# DESIGN AND FABRICATION OF MINI DRILL MACHINE

A Thesis

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DEPARTMENT OF MECHANICAL ENGINEERING

SONARGAON UNIVERSITY (SU)


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Supervisor: M. I. Washif Rahman

Lecturer

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# ABSTRACT

The mini drill press with a DC motor is a compact and versatile tool designed for precision drilling in various materials. This apparatus comprises essential components such as a DC motor, drill bit, bit holder, couplings, joints, mounts, rods, base frame, and screws/bolts. The DC motor serves as the powerhouse, converting electrical energy into mechanical force to drive the drill bit. The drill bit, secured by the bit holder, is the primary cutting tool responsible for creating holes. Couplings efficiently transmit power between different parts, ensuring a seamless operation. Joints provide flexibility and facilitate adjustments, while mounts and rods contribute to the overall stability of the drill press. The base frame acts as a robust foundation, incorporating a platform for work piece placement. Screws and bolts play a crucial role in fastening components, guaranteeing structural integrity during operation. This mini drill press amalgamates these elements to deliver a reliable and efficient tool for individuals requiring precision drilling capabilities in a compact and maneuverable form. Its design emphasizes functionality, ease of use, and adaptability for a diverse range of applications.

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# CHAPTER 1
# INTRODUCTION

## 1.1 Introduction

A drilling machine, called a drill press, is used to cut holes into or through metal, wood, or other materials. Drilling machines uses a drilling tool that has cutting edges. Press drill machine performs operations like counter-sinking, boring, counter boring, spot facing, reaming, and tapping. Hand drilling machine has a lot of disadvantages like, it requires efforts of the person using it and also it does not provide accurate results. Hence to overcome such disadvantages, press drill machine is used. In this drill press project, a cutting tool is attached to the drill press by chuck or Morse taper and is rotated and fed into the work at variable speeds. This Mini Drill press consists of a DC motor, rack and pinion with frame which provides support to the entire device. This drill press machine also consists of aside shaft gear, a DC motor with a spindle which is-attached vertically.

For vertical up down motion, rack and pinion provision is given. This drill press machine makes drilling easy and efficient. Drilling machine is one of the most important machine tools in a workshop. It was designed to produce a cylindrical hole of required diameter and depth on metal work pieces. Though holes can be made by different machine tools in a shop, drilling machine is designed specifically to perform the operation of drilling and similar operations. Drilling can be done easily at a low cost in a shorter period of time in a drilling machine. Drilling can be called as the operation of producing a cylindrical hole of required diameter and depth by removing metal by the rotating edges of a drill. The cutting tool known as drill is fitted into the spindle of the drilling machine. A mark of indentation is made at the required location with a center punch.

The rotating drill is pressed at the location and is fed into the work. The hole can be made up. Optical measuring systems came to offer new ways to determine distances, deformations or vibrations through more accurate and greater range methods. Techno-logical progress has allowed a significant improvement of several components, including the optical ones. Thus, the development of essential measurement methods is crucial to keep up with technological advances. In this paper, the three basic methods of measurement

are studied – triangulation, telemetry, covering their main applications, advantages and disadvantages, and theoretically substantiating each of the methods. The results of simulation routines for each method are shown along this work. For the triangulation method we made two experiments which demonstrate the functioning of the method in measuring distances and surfaces. For the telemetry method, experimental setups were studied to apply the method of pulse telemetry and phase comparison telemetry to measure distances; thus, it is intended to set up the basis for the future development of more complex methods.

## 1.2 Background Study

A background study for a mini drill press project involves researching and understanding the key aspects related to the construction, functionality, and design considerations of a DIY mini drill press with a DC motor. Here are the areas you might want to explore in your background study. Look into existing designs and commercial mini drill presses to understand their features, structures, and functionalities. Analyze different models to gather insights into what works well and identify potential improvements or modifications for your DIY project. Familiarize yourself with the fundamental components of a drill press, including the motor, drill chuck, bit holder, base frame, mounts, rods, joints, and fasteners (screws and bolts). Understand the roles each component plays in the overall functionality of the drill press. Research DC motors suitable for drill press applications. Consider factors such as power requirements, RPM (revolutions per minute), torque, and motor size.

Understand how to connect and control a DC motor for optimal performance. Explore different types and sizes of drill bits suitable for your mini drill press. Understand the design principles of bit holders and how they securely hold drill bits during operation. Research materials commonly used in drill press construction, such as metals for frames and structural components. Understand the properties of these mate Explore adjustable features in drill presses, such as vertical movement mechanisms and joints. Understand how these mechanisms work and consider incorporating similar features into your mini drill press design for versatility. rials and how they contribute to the stability and durability of the drill press.

## 1.3 Objectives

The objectives of this project are:

- To study of an Design And Fabrication Drill Press.
- Press drill machine performs operations like countersinking, boring, counter boring, spot facing, reaming, and tapping.
- To take necessary notes from the project for future improvements.

## 1.4 Organization of the Book

- Chapter 1: **Introduction.** This chapter is all about background study, air purifier, use or air purifier, Objectives and thesis book organization.

- Chapter 2: **Literature Review-** Here briefly describe about air purifier technology, filter availability, previous book review, Block diagram, Structural Diagram, Components List and Summary of this chapter.

- Chapter 3: **Hardware Analysis-** This chapter is discussed about our project hardware . Here we describe our hole instrument details.

- Chapter 4: **Methodology–** Here briefly discuss about project methodology, hardware parts, our system working mechanism, project final image, working principle and our system overview.

- Chapter 5: **Results and Discussion–** Here briefly discuss about project discussion, result analysis, advantages, disadvantages, application and our system overview.

- Chapter 6: **Conclusion** – This chapter is all about our thesis future recommendation and this project conclusion.

# CHAPTER 2
# LITERATURE REVIEW

## 2.1 Introduction

In this chapter we will discuss some literature review. Here are some of the ideas we got after this project related literature.

## 2.2 Literature Review

As the development of computers and electronic communication equipment progressed and a variety of technologies have evolved the efficiency of manufacturing processes and systems has vastly improved. These developments have been termed as computer integrated manufacturing, or CIM.1 The aspect of CIM that will be utilized for this project is process automation. Automation involves automatic handling between machines, and the continuous processing at those machines. Automation only exists when a group of related operations are tied together mechanically, electronically, or with the assistance of computers.1 The word "automation" originated at Ford Motor Company in 1945 to describe "a logical development" in technical progress where automatic handling between machines is combined with continuous processing of machines. [1]

This implies that machines are considered automated only when they are mechanically joined for continuous automatic handling and processing.1 Now with a proper definition to give a foundation, the evaluation of automation can begin. It today's society everyone is looking for a way to make things faster for less money, without sacrificing the quality of their product. This is also held as a high priority for the proposed project. But if automation can't move us in that direction, the question was asked, "is it really worth implementing?" [2]

The original objective of automation was the reduction in direct labor costs, but as automation becomes more prominent other benefits have been observed. Safety is one of those factors that contributed to the success of automation. Automation has been proven to reduce the amount of industrial accidents, which is important for positive employee morale1 . Tying this to the given project, the drill press can injure someone who gets their

hands too close to the drill, or doesn't have the adequate training for operation. Automation of a production is said to remove the human from direct participation in the operation.2 By automating the drill press the operator will not have to worry about their safety because while the drill is on they will not be required to be so involved with the drilling process, therefore assisting in avoiding a potential injury. [3]

Although the safety of the operator is very important, it is not the main benefit that will be obtained in this project, nor is it the main motivation for implementing an automated system. By automating the drill press the productivity of the PC boards will vastly increase. There will be a small amount of time needed to train students on how to use the new production system, but once they have the knowledge the production rate, and output per hour will greatly improve due to the fact that the program will move the drill to the desired point to drill rather than the operator taking the time to move the drill to that point with an sufficient amount of accuracy. [4]

This leads into another benefit of automation: improved quality. Automated production usually achieves greater consistency, and accuracy in processing. At its current state there is a relatively low accuracy due to human error. The operator positions the table to the desired coordinates, and because humans are not perfect, there tends to be a certain amount of human error that can vary depending on numerous outside variables. But with an automated system, as mentioned before, the human is removed from the process, which will lead to an increase in accuracy, and as a result improve the quality of the product being drilled2 . One last advantage, which I previously touched upon, of automation that will undeniably be observed through this project, is the reduction of work in process. On the macro-level of automation, the work in process is when the product is either being processed or between processing operations. [5]

Automation tends to reduce work in process by reducing the time the product spends in the factory. On our micro level of automation there is only one process that can be evaluated, but the time it takes to complete that process will decrease because of the implementation of automation. Previously the operator had to drill a hole as close as they could to the desired coordinates, which took time to locate each hole. But with the automated system all of the coordinates are entered into a spreadsheet, where those

coordinates are exported to the controller, and then once one hole is drilled the system will then move the drill to the next desired position until all holes are made. [6] Therefore the time it takes to move from one hole to the next is significantly decreased, the total time of production will also be minimized. One final aspect of the project that needs to be researched comes back to the goal of today's society, economics. Currently the drill press is working, and has so far provided the students with quality holes. But the question is will this project be completed, within the allotted budget, and confirm that it also produces the benefits mentioned above. Designing and constructing this automated system is not necessarily the easiest way of obtaining an automated drill press. One way of acquiring an automated drill press would be to purchase one. [7]

After searching numerous catalogs, and Internet sites, a conclusion has been reached that there are three different levels of automated drilling machines. When dividing anything into different categories there is always a grey area, but for easy comparison of automated, also known as computer numerical control, drill presses can be categorized as excellent, decent, and substandard. When looking to buy a drill the final decision depends on what type of specifications the buyer is trying to meet, and what kind of budget they are dealing with. The most expensive and elaborate drill found through an extensive search was the Cameron CNC Micro Drilling Center Model 2001 (Appendix A, Figure 1). This drill has triple axis movement, an excellent resolution, and a fast traveling speed. This package includes a laptop computer, software, stepper motors, along with a security lock, and a clean room enclosure with a vacuum nozzle. [8]

This equipment, which is very precise and sophisticated, yet easy to use, . Sherline's newest drill brings the best features of full size shop drills into a miniature machine shop with a column that offers 4 additional directions of movement compared to their other models. The base extends 14" long to accommodate the additional mechanism of the column. With this drill, holes can be drilled from almost any angle with the part mounted square to the table. This drill, along with all of their models, can be purchased with either English or Metric measuring systems. . Because of the large amounts of money it requires to purchase a brand new drill, used machinery can also be considered. Sticking with the Sherline models, a used less expensive drill was found on an auction web site. [9]

This 5000A/5100A deluxe drill Package (Appendix A, Figure 3) comes with a variety of selected popular accessories, and a handbook to guide you through the computer interface. The Model 5000 features a solid 10" aluminum base, precision machined dovetailed slides with adjustable gibs, permanently lubricated spindle bearings, adjustable pre-load anti-backlash feed screws on x and y axes, two laser engraved aluminum hand-wheels, one laser engraved hand-wheel with thrust bearings, and many other features4 . But because it is used, and from an auction web site, it is hard to tell what you will really get when the drill arrives. This item can be purchased at a bargain price of 900.00 dollars. In the Sherline catalog this particular item is price listed at $1100.00, which does not include the cost of accessories3 . When considering the benefits of an automated piece of machinery the disadvantages are quite minuscule when compared to the benefits that will transpire. The only real draw back to an automated drill press is the cost. That is where the proposed project comes into play. Using the present drill press, and acquiring the different positioning and assembly parts and software, an automated drill press can be assembled at a much lower cost. In turn, the demands of today's society are being met by utilizing the ultimate option of producing the same result at a fraction of the cost. [10]

## 2.3 Block Diagram

In our project we have set up an design and fabrication of mini drill press in this diagram we will show by block the individual parts.

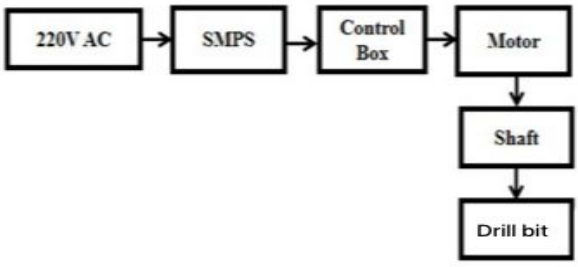



Figure 2.3: Block Diagram of Design and Fabrication of Mini Drill Press

## 2.4 Schematic Diagram

The schematic diagram here is representing the electrical circuit and the components of the Design And Fabrication Of Mini Drill Press Here we connect equipment with he smart wire connection.

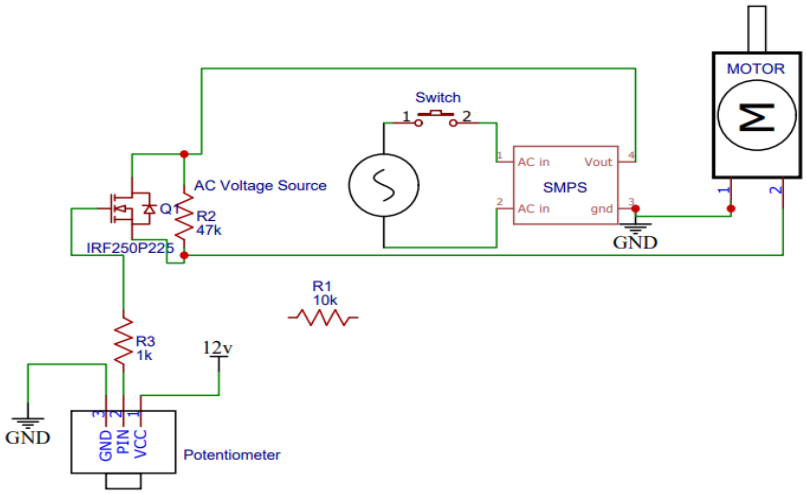



Figure 2.4: Schematic Diagram of Design And Fabrication of Mini Drill Press [18]

## 2.5 Components List:

Hardware Part:

1. DC Motor
2. SMPS
3. Slider
4. Spring
5. Drill Bit
6. Bit Holder
7. Couplings
8. Joints
9. Mounts
10. Rods
11. Base Frame
12. Screws & Bolts

## 2.6 Summary

The above discussion gives an idea about the Design And Fabrication Of Mini Drill Press. All that work on this system already been done here, and the results of their work, the use of Mini Drill Press in the situation are described in detail. From this we also got the direction of work of the project.

# CHAPTER 3
# HARDWARE ANALYSIS

## 3.1 DC Motor

A **DC motor** is an electrical motor that uses direct current (DC) to produce mechanical force. The most common types rely on magnetic forces produced by currents in the coils. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor. DC motors were the first form of motors widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field wingdings. Small DC motors are used in tools, toys, and appliances.


Figure 3.1: 775 DC motor 12V

The universal motor, a lightweight brushed motor used for portable power tools and appliances can operate on direct current and alternating current. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications. A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. The direction and magnitude of the magnetic field produced by the coil can be changed with the direction and magnitude of the current flowing through it.

A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The windings usually have multiple turns around the core, and in large motors there can be several parallel current paths. The ends of the wire winding are connected to a commutator. The commutator allows each armature coil to be energized in turn and connects the rotating coils with the external power supply through brushes. (Brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes.)

The total amount of current sent to the coil, the coil's size, and what it is wrapped around decide the strength of the electromagnetic field created. The sequence of turning a particular coil on or off dictates what direction the effective electromagnetic fields are pointed. By turning on and off coils in sequence, a rotating magnetic field can be created. These rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets) in the stationary part of the motor (stator) to create a torque on the armature which causes it to rotate. In some DC motor designs, the stator fields use electromagnets to create their magnetic fields which allows greater control over the motor. At high power levels, DC motors are almost always cooled using forced air.

Different number of stator and armature fields as well as how they are connected provide different inherent speed and torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature. Variable resistance in the armature circuit or field circuit allows speed control. Modern DC motors are often controlled by power electronics systems which adjust the voltage by "chopping" the DC current into on and off cycles which have an effective lower voltage. Since the series-wound DC motor develops its highest torque at low speed, it is often used in traction applications such as electric locomotives, and trams. The DC motor was the mainstay of electric traction drives on both electric and diesel-electric locomotives, street-cars/trams and diesel electric drilling rigs for many years. The introduction of DC motors and an electrical grid system to run machinery starting in the 1870s started a new second Industrial Revolution.

DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles and today's hybrid cars and electric cars as well as driving a host of cordless tools. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines. Large DC motors with separately excited fields were generally used with winder drives for mine hoists, for high torque as well as smooth speed control using thyristor drives. These are now replaced with large AC motors with variable frequency drives.

## 3.2 Slider

A slide, or sometimes called a drawer roller, is a mechanism that allows for telescopic motion in one axis. They are commonly found in a wide range of machine applications like desk drawers, kitchen cabinets, and pull out cutting boards but can be used in a wide range of applications that require linear extension and retraction. Drawer slides generally work by allowing one grove component to slide over a rolling component, which allows the entire mechanism to extend or retract. Drawer slides are not motorized but can be coupled with a linear actuator to provide greater stability. Generally, you will use a pair of drawer slides in any application and will most likely encounter two main types: Roller Slides and Ball-Bearing Slides.

Figure 3.2: Slider [19]

Roller slides consists of two components, the cabinet member and the drawer member, each having their own roller, usually made of plastic. As their names suggest, cabinet member mounts to a stable or grounded component, i.e. the cabinet, and the drawer member attaches to the moving component, i.e. the drawer. Each roller will fit into the groove found on the other member and will be at opposite ends of the mechanism when fully retracted with the cabinet member's roller being at the front. As the mechanism is extended, the cabinet member's roller allows the drawer member to move outwards and the roller of the drawer member follows in the grove of the cabinet member. When fully extended, the two rollers will meet. This two-roller design gives the mechanism horizontal stability and allows for level extension

## 3.3 Spring

Figure 3.3: Spring [20]

Springs are a flexible machine elements that store mechanical energy when subjected to tensile, compressive, bending, or torsional forces. When the spring is deflected, it stores energy and, at the same time, exerts an opposing force. The relationship between the amount of deflection and the force exerted depends on the characteristics of the spring. The most common form is a cylindrical, helical spring with a constant pitch. This type of spring is a round wire spooled into a cylindrical form.

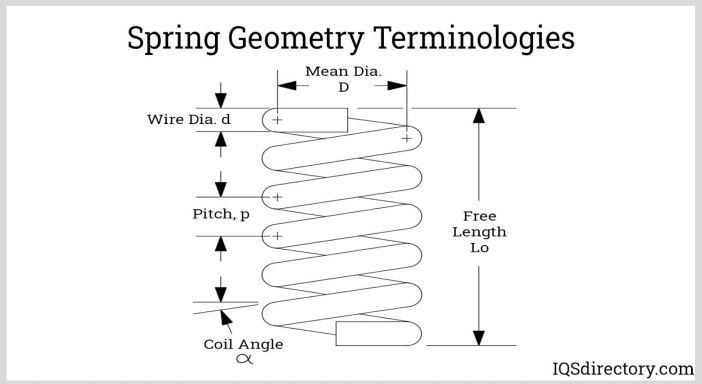



Figure 3.3: Overview of Spring Design [21]

The relationships stated above are only applicable for cylindrical, helical springs with constant pitch, and round wire coils. There are other types of springs that are governed by different equations and factors. Moreover, this discussion only tackled the relationships between force, deflection, and stress. Designing springs can also involve determining the right type of ends, critical buckling, fatigue life, and performance in vibration and surging.

## 3.4 Drill Bit

Drill bits are cutting tools used in a drill to remove material to create holes, almost always of circular cross-section. Drill bits come in many sizes and shapes and can create different kinds of holes in many different materials. In order to create holes drill bits are usually attached to a drill, which powers them to cut through the workpiece, typically by rotation. The drill will grasp the upper end of a bit called the shank in the chuck. Drills come in standardized drill bit sizes. A comprehensive drill bit and tap size chart lists metric and imperial sized drills alongside the required screw tap sizes. There are also certain specialized drill bits that can create holes with a non-circular cross-section.

Figure 3.4: Drill Bit [22]

## Drill geometry has several characteristics:

The spiral (or rate of twist) in the drill bit controls the rate of chip removal. A fast spiral (high twist rate or "compact flute") drill bit is used in high feed rate applications under low spindle speeds, where removal of a large volume of chips is required. Low spiral (low twist rate or "elongated flute") drill bits are used in cutting applications where high cutting speeds are traditionally used, and where the material has a tendency to gall on the bit or otherwise clog the hole, such as aluminum or copper. The point angle, or the angle formed at the tip of the bit, is determined by the material the bit will be operating in. Harder materials require a larger point angle, and softer materials require a sharper angle. The correct point angle for the hardness of the material influences wandering, chatter, hole shape, and wear rate.

The lip angle determines the amount of support provided to the cutting edge. A greater lip angle will cause the bit to cut more aggressively under the same amount of point pressure as a bit with a smaller lip angle. Both conditions can cause binding, wear, and eventual catastrophic failure of the tool. The proper amount of lip clearance is determined by the point angle. A very acute point angle has more web surface area presented to the work at any one time, requiring an aggressive lip angle, where a flat bit is extremely sensitive to small changes in lip angle due to the small surface area supporting the cutting edges.

The functional length of a bit determines how deep a hole can be drilled, and also determines the stiffness of the bit and accuracy of the resultant hole. While longer bits can drill deeper holes, they are more flexible meaning that the holes they drill may have an inaccurate location or wander from the intended axis. Twist drill bits are available in standard lengths, referred to as Stub-length or Screw-Machine-length (short), the extremely common Jobber-length (medium), and Taper-length or Long-Series (long).

Most drill bits for consumer use have straight shanks. For heavy duty drilling in industry, bits with tapered shanks are sometimes used. Other types of shank used include hex-shaped, and various proprietary quick release systems.

## 3.5 Bit Holder

The tool post is the part of a metalworking lathe which either holds the tool bit directly or holds a tool holder which contains the tool bit. There are a great variety of designs for tool posts and tool holders. A form tool is precision-ground into a pattern that resembles the part to be formed.

Figure 3.5: Bit Holder

The form tool can be used as a single operation and therefore eliminate many other operations from the slides (front, rear and/or vertical) and the turret, such as box tools. A form tool turns one or more diameters while feeding into the work. Before the use of form tools, diameters were turned by multiple slide and turret operations, and thus took more work to make the part.

For example, a form tool can turn many diameters and in addition can also cut off the part in a single operation and eliminate the need to index the turret. For single-spindle machines, bypassing the need to index the turret can dramatically increase hourly part production rates. On long-running jobs it is common to use a *roughing tool* on a different slide or turret station to remove the bulk of the material to reduce wear on the form tool. There are different types of form tools. Insert form tools are the most common for short- to medium-range jobs (50 to 20,000 pcs). Circular form tools are usually for longer jobs, since the tool wear can be ground off the tool tip many times as the tool is rotated in its holder. There is also a skiving tool that can be used for light finishing cuts. Form tools can be made of cobalt steel, carbide, or high-speed steel. Carbide requires additional care because it is very brittle and will chip if chatter occurs. A drawback when using form tools is that the feed into the work is usually slow, 0.0005" to 0.0012" per revolution depending on the width of the tool.

Wide form tools create more heat and usually are problematic for chatter. Heat and chatter reduces tool life. Also, form tools wider than 2.5 times the smaller diameter of the part being turned have a greater risk of the part breaking off. When turning longer lengths, a support from the turret can be used to increase turning length from 2.5 times to 5 times the smallest diameter of the part being turned, and this also can help reduce chatter. Despite the drawbacks, the elimination of extra operations often makes using form tools the most efficient option.

**Holders used on sharpers**

**Clapper box**

Shapers often employ a kind of tool holder called a *clapper box* that swings freely on the return stroke of the ram or bed. On the next cutting stroke, it "claps" back into cutting position. Its movement is analogous to that of a butterfly-style check valve.

**Holders used on milling machines**

**Fly cutters**

Fly cutters are a type of milling cutter in which one or two tool bits are mounted. The bits spin around with the rotation of the spindle, taking facing cuts. Fly cutters are an application of tool bits where the bits are part of a rotary unit .

## 3.6 2 Flexible Couplings

A **c**oupling is a device used to connect two shafts together at their ends for the purpose of transmitting power. The primary purpose of couplings is to join two pieces of rotating equipment while permitting some degree of misalignment or end movement or both. In a more general context, a coupling can also be a mechanical device that serves to connect the ends of adjacent parts or objects. Couplings do not normally allow disconnection of shafts during operation, however there are torque-limiting couplings which can slip or disconnect when some torque limit is exceeded.

Figure 3.6: 2 Flexible Coupler

Shaft couplings are used in machinery for several purposes. A primary function is to transfer power from one end to another end
Other common uses:

- To alter the vibration characteristics of rotating units
- To connect the driving and the driven part
- To introduce protection
- To reduce the transmission of shock loads from one shaft to another
- To slip when overload occurs

**Balance**

Couplings are normally balanced at the factory prior to being shipped, but they occasionally go out of balance in operation. Balancing can be difficult and expensive, and is normally done only when operating tolerances are such that the effort and the expense are justified. The amount of coupling unbalance that can be tolerated by any system is dictated by the characteristics of the specific connected machines and can be determined by detailed analysis or experience.

## 3.7 Joints

**Hinged Joints**

Hinged joints allow for rotational movement around a fixed point. They can be used to create adjustable angles or facilitate the vertical movement of certain parts of the drill press, such as the drilling platform.

**Sliding Joints**

Sliding joints enable linear movement along a specified path. These joints can be utilized to create adjustable components, such as the height adjustment mechanism in the mini drill press.

**Pivoting Joints**

Pivoting joints allow components to rotate around a central axis. They are useful for creating swiveling or tilting features in the drill press design, providing versatility in its operation.

**Threaded Joints**

Threaded joints involve components with threads that interlock, allowing for adjustable connections. These joints are often used in situations where fine adjustments are required, such as in height-adjustable components.

**Locking Joints**

Locking joints secure two components in a fixed position. These are essential for maintaining stability during the operation of the drill press, preventing unwanted movement or vibrations.

**Dovetail Joints**

Dovetail joints are interlocking joints with a trapezoidal shape. They are often used to create sturdy and durable connections, such as in the construction of the base frame or mounting components.

**Pinned Joints**

Pinned joints involve the use of pins or dowels to connect two components. These joints provide a stable connection while allowing for rotational movement, and they are commonly used in structural elements.

**Flexible Joints**

Flexible joints, such as universal joints, allow for movement in multiple directions. They can be used to create articulated arms or linkages that contribute to the adjustability of the drill press.

**Welded Joints**

Welded joints involve fusing metal components together using welding techniques. Welding provides a strong and rigid connection, often used in structural elements of the drill press.

## 3.8 Mounts

Motor Mount the motor mount is a structure that securely holds and positions the DC motor. It is designed to provide a stable foundation for the motor while allowing for proper alignment with other components like the drill chuck.

**Base Frame Mounts**

These mounts are used to secure the entire drill press to a workbench or another surface. They are integral to the stability of the drill press during operation and help absorb vibrations.

**Drill Chuck Mount**

The drill chuck mount holds and positions the drill chuck, which in turn holds the drill bit. It ensures that the drill chuck is properly aligned with the motor, facilitating smooth and accurate drilling.

**Vertical Movement Mechanism Mounts**

If your mini drill press includes a vertical movement mechanism for adjusting the drilling depth, mounts are used to secure and guide the rods or components responsible for the vertical movement. These mounts ensure that the movement is precise and controlled.

**Bit Holder Mount**

The bit holder mount secures the bit holder, ensuring that it remains in place during drilling. It is designed to accommodate the bit holder and align it with the drill chuck for optimal performance.

**Joint Mounts**

Mounts are used in conjunction with joints to secure and stabilize components that allow movement, such as hinged or pivoting joints. These mounts ensure that the joints function smoothly while maintaining structural integrity.

**Adjustable Component Mounts**

If there are adjustable components in your mini drill press, such as those with sliding or threaded joints, mounts are used to secure these components in the desired position. This could include components related to height adjustment or angle adjustment.

**Rod Mounts**

In a mini drill press with a vertical movement mechanism, mounts are used to secure and guide the rods responsible for the movement. These mounts play a crucial role in maintaining the alignment and stability of the vertical movement.

**Locking Mechanism Mounts**

If there are locking mechanisms or clamps used to secure adjustable components, mounts are involved in providing a stable foundation for these mechanisms. They contribute to the overall rigidity of the drill press.

## 3.9 Rods

Hey play a crucial role in maintaining stability, alignment, and control of various moving parts. Here is a description of different types of rods and their roles in a mini drill press

**Vertical Movement Rods:**

These rods are often part of the vertical movement mechanism in a mini drill press. They are responsible for guiding the drilling platform or the entire drilling assembly in the vertical direction, allowing for adjustable drilling depths.

**Guide Rods:**

Guide rods are used to guide and support moving components, ensuring smooth and precise movement. In a drill press, they may be employed to guide the vertical movement of the drilling platform or other adjustable parts.

**Connecting Rods:**

Connecting rods are used to link or transmit motion between different components of the drill press. For example, a connecting rod may link the DC motor to the drill chuck, facilitating the transfer of rotational motion.

**Stabilizing Rods:**

Stabilizing rods are employed to enhance the stability of the drill press structure. They may connect different parts of the frame or provide additional support to prevent vibrations and ensure accuracy during drilling.

**Threaded Rods:**

Threaded rods are used in conjunction with threaded joints to provide an adjustable and secure connection between components. They can be used for height adjustment or to fine-tune the position of certain elements in the drill press.

**Drive Rods:**

In the context of a drill press, drive rods may be utilized to transmit rotational motion from the DC motor to other components, such as the drill chuck. These rods play a role in the power transmission within the drill press mechanism.

**Supporting Rods:**

Supporting rods provide additional support to various components, helping distribute loads and maintain the structural integrity of the drill press. They contribute to the overall strength and rigidity of the assembly.

**Alignment Rods:**

Alignment rods are used to ensure precise alignment between different components of the drill press. Proper alignment is crucial for accurate drilling, and these rods help maintain the intended orientation of moving parts.

**Adjustable Length Rods:**

Some rods in a mini drill press may have an adjustable length feature, allowing for changes in the overall height or position of specific components. This adjustability contributes to the versatility of the drill press.

## 3.10 Base Frame

The base frame is typically constructed from sturdy and durable materials to ensure stability and support. Common materials include steel, aluminum, or robust plastics, depending on the desired strength and weight of the drill press.

Figure 3.10: Base Frame

## Construction:

The base frame is usually designed as a rigid and stable structure. It may consist of welded or bolted joints to connect various components, creating a solid foundation for the drill press.

**Size and Dimensions:**

The size and dimensions of the base frame depend on the intended use and the space available. It should be large enough to provide stability and accommodate the other components of the drill press while being compact for ease of use and storage.

**Mounting Points:**

The base frame includes mounting points for attaching the motor, drill chuck, vertical movement mechanism, and other essential components.

## 3.11 Screws & Bolts

Screws designed for use in metal, these screws have coarse threads and often come with a tapered point.

**1.Machine Screws**: Primarily used for metal-to-metal fastening, machine screws have finer threads and are often paired with nuts or threaded holes.

**2.Self-Tapping Screws:** Equipped with a pointed end, self-tapping screws are designed to create their own threads as they are driven into materials like metal or plastic.

**Thread Types**:

**1.Coarse Threads**: Commonly found on screws, they provide a strong grip in softer materials.

**2.Fine Threads:** Often used in machine screws for a tighter and more precise fit.

**Heads:**

**1.Flat Head**: Sits flush with the material surface.

**2.Round Head**: Projects slightly above the material surface.

**3.Pan Head**: Similar to round heads but with a slightly flatter top.

**4.Oval Head**: Combines the features of flat and round heads.

**Applications:**

Screws are versatile fasteners used for a wide range of applications, including fastening components together, attaching hardware, and providing strong connections in various materials.

## Bolts:

**1.Hex Bolts**: Have a hexagonal head and are tightened with a wrench or socket.

**2.Carriage Bolts**: Have a smooth, rounded head and a square neck under the head, preventing them from turning during installation.

**3.Eye Bolts**: Feature a looped head and are used for attaching cables or hooks.

**Threaded Length:**

Bolts typically have a longer threaded section compared to screws. They often require nuts to secure the joint.

**Head Types:**

**1.Hex Head:** Requires a wrench or socket for tightening.

**2.Square Head**: Similar to hex heads but with a square shape.

**3.Round Head**: A circular head that may protrude slightly above the material surface.

**Nuts and Washers:**

Bolts are commonly used with nuts and washers. The nut is threaded onto the bolt to secure the joint, and washers may be used to distribute the load and provide a smooth surface.

**Applications:**

Fasteners are used to assemble joints, allowing for flexibility, adjustability, or controlled movement in the drill press.

**Base Frame Construction**:

Screws and bolts are essential for assembling the base frame, connecting different parts to create a sturdy foundation for the drill press.

**Vertical Movement Mechanism**:

If the mini drill press has a vertical movement mechanism, screws or bolts may be used to assemble and secure components responsible for vertical adjustment.

## 3.12 Switched Mode Power Supply (SMPS)

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC load, such as a personal computer, while

converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles). In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.


Figure 3.8: SMPS

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.

12V 5A Industrial SMPS Power Supply – 60W – DC Metal Power Supply – Good Quality – Non Waterproof with Aluminum casing.

- Input Voltage: AC 100 – 264V 50 / 60Hz
- Output Voltage: 12V DC, 0-5A
- Output voltage: Adjustment Range: ±20%
- Protections: Overload / Over Voltage / Short Circuit

- Auto-Recovery After Protection
- Universal AC input / Full range
- 100% Full Load Burn-in Test
- Cooling by Free Air Convection
- High Quality and High Performance
- LED power supply with a metal body for hidden installation for LED lighting
- Design with Built-in EMI Filter, improve signal precision.
- Certifications: CE & Rosh
- No Minimum Load.
- Compact Size Light Weight.
- High Efficiency, Reliability & low energy consumption
- Category – Switch Mode Power Adaptor (SMPS)

Switched-mode power supplies are classified according to the type of input and output voltages. The four major categories are:

- AC to DC
- DC to DC
- DC to AC
- AC to AC

A basic isolated AC to DC switched-mode power supply consists of:

- Input rectifier and filter
- Inverter consisting of switching devices such as MOSFETs
- Transformer
- Output rectifier and filter
- Feedback and control circuit

The input DC supply from a rectifier or battery is fed to the inverter where it is turned on and off at high frequencies of between 20 KHz and 200 KHz by the switching MOSFET or power transistors. The high-frequency voltage pulses from the inverter are fed to the transformer primary winding, and the secondary AC output is rectified and smoothed to produce the required DC voltages. A feedback circuit monitors the output voltage and instructs the control circuit to adjust the duty cycle to maintain the output at the desired level.

## Basic working concept of an SMPS

A switching regulator does the regulation in the SMPS. A series switching element turns the current supply to a smoothing capacitor on and off. The voltage on the capacitor controls the time the series element is turned. The continuous switching of the capacitor maintains the voltage at the required level. Design basics AC power first passes through fuses and a line filter. Then it is rectified by a full-wave bridge rectifier. The rectified voltage is next applied to the power factor correction (PFC) pre-regulator followed by the downstream DC-DC converter(s). Most computers and small appliances use the International Electro technical Commission (IEC) style input connector. As for output connectors and pin outs, except for some industries, such as PC and compact PCI, in general, they are not standardized and are left up to the manufacturer. There are different circuit configurations known as topologies, each having unique characteristics, advantages and modes of operation, which determines how the input power is transferred to the output. Most of the commonly used topologies such as fly back, push-pull, half bridge and full bridge, consist of a transformer to provide isolation, voltage scaling, and multiple output voltages. The non-isolated configurations do not have a transformer and the power conversion is provided by the inductive energy transfer.

### Advantages of switched-mode power supplies:

- Higher efficiency of 68% to 90%
- Regulated and reliable outputs regardless of variations in input supply voltage
- Small size and lighter
- Flexible technology
- High power density

### Disadvantages:

- Generates electromagnetic interference
- Complex circuit design
- Expensive compared to linear supplies

Switched-mode power supplies are used to power a wide variety of equipment such as computers, sensitive electronics, battery-operated devices and other equipment requiring high efficiency.

## Switch Mode Power Supply

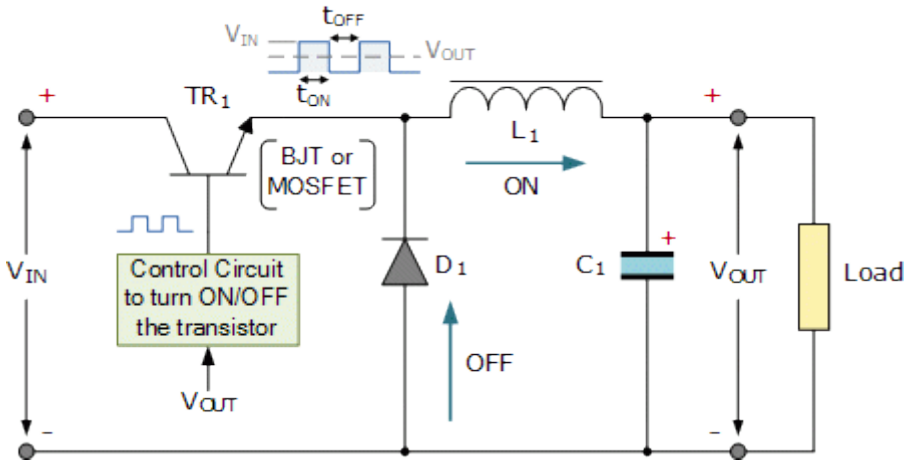



Figure 3.10: Power Supply Connection [17]

Linear voltage IC regulators have been the basis of power supply designs for many years as they are very good at supplying a continuous fixed voltage output. Linear voltage regulators are generally much more efficient and easier to use than equivalent voltage regulator circuits made from discrete components such a Zenner diode and a resistor, or transistors and even op-amps. The most popular linear and fixed output voltage regulator types are by far the 78… positive output voltage series, and the 79… negative output voltage series. These two types of complementary voltage regulators produce a precise and stable voltage output ranging from about 5 volts up to about 24 volts for use in many electronic circuits. There is a wide range of these three-terminal fixed voltage regulators available each with its own built-in voltage regulation and current limiting circuits. This allows us to create a whole host of different power supply rails and outputs, either single or dual supply, suitable for most electronic circuits and applications. There are even variable voltage linear regulators available as well providing an output voltage which is continually variable from just above zero to a few volts below its maximum voltage output.Most d.c. power supplies comprise of a large and heavy step-down mains transformer, diode rectification, either full-wave or half-wave, a filter circuit to remove any ripple content from the rectified d.c. producing a

suitably smooth DC. voltage, and some form of voltage regulator or stabilizer circuit, either linear or switching to ensure the correct regulation of the power supplies output voltage under varying load conditions. Then a typical DC. power supply would look something like this:

**Typical DC Power Supply**

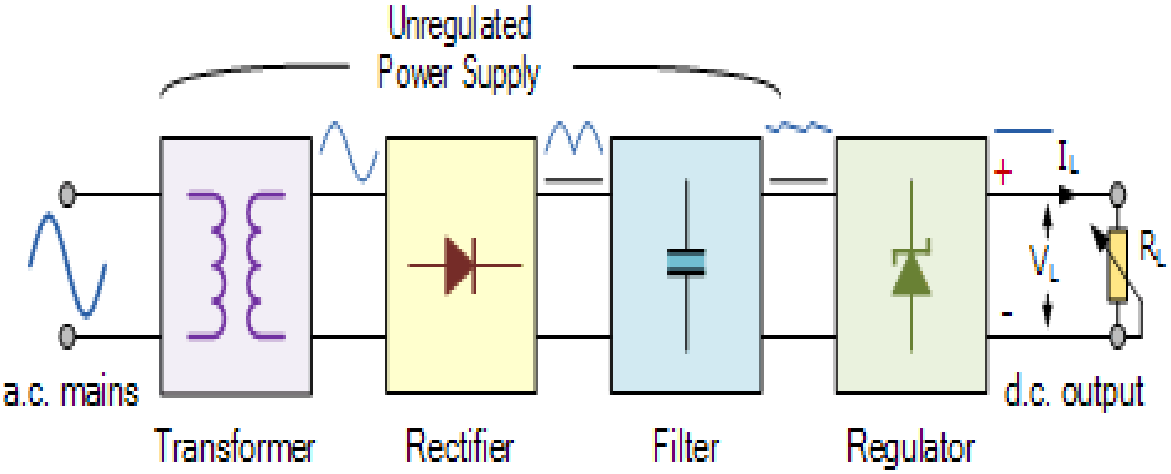



Figure 3.11: DC Power Supply Step [16]

These typical power supply designs contain a large mains transformer (which also provides isolation between the input and output) and a dissipative series regulator circuit. The regulator circuit could consist of a single zener diode or a three-terminal linear series regulator to produce the required output voltage. The advantage of a linear regulator is that the power supply circuit only needs an input capacitor, output capacitor and some feedback resistors to set the output voltage.

# CHAPTER 4

# METHODOLOGY

## 4.1 Our methodologies for the project:

- Creating an idea for design and construction of an **Design And Fabrication Of Mini Drill Machine.** And designing a block diagram & circuit diagram to know which components we need to construct it.
- Collecting all the components and programming the micro-controller to control the whole system.
- Setting up all the components in a PCB board & then soldering. Lastly, assembling all the blocks in a board and to run the system & for checking purposes.

## 4.2 Our Project Final Image

Figure 4.2: Our Final System Overview

## 4.3 Working Principle

The DC 12V motor is powered by the SMPS, and it rotates its shaft when energized. The 5mm flexible coupler is connected to the motor shaft on one end and to the input of the rack and pinion system on the other end. The flexibility of the coupler allows for a slight misalignment and absorbs vibrations, reducing stress on the motor. The rack is a linear gear with teeth along its length, and the pinion is a small gear attached to the motor shaft. As the motor rotates, the pinion engages with the teeth of the rack. The rotation of the pinion causes the rack to move vertically. Bearings are placed at key points to support the rotating parts, reducing friction and ensuring smooth operation. Bearings are especially important where the rack and pinion system engages with the frame to allow smooth vertical movement. The speed control will be the potentiometer. The SMPS provides a stable DC power source to the motor, and the electrical connections ensure proper functioning. Safety features such as emergency stops or protective guards can be incorporated into the electrical system.

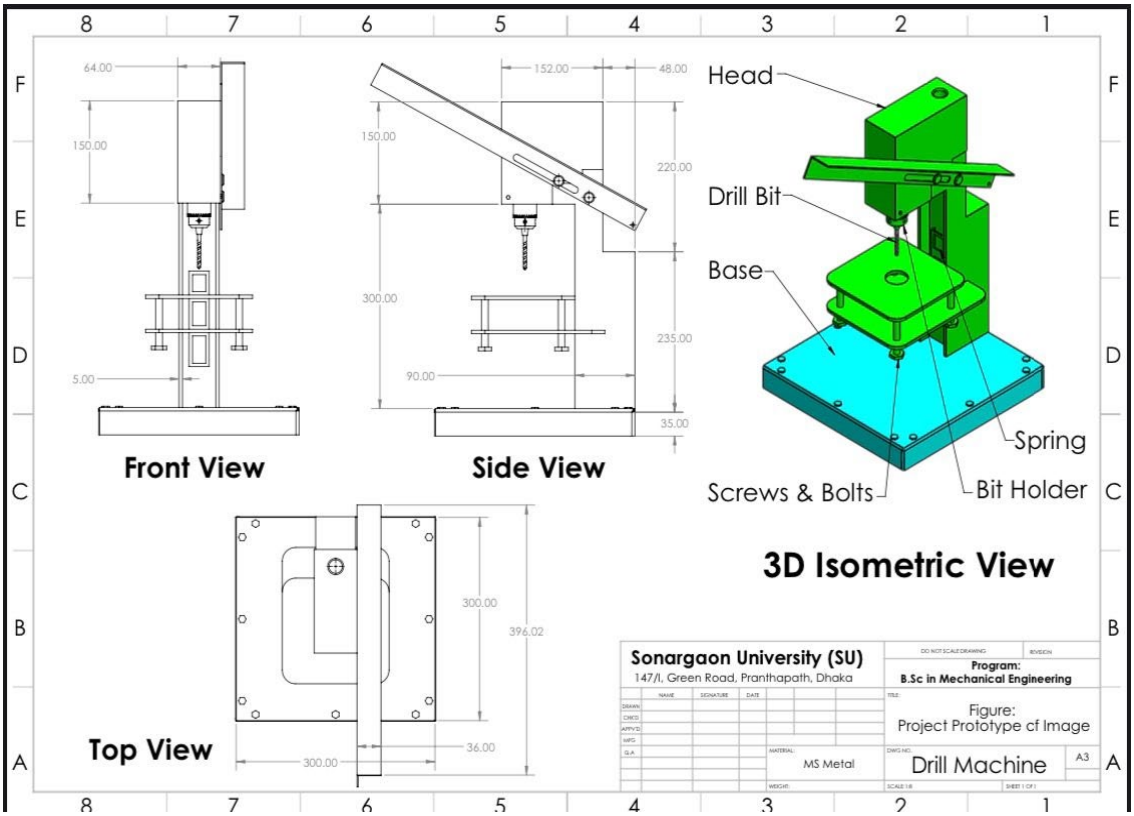
## 4.4 Cost Analysis

In the below table we have summarized our project expenditure.

**Table 1: Lists of Components with Price**.

| Sl. No | Product Name | Specification | Qty. | Unit Price (Taka) | Total Price (Taka) |
|---|---|---|---|---|---|
| 01 | SMPS | 12V | 1 | 650 | 650 |
| 02 | DC Motor | 12V | 1 | 880 | 880 |
| 03 | Slider | | 1 | 300 | 300 |
| 04 | Spring | | 1 | 140 | 140 |
| 05 | Potentiometer | | 1 | 80 | 80 |
| 06 | Frame Base | | 1 | 4070 | 4070 |
| 07 | Others | | | | 1850 |
| | | | | Total = | 7970/= |

## 4.5 2D & 3D view: -


Front View
Side View
Top View
3D Isometric View
Head
Drill Bit
Base
Spring
Screws & Bolts
Bit Holder
Sonargaon University (SU)
147/I, Green Road, Pranthapath, Dhaka
Program:
B.Sc in Mechanical Engineering
Figure:
Project Prototype cf Image
MS Metal
Drill Machine
A3

# CHAPTER 5
# RESULTS AND DISCUSSION

## 5.1 Results

Now, it's time to talk about the results.

- ❑ Finally, we have completed our project successfully & check our project its run accurately according to our objective.
- ❑ At first, we start our system.
- ❑ Mount the DC 12V motor securely on the frame, ensuring proper alignment with the flexible coupler.
- ❑ Attach the 5mm flexible coupler to the motor shaft and the input of the rack and pinion system. Secure with appropriate fasteners.
- ❑ Place bearings at critical points, such as where the rack and pinion system engages with the frame, to reduce friction and enhance stability.
- ❑ The user can control the operation of the **Mini Drill Machine**, turning it on or off and adjusting the vertical position of the drill head as needed.
- ❑ The speed control will be the potentiometer.

## 5.2 Advantages

There are certainly many advantages of our project and some of the major ones have been given below:

- Precision and Accuracy: The **Mini Drill Machine** allows for precise control over drilling depth and placement, ensuring accurate and repeatable results in various materials.
- Versatility: Suitable for drilling a variety of materials such as wood, plastic, and metal, making it versatile for different DIY and workshop projects.
- Smooth Operation: The inclusion of a rack and pinion system, along with bearings, ensures smooth and efficient operation, reducing friction and providing stability during drilling.
- Cost effective: Building a mini drill machine with common components can be a cost-effective alternative to purchasing a commercial drill machine, especially for those with specific design preferences.

- User-friendly: Easy-to-use controls for turning the drill machine on or off and adjusting the vertical position of the drill head, enhancing user convenience.
- Safety Features: Incorporation of safety features, such as emergency stops and protective guards, promotes safe operation, reducing the risk of accidents or injuries.

## 5.3 Disadvantages

- Limited Power: The DC 12V motor may have limitations in terms of power compared to larger drill presses. This could impact the drill's ability to handle more robust or demanding drilling tasks.
- Size Limitations: The compact design, while advantageous for smaller spaces, may pose challenges when dealing with larger or unusually shaped work-pieces.
- Material Limitations: The mini drill machine may not be as suitable for heavy-duty drilling in certain metals or exceptionally hard materials due to the limitations of the motor and overall design.
- Maintenance Requirements: DIY projects might require more frequent maintenance compared to commercial drill presses. Bearings, gears, and other moving parts may need periodic checks and lubrication.
- Limited Speed Control: he speed control of the drill machine may be limited compared to commercial models, potentially restricting its versatility for different drilling tasks.

## 5.4 Applications

This project has applications in many fields due its necessity. We have selected a few of them and they are given below:

- Woodworking.
- Metalworking.
- Plastic Fabrication.
- Electronics Work.
- DIY Home Improvement.
- Educational Use.

## 5.5 Discussion

While working on our project, we did face some difficulties as it is a very complex system but the end results, we came up with were quite satisfactory. We have put the whole system through several tasks to validate our work and also have taken necessary notes for future improvements. Some future recommendations that we have involves improvement in system design and wiring, adding features for more efficient.

## 5.6 Test result: -

Time calculation

| SL | Materials | Thickness | UOM | Result |
|---|---|---|---|---|
| 1 | Metal Sheet | 2mm | Sec | 3.26 |
| 2 | PVC Sheet | 6mm | Sec | 4.18 |
| 3 | Ply Board | 6mm | Sec | 7.31 |

# CHAPTER 6
# CONCLUSION

## 6.1 Conclusion

In conclusion, a DIY mini drill press project, incorporating components such as a DC 12V motor, SMPS, flexible coupler, rack and pinion system, and bearings, offers a cost-effective and versatile solution for individuals engaged in DIY, hobbyist, or small-scale workshop activities. While the project comes with its advantages, such as precision drilling, compact design, and customization potential, it's essential to consider potential disadvantages, including limited power, size constraints, and the need for maintenance. The mini drill press's applications span woodworking, metalworking, electronics work, model making, jewelry making, and various DIY home improvement projects. Its compact size, user-friendly controls, and versatility make it a valuable addition for those seeking a portable and efficient drilling solution. Before embarking on such a project, individuals should assess their technical skills, safety considerations, and specific project requirements. Thorough testing, adherence to safety guidelines, and proper maintenance are crucial to ensuring the successful and safe operation of the DIY mini drill machine.

## 6.2 Future Scope

As we have already discussed about the limitations of our project so definitely there's room for improvement and thus we have lots of future scope of work available to us for this project. Some of these are listed below:

- **Smart and Connected Drilling:** Integration of IOT (Internet of Things) technology for smart drill presses that can be monitored and controlled remotely.
- **Advanced Materials and Coatings:** Exploration of new materials and coatings for drill bits and components to enhance durability, reduce friction, and improve overall performance.
- **Enhanced Safety Features:** Integration of advanced safety features, such as machine learning algorithms for detecting potential hazards, emergency shutdown systems, and improved user interfaces to promote safer operation.

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