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PLC Programming for Vision Checking System with Linear Servo Motors

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Abstract - PLC programs provide precise control over machinery and industrial processes. They dictate how equipment operates, ensuring tasks are performed accurately and consistently according to predefined parameters. In this project, I create the PLC program for a Mitsubishi PLC and design the HMI screen template using Mitsubishi HMI software for a vision checking system integrated with linear servo motors. In vision checking system with linear servo motors inspects PCBA and wiring using a vision camera moved by a servo gantry system. Safety measures are implemented. The program includes auto, manual, and homing sequences, along with mode selection, error handling, counter, shift, and tower lamp functions. HMI screens are designed to teach machine operation. In auto mode, servos move to positions set in the HMI recipe screen. Manual mode allows servo jogging and movement between positions via the HMI servo screen. Pressing the homing button moves servos to user-set home positions. Safety measures, including light curtains, door switches, and fixture sensors, halt the machine and sound a buzzer in case of errors. Counter and shift programming displays running shift and component counts. Programs are tailored to input/output device operations.

***Key Words*:** PLC Programming, HMI Screen designing.

1. INTRODUCTION

Machine automation aims to streamline processes, increase efficiency, reduce errors, and enhance productivity across industries by employing machines and computer systems. It optimizes workflows, minimizes human errors, and enables higher output levels with the same or fewer resources. Automation serves various objectives such as cost reduction, quality improvement, scalability, and innovation, tailored to specific industry needs. Linear servo motors provide precise control over motion, rapid acceleration and deceleration, smooth operation, and high force density, making them ideal for applications requiring precise positioning, rapid changes in motion profiles, and compactness. They enable the camera to reach exact positions for vision inspection efficiently.

2. MATERIAL AND METHODS

2.1 MACHINE STRUCTURE AND HARDWARE:

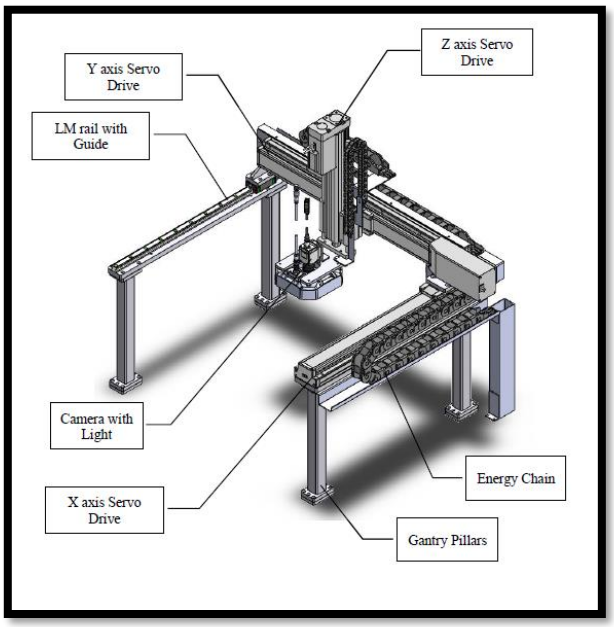


Fig -1

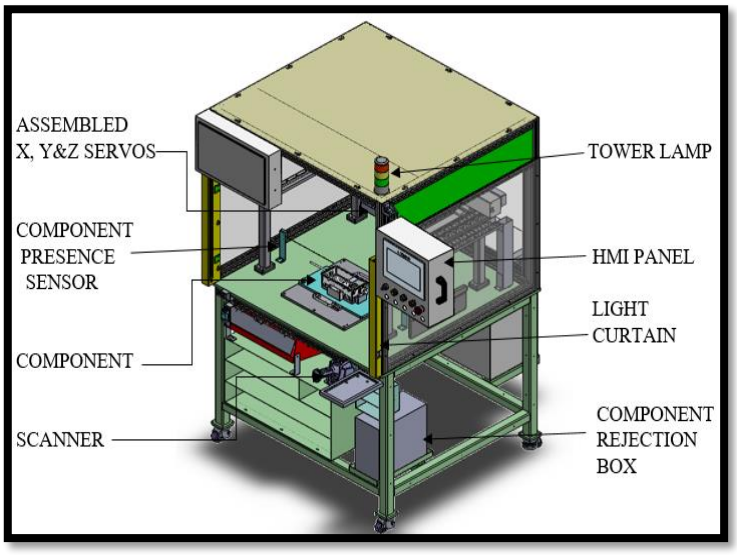


Fig -2

2.2 THE MACHINE IS ASSEMBLED WITH THESE MAJOR FEATURES

Mitsubishi PLC (FX 5U-64MR/ESS Series), Mitsubishi HMI (MELSEC IQ-F SERIES) monitor with panel, X and y axis linear servo motors (LEKFS40REB-500B-R5C917), Z axis linear servo motor (LEKFS40REB-500B-R5C917), Camera with module (CV-X SERIES), QR hand Scanner.

2.3 SOFTWARE AND PROGRAMMING

2.3.1 SOFTWARE

Fig -3

To develop a PLC program for controlling machine operations, including working sequences, MELSOFT GX Works3 software is essential.

Fig -4

Creating HMI screen templates for the machine requires the indispensable use of MELSOFT GT Designer3.

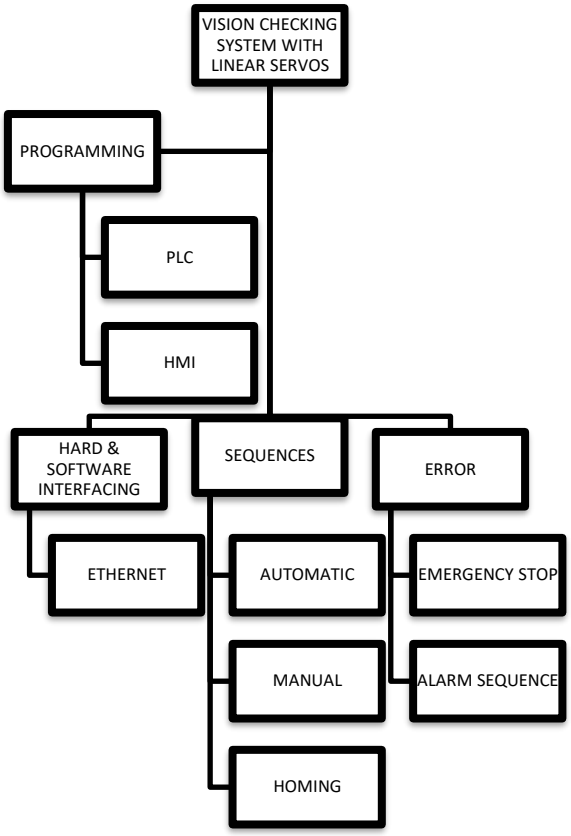
2.3.2 PROGRAMMING

The PLC program for the vision checking system with linear servo motors is created in GX Works3, incorporating conditions such as auto sequence, manual sequence, homing sequence, shift change, counter, error sequence, mode selection, and tower lamp. The HMI screen templates are designed in GT Designer3.

2.4 INTERFACING AND LOADING PROGRAM

All machine hardware components are connected to the PLC via Ethernet cables through an Ethernet hub. Communication with each hardware component is established by pinging its respective IP address to ensure connectivity and proper functioning.
After creating the PLC program for the vision checking system machine using Mitsubishi PLC Software (MELSOFT GX Works3), the program is loaded into the PLC for implementation and execution. Also load the HMI screen templates from Mitsubishi HMI Software (MELSOFT GT Designer3) to HMI monitor.

2.5 BLOCK DIAGRAM



3. RESULTS

The user sets the value through the HMI, prompting the linear servos to move to that position in manual mode, while the vision camera can access manually. In automatic mode, once the cycle starts, the linear servos move to the position set by the user in the recipe screen in HMI, completing one full cycle of operation. Pressing the homing push button causes the servos to move to their home position. The mode selection, shift changing, and tower lamp indications work perfectly. Finally, the component vision is confirmed as ok, and the count is displayed on the HMI screen. If the vision is not ok, that count is also displayed on the HMI screen.

4. CONCLUSION

A vision checking system provides a complete solution for automated quality checks in different industries. It uses advanced imaging tech, machine learning, and precise analysis to find defects and ensure products meet strict standards. These systems can spot problems accurately, even in complex environments, ensuring consistent quality and reducing the chance of faulty products reaching markets. Adding linear servo tech improves their abilities, making inspections even more precise and dynamic. This combo of tech brings together

the strengths of both systems, creating a thorough solution for automated quality checks. Linear servo systems control motion precisely, helping cameras and sensors position accurately. This accuracy boosts defect detection and improves quality control in vision checking.

5. REFERENCES

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