capacitance depends on the fluid level. An empty tank has a lower capacitance while a filled tank has a higher capacitance.

F. Start push button

To start a belt conveyor the operator presses the Start button. This provides power momentarily to a relay coil. As the relay coil is energized, it closes its normally-open contact so that power is provided through the normally-open relay contact to both the relay coil and the conveyor. Coal conveyor is the electrical that uses electricity. As long as the relay is energized, the circuit is complete and power is provided to the conveyor. This button is must for safe and reliable operation of belt conveyor.

G. Emergency stop

Emergency stop (E-Stop) buttons are an important safety component of many electrical circuits, especially those that control hazardous equipment such as gas pumps, moving machinery, saws, mills, and cutting tools, conveyor belts, and many other types of equipment. They are designed to allow an operator or bystander to stop the equipment in a hurry should anything go wrong. Pressing the E-Stop button breaks the circuit and removes power from the holding relay that keeps the circuit energized and allowing the relay to return to its normally closed position.

H. Belt conveyor

Conveyors are durable and reliable components used in automated distribution and warehousing. In combination with computer controlled pallet handling equipment this allows for more efficient retail wholesale and manufacturing distribution. It is considered a labor saving system that allows large volumes to move rapidly through a process, allowing companies to ship or receive higher volumes with smaller storage space and with less labor expense. These are the synthetic rubber belts which move on metallic rollers called idlers and are used for shifting of coal from one place to other places. Coal helps fuel stoves and other devices around the world. Once it's extracted from underneath the ground, there are various options available when it comes to transporting it to where it needs to go. After it's arrived at the processing facility or other commercial/industrial area, it's time to unload it onto a conveyor belt. You can either shovel it out on your own or dump it out of the vehicle it was transported in before it reaches its next destination. Conveyor belts are also used to transport material into processing equipment and back out again. These belts optimize productivity.

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I. LED

LED is a light emitting device. It is used for giving an indication during an rise in temperature and oil level reduction in the low tension motor.

IV. HARDWARE MODULES OF THE SYSTEM

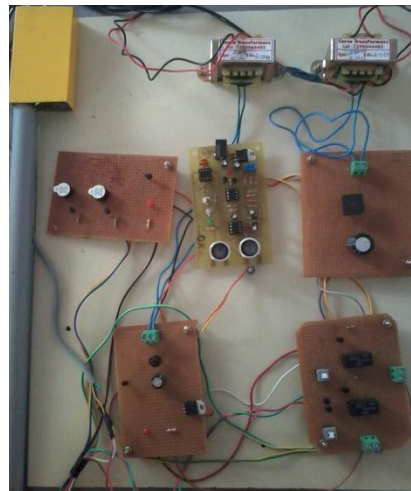


Fig 2:Partial Hardware Model

A. Description

The hardware consists of two supply boards they are input power supply of 12V and conveyor power supply of 24V. At first, the 230V AC supply is step down to 12V and this AC voltage is rectified to DC voltage by the bridge rectifier and then this voltage is sent to the capacitor for removing the harmonics present in the voltage. This filtered voltage is then regulated by the voltage regulator to 5V. The conveyor power supply is converted to 24V DC supply with the help of step down transformer and bridge rectifier as same as the above. The input power supply is given to the sensors like ultrasonic sensor, temperature sensor and level sensor. In the ultrasonic sensor, the transmitter and receiver are used where it will sense the belt conveyor by transmitting and receiving the signal continuously which is passed through it. If any tear up occurs in the belt conveyor, the sensor will not receive the transmitted signal thus giving the signal to the Plc to stop the coal conveyor. After getting stopped, the belt conveyor will be removed for maintenance either in forward or reverse direction by using the relay. LED is used for indication of ultrasonic working. The temperature sensor is used to sense the temperature and gives indication which it reaches above the room temperature. Here level sensor is used to detect the level of oil in the Low Tension motor and gives indication when oil level gets decreased due to which it will stop the belt conveyor to move.

V. OVERALL PROPOSED SYSTEM OPERATION

The belt conveyor operation which can be distracted due to three main faults can be sensed by using sensors and plc is used to control the faults which were sensed by the sensor. All train parameters, rail flaw inspection and other parameters could be controlled by using microcontrollers. If there are any problems such as coal conveyor tear up, temperature rising and oil level reduction etc., will be sent to plc for processing to get right response. Due to fast and reliable processing, the operations of coal conveyor can successfully be controlled in real-time. Thus plc is the best control processor for the belt conveyor in thermal power plant. Once the conveyor starts running, if there is proper operation, the conveyor continues to run without stopping. Once the conveyor senses red signal the motor stops. When there is any temperature change above the abnormal value, then the motor stops. The ultrasonic sensor senses the tear up in the coal conveyor and signals the controller by giving a buzzer sound. The oil level reduction control can be done using capacitance level sensor.

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VI.SIMULATION SOFTWARE

Plc is a device which can control the output devices depending on the developed program and the input devices. To get maximum efficiency from machine and control them with human logic to reduce complex circuitry of entire system. To eliminate the high costs associated with inflexible, relay- controlled systems. Ladder Logic Programming language used to represent electrical sequences of operations. Plc is designed to provide flexibility in control based programming. Proteus is the software used for our simulation. This is easy to construct and provides faster results. The allowable use of LEDs are another major tool to employ this software in simulation. As a whole it is the best operation for the interaction between hardware and software for controlling the belt conveyor faults automatically. Fig 3 shows the simulation results.

VII. SIMULATION RESULTS

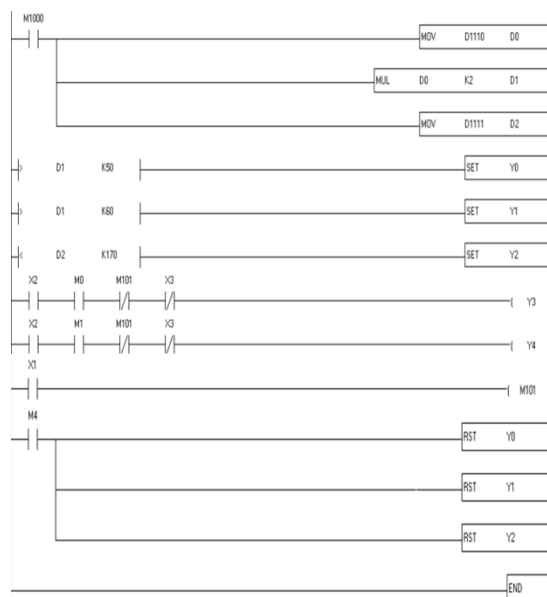


Fig 3:Simulation output

The switch which is to be kept ON always in order to give a continuous supply for the sensors to sense the faults in the belt conveyor. The temperature sensor and oil level detector are taken as analogue signal, while the ultrasonic sensor is taken as digital signal since there is no variation in it. The belt conveyor gets ON only if three conditions are satisfied that is (a)whether the ultrasonic sensor is sensing continuously,(b)whether the forward and reverse direction of the belt conveyor is satisfied,(c)whether the oil level in the tank which is kept in Low Tension motor is at a particular level, if all these conditions are satisfied the motor will start to run. The temperature at normal level will not show any detection and the belt conveyor runs normally, when the temperature reached 45° C, the LED showed low fire and the motor stopped running. The temperature till 60° C the buzzer indicates a medium fire and if exceeded shows high fire.

The Ultrasonic sensor will detect the belt conveyor by transmitting and receiving the signal continuously. If the tear up occurs in the belt conveyor, the sensor will not receive the signal which is transmitted to the belt conveyor hence the sensor will give the output which will be send to the plc for controlling. The oil level can be detected by the level sensor, if there is a decrease in the level of oil below a particular level, the sensor will give the output in the form of buzzer to the plc for controlling the fault.



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VIII. CONCLUSION

Belt conveyor in Thermal Power Plant will be controlled using Programmable Logic Controller, sensors and Ultrasonic detectors, etc. In the point of view of reducing human errors, PLCs are important part to design with more reliable and less power consumption for conveyor control operations. This proposal gives better accuracy, reliable operation in Real-time where the human life is very important that, it protects them from a major risk during fault condition. This proposal is automatic fault detector in the conveyor. Thus the control and monitoring process is done to protect the coal conveyor.

ACKNOWLEDGEMENT

We represent our gratefulness to North Chennai Thermal Power Plant where we were permitted to do our project and to Mr.G.Prabakar who guided us to complete our project in a good and successful manner.

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