

PLC BASED COAL CONVEYOR AUTOMATION AND SCADA

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Abstract: This paper focus on implementation modern PLC technology in coal transportation area where coal level detection is an important aspect to improve coal handling system in thermal power plants and coal mining areas. for this real time operation of coal handling and coal level detection in storage tanks, the modern PLC technology uses wide range feedback sensors and perform automatic operation in respective areas. The coal handling and segregation of coal impurity from coal and safe operation are summed up and the whole system is monitored and controlled by PLC technology. Our project uses an LDR sensors for coal level detection, proximity sensor and electro magnet for detection and removal of metallic impurities from coal conveyor and PLC which controls the system operation

Keywords: Automation, real time operation, level detection, Feedback sensors, Programmable logic controller, SCADA, Coal conveyor.

I. INTRODUCTION

Control engineering has been subjected to rapid change and development with new inventions and technology over period of time. In the past, humans were main source for controlling a system. More recently, by the use of electricity human work was replaced by relays. These relays allow power to be switched on and off without a mechanical switch. It is common to use relay to make simple logical control decisions. The development in PLC technology began in the year 1970 and still being developed to provide low cost operation. Because of the wide range of features and operational capabilities of PLC, PLC has become common choice in the industries.

II. CURRENT SCENARIO OF COAL MINING AREA

A Thermal power plants and coal mining areas typically has storage tanks, bunkers and stockpiles where coal is stored. the actual present situation in most of the mining areas, due to lack of infrastructure and automation ,human workforce is continuously engaged in separating coal impurities from coal and keeping continuous watch on coal level storage tank. In the coal mining areas large amount of expenditure is spent on the coal quality monitoring. The surrounding atmosphere near the coal mining area contains hazardous chemicals and gaseous which are harmful to the health of the labors. During digging coal from the earth, metal particles get mixed up in the coal, also while transporting the coal the coal dealers introduced other impurities to the coal for increasing the weight of the coal for gaining he profits. This reduces the quality of the coal. When metal get introduced in the coal crusher then crusher draws large amount of current to increase the torque. this large inrush of the current into the

windings may cause excessive heating and there are possibilities of burning of the winding causing heavy damage to the motor hence it is very important to provide quality coal to the crusher and furnace.



Fig 1. coal conveyor

III. PLC SYSTEM

PLC (A programmable logic controller) is an industrial computer control system that continuously monitors the state of the input devices and makes decision based on the custom program to control the state of the output devices. the first PLC offered relay functionality, thus replacing original hardware relay logic, which used electrically operated device to mechanically switch electrical circuits. they met the requirement of modularity expandability, programmability and ease of use in an industrial environment. the PLC wiring can be easily understood and are being easily installed, use less space. PLC system is widely used in food processing, pulp, metals, beverage and manufacturing industries, etc.

IV. PLC ARCHITECTURE

PLC is designed with its input/output module that continuously monitors the status in input devices connected, a programmable memory, processor and the power supply.

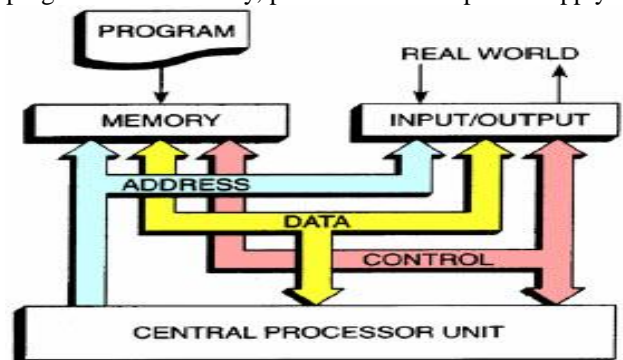


Fig 2: PLC Architecture

A) INPUT/OUTPUT MODULE: the input module has terminal into which outside process electrical signal generated by sensor or transducer are entered. The output module has terminal to which output signal are sent to actuate relays, solenoids, various, solid state switching, devices, motors etc. Mainly input/output modules provides electronic isolation between CPU and input/output devices to protect CPU from electrical surges. the input module converts input signal into low dc level usable by CPU and output module converts low dc level into usable by output devices.

B) PROCESSOR: central processing unit is the brain of the system. it consist of microprocessor, memory and power supply. Microprocessor carries out all the mathematical and logical operation and reads the status of the connected input devices.

C) MEMORY: memory stores the program data and instruction that executes the control program. the old PLC used non volatile magnetic memory but new generation PLC provide battery backup RAM or other non volatile flash memory.

D) POWER SUPPLY: power supply is needed to provide power to PLC and any other module

V. PLC PROGRAMMING

PLC program are typically written in special application software on a personal computer then program can be downloaded into the PLC by direct communication cable or via network to the PLC. while ladder logic is the most commonly used PLC programming language, it is not the only one .the modern PLC can be programmed in variety of ways from ladder logic to programming language such as BASIC & C. the five programming language defined by international standard IEC 61131-3 for PLC are:

- 1) FBD: function block diagram. 2) ST: structure text 3) IL: instruction list 4) LD: ladder diagram 5) Sequential function chart

VI. LADDER DIAGRAM

Ladder logic is a graphical programming language .ladder logic can be though of as a rule based language rather than procedural language. A rung in a ladder represents a rule, when implemented in PLC, the rules are typically executed sequentially by software in continues loop(scan).ladder logic has contact that makes or breaks circuit to control coils. the coils may represent a physical output which operates some device connected to PLC. ladder program process inputs at the beginning of a scan and output at the end of the scan .each rung on ladder diagram represents an operation on control process. the processor scans the ladder program and evaluates the logical continuity of each rung referring the input condition .if the input conditions are met then output will turn on(1) and if condition are not met then output will turn off(0)

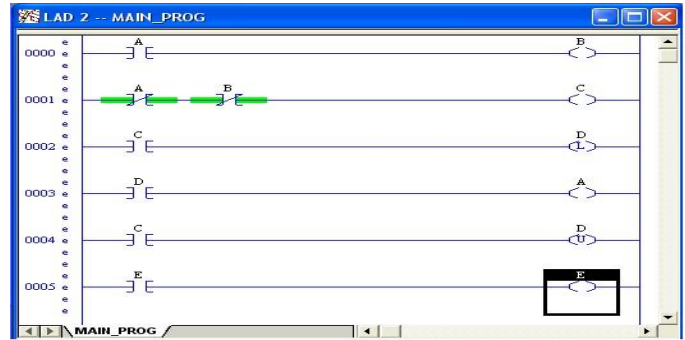


Fig3: ladder diagram

VII. PLC SOFTWARE

PLC software are mainly vendors dependent and varies from manufacturer to manufacturer. not only on vendors but also on its model type and series. even for vendor is same the application software is different for various models. for PICO controller we use pico soft software that lets you to create, save, simulate, document and transfer circuit diagrams to pico controller. built in simulation capabilities lets you to test the validity of your program. picosoft pro programming software offers additional functionality programming ease for picoGFX controller. for higher models RSLogix is used as a programming software.

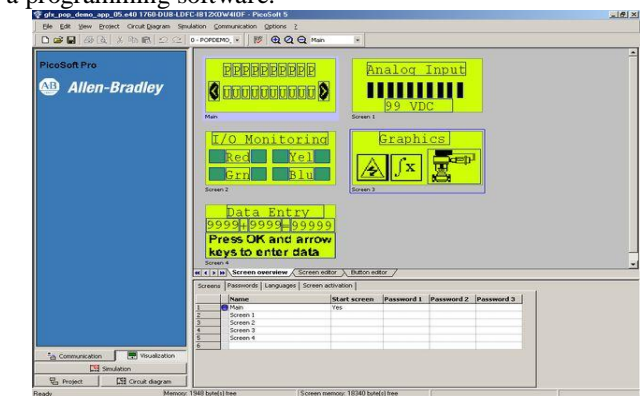


Fig 4: Picosoft software

Communication: PLC have built in communication ports, usually 9-pin RS232, RS-485, ETHERNET, and various protocols are usually included many of these protocols are vendor specific. Modern PLC is capable to communicate over network to some other system.

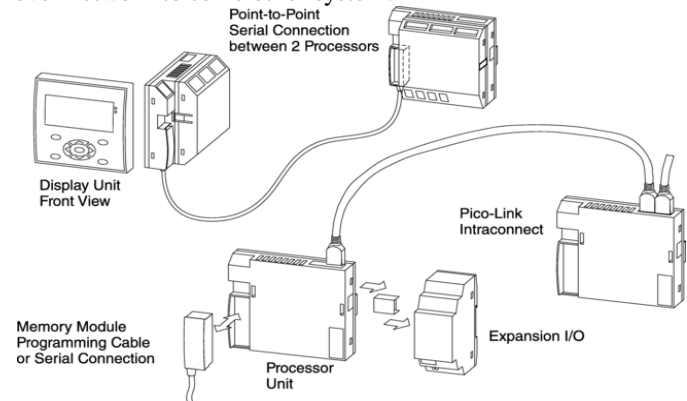


fig 5: communication ports

VIII. INPUT/OUTPUT DEVICES

A) Proximity sensor: A proximity sensor is a sensor able to detect the presence of the near by object without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation and identifies the changes occurring respective to original field emitted. different proximity sensors are available in market for various material detection. different proximity sensors are available in market for various material detection. for example capacitive and photoelectric sensors are used for non metallic target; where as an inductive proximity sensor is used for metallic target. in our project we have used Dolphin India M30 inductive proximity sensor having sensing range of 30mm to detect the metal in the coal.



Fig 6: proximity sensor

B) LDR sensor: in our project we have used LDR sensor to detect the coal level in the storage tanks. A light dependent resistor (LDR) is a device whose resistivity is a function of the incident electromagnetic radiation hence an light sensitive device. When light falls on the LDR then its resistance decreases which results in the increase in the voltage at pin 2 of the IC555. IC555 has built in comparator that compares the input voltage at pin 2 and 1/3rd of the power supply voltage. when input falls below the 1/3rd of the power supply then output is high otherwise it is set low. so in brightness input voltage rises so we obtain no positive voltage at the output of pin3 to drive the relay or LED. besides in poor light condition we get output to energize.

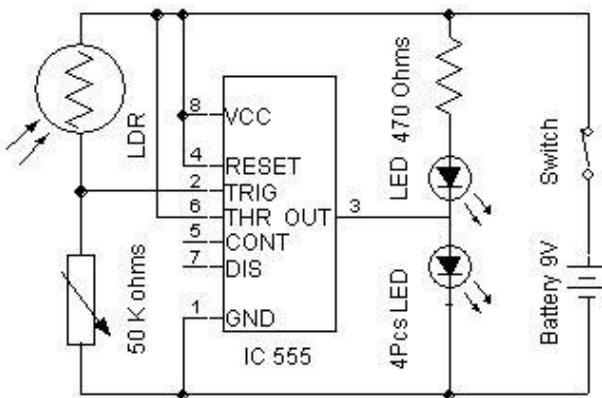


Fig 7: LDR sensor circuit diagram

C) Output Devices: some of the commonly controlled devices are motors, solenoids, relays, indicators, buzzers, transistors etc. output from the PLC are often relays, but they

can also be solid state electronics such as transistors for DC output or TRIACS for AC output. in our project we have used 100RPM Johnson dc motor have torque of 10 kg/cm.



Fig 8. DC motor

IX. METHODOLOGY

The working of our project summed up by the two operations. The first operation is based on the removal of the metal impurities from the coal passing through coal conveyor belt for which we used inductive proximity sensors for metal detection and the electromagnet for removing the metallic elements. the second operation is based on the monitoring the coal level in the storage tank by locating LDR sensors at different height in the coal storage tanks giving out the signal to PLC for start and stop of the conveyor motor.

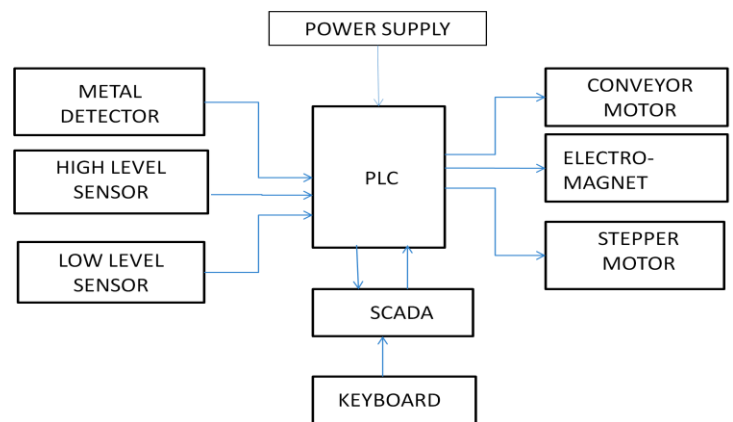


Fig 9. block diagram

X. SCADA

SCADA (supervisory control and data acquisition) is a monitoring system that communicates and operates over special communication channel. SCADA is the technology that enables a user to collect data from one or more distance facilities and send limited control instruction to these facilities. it allows operator in centrally wide distributed area such as an oil or gas field area to operate the valves switches from single control room. SCADA system is accompanied with master terminal units and remote terminal units and proper communication channel. the master terminal unit presents the data to operator by collecting the data from the remote terminal units located at the remote site over a communication channel.

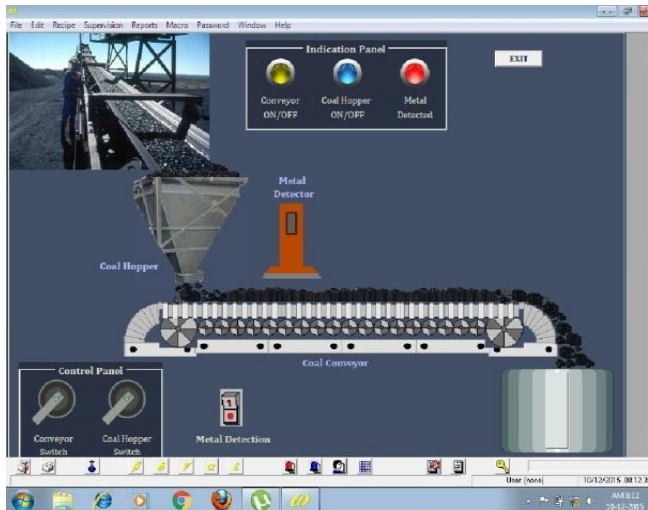


Fig 10: Coal handling SCADA system

XI. CONCLUSION

Thus with the adaption of modern PLC technology the coal level in the storage tanks can be well controlled by the PLC without introducing the external human errors. the main objective behind the project is to avoid the use of human workforce in the hazardous remote field. hence though the project model is designed keeping in mind about the need for mining area and thermal power plant, the use of this technology can also be extended for implementing in the other process industries and further research application as well.

XII. ACKNOWLEDGMENT

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