Industrial Automation Project Report

***Abstract*—This project focuses on automating a stamping machine that processes 10 parts in one operational cycle. The problem addressed is the need for a synchronized, precise, and efficient stamping process with minimal human intervention, ensuring high productivity and consistent quality. In traditional stamping processes, inefficiencies and inconsistencies often arise due to the reliance on manual intervention. This can result in delays, variable stamping quality. Additionally, the repetitive nature of the task can lead to worker fatigue, which further impacts productivity and accuracy. The challenge lies in automating the coordination between sensors and actuators to streamline operations while maintaining precision and reliability. The project employs a programmable logic controller (PLC) to automate the stamping machine's operations on OpenPLC platform. Proximity sensors detect part presence and monitor cylinder movements, while solenoid-actuated cylinders handle clamping, stamping, and ejecting parts. The system is programmed to execute a sequential workflow: a part is clamped, stamped, and ejected, with sensors ensuring precise positioning at each step. A timer ensures consistent stamping pressure, and counters track cycles to pause the machine after 10 parts are processed. The automated stamping machine successfully processes 10 parts per cycle with precision and consistency. The system ensures accurate clamping, stamping, and ejection, achieving high-quality impressions on each part. Operational efficiency improved significantly, with reduced manual intervention and downtime. The machine operates reliably, meeting production targets while maintaining consistent output quality.**

I. Introduction

A. *Project Requirement*

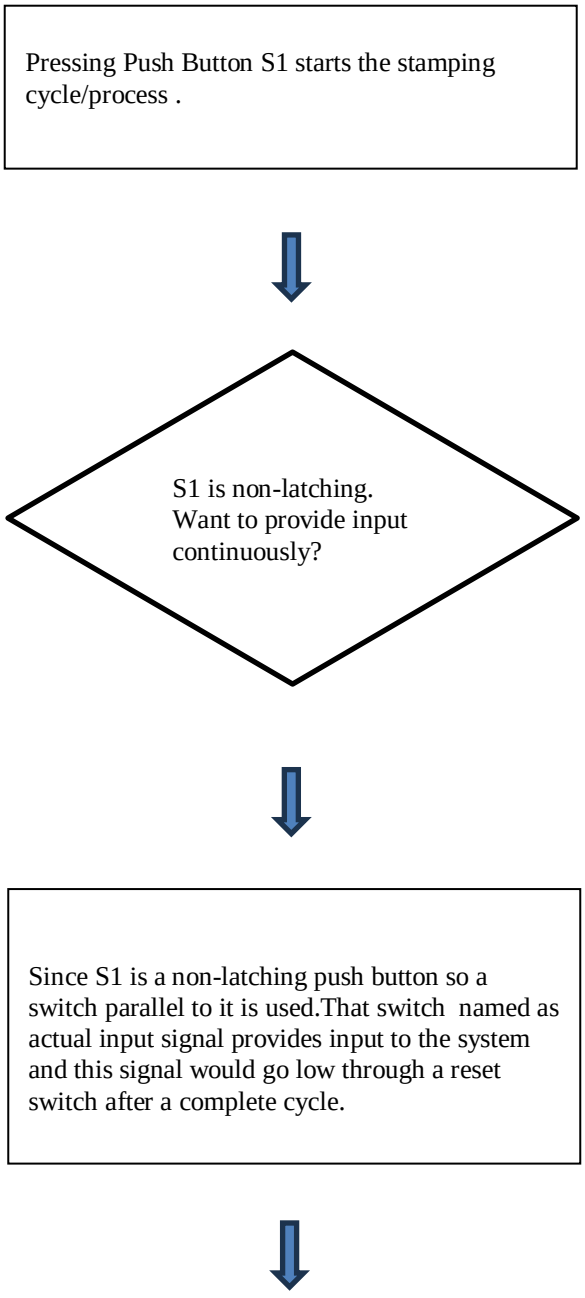
This project involves the automation of a stamping machine designed to process 10 parts in a single operational cycle. The goal is to create a system that operates with precision and consistency while reducing manual intervention. Ensuring efficiency and accuracy in such operations is essential for maintaining product quality and meeting production targets.The automation leverages a programmable logic controller (PLC) to coordinate the machine's components, including sensors and actuators, to perform tasks like clamping, stamping, and ejecting parts. Manual operations need to be replaced with automated workflows to address key challenges such as delays, inconsistent stamping quality, and worker fatigue. This improves operational efficiency ,also ensures repeatability and reduced operational costs.

B. *Practical Importance*

Practically, this project has significant industrial relevance as it demonstrates how automation can enhance productivity and quality in manufacturing processes. From a learning perspective, it provides hands-on experience with automation tools, sensor integration, and sequential programming, which are essential skills in modern engineering. This project bridges the gap between theoretical concepts and their application in solving real-world problems, making it valuable for both academic and professional growth.

II. METHODOLOGY

Following is the flow diagram of the solution developed in order to automate the stamping process.



Using the input signal and B7 proximity sensor indicating presence of part in magazine, double actuating cylinder 1.0 actuates forward and clamps the part.

First part of processing (clamping) is done.

B2 proximity sensor indicates that cylinder 1.0 has extended fully.This B2 high signal starts on-delay timer and actuates single actuating cylinder 2.0.

As long as the timer is timing ,single actuating cylinder 2.0 remains extended and stamps the part. After four seconds it retracts. This logic is implemented by XOR gate.

Second part of processing (stamping) is done.

When cylinder 2.0 retracts,single actuating cylinder 3.0 extends,ejects the part and retracts.Retraction is done by high value of B6.AND logic is used to ensure that cylinder 3.0 only extends when cylinder 2.0 has completed its stamping and has retracted.This is done using Q bit of timer on delay.

Third part of processing (ejecting) is done.

Two up counters are used to count extensions and retractions of cylinder 3.0.I have used subtraction and comparison blocks to ensure that cylinder 3.0 has extended and then retracted as well.When cylinder 3.0 has completed its one cycle,timer off delay starts timing and during its timing period of 2 seconds, cylinder 1.0 remains retracted and then extends for processing of second part.

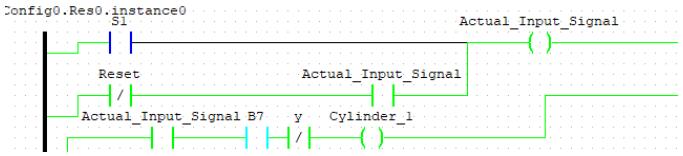
All cylinder movements are complete.

Whenever cylinder 1.0 retracts ,a counter increments the number of parts being processed.When this number reaches 10,an output x goes high and starts on delay timer.XOR gate is implemented between x and Q bit of timer.XOR gives high output when this on delay timer is counting for 30 seconds meaning that the variable actual input signal that goes high due to pressing push button S1 is now low due to reset switch.

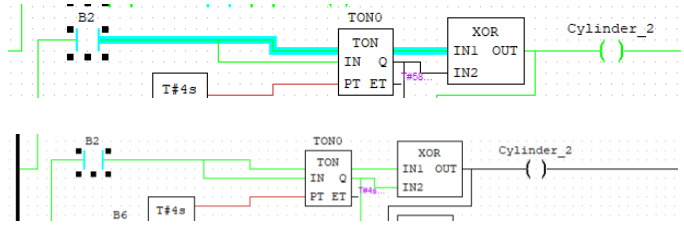
During these seconds,the stamping would stop and would only restart when S1 is pressed again.As a result ,counter for part processing is reset.

III. RESULTS

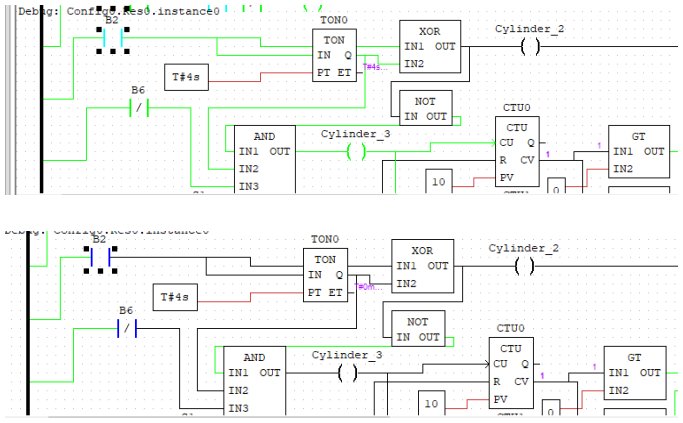
A. *Latching Input and Clamping of Cylinder 1.0*



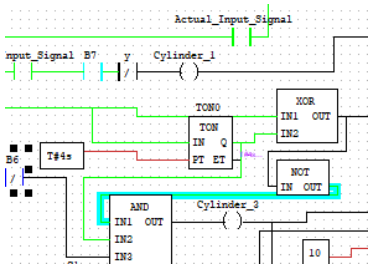
B. *Stamping of Cylinder 2.0*

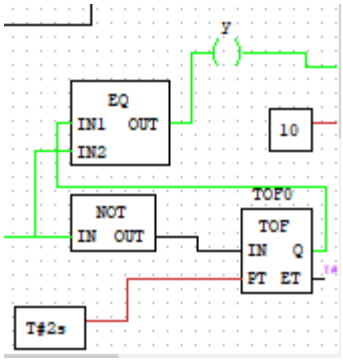


C. *Ejecting by Cylinder 3.0*

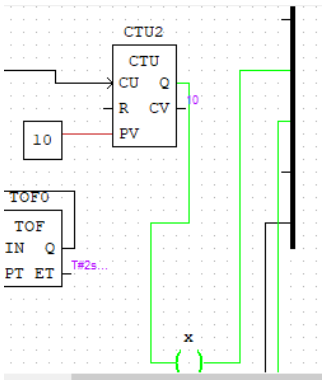


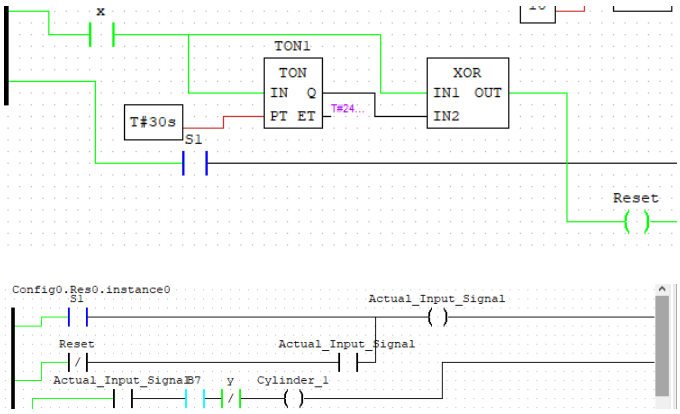
D. *Retraction by Cylinder 1.0*





E. *Undo Latching*





F. *End Solution*

The automated stamping machine system accurately processes 10 parts per cycle. Clamping, stamping and ejecting processes through cylinder movements are ensured to be precise.A 30 second break is well implemented between cycles.

IV. ISSUES FACED

A. *Using sensor inputs to control cylinder 2.0 and 3.0 movements.*

B. *Building logic to make cylinder 1.0 retract.*

V. *SUGGESTION*

This course provides valuable insights regarding the field of automation. One learns a lot about sensor integration,sequential programming in automation processes .So it would be better if we have two labs of industrial automation course per week.

REFERENCES

Reference [1] was cited for abstract and introduction portion.

[1] https://chatgpt.co