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# PLC BASED AUTOMATIC & MANUAL CONTROL OF ROBOTIC ARM

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## Abstract:

The main objective of this project is to control the Robotic Arm manually and automatically by using Programmable Logic Control(PLC) to pick the moving object on a conveyor belt, Drilling, screws for secure wiring connections, wiring in panel. In industries highly advanced robots are used, but still the controlling is done by manually or controllers like Arduino, 8051 etc. There are several disadvantages by using micro controllers which cannot work in the environments with the high levels of vibrations, corrosion, humidity, and other environmental factors. All these problems are overcome by using Programmable Logic Controller based robotic arm. Push button station is used to control the robotic arm in manual mode. Using Programming Device user can enter, edit and upload the program in Programmable Logic Control(PLC) to work in an Automatic mode. In automatic mode sensor gives feedback to the PLC to find the current position of Robotic arm. This project focuses to create and build more compact, useful and cheaper robotic arm to perform various functions where human is proven too dangerous to perform a specific task and also to eliminate human errors to get more precise work. This project demonstrates the effectiveness of PLC-based robotic arms in improving industrial automation and efficiency.

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### INTRODUCTION:

Robotic arm is used in science and industry to replace humans and They perform tasks like humans. In fact, some industries have Robotic arm. Robotic arm is designed to manipulate and parts, tools, or special manufacturing element through programmable movements.

### II. DESIGN AND CONSTRUCTION:

Serial Link: Serial manipulators are the most common industrial robots and they are designed as a series of links connected by motor-actuated joints that extend from a base to an end-effector. Often they have an anthropomorphic arm structure described as having a” shoulder", an "elbow",

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and a "wrist".structure: metal profile was used in design of the robot arm. Stepper engine was placed on table that moves with screw shaft and stepper motor were placed in the box made of aluminum plate

construction of Robotic Arm

The joints that connect the links provide the system with its rotational and translational movement capabilities. An end effector is also usually added to the end of the wrist-joint where a human hand would be on a human arm.

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**III. WORKING PRINCIPLE:**

Power On: The SMPS powers the S7-1500 PLC, Profibus module, and stepper motor driver. Program Execution:

The S7-1500 PLC runs a logic program (e.g., written in Ladder Logic or Structured Text) defining a task, such as rotating the arm to pick an object and placing it elsewhere.

Motor Control:

The stepper motor driver converts these commands into electrical pulses, driving the closed-loop stepper motor to move the arm.

The motor's encoder sends real-time position feedback to the driver, which may relay it to the PLC via Profibus.

System Check: The PLC initializes by checking the status of the stepper motor (via feedback from the closed-loop system) and ensuring the arm is at a "home" position (e.g., a default starting point).

**IV .COMPONENTS:**

Here are the components used in plc based automatic&manual control of robotic arm

Main Components

1. S7-1500 CPU:

The SIMATIC S7-1500 CPU is the central processing unit (CPU) that forms the heart of the Siemens SIMATIC S7-1500 Programmable Logic Controller (PLC), executing user programs and enabling network communication with other automation components.

The S7-1500 CPU is responsible for executing the user-written program and managing communication with other automation components, including I/O modules, communication modules, and other PLCs or devices on the network.

Purpose: Acts as the central control unit, processing inputs, executing logic, and sending output commands to control the robotic arm.

Working: The S7-1500, a high-performance PLC from Siemens, runs a user-programmed logic (e.g., in Ladder Logic or Structured Text) using its CPU. It supports advanced features like fast processing, integrated diagnostics, and communication protocols.

2. PROFINET INTERFACE MODULE ET200S:

A Profibus interface module is a hardware component that allows a controller (like a PLC) to connect to and communicate with field devices (like sensors and actuators) over a PROFIBUS network.

Purpose: Facilitates communication between the S7-1500 PLC and other devices (e.g., stepper motor driver or external sensors) using the Profibus protocol.

Working: Profibus (Process Field Bus) is an industrial communication standard that allows the PLC to exchange data with field devices quickly and reliably. The interface module connects the PLC to the network, enabling control and feedback signals to flow seamlessly.

3. STEPPER MOTOR DRIVER:

A stepper motor driver is an electronic circuit that converts control signals (like pulses and direction) into the necessary voltage and current to drive a stepper motor, enabling precise and controlled movement.

Purpose: Controls the closed-loop stepper motor by converting PLC signals into precise electrical pulses.

Working: The driver receives digital signals from the PLC (e.g., direction and step commands) and translates them into current pulses that drive the stepper motor. It adjusts speed, direction, and position based on the PLC's instructions.

4. CLOSED LOOP STEPPER MOTOR:

A closed-loop stepper motor uses feedback, typically from an encoder, to monitor its actual position and correct for errors, unlike open-loop stepper motors that rely solely on programmed steps.

Closed-loop stepper motors incorporate a feedback system, such as an encoder, to continuously monitor the motor's position.

Purpose: Drives the robotic arm's movements (linear motion) with high precision and feedback. Working: Unlike traditional open-loop stepper motors, a closed-loop stepper motor includes an encoder that provides position feedback to the driver or PLC. This ensures the motor reaches the exact position commanded, correcting any missed steps or errors in real-time

## V. DEVELOPMENT:

Enhanced Adaptability and Collaboration: Robots will become more flexible and able to handle a wider range of tasks, working alongside humans in areas like manufacturing, healthcare, and agriculture.

Increased Autonomy:

AI and machine learning will enable robots to perform complex tasks like advanced planning, fault prediction, and real-time adaptation to environmental changes.

Robotic Arms in Healthcare:

Robotic arms will play a larger role in surgeries, diagnostics, and rehabilitation, assisting with tasks like patient lifting and handling.

Robotic Arms in Space Exploration: Future missions will rely on robotic arms with increased autonomy for tasks like object manipulation and assembly in space.

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## VI. CONCLUSIONS :

The PLC-based automatic and manual control of robotic arms represents a powerful and versatile solution for modern automation needs. It combines the reliability, precision, and robustness of PLCs with the flexibility to operate in both automated and human-guided modes, addressing a wide range of industrial and emerging applications. The system's advantages—such as cost-effectiveness, safety integration, and ease of programming—make it an efficient choice for tasks requiring consistency and adaptability. Looking forward, its future scope is promising, with advancements like AI integration, Industry 4.0 connectivity, and collaborative robotics poised to enhance its capabilities further. As technology evolves, PLC-based robotic arms will continue to drive productivity, safety, and innovation across diverse sectors, solidifying their role as a cornerstone of automation.

  

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