

Pneumatic Based Low Cost Automatic Loading of Brake Piston for Machining Process in Lathe/CNC Chuck

Submitted in fulfillment of the requirements for the award of
Bachelor of Engineering degree in Mechatronics

by

Praveen kannaa U.K(39090038)

Ragul.U(39090041)



**DEPARTMENT OF MECHATRONICS
SCHOOL OF MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

MAY - 2023

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Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai – 600 119

www.sathyabama.ac.in

DEPARTMENT OF MECHATRONICS

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Ragul.U (39090041)** and **Praveen kannaa U.K (39090038)** who carried out the project entitled "**Pneumatic Based Low Cost Automatic Loading of Brake Piston for Machining Process in Lathe/CNC Chuck**" under our supervision from June 2022 to May 2023.

Internal Guide

Dr. Ritesh Kumar M.Tech., Ph.D.

Head of the Department

Dr. S. Prakash M.E., Ph.D.

Submitted for Viva Voce examination held on ____ May 2023

Internal Examiner

External Examiner

DECLARATION

We, **Ragul.U (39090041)** and **Praveen kannaa U.K (39090038)** hereby declare that the Project Report entitled “**Automatic Loading and Unloading of Brake Piston for Machining Process**” done by us under the guidance of **Dr. Ritesh Kumar, M.Tech., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechatronics.

1. 

2. 

DATE: ____ May 2023

PLACE: Chennai, Tamil Nadu

SIGNATURE OF THE CANDIDATE

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I am pleased to acknowledge my sincere thanks to Board of Management of SATHYABAMA for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

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I would also wish to thank my parents for all the tireless efforts they made for making me able to do what I do today.

ABSTRACT

A population boom has undoubtedly occurred in this advanced technological period. The population is growing, and there is a huge demand for goods. The growth in production is a result of both human and mechanical labour. 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 a piston by manual is a time-consuming process. There might also be the wrong loading of the components. In this research work we are going to develop a system for loading a brake piston into the chuck of a CNC/lathe machine. This low-cost automatic loading and unloading of the piston inside the chuck could be used for the piston to undergo a machining process like facing, turning, grooving. This could be achieved with the help of pneumatic, hydraulic, electric actuating systems. The system is built at the side of the chuck.

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LIST OF ABBREVIATION

CNC	Computer Numeric Control
PLC	Programmable Logic Controller
CAD	Computer Aided Design

CHAPTER-1

INTRODUCTION

1.1 MACHINING PROCESS:

In this modern era, there is an increase in the population. Due to this, the requirement of the products is also very high. So, the rate of production has also increased. The increase in production involves both the man power activities and machine power activities. In certain production processes, man power is essential and inevitable, whereas in some other areas of work, man power alone cannot work. It needs machine power also.

Machining is the process of converting raw materials into required shapes and sizes. Machining usually refers to metal working. However, it can also be used in connection with the manufacture of wood, plastics, ceramics, stone and other materials. If you have a raw material that you want to form into a specific shape for a specific purpose, use a machining process to shape that raw material into the final product. Examples of machined products include nuts and bolts, auto parts, flanges, drill bits, signs, and many other tools and items for various industries.

Machining process majorly cover these three types Turning, Drilling, Milling operations. Fig:1.1 displayed the detailed view of machining types.

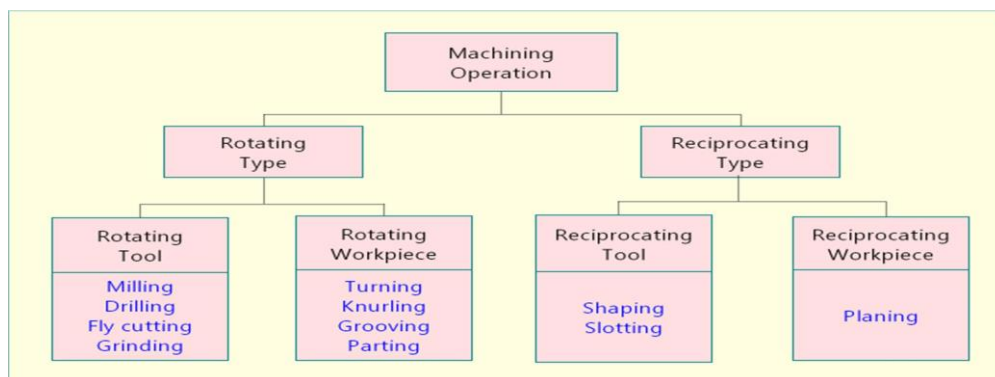


Fig:1.1 : Types of machining process

1.1.1 Facing

In machining, a facing operation is a type of cutting operation where the cutting tool is used to create a flat surface on the end or face of a workpiece. This operation is typically performed on a lathe or milling machine. Fig:1.2 displays the position of workpiece, facing tool.

In a facing operation on a lathe, the cutting tool is mounted perpendicular to the workpiece and moves in a straight line across the end of the workpiece. This removes material and creates a flat surface. The depth of cut can be adjusted to create a desired surface finish.

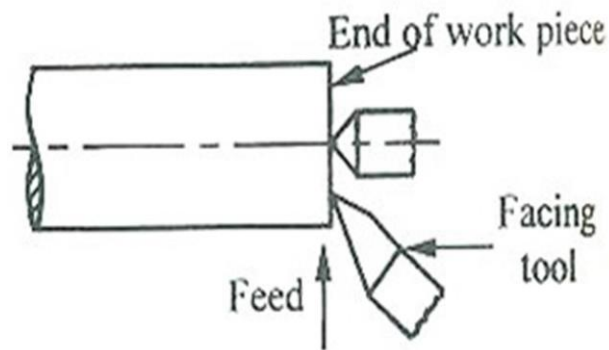


Fig:1.2 : Facing

1.1.2 Plain Turning

Turning is a machining process used to create cylindrical parts by rotating a workpiece against a cutting tool. The process involves removing material from the workpiece using a cutting tool that is fed into the rotating workpiece. This results in the creation of a cylindrical shape that is concentric with the axis of rotation which is displayed in Fig:1.3.

A plain turning operation involves the use of a single-point cutting tool that is fed parallel to the axis of rotation of the workpiece. The tool is held in a tool holder that is mounted on a tool post, which can be moved along the lathe bed to control the depth of cut.

During the turning process, the workpiece is rotated at a constant speed while the cutting tool is fed into the workpiece at a controlled rate. The depth of cut is determined by the amount of material that is to be removed from the workpiece.

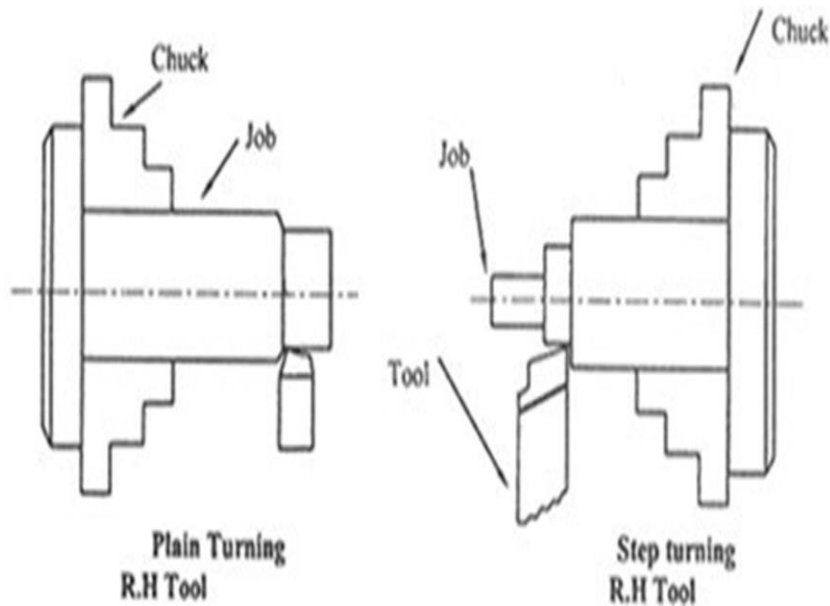


Fig:1.3 : Plain Turning & Step Turning

1.1.3 Step Turning

Step turning is a machining operation used to create a circular profile on a workpiece. It involves removing material from a rotating workpiece using a cutting tool while simultaneously moving the tool perpendicular to the axis of rotation which is displayed in the Fig:1.3.

The process of step turning is typically performed on a lathe or a turning center. The workpiece is secured in a chuck or a collet and rotated at a specific speed. The cutting tool, which is mounted on a tool holder, is then fed into the workpiece at a specific angle and depth.

1.1.4 Taper Turning

Taper turning is a machining operation used to create a conical shape on a cylindrical workpiece, such as a rod or a shaft as you see in the below Fig:1.4. The process

involves gradually reducing the diameter of the workpiece from one end to the other, resulting in a tapered shape.

The most common method of taper turning is by using a lathe, which is a machine tool that rotates the workpiece while a cutting tool removes material. To perform taper turning on a lathe, the cutting tool is set at a specific angle to the axis of rotation, and the workpiece is gradually fed into the tool at a controlled rate. As the cutting tool removes material, the diameter of the workpiece decreases, resulting in a tapered shape.

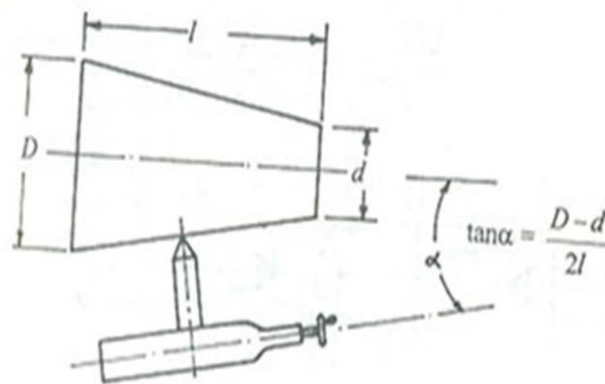


Fig:1.4 : Taper Turning

1.1.5 Knurling

Knurling is a machining process used to create a pattern of small, diamond-shaped ridges or knurls on the surface of a workpiece. Knurling can be performed using a lathe or a knurling tool.

The purpose of knurling is to improve the grip and traction of a surface, which can be useful in a variety of applications, such as handles for tools, knobs for machinery, and grips for pens or pencils. Knurling can also be used for decorative purposes.

The knurling tool consists of two hardened, serrated wheels that are pressed against the surface of the workpiece, creating the knurl pattern. The wheels are rotated while being pressed against the workpiece, which creates the diamond-shaped ridges.

1.1.6 Drilling

Drilling is a machining operation used to create a hole in a workpiece. It is a common operation in manufacturing and fabrication processes, and is typically performed using a drill bit.

The drilling process involves rotating the drill bit while applying axial force to the workpiece, which results in the creation of a hole. The drill bit is typically made of high-speed steel or carbide, and comes in a range of sizes and shapes to accommodate various hole sizes and shapes.

1.1.7 Grooving

Grooving is a machining operation that involves creating a channel or groove on a workpiece. It can be performed on a lathe machine using a specialized grooving tool. It's important to note that the grooving tool should be properly sharpened and maintained to ensure optimal performance and a high-quality finish. Additionally, care should be taken to ensure the workpiece is properly supported and clamped to prevent movement or damage during the grooving operation.

1.2 LATHE PARTS:

LATHE is a machine which has several parts in it. They are

1.2.1 Bed

A lathe bed is the base or foundation of a lathe machine. It is usually a long and rigid horizontal structure made of cast iron or steel that supports the headstock, tailstock, and carriage of the lathe. The bed provides a stable and flat surface for the various components of the lathe to move smoothly and accurately during operation.

The shape and design of the lathe bed can vary depending on the type and size of the lathe, but most beds have a V-shaped or flatway surface that guides the movement of the carriage and tailstock. The bed is typically mounted on legs or a stand and may have additional features such as chip trays or coolant channels to facilitate the machining process.

1.2.2 Head stock

The lathe headstock is the part of a lathe machine that supports the spindle and provides the rotational power to the workpiece. It is typically located at the left end of the lathe bed, opposite the tailstock. The headstock houses the spindle, which is driven by the lathe's motor or an external power source.

The spindle is a rotating shaft that holds the workpiece or the chuck that grips the workpiece. The headstock also contains various components such as bearings, gears, belts, and pulleys that transmit the rotational power from the motor to the spindle. These components also allow the spindle to be adjusted for different speeds and feeds, which are necessary for machining different materials and workpieces.

1.2.3 Carriage

In the context of a lathe machine, a carriage is a component that holds and moves the cutting tool along the work piece. The carriage is mounted on the lathe bed and can be moved longitudinally by turning a lead screw or hand crank.

The carriage typically consists of several components, including a saddle that holds the cutting tool, a cross slide that moves the cutting tool perpendicular to the workpiece, and a compound rest that allows the cutting tool to be adjusted at an angle relative to the workpiece.

1.2.4 Saddle

A saddle in a lathe is a component that moves along the lathe bed and supports the cutting tool or the workpiece being machined. The saddle is mounted on the lathe bed and can be moved along it using a hand crank or an automated feed mechanism.

The saddle is an essential part of a lathe because it allows for precise movement of the cutting tool or the workpiece, which is necessary for accurate machining. The saddle typically has a dovetail or V-shaped guide that slides along the lathe bed,

providing stability and ensuring that the tool or workpiece is held securely in place during machining.

1.2.4.1 Cross slide

A cross slide is an essential part of a lathe machine that moves the cutting tool perpendicular to the axis of rotation of the workpiece. It is a mechanical device that allows the machinist to control the depth and direction of the cut.

The cross slide typically consists of a cast-iron base that is bolted to the bed of the lathe machine. The base holds the cross slide assembly, which consists of a dovetail slide, a saddle, and a tool post. The dovetail slide provides the sliding mechanism, while the saddle holds the cutting tool and can move along the slide. The tool post is attached to the saddle and holds the cutting tool.

1.2.4.2 Compound rest

In a lathe machine, the compound rest is a component that holds the cutting tool and provides the necessary support and adjustability for the tool during turning operations. It is located on top of the cross-slide and can be swiveled to different angles to enable the cutting tool to create various angles and shapes.

The compound rest consists of a base that is mounted to the cross-slide and a top slide that can be rotated to different angles. The cutting tool is clamped onto the top slide and can be adjusted vertically and horizontally to achieve the desired depth and angle of cut.

The compound rest is an essential component of a lathe machine and is used to create various types of cuts, such as facing, turning, drilling, and boring. It allows the operator to make precise cuts and shapes on the workpiece by adjusting the cutting tool to the correct position and angle.

1.2.4.3 Tool post

A tool post is a component in a lathe that holds and secures cutting tools. There are different types of tool posts available for lathes, but the most commonly used types are the quick-change tool post and the lantern tool post.

The quick-change tool post allows for rapid tool changes without the need to manually adjust the tool height or position. It consists of a base that mounts to the lathe's cross-slide, a tool holder body that attaches to the base, and various tool holders that attach to the body. The tool holders are designed to hold specific types of cutting tools and can be easily swapped out by releasing a locking lever.

1.2.5 Apron

An apron is an essential component of a lathe machine. It is a metal plate or casting mounted to the carriage, which is responsible for controlling the movement of the cutting tool and the workpiece. The apron typically houses the gears, clutches, and other mechanisms that control the feed and speed of the lathe.

The apron of a lathe is designed to protect the lead screw, feed rod, and other essential components from chips, dust, and debris generated during the machining process. It also helps to keep the cutting fluid and lubricants contained, preventing them from splashing or leaking onto the operator or the surrounding area.

If the apron is not functioning correctly, it can affect the performance of the lathe and even cause damage to the machine or the workpiece. Common problems with aprons include wear and tear, damage to the gears or clutches, and contamination by debris or coolant.

1.2.6 Lead screw

A lead screw is an important component of a lathe machine. It is a long, threaded rod that is used to move the cutting tool in a precise and controlled manner along the length of the workpiece being machined. The lead screw is connected to the lathe's

carriage assembly, which holds the cutting tool, and rotates as the workpiece is turned by the lathe's spindle.

As the lead screw rotates, it engages with a set of gears on the carriage assembly, causing the carriage to move along the lathe bed. The pitch of the thread on the lead screw determines the distance the carriage will move for each revolution of the lead screw. By adjusting the speed and direction of the lead screw, machinists can control the depth and direction of the cuts made by the cutting tool.

1.2.7 Tail stock

The tailstock is located at the opposite end of the lathe bed and is used to support and stabilize the workpiece. It can be moved along the bed to accommodate workpieces of varying lengths. The tailstock also contains a quill that can be extended or retracted to provide additional support and can be used to hold a drill bit for drilling operations.

1.3 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

An industrial robot normally refers to a robotic arm used in production environment for machining, welding, painting applications.

Types:

Polar robot:

It has a telescopic arm that can be moved up or down about horizontal pivot. The pivot is presented in a rotating base. Based on its setup the work volume of the robot is spherical in shape.

Cartesian robot:

It is also called as xyz or rectilinear robot. It has three perpendicular slides. With the action of these three slides it can create a rectangular work volume.

Cylindrical robot:

An arm which is attached to the slide present in the vertical column, slide can be move up and down with the help of the column. An arm present in the slide rotates radially. So it could create a work volume of cylinder in shape.

Jointed arm robot:

Basically the structure of this robot looks similar to human arm. And it consists of rotating joints.

1.4 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.

1.4.1 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.

1.4.1.1 Basic pneumatic system

A basic pneumatic system is a system that uses compressed air to transmit and control power. The system consists of several components, including an air compressor, a storage tank, a pressure regulator, various valves, and pneumatic actuators or cylinders.

When the system is in operation, the air compressor compresses atmospheric air and stores it in the storage tank. The pressure regulator reduces the pressure of the compressed air to a lower, more stable level, and the valves control the flow of compressed air to the pneumatic actuators or cylinders. The pneumatic actuators convert the compressed air into mechanical energy, which is used to move loads and perform work.

1.4.1.2 Advantages

Pneumatic systems are widely used in different industries for the driving of automatic machines. A pneumatic system has following advantages.

- **High force-to-weight ratio:** Pneumatic actuators can provide a high output force relative to their size and weight. This makes them ideal for applications where space is limited, or where a high level of force is required.
- **Quick response time:** Pneumatic actuators can respond quickly to changes in input signals, making them well-suited for applications where fast and precise movements are necessary.
- **Simple design:** Pneumatic actuators have a relatively simple design and are easy to install and maintain. They also require less space and are less complex than other types of actuators.
- **Cost-effective:** Pneumatic actuators are generally less expensive than hydraulic or electric actuators, making them a popular choice for a wide range of applications.

- **Safe operation:** Pneumatic actuators are considered to be safe to operate since they use compressed air, which is a clean and non-toxic energy source. They also do not generate heat, which can be a safety concern in some applications.
- **Compatibility with hazardous environments:** Pneumatic actuators can be designed to operate in hazardous environments, such as those with explosive gases or dust. This makes them an ideal choice for industries such as oil and gas, chemical, and mining.

1.4.1.3 Disadvantage of Pneumatic actuators

Pneumatic actuators are used in a wide range of industrial applications to control the movement of valves, dampers, and other process control devices. While they offer many advantages, such as speed, reliability, and simplicity, they also have a few disadvantages, including:

- **Limited Control:** Pneumatic actuators provide limited control over the motion of the valve or damper they are controlling. They are only able to move in a linear or rotational motion, and cannot provide precise positioning or variable speed control.
- **Sensitivity to Contamination:** Pneumatic actuators are sensitive to contamination, such as dust and moisture, which can cause wear and tear on the actuator components, resulting in reduced performance and shorter service life.
- **High Energy Consumption:** Pneumatic actuators require a significant amount of compressed air to operate, which can be expensive and energy-intensive. This can result in higher operating costs and a larger carbon footprint.
- **Noise:** Pneumatic actuators can be noisy, especially when operating at high speeds or in environments with high ambient noise levels. This can be a concern in certain applications, such as in hospitals, schools, or residential areas.
- **Maintenance:** Pneumatic actuators require regular maintenance to ensure they are functioning properly. This includes replacing seals, checking for leaks, and cleaning or replacing filters. Failure to perform regular maintenance can result in decreased performance, increased downtime, and higher operating costs.

1.4.1.4 Limitations of pneumatic systems

Although pneumatic systems have many advantages, there are also some limitations and drawbacks to consider:

- **Limited power output:** Pneumatic systems are generally not as powerful as hydraulic or electric systems, and are typically used for light to medium-duty applications.
- **Noise:** Pneumatic systems can be quite noisy, particularly when exhaust air is released from the system. This can be a problem in noise-sensitive environments or in applications where the noise could be distracting or disturbing.
- **Air quality:** The quality of the compressed air used in a pneumatic system can have a significant impact on its performance and reliability. Moisture, contaminants, and other impurities in the air can damage components and reduce the efficiency of the system.
- **Temperature sensitivity:** Changes in temperature can affect the performance of a pneumatic system, particularly if the air supply is not properly regulated or if the system is exposed to extreme temperatures.
- **Maintenance requirements:** Pneumatic systems require regular maintenance to ensure that they operate safely and efficiently. Components such as filters, regulators, and lubricators must be checked and replaced as needed, and leaks and other issues must be addressed promptly to prevent damage to the system.
- **Limited control options:** Pneumatic systems are not always suitable for applications that require precise control over the motion or speed of a load, as the control options available may be limited.

In summary, while pneumatic systems have many advantages, they are not suitable for all applications and can have some limitations and drawbacks that need to be considered.

1.4.2 Hydraulic system

Hydraulic drive is generally present with larger robots. The usual advantages of the hydraulic drive system are that it provides the robot with great speed and strength. The main disadvantage of this robot is it requires more floor space. Oil leakage is nuisance.

1.4.2.1 Advantages of Hydraulic system

Hydraulic actuators have several advantages over other types of actuators, including:

- **High force output:** Hydraulic actuators can generate a large amount of force due to the incompressible nature of hydraulic fluids. This makes them ideal for heavy-duty applications such as lifting, pushing, or pulling heavy loads.
- **Precise control:** Hydraulic actuators can be controlled with high precision, making them suitable for applications that require accurate positioning or movement control. The use of hydraulic pressure control valves enables operators to achieve the desired level of accuracy.
- **Smooth operation:** Hydraulic actuators offer a smooth and quiet operation, with little or no vibration. This makes them ideal for applications where noise and vibration are a concern, such as in laboratory equipment, medical devices, and precision machinery.
- **High durability:** Hydraulic actuators are typically built to withstand high pressure and extreme temperatures, making them highly durable and reliable. This makes them suitable for use in harsh environments, such as industrial or offshore applications.
- **Low maintenance:** Hydraulic actuators require minimal maintenance, as they have few moving parts and do not require lubrication. This reduces maintenance costs and downtime, making them a cost-effective option for many applications.

1.4.2.2 Disadvantage of Hydraulic system

Hydraulic actuators have several disadvantages, including:

- High initial cost: The cost of purchasing and installing hydraulic systems can be quite high compared to other actuation systems, such as electrical or pneumatic systems.
- High maintenance costs: Hydraulic systems require regular maintenance, including changing fluids and filters, checking for leaks, and ensuring that all components are functioning properly. These maintenance costs can add up over time.
- Potential fluid leaks: Hydraulic systems are prone to fluid leaks, which can be hazardous to the environment and can also cause damage to equipment and machinery.
- Complexity: Hydraulic systems can be complex and require skilled technicians to install and maintain them.
- Limited speed and precision: Hydraulic actuators may not be suitable for applications that require high-speed or precise movements, as they may experience delays and inaccuracies due to the time it takes for fluid to flow through the system.
- Limited temperature range: Hydraulic fluids can be sensitive to temperature changes, which can affect the performance of the actuator. In extreme temperatures, hydraulic systems may require additional cooling or heating to maintain optimal performance.

Overall, while hydraulic actuators have several advantages, they also have several disadvantages that should be considered when selecting an actuation system for a particular application.

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

1.4.3.1 Advantages of electric drive

Electric actuators have several advantages over other types of actuators:

- **Energy efficiency:** Electric actuators are more energy-efficient than other types of actuators because they convert electrical energy directly into mechanical energy, without the need for hydraulic or pneumatic systems.
- **Precision and control:** Electric actuators offer precise and accurate control, making them ideal for applications that require precise positioning and control, such as in robotics and automation.
- **Low maintenance:** Electric actuators require minimal maintenance, making them a cost-effective solution in the long run. Unlike hydraulic or pneumatic systems, electric actuators do not require frequent oil changes or air filters.
- **Environmentally friendly:** Electric actuators do not produce any emissions, making them environmentally friendly. They are ideal for applications where emissions are a concern, such as in clean room environments.

1.4.3.2 Disadvantage of electric drive

There are several potential disadvantages to using electric actuators

- **Power limitations:** Electric actuators require a source of electrical power, which can be a limitation in some applications where power is not readily available or where it is difficult to run power cables.
- **Reliability concerns:** Electric actuators can be more prone to failure than mechanical or hydraulic actuators, as they have more components and electronics that can fail or be damaged.
- **Cost:** Electric actuators can be more expensive than other types of actuators, particularly in applications that require high force or torque.
- **Control complexity:** Electric actuators require sophisticated control systems to operate, which can be complex and difficult to implement in some applications.

- Environmental limitations: Electric actuators can be affected by environmental factors such as temperature, humidity, and exposure to chemicals, which can limit their use in certain applications.

1.5 COMPONENTS

1.5.1 Air filter

An air filter is an essential component in a pneumatic system. It is used to remove impurities and contaminants, such as dust, dirt, and moisture, from the compressed air that powers the system. These impurities can cause damage to the components of the system, reduce its efficiency, and affect the quality of the products being produced.

There are different types of air filters available for use in pneumatic systems, such as particulate filters, coalescing filters, and adsorption filters. Particulate filters remove solid particles from the compressed air, while coalescing filters remove oil and water droplets. Adsorption filters are used to remove odors, fumes, and vapors from compressed air.

It is important to select the right type of air filter for a specific pneumatic system, based on the level of contaminants that need to be removed and the required flow rate of the compressed air. Regular maintenance of the air filter is also important to ensure its proper functioning and prevent any damage to the system.

1.5.2 Pressure regulator

A pressure regulator is a device used in a pneumatic system to regulate and control the pressure of the compressed air. It is installed between the air compressor and the rest of the pneumatic components, such as valves, cylinders, and actuators.

The pressure regulator works by reducing the pressure of the compressed air to a specified level and maintaining it at a constant level, regardless of fluctuations in the

upstream pressure. This ensures that the pneumatic components receive a steady supply of compressed air at the required pressure, which is necessary for their proper functioning.

1.5.3 Lubricator

A lubricator in a pneumatic system is a device that injects a controlled amount of lubricating oil into the compressed air stream. The purpose of a lubricator is to lubricate the components of the pneumatic system, such as valves, cylinders, and air tools, to reduce friction and wear, and to prolong their lifespan.

The lubricator is typically installed downstream of the air compressor and upstream of the pneumatic components. It contains a reservoir for holding the lubricating oil, a sight glass to monitor the oil level, and a metering device to control the amount of oil injected into the compressed air stream.

1.5.4 Mufflers

Mufflers are devices used in pneumatic systems to reduce the noise generated by the exhaust of compressed air. They are typically installed at the exhaust ports of pneumatic components, such as valves, cylinders, and actuators.

When compressed air is exhausted from a pneumatic component, it creates a high-pressure, high-velocity flow that can produce loud noise and cause hearing damage to nearby personnel. Mufflers work by diffusing and slowing down the flow of air, which reduces the noise level and eliminates any potential hearing damage.

1.5.5 Selection of Pneumatic Valves

The selection of pneumatic valves for a specific application involves considering various factors such as the required flow rate, pressure range, and operating conditions. Pneumatic valves are used in a wide range of applications, including

controlling the flow of compressed air to pneumatic cylinders, actuating rotary or linear motion, and regulating pressure.

The following are some important factors to consider when selecting pneumatic valves:

- **Valve Type:** There are different types of pneumatic valves available, including directional control valves, pressure control valves, flow control valves, and shut-off valves. The type of valve selected will depend on the specific application and the function it needs to perform.
- **Flow Rate:** The flow rate required for the application will determine the size of the valve and the diameter of the valve port.
- **Pressure Range:** The pressure range of the application will determine the maximum operating pressure of the valve.
- **Operating Temperature:** The operating temperature of the application will determine the materials used to construct the valve and the type of seals needed to ensure reliable operation.
- **Actuation Method:** Pneumatic valves can be actuated manually, mechanically, electrically, or pneumatically. The selection of the actuation method will depend on the specific application requirements.
- **Environmental Factors:** Environmental factors such as humidity, dust, and corrosive gases may affect the performance and lifespan of the valve. Valves selected for use in such environments should be constructed with appropriate materials and have adequate protection to ensure reliability.

Overall, the selection of pneumatic valves should be based on a thorough understanding of the application requirements, and the appropriate valve type, size, and actuation method should be chosen to ensure reliable operation and efficient performance.

1.5.6 Direction Control Valve

Directional control valves are an essential component of pneumatic systems that control the direction of compressed air flow. These valves are used to control the motion of pneumatic actuators, such as cylinders, by directing the flow of compressed air into and out of the actuator.

Directional control valves can be either manually operated or automated, and they come in a variety of types, including two-way, three-way, and four-way valves. Two-way valves have two ports, one for compressed air inlet and one for outlet. Three-way valves have three ports, one for inlet and two for outlet, while four-way valves have four ports, two for inlet and two for outlet.

1.5.7 Two Way Valve

A two-way valve is a type of directional control valve used in pneumatic systems to control the flow of compressed air. It has two ports, one for compressed air inlet and one for outlet. The valve is designed to allow or block the flow of compressed air through the two ports, depending on its position.

In its closed position, the valve blocks the flow of compressed air through the ports, and in its open position, it allows the flow of compressed air through the ports. The valve is operated manually or automatically using a mechanical or electrical actuator.

1.5.8 Three Way valve

A three-way valve is a type of directional control valve commonly used in pneumatic systems to control the flow of compressed air. It has three ports, one for compressed air inlet and two for outlet. The valve is designed to allow or block the flow of compressed air through the ports, depending on its position.

In its closed position, the valve blocks the flow of compressed air through both outlet ports, and in its open position, it allows the flow of compressed air through one of the

outlet ports while blocking the other. The valve is operated manually or automatically using a mechanical or electrical actuator.

1.5.9 Four Way Valve

A four-way valve is a type of directional control valve used in pneumatic systems to control the flow of compressed air. It has four ports, two for compressed air inlet and two for outlet. The valve is designed to allow or block the flow of compressed air through the ports, depending on its position.

In its closed position, the valve blocks the flow of compressed air through both outlet ports and both inlet ports. In its open position, it allows the flow of compressed air through one of the inlet ports while blocking the other, and allows the flow of compressed air through one of the outlet ports while blocking the other. The valve is operated manually or automatically using a mechanical or electrical actuator.

1.5.10 Five Way Valve

A pneumatic five-way directional control valve is a device used in pneumatic systems to control the flow of compressed air. It has five ports that allow the valve to direct the flow of compressed air to different parts of a system. The valve can control the direction of airflow, the amount of airflow, and the speed at which the air flows.

The five ports on the valve are labeled with letters, typically P, A, B, R, and S. The P port is the inlet for compressed air, while the A and B ports are the outlets for air. The R port is used as an exhaust port, while the S port is used for the supply of pilot air.

1.5.11 Flow Control Valve

A pneumatic flow control valve is a device used in pneumatic systems to regulate the flow of compressed air or other gases. It works by controlling the amount of air that is allowed to flow through a pipe or tubing. This type of valve is typically used in applications where it is necessary to control the speed or rate of air flow, such as in pneumatic cylinders or air-powered tools.

1.5.12 Pneumatic Actuators

Pneumatic actuators are devices that convert energy from compressed air into mechanical motion. They are commonly used in various industrial and manufacturing applications where precise and reliable linear or rotary motion is required.

Pneumatic actuators typically consist of a cylinder, piston, and valve assembly that controls the flow of compressed air into and out of the cylinder. When compressed air is supplied to the cylinder, it pushes the piston, which in turn generates linear or rotary motion.

Pneumatic actuators are popular in industrial automation because they are relatively simple, reliable, and cost-effective compared to other types of actuators, such as hydraulic or electric actuators. They are also suitable for use in hazardous environments, as compressed air is non-flammable and does not generate sparks.

1.5.13 Pneumatic Cylinders

There are several types of pneumatic cylinders, including single-acting cylinders, double-acting cylinders, and telescoping cylinders. Single-acting cylinders use compressed air to move the piston in one direction, while a spring or other external force returns the piston to its original position. Double-acting cylinders use compressed air to move the piston in both directions. Telescoping cylinders are designed to provide long strokes in a compact space by using a nested set of cylinders that extend and retract.

1.5.14 Classification of pneumatic cylinders

1.5.14.1 Single acting cylinder

A single-acting pneumatic cylinder is a type of pneumatic actuator that converts compressed air pressure into linear motion. It consists of a cylinder with a piston inside, which is pushed or pulled by the compressed air entering one end of the

cylinder. The other end of the cylinder is vented to the atmosphere or connected to a spring, which returns the piston to its original position when the air pressure is released.

The operation of a single-acting pneumatic cylinder is controlled by a 3-way directional control valve, which supplies compressed air to the cylinder to extend the piston or vents the air to retract the piston. The piston in a single-acting cylinder can only move in one direction and relies on an external force, such as a spring, to return it to the initial position.

1.5.14.2 Double acting cylinder

A double-acting pneumatic cylinder is a device that converts pneumatic energy into mechanical energy to generate linear motion. It is composed of a cylinder with a piston and two ports, one for compressed air to enter and another for the air to exit. The piston is connected to a rod, which extends or retracts when the air is directed to one side or the other.

Unlike a single-acting cylinder that uses air pressure to move the piston in one direction and a spring to return it to the original position, a double-acting cylinder can generate force in both directions, extending and retracting the rod based on the direction of the airflow. This makes it useful in a variety of industrial applications, such as in manufacturing, automation, and material handling systems.

To control the motion of a double-acting pneumatic cylinder, a directional control valve is typically used to regulate the flow of compressed air into and out of the cylinder. The valve can be operated manually or electronically, and it allows for precise control of the cylinder's movements, including speed, direction, and force.

1.6 LOW COST AUTOMATION

As liberalization and globalization take hold, it is essential that businesses look into ways to increase automation and productivity in order to remain competitive. low cost

automation is a method that, in this regard, holds great promise for any type of industrial organization. Low cost automation is a technology that uses primarily readily accessible, conventional equipment to automate some aspects of already existing tools, procedures, and equipment.

There are many different systems (hydraulic, pneumatic, and electrical) that can be used in low cost automation. Because of their low cost, simplicity in manufacturing, safety during operation, etc., pneumatic circuits are quite popular for low cost automations. While generally more expensive than pneumatic systems, hydraulic systems are useful in applications where high forces and precise speed control are needed to achieve precise positioning. However, hybrid systems are used in the majority of real-world applications because they combine the benefits of various devices while at the same time minimizing their individual drawbacks. This uses multiple systems, each of which is properly interfaced with the others. They go by the names hydro pneumatic, electro pneumatic, electro hydraulic, etc. depending on the systems that are connected.

CHAPTER-2

LITERATURE SURVEY

2.1 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]

2.2 DESIGN & DEVELOPMENT OF A TWO-JAW PARALLEL PNEUMATIC GRIPPER FOR ROBOTIC MANIPULATION

The research work “Design & Development of a Two-jaw parallel Pneumatic Gripper for Robotic Manipulation” is proposed by ARDHENDU PRASAD NANDA. Here he discussed about the various types of grippers like Dual Motion Gripper, Pneumatic Three jaw Parallel Gripper, Parallel Gripper with a T-slot, Compact Low Profile 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.

2.3 ACCURATE POSITION CONTROL OF A PNEUMATIC ACTUATOR USING ON/OFF SOLENOID VALVES

The paper “Accurate Position Control of a Pneumatic Actuator Using On/Off Solenoid Valves” is written by B.van Varseveld and M.Bone. The paper describes to use On/Off valve using Pulse width modulation in place of rather 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. Also the overall efficiency of the actuators is compared with servo valves efficiency which is obtained by various other researchers.

2.4 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.

2.5 RESEARCH ON AUTOMATIC LOADING AND UNLOADING TECHNOLOGY FOR VERTICAL HOT RING ROLLING PROCESS

Wang Xiaokai, Wang Dehui, Mei Xuesong, Hua Lin, Dai Yutong, Wu Jian 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 high quality and production of the rings is efficiently achieved.

2.6 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.

2.7 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 for loading and unloading mechanism for a job on CNC lathe. 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 fluidsims. From this article I get an idea to controlling of the actuating cylinder and the mechanism for loading and unloading.

2.8 DEVELOPMENT OF A SPECIALIZED LATHE CHUCK FOR TURNING OPERATIONS OF CAST IRON ROPE WHEELS.

In the article, written by Izabela Miturska, Anna Rudawska, Nadezda Cubonova, Natasa Naprstkova discuss the use of lathe chucks in machine building companies is the result of a great deal of work and the development of technical thought. Due to the progress and the possibility of increasing efficiency and at the same time relieving people from work that requires a lot of effort, especially physical effort, the use of better and more efficient production methods is a target that should be pursued nowadays.

On the basis of the specialized lathe chuck model presented in the paper, the correctness of application of the proposed solution was demonstrated. The analysis of the correctly function of the chuck was carried out by means of simulations.

2.9 DESIGN OF A MATERIAL HANDLING EQUIPMENT: BELT CONVEYOR SYSTEM FOR CRUSHED LIMESTONE USING 3 ROLL IDLERS-

In this paper, they explain 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.

2.10 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.

2.11 FABRICATION OF PNEUMATIC PICK AND PLACE ROBOT

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

2.12 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.

2.13 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.

CHAPTER-3

AIM AND SCOPE

3.1 AIM

To develop an automatic loading and unloading of components in CNC / Lathe machine, thereby saving man power and increase productivity.

3.2 OBJECTIVES:

- Man power reduction
- Machine cycle time reduction
- Reduction of rejections
- Increased productivity
- Reduced Operator fatigue
- Improved morale of the operator
- Improved safety environment

3.3 PROBLEM DEFINITION:

While doing the loading and unloading of component manually, There is a great chance of not inserting the work piece to its determined position. There might be also be loading of component in reverse direction this would definitely damage the machine. When loading and unloading the component manually, it is not possible for a human being to do the job at constant speed every time. The consistency may not be so accurate. At the start of the shift, he may perform at a faster rate. As the time pass by, due to fatigue and other reasons, he may not repeat the job at the same rate of time. From the above reasons if wrong loading occurs, the components is going to waste but the time spent is not going to be recovered. This results in poor productivity.

There are several difficulties that can arise during manual lathe operation, including:

Precision: Manual lathes require a high level of skill and precision to operate effectively. The operator must have a thorough understanding of the lathe's

functions and be able to make precise adjustments to the cutting tool and workpiece.

Tool Selection: Choosing the right tool for the job can be difficult. The operator must have knowledge of the various cutting tools available and their appropriate uses.

Safety: Manual lathe operation can be dangerous if proper safety precautions are not taken. The operator must be trained in safety procedures and wear appropriate personal protective equipment.

Workpiece Setup: Proper setup of the workpiece is critical to achieving accurate results. The operator must be able to securely clamp the workpiece in the lathe and position it correctly for machining.

CHAPTER-4

FLOW CHART , COMPONENTS USED & EXPERIMENTAL WORK

4.1 METHODOGY

First the brake pistons are arranged in rack linearly. A 50 mm stroke cylinder is fixed at middle of the stand. Cylinder present at the first will retract so it will allow one piston to enter, then the piston at last will retract and allow the piston to fall into the holder. The holder is firmly holed by the 300 mm stroke cylinder. As soon as the piston falls in the holder, the 300 mm stroke cylinder will extract and go near to the chuck. In the piston holder, a 50 mm stroke cylinder is present to load it into the chuck. This is how the process runs.

FLOW CHART

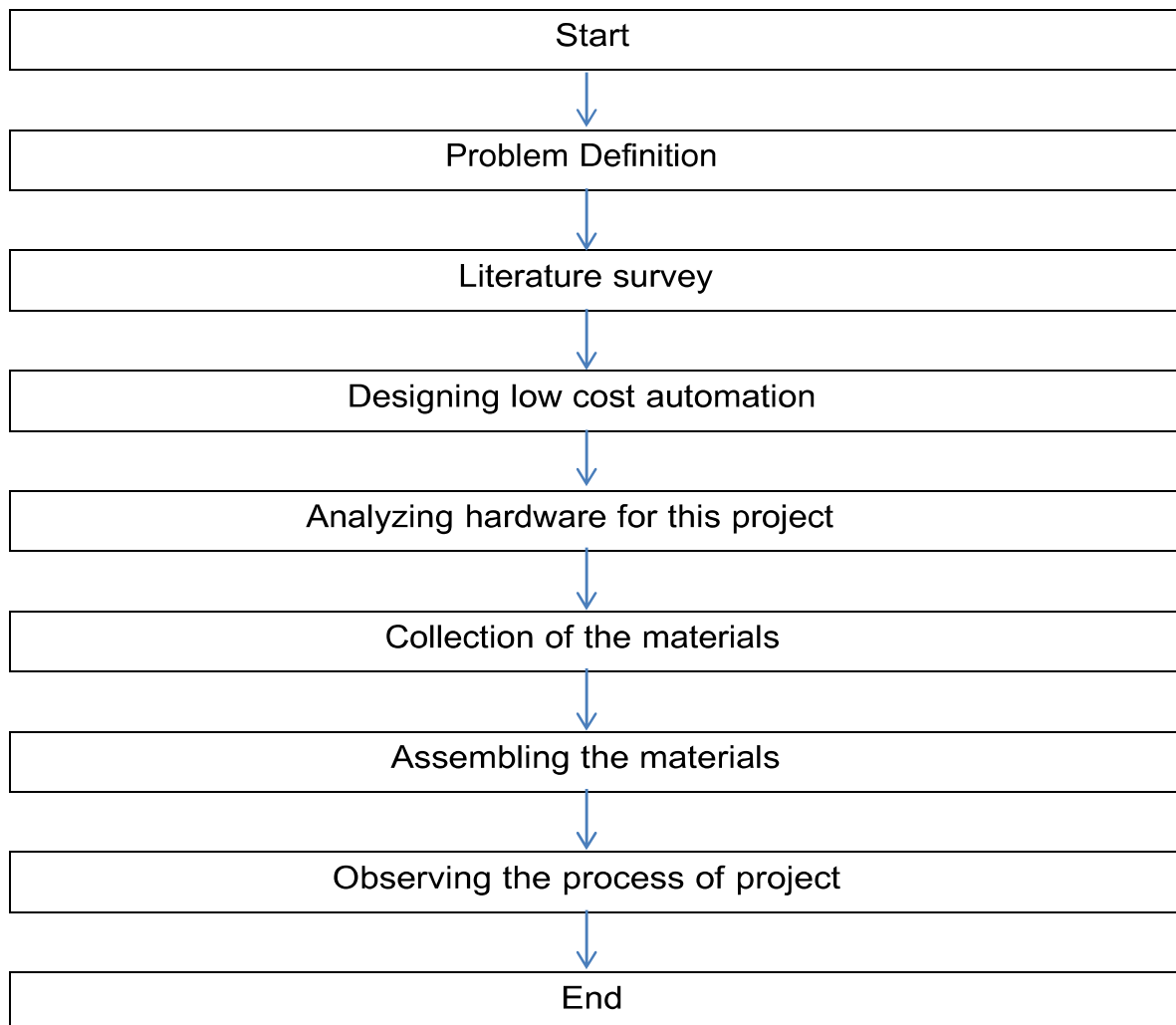


Fig:4.1 : procedure to develop low cost automation

4.2 COMPONENTS USED

4.2.1 Chute

It is made tray like shape through which the work piece rolls to the loader. The raw material is arranged one by one. The chute will hold more number of work pieces. The chute allows all the pistons to roll. But the requirement is to allow the pistons to flow one by one into the loader mechanism. For this purpose, stopper cylinders are used.

4.2.2 Stopper Cylinders

There are two stopper cylinders. The stopper cylinders are used to control the movement of the work pieces. They are about 50mm length shown in Fig:4.2. They allow the work pieces to move in such a way that only one work piece is loaded at a time. One stopper cylinder forwards and stops the movement of the piston. At the same time, the other cylinder goes back. The piston held in between the two cylinders will roll down to the loader unit for getting prepared to be loaded in the collet.



Fig:4.2 : Pneumatic Cylinder

4.2.3 Loader mechanism

The loader unit is used to load the work piece in to the collet. The loader has a hydraulic cylinder which actuates the movement of the loader unit and at the same time pushed the piston in the v block into the opening of the collet. After loading the piston into the collet, the collet clamps the work piece. When this is achieved, the loader retracts and reaches to the home position.

4.2.4 V Block

The V block bracket has a rectangular frame as the base structure. At the bottom of the rectangular frame there is a V shaped structure. The V shaped structure has one slant surface inclined at an angle of 30 degrees with respect to the horizontal surface and the other slant surface inclined at an angle of 60 degrees with respect to the horizontal surface. The top part of the bracket has a threaded hole. The hole is used to connect the bracket to the loader unit cylinder piston rod.

4.2.5 Collector cylinder

The collector cylinder is larger in size with more length of stroke. The collector cylinder has a bracket attached at the end of its piston. It holds the work piece rigidly when ejected from the collet. It is arranged in such a way that the piston rod when extends, reaches the spindle center

4.2.6 Strip Cylinder

The strip cylinder is smaller in size and it has the length of stroke slightly more than the length of the work piece. The piston rod is connected with a strip plate in C shape, which accommodates the face of the work piece and strips the work piece from the collector cylinder. The plate functions like a fork. With this aid, the piston is removed from the collector and unloads into the chute 2

4.2.7 Ejector cylinder

The ejector is a rod which is coupled to the piston rod of the cylinder kept at the rear side of the spindle. The ejector pushes the work piece from the collet to the collector cylinder, which in the advanced condition and is waiting to receive the finished component to be unloaded from the machine.

4.2.8 Components of brake

4.2.8.1 Brake Housing-

The housing of a brake piston is a component found in a brake system that serves as the casing for the piston. The brake piston is responsible for pressing against the brake pad and creating friction with the brake rotor, thereby slowing or stopping the vehicle.

The housing of a brake piston is typically made of metal, such as cast iron or aluminum, and is designed to withstand the high temperatures and pressures generated by the brake system. The housing is often threaded and may have a seal or boot to prevent dirt and debris from entering the brake system and damaging the piston.



Fig:4.3 : Brake housing

The brake piston housing is an essential part of the brake system and must be properly maintained to ensure the brakes function correctly. Regular inspections and cleaning of the brake caliper and piston housing can prevent corrosion and buildup of debris, ensuring the brake system remains in good working order.

In the event of a brake system failure, the brake piston housing may need to be replaced. This typically involves removing the caliper from the rotor, removing the old housing, and installing a new one. It is important to use the correct housing for the make and model of the vehicle to ensure proper fit and function.

4.2.8.2 Brake Carrier

The carrier of a brake piston is a component that serves as a mounting platform for the brake caliper and piston. The carrier is typically made of metal, such as cast iron or aluminum, and is designed to withstand the high temperatures and pressures generated by the brake system.

The carrier holds the brake caliper in place and provides a stable platform for the brake pads and piston to operate against the brake rotor. The carrier may be bolted or clipped onto the vehicle's suspension or steering knuckle, and is often equipped with a slide mechanism to allow for proper alignment of the brake pads with the rotor.



Fig:4.4 : Brake caliper

In some brake systems, the carrier may also be designed to help dissipate heat generated by the brake system. This may be achieved through the use of cooling fins or channels built into the carrier, which help to direct airflow over the caliper and brake rotor, improving cooling and reducing the risk of brake fade.

The carrier of a brake piston is an essential part of the brake system and must be properly maintained to ensure the brakes function correctly. Regular inspections and cleaning of the carrier can prevent corrosion and buildup of debris, ensuring the brake system remains in good working order.

In the event of a brake system failure, the carrier may need to be replaced. This typically involves removing the caliper from the carrier, removing the old carrier, and installing a new one. It is important to use the correct carrier for the make and model of the vehicle to ensure proper fit and function.

4.2.8.3 Brake Piston –

The piston of a brake caliper is a crucial component of a disc brake system in a vehicle, below Fig:4.5, Fig: 4.6 display the structure of brake piston. Its purpose is

to push the brake pads against the rotor, creating the friction that slows down or stops the vehicle.

The piston is typically made of aluminum or stainless steel and is located inside the brake caliper. When the brake pedal is pressed, hydraulic pressure is created, which is transmitted to the piston through the brake fluid. This pressure causes the piston to move outwards towards the brake rotor, which in turn causes the brake pads to be pushed against the rotor.

In summary, the piston of a brake caliper is a critical component of a vehicle's braking system. Its proper functioning is essential for safe and effective braking, and regular maintenance is important to ensure its longevity and reliability.

The piston is designed to fit snugly inside the caliper bore to prevent any fluid from leaking out. It is also coated with a special material that can withstand high temperatures generated by the friction between the brake pads and the rotor.

It is important to keep the piston clean and free from any debris or corrosion, as any dirt or rust can cause the piston to stick and prevent it from moving freely. This can lead to uneven wear on the brake pads and rotors, reduced braking performance, and even brake failure in extreme cases.

Regular maintenance of the brake system, including cleaning and lubricating the pistons, can help ensure that the brakes function properly and safely. In some cases, the piston may need to be replaced if it becomes damaged or worn out.



Fig:4.5 : Brake piston



Fig:4.6 : Brake piston

4.3 SOLIDWORKS MODEL

The Solid Works software is used to design the model of this project. Solid Works is a popular 3D computer-aided design (CAD) software used by engineers, designers, and manufacturers to create and visualize product designs. With the program, users may develop technical drawings and documentation as well as 3D models of components and assemblies, which replicate their performance.

The parametric modeling function in Solid Works, which enables users to modify the design while keeping connections between features, is one of several tools available for building complicated geometry. The program has tools for producing realistic drawings and animations of designs, making it a useful tool for advertising and sales.

In conclusion, Solid Works is a strong and adaptable tool for developing and visualizing product designs.

The Solid Works model include the model dimensions, tolerances, and materials specifications that comply with minimal small industry standards, and it may be used to simulate the machine's operation to ensure that all components are working together correctly.

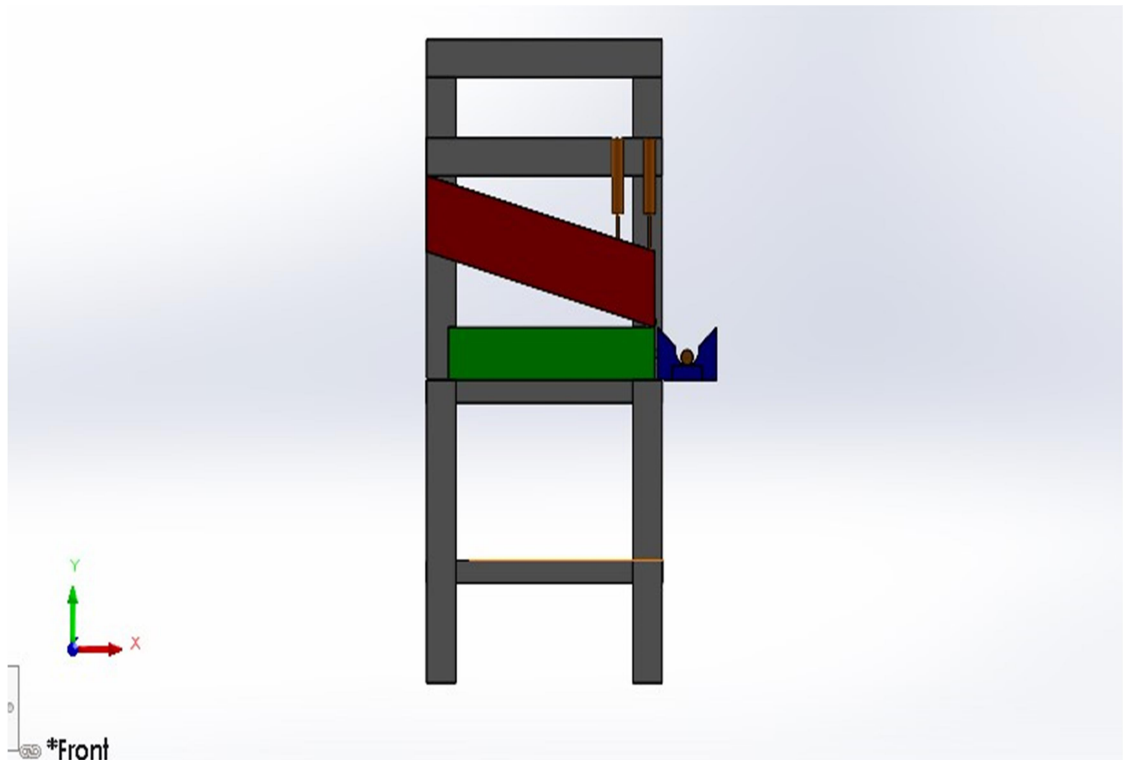


Fig:4.7 : Front view of CAD Diagram

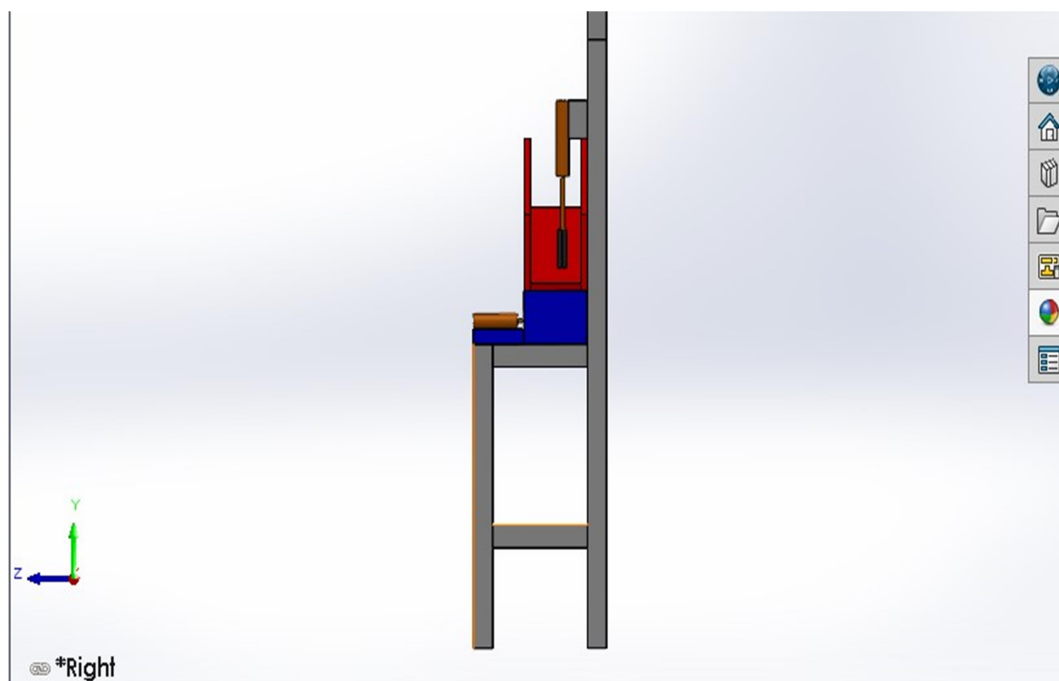


Fig:4.8 : Side view of CAD Diagram

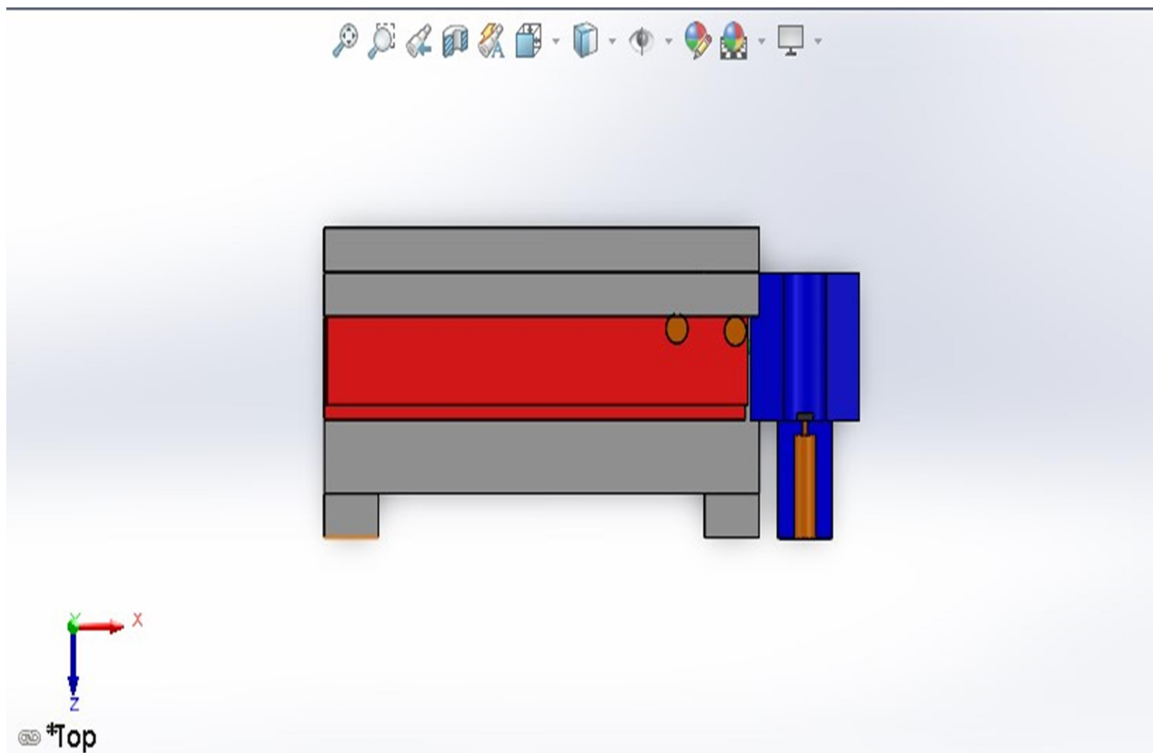


Fig:4.9 : Top view of CAD Diagram

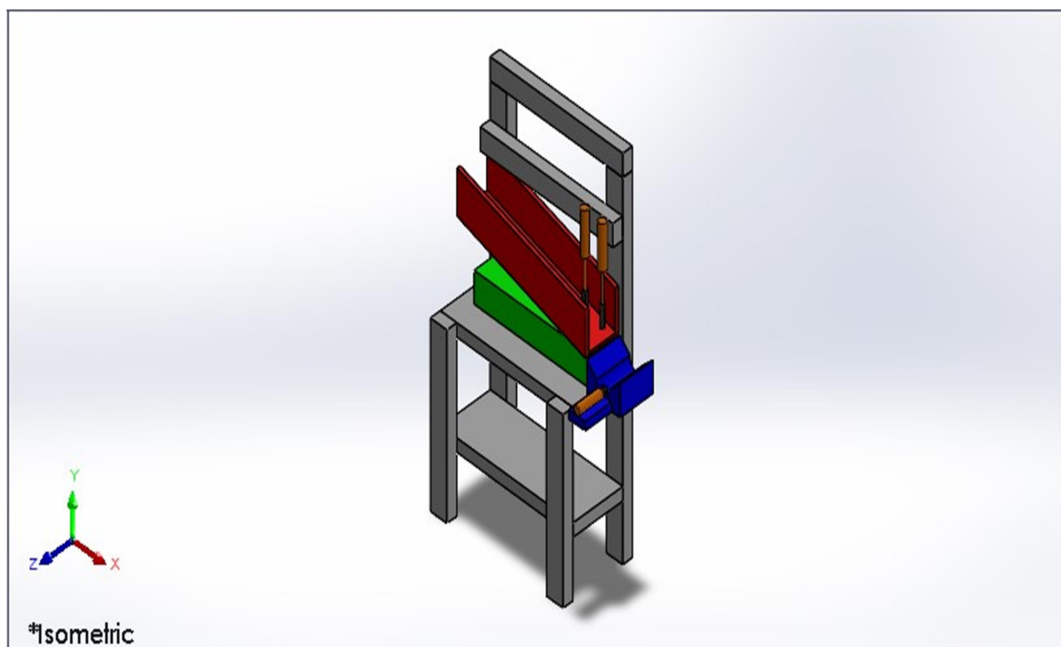


Fig:4.10 : Isometric view

4.4 EXPERIMENTAL WORK



Fig:4.11 : Frame work of loading mechanism

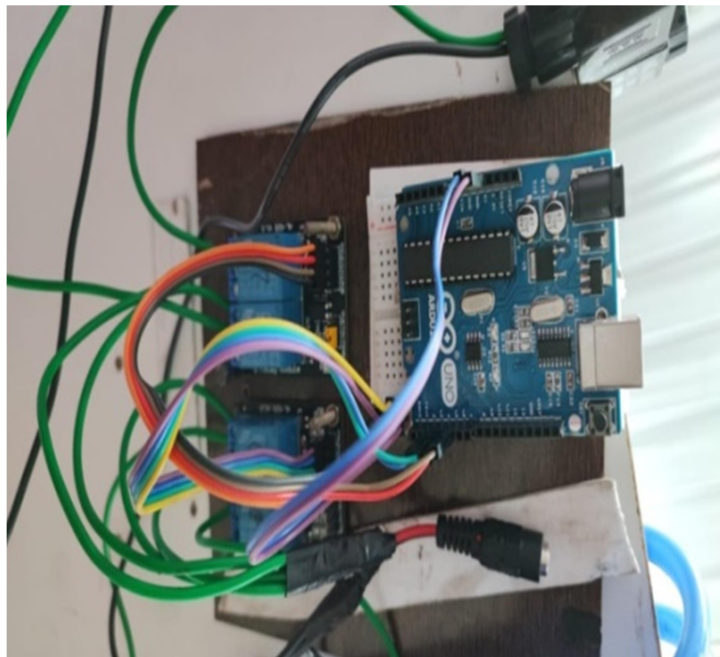


Fig:4.12 : Arduino connection

The total frame work for the loading mechanism displayed in the Fig:4.10 which is used for the automatic loading process. And the wiring connection integrated with the setup is displayed in Fig:4.11.



Fig:4.13 : Setup stand

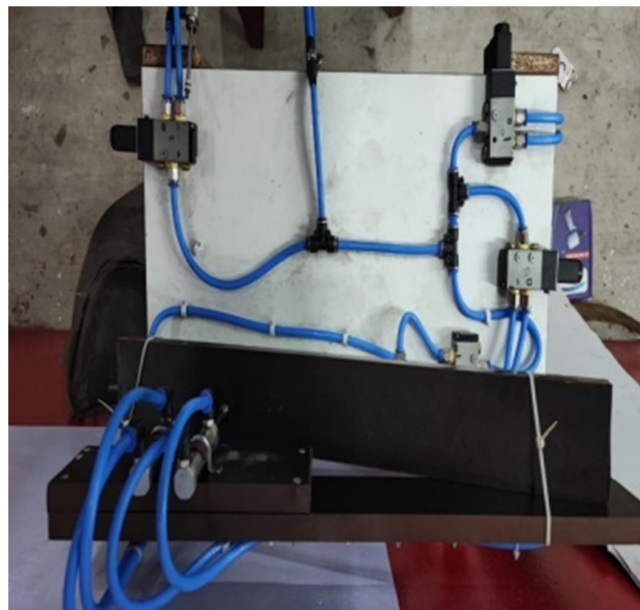


Fig:4.14 : Top view of Loading mechanism

The above Fig:4.13 shows the structure of the setup stand and Fig:4.14 display the top view of the pneumatic setup.

4.4.1 Specifications of components

Pneumatic Actuator 1:

Stroke Length – 300mm

Bore Diameter – 32mm

Maximum Pressure – 10 Bar

Pneumatic Actuator 2:

Stroke Length – 50mm

Bore Diameter – 16mm

Maximum Pressure – 7 Bar

Pneumatic Solenoid Valve:

Pressure – 7 Bar

12v Solenoid

5/2 Solenoid Valve

4.4.2 Force Calculation

300 mm Actuator:

Cylinder Pressure (P) = 4 Bar

Piston Diameter (D) = 32mm

Piston Area (A) = 804.2mm²

Exertion Force = $P * A = P * (\pi/4) * D^2 = 321.7 \text{ N}$

50 mm Actuator:

Cylinder Pressure (P) = 4 Bar

Piston Diameter (D) = 16mm

Piston Area (A) = 201.06mm²

Exertion Force = $P * A = P * (\pi/4) * D^2 = 80.42 \text{ N}$

4.4.3 Program

The main objective of automation is to reduce the cost and increase production and to control the process the pneumatic cylinder are controlled by the arduino and the code is created as per the requirement of the operation. The connection of the components with the arduino is shown below in Fig:4.14.

```
int a=2;
int b=3;
int c=4;
int d=5;
void setup()
{
  pinMode(a,OUTPUT);
  pinMode(b,OUTPUT);
  pinMode(c,OUTPUT);
  pinMode(d,OUTPUT);
  digitalWrite(a,HIGH);
  digitalWrite(b,LOW);
  digitalWrite(c,LOW);
  digitalWrite(d,LOW);
  Serial.begin(9600);
}
void loop()
{
  delay(100);
  digitalWrite(a,LOW);
  delay(2000);
  digitalWrite(a,HIGH);
  delay(2000);
  digitalWrite(c,HIGH);
  delay(2000);
  digitalWrite(b,HIGH);
```

```

delay(2000);
digitalWrite(d,HIGH);
digitalWrite(c,LOW);
delay(500);
digitalWrite(d,LOW);
digitalWrite(b,LOW);
delay(10000);
}

```

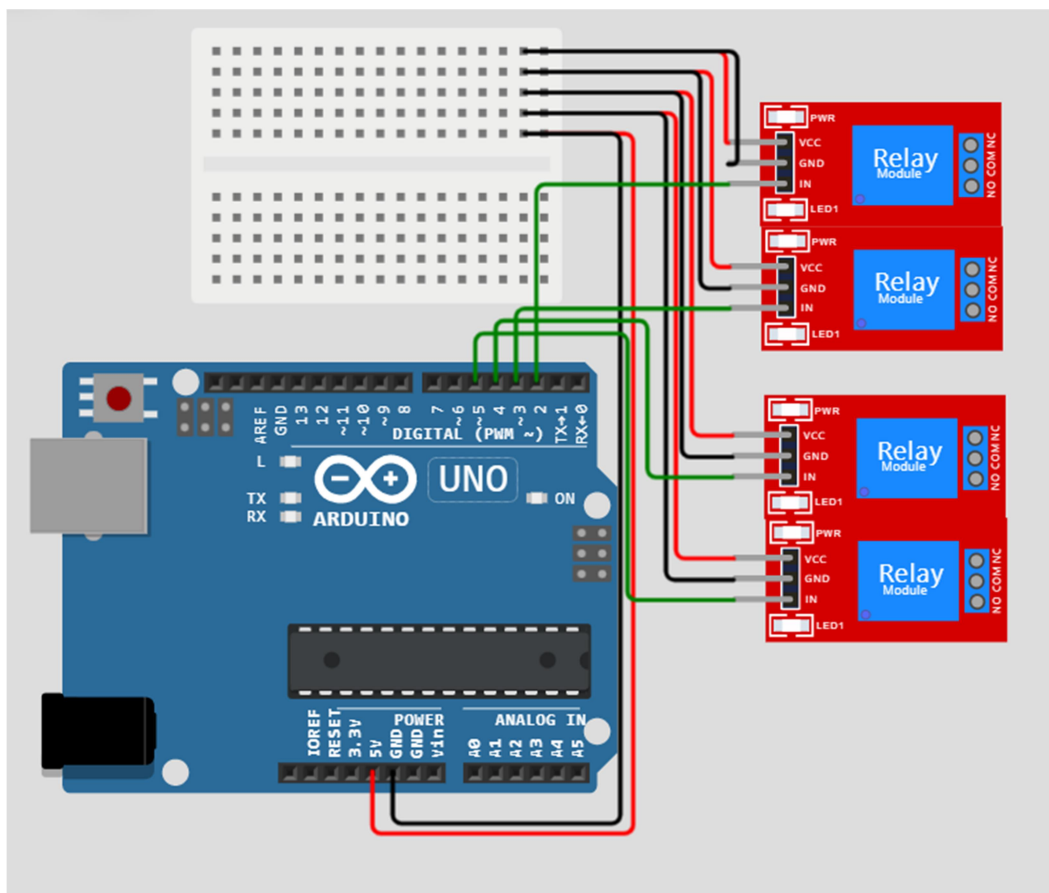


Fig:4.15 : Virtual connection the arduino

CHAPTER – 5

RESULTS AND DISCUSSION

The manual loading of the brake piston into the lathe machine is a time consuming process, the below table 7.1 lists the amount of time taken to finish each process during manual loading process.

Table 7.1 : 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

While working with the automatic operation of loading and unloading process of the brake piston reduces the time and increase the profit, below table 7.2 list out the time taken for automatic process.

Table 7.2 : Time Data for automatic Loading:

Activity	Time Taken
collecting work piece from pallet	0
Placing it in chuck	2
Machining time	18
Removing work piece from chuck	5
Total time	25

Total time saved through the automation $38 - 25 = 13$ sec

Manual method: Time taken for manufacturing of one product is 38 sec .So, 757 products are manufactured per shift.

Automation method: Time taken for manufacturing of one product is 25 sec .So, 1152 products manufactured per shift. In the automation method the productivity increased by 65.7%

Chapter – 6

SUMMARY & CONCLUSION

The developed system will normally load the piston into the chuck. But in an industrial point of view there will be a limited space for the machinery setup to complete the whole machining process. Further we planned to fix a small conveyor in that the piston will travel to turning process after completing the facing process. There also we planned to make a same loading mechanism what we did before for facing, and then we expand the conveyor for final rough and smooth finishing.

The low cost automation which was developed can used to load and unload brake piston in the chuck to save the production time, gain profit and reduce human error. While comparing with automation, human loading take ten seconds to pick up the piston and load it into the chuck and machining process takes fifteen seconds and unloading the piston and arrange it on the tray take ten seconds. But the same process if we integrate the automation process the loading time is less than two seconds and machining process takes fifteen seconds and unloading takes five seconds, by integrating the automation process while machining of the piston goes on the actuator readily holds the piston so after the unloading process another piston is loaded within two seconds.

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ANNEXURE:

- Review paper titled of “A Review on Automatic Loading and Unloading of Brake Piston in Machining Process” by Ritesh kumar, U.Ragul, U.K.Praveen Kannaa has been presented in NCMAE-23 conference on 25th February 2023.
- Review paper titled of “A Review on Automatic Loading and Unloading of Brake Piston in Machining Process” by Ritesh kumar, U.Ragul, U.K.Praveen Kannaa has been communicated to International Journal of Science and Research
- Research Paper Titled “Pneumatic Based Low Cost Automatic Loading of Brake Piston for Machining Process in Lathe/CNC Chuck” by Ritesh kumar, U.Ragul, U.K.Praveen Kannaa has been presented in ICDTM 2023 conducted by SASTRA University, Thanjavur on 9-April, 2023.