"DESIGN OF PICK AND PLACE ARM FOR CONVEYOR BELT USING PLC"

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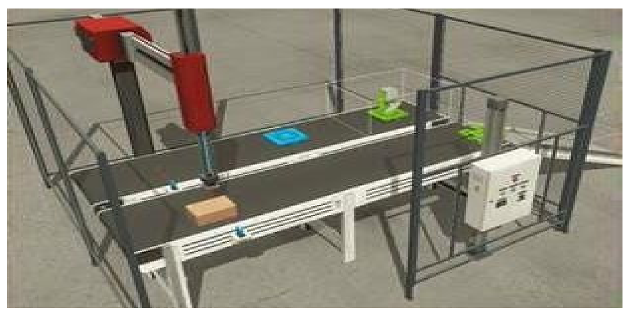
Abstract: Automation entails the utilization of automatic control to manage a myriad of machinery, networks, and switches, thereby reducing the necessity for human intervention. This project aims to develop an autonomous system capable of transferring items or materials from one location to another efficiently. Various power sources such as servo motors, hydraulic systems, and pneumatic systems can facilitate object movement. Key mechanical principles, including mechanical arm manipulation and piston-cylinder operation, form the basis of this endeavor, with emphasis placed on pneumatic systems. The integration of programmable logic controllers (PLCs) orchestrates the entire design, which finds application in industrial settings for executing repetitive tasks swiftly and with minimal human involvement. Essential functions encompass gripping, lifting, transporting, positioning, and releasing objects to designated destinations.

Keywords: Automation, Pneumatics, PLC, Gripper

Introduction

Automation revolutionizes the landscape of manufacturing by diminishing the reliance on human labor in the production of goods and services across various industrial sectors. It entails the integration of control systems and programmable controllers to execute predefined tasks systematically and seamlessly, leveraging both hardware and software. In contemporary business environments, automation finds application in enterprises of all scales, alleviating the burden of manual control which often demands constant monitoring and adjustments from operators. Automated systems offer practicality through continuous and automatic measurements and corrections, enhancing productivity, efficiency, and process quality. Notably, pneumatic systems have emerged as a cornerstone of automation, fostering advancements in quality control, operational effectiveness, and productivity. Pneumatic arms, controllable during processes, augment workforce capacity and extend operational hours, facilitating the execution of arduous and time-consuming tasks in industrial settings.



Leveraging Programmable Logic Controllers (PLCs), modern industrial processes achieve comprehensive automation, seamlessly regulating operations without human intervention. Among prevalent automation mechanisms, pick-and-place systems stand out, employing pneumatic power for product transfer, either manually or automatically through solenoid valves. Integral to these systems is the PLC-programmed control of grasping and lifting actions, orchestrating efficient material handling. This paper delineates a design paradigm employing automation principles, featuring a conveyor belt system propelled by a DC motor, integrated with proximity sensors and pneumatic cylinders controlled by PLCs to optimize material movement within industrial contexts.

LITERATURE REVIEW

[1]M.Cianctietti, A.Arienti, B.M.Follador, B.Mazzalai, P.dario[1] They take inspiration from the octopus, whose exceptional dexterity, changing stiffness, and extremely complicated behaviour make for an intriguing robotics model. In this experiment, they examine the primary characteristics and patterns of the octopus arm's movement. They come tothe conclusion that the mechanism at the base of the robotic arm, which was modelled after the muscular hydrostat of the octopus, worked as intended. The major goal of the project by Ravi Kumar Mourya, Amit Shelke, and Saurabh Satpuite [2] is to build and implement a four DOF pick and place robotic arm. They came to the conclusion that the ideal manipulator was modelled using CAD software such as Creo1.0 and Auto CAD. Theoretical inverse kinematics analysiswas done to ascertain the position and orientation of the end effectors. FE Analysis was performed using Ansys software.

[2] **Prof. S.N.Teli, Akshay Bhalerao, Sagar Ingole** [3] ,The purpose of this project is to design and build a pneumatic arm that can pick up and position cylindrical objects. They get to the conclusion that the manual defect control and direction control valve regulate the arm. By using a helical slot mechanism, a pneumatic cylinder rotates and moves thearm. 25 kg are in each arm's weight. The model should be able to lift at least 10 kg. R. Ballamurgan [4], S. Premkumar,
K. Surya Varman The purpose of the experiment is to combine a pick-and-place robotic arm with a suction sucker and gripper mechanism. These robots have a single robotic arm that is capable of grabbing, sucking, lifting, placing, and releasing objects. It will cut down on cycle time, ideal time, operating costs, and space usage. It is simple to use and works well for handling glass.

[3]M.Pellicciari, G.Berselli, F.Leali, A. Verganana [7] This research demonstrates a technique for lowering the pick- and-place robotic arm's overall energy usage. Following the development of electromechanical models for both series and parallel manipulators, constant time scaling is used to determine the energy-optimal trajectories. It has been observed that completely dismantling a system is not always advantageous. Energy usage of a specific operation as a function of job completion time. The development of online programming techniques and the refinement of the motor model are among the upcoming tasks.

[4]Mohd Ashiq Kamaril, Yusuff, Reza Ezucin Samin, Babul Salam, Kader Ibrahim [8], their article discusses the creation of a wireless mobile robot arm. The pick and place process is controlled by a wireless PS2 controller. This robot'sdevelopment is based on the Arduino Mega Platform. To determine the performance of an arm, speed, distance, and load analysis are performed. This robot is anticipated to solve issues like picking up or placing objects far from the operator and quickly and safely placing dangerous objects.

[5]H. Hagenah, W. Bohm, T. Breitsprecher, M. Merklein, S. Wartzack [9], This paper will demonstrate how cutting-edge lightweight robot arms can be constructed using contemporary materials like cellular titanium and nanocrystalline aluminium. It will cover the establishment of a basic design, its optimisation using topology optimisation, and the formulation of the product specification. To study various beginning settings and boundary conditions for this optimisation, intelligent modelling is needed. The development and analysis of various new lightweight building materials and the associated manufacturing techniques.

[6]Mohd Aliff, Shujiro Dohta, Tetsuya Akagi, flexible Hui Li [10] The goal of the project is to create an actuator that is lightweight and can be used in a robot arm with flexible hoses. The trajectory control of the robot arm and the Slavic Master's degree height flexible control are proposed in this study. This robot arm's 3DOF capabilities—bending,expanding, and contracting—will be used in a device for the rehabilitation of human wrists. In this research, an analytical model of a robot arm with a flexible hose for a Slavic Master's degree in trajectory control is proposed.

3.A Double-Acting Cylinder

Air pressure is used by double-acting cylinders (DAC) to move during both extend and retract strokes. One for outstrokeand one for instroke, they each have a port that lets air in. This design has no restrictions on stroke length, but the pistonrod is more prone to buckling and bending. Calculations involving addition should also be done.

Fig1: double acting cylinder

3.B Solenoid Valve

A 5/2-way single solenoid valve has one input, two output, and two exhaust ports, also known as a 5-port, 2-position single solenoid directional control valve. The single-coil type of 5/2 pneumatic valve usually has a spring or pilot air returns to that when de-energized, the valve returns to its starting function.

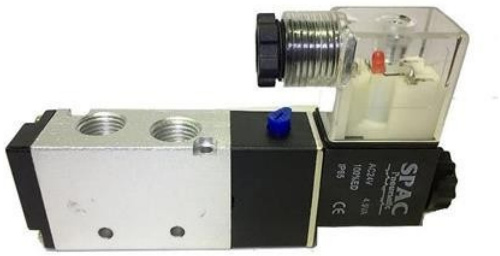


Fig2: 5/2 solenoid valve

3.C Conveyor System

A mechanical handling device for quickly and effectively moving loads and materials automatically around a space is a conveyor system. Among other advantages, this approach minimises human error, lowers workplace risks, and lowers labour expenses. They are helpful for transporting large or heavy objects from one place to another. To move objects, a conveyor system may employ a belt, wheels, rollers, or a chain. A belt is typically stretched across two or more pulleys in conveyor systems. To allow for continuous rotation, the belt creates a closed loop around the pulleys. One pulley, referred to as the driving pulley, tows or drives the belt that transports objects from one place to another.

Fig3: conveyor system

4.D DC Motor

A DC motor is any of a class of rotary electrical motor that converts direct current (DC) electrical energy into mechanicalenergy. The most common types rely on the forces produced by induced magnetic fields due to flowing current in the coil. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

Fig4:DC Motor

4.E PLC(Programmable Logic Controller)

A programmable logic controller is a small computer that has inputs for data and outputs for sending and receiving commands. A PLC's primary duty is to regulate a system's operations using the underlying logic that has been programmed into it. PLCs are used by businesses all over the world to automate their most crucial procedures. A PLC receives inputs from both automated data collection points and human input points like buttons and switches. The PLC then chooses whether or not to modify theoutput based on its programming. Theoutputs of a PLC are capable of operatinga wide range of machinery, including motors, solenoid valves, lighting, switchgear, safety shutoffs, and many more.

PLCs continue to be a key component of many industrial control systems today. They continue to be the most widely utilised industrial control technology in the world. For a wide range of jobs, from engineers developing the system to electrical technicians maintaining it, proficiency with PLCs is a prerequisite.

Fig5: PLC(Programmable Logic Controller)

4.F Gripper

These devices, which are also known as hand grippers, are mostlyused to test and strengthen the hands. One type of grip strength is known as crushing grip, which is defined as a grip in which the four fingers rather than the thumb are the mainmoving parts. The actual point of contact between a robot arm and a workpiece is a robot gripper. One of the advantagesis material handling, so it's critical to select the proper kind of gripper for your application.

Fig6:Gripper

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MECHANICAL DESIGN

5.1 CAD MODEL

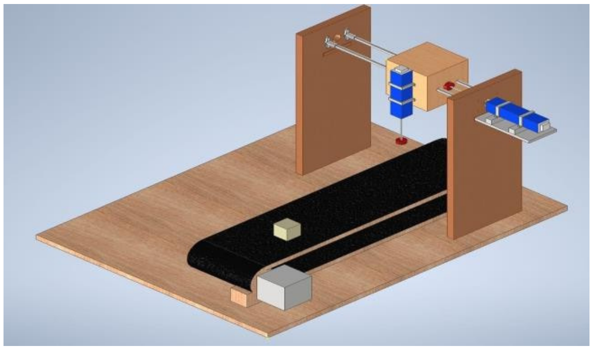


Fig7: CAD model of pick and place arm for conveyor belt using PLC

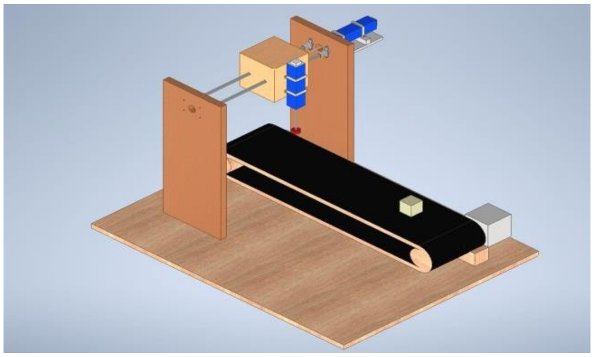
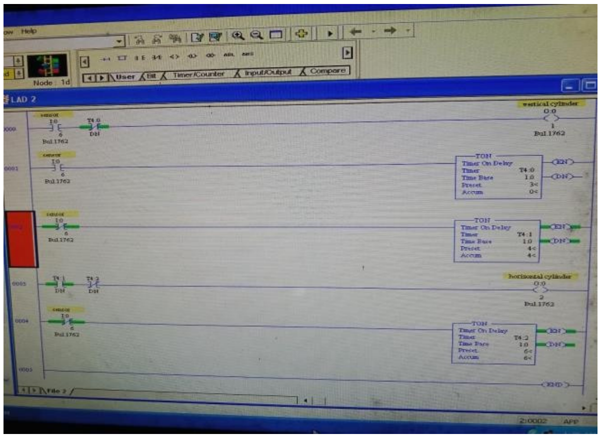


Fig7: ***CAD model of pick and place arm for conveyor belt using PLC***

PROGRAMMING

6.1 PLC Programming

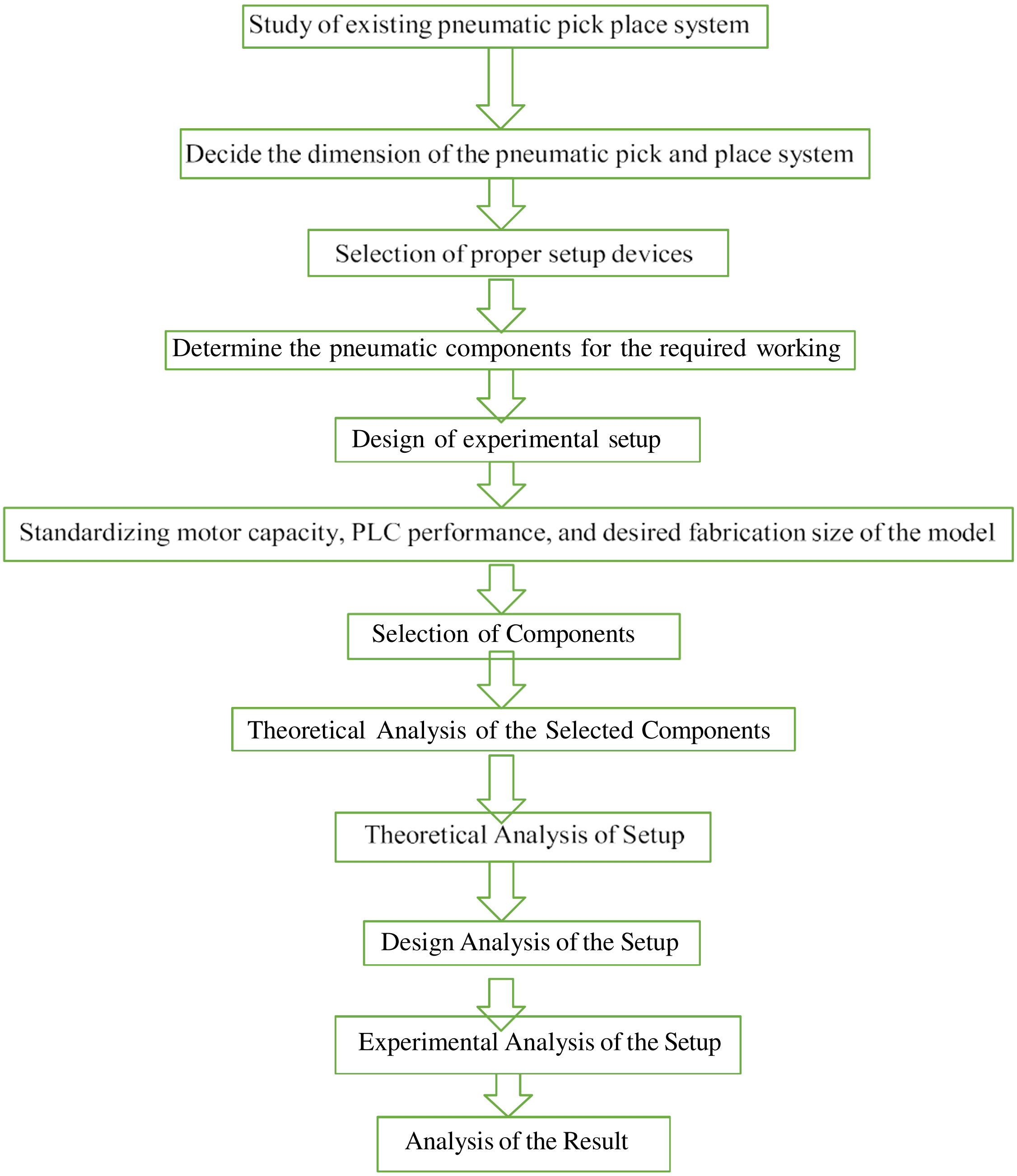


CONCLUSION

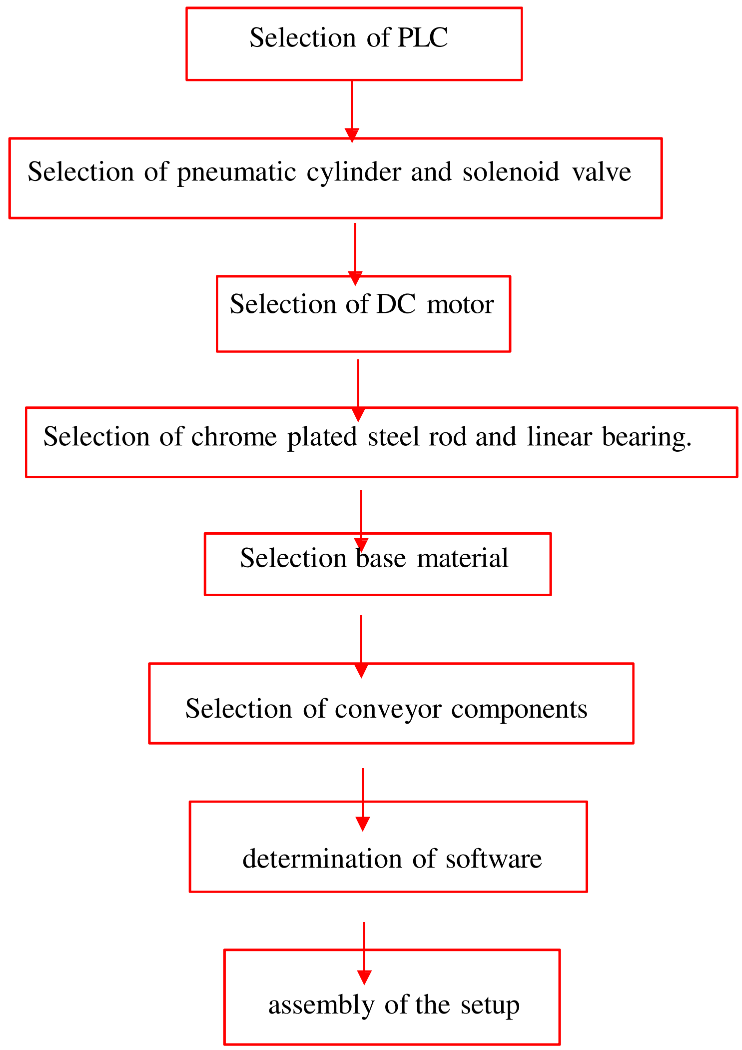
In the development of the pneumatic pick and place system prototype, the integration of PLCs, sensor technology, and pneumatic systems has yielded a comprehensive solution for efficient material handling. Key components such as directional control valves, double-acting cylinders, and grippers constitute the pneumatic system, orchestrating precise movements essential for effective pick and place operations. The synergy between conveyor movement and cylinder actions forms the backbone of the system design, optimizing the transfer of materials within industrial settings. Leveraging ladder logic programming, the PLC governs the entire hardware assembly, ensuring seamless control and coordination of the system's functionalities. By embracing automation, this prototype significantly reduces the reliance on human labor, enhances time efficiency, and accelerates the pace of process completion. Moreover, the streamlined design requiring minimal wiring contributes to a compact workspace footprint, further enhancing its practicality in diverse industrial environments.

I. METHODOLOGY

4.1 plan of action:



4.2 procedure:



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