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DESIGN AND IMPLEMENTATION OF FIELD BUS REMOTE PLC FOR WHEEL FORMATION PRESS

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Abstract — Automation is basically the delegation of human control function to technical equipment, aimed to achieve higher productivity, superior quality and efficient use of energy and raw materials. Now-a-days PLC serves this purpose. PLC is an industrial computer that monitors input, makes decision based on its program and controls output to automate a process or machine. It is designed for multiple input and output arrangements, extended temperature ranges, immunity to electrical noise and resistant to vibration and impact. It can be effectively used in applications ranging from simple control such as small number of relay to complex automation system. The PLC used in this project is micro PLC of the SIEMENS Company's SIEMANTIC S71200. The operation can be done through control panel. A control panel is an area where control or monitoring instruments are displayed. Conventional control panel are most often equipped with push buttons and analogue instruments, whereas today in many cases touch screens are used to monitor are display the output. This control panel is designed to control the 25 ton car wheel formation press which has five motors for press and two pumps for hydraulic function and lubrication. Roll former press for wheel formation purpose are used. As PLC is a real time system, it is most suitable for flexible and accurate operation of the machine.

Keywords — Programmed Logic and controlled, Variable Frequency Drive, Totally Integrated automation, Human Machine Interface, Hydraulic press.

I. INTRODUCTION

Wheel formation press are using for 25 tons to make a rim. It makes up the outer circular design of the wheel on which the inside of the tire is mounted on vehicle. Hydraulic pressis consists oil tank, pneumatic cylinder, oil pump, solenoid valves, etc. The hydraulic press is entirely controlled by PLC. In control panel consists PLC kit, relays, MCB, MPCB, and SMPS. Human machine interface is used to monitoring and view the current position of the hydraulic press.

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II. SYSTEM BLOCK DIAGRAM

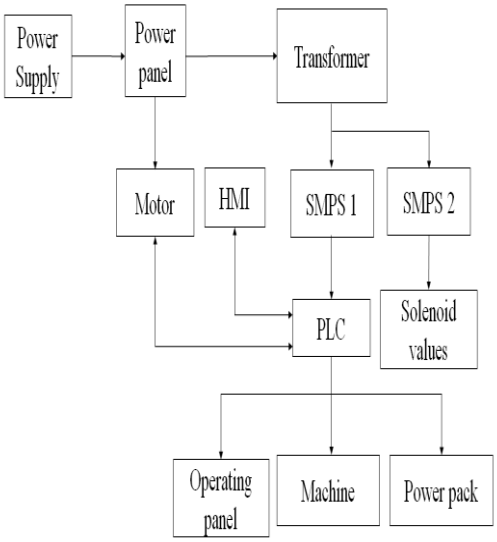

Figure 2.1 : Functional diagram

1) Motor protection circuit breaker

Motor protection circuit breaker is a combination protection unit comprising the function of a switch, a short circuit protective device and an over load relay. They are designed for various current rating to suit different capacity motors.

The MPCBs may be combined with a magnetic contactor to provide two component combination starters and with the addition of an overload relay. They generally provide contacts to indicate (Trip,

Not tripped) and also axillaries contacts normally open closed-operational range usually from 0.11A to 100A and this is usually adjustable from the front of the unit as opposed to MCB which are generally set. They are also more expensive.

2) Miniature Circuit Breaker

MCB is a protecting device. It is used before the feeder. This should be selected according to the capacity of the feeder. The function of a CB is to make a breaker box used in an industrial live wire in a circuit breaker box.Nowadays we use more commonly Miniature Circuit Breaker or MCB in low voltage electrical network instead of fuse. The MCB has some advantages compared to fuse.

3) Moulded Case Circuit Breaker

In most of the cable the MCCB used as income for higher capacity feeder for better protection. MCCB are CB where their current carrying parts, mechanism and trip device are completely contained within a moulded case of insulating materials. MCCB are available in various frame size with various interrupting rating for each frame size. MCCB are designed to provide circuit protection for low voltage distribution system. They protect connect device against over load and/or short circuit.

4) Contactor

Contactor is an essential component in the control panel. It actuates when the signal from the controller (PLC, relay logic) comes it is similar to relay. It is also consist of relay. It is used for a high load. Contactor the black colour Centre button in the contactor closes inside when supply enter into the contactor according to the program given in the PLC.

5) Relay

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. Protective relays which can prevent equipment damage by detecting electrical abnormalities, including over current, under current, over loads and reverse currents. In addition, relays are also widely used to switch starting coils, heating elements, pilot lights and audible alarms. Solid state relays used here. With SSR, there are no contacts and switching is totally electronics.

6) Switched Mode Power Supply

The switched mode power supply converts the available unregulated ac or dc input voltage to a regulated dc output voltage. However in case of SMPS with input supply drawn from the ac mains, the input voltage is rectified and filtered using a capacitor at the rectifier output. There are several different topologies for the switched mode power supply circuits. Some popular ones are: fly back, forward push–pull cuk, epic, half bridge and H-bridge circuits. Switched-mode power supplies have applications in various areas.

7) Induction motor

An induction motor or asynchronous motor is an AC electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. An induction motor can therefore be made without electrical connections to the rotor. An induction motor's rotor can be either wound type or squirrel-cage type.

A squirrel-cage rotor is the rotating part of the common squirrel-cage induction motor. It consists of a cylinder of steel laminations, with aluminum or copper conductors embedded in its surface. In operation, the non-rotating stator winding is connected to an alternating current power source; the alternating current in the stator produces a rotating magnetic field. The rotor winding has current induced in it by the stator field, and produces its own magnetic field. The interaction of the two sources of magnetic field produces torque on the rotor.

8) Variable-Frequency Drive

A Variable Frequency Drive (VFD) is a type of motor controller that drives an electric motor by varying the frequency and voltage supplied to the electric motor. Other names for a VFD are variable speed drive, adjustable speed drive, adjustable frequency drive, AC drive, Micro drive, and inverter.

VFDs are used in applications ranging from small appliances to large compressors. About 25% of the world's electrical energy is consumed by electric motors in industrial applications, which can be more efficient when using VFDs in centrifugal load service. The AC electric motor used in a VFD system is usually phase induction. Some types of single-phase motors or synchronous motors advantageous in some situations can be used, but three-phase induction motors are generally preferred as the most economical motor choice. Motors that are designed for fixed-speed operation are often used.

9) 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.

10) 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.

11) 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 proximity sensor.

III. CONTROL PANEL

Control panel is a cabinet which contain electrical components to control the functioning of machine and PLC sequence for all types of equipment.

A panel board is an element of a system used to supply electricity .primary function is to divide an electrical feed into supplementary circuits while providing shielding and protection for each circuit in an enclosed space. Panel board is tend to made up of circuit breaker, bus bars, switches, relays and other protective equipment's. The panel board consists MS channel to place the components and PVC channels to provide wiring.

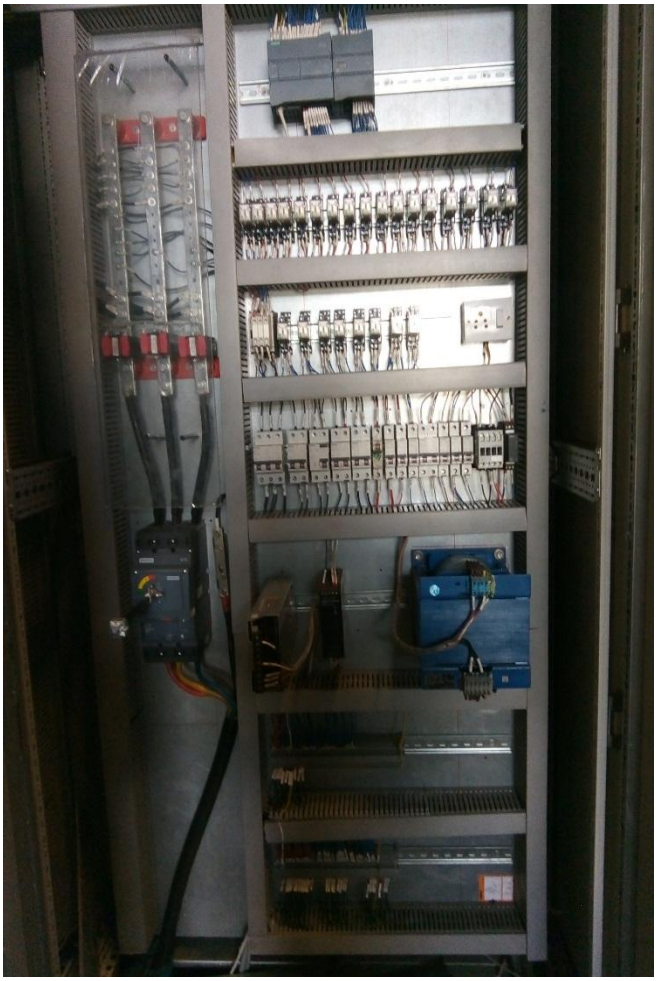

Figure 3.1 :Control panel picture PLC side

Figure 3.2 : Panel protection side

IV. SOFTWARE DETAILS

The software used in the proposed system of our project is TIA (Total Integrated Automation) V13. It is an overall project management tool that allows for complete system (multiple controller, HMIs, networks, DCSs, etc.,) to be programmed, monitored, saved and stored all in one software package. In this project tools two types of standards package 1 and package 2 are using. The user-friendly and involved operability of the TIA portable as well as the integrated system diagnostic contribute to efficiency working. And easily communication, high efficiency now days trending upgraded communication.

A. Design steps of TIA-V13

Step1: Start
Step2: Create a new project
Step3: Add devices
Step4: Device configuration
Step5: Communication through Ethernet
Step6: Program downloading
Step7: Program executing in machine
Step8: Stop

B. Ladder logic program

Ladder logic was originally a written method to document the design and construction of relay racks as used in manufacturing and process control. Ladder logic is widely used to program PLCs, where sequential control of a process or manufacturing operation is required.

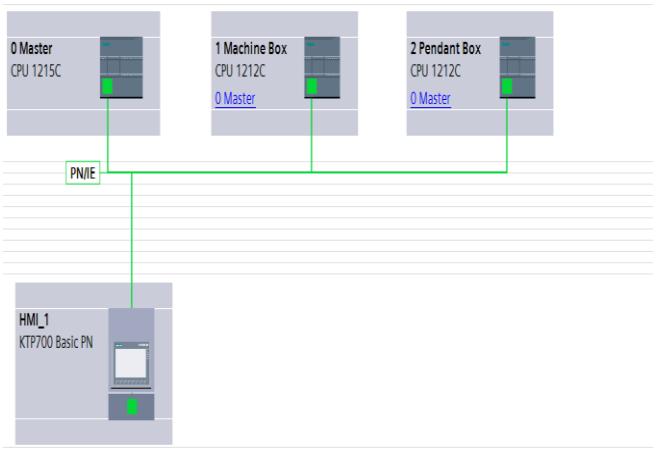

Figure 4.1 : TIA Portal

1) Auto cycle start

The auto or manual mode was decided by using the selector switch. When auto mode was selected the PLC enables the auto cycle. The wheel formation was placed in the die and the auto cycle was started.

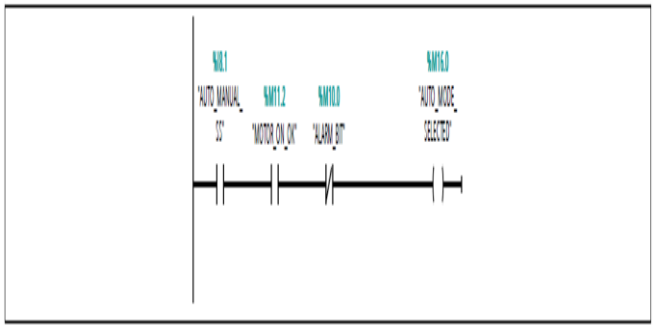

Figure 4.2 : Ladder logic for auto cycle start

2) Main ram up

When the machine is ready for the cycle, the PLC enables the output to the loading valve. So that the

main ram starts to move up. The program was adjusted change the speed of the main ram.

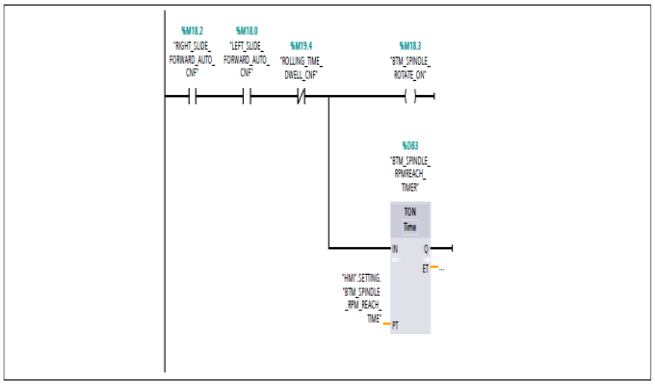

Figure 4.3 : Ladder logic for main ram up

3) Pressing on

On reaching the proximity sensor mounted on the machine, the signal is sent to the PLC. Now the ram starts pressing the material at the specified pressure after receiving signal from proximity sensor mounted. The pressure can be up to 210 bars.

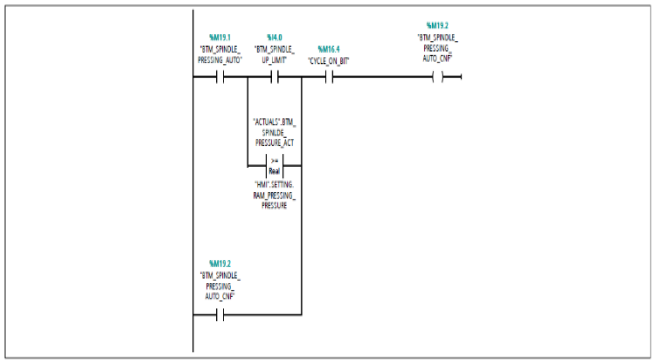

Figure 4.4 : Ladder logic for pressing on

4) Rolling dwell time

The actual pressure applied was measured by rolling dwell and sent to the PLC. It compares the actual pressure applied with reference value. When pressure acting equal with reference it stops the pressing.

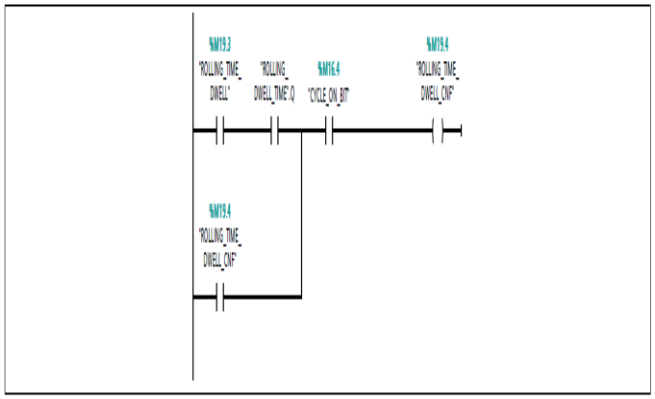

Figure 4.5 : Ladder logic for rolling dwell time

5) Main ram down

After the decompression process, the main ram is moved down to its original position. It is confirmed by proximity sensor mounted on the top.

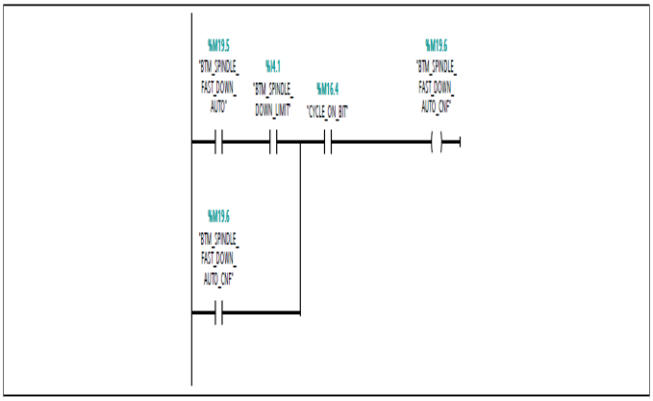

Figure 4.6 : Ladder logic for main ram down

6) Loader out confirm

After all the process the loader out was completed, and the machine is ready for next cycle.

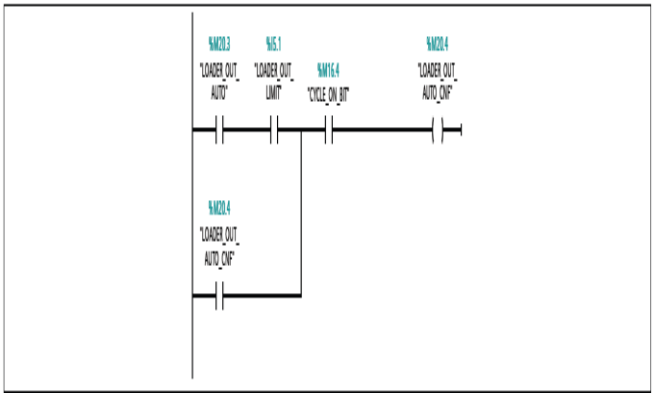

Figure 4.7 : Ladder logic for loader out confirm

7) Cycle end

The cycle end process is end of the ejector the material.

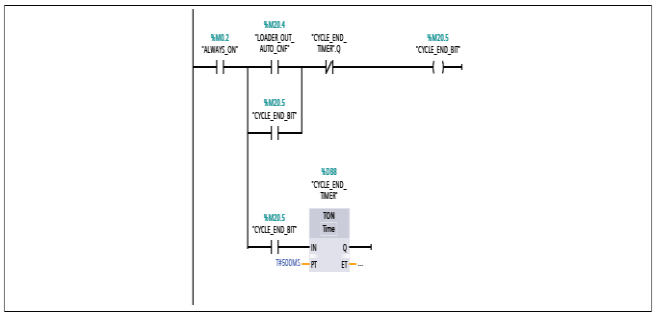

Figure 4.8 : Ladder logic for cycle end

V. RESULT OF PRODUCT

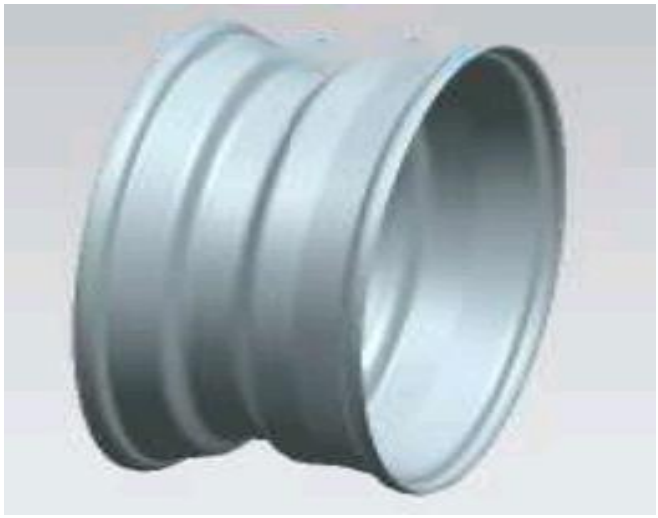

Figure 5.1 : Result of product

VI. CONCLUSION

Previous days the industrial machines operating in manual. In manual operation occurred in many accident So we can help of automation operation. Automation to eliminate the manual operation. The PLC operations involve master and slave communication which is easy to operate from a personal computer itself. Thus the operating time is low and also gets with high production. Existing system is used in relay control but proposed system is replacing in PLC.

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