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PLC Based Pick and Place Robot with 4 DOF

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ABSTRACT:The pick and place robot is one of the technologies in manufacturing industry and designed to perform various functions. The system is very important to eliminate human errors and to get more precise work. It can also save the cost in long term and help to solve problems and tasks that cannot be done such as on high temperature area, narrow area and very heavy load thing. This project is a basic development and modification for that type of robot where it use the peripheral interface Programmable Logic Control (PLC) as the robot brain to control all of the robot movement. The rotation of tills robot is 360 degree (clockwise) and -360 degree (counter clockwise). The electromagnetic gripper will move horizontally to pick up and hold the object from one place to another place. This robot is used to pick and place the object only in their specifications (up to 300mm horizontal and 300mm vertically). The benefit of this project is the robot can pick the object using electromagnetic gripper which is simple in construction and also cost effective.

KEYWORDS:PLC, 4DOF (degree of freedom), Robot, Gripper,

I. INTRODUCTION

Pick &Place robots are used in a wide variety of material transfer applications basically; the machine takes a product from one spot in the manufacturing process and places it into another location. A good example is a robot picking items off a conveyor belt and placing them into packaging boxes.

The typical pick and place application requires high amounts of repetitive motion. Robots can eliminate human operation of hazardous tasks such as chemical spraying or heavy lifting. Pick and place robots have high return on investment when consistent shaped parts or containers are handled. Unlike human operators, robots also have the ability to work for an extended time.

II. RELATED WORK

PLC Overview:

It is a device which is widely used in industry to automate event based control, interlocking of operations and sequencing of operations. PLC is used in almost all process industries, where there is requirement of process safety and interlocks e.g. thermal power plant, steel industry, cement industry, pharmaceutical industry, petrochemical industry etc.

Definition:

A PLC is a digitally operating electronic device which uses a programmable memory for internal storage of instructions for implementing specific functions, such as logic sequencing, timing, counting and control through digital or analog input/output modules.

A programmable logic controller, also called a PLC or programmable controller, is a computer-type device that is used to control equipment in an industrial facility. The kinds of equipment that PLCs can control are as varied as the industrial facilities themselves. E.g. Conveyor systems, food-processing machinery, auto assembly lines.

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PLCs have been gaining popularity on the factory floor and will probably remain predominant for some time to come. Most of this is because of the advantages they offer.

- Cost effective for controlling complex systems.
- Flexible and can be reapplied to control other systems quickly and easily.
- Computational abilities allow more sophisticated control.
- Trouble shooting aids make programming easier and reduce downtime.
- Reliable components make these likely to operate for years before failure.

Programmable logic controllers - PLC's! Are microcomputer devices used for sequential control? Originally these devices were designed to replace relay logic circuits and the basic programming language, ladder diagram, resembles relay logic schematics. PLC's are real-time controllers with cyclic behaviour. Each cycle consists of three steps. The first step scans the inputs to the controller and maps a picture of the input status into the controller memory. After that a program stored in the controller memory is processed, taking into account the memory image of the inputs. As a result, an image of the outputs is produced. In the third step the image of the output variables is mapped to the actual outputs. The first languages used for PLC programming were ladder diagram and instruction list. Ladder diagram has a background that is historically connected with the relay logic used in control before programmable logic controllers emerged. The basic structure of a ladder diagram program therefore looks like an electrical scheme, with contacts and coils connected between two power rails.

III. WORKING

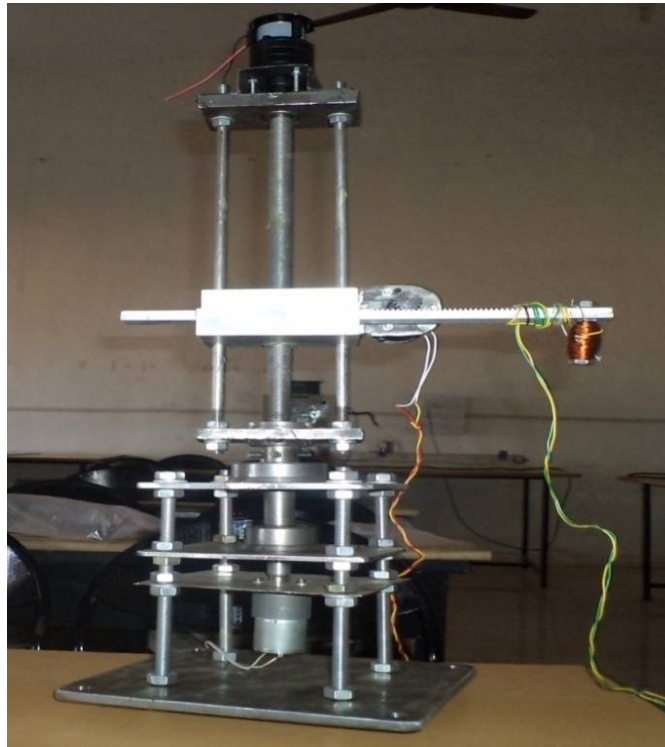


Fig.1: Working model PLC Based Pick and Place Robot

Working of PLC based pick and placed robot with 4- DOF:

Basically the robot used is the cylindrical type. It consist of following joints,

1. Two prismatic joints.
2. One rotary joint.

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So the aim is to lift or pick the object (work piece) from a specific position, move it and pass to the desired position. Let,

- Block is in position A
- The gripper is in position B
- The object is at position C
- Final position is at D

When the switch is on, automatic control system is operating by using a PLC. Initially the first motor is operated and screw is rotated, the block moves up and down from position A , the block position is maintained to the height of the work piece in position C. Now the block is in the level of work piece but the Gripper cannot Grip the work piece, so in order to Grip the work piece it is necessary to maintain the Gripper level near to the work piece, for these automatically the motor attached to pinion is operated and rake moves horizontally. The Gripper attached to the rack, Gripper is a move toward work piece.

The Gripper is Electromagnetic type. When supply is given to Gripper wire, the magnetism is created in it and the work piece is to Gripped. Now the Gripper is at position C with the work piece, next motion is rotated. For rotary motion next motor is operated and the whole assembly above base is rotated clockwise or anticlockwise as per the position of the work piece storage. Now our aim is to move the work piece from position C to the position D. If the position D not attained only by the rotary motion then automatically other motors are operated and horizontal or vertical motion is performed in combination with rotary motion. And finally Gripper is coming to position D. When the Gripper reaches to position D, supply is cut automatically, magnetism is cut off. And work piece is released from the Gripper at the desired position.

Specification of PLC based pick and placed robot

Sr. No.	Parameter	Value- unit
1.	Total vertical distance	300 mm
2.	Total horizontal distance	300 mm
3.	Rotation Angle	360 degrees
4.	DC Motor Speed	25 -125 RPM
5.	Gripper Capacity	50gm

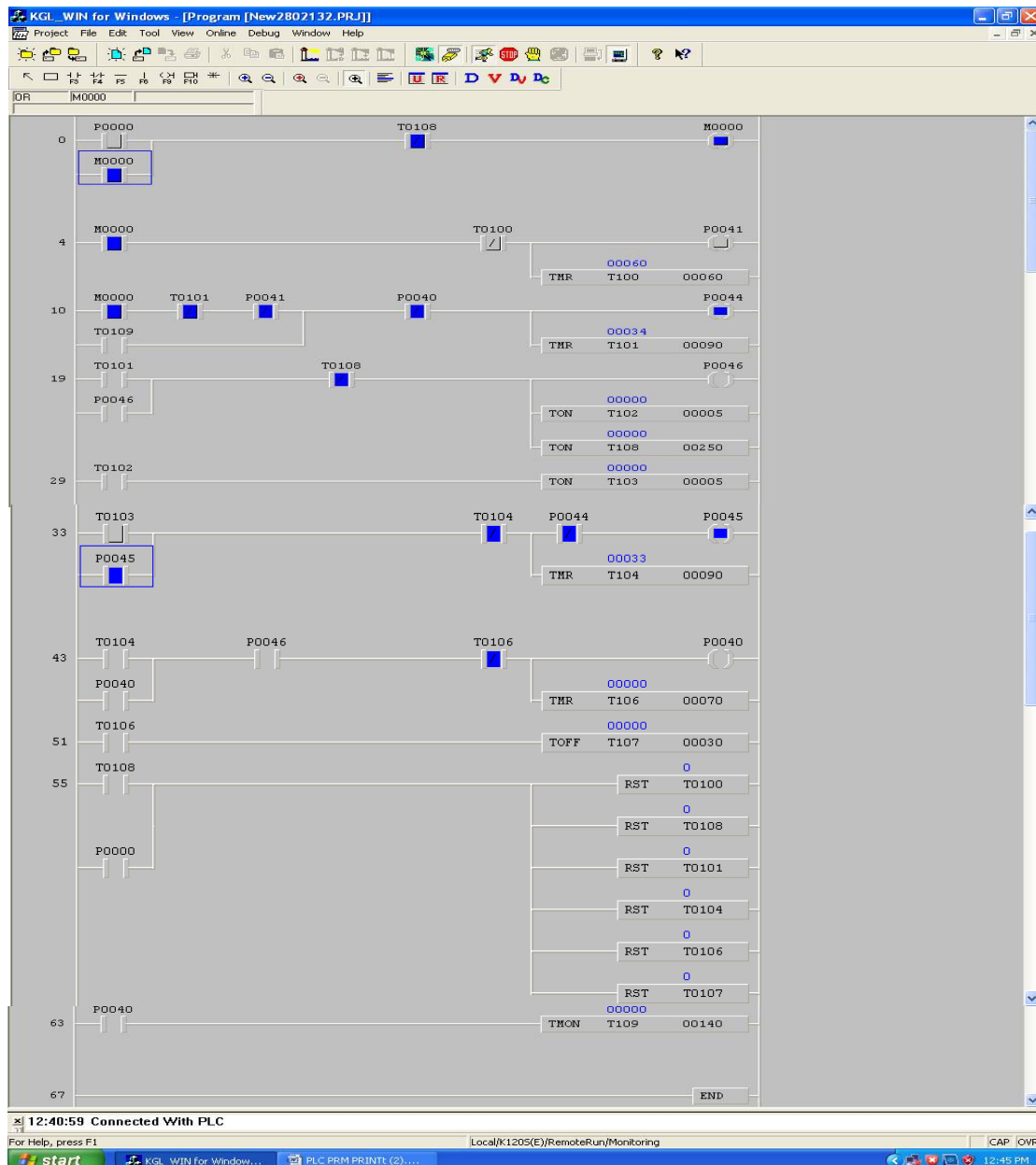
The proposed PLC based pick and placed robot consist of a screw, rack and pinion , electromagnetic gripper, Timer, Three DC motors, proximity sensors. The PLC is used here as a controller of the system.

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IV. PLC PROGRAMMING FOR PLC BASED PICK AND PLACED ROBOT



V. CONCLUSION

1. The work piece can cache and gripped within specified time.
2. As we make cylindrical (post) type robot with three DOF performing well picks and placed function.
3. PLC is successfully interfaced and operated for automation of robot.
4. Eliminate the usage of human power to pick up things.

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