



# **PLC Based Sequence Detection and Monitoring System**

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**ABSTRACT:** This paper presents sequence detection and monitoring system for geared shaft assembly based on programmable logic controller (PLC) technology. PLC based assembly system which recognizes that the worker has to pick up washers, gears, guide sleeves, circlip etc as per the pre-defined sequence. All sensor output fed to Controller and it will detect the sequence if it is ok then operation complete indicator will turn glow. If sequence is not follow it will not process next operation. Main advantage of system is that system is very effective in preventing defects from being passed to next process which reduces Reworks, Scrap, and Wrong shipments.

**KEYWORDS:** Geared Shaft Assembly, Programmable Logic Controller, Sequence Detection and Monitoring System, Zero quality Control.

## **I. INTRODUCTION**

The basic principles of this project are designing or developing tools, techniques and processes such that it is impossible or very difficult for people to make mistakes. It is a simple principle that can lead to massive savings. This system will reduce the cost of failure dramatically. No defective part will be passed to the next process. So at the end of the process you can trust that you have a good quality parts on your hand. In this project system can recognize that the worker has to pick up 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 sensor output fed to PLC and it will detect the sequence if it is ok then operation complete indicator will turn glow. If sequence is not follow it will not process next operation. It is not possible to eliminate all the mistakes people make. People are not mistake proofed by their nature. But organization can avoid these mistakes from reaching the customer, which is known as a defect in this case. Mistakes can be stopped as soon as they happen at least. The basic concept of this project is avoiding the problems by correcting the process. The aim of this system is to eliminate defects in a product by preventing or correcting mistakes as early as possible. People are human and cannot be expected to do everything like a machine, exactly the same each time. A simple distraction can lead to a part of their work being done wrong. It is also not necessarily their fault, as poorly designed processes that require a great deal of attention can contribute severely to problems.

## **II. BACKGROUND**

- **Role of Electronics in Automation**

A constant demand for better and more efficient manufacturing and process Machinery has led to the requirement for higher quality and reliability in control techniques. One of the latest techniques in solid state controls that offer flexible and efficient operation to the user is “PROGRAMMABLE CONTROLLERS”. The basic idea behind these programmable controllers was to provide means to eliminate high cost associated with inflexible, conventional relay controlled systems. Programmable controllers offer a system with computer flexibility:

- Suited to withstand the industrial environment
- Has simplicity of operation
- Maintenance by plant technicians and
- Reduce machine down time and provide expandability for future

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So to reduce effect of all these human errors while assembly of geared shaft in automobile industry, we developed system using PLC & sensors. All sensor output fed to PLC and it will detect the sequence if it is ok then operation complete indicator will turn glow. If sequence is not follow it will not process next operation. Thus such a simple principle can lead to massive savings.

- **About sequence detection and monitoring system**

All sequence detection and monitoring system automated using PLC (programmable logic controller). PLC atomizes the plant which not only monitor but controls sequence of operation on each stage. It controls sensors, pressing operation by using pneumatic valve

### III. DESIGN OF SEQUENCE DETECTION AND MONITORING SYSTEM

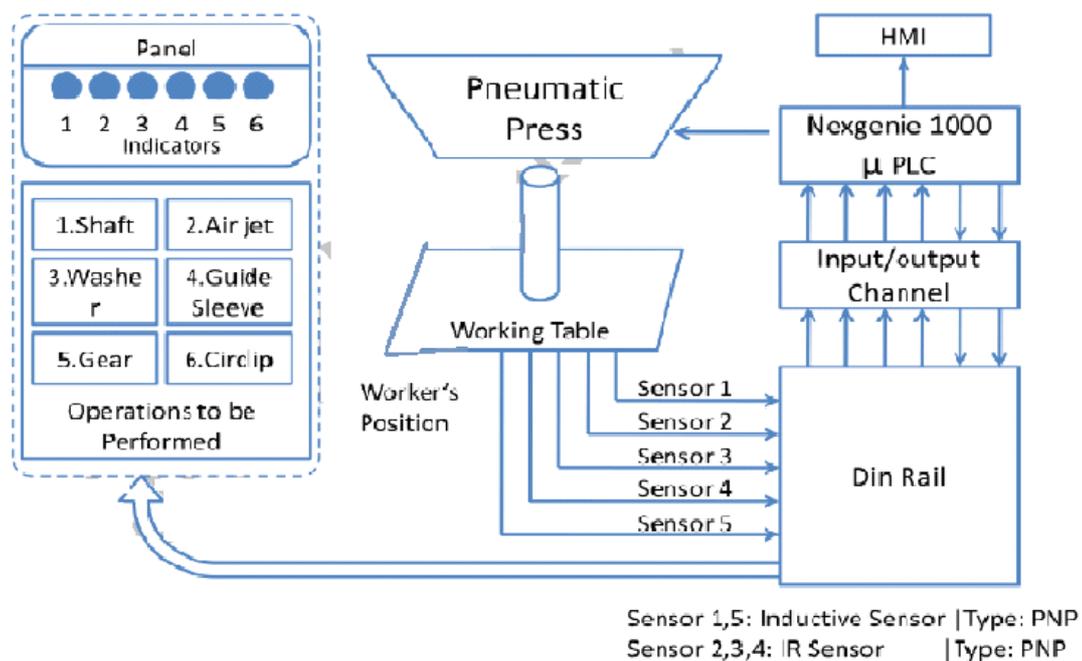


Fig 1. block diagram of sequence detection and monitoring system

- **Input Module**

The input module includes the IR sensors, inductive sensor. The sensors whose output is given as an input to the PLC. The sensors kept near the input side, where the part of assembly (gear, shaft) to be inserted the conveyor, are called detection sensors. Thus, these are the inputs given to the input module.

- **Signal Conditioning**

The output of the sensors cannot be given directly to the PLC as the input voltage to the PLC should be 24V. Hence they are given through signal conditioning circuits which condition the input signals and in turn give it as an input to the PLC.



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- **PLC**

PLC's are well-adapted to a range of automation tasks .All monitoring operations are done using the PLC. The entire sequence detection and monitoring process is semi automated by feeding the necessary conditions into the PLC using ladder logic. Ladder logic is one of the methods of programming a PLC. Thus, depending on the logic developed the various operations take place and the filling and capping of bottles are done. PLC consists of an I/O unit, central processing unit, and a memory unit. All logic and control operations, data transfer and data manipulation operations are done by the central processing unit. The results and statuses are stored in the memory of the PLC.

- **Pneumatic Valve**

The Pneumatic Valve operated when it get signal from PLC to press the circlip. It mainly used to pressing operation

- **Output Module**

The indicator is used as output devices in the sequence detection and monitoring process .Different assembly parts like gear shaft are inserted sequentially depending on input process. This completes the sequence detection and monitoring process as we want.

## IV. ACTUAL SEQUENCE DETECTION AND MONITORING PROCESS

### Sequence of Operations to be performed

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 lifter on
7. Place guide sleeve on to shaft
8. Detect position of guide sleeve on shaft
9. Insertion 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

The worker has to insert various elements such as washers, bearings, various gears, guide sleeves, etc as per the pre-defined sequence. The sequence of operation to be performed is as per the list given above. The system even can recognize the position of the gear when all process is done successfully then signal send to press to insert circlip. The heart of the system is PLC, which controls the operation of the system. Various sensors such as IR proximity sensors, inductive proximity sensors are connected to sense the parameters then to the PLC. In this system we are going to use Mitsubishi's Nexgenie 1000  $\mu$  PLC having along with associated circuitry i.e. (power supply, connecting wires, indicators etc).

## V. CONCEPT OF POKA-YOKE

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

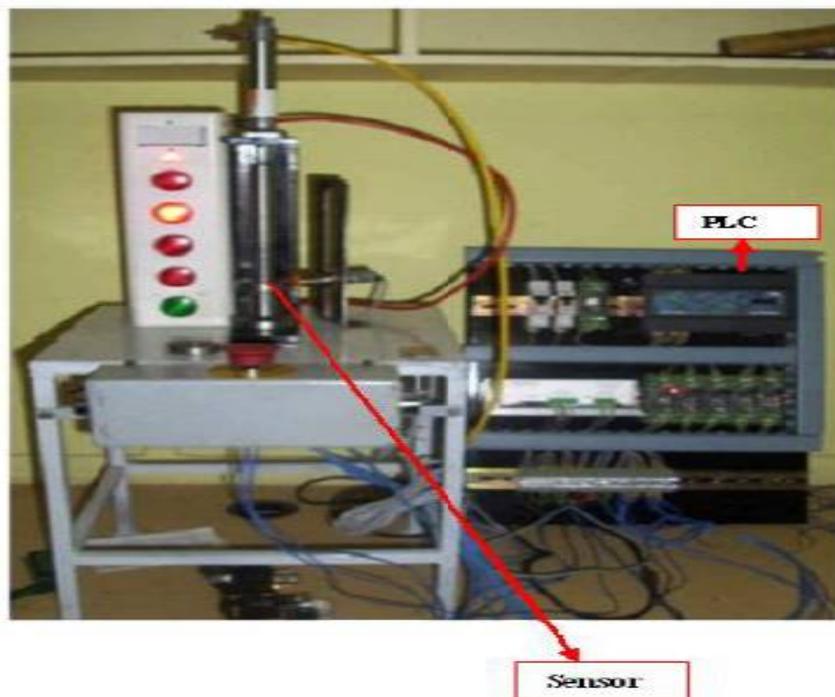
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correct i.e. OK then operation complete indicator will turn glow and process the next operation. If sequence is not followed it will not process next operation. Our aim is to:

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.



**Fig: Implementation of Sequence Detection and Monitoring System**

## VI. CONCLUSION

This paper gives successful results as previously described scheme indicating 30% increase in production. 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.

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