

A Review on Pneumatic Based Automatic Loading of Components in Lathe Chuck for Machining Process

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Abstract: *In this modern era, we are experiencing an increase in the population. Due to the increase in the population, the need for products is huge. Both man power and machine power are required to increase production. In this era, to create a finished product, a material has to undergo a different machining process. Normally, these processes are done manually. The loading and unloading of a material in chuck requires more cycle time. So, there is a need for the necessity of automation, to reduce loading time and increase productivity. Instead of loading manually, we can imply low cost automation. The loading and unloading of components by manual is a time - consuming process. There might also be wrong loading of the components. In this review work we are going to see an automatic system for loading and unloading of a brake piston in chuck of a CNC/Lathe machine. The low cost automatic loading and unloading of components inside the chuck could undergo processes like facing, turning, grooving. The system could be achieved with the help of pneumatic, hydraulic, electric actuating systems.*

Keywords: Automation, production, lathe, CNC, pneumatic, hydraulic and electric

1. Introduction

In this modern era the requirement of the products is very high. So, the rate of production is also increased. There is a need for the necessity of automation to increase productivity. Below mentioned literature survey we know about the controlling of actuator, PLC and lathe components, automatic loading mechanism for different process and place of the elements.

Machining Process

Machining is the process of converting raw materials into required shapes and sizes. Machining usually refers to metal working. There are various process in machining namely facing, turning, step turning, grinding, grooving, etc.

Previous Methods

Early days the machining operations of the materials are manually loaded and unloaded by humans. From the perspective of industry they spend less investment and need more profit and quality output. But the error occurs during manual operations are:

- More fatigue for the operators
- Chance of wrong loading of the component
- More consumption of time
- Low productivity
- Separate Man for each machine

Drive Systems

Drive system of robot refers to move its body with the help of the power delivered to the robot. The power could be of three types namely pneumatic, hydraulic, and electric.

Pneumatic System

Pneumatic drive is by and large saved for littler robots that

have less degrees of flexibility. These robots are regularly restricted to straightforward choose and put operation with quick cycles. Pneumatic control can be promptly adjusted to the incitation of cylinder gadgets to supply translational development of sliding joints. It can also be utilized to functions rotating actuators for rotational joints.

Components:

- Double acting pneumatic cylinders:
- Directional control valves
- FRL unit
- Pneumatic grippers



Figure 1: Pneumatic components (source: google)

Hydraulic System:

Larger robots are often those with hydraulic drives. The robot gains more speed and strength thanks to the hydraulic drive system, which is one of its typical benefits. This robot's biggest drawback is that it takes up more floor area. Leaking oil is a hassle.

Electric System

Electric system does not provide speed and strength when compared to hydraulic system. But it is very suitable for repeatability and accuracy. It also has advantage, it requires

Volume 12 Issue 5, May 2023

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less working space. It is actuated by dc stepper motors or dc servo motors.

Low Cost Automation

As liberalisation and globalisation take hold, it is essential that businesses look at ways to increase automation and productivity in order to remain competitive. Low cost automation is a method that, in this aspect, holds great promise for any type of industrial organisation. Low cost automation is a technology that uses primarily readily accessible, conventional equipment to automate some aspects of already existing tools, procedures, and equipment.

2. Literature Survey

Plc Based Pneumatic Pick and Place System

Purva Rakhade proposed a "PLC based pneumatic pick and place system". The outcome of this project is to pick and place the component with the help of pneumatic, hydraulic and servo motors controlled by PLC. The component is travel in the conveyer when it reaches the end of the conveyer the sensor detects and passes the signal to directional control valve. With the help of pneumatic gripper the vertical actuator goes down and pick and with the help of horizontal gripper it place the component in other conveyer. [1]

Design & Development of a Two - jaw parallel Pneumatic Gripper for Robotic Manipulation

This research work was proposed by Ardhendu Prasad Nanda. Here he discussed about the various types of grippers like Dual Motion Gripper, Pneumatic Three jaw Parallel Gripper, Compact Parallel Gripper etc. Also he mention about the factors for choosing the grippers and the jaws models. Mention the specification of grippers like stroke spread, force and weight. [2]

Accurate Position Control of a Pneumatic Actuator Using On/Off Solenoid Valves

This paper was written by B. van Varseveld and M. Bone. The paper explain to use On/Off valve using Pulse width modulation instead of using costly servo valves. The accurate positions of pneumatic actuator are normally done by servo motors. But using these servo motors is bit expensive. Instead they use solenoid valve for fast, accurate and it also cost less. The actuators efficiency is compared with servo valves efficiency. [3]

Industrial Robotics Technology, Programming, and Applications

In this book "Industrial robotics" written by Groover, Weiss, Nagel, Odrey, Dutta discuss about the work volume of a robot like spherical, rectangular, cylinder. They mention three types of drive system pneumatic, hydraulic and electric. They explain their applications, advantages and disadvantages. It explains about end effectors and its type's mechanical gripper and its mechanism and also vacuum grippers, magnetic grippers and adhesive grippers. With the help of this book I came up with knowledge in drive system which I want to use in my work. I came to know about the grippers, the working and its types. [4]

Research on Automatic Loading and Unloading Technology for Vertical Hot Ring Rolling Process

Here they proposed idea for automatic loading and unloading of a hot rings in rolling process. The temperature of the rings is high and these are used in automotive sectors. So to automate this process they proposed a system with help of pneumatic drive system. The hot rings are hold with the help of loading manipulator. The unloading is done by unloading fork. After this setup they analysed the hot rings. Finally they achieved the required output. [5]

Automation of Loading and Unloading to CNC Turning Centre

In this article, they developed automation for loading and unloading of socket into CNC machine. The socket should undergo rough turning process. Earlier the works was done by human, carrying the socket from the store and loading the socket in the chuck, and close the chuck foot operated and then he collects. Due to manual process the loading and unloading of component takes much time. Then they proposed a system, with the help of pneumatic actuators and the socket is hold and travel to the chuck by long stroke cylinder and it is loaded into the chuck by short stroke. Then it is machined and collected. [6]

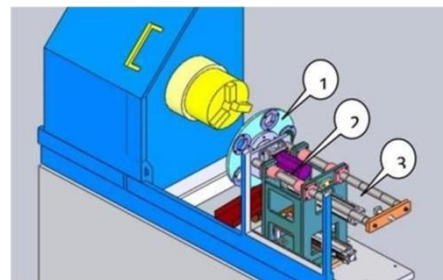


Figure 2: Automation of Loading and Unloading to CNC Turning Centre [6]

Design and Fabrication of Automatic Loading and Unloading Mechanism for a Job on CNC Lathe

In this paper written by P. N. Wakchaure, Umesh Kumar, Sasane Suraj, Thorat Lalit they developed a low cost automation. This system is developed to overcome materials quality, increase quantity, reduce time and cost. It consists of large actuator cylinder to take the job near to chuck. There they placed job pushing cylinder to place the job into the chuck. Then after the machining process is completed, the ejector cylinder place there helps the job to move back to holder of Maxine cylinder, then it place it to the finished pallet and the cycle repeats. The whole process is controlled with the help of PLC controller. The simulations of these pneumatic cylinders are done with help of FESTO fluidsim. Form this article I get an idea to controlling of the actuating cylinder and the mechanism for loading and unloading. [7]

Design of a Material Handling Equipment: Belt Conveyor System for Crushed Limestone Using 3 roll Idlers -

In this paper, they explains how to transport raw materials or product from one process to another process. This equipment are built in easy design such that they make easy, cheap, fast and safe loading and unloading with minimum human help. This paper discussed about the design calculations and considerations for conveyor system, product to be handled

also its load capacity to make fast, continuous and efficient movement of crushed limestone without any delay during loading and unloading.

Review Paper on Lathe Machine Components and It’s Application –

In this research paper, they explain lathe parts such as spindle, tailstock, carriage, chuck and jaws, also lathe application in industry. The lathe machine is the most useful machine tool in a tool room workshop and has various applications for making operations required to make a work piece of desired shape and size.

Design of Pneumatic Pick and Place Automation for Groove Grinding Machine

In this paper, they developed pneumatic pick and place especially for groove grinding machine. They have divided the setup into horizontal and vertical to reduce total weight of the setup. Front and back for horizontal and upward and downward motion for vertical.



Fig 1.3 Design of Pneumatic Pick and Place Automation for Groove Grinding Machine [10]

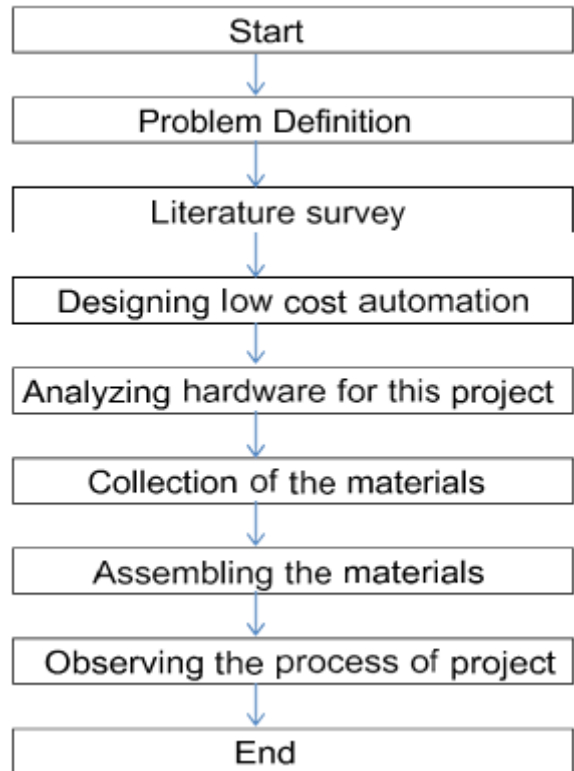
Fabrication of Pneumatic Pick and Place Robot

In this article, they explained about their pneumatic based pick and place robot. And all the task performed by this system are non-intervention of humans. They have used automobile battery. This robot is a seven degree of freedom robot.

Design and Implementation of Pick and Place Robotic Arm

In this work, they developed a 4-DOF pick and place robot. To provide accurate position of the gripper they have used four servo motors. And these motors are controlled by the atmega-16 microcontroller.

3. Flowchart



Time data for manual loading

Activity	Time Taken
collecting work piece from pallet	5
Placing it in chuck	5
Machining time	18
Removing work piece from chuck	10
Total time	38

4. Conclusion

The machining for different types of components can be made by different methods and different drive system. The drive systems are Pneumatic, Hydraulic, Electric. The drive system can be selected based upon their factors. But for low cost automation the right choice is pneumatic system. The pneumatic drive system make this system more effects and the setup cost is low while comparing to others. This system can be used for automatic loading for various components without changing its design. To conclude this automatic loading system has various advantages:

- Prevention of wrong loading of component
- Reduce Loading time
- Reduce human fatigue
- Increase Productivity
- More profitable

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