A Review on Topologies for PLC Control Panel for Special Purpose Machine

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ABSTRACT :- An Industrial Control Panel (ICP) can be defined as an assembly of a systematic and standard arrangement of two or more components such as motor controllers, overload relay, fuse disconnect switches, circuit breakers and other related control devices including pushbuttons, selector switches, timers, switches, with associated wiring, terminal blocks, pilot lights and many more similar components .Its is possible to track, disconnect or isolate a part or whole of the electric circuit with the support of control panel. These control panels can be used in households and businesses, power grids, various industries and a number of other establishment.

The use of special purpose machine (SPM) and automation minimizes possibility of human error and reduces human fatigue in carrying out repetitive operations. It also assures the quality and interchange ability of parts, by carrying out same designed process each time without shortcuts. The SPM are generally product specific and they are required to be designed and developed for each specific requirement.

KEYWORDS: Automation, Logic Control, PLC, Components.

I.INTRODUCTION

When installing a PLC for use in a control panel and for a factory floor application, the total hardware configuration must be considered. Questions such as how the PLC will fit in the panel, what to include, and how to wire it must be considered. Power must be furnished to the components at the correct voltage and sufficient current. The environment of the control panel may need to be considered as well, whether it will need heat or coolant, protection from moisture or other foreign material. Power may be furnished to the control panel at 120 VAC. Voltage may be exposed at terminals if the design is not finger-safe. Other control panels use 24 VDC exclusively. A majority of student trainer models use 24 VDC since it is much safer for the student to wire I/O without much fear of electrical shock. Trainers used in schools usually have a 24 VDC power supply.

Other devices found in control panels and on most trainers are terminal strips, push buttons, pilot lights, switches, a safety disconnect switch, and of course a PLC. Some control panels have a MCR (master control relay) which has the purpose of shutting down the entire panel if the MCR is not engaged. Most trainers and control panels have either fuses or circuit breakers for circuit protection.
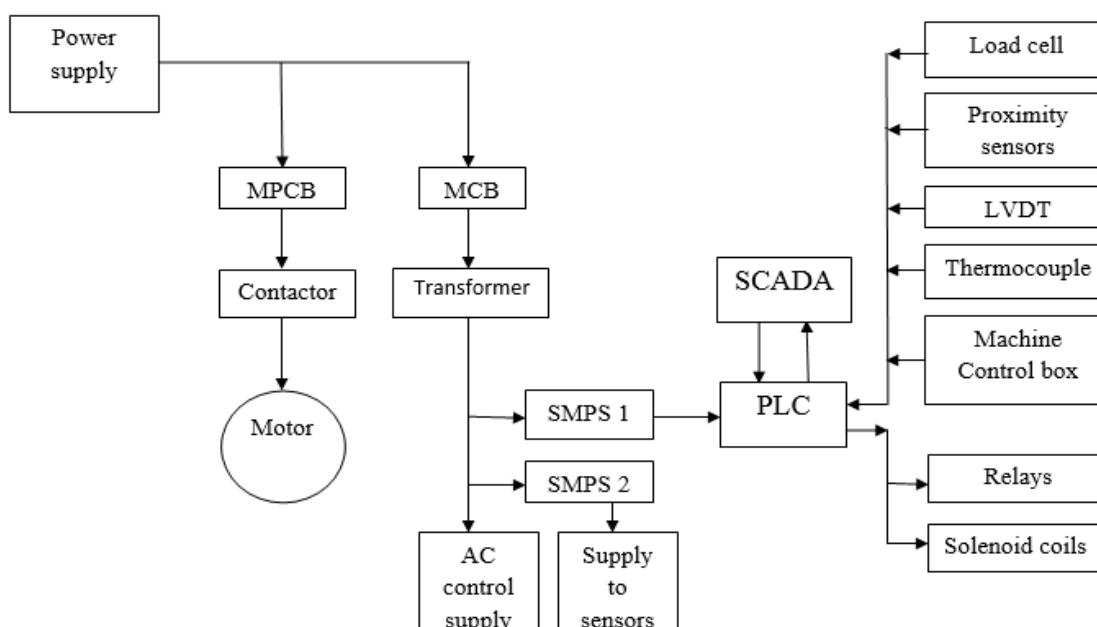
II.BLOCK DIAGRAM

FIG 1: BLOCK DIAGRAM

MCB:
MCBs or Miniature Circuit Breakers are electromechanical devices which protect an electrical circuit from an over current. The over current, in an electrical circuit, may result from short circuit, overload or faulty design. An MCB is a better alternative to a Fuse since it does not require replacement once an overload is detected. Unlike fuse, an MCB can be easily reset and thus offers improved operational safety and greater convenience without incurring large operating cost. The principal of operation is simple. An MCB functions by interrupting the continuity of electrical flow through the circuit once a fault is detected.

CONTACTOR:
A contactor is an electrically controlled switch used for switching an electrical power circuit, similar to a relay except with higher current ratings and a few other differences .Contactors typically have multiple contacts, and those contacts are usually normally-open, so that power to the load is shut off when the coil is de-energized .Perhaps the most common industrial use for contactors is the control of electric motors.

CONTROL TRANSFORMER:
A control transformer, (also known as an industrial control transformer, or a control power transformer, or even a machine tool transformer), is essentially an isolation transformer that provides excellent voltage regulation. A control transformer is very often designed to produce a high level of secondary voltage stability during brief periods of overload condition, typically known as inrush current.

SMPS:
The electronic power supply integrated with the switching regulator for converting the electrical power efficiently from one form to another form with desired characteristics is called as Switch-mode power supply. It is used to obtain

regulated DC output voltage from unregulated AC or DC input voltage. A switched-mode power supply (SMPS) is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies, and storage components such as inductors or capacitors to supply power when the switching device is in its non-conduction state.

RELAY:
A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit .When there is current through the coil of wire on the control side a magnetic field is produced. This magnetic field attracts the armature and closes the contacts on the load side. In normally open (NO) relay the contacts are in normally open state. When the coil is energized the contacts are closed .In normally closed (NC) relay the contacts are in normally closed state. When the coil is energized the contacts are opened.

PROXIMITY SENSOR:
A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact .A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensors target.

LVDT:
The term LVDT stands for the linear variable differential transformer. It is the most widely used inductive transducer that convert the linear motion into the electrical signals. LVDT works under the principle of mutual induction, and the displacement which is a non-electrical energy is converted into an electrical energy. The output voltage of an LVDT is linear function of core displacement.

LOAD CELL:
Load cell is a type of transducer which performs the functionality of converting force into an electric output which can be measured. Piezoelectric load cells work on the same principle of deformation as the strain gauge load cells, but a voltage output is generated by the basic piezoelectric material - proportional to the deformation of load cell. The acting pressure was displayed in special meter.

PLC:
Programmable Logic Controller (PLC) is a digital computer used for the automation of various electromechanical processes in industries, such as control of machinery on factory assembly lines. These controllers are specially designed to survive in harsh situations and shielded from heat, cold, dust, and moisture etc. PLC consists of a microprocessor which is programmed using the computer language. The program is written on a computer and is downloaded to the PLC via cable. These loaded programs are stored in non – volatile memory of the PLC. During the transition of relay control panels to PLC, the hard wired relay logic was exchanged for the program fed by the user. A visual programming language known as the Ladder Logic was created to program the PLC .The analog and digital input modules are connected to plc for connecting LVDT and load cell.

III.CHALLENGES

OVERSIZED BREAKER OR FUSES:
Sometimes this problem is called "overfusing". this condition occurs whenever a load carrying wire is undersized when compared to the rating of the fuse or breaker to which it is connected. This condition can be very serious and has potential to burn down a industry.

TEMPERATURE AND HUMIDITY:
Rules for construction of a control panel were concentrates on issues that must be considered if the PLC application is to work properly. For example, it is important to consider the temperature inside and outside the control panel housing the PLC. When the panel enclosure is installed, the temperature might be in the 70 degree range. However, during the

course of a year, many enclosures are subjected to very hot or very cold temperatures causing electronics to potentially fail. If a panel is not adequately heated in northern climates, the electronics will stop working. Interestingly enough, the panels controlling oil through the Alaska pipeline were not heated. They are very well insulated however, and the heat from the PLC was adequate to keep the PLC and the other enclosure contents running. If one of these PLCs lost power, it was very difficult to re-start the panel since the power supply attached to the PLC would not turn on if the temperature was very low. Electricians used blow torches to heat the panel until the PLC was warm enough to restart. Heat generated from the power supply warmed the electronics inside the panel. Then the door could be closed and the system restarted

Moisture and humidity may be a problem as well. Remember that water condenses at the surface of a wall where hot moist air meets cold dry air. If this occurs, the outside or inside of a panel will sweat and accumulate water. Also, water may enter a panel through conduit from above based on the same condensation process. Use of water barriers helps protect a panel from this situation. Meyer Hubs are a specific type of conduit condensate protection. If a food application is being planned, do not forget the use of water hoses on a panel. The best panel must be well planned to protect from the effects of high pressure water spray.

CORROSION:

Corrosion is probably the most common problem, and it ranges from very minimal to very excessive. Any source of moisture, such as humidity or even a steady dripping of water entering from main service wire ,can do a whole lot of serious damage to electrical control panel

IV. CONCLUSION

Thus in all industries many manual operations are done and many accidents also according for the operators and thus it cannot be avoided at any situations. We can make the manual operations by automatic and thus it reduces the manual operations as well as the accidents occurring to the operators can be avoided. The PLC operation involves the operation with SCADA which is very easy to operate from a personal computer itself. Thus the operating time also get reduced with high production. Today industrial automation software requirements include capability to implement application involving widely distributed devices, high reuse of software components, formal verification that specifications are fulfilled.

REFERENCES

1. Erickson,K.T.(1996) 'programmable logic controller' .potential IEEE,Vol.5,pp.14-17
2. RathodBalasahepS,Sathish.M.Rajmane 'A case Study on design of a flywheel for punching press operation' IJEAT, Vol.3,april-2013
3. Flochova,J, Auxt,F ,May2007, "decision and control",IEEE transactions on automation design,vol.46,no.pp.1874-1879
4. Frank D.Petruzella ," programmable logic controller", Tata Mcgraw Hill,3rd edition,2005
5. 'Omran selection guide', vol.3-2013
6. 'Power engineering guide-Siemens' edition 8.0
7. www.electrical4u.com
8. www.electrical-engineering-portal.com
9. www.indiapowerhouse.com