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Automated Poka Yoke System for Geared Shaft Assembly

Tejas R Bakliwal[1], Prof. Manoj A Mechkul [2]
[1]*Department of E&TC, UG Student, College of Engineering, Chandwad, tejasbakliwal@gmail.com*
[2]*Department of E&TC, Asst. Professor, College of Engineering, Chandwad, mechkulmanoj@gmail.com*

Abstract- In this paper we propose a system using PLC (Programmable Logic Controller) & Sensors which will reduce all human errors while assembly of geared shaft in automobile industry .Every human being makes mistake in work. Traditionally managers think these are due to the carelessness of the workers. But lean manufacturing understands that large portion of these mistakes is due to the problems in the system itself. Therefore lean manufacturing needs a system which is mistake proof by nature itself. This is known as “Zero Quality Control” or “Poka-yoke”. All sensor output fed to PLC for the detection of sequence. If the sequence is OK then Pneumatic Press will be automatically operated by PLC to complete the operation. If sequence is not followed, it will not process for next operation. Thus, this simple principle can lead to massive savings in Manufacturing Industries.

Keywords- Lean manufacturing, Zero Quality Control, Poka-yoke, PLC (Programmable Logic Controller), Pneumatics, Sensor

I. INTRODUCTION

Manufacturing is an increasingly complex process yet increased quality and shorter lead times are being demanded. Customers demand quality and expect perfection. Zero Quality Control or Pokayoke System provides a complete system to control and track the quality of products throughout the manufacturing process. Poka Yoke, Japanese term meaning “mistake proofing or to avoid inadvertent errors”, assists your facility in producing world class products. In this paper I propose the system that can recognize that the worker has to pick gear as per defined sequence. Even it can recognize the position of the gear when all process is done successfully then signal send to Press to insert circlip. All sensors’ is output fed to PLC and it will detect the sequence if it is all correct i.e. OK then operation complete indicator will turn glow and process the next operation. If sequence is not followed it will not process next operation.

Our aim is to:

1. To develop an error free system which provides quick feedback early in the process, detecting localization mistakes before the application ever reached the formal testing phase.

2. To establish real - time approach which provide a simple and robust way for us to detect and correct mistakes that would have been difficult to detect through traditional system testing.

3. To design, implement and test the performance of PLC based Sequence Detection and Monitoring System.

II. SYSTEM MODEL

2.1. Basic Architecture

The whole set up includes Programmable Logic Controller (PLC), accessories connecting PLC and Sensors, IR sensors, inductive sensors, Pneumatic Press and its components, Indicator panel, and oil dispensing unit. The System Architecture is as follows:

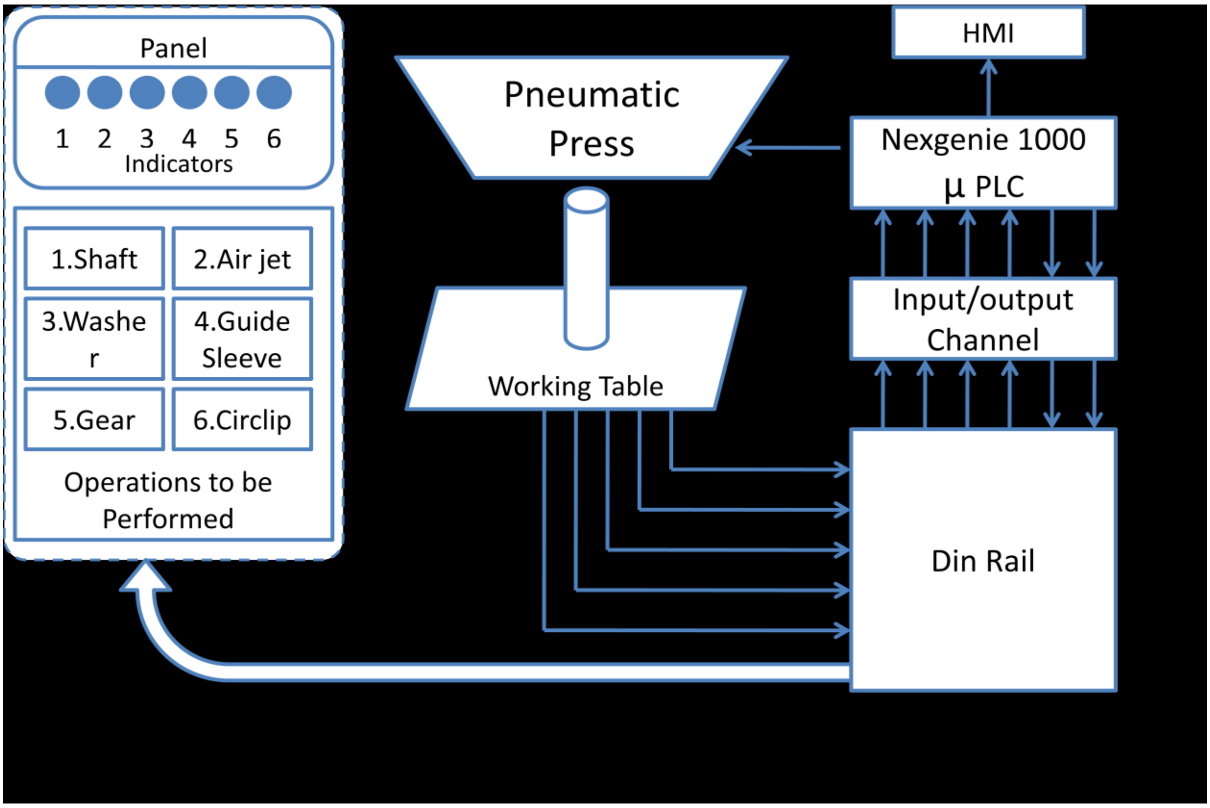

Figure 1. System Architecture

2.2. Data Flow

The data signals in this system flows from switches and sensors to PLC through input-output channel then data in PLC is processed and the output is given through the output channel through PLC to switching relay and then through relay to Solenoid valve and indicators. The data Flow diagram is shown in figure below:

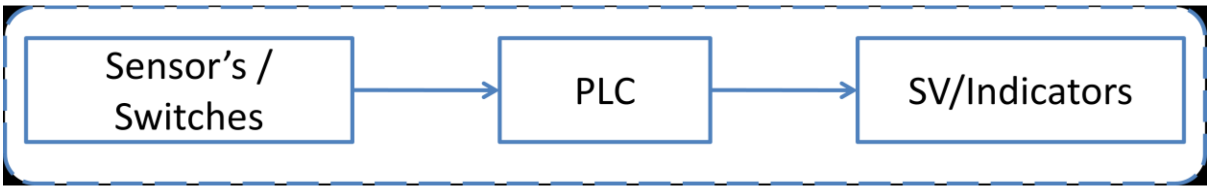

Figure 2. Data signal Flow Diagram

2.3. Electrical Signal Flow

The whole system works on 24 V DC standard powers. The signal of 24 V DC flows from power supply unit to PLC, Sensor, Solenoid Valve and indicators The Electrical signal flow diagram is as follows:

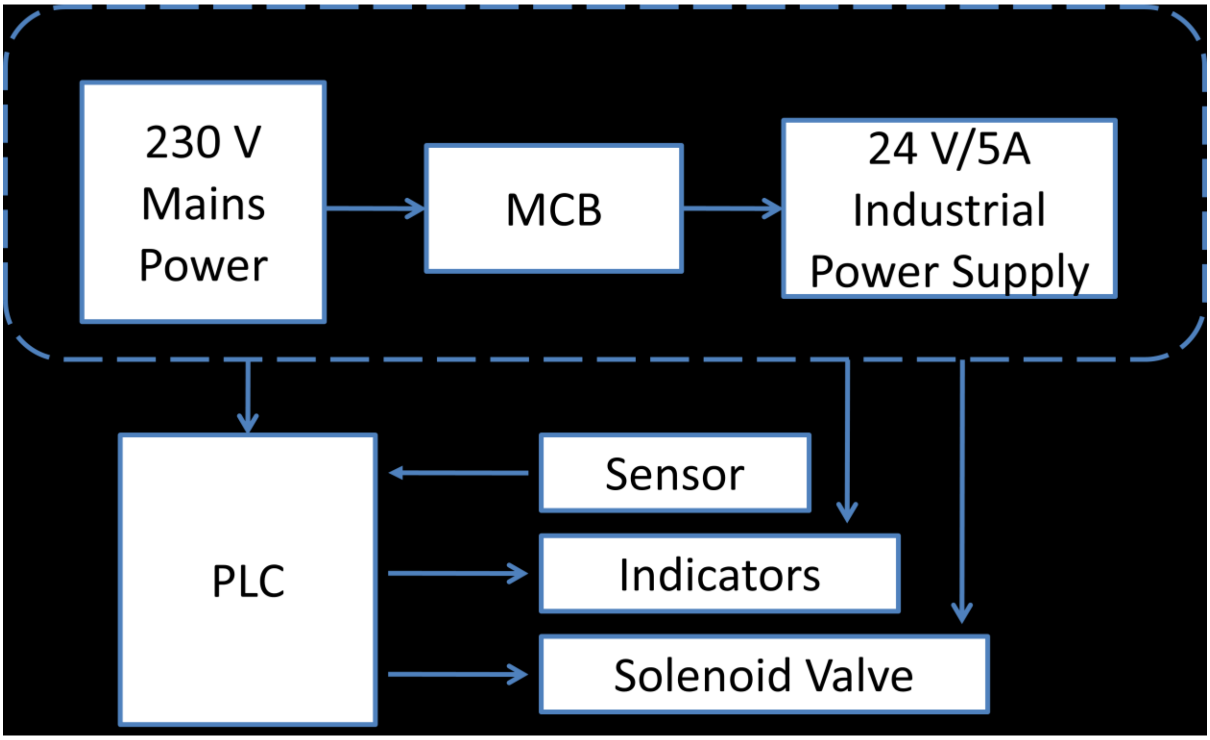

Figure 3. Electrical Signal Flow Diagram

III. OPERATION SEQUENCE

The sequence of operation to be performed is as per the list given below. Elements such as washers, bearings, various gears, guide sleeves, etc as per the pre-defined sequence by the worker on the field. The system even can recognize sequence of the operation and also the position of the gear when all process is done sequentially and successfully then active signal is send to press to insert circlip.

Operation Sequence:

1. Shaft insertion in fixture
2. Washer insertion
3. Insertion of gear
4. Oil dispenser operate
5. Air jet on gear1 to rotate it.
6. Guide sleeve lifter1 on
7. Place guide sleeve on to shaft
8. Detect position of guide sleeve on shaft
9. Selection of circlip
10. Press will be ready for operation. (indicator shows press ready)
11. Push button for press operation
12. Give signal to lifter 1 cylinder to go down
13. Counter
14. End of operation

IV. FLOW CHART

The algorithm of system is implemented as represented in figure 4. Select required component as per the desired sequence and the process continues till last component is inserted.

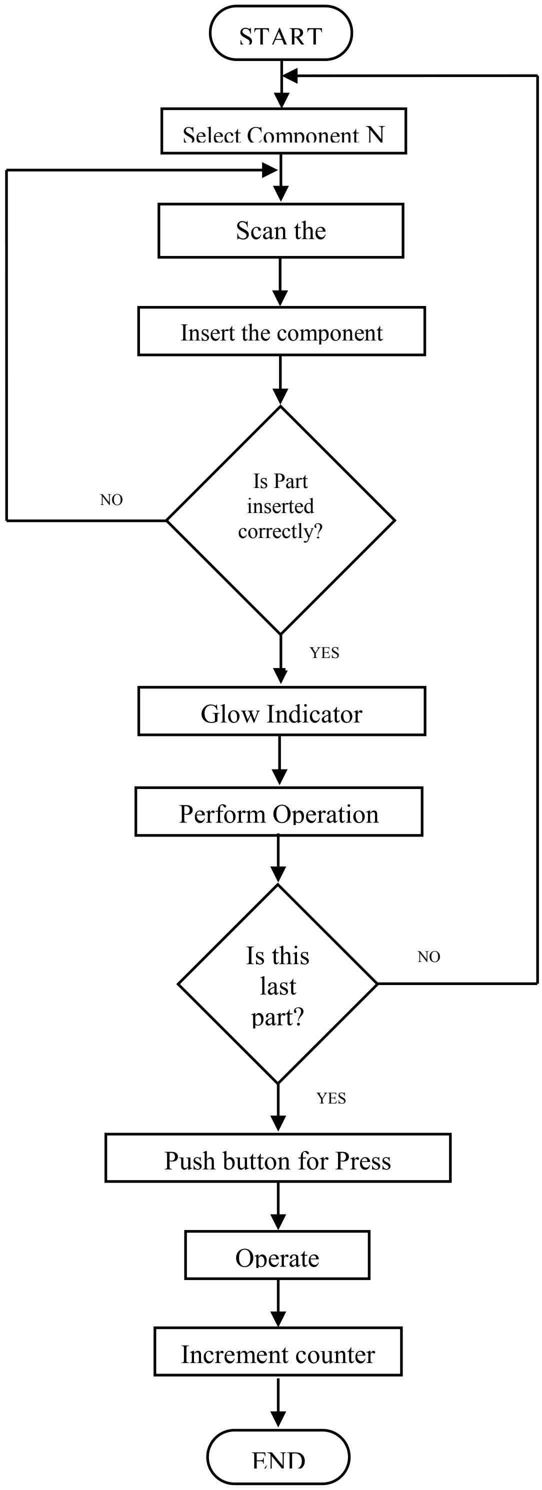

Figure 4. Flowchart of the system

V. PROGRAMMABLE LOGIC CONTROLLER (PLC)

The heart of the system is Programmable Logic Controller, which controls the operation of the system. Various sensors and switches such as IR proximity sensors, inductive proximity sensors and mushroom, emergency switch are connected to PLC as an input. In this system we are going to use Messung's Nexgenie 1000 μ PLC along with associated components i.e. (power supply, connecting wires, indicators etc). We are using CoDeSys® to program the PLC

VI. RESULT AND CONCLUSION

Successful results were obtained from the previously described scheme indicating 30% increase in production. The comparison between the traditional system and PLC based system is shown in graph shown below figure 5

With this monitoring system error will be detected while processing which results in zero rejection. Despite the simplicity of the method used, this system presents higher efficiency, lower operating cost, accuracy in monitoring. Thus, this system proved to be a versatile and efficient Control tool in an automobile industrial application

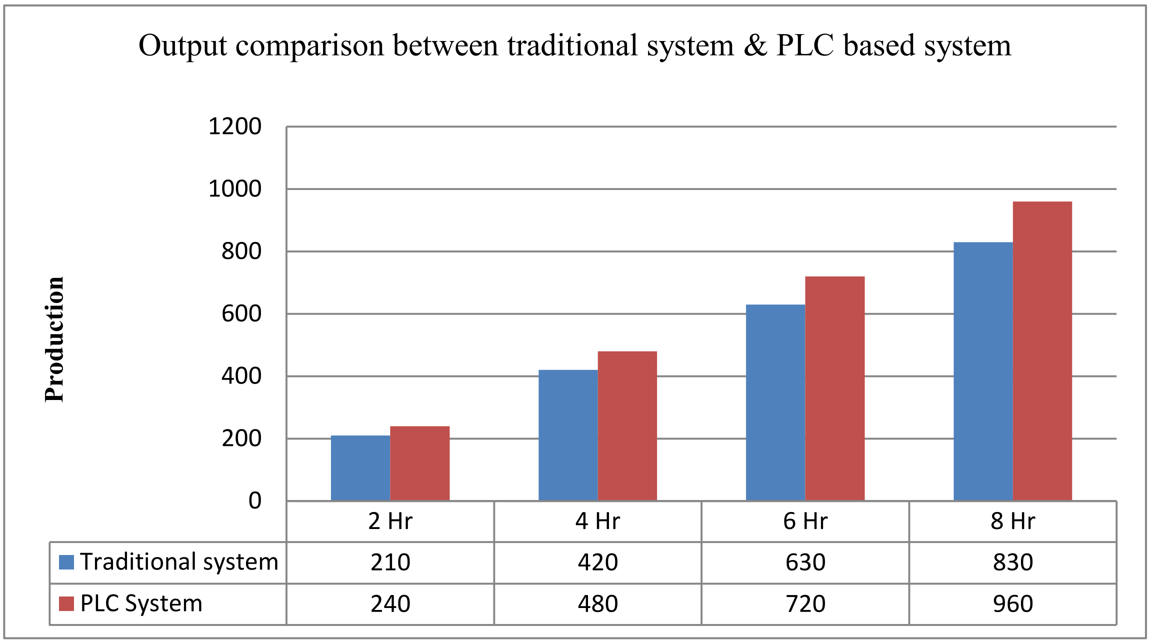

Figure 5. Graph of comparison between traditional system & PLC based system

VII. ACKNOWLWDGEMENT

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