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**360° ROTATING FLEXIBLE DRILLING MACHINE**

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## 1. INTRODUCTION

In the 20<sup>th</sup> century, industrial revolution takes place. After that industries are developed on the large scale. Products are required to produce by the mass production techniques to reduce the cost. For that purpose different techniques are developed. As many processes have to take place simultaneously, there is need for the help in working. For doing different work we need help. Special purpose machines are developed for this. In the perforation of different work for that machine is defined as a device or machine which works according to our order. Our order should be completed in time with precision so the term called Machine comes into play. “Machine – A servant play’s important Role in it.” Automation has become key to unlock the manufacturing secrets and the way for determining finest possibility of processing operation in the industries, that will lead to achieve high throughput, accuracy and repeatability in production. Automation leads to perform almost all associate activities in manufacturing industries. While overcoming all parameter of manufacturing, automation has provided advance solution for performing nearly all operation like Milling, Drilling, etc.

In the field of Technology, every day a new technique is ruled. It has his own characteristic due to which we have to adopt it. Today is the World of “New Technology” which we have to take in practice. Machines is one of the areas in the development. Machines are widely used in the Mechanical field. In the mechanical Industries, machines are widely used for the art of wing manufacturing processes (cutting, drilling, welding etc.). Machines could accomplish many repetitive task for us. Machine can do hazardous jobs and can reach places where it’s difficult for human beings to reach. Industries are basically meant for production of useful goods and services at low production cost, machinery cost and low inventory cost. Nowadays, every task has been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure. Every industry desires to

increase the productivity rate maintaining the quality of the product at comparatively low cost. In any industry considerable portion of investment is being made for machinery installation.

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 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. Today the Industrial growth purely depends upon latest machines; therefore, the subject of advance machines is extending too widely.

This project focuses on developing a multi-directional drilling arm that can rotate and move in all directions to drill holes at various angles. The system uses a combination of link mechanisms and a rotary base, allowing complete 360° rotation. This model provides great versatility and reduces the time and effort required for repetitive setup. It is compact, efficient, and suitable for small-scale workshops, maintenance operations, and educational laboratories.

### **1.1. Problem definition:**

The conventional drill machine has two main parts first drill head & another is drill table. Assembly normally involves tedious work while adjustment of drill table during job holding also there is problem in hole drilling. To overcome this problem we can do the project on design & fabrication of 360 degree rotating flexible drilling machine table which is capable of drilling holes in any direction around drill table.

### **1.2. Statement of project:**

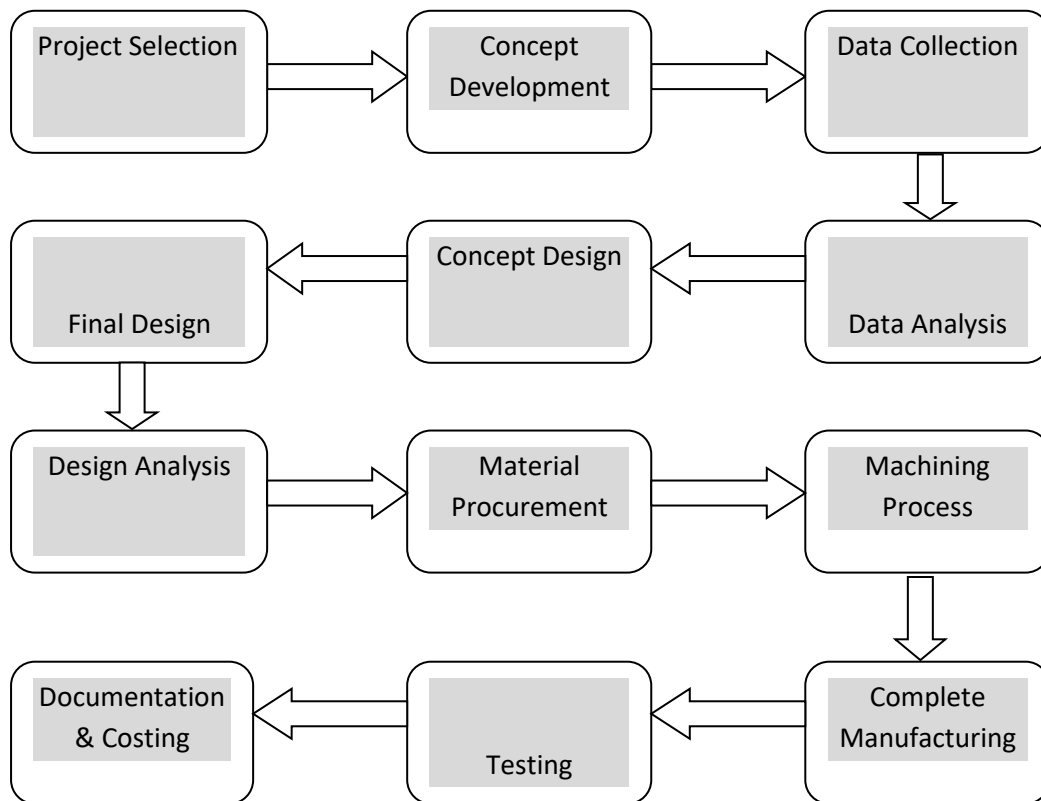
The statement of project is “**Design & fabrication of 360 degree rotating flexible drilling machine**” for the drilling of mechanical components as per requirements for industry in any direction around drill table.

**1.3. Objective:**

1. The main objective of this project is to achieve flexibility, precision, and efficiency during drilling operations.
2. This project mainly focuses on the application of modification of conventional portable drilling for small-scale 360 degree drill units.
3. The 360° Flexible Drilling Machine is designed to simplify and improve the process of drilling at multiple angles and positions without repositioning the work piece.
4. To reduce the efforts and maintain the accuracy in drilling process.
5. To performed the most rigid operation with high speed drilling in any type’s drill profile.

**1.4. Process flow chart & work methodology to solve the problem:**

The below flow chart shows the sequential operation/steps that will be performed during the project process.



In this chapter introduction of the project as well as the problem definition are discussed. To solve all the problems discussed above we are producing a new machine, as our project under this topic in our academic year, we are preparing a working scale model of this machine. We

have proposed a methodology to solve the problems. Our methodology is divided in different parts, under different titles. Sequence of proposed methodology is as follows –

1. Proposed Methodology 1 – Basic Information & Literature survey.
2. Proposed Methodology 2 – Design of Machine Components.
3. Proposed Methodology 3 - Selection of Components for Machine.
4. Proposed Methodology 4 –Fabrication of Machine parts.
5. Proposed Methodology 5 – Assembly, Testing & Documentation of Machine.

### **1. Proposed Methodology 1: Basic Information & Literature survey.**

This project report discusses about how to use literature data & identify the problems from field. By studying the literature of previously available system that help in maximizing the output by minimizing the effort, cost, time & money in future develop new machine.

### **2. Proposed Methodology 2: Identify & Design of Machine Components Available in Market.**

This project work will first introduce the background of the study. Presents the design constraints that influence on the use, efficiency & benefits their impacts on machine. After that machine parts design all different existing machine assembly units will done to make a probable machine model.

### **3. Proposed Methodology 3: Selection of Components for Machine as per design specifications.**

We will discuss the construction & working of system components. Various resources and factors were considered for getting the information on the project: First, the requirement of the field is to identify. The specification of the material is thought according to the need. Then, the allocation of budget is taken into consideration. Different research papers were read; we visited many markets & fields.

### **4. Proposed Methodology 4: CAD modelling & Fabrication of Machine parts.**

This project work will start to manufacture after purchasing of required specification material & making sample simulations which will be easy for visualization. After that manufacturing procedure of machine will be done, after this cost estimation of machine will calculate.

## **5. Proposed Methodology 5: Assembly & Testing of Machine.**

Finally, after complete manufacturing procedure, will test the working model which will satisfy probable objectives or not. After that complete working & satisfied testing will discuss advantages & applications of the machine while performing satisfied operation with complete report writing.

### **1.5. Scope:**

The project shall concern with design & modification in conventional drill machine with drill 360 degree flexible machine. During conventional drill machine working normally involves tedious work while adjustment of drill table during job holding also there is problem hole drilling. The scope for this project is to overcome this problem so we can do the project with 360 degree flexible drill machine which is capable of drilling hole without removing job from place.

## **2. LITERATURE SURVEY**

Rohit D. Mardane, Dr. A R Sahu, done the work on Design & Fabrication of Automated Attachment For Positioning Bed Of drilling Machine with Respect To CAD model , according to his work, introduce a special purpose attachment for drilling machine, which will convert any drilling machine into automated drilling machine. This machine will serves as a new solution in industry. Industrial automation has proven itself an essential part of the industries today. Its application has provided new solutions, making more concepts in manufacturing processes implementable. In this paper author proposing an automated attachment for drilling machine to position worktable with reference to CAD model . With detail study through literature review, analyzing, modeling, and experiments, the implementation of concept have delivered acceptable results. The drilling and positioning as per coordinate extraction program can achieve accurately with the precision of 1mm point to point. The drilling operation can be perform once points are selected and „RUN“ radio button click with delay less than 3 seconds. This system is design for small scale industry for drilling plastics and aluminum parts, like heat sink of LED as an alternate solution to CNC machine at low cost. Based on the above review papers the possibility of successful implementation of the project concept can be assure. We have identified the scope of project in small and medium scale industries. The main prospect of the project is to provide low cost automated solution as ‘Special Purpose Attachment for Bench Drilling Machine. [1]

Deepak Devasagayam, Anthony Ignatious, Jason Kalathingal , Joy Kakde ,Abhishek Wighe ,done the work on ,Design and Fabrication of Automatic Wood Drilling Machine, according to his work, CNC is a Computerized Numerical Control machine which is widely used in today's major industries to increase the production rate and thus the profit. It makes utilization of latest electronic and software developments to bring automation along with ease of being operated in less time. Thus, high degree of advancement in machine comes with very high cost thus increases the capital cost. It is sometimes impossible for start-ups & small scale industries to afford them. This paper aims to design and fabricate an automatic vertical drilling machine for point to point drilling in wooden planks. The system consists of two main parts: a mechanical setup that can move in X, Y and Z directions, and a software program that controls overall operation of the whole system. We show that our system successfully performs both of the above tasks. Operator would put coordinates of proposed holes in the given graphical window on computer. The drilling machine will travel to the respective co-ordinates with lead screw mechanism which is driven by stepper motor, being controlled by Arduino Mega microcontroller. This paper emphasizes on implementation and testing of suitable mechanism and software to bring automation and accuracy with negligible cost. It also enables lesser skilled operators to create components using CNC mechanism. the proposed Automatic wood drilling machine is equipped with three dimensional movements and considered to produce good precision accuracy for a competitive development cost comparing with another machine products manufactured by other companies which are not accurate, especially in drilling holes and with high cost material that is used in design. In this study, we have designed and developed a drilling machine that is able to follow the path prescribed by user and drill holes on wooden planks. We have tested our system and showed that the automatic wood drilling machine successfully drilled holes on wooden planks. [2]

Rajendra Kelwa, done the work on, Design and Fabrication of Drilling Cum Cutting Machine, according to his work, In an industry a considerable portion of investment is being made for machinery installation. So in this project I have a proposed a machine which can perform operations like drilling, cutting some lathe operations at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously. This project presents the concept of Multi-Function Operating Machine mainly carried out for production based industries. I have developed a conceptual model of a machine which would be capable of performing different operations simultaneously and is also economically efficient. On the main shaft a bevel gear

system is used for power transmission at two locations. These bevel gears are used to transmit motion in the radial direction and drives drilling center. By using scotch yoke mechanism perform cutting operation. This model facilitates to complete two operations simultaneously with a single power source. The production based industries wanted low production cost and high work rate which is possible through the utilization of multi-purpose machine which will less power as well as less time, since this machine provides working at different center it really reduced the time consumption up to appreciable limit. In an industry a considerable portion of investment is being made for machinery installation. So in this project we have proposed a machine which can perform operations drilling and cutting at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously. [3]

Yousef M. Abueejela, A. Albagul, Ibrahim A. Mansour and Obida M. Abdallah ,done the work on ,Automated Drilling Machine Based on PLC, according to his work, design and fabricate an automated drilling machine based on PLC to produce holes (8mm depth) in the center of a cubic work pieces (3 cm ×2 cm × 3cm). The drilling machining process proposed for a cycle of drilling. The cycle process is start when the start switch is pressed; the linear motor is put in place the drilling head in home position, and rotates the rotary disk to bring the first work pieces to desired position. Meanwhile, the drilling process is running after the inductive sensor in the (desired position) sense the object. Then the process will stop automatically when made the hole and went back to the home position, after that the rotary disk start to rotate quarter cycle to carry the drilled object out the table during the lower rotary disk. The PLC used to perform these operations, by reading data from sensors and actuate the DC motors. At the end of this project, the result shows that the designed system was able to run the drilling process autonomously for three object per minute based on the desired sequence. the automated drilling machine was successfully designed and implemented based on PLC control system. The prototype is done to drill a small hole in wood work-piece about (8mm) in depth, and perform drilling for 3 objects per minute, in order to increase the efficiency of small drilling machines instead human work. From the results of drilling performance testes, the system was apple to drill small holes and all the objectives were done successfully as proposed. [4]

R.Anandhan, P.Gunasekaran, D.Sreenevasan, D.Rajamaruthu, done the work on ,Design and Fabrication of Angular Drilling Machine, according to his work, Now a day, machines are widely controlled by embedded system. To meet the need of exploding population economic

and effective control of machines is necessary. Our project even is rotated to easily drill at any direction. So that job setting operation is not complicated as well as reduces the setting time for the operation. It also takes into consideration the most effective method of controlling the drilling machine by manually. Materials like wood, plastic and light metals can be drilled with this. The work piece is fixed on the work table, which is provided with a moving arrangement. The drilling machine is one of the most important machine tools in a workshop. In a drilling machine holes may be drilled quickly and at a low cost. The hole is generated by the rotating edge of a cutting tool known as the drill, which exerts large force on the work clamped on the table. As the machine tool exerts vertical pressure to original a hole it loosely called a “drill press”. Drilling is the operation of producing circular hole in the work-piece by using a rotating cutter called drill, the most common type of drill is the twist drill. The machine tool used for drilling is called drilling machine. The drilling operation can also be accomplished in a lathe, in which the drill is held in the tailstock and the work is held and rotated by a chuck. This angular drilling is performed for Different Angle Drilling in the working job. Indexing Plate and Up/down mechanism is available in this Angular Drilling Machine. This project is an efficient operation and competitive cost. Since a number of operation and angular hole can be performed in a simple unit. It is efficient and economical. Considering its uses and cost of project, it becomes relatively cheap when compared to other units. [5]

G.Prasanth Kumar , P.Guna Sekhar , P.Nadeem Khan , P.Rajesh , B.V.Krishnaiah, ,done the work on ,Design & Fabrication of 360° Flexible Drilling Machine, according to his work, In previous drilling machine many of the problems arise during drilling. Some parts cannot drill due to small work space between drill bit and work piece. So we use hand drills in this cases but it cause alignment problems. So here i propose a 360 degree flexible drill that can be mounted on a table or wall and can be used to drill holes horizontally, vertically or even upside down. So this make it possible for easy drilling in even complicated parts and surfaces. This project is an efficient operation and competitive cost. Since a number of operation and hole can be performed in a simple unit. It is efficient and economical. Considering its uses and cost of project, it becomes relatively cheap when compared to other units. [6]

Raut Shreyank Prakash, Routela Dinesh Singh Bahadur Singh, Sabale Aniket Prakash, Prof.Varghese Koshy, , ,done the work on ,Design and Fabrication of Multi Axis Drilling

Machine, according to his work, The industrial sectors greatly demands for productivity and quality. Productivity and quality, both should be maintained in order to endure in market. One of the key factor on which productivity depends is manufacturing competence with which the operation are carried out in some organization. It can be increased by reducing the total machining time. The best method to improve the productivity along with quality is by use of special purpose machine. In the existing radial drilling machine performance can be increased by design and development of multi axis drill machine. In small scale industries and automobile maintenance shops, there are many needs of drilling multiple holes. In order to create multiple hole at certain distance at a same time than the usual method followed is changing the position of the workpiece in order to satisfy the hole position. The main disadvantage of altering the position of the workpiece is that it reduces the accuracy of the finished components. So in our project we have planned to use multi spindle drilling head instead of using single spindle. If we use multiple spindles we can decrease the time required to complete the operation. This helps in reducing the cost of drilling operation. So this system is one of the efficient process with increase in the accuracy of the operation. Medium scale industry can use this machine for job production. By using our machine, industries are able to reduce the total production cycle time as compared to conventional machining. Also skilled labor is not required, because use of limit switch for controlling depth of holes makes operation easier than conventional machining. [7]

Sriranga V Deshpande, P U Karthik, Naveen Kumar D, Dr Vijendra Kumar, Dr K. S Badrinaryan, done the work on ,Design and fabrication of 3-axis CNC Milling machine, according to his work, Now a days with a digital control it's became more and more useful to use such a machine tools with a coded software. This paper will present the design and fabrication of 3-axis milling machine. computer numerically-controlled (CNC) machine which comprise the use of Arduino micro controller to produce pulse-width modulation (PWM) outputs in order to run the stepper motors that will be used in this work. A milling 3-axis CNC is previously used precisely surfaced designed for snapping of wood, plastic sheet and thin sheet of metal alloy by using a rotating drill bit which its accuracy is much lesser than using a lesser cutter technique this machine tool is portable and it's controlled by computer (PC). Design and Fabrication of CNC with precision Stepper motors that contacted with the lead screw moment along 3 -axis. From this project, we learned the principle of CNC machine. We gained better understanding in the modes of operation of CNC machine. There is various type of modern CNC machines use in industry. Automatic generation of different

preparatory (G codes) and miscellaneous function (M codes) is used in CNC part programming for completing a successful CNC program. Specifically, CNC milling machine works with a computer numerical control that writes and read G-code instructions to drive machine tool to fabricate components with a proper material removal rate. G-codes are commands for CNC machines to follow so that they can operate on their own without human control. Zero set up is very important step to obtain an accurate geometry of the work piece. From this project, we would conclude that it gives an idea for the beginners to understand on how the CNC machines work virtually. [8]

Phyo Wai Lin ,done the work on Design and Fabrication of a Small-scale, CNC Milling Machine, according to his work, This paper reports the design and fabrication of small-scale CNC milling machine which is capable of 3-axis simultaneous interpolated operation. The idea behind this work is to design low cost and easy portable machine which is achieved by incorporating the features of a standard PC interface with ATMEGA 328 micro controller based CNC system in an Arduino. The system also features an offline G-Code parser and then interpreted on the micro-controller from a USB. The main objective of this work is the development of a model of CNC machine on educational purposes. The design CNC machine with workspace of 150mm ×150mm using a precision stepper motors that combined with lead screws in moving the axis smoothly on linear bearings that increases a more precisely results obtained. In this work, a small-scale 3 axis CNC milling machine was designed and fabricated with a low price. This proposed machine is easy to implement, inexpensive and comparable to the commercially available machines. The components of CNC machine are selected to provide accuracy and simplicity with-in limited budget. The accuracy of the CNC machine body parts assembly has succeeded to achieve the objectives in precisely and repeatability goal. In future work, the Y-axis guide ways of the machine are modifying to be able to machine more load of object and to increase machine rigidity. And also it is planned to do the stress analysis of the machine body structures. [9]

M.Tamilarasan, G. Kalaiyaran, G. Anbarasan, B.Arun Kumar, D.Arun Kumar, „done the work on ,Design and fabrication of fixture for milling machine in Industry, according to his work, A fixture is a work holding device or supporting device used in manufacturing industry. Each component of a fixture is designed for one of two purposes location or support. In the industries they are using these fixtures for achieving the greater production and providing good quality products. Using a fixture improves the economy of production by

allowing smooth operation and quick transition from part to part, reducing the requirement for skilled labor by simplifying how work pieces are mounted, and increasing conformity across a production run. So in this project we are aiming to make the fixture for complicated components and machining is done by using this fixture to improve the production standards. Milling operations tend to involve large, straight cuts that produce lots of chips and involve varying force. Locating and supporting areas must usually be large and very sturdy in order to accommodate milling operations; strong clamps are also a requirement. Due to the vibration of the machine, positive stops are preferred over friction for securing the workpiece. For high-volume automated processes, milling fixtures usually involve hydraulic clamps. In this project we are actually done the designing and fabrication of the fixture for the respected hydraulic unit valve and manufactured the fixture for the VMC milling machine for the industrial purpose. And by using this fixture we improves the economy of production by allowing smooth operation and quick transition from part to part, reducing the requirement for skilled labor by simplifying how work pieces are mounted, and increasing conformity across a production run.[10]

## **2.1. Manual Drilling Machine:**

### **2.1.1. Introduction:**

The basic parts of a drilling machine are its base, supporting arms, drill head and chuck. The base made of cast iron or other hard material may rest on a bench, floor depending upon the design. Larger and heavy-duty machines are grounded on the floor. The arms are mounted on base with the help of hinge to rotate about it. It is accurately machined and the arms can move up, down and rotate about x-axis. The drill chuck, an electric motor and the mechanism meant for driving the chuck at different speeds are mounted on the top of the upper arm. Power is transmitted from the electric motor to the drill chuck. It is design for drilling small holes at high speeds in lightweight components. High speed and hand feed are necessary for drilling small holes. The base of the machine is mounted either on a bench or on the floor by means of bolts and nuts. It can handle drills up to 15.5mm of diameter. The feed of depth to drill is given purely by hand into the work. The operator can sense the progress of the drill into the work because of hand feed. [1]



**Fig.2.1. Portable Bench (sensitive) Drilling Machine.**

### **2.1.2. Components:**

- **Base:** The base is made of cast iron and so can withstand vibrations. It may mount on a bench or on the floor. It supports all the other parts of the machine on it.
- **Column:** The column stands vertically on the base at one end. It supports the worktable and the drill head. The drill head has drill spindle and the driving motor on either side of the column.
- **Table:** The table is mounting on the vertical column and can be adjusting up and down on it. The table has 'T' -slots on it for holding the workpiece or to hold any other work holding device. The table can be adjusting vertically to accommodate workpiece of different heights and can be clamped at the required position.
- **Drill head:** Drill head is mounted on the top side of the column. The drill spindle and the driving motor are connected by means of a V-belt and cone pulleys. The motion is transmitted to the spindle from the motor by the belt. The pinion attached to the handle meshes with the rack on the sleeve of the spindle for providing the drill the required down feed. There is no power feed arrangement in this machine. The spindle rotates at a speed ranging from 50 to 2000 r.p.m. [1]

## 2.2. Automated Drilling Machine:



**Fig.2.2. Automatic PCB drilling machine.**

**2.2.1. Introduction:** Automatic drilling machine is a device for making holes in components without human interface. Manually operated machine creates problems such as low accuracy, high setup time, low productivity, etc. A CNC machine overcomes all these problems but the main disadvantage of a CNC drilling machine is the high initial cost and requirement of skilled labour for operating the machine. The need for skilled operator is eliminated by providing a software with a more user-friendly graphical user interface.[1]

### 2.2.2. Components:

- **Mechanical Components:** Its includes the structure of the drilling machine i.e. the base, support structure, beams, lead screw, bearing, gears, etc.
- **Electronics System:** It consists of the motor, motor control unit, power unit and interfacing.
- **Controls or computing system:** It positions the drilling end at the required position and it provides the depth of cut.[1]

## 2.3. Up-Right Drilling Machine:

These are medium heavy-duty machines. It specifically differs from sensitive drill in its weight, rigidity, application of power feed and wider range of spindle speed. Fig.2 shows the line sketch of up-right drilling machine. This machine usually has a gear driven mechanism for different spindle speed and an automatic or power feed device. Table can move vertically and radially. Drill holes up to 50mm. [16][17]

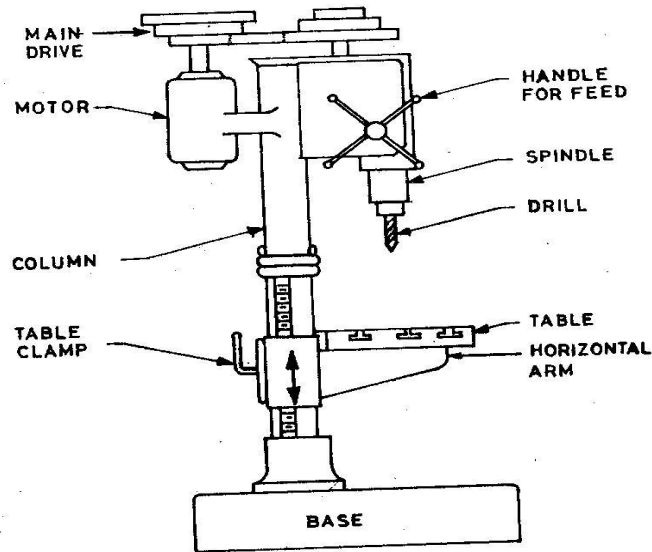


Fig.2.3. Up-Right Drilling Machine.

#### 2.4. Radial Drilling Machine:

It is the largest and most versatile used for drilling medium to large and heavy work pieces. Radial drilling machine belongs to power feed type. The column and radial drilling machine support the radial arm, drill head and motor. Fig.3 shows the line sketch of radial drilling machine. The radial arm slides up and down on the column with the help of elevating screw provided on the side of the column, which is driven by a motor. The drill head is mounted on the radial arm and moves on the guide ways provided the radial arm can also be swiveled around the column. The drill head is equipped with a separate motor to drive the spindle, which carries the drill bit. A drill head may be moved on the arm manually or by power. Feed can be either manual or automatic with reversal mechanism.[16][17]

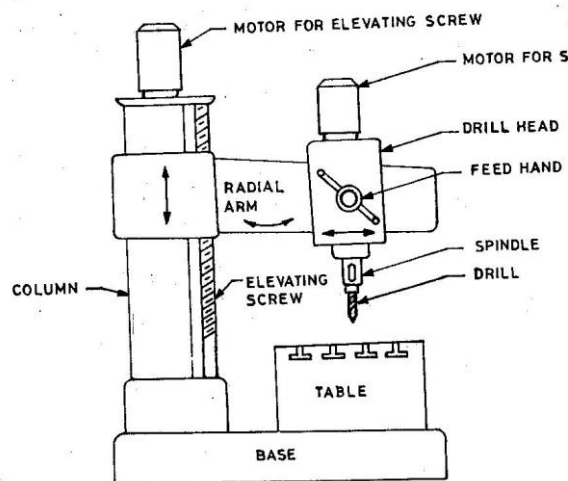


Fig.2.4. Radial Drilling Machine.

## **2.5. Kinematic System and Principle of Working: [16][17]**

Kinematic system in any machine tool is comprised of chain(s) of several mechanisms to enable transform and transmit motion(s) from the power source(s) to the cutting tool and the workpiece for the desired machining action. The kinematic structure varies from machine tool to machine tool requiring different type and number of tool-work motions. Even for the same type of machine tool, say column drilling machine, the designer may take different kinematic structure depending upon productivity, process capability, durability, compactness, overall cost etc targeted.

### **2.5.1. Cutting motion:**

The cutting motion in drilling machines is attained by rotating the drill at different speeds (rpm.). Like centre lathes, milling machines etc, drilling machines also need to have a reasonably large number of spindle speeds to cover the useful ranges of work material, tool material, drill diameter, machining and machine tool conditions. It is that the drill gets its rotary motion from the motor through the speed gear box (SGB) and a pair of bevel gears. [5]

### **2.5.2. Feed motion:**

In drilling machines, generally both the cutting motion and feed motion are imparted to the drill. Like cutting velocity or speed, the feed (rate) also needs varying (within a range) depending upon the tool-work materials and other conditions and requirements. The drill receives its feed motion from the output shaft through the feed gear box (FGB), and the clutch. The feed rate can be changed to any of the 6 rates by shifting the gears in the FGB. And the automatic feed direction can be reversed, when required, by operating the speed reversal mechanism, RM-s as shown. The slow rotation of the pinion causes the axial motion of the drill by moving the rack provided on the wheel.[5]

### **2.5.3. Job holding work:**

Small jobs are generally held in vice and large or odd shaped jobs are directly mounted on the bed by clamping tools using the T-slots made in the top and side surfaces of the bed.[5]

### 3. CONSTRUCTION

The 360 degree rotating flexible drilling machine having following main components this can be given below,

- 1) Supporting base frame.
- 2) Guide plates.
- 3) Drill bit.
- 4) Drill Machine.
- 5) Bearings.
- 6) Nut & Bolts
- 7) Washers
- 8) Foundation grippers.

The main components of machine are as follows:

**3.1. Frame:** The main function of frame is to carry whole assembly on it so it has to be strong enough to hold it. The frame is made of M.S. angles and it is formed out of mild steel.

#### 3.2. Guide Shaft:

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a drill holder plates for the purpose of drilling.



**Fig.3.1. Guide Shaft.**

#### 3.3. Washer:

A washer is a thin plate (typically disk-shaped) with a hole (typically in the middle) that is normally used to distribute the load of a threaded fastener such as a screw or nut. Other uses are as a spacer, spring (wave washer), wear pad, preload indicating device, locking device, and to reduce vibration (rubber washer). Washers usually have an outer diameter (OD) about twice the width of their inner diameter (ID). Washers are usually metal or plastic. High quality

bolted joints require hardened steel washers to prevent the loss of pre-load due to Brinelling after the torque is applied. Rubber or fiber gaskets used in taps (or faucets, or valves) to stop the flow of water are sometimes referred to colloquially as *washers*; but, while they may look similar, washers and gaskets are usually designed for different functions and made differently.



**Fig.3.2. Washer.**

### **3.4. Nut and Bolt:**

As nuts and bolts are not perfectly rigid, but stretch slightly under load, the distribution of stress on the threads is not uniform. In fact, on a theoretically infinitely long bolt, the first thread takes a third of the load, the first three threads take three-quarters of the load, and the first six threads take essentially the whole load. Beyond the first six threads, the remaining threads are under essentially no load at all. Therefore, a nut or bolt with six threads acts very much like an infinitely long nut or bolt.



**Fig.3.3. Nut and Bolt.**

### **3.5. Drill bits:**

Drill bits are cutting tools used to create cylindrical holes. Bits are held in a tool called a drill, which rotates them and provides torque and axial force to create the hole. Specialized bits are also available for non-cylindrical shaped holes. The shank is the part of the drill bit grasped by the chuck of a drill. The cutting edges of the drill bit are at one end, and the shank is at the other. Drill bits come in standard sizes, described in the drill bit sizes article. A comprehensive drill bit and tap size chart lists metric and imperial sized drill bits alongside the required screw tap sizes. The term drill may refer to either a drilling machine or a drill bit

for use in a drilling machine. In this article, for clarity, drill bit or bit is used throughout to refer to a bit for use in a drilling machine, and drill refers always to a drilling machine.



**Fig.3.4. Drill bit.**

### **3.6. Drill Machine:**

Electric Drill is a type of equipment that runs on electricity could also be classified as a large mechanical drill. These electric drills are typically used to drill small diameter holes in materials. Portable drilling machines are operated at higher speeds. A drill is a tool used for making round holes or driving fasteners. It is fitted with a drill bit for making holes, or a screwdriver bit for securing fasteners. Drills are commonly used in woodworking, metalworking, construction, machine tool fabrication, and utility projects. Specially designed versions are made for surgery, dentistry, miniatures, and other applications.



**Fig.3.5. Portable electric drilling machine.**

#### 4. WORKING

Our 360 degree flexible drilling machine has two main parts first drill head & another is base drill table. The Job to be drill should be place on base table. In this project drill head moves in 6-ways as shown in fig.4.1. Having co-ordinates of moving drilling machine with 360 degree drill head which is capable of drilling straight hole as per requirements for industry. The 360° Flexible Drilling Machine works on the principle of a link mechanism with rotary joints. The drill head is attached to a movable arm that can rotate horizontally and vertically. The linkages will provides the rotary motion for drilling, while the arms provide flexibility in positioning. The motion of drill table as given below,

- 1) Linear +X & -X.
- 2) Linear +Y & -Y.
- 3) Linear +Z & -Z.

The machine will work in combine function as a drilling & milling also by making simple changes in attachments.

1. Base Plate: Provides stability and support to the entire setup.
2. Rotating Arm: Allows 360° rotation and movement of the drill head.
3. Drill Motor: Provides rotational power for drilling.
4. Joints and Links: Help in adjusting the arm in various directions.
5. Power Supply: Provides electric energy to the motor.

**Fig.4.1.** 360° degree rotating flexible drilling machine.

#### 5. DESIGN

##### 5.1. Metallurgical specification:

The machine is basically made up of mild steel.

##### Reasons:

- 1) Mild steel is readily available in market.
- 2) It is economical to use.
- 3) It is available in standard sizes.
- 4) It has good mechanical properties i.e. it is easily machinable.
- 5) It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure.
- 6) It has high tensile strength.
- 7) Low co-efficient of thermal expansion.

### 5.2. Properties of Mild Steel:

M.S. has carbon content from 0.15% to 0.30%. They are easily weldable thus can be hardened only. They are similar to wrought iron in properties. Both ultimate tensile and compressive strength of these steel increases with increasing carbon content. They can be easily gas welded or electric or arc welded. With increase in the carbon percentage weld ability decreases. Mild steel serve the purpose and was hence was selected because of the above purpose.

### 5.3. Approach to mechanical design of system.

In design the of parts we shall adopt the following approach;

#### Selection of appropriate material.

- Assuming an appropriate dimension as per system design.
- Design check for failure of component under any possible system of forces.

#### Mechanical design:

In mechanical design the components are listed down and stored on the basis of their procurement in two categories.

- Design parts
- Parts to be purchased.

For designed parts detailed design is done and dimensions there obtained are compared to next dimensions which are already available in market. This simplifies the assembly as well as the post production and maintenance work. The various tolerances on work are specified. The process charts are prepared and passed to manufacturing stage. The parts to be purchased directly are selected from various catalogues and are specified so as to have ease of procurement. In mechanical design at the first stage selection of appropriate material for the part to be designed for specific application is done. This selection is based on standard catalogues or data books;

eg:- ( PSG DESIGN DATA BOOKS ) ( SKF BEARING CATALOGUE ) etc.

### 5.4. Machining Parameters:[11]

Cutting Speed of drill bit  $V = \pi DN$

Where, D = diameter of drill in mm = 4mm

N = speed of rotation in mm = 1440 rpm

$V=18095.57$  mm/sec

Feed Rate  $f = 40 \text{ mm/min}$

Depth of Cut  $d = D/2$ ,  $d = 2 \text{ mm}$

Material Removal Rate  $MRR = \frac{\pi}{4} D^2 \times f \times N$

$MRR = 723822.9 \text{ mm}^3/\text{min}$

Machining Time  $t = L/f$

Where,  $L = \text{length of the hole to be drilled} = 10\text{mm}$

$f = \text{feed of the drill} = 40 \text{ mm/min}$

$t = 0.25 \text{ min}$

Power of motor  $P = 50 \text{ watt}$

Power  $P = \frac{2\pi T}{60}$

$50 = \frac{2\pi T}{60}$

$T = 477.46 \text{ N-mm}$

## 6. PROCESS SHEETS

### 6.1. PART NAME: Mounting table base frame.

Part weight – 5 kg

Part material – M.S.

Part quantity – 1

| Sr. No. | Operation                                      | Machine          | Tool             | Time   |
|---------|--|------------------|------------------|--------|
| 1       | Cutting the material as per our required size. | Cutting machine  | Cutting machine  | 35 min |
| 2       | Welding the frame as per required size.        | Welding machine  | Arc Welding tool | 45 min |
| 3       | Grinding the frame.                            | Grinding machine | Grinding machine | 20 min |

**6.2. PART NAME: Rotating arm.**

Part weight – 1.5 kg

Part material – M.S.

Part quantity – 01

| Sr. No. | Operation                                      | Machine          | Tool             | Time   |
|---------|--|------------------|------------------|--------|
| 1       | Cutting the material as per our required size. | Cutting machine  | Cutting machine  | 30 min |
| 2       | Drilling the pipe as per required size.        | Drilling machine | Drilling tool    | 10 min |
| 3       | Welding the pipe as per required size.         | Welding machine  | Arc Welding tool | 15 min |
| 4       | Grinding the Pipe.                             | Grinding machine | Grinding machine | 10 min |

**6.3. PART NAME: Flexible Plates.**

Part weight – 0.5 kg

Part material – M.S.

Part quantity – 04

| Sr. No. | Operation                                    | Machine          | Tool             | Time   |
|---------|--|------------------|------------------|--------|
| 1       | Cutting the plates as per our required size. | Cutting machine  | Cutting machine  | 20 min |
| 2       | Drilling the plates as per required size.    | Drilling machine | Drilling tool    | 15 min |
| 3       | Grinding the plates.                         | Grinding machine | Grinding machine | 10 min |

**6.4. PART NAME: Drill holding plate.**

Part weight – 0.2 kg

Part material – M.S.

Part quantity – 01

| Sr. No. | Operation  | Machine         | Tool            | Time   |
|---------|--|-----------------|-----------------|--------|
| 1       | Cutting the plate as per our required size.      | Cutting machine | Cutting machine | 20 min |
| 2       | Drilling the holes for fixing the drill machine. | Drill machine   | Drill machine   | 15 min |

|   |                            |                  |                  |        |
|---|----------------------------|------------------|------------------|--------|
| 3 | Grinding the plate.        | Grinding machine | Grinding machine | 10 min |
| 4 | Welding the bolt to plate. | Welding machine  | Arc Welding tool | 20 min |

## 7. COST ESTIMATIONS

### 7.1. TOTAL COST OF MATERIAL

| Part Name | Material | Wt in kg | Rate / kg | Total Rate |
|-----------|----------|----------|-----------|------------|
| Plate     | M.S      | 3        | 70        | 210        |
| Pipe      | M.S      | 2        | 80        | 160        |
| Angle     | M.S      | 7        | 70        | 490        |

**TOTAL COST OF MATERIAL: 860/- RS.**

### 7.2. COST OF MACHINENING

| Machine Name | Using Time (min) | Rate /hr | Total Rate Rs/- |
|--------------|------------------|----------|-----------------|
| Cutting      | 105              | 500      | 880             |
| Welding      | 80               | 800      | 1050            |
| Grinding     | 50               | 500      | 420             |
| Drilling     | 40               | 500      | 330             |

**TOTAL COST OF MACHINENING: 2,680/- RS.**

### 7.3. COST OF STD PART

| Sr.No. | Name               | Qty. | Rate | Total Rate |
|--------|--------------------|------|------|------------|
| 1      | Drill machine      | 1    | 950  | 950        |
| 2      | Drill Bit          | 1    | 40   | 40         |
| 3      | Washer 5 mm        | 10   | 5    | 50         |
| 4      | Nut & bolt         | 12   | 5    | 60         |
| 5      | Foundation gripper | 4    | 20   | 80         |

**TOTAL COST OF STD PART: 1,180/- Rs.**

**7.4. COST OF TRANSPORTATION & OVERHEAD = 1000 / - Rs.**

**7.5. TOTAL COST OF PROJECT =**

Cost of material + Cost of machining + Cost of STD part + Cost of transportation & overhead

$$= 860 + 2680 + 1180 + 1000$$

$$= \mathbf{5,720/-}$$

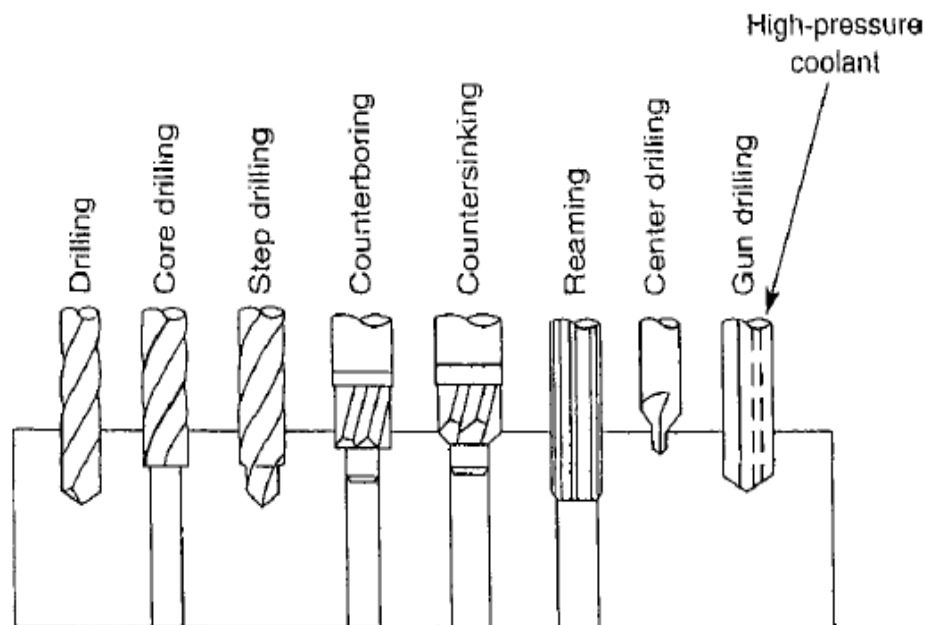
## 8. ADVANTAGES & APPLICATIONS

### 8.1. Advantages:

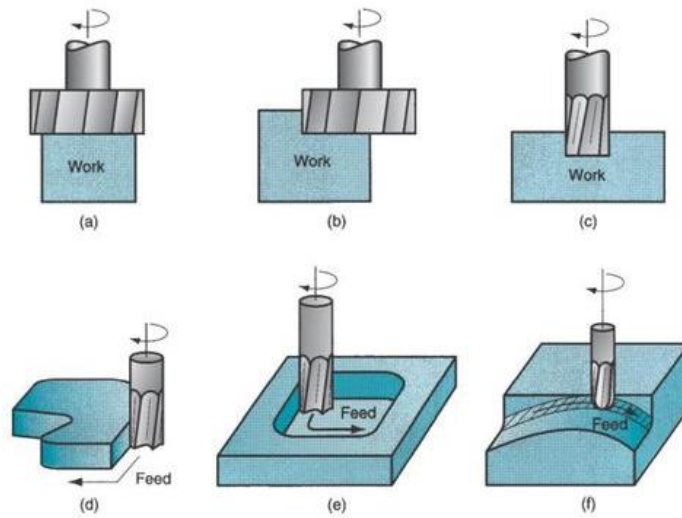
- 1) It provides multiple drilling sizes & types of the holes.
- 2) The operation of the new drill machine is well controlled.
- 3) Complex shapes can be drill as per requirement easily.
- 4) Well balanced system.
- 5) It approximately having higher efficiency that of old machine in low cost application machine.
- 6) It minimizes misalignment & less floor space is required.
- 7) Only simple support structures are required fabrication is easy.
- 8) It is a faster process of drilling.
- 9) Wide variety of materials can be drill easily.
- 10) Highly accurate profiles drilling can be easily obtained.
- 11) More accurate and economical in mass production.
- 12) A finished work pieces are made within less time.
- 13) It increases the safety and working condition.

### 8.2. Applications:

- 1) It is used for Drilling & milling of all types of plywood, wooden material. It is used reaming, counter boring for higher finishing for drilling metal.



## Face milling operations



Face milling: (a) conventional facemilling, (b) partial face milling, (c) end milling, (d) profile milling, (e) pocket milling, and (f) surface contouring.



## 9. CONCLUSION

While concluding this report, we feel quite fulfill in having completed the project assignment well on time, we had enormous practical experience on fulfillment of the manufacturing schedules of the working project model. We are therefore, happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose. Although the design criterions imposed challenging problems which, however were overcome by us due to availability of good reference books. The selection of choice raw materials helped us in machining of the various components to very close tolerance and thereby minimizing the level of balancing problem. Needless to emphasis here that we had lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction to solve the problem in industrial field for social welfare. We had selected a plywood sample for drilling for comparing time required for conventional old drill machine & new modify drill machine are compare both performance. Sample drilling job, SQUARE 50mm X 50mm X 10mm. with 3 mm Holes. 4Nos. This conventional old drill machine required more time & efforts with tedious work of job setting, while new modify drill machine required less time & efforts to set the job. The 360 degree flexible drilling machine has achieved optimum benefits with regard to reliability, safety appearance, and ease of use. All the objectives set up for this system have been achieved successfully. In terms of mechanical design, the X-axis, the Y-axis, the Z-axis module and the end-effectors drilling machine module were designed and fabricated properly. In the future, we would like to expand features & applications of the drilling machine in order optimize its performance.

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