



# AN AUTOMATION OF RIVETING MACHINE USING PLC AND HMI

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## ABSTRACT

In the industrial area, there exists a large number of machines applying PLCs to constitute a powerful tool for automating sequential industrial processes. The functions of the proposed system includes an automatized riveting process with X/Y platform controlled by PLC based on HMI interface. The history of work piece riveting can be also recorded and tracked for the production management. The capability of the proposed method can be easily expanded to a variety of applications according to the requirements of users.

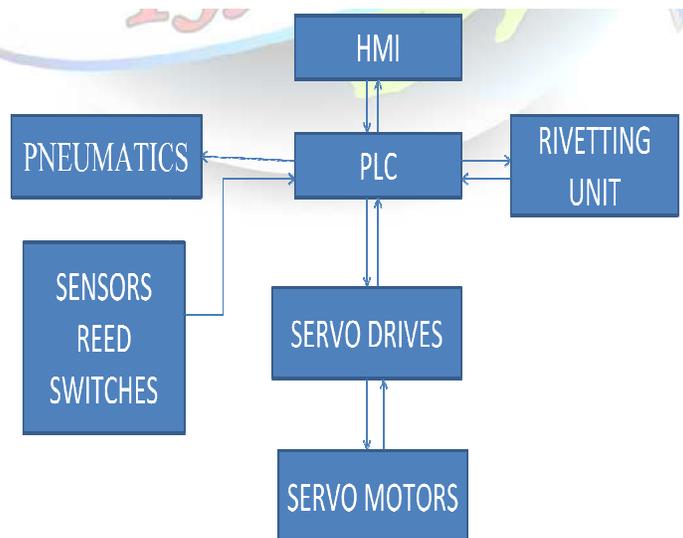
**Keywords:**-PLC,HMI.

## I.INTRODUCTION

The Riveting machines are used to automatically set rivets in order to join metallic materials together. The riveting machines offer greater consistency, productivity, and lower cost when compared to manual riveting. Automatic feed riveting machines include a hopper and feed track which automatically delivers and presents the rivet to the setting tools which overcomes the need for the operator to position the rivet. The downward force required to deform the rivet with an automatic riveting machine is created by a motor and flywheel combination, [pneumatic cylinder](#), or [hydraulic cylinder](#). Manual feed riveting machines usually have a mechanical lever to deliver the setting force from a foot [pedal](#) or hand lever.

The PLC particularly provides superiority in easy programming as well as digital communications I/O. It also presents ascendant capacity in complex sequence control functions. For this reason, the PLC like Mitsubishi series has been still widely used in modern industry. The development of fast and precise position is obtained by Human-Machine Interface (HMI). The PLC will give a good solution for the HMI sequential control in automated industry.

## II.PROPOSED METHODOLOGY



In this system PLC acts as a master which controls all the sequence of operation. HMI is front end between operator and PLC. Operator provide command to the PLC through HMI. PLC runs the sequence as per command given by operator whether it is manual operation or auto. PLC gives command to motion controller module to control axis movements of servo motors using servo drive. Pneumatics will be controlled by PLC depending on command and feedback of sensor. Proximity and reed switches provides position feedback of pneumatic cylinders. [7] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. The speed of rotation of DC motor i.e., velocity of AGV is controlled by the microprocessor controller. This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

### III. COMPONENTS REQUIRED

#### [1] CONTROL PANEL

Make: RITTAL

Specification: SIZE -760Wx760Hx300D.

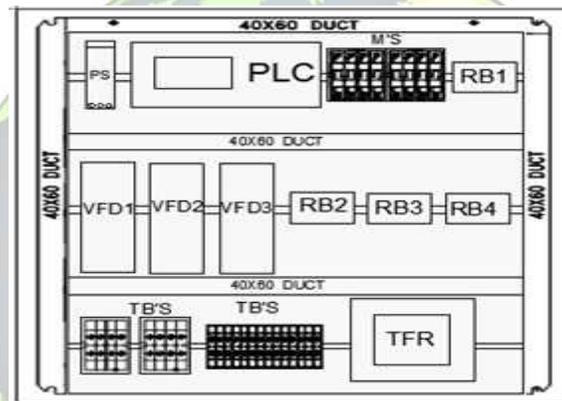


Fig. control panel

#### [2] SERVO MOTOR

A servo motor is a rotary actuator that allows for precise control of angular position .It consists of a motor coupled to a sensor for position feedback. It also requires a servo drive to complete the system.

Make: MITSUBISHI

Specification:

Voltage:2-3Kw

Speed:2000RPM



Fig. Ac servomotors

#### [3]SERVO DRIVE

A servo drive is a special electronic amplifier used to power electric servo mechanism. A servo drive monitors the feedback signal from the servo mechanism and continually adjusts for deviation from expected behavior. A servo drive receives a command signal from a control system, amplifies the signal, and transmits electric current to a servo motor in order to produce motion proportional to the command signal. A sensors attach to the servo motor reports the motors actual status back to the servo drive.



Fig.AC servo drives.

#### [4] SENSORS

##### [4.1] PROXIMITY SENSOR

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. It often emits an electromagnetic field of electromagnetic radiation. These proximity sensors operate by breaking or disturbing an air flow.



Fig. proximity sensor

##### [4.2] MAGNETIC REED SWITCHES

The reed switch is an electrical switch operated by an applied magnetic field. It consists of a pair of contacts on ferromagnetic metal reeds in a hermetically sealed glass envelope. the contacts may be normally open ,closing when a magnetic field is applied.

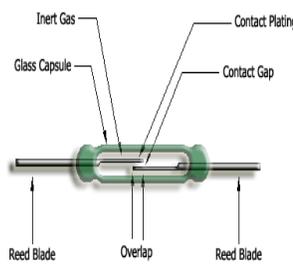


Fig. magnetic reed switches

#### [5]PNEUMATICCYLINDERS

pneumatic cylinders are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Pneumatics will be controlled by PLC depending on command and feedback of sensor. Proximity and reed switches provides position feedback of pneumatic cylinders.



Fig. pneumatic cylinders

#### [6] SWITCH MODE POWER SUPPLY [SMPS]

It is used to obtain regulated DC output voltage from unregulated AC or Dc input voltage.

**Make:** OMRON

##### Specification

- Power - 50W
- Output voltage - 24VDC
- Output current -2.1 A



Fig. Switch mode power supply.

#### [7] MINIATURE CIRCUIT BREAKER [MCB]

MCB are electromechanical devices which protect an electrical circuit from an over current.  
Make: SIEMENS.

##### Specification

- 2 POLE
- Output Current: 10 AMPS
- Output voltage: 240/415V



Fig.4.7. 2pole,10A MCB

#### [8] VARIABLE FREQUENCY DRIVE [VFD]

It is a type of adjustable speed drive used in electro mechanical drive system to control AC motor speed and torque by varying motor input frequency and voltage.

##### Specification

- Output frequency: 0.1~600Hz
- 3 points adjustable V/f curve
- Built-in PID feedback control
- RFI-switch for IT mains
- RS-485 communication interface (RJ-45) with Mod bus protocol



fig. Three points adjustable v/f curve.

#### [9] RELAY BOARD

Make: ELMEX.

##### Specification

- 8-channel, 24VDC
- 16-channel, 24VDC



fig. 8 channel relay module

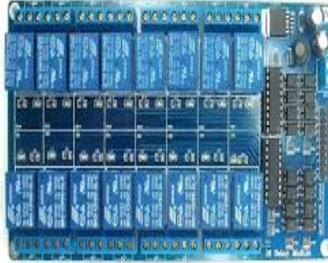
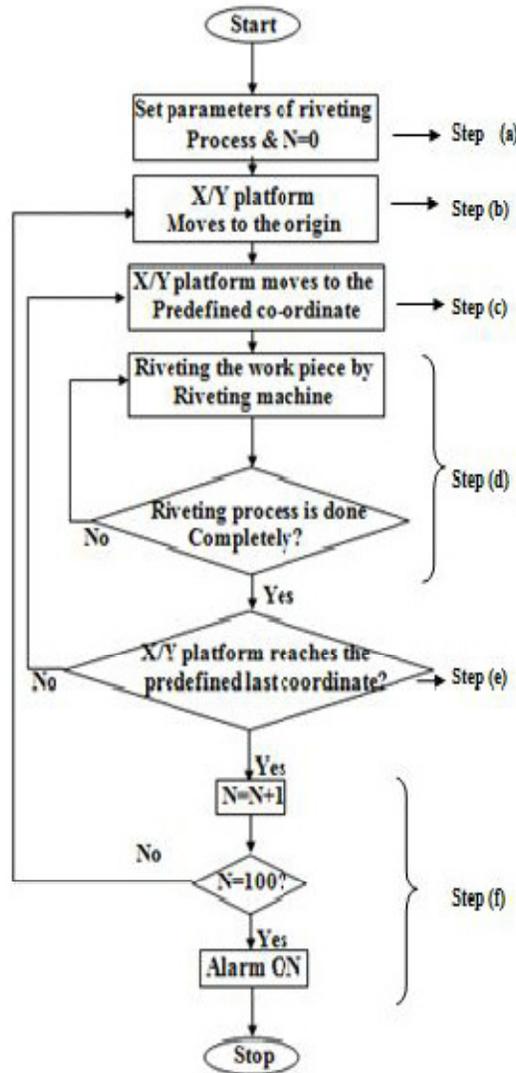


Fig.16 channel relay module

#### IV. FLOWCHART OF THE PLC PROGRAMMING FOR AUTOMATIC RIVETING PROCESS

The PLC controls the Riveting Machine as well as X/Y platform using its I/O interface. Before the riveting process, the work piece is placed on the X/Y platform table so that it can be riveted sequentially. The main procedure is briefly described as follows:

- a) Set parameters of work piece riveting process, i.e. servo motor motion parameters and predefined coordinates of riveting process. N is to count the number of riveted work pieces.
- b) The X/Y platform is set to move to the origin initially.
- c) The X/Y platform starts to move toward the predefined coordinate. For example, if there are 5 predefined locations for work piece riveting process, and the same process will be carried on sequentially from the first, second, 3<sup>rd</sup> to 5<sup>th</sup> point (location) in this case.
- d) Riveting the work piece by the riveting machine until the process is done completely.
- e) Check if the X/Y platform has finished one riveting cycle (riveting 5 points of work piece). If not, go back to Step(c).
- f) Increase the number of completed riveted work pieces. Check if it has reached the predefined number, for example N= 100. If yes, the alarm is set on to advise that the riveting job is done. Otherwise, go back to Step (b). Note N can be adjusted according to the factory's requirement.



### V. CONCLUSION

The proposed scheme can carry out both fast and accurate riveting process, monitoring and control function.

#### MERITS

- Greater consistency and productivity.
- Increase in accuracy and repeatability.
- Less human error.

#### DEMERITS

- Requirement of skilled person to handle the plant.
- High investment cost.

#### APPLICATIONS

- Automobile industry.
- Break shoe riveting.
- Riveting machines are used in a wide range of applications including brake linings for commercial vehicles, aircraft, and locomotives, textile and leather goods, metal brackets, window and door furniture, latches and even mobile phones.



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