Vol. 5, Issue. 8, 2018, ISSN 2349-0780

Automation of Hydraulic Trainer by Using Programmable Logic Controller (PLC)

Prof. Sachin Jadhav[1], Mr. Rohit Waghmare[2], Mr. Shrirang Solanke[3],

Mr. Shubham Patil[4], Mr. Nitin Patil[5]

Department of Mechanical Engineering, Dr. D. Y. Patil School of Engineering Pune.

Abstract: This paper reports design and development of PLC based controller for hydraulic Trainer. The programmable logic controller (PLC) is the central controlling unit in the system. PLC control system was design according to the control requirements to the Hydraulic system. The programmable logic controller (PLC) system will increase accuracy, precision, efficiency and reduced human intervention. It increases flexibility in process controls. The Hydraulic training system is develop to meet increasing requirement of fluid power technology. The standard Hydraulic Trainer includes human intervention and errors. These errors are reduced by Hydraulic Trainer Automation. The proposed Automation system involves opening and closing of control valves. This paper distinguishes the present Hydraulic system and Automation system. Automation is widely used in manufacturing industries.

Keywords: Automation, control system, Hydraulic system, PLC.

I. INTRODUCTION

Over the time Hydraulic systems emerged and developed rapidly mainly due to the need for high precision control. These Hydraulic systems is using mechanically adjustable on/off valves and flow control valves together with pressure switches and limit switches and etc. The Automation is done by PLC. Automation is the process of having machines follows a predetermine sequence of operation with or without human intervention in manufacturing process. The main objective of Automation is integration of process of system. Increased safety level of operator as well as system, to increased productivity, improve quality, efficiency and reduced labour cost as well as human errors. For Automation of system the basic requirements are power source, suitable inputs and outputs, proper feedback and commands. The present Automaton has taken series of transformation from PLC.

A PLC is first building block of Automation system. A PLC is special form microprocessor based controller that uses a programmable memory to store instruction and implement function such as logic, sequencing, timing, counting and arithmetic machines and processes. As illustrated in fig1.1

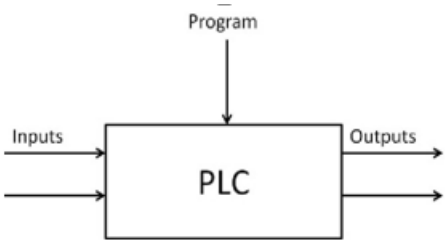

Fig.1.1 A programmable logic controller

Most PLC's are programmed using ladder logic which has its origin in wiring diagrams used to discrete physical relays and timers in control system. Initial Automation needs in the industrial process operations were driven by the needs to automate existing manual process and hence gain better yield and consistency in product quality. The technologies are available from the late 1970's fulfilled this need subsequently. The Automation needs of the industry are driven by the standards and regulations for keeping up the environmental standards. In the 1990's the safety of equipment and people become an additional requirements in the Automation plant and lead to widespread usage of the safety system and emergency shutdown and startup operation being automated. Industrial process Automation systems play a bigger role in assisting the process operations for better efficiency.

1.1 Review of existing system.

According to our review, most of the Existing Hydraulic systems in Industries in India mainly include manual operation. There are many drawbacks of these manual systems some of them are listed below:

- Low Accuracy or Repeatability in production.
- Requires skilled workers to operate the system.
- There are comparatively more possibilities of accidents.
- Manual process is time consuming process.

2. Important components of Hydraulic system

2.1. Oil Reservoir

- Main function of 'Oil Reservoir' is to store sufficient amount of hydraulic oil in system.
- To settle down the contaminants& cool the hot return oil.
- To remove air bubbles.
- To separate water from oil.

2.2. Rotary pump

- The function of Rotary pump is to pump hydraulic oil to the hydraulic circuit.
- It converts the mechanical energy into hydraulic energy.

2.3. Pressure relief valve

- It is an important component which is required for every positive displacement pump.
- This valve is connected at the outlet of pump.

2.4. Actuator

- Actuator produces work. There are two types, linear and rotary.
- Linear actuator is called cylinder and Rotary actuator is called Motor.
- Cylinder develops force and motion and converts hydraulic energy into mechanical energy.

2.5. Pressure gauge

- It is important component of hydraulic system.
- It shows the pressure reading.

- Without pressure gauge, it is not possible to make the pressure relief valve setting, unloading valve setting etc.

2.6. Directional control valve

- It controls the direction of flow of oil.

2.7. Flow control valve

- It controls the direction of flow of oil by which speed of extension or retraction of actuator is controlled.

2.8. Filter

- Main function is use to remove suspended solid contaminates from the oil and to provide clean hydraulic oil to the system.

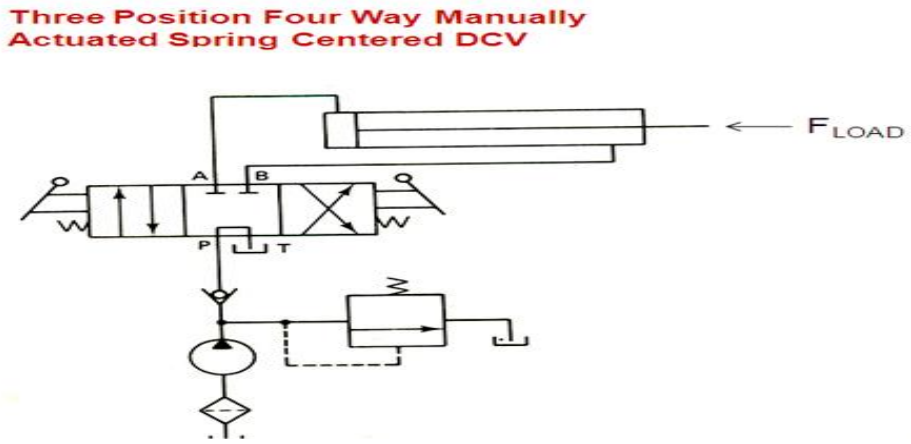

Fig. 2.1 Basic Hydraulic System

3. Programmable Logic Controller (PLC)

Programmable logic controller is globally known as 'Work Horse' of industrial automation. Its invention was to replace large sequential relay circuits for machine control. PLC's were first introduced in the late 1960's. Typically PLC system has basic functional components of processor unit, memory, power supply unit, input or output interface section, communication interface and programming device. Fig 3.1 shows basic arrangements of PLC.

PLC has four main units:

3.1. The program memory

It is the memory space where the program instructions for the logical control sequence are stored.

3.2. The Data Memory

The status of input/outputs likes, switches, previous values of data and other working data is stored.

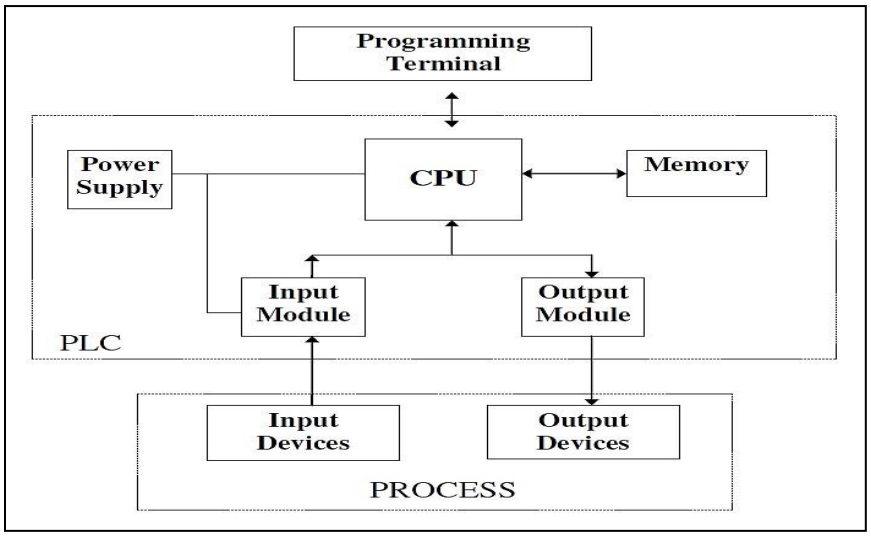

Fig.3.1 Block diagram of PLC with I/O.

3.3. The Input Devices

These are the hardware/software inputs from the field from industrial process. The signals maybe sensors, switches proximity detectors and interlock settings etc. These inputs trigger the sequences in user program as when this switch is hit by incident or accident the whole PLC process is suspended to a halt situation.

3.4. The output devices

The output ports of a PLC are of the relay type or to isolator with transistor traic types depending on the devices connected to them, which are to be switch on or off. Generally the digital signal from an output channel of a PLC is used to control an actuator, which in turn controls some process. The term actuator is used for the device that transforms the electrical signals into some more powerful action.

II. LITERATURE REVIEW

Abdul gaffer Dodd Amani, Charukeerthi [1], in this research paper they studied the various components from the field of electro hydraulic proportional and control technique as well as to provide information concerning the application in engineering concerned together with a certain amount of theoretical basics. In order to keep the explanation to generally understandable level, proportional valve and closed loop proportional valves are deals with together in same paper in order to make it easier to differentiate between these closely related techniques. The interfacing of PLC and advance hydraulic technique can replace the manual operation into automatic system. Fast and accurate position control can be achieved with the closed loop proportional control system.

Mallikarjun G.Hudedmani, Umayal R M, Shiva Kumar Kabberalli, Raghavendra Hittalamani [2] In this research paper they studied PLC is the central controlling unit in the industry or process. The effective operation of the process and safety consideration if program appropriately can meet the required objectives. The present technique paper briefly distinguishes present automation systems and the past technologies to identify and explore the capabilities of PLC's for any process. The previous system includes the human intervention and errors and these automated system reduced the human intervention and increase flexibility in process control. The PLC base automation work will surely turn the production activities into properties. The complex operation and reduction in setup time can be greatly reduced by making use of PLC based automation. The present work explored the control scheme for industrial automation and system monitoring to improve system operation, system reliability etc.

Marian Blejan, Ioana I lie, Radu Radoi, and Cornelius Cristescu[3] In this research paper they studied which implements their research about electro hydraulic system driven by control PLC's. This type of control system can be very easy to meet hydraulic process requirements, improve to the system stability, reliability and automation level. It can be integrated in a tracking IT system because it has capability for communication via Ethernet; they can be implemented in the PLC additional function, namely mount ring and control, using devices completed to the serial bus; changing of the operation algorithm only requires rewriting of the software in the PLC's, which the classic version requires hardware modification as well; the PLC that implements the automatic controller may be equip with HMI console.

Wang Hong a*[4] In this research paper they studied work piece turnover is completed automatically by the automatic turn over device in automatic production line, work piece turn over device is an important part of automatic production line. Its hydraulic system was design, its working principle was analyzed and the PLC control system was design according to the control requirements to the hydraulic system of work piece turn over. The Simon's PLC of SIMATIC S7-200 CPU266 was selected and STEP 7-Micro/WIN programming software was used to program system control process. Using PLC control hydraulic system can be very easy to meet process requirements, improve greatly the system stability, reliability, and security and automation level.

Ranjeeta Singh, H.K Verma [5] In this research paper they studied design of PLC based controller for pneumatic pressing machine and it's development, which performs the most critical operation in a engine bearing manufacturing plant. They review the manufacturing processes of engine bearings and discuss the need of automating pneumatic press. The proposed automation system involves (a) Speed control by replacing the conventional method with variable frequency drive, (b) feeder and Pusher control using PLC, (c) Fault detection and safety measures, (d) And PLC based sequential control of all the process carried out on pneumatic press. It has been evaluated by emulating PLC program on RSLogix emulate-500 and the press operation on FluidSIM-P.

III. METHODOLOGY

In Hydraulic machine, the hydraulic fluid is fed throughout the hydraulic cylinders and pressurized according to the resistance present. The fluid is controlled automatically with the help of PLC and control valves and it distributed through hoses and tubes. The hydraulic machinery is popular due to the very large amount of power that can be transferred through small tubes and flexible hoses, and this power is used by the high power density and wide array of actuators. Hydraulic machinery is operated by the use of hydraulics, where a liquid is the powering medium.

Vol. 5, Issue. 8, 2018, ISSN 2349-0780

IV. WORKING

Principle:

Pascal's Law states that the "Pressure applied to any part of a confined fluid transmits to every other part without any losses. The pressure acting with equal forces on all equal areas of the confining walls and it is perpendicular to the walls". This is the basic principle for any hydraulic system.

Operation:

Since the all hydraulic systems works on the principle of Pascal's Law, its working is similar to another hydraulic system. A hydraulic System consists of basic components that include the rotary pump, flow control valves, direction control valves, pressure relief valve, actuators, oil reservoirs, the hydraulic pipes, etc. The working of this system is very simple. Actuator produces work. There are two types, linear and rotary, linear actuator is called cylinder and Rotary actuator is called Motor. The fluid (usually oil) is poured in the cylinder having a small diameter. This cylinder is known as the slave cylinder. Cylinder develops force and motion and converts hydraulic energy into mechanical energy. The piston in this cylinder is pushed so that it compresses the fluid in it that flows through a pipe into the larger cylinder.

Proposed System Control Using PLC:

PLC is called as Programmable Logic Controller and It is used for automation of typically industrial mechanical processes, such as control of machinery on factory assembly lines. A 4/2 solenoid DCV is used in Hydraulic System and it acts as the final control element of the cylinder of the system. It is used in many industries. In this automatic control process, The movement of the solenoid valve is controlled by the limit switches, which is connected with the control unit of the PLC, when pushbutton is pressed the solenoid starts to move downward direction. The cylinder is extend. The cylinder must remain in in its extended position until it reaches the particular position, then limit switch opens the contact. Now the solenoid moves in upward. This is the automatic process which is continuously happened. The movement of the solenoid is controls by the limit switch by opening and closing. All the inputs and outputs devices are connected to the PLC. The hydraulic circuit, PLC wiring diagram and the Ladder program is analyze for getting a better understanding of the PLC - controlled hydraulic system.

Block Diagram of Proposed System:

The hydraulic circuit for the control of the double-acting cylinder consists of the 4/2-way double solenoid valve with coils Y1 and Y2. The connection of the pushbutton (PB1) and the sensor (S2) connected to the input of the PLC at addresses I1 and I2 respectively and the solenoid coils Y1 and Y2 to the output of the PLC at addresses O1 and O2 respectively as shown in the PLC wiring diagram. The ladder diagram to realize the control task is also given.

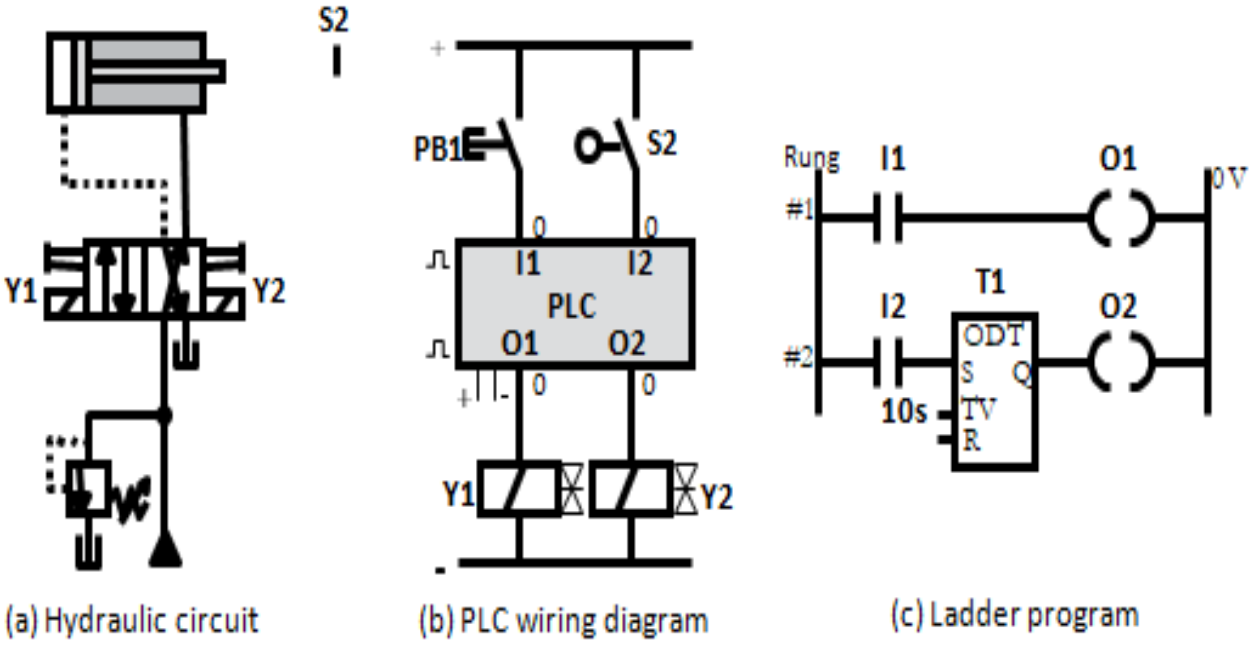

Fig. Hydraulic System with PLC Controller.

V. CONCLUSION

The proposed system provides the automatic control of hydraulic machine. The system are operating and controlled is done without any damaged. The time consumption and man power is reduced. The system designed is very precise and very easy to handling. This process can be used effectively in any automation industry.

ACKNOWLEDGMENT

We take this immense pleasure in thanking Prof. R. N. Garad, Head of the Department, Mechanical Engineering and Prof. Y. S. Gandal, Project Coordinator for permitting me to carry out this Project work. We wish to express my deep sense of gratitude to my Project Guide, Prof. Sachin Jadhav for his able guidance and useful suggestions, which helped me in completing this Project Stage I work in time. We would like to thank Dr. E. B. Khedkar, Principal, who has been a source of inspiration throughout the academics. We would also like to thank the entire Faculty Members of Mechanical Engineering for all their valuable assistance in the Project Stage I work. Finally, yet importantly, we would like to express my heartfelt thanks to all anonymous Researchers, Scientists, Engineers, my beloved Parents, my friends / Classmates for their help and wishes for the successful completion of this Project work.

REFERENCES

[1] M.V.S. Babul, A. Rama Krishna, and K.N.S. Suman, "Review of Journal Bearing Material and Current Trends," Columbia International Publishing American Journal of Material Science and Technology,2015, Vol.4 No .2,pp.72-83.
[2] Xuelin Hu.Programmable logic controller application technology. Beijing: Higher Education Press; 2007
[3] Guanghuai Wang. Application of Hydraulic technology. Harbin Institute of technology Press; 2005
[4] BoschRexroth product catalog, Electro-hydraulic and application of advanced hydraulic system.
[5] Sudeep Kelaginamane, Sridhar D.R. "PLC Based pneumatic Punching machine" Journal of Mechanical Engineering and Automation, vol 5, no (3 B), pp. 76-80, 2015.
[6] Maha M. Lash in, "Different application of PLC " International journal of computer science, engineering and information technology (IJCSEIT), vol. 4, no 1, pp. 27-32, 2014.
[7] D. V. Pushpa Latha, K. R. Sudha, Swati Devabhaktuni, "PLC based Smart Street Lighting Control" I.J. Intelligent Systems and Application, vol 06, no 1, pp. 64-72, 2013.

Author Name :

Sachin Jadhav	M.E (Design)
Rohit Waghmare	B.E (Mechanical)
Nitin Patil	B.E (Mechanical)
Shrirang Solanke	B.E (Mechanical)
Shubham Patil	B.E (Mechanical)