International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 06 | June -2017 www.irjet.net p-ISSN: 2395-0072

Pick and Place Robotic Claw for Engineering Applications

Apurva More[1], Vaibhav Murkute[2], Shweta Kulkarni[3], Ajitesh Handu[4]

[1]*Apurva More, Student, B.E. (Instrumentation & Control), DYPCOE-Akurdi, Pune*
[2] *Vaibhav Murkute, Student, B.E. (Instrumentation & Control), DYPCOE-Akurdi, Pune*
[3]*Shweta Kulkarni, Student, B.E. (Instrumentation & Control), DYPCOE-Akurdi, Pune*
[4]*Ajitesh Handu, Student, B.E, (Instrumentation & Control), DYPCOE-Akurdi, Pune*

Abstract – *This paper presents a PLC (Programmable Logic Controller) operated Pick and Place Robotic Claw. This system enables an object to be picked and placed automatically for a wide range of applications. The robotic claw is an open or closed kinematic chain of rigid links interconnected by movable joints. At the end of claw, a wrist joint connects end effectors which may be a tool and its fixture or gripper could be used to pick up, hold and move the object from place to another. In this way a pick and place robot can be designed for a workstation where loading and packing of components such as lead batteries is been presented. It can also solve problems related to the tasks to be performed on heavy load, high temperature area or narrow area.*

Key Words: Claw, Pick and place, PLC, Robot, Stepper motor

1. INTRODUCTION

Mankind has always strived to create artefacts with the aim of finding substitutes for him or to carry out his orders and also to work in a hostile environment. The popular concept of a robot is of a machine that looks and works like a human being. Over the past few decades, the industry has been making rapid advancements in automation and moving towards Robotics, to increase productivity and to deliver uniform quality. The industrial robots today may not always look like a human being although all the research is directed to provide more and more anthropomorphic and human-like features and super-human capabilities in the robots. One type of robot commonly used in industries is a robotic manipulator or simply a robotic claw.
Inspired by this concept we came up with the project- PICK AND PLACE ROBOTIC CLAW.
All the various problems and obstructions for the loading process have been deeply analyzed and been taken into consideration while designing the pick and place system.

1.1 Objectives

The main objective of this project is to control the movement of the robotic claw as per the placement of objects. The claw is controlled using stepper motors and drivers and operated by PLC.
The installation of Pick and Place system in industries is associated with the following objectives:
1. Saving of manpower.
2. Improved quality and efficiency in manufacturing processes.
3. Ability of the system to operate or work in any hostile environment.

1.2 Factors to be considered while designing the system

While designing of pick and place robots, various factors are to be considered. A few of them are discussed as follows.

Controls
The mechanical structure of a robot is controlled to perform different tasks. The robot is controlled in three distinct phases - perception, processing and action. The sensors give information about the changes associated with environment or the robot itself (e.g. the position of its joints or its end effectors). This information is then processed and the controller produces corresponding appropriate signals to drive the actuators (motors) which move the mechanical structure.

Methods of Programming
The basic methods of programming a robot are Teach Method, Lead Through and Off-line Programming.

Degree of Freedom
The number of Degree of Freedom (DOF) that a system possesses is the numbers of independent position variables that need to be specified in order to define the system or process completely. It could also refer to the different number of ways in which a robot arm can move in the particular direction.

2. HARDWARE IMPLEMENTATION

Pick and Place system is operated by PLC on 24 volts DC supply. To start the operation, first put the SPDT switch in ON position. The program will not run if the SPDT switch is in OFF position. This can be used to start and stop the motor.

MODE OF OPERATION: The operation starts from the top left.SM1 moves horizontally till it reaches the proximity switch. Once the proximity is energized the forward motion of SM1 ceases and SM3 starts to operate which opens the claw for a fixed period of time. Now SM2 begins to operate in vertically downward direction for a fixed amount of time,

enough for the assembly to reach near the object to be picked. Now the SM3 operates in the opposite direction which lets the claw close in on the object and grasp it. Afterwards, SM2 starts to operate in reverse and begins upwards motion for the same amount of time. SM1 moves in reverse direction to regain the starting position, SM2 operates in forward direction and lastly SM3 directs the claw to open and drop the object at the designated place.
Figure 1 shows the Pick and Place system installed in industries.

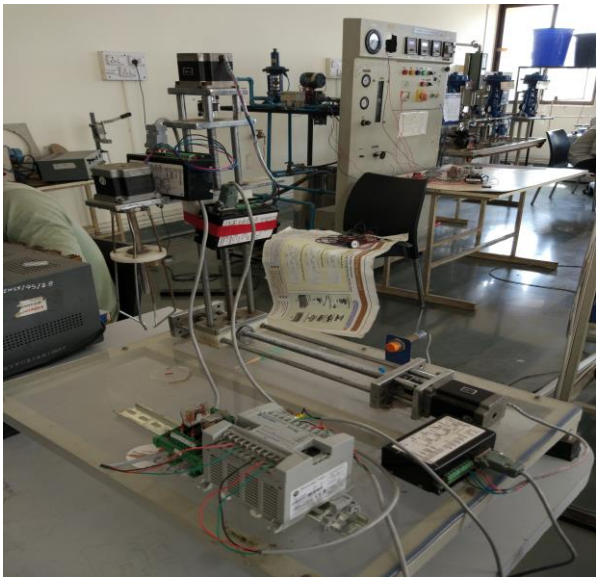

Fig -1: Pick and place system

Keeping in view the cost, production rate and complexity, the elements chosen were as follows:

Programmable Logic Controller (PLC)
A Programmable Logic Controller or PLC is a digital computer with a built-in operating system (OS). This OS is highly specialized and optimized to handle incoming events in real time.
A typical block diagram of PLC shown in figure 2 consists of the following basic parts:
• CPU
• Programming device
• Input and output module
The system is user programmable. The programming language used is called RLL (Relay Ladder Logic).

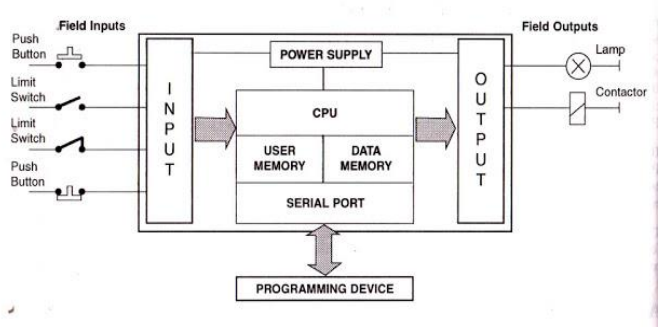

Fig -2: Block Diagram of PLC

Inductive Proximity Sensor
An inductive proximity sensor is used to detect the position of metal objects. The sensing range of an inductive switch is dependent on the type of metal being detected. Ferrous metals such as iron and steel allow for a longer sensing range, while non-ferrous metals such as aluminium and copper can reduce the sensing range by up to 60 percent. The output of an inductive sensor has two possible states. Therefore an inductive sensor is also referred to as an inductive proximity switch.

Stepper Motor
A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. The speed of the motor shaft's rotation is directly related to the frequency of the input pulses applied. A stepper motor divides a full rotation into a number of steps. Thus the motor can be turned to a precise angle. 3 stepper motors along with their drivers have been used in the system for movement of the claw in horizontal direction, vertical direction and rotation respectively.

3. APPLICATIONS

1. Material handling in industries
2. Packaging and wrapping of goods
3. Games and casino
4. Construction work
5. Shipping industry
6. Food industry

4. ADVANTAGES

1. Accuracy
Robots have wide reaches, repeatability and precise tooling. Due to such high precision capability, they are used for pick and place applications.

2. Flexible Pick and Place
One of the main advantages of robotics is flexibility. The robots are used in the applications where products have multiple changes in shape and type. Pick and place robots are easily programmable. Also, robots provide a high level of movement flexibility.

3. Robots are Space efficient:
They are designed with compact bases and hence they conserve floor space.

4. Cost effective
The precision and reliability of these robots results in less wasted material and more efficient use of time thereby making pick and place robots an extremely cost effective solution.

5. Robots maximize safety
They are labor-intensive and repetitive. Pick and Place robots are unaffected by the stresses or load of the application. They are able to work without making mistakes.

5. DISADVANTAGES

1. Expense:
The initial investment to integrate automated robotics into your business is significant, especially when business owners are limiting their purchases of robotic equipment. The cost of robotic automation should be calculated in light of a business' greater financial budget. Regular maintenance needs can have a financial toll as well.

2. ROI (Return on Investment):
In corporate, industrial robots do not guarantee results. Without planning, companies can have difficulty achieving their goals.

3. Expertise:
Employees will require special training programs to interact with the new robotic equipment. This normally takes time and financial output.

4. Safety:
Robots may protect workers from some hazards, but in the meantime, their presence can create other safety problems. These new dangers must be taken into consideration.

6. CONCLUSION AND FUTURE SCOPE

Thus a Pick and Place Robotic Claw is a cost effective solution for lifting, movement, placement and alignment of objects in the industrial applications.
The future scope or various tasks which a pick and place robot can perform are as follows:

Pick and place
The robots could be used for placing products in cartons and transferring the cartons and products between different stations in the packaging lines. High speed pick-and-place robots for placing small items like candy and cookies in packages are often combined with a visual observation system for identifying products.

Handling of flexible packages
Flexible packaging material is a soft package made of film, foil or paper sheeting. Popular forms are stand-up pouches, bags, sachets and envelopes. These packages are often filled and sealed with some material and then finally put into a case by top loading with the help of a robot.

Palletizing and de-palletizing
Palletizing is a process in which packages are placed on a pallet alternatively. De-palletizing is simply removing these packages from a pallet. The robotic claw could serve this purpose.

7. ACKNOWLEDGEMENT

We would like to extend our sincere gratitude to Mr. Pauroosh Kaushal (Asst. Professor, D.Y. Patil College of Engineering, Akurdi) for his technical guidance and support.

8. REFERENCES

[1] R.K. Mittal and IJ Nagrath "Robotics and Control" BITS Pilani, 2003.

[2] Ratheesh Rajan- "Foundation Studies for an alternate approach to motion planning of dynamic systems", M.S.E, The University of Texas, Austin, 2001.

[3] The Math Works Inc. MATLAB 7.0 (R14SP2), 2005.