PROJECT REPORT

ON

"ROBOTIC ARM ASSISTED DRILLING MACHINE"

Submitted by

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Under the Guidance of

PROF.R.D.KALE

In partial fulfillment of

Diploma in Mechanical Engineering

At

DEPARTMENT OF MECHANICAL ENGINEERING

MIT POLYTECHNIC

PUNE – 411038

Affiliated To

MAHARASTRA STATE BOARD

OF TECHNICAL EDUCATION

MIT POLYTECHNIC
Department of Mechanical Engineering
PUNE-411038

CERTIFICATE

This is to certify that the Project entitled **Robotic Arm Assisted Drilling Machine,** submitted by **Mr. NILAY PAWALE** is a record of bona-fide work carried out by him/her, in the partial fulfillment of the requirement for the award of Diploma in Mechanical Engineering at MIT Polytechnic, Pune under the Maharashtra State Board of technical education. This work is done during year 2016-17, under our guidance.

Date: ……………….

Project Guide

[Prof.R.D.Kale]

Acknowledgement

We take this opportunity to express our deepest sense of gratitude and sincere thanks to those who have helped us in completing this task.

We express our sincere thanks to our Project Guide **Prof. R.D.KALE**, Lecturer in Mechanical Engineering, who has given us excellent guidance, continuous encouragement for the completion of this work. His kind assistance and constant inspiration will always help us in our future also.

We are thankful to **Prof. Dr. N.K. Patil**, Head of the department, Mechanical engineering for his valuable suggestions and continuous inspiration.

We are thankful to Principal, **Prof. Dr. Rohini Kale**, for encouraging us to undertake this project and she has taken keen interest in making the project and report absolutely flawless. We are thankful to Prof. R.D. Kale, workshop superintendent and entire staff of Workshop for providing machining facilities and share their valuable experience with us. Credit goes to our friends, staff members of Mechanical Engineering Department and the staff of Institute's Central Library, for their help and timely assistance.

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Diploma in Mechanical Engineering

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ABSTRACT

Machine tools probes play a vital role in enabling manufacturing companies to deliver components and products to the highest possible specifications. The conventional drilling machine which we use today has greater capacity, has rigid construction, can withstand high forces but if the work piece is simple and small in size, the fabrication on the conventional drilling machine would be an expensive affair as it will extract more electricity. This project will overcome the problem of extraction of electricity and also it is simple to use. It will have simple construction, portable to be carried anywhere for machining. This will decrease the slight losses of time and electricity which will result in cost effectiveness of the machine and also will lead to profit of the part that is being machined.

The project, Robotic assisted drilling machine comes under the fields of portability and automation. The project aims to provide portability, by making the machine movable, hence making the machine to work in any working conditions irrespective of the space which it will require and to provide automation, by the addition of the robotic arm which assists to load and unload the work piece on the drilling machine. This project is also cost effective which will be more economical and also simple in construction. This project will be more helpful who need portability of the machine and also for those who do not want more expenses on the machine.

CHAPTER 1: INTRODUCTION

Topic of the Project: Robotic Assisted Drilling Machine

The project, Robotic assisted drilling machine comes under the fields of portability and automation. The project aims to provide portability, by making the machine movable, hence making the machine to work in any working conditions irrespective of the space which it will require and to provide automation, by the addition of the robotic arm which assists to load and unload the work piece on the drilling machine. This project is also cost effective which will be more economical and also simple in construction. This project will be more helpful who need portability of the machine and also for those who do not want more expenses on the machine.

The project we decided to make helped us to do the project by these three points:

1. Motivation
2. Background
3. Need of the Project

1. Motivation:

The motivation of this project came to us from our course subjects which include the machine tools and the automation of the systems. Then the idea of portability came by reducing the complex construction and size of the machine to a more simple construction and minimum size of the machine tools which is more and is not everyone's cup of tea. This has led us to do this project which may be beneficial to many manufacturing facilities and start-ups as this project may benefit them.

2. Background:

A machine tool is a machine for handling or machining metal or other rigid materials, usually by cutting, boring, grinding, shearing, or other forms of deformation. Machine tools employ some sort of tool that does the cutting or shaping. All machine tools have some means of constraining the work piece and provide a guided movement of the parts of the machine. Thus the relative movement between the work piece and the cutting tool (which is called the tool path) is controlled or constrained by the machine to at least some extent, rather than being entirely "offhand" or "freehand". It is a power driven metal cutting machine which assists in managing the needed relative motion between cutting tool and the job that changes the size and shape of the job material. Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multi-point. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work-piece, cutting off chips from the hole as it is drilled. A drill is a tool primarily used for making round holes or driving fasteners. It is fitted with a bit, either a drill or driver, depending on application, secured by a chuck. Some powered drills also include a hammer function. The need of drilling machine is much necessary in manufacturing and fabrication purposes. The inclusion of automation provides better reliability and better speed in the work. This project can fulfil the needs of portability and costs issues for a drilling machine.

3. Need of the Project:

Machine tools probes play a vital role in enabling manufacturing companies to deliver components and products to the highest possible specifications. The conventional drilling machine which we use today has greater capacity, has rigid construction, can withstand high forces but if the work piece is simple and small in size, the fabrication on the conventional drilling machine would be an expensive affair as it will extract more electricity. This project will overcome the problem of extraction of electricity and also it is simple to use. It will have simple construction, portable to be carried anywhere for machining. This will decrease the slight losses of time and electricity which will result in cost effectiveness of the machine and also will lead to profit of the part that is being machined.

CHAPTER 2: LITERATURE SURVEY

Research Papers:

1. "Horizontal Directional Drilling Machine and Method Employing Configurable Tracking System Interface" by Kevin L. Alft, Pella, IA (US); Gregory W. Draper, Pella, IA (US); Hans Kelpe, Pella, IA (US), Vermeer Manufacturing Company, Pella, IA (US)

A system and method for controlling an underground boring tool involves the use of one or more of a gyroscope, accelerometer, and magnetometer sensor provided in or proximate the boring tool. The location of the boring tool is detected substantially in real-time. A controller produces a control signal substantially in real-time in response to the detected boring tool location and sensed parameters of a boring tool driving apparatus. The control signal is applied to the driving apparatus to control one or both of a rate and a direction of boring tool movement along the underground path. The gyroscope, accelerometer, and magnetometers may be of a conventional design, but are preferably of a solid-state design. Telemetry data is communicated electromagnetically, optically or capacitive between the navigation sensors at the boring tool and the controller via the drill string or an above-ground tracker unit. The tracker unit may further include a re-calibration unit which communicatively cooperates with the navigation sensors to re-establish a proper heading or orientation of the boring tool if needed. The controller determines a location of the boring tool in at least two of x-, y-, and z-plane coordinates and may also determine an orientation of the boring tool in at least two of yaw, pitch, and roll. A hand-held remote unit may be used by an operator to control all or a sub-set of boring system functions.

What is claimed is:

1. A horizontal directional drilling machine, comprising: a base machine capable of propelling a drill string rotationally and longitudinally during a boring operation, a drilling tool coupled to the drill string; an operator control station with which a machine operator can control the base machine; and an interface comprising a display, the interface configurable to receive information from a plurality of tracking systems of differing types,

the interface receiving machine information from the base machine and location information from a particular tracking system of a particular type, the display displaying the machine and location information for use by the machine operator.

2. The machine of claim, wherein the plurality of tracking systems comprises a plurality of walkover tracking systems of differing types, the interface configurable to receive the location information from a particular walkover tracking system of a particular type.

3. The machine of claim, wherein the particular walkover tracking system transfers data to the interface using a wireless communication link.

4. The machine of claim 3, wherein the wireless communication link comprises a one way wireless communication link over which data is transferred from the particular walkover tracking system to the interface.

5. The machine of claim, wherein the wireless communication link comprises a two way wireless communication link over which data is bi-directionally transferred between the particular walkover tracking system and the interface.

6. The machine of claim, wherein the plurality of tracking systems comprises a plurality of down-hole tracking systems of differing types, the interface configurable to receive the location information from a particular down-hole tracking system of a particular type.

7. The machine of claim, further comprising a communication link communicatively coupling the particular down-hole tracking system with the interface, the communication link comprising a conductor passing through the drill string.

8. The machine of claim, further comprising a communication link communicatively coupling the particular down-hole tracking system with the interface, the communication link comprising an acoustic system utilizing the drill string as an acoustic communication link.

9. The machine of claim, further comprising a communication link communicatively coupling the particular down-hole tracking system with the interface, the communication link comprising a mud pulse system.

10. The machine of claim, wherein the plurality of tracking systems comprises a down-hole tracking system and a walkover tracking system, further wherein first locating information is communicated between the down-hole tracking system and the interface and second locating information is communicated between the walkover tracking system and the interface.

2. "PORTABLE DRILLING MACHINE" by Jong Oh Kim, 761-10 Wongok-dong, Danwon-ku. Ansan city Kyungki-do (KR)

A portable drilling machine includes a housing; a drill chuck positioned on a front surface of the housing; a drill bit detachably coupled to the drill chuck; a driver positioned inside the housing to provide either the drill bit or the drill chuck with a rotational driving force; an anti-dust cover having a rear anti-dust cover formed in a cup shape with a drill through-hole formed in a central region of a bottom surface of the rear anti-dust cover and a front anti-dust cover formed in a tube shape to be coupled to the rear anti-dust cover, the front anti-dust cover being adapted to move towards the bottom surface of the rear anti-dust cover when acted on by pressure towards the housing and return to original position when the pressure is removed; and a retainer for detachably coupling the rear anti-dust cover to an outer surface of either the housing or the drill chuck. The rotational motion of the drill bit is not interfered with by the anti-dust cover, and the dust collection space is increased.

<u>What is claimed is</u>:

1. A portable drilling machine comprising: a housing; a drill chuck positioned on a front surface of the housing; a drill bit detachably coupled to the drill chuck; a driver positioned inside the housing to provide either the drill bit or the drill chuck with a rotational driving force; an anti-dust cover having a rear anti-dust cover formed in a cup shape with a drill through-hole formed in a central region of a bottom surface of the rear anti-dust cover and a front anti-dust cover formed in a tube shape to be coupled to the rear anti-dust cover, the front anti-dust cover being adapted to move towards the bottom surface of the rear anti-dust cover when acted on by pressure towards the housing and return to original position when

the pressure is removed, wherein the front anti-dust cover is formed as a corrugated tube adapted to retract towards the bottom surface of the rear anti-dust cover when acted on by pressure towards the housing and extend to original position when the pressure is removed; and a retainer for detachably coupling the rear anti-dust cover to an outer surface of either the housing or the drill chuck, wherein the rear anti-dust cover has a pair of retaining posts formed on a peripheral wall of the rear anti-dust cover while facing each other and a linear retaining slot defined between the retaining posts in a longitudinal direction of the rear anti-dust cover, the front anti-dust cover being coupled to the rear anti-dust cover by a fastener inserted into the retaining slot.

2. The portable drilling machine as claimed in claim 1, further comprising a filling member mounted in the retaining slot.

3. The portable drilling machine as claimed in claim 2, wherein the filling member has a pair of screening members formed on both sides of the fastener, respectively, and a connector for connecting the screening members to each other along the longitudinal direction.

4. A portable drilling machine comprising: a housing; a drill chuck positioned on a front surface of the housing; a drill bit detachably coupled to the drill chuck; a driver positioned inside the housing to provide either the drill bit or the drill chuck with a rotational driving force; an anti-dust cover having a rear anti-dust cover formed in a cup shape with a drill through-hole formed in a central region of a bottom surface of the rear anti-dust cover and a front anti-dust cover formed in a tube shape to be coupled to the rear anti-dust cover, the front anti-dust cover being adapted to move towards the bottom surface of the rear anti-dust cover when acted on by pressure towards the housing and return to original position when the pressure is removed, wherein the front anti-dust cover is formed as a corrugated tube adapted to retract towards the bottom surface of the rear anti-dust cover when acted on by pressure towards the housing and extend to original position when the pressure is removed;

3. "Portable drilling machine with internal motor control cord" by Robert E. Strange**,** William C. McKay**,** Michael D. Fangmann

A portable electromagnetic drilling machine which is provided with an enclosed motor power control cord that connects the machine electrical control panel to a machine electric drive motor for a cutting tool spindle. The provision of an enclosed electric motor power control cord eliminates any wrongful or inadvertent lifting of the machine by said cord, and insures the lifting and carrying of the machine will be carried out by a handle on the machine housing.

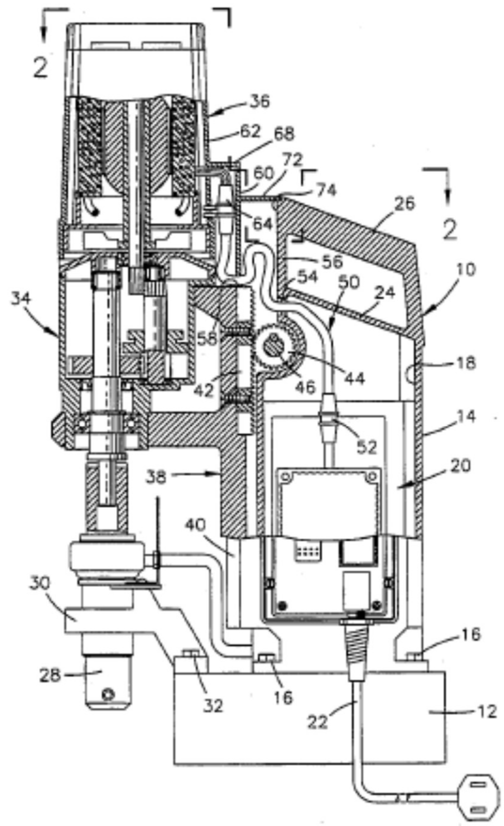

Figure 2.1- Machine Casing

What is claimed is:

1. A portable electromagnetic drilling machine (10) having an electromagnetic base (12), a housing (14) with an inner wall (56) mounted on said base, a cutting tool spindle (28) mounted on said base (12), and an electric spindle drive motor (36) slid ably mounted on said housing (14) for upward and downward movement with the cutting tool spindle (28), wherein:

(a) The machine (10) has an electrical control panel (20) mounted in the housing (14);
(b) The housing (14) has a chamber (18) formed therein above electrical control panel (20);
(c) The machine (10) has an electric motor power control cord (50) having a lower end positioned in chamber (18) above electrical control panel (20) and being operatively connected to said electrical control panel (20);
(d) The electric motor power control cord (50) having an intermediate portion extended through an opening (54) in the inner wall (56) of the housing (14) and into a space (74) between housing inner wall (56) and electric drive motor (36);
(e) The electric motor power control cord (50) having an upper end fixedly supported on the electric drive motor (36) in an enclosure means (60,66,68) mounted on drive motor (36), and cord (50) being operatively connected to the drive motor (36); and,
(f) Cover means (72) for enclosing the space (74) between s cord enclosure means (60,66,68) on the electric drive motor (36) and the housing inner wall (56).

4. "Electric drilling machine" by Jean Roger, Conflans Sainte Honorine, France

The machine comprises an electric driving motor, a speed reducer having at least two mechanical ratios coupled to the output shaft of the motor, a device for changing the mechanical ratio and a speed variation of the electric motor. The machine further comprises devices (7, 35, 36, and 41) for selecting and displaying the speeds of rotation of the electric motor coupled to the device for changing the mechanical ratio.

<u>What is claimed is</u>:

1. A machine, in particular an electric drilling machine, comprising a chuck, an electric driving motor having an output shaft, a speed reducer providing at least two mechanical ratios and coupled to the output shaft of the motor and to said chuck for driving the latter, changing means associated with the speed reducer for changing the mechanical ratio thereof, an electronic speed variation associated with the motor for varying the speed of the motor, control means operatively connected to said electronic speed variation for allowing selection of a plurality of predetermined discrete settings of said electronic speed variation, and display means connected to said changing means and said control means, said display means comprising means for displaying only those numbers corresponding to speeds within a range of discrete speed numbers, each of said discrete speed numbers being determined by

a combination of particular settings of said mechanical ratio changing means and said control means, and being constant during operation of the machine.

2. A machine according to claim, wherein said display means comprises a display device, electronic means for controlling the display device in accordance with speed numbers to be displayed, first switching means coupled to the mechanical ratio changing means for placing said electronic control means in a state for displaying a group of speed numbers corresponding to the position of said first switching means, and second switching means coupled means in a state for displaying a given speed number among said group of speed numbers, said given speed number being determined by the position of said control means.

3. A machine according to claim, wherein said first switching means comprise a switch having a movable element which is mechanically connected to said mechanical ratio changing means through a unit for adapting the travel of the mechanical ratio changing means to the travel of the movable element of said switch.

4. A machine according to claim, wherein the mechanical ratio changing means comprise a splined spindle driven connected to said output shaft, a wheel axially slid ably but driven mounted on the splined spindle, the wheel having two sets of teeth, a fork for axially displacing the wheel, an actuating knob mechanically connected to the fork, said adapting unit comprising a push-member adapted to be shifted by said fork and carrying, at an end thereof opposed to the fork, a first elastically yieldable means for actuating a finger member which is adapted to come into contact with the movable element of the switch.

5. A machine according to claim, comprising, placed between said first elastically yieldable means and a fixed partition wall of the machine, a second elastically yieldable means which is less stiff than the first elastically yieldable means and adapted to reduce the vibrations of said adapting unit to a minimum.

6. A machine according to claim, wherein said first elastically yieldable means comprise a first substantially diamond-shaped spring strip fixed to said push-member and carrying said finger member, and said second elastically yieldable means comprise a second substantially diamond-shaped spring strip less stiff than the first spring strip and fixed to the first spring

strip with said finger member adapted to cooperate with the movable element of said switch.

7. A machine according to claim, wherein said first elastically yieldable means comprise a first coil spring mounted between said push-member and an intermediate member carrying said finger member, and said second elastically yieldable means comprise a second coil spring which is less stiff than the first spring and bears against said intermediate member and against a fixed partition wall of the machine.

8. A machine according to any one of the claims, wherein the display device comprises groups of electroluminescent diodes the illumination of which diodes is adapted to form segments of figures to be displayed, said electronic control means of the display device being arranged to ensure the display only of numbers contained in a predetermined table of speed values, said table having rows and columns, the rows corresponding to speed values as determined by the position of said changing means and the columns corresponding to speed values as determined by the position of said control means, each of said speed values corresponding to speeds at which the machine is adapted to operate and said electronic control means comprising for this purpose as many stages as said table comprises columns.

9. A machine according to any one of the claims, wherein said second switching means comprise a first switch having a plurality of positions each corresponding to a stage of said electronic control means, and a second switch coupled to said first switch and operatively connected to said speed variation of the motor for regulating the setting of said speed variation. Add the following claims.

10. A machine, in particular an electric drilling machine, comprising an electric driving motor having an output shaft, a speed reducer providing at least two mechanical ratios and coupled to the output shaft of the motor, changing means associated with the speed reducer for changing the mechanical ratio thereof, an electronic speed variation associated with the motor for varying the speed of the motor, control means operatively connected to said electronic speed variation for selecting a plurality of discrete settings of said variation, and display means operatively connected to said changing means and said control means for displaying a speed value as determined by the selected positions of said mechanical ratio changing means and said control means. A switch means having a movable element which

is mechanically connected to said mechanical ratio changing means through a unit for adapting the travel of the mechanical ratio changing means to the travel of the movable element of said switch means, the mechanical ratio changing means comprising a splined spindle driven connected to said output shaft, a wheel axially slid able but driven mounted on the splined spindle, the wheel having two sets of teeth, a fork for axially displacing the wheel, an actuating knob mechanically connected to the fork, said adapting unit comprising a push-member adapted to be shifted by said fork and carrying, at an end thereof opposed to the fork, a first elastically yieldable means for actuating a finger member which is adapted to come into contact with the movable element of said switch means.

5.” Design of low Cost CNC Drilling Machine” by Gautam Jodh 1 , Piyush Sirsat 1 , Nagnath Kakde 1 , Sandeep Lutade 1 1Department of Mechanical Engineering, DBACER, Nagpur, India

A drilling machine is a device for making holes in components. The manually operated type of drilling 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. Hence, there arises a need for a low cost CNC machine which can not only drill holes with high accuracy and low machining time but also have low initial cost. The need for skilled operator is eliminated by providing a software with a more user friendly graphical user interface. This paper aims at describing the design of a computer numeric control drilling machine. The said machine is designed with a view to keep the cost of the machine at minimum, hence making is suitable for use in small or medium scale industries. Along with the design of the mechanical components, the electronics and the software has also been designed. The said machine has also been fabricated and successfully tested.

COMPONENTS

The machine consists of the following components i. The mechanical components It includes the structure of the drilling machine i.e. the base, support structure, beams, lead screw, bearing, gears, etc. ii. The electrical system The electrical system consists of the motor, motor control unit, power unit and interfacing. iii. The control or computing system

The control or the computing system positions the tip of the drill at the required position and the provides the depth of cut.

OPERATING THE MACHINE

Drilling machine connections. The adapter is connected to AC power supply and the point provided on the machine circuit board. The RS 232 cable is connected to the corresponding port on the machine circuit board and the PC. The power to the machine is switched on using the ON/OFF switch provided on the circuit board. B. Steps open the exe file of the program. The program screen appears. Start the program from the drop down menu in the tool bar at the top left corner. Click on the _Reset axis ‘button. This will move the CMM to its home position Enter the desired values of X, Y and depth of cut in the respective text. Click _Start ‘button. The machine X and Y motors start and position the drill on the desired position. The drill motor starts and then the Z axis motor starts, thus providing the depth of cut.

6. “Modular drilling machine and components thereof” By Clyde A. Willis, Wichita Falls, Tex.

A drilling machine includes a drilling substructure skid which defines two spaced parallel skid runners and a platform. The platform supports a draw works mounted on a draw works skid, and a pipe boom is mounted on a pipe boom skid sized to fit between the skid runners of the drilling substructure skid. The drilling substructure skid supports four legs which in turn support a drilling platform on which is mounted a lower mast section. The legs are pivotably mounted both at the platform and at the drilling substructure skid and a pair of platform cylinders are provided to raise and lower the drilling platform. A pair of rigid, fixed length struts extend diagonally between the platform and the substructure skid away from the platform such that the struts do not extend under the platform and obstruct access to the region under the platform. Preferably, the pipe boom skid mounts a pipe boom as well as a boom linkage, a motor, and a hydraulic pump adapted to power the pipe boom linkage. Preferably the substructure skid is formed in upper and lower skid portions, and leveling rams are provided to level the upper skid portion with respect to the lower skid portion. Mechanical position locks hold the upper skid in relative position over the lower skid.

What is claimed is:

1. In a modular earth drilling machine, the improvement comprising: a first skid; a pipe boom; means for pivot ably mounting the pipe boom to the first skid such that the pipe boom is movable between a raised position and a lowered position; means, mounted on the first skid, for moving the pipe boom between the raised and the lowered positions; means, mounted on the first skid, for powering the pipe boom moving means; a second skid comprising a lower skid portion, an upper skid portion movably mounted with respect to the upper skid portion with respect to the lower skid portion such that the upper skid portion can be levelled after the lower skid portion has been located in place; a drilling substructure pivot ably mounted to the upper skid portion of the second skid such that the drilling substructure is movable between an upper position and a lower position, said drilling substructure defining a drill string axis when in the upper position; means, mounted on the second skid, for moving the drilling substructure between the upper and lower positions; a third skid; a draw works mounted on the third skid, said draw works comprising a winch and means for driving the winch; means for releasable securing the first skid fixedly in position with respect to the upper skid portion of the second skid such that the pipe boom is aligned properly with the drilling substructure to position a drilling tubular on the drill string axis when the pipe boom is in the raised position; and means for releasable securing the third skid fixedly in position with respect to the upper skid portion of the second skid such that the winch is aligned properly with the drilling substructure; said first, second, and third skids forming three separate modules adapted for separate transport and for ready assembly; upper skid portion of the second skid providing a rigid support for the first and third skids and the drilling substructure.

2. The invention of claim 1 wherein the means for moving the drilling substructure comprises a pair of hydraulic cylinders, each mounted between the drilling substructure and the upper skid portion of the second skid.

3. The invention of claim wherein the first skid further comprises a second winch adapted to pull the first skid into position on the upper portion of the second skid.

4. The invention of claim wherein the drilling substructure comprises a platform and wherein the invention further comprises a pair of fixed length struts, each removable mounted to extend diagonally between the platform and the upper portion of the second skid to brace and hold the drilling substructure in the upper position, such that the struts never extend beneath the platform.

5. The invention of claim 1 wherein the upper skid portion of the second skid defines a pair of spaced, parallel skid runners sized to receive the first skid there between, and wherein the drilling substructure comprises a drilling platform and four legs, each pivot ably mounted at one end to the drilling platform and at the other end to a respective one of the skid runners such that two of the legs are mounted on each of the skid runners.

7. "Automatic drilling machine" by Koji Matsushima, Hamamatsu, Japan ,Nippon Gakki Seizo Kabushiki Kaisha, Japan

Successively supplied rod materials with one or more flat surfaces such as tuning pins used for pianos are intermittently and periodically forwarded in axial alignment to each other along a prescribed guide path towards a drilling station with axial postures thereof being regulated through rolling and, when required, sliding contacts with machine parts and, drilled transversely preferably by a pair of drills from two opposite sides with difference in timing and stroke without development of metal refuses and, after the drilling operations, the results in the drilling operation are preferably inspected in mechanical or photoelectrical manner in order to stop the entire machine running when any failure in the drilling operation is detected, all the recited operations being carried out fully automatically.

<u>What is claimed is</u>:

1. A machine for automatically drilling holes through elongated rods each having one or more flat outer surfaces, said machine comprising: a pushing member for forwarding said rods seriatim in longitudinal axial alignment to each other to a drilling station along a guide

path, said station having a drilling action thereat; means regulating the longitudinal axial posture of each rod so as to fit the drilling action at said station, said axial posture regulating means comprising a guide defining said guide path for said rods, an axial posture regulating member adjacent said guide, means resiliently urging said regulating member into contact with said flat surface of each rod, exerting substantially tangential pressure on an edge of at least one of said flat outer surfaces of a non-aligned rod until said non-aligned rod becomes aligned and thereafter maintaining substantially uniform pressure on at least two edges of said at least one of said flat outer surfaces, thereby rotating said non-aligned rod to an aligned position and maintaining said rod in said aligned position when the rod is forwarded by said forwarding means; and means for drilling a hole diametrically through each rod in said drilling station, said means for drilling a hole including a pair of drills located on two opposite sides of the rod in said drilling station and oriented substantially perpendicular to the longitudinal axis of said rod, and means driving said pair of drills at mutually different stroke and timing relationships.

2. The machine of claim, further comprising means inspecting the success of the drilling action, said inspecting means comprising a first inspecting pin axially reciprocal in the drilling direction and a second inspecting pin axially reciprocal perpendicular to said drilling direction, said pins being both in a common plane perpendicular to the axial direction of said rod materials.

3. The machine of claim comprising a first block mounted to be axially movable in said drilling direction, said first inspecting pin being mounted in said first block, means resiliently urging said first inspecting pin toward a rod member said drilling machine, means reciprocating said first block with said first inspecting pin in said drilling direction, a second block mounted to be movable in a direction perpendicular to said drilling direction, said second inspecting pin being mounted within said second block, whereby said first and second inspecting pins are movable in a common plane, means resiliently urging said second pin toward a rod member in said drilling machine, means reciprocating said second block with said second inspecting pin in said direction perpendicular to said drilling direction, and an electric device affixed to said first and second inspecting pins for providing an electrical signal when movements of both said inspecting pins towards a rod member in said drilling machine are inhibited.

4. The machine of claim wherein said first block reciprocating means comprises a slider slid ably supported by the framework of said machine, said first block being fixedly mounted on said slider, a cam follower roller rotatable disposed on one end of said slider, a rotary main shaft, a peripheral cam on said rotary main shaft, and means urging said cam follower roller into resilient pressure contact with said peripheral cam.

5. The machine of claim, wherein said electric device comprises two limit switch means mounted to maintain contact with parts of said first and second inspecting pins when said pins are moved toward said rod material, and to break electric contact when movement of said pins is barred.

8. "Evaluation of Work Measurement Concepts for a Cellular Manufacturing Reference Line to enable Low Cost Automation for Lean Machining" by Stefan Seifermann*, Jörg Böllhoff, Joachim Metternich and Amin Bellaghnach Institute of Production Management, Technology and Machine Tools, Technische Universität Darmstadt, Otto-Berndt-Str. 2, 64287 Darmstadt, Germany

Cellular Manufacturing has been proven to be an economic, efficient and lean approach bringing flexibility into machining areas. Corresponding solutions use several basic machines that are adapted to the machining task in a right-sized equipment approach. However, the use of basic, low cost machinery providing just necessary functions results in a relatively high manual operation effort. The preferred approach in order to reduce manual work in production is automation. Traditional automation of man-machine systems – especially in western countries – tends to be comprehensive and thus often complex and expensive. A low cost, lean automation intelligently being adapted to the individual task, as well as a decision method for choosing the tasks worth being automated, is required. The first step on the road towards a scientifically sound low cost automation method for a Cellular Manufacturing line is identifying and quantifying the different manual tasks which could potentially be automated. Therefore, this paper starts with investigating existing analytical methods for measuring work. The different measuring concepts have been applied to the Cellular Manufacturing reference line at the Process Learning Factory at TU Darmstadt. An adequate evaluation system considering reality, detail, and variation and effort levels has been defined in order to assess the results' suitability for evaluating manual work in a Cellular Manufacturing line, pointing out potentials and limits of the individual approaches. As the final outcome, a ranking of different work measurement concepts for the

Cellular Manufacturing reference line is presented, verifying the applicability of the general approach and serving as a basis for further evaluation of other lines.

With the results of the study, the basic foundation for a scientifically sound method for automating a Cellular Manufacturing line on a low cost basis is laid. By leveraging the various methods for work measurement in the Cellular Manufacturing reference line in the Process Learning Factory at TU Darmstadt, the different manual tasks showing yielding potential to be automated for Cellular Manufacturing have been identified allowing the quantification of contained benefits. Executing work measurement using MTM-1 has proven to give the best results when considering the trade-off of reality, detail, influence and effort at the reference line. The approach presented has been proved viable and serves as a basis for further application and verification on other Cellular Manufacturing lines. However, for cases where an actually existing operating system can be used as reference, time study approaches with the same level of detail need to be further evaluated and compared with the same evaluation criteria in a next step.

They might present a good alternative for these environments. Besides, the analysis showed that the basic movements for operating the different machines in a Cellular Manufacturing line are pretty similar, except for additional positioning work in some special cases.

9. "Automated end effectors component reloading system for use with a robotic system" By Frederick E. Shelton, IV, Hillsboro, OH (US); Jerome R. Morgan, Cincinnati, OH (US)

A surgical instrument. The surgical instrument includes end effectors that comprises a staple channel and an anvil that is movably translatable relative to the staple channel. A tool mounting portion is configured to interface with a robotic system and operable communicate with the end effectors. The instrument further includes a first sensor that has an output that represents a first condition of a portion of the robotic system. A second sensor has an output that represents a position of the anvil. A third sensor has an output that represents a position of a reciprocating knife within the end effectors. An externally accessible memory device communicates with the first, second and third sensors.

What is claimed is:

1. An automated reloading system for replacing a spent surgical end effectors component in a robotic tool portion of a robotic surgical system with a new surgical end effectors component, said automated reloading system comprising: an extraction system supportable within a work envelope of the manipulate robotic tool portion of the robotic surgical system, said extraction system configured to automatically dislodge said spent surgical end effectors component from a component support portion of said robotic tool portion when robotic tool portion moves said spent surgical end effecter component into extractive engagement therewith; and a new component support arrangement supportable within the work envelope, said new component support arrangement supporting at least one said new surgical end effectors component in a loading orientation such that when said manipulate robotic tool portion moves said component support portion into loading engagement with one of said at least one new surgical end effectors components, said one of said at least one new surgical end effectors components is loaded therein.

2. The automated reloading system of claim further comprising a collection receptacle adjacent said extraction system such that when said spent surgical end effectors components are dislodged from their respective end effectors support portions, said spent surgical end effectors components automatically collect within said collection receptacle.

3. The automated reloading system of claim wherein said extraction system comprises an extraction hook member configured to hopingly engage said spent surgical end effectors component when said spent surgical end effecter component is brought into extractive engagement therewith.

4. The automated reloading system of claim 2 wherein said extraction system comprises an extraction member movably supported adjacent said collection receptacle for selective movable extractive engagement with said spent surgical end effectors component.

5. The automated reloading system of claim 4 wherein said extraction member comprises an extraction hook member rotatable supported adjacent said collection receptacle.

10. “Automated robotic measuring system” by Homer Eaton, Carlsbad, CA (US)

An automated coordinate measuring system comprising a measuring arm used for acquisition of geometry data that incorporates an exo-skeletal structure resilient to physical perturbations including thermal changes and vibrations which may affect coordinate data acquisition. The system may be adapted to a portable platform allowing for convenient positioning and alignment of the measuring arm in a wide variety of environments.

What is claimed is:

1. A positioning system comprising: an articulated supporting arm comprising a plurality of jointed interconnected support arm segments moveable about a plurality of axes; a plurality of compliant members positioned on said supporting arm; an articulated measuring arm comprising a plurality of jointed interconnected measuring arm segments capable of a plurality of degrees of freedom of movement and supported by said compliant members wherein said compliant members provide a yielding characteristic between the articulated supporting arm and the articulated measuring arm; and at least one alignment detector configured to detect the alignment between the articulated supporting arm and the articulated measuring arm.

2. The positioning system of claim wherein, the articulated supporting arm and articulated measuring arm are aligned such that movement of the articulated supporting arm in a first direction effectuates movement of the articulated measuring arm in the same relative direction.

3. The positioning system of claim wherein, the articulated supporting arm and articulated measuring arm are generally coaxially aligned.

4. The positioning system of claim wherein, mechanical stress along the measuring arm is reduced by the support provided by the compliant members.

5. The positioning system of claim wherein, the yielding characteristic of the compliant member is provided by a gas-filled chamber between the articulated supporting arm and the articulated measuring arm

6. The positioning system of claim wherein, the alignment detector comprises at least one strain gauge configured to measure deformation in the compliant members indicative of the relative alignment between the articulated supporting arm and the articulated measuring arm.

7. The positioning system of claim wherein, the articulated supporting arm and articulated measuring arm are generally coaxially aligned.

8. The positioning system of claim wherein, the support arm segments of the articulated supporting arm are shaped so as to at least partially contain the measuring arm segments of the articulated measuring arm.

9. The positioning system of claim 8 wherein, the plurality of compliant members position and support the measuring arm segments of the articulated measuring arm within the support arm segments of the articulated supporting arm.

10. The positioning system of claim wherein, the yielding characteristic of the compliant members permit a degree of angular offset between the articulated supporting arm and articulated measuring arm.

11. The positioning system of claim 10 wherein, angular offset between the articulated supporting arm and articulated measuring arm is effectuated by stress applied to either the articulated supporting arm or the articulated measuring arm.

12. The positioning system of claim wherein, mechanical stress along the measuring arm is reduced by the support provided by the compliant members.

13. The positioning system of claim wherein, the compliant members are formed from an at least partially deformable material.

Machine tools

A machine tool is a machine for handling or machining metal or other rigid materials, usually by cutting, boring, grinding, shearing, or other forms of deformation. Machine tools employ some sort of tool that does the cutting or shaping. All machine tools have some means of constraining the work piece and provide a guided movement of the parts of the machine. Thus the relative movement between the work piece and the cutting tool (which is called the tool path) is controlled or constrained by the machine to at least some extent, rather than being entirely "offhand" or "freehand". It is a power driven metal cutting machine which assists in managing the needed relative motion between cutting tool and the job that changes the size and shape of the job material. Today machine tools are typically powered other than by human muscle (e.g., electrically, hydraulically, or via line shaft), used to make manufactured parts (components) in various ways that include cutting or certain other kinds of deformation.

With their inherent precision, machine tools enabled the economical production of interchangeable parts.

History

Forerunners of machine tools included bow drills and potter's wheels, which had existed in ancient Egypt prior to 2500 BC, and lathes, known to have existed in multiple regions of Europe since at least 1000 to 500 BC. But it was not until the later Middle Ages and the Age of Enlightenment that the modern concept of a machine tool—a class of machines used as tools in the making of metal parts, and incorporating machine-guided tool path—began to evolve. Clockmakers of the middle Ages and renaissance men such as Leonardo da Vinci helped expand humans' technological milieu toward the preconditions for industrial machine tools. During the 18th and 19th centuries, and even in many cases in the 20th, the builders of machine tools tended to be the same people who would then use them to produce the end products (manufactured goods). However, from these roots also evolved an industry of machine tool builders as we define them today, meaning people who specialize in building machine tools for sale to others.

Historians of machine tools often focus on a handful of major industries that most spurred machine tool development. In order of historical emergence, they have been firearms (small arms and artillery); clocks; textile machinery; steam engines (stationary, marine, rail, and otherwise) (the story of how Watt's need for an accurate cylinder spurred Boulton's boring machine is discussed by Roe); sewing machines; bicycles; automobiles; and aircraft. Others could be included in this list as well, but they tend to be connected with the root causes already listed. For example, rolling-element bearings are an industry of themselves, but this industry's main drivers of development were the vehicles already listed—trains, bicycles, automobiles, and aircraft; and other industries, such as tractors, farm implements, and tanks, borrowed heavily from those same parent industries.

Machine tools filled a need created by textile machinery during the Industrial Revolution in England in the middle to late 1700s. Until that time, machinery was made mostly from wood, often including gearing and shafts. The increase in mechanization required more metal parts, which were usually made of cast iron or wrought iron. Cast iron could be cast in moulds for larger parts, such as engine cylinders and gears, but was difficult to work with a file and could not be hammered. Red hot wrought iron could be hammered into shapes. Room temperature wrought iron was worked with a file and chisels and could be made into gears and other complex parts; however, hand working lacked precision and was a slow and expensive process.

James Watt was unable to have an accurately bored cylinder for his first steam engine, trying for several years until John Wilkinson invented a suitable boring machine in 1774, boring Boulton & Watt's first commercial engine in 1776.

American production of machine tools was a critical factor in the Allies' victory in World War II. Production of machine tools tripled in the United States in the war. No war was more industrialized than World War II, and it has been written that the war was won as much by machine shops as by machine guns.

The production of machine tools is concentrated in about 10 countries worldwide: China, Japan, and Germany, Italy, South Korea, Taiwan, Switzerland, US, Austria, Spain and a few others. Machine tool innovation continues in several public and private research centres worldwide.

Drilling

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multi-point. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work-piece, cutting off chips from the hole as it is drilled.

In rock drilling, the hole is usually not made through a circular cutting motion, though the bit is usually rotated. Instead, the hole is usually made by hammering a drill bit into the hole with quickly repeated short movements. The hammering action can be performed from outside the hole (top-hammer drill) or within the hole (down-the-hole drill, DTH). Drills used for horizontal drilling are called drifter drills.

In rare cases, specially-shaped bits are used to cut holes of non-circular cross-section; a square cross-section is possible.

Automation

Automation is the technology by which a process or procedure is performed with minimal human assistance. Automation or automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention.

Automation covers applications ranging from a household thermostat controlling a boiler, to a large industrial control system with tens of thousands of input measurements and output control signals. In control complexity, it can range from simple on-off control to multi-variable high-level algorithms.

In the simplest type of an automatic control loop, a controller compares a measured value of a process with a desired set value, and processes the resulting error signal to change some input to the process, in such a way that the process stays at its set point despite disturbances. This closed-loop control is an application of negative feedback to a system. The mathematical basis of control theory was begun in the 18th century and advanced rapidly in the 20th.

Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques. The benefit of automation includes labour savings, savings in electricity costs, savings in material costs, and improvements to quality, accuracy, and precision.

The World Bank's World Development Report 2019 shows evidence that the new industries and jobs in the technology sector outweigh the economic effects of workers being displaced by automation.

Job losses and downward mobility blamed on Automation has been cited as one of many factors in the resurgence of nationalist and protectionist politics in the US, UK and France, among other countries since 2010s.

The term automation, inspired by the earlier word automatic (coming from automaton), was not widely used before 1947, when Ford established an automation department. It was during this time that industry was rapidly adopting feedback controllers, which were introduced in the 1930s.

Low Cost Automation

- The lay man meaning of Low Cost Automation is to implement automation at the lowest cost. LCA is defined as “a system where man and machine collaborate and work together, to achieve a goal with less investment".
- An automation, which is easy to implement with high flexibility and reliability, which occupies less space (lean concept), that needs zero or minimum maintenance (high efficiency), with minimum investment and running cost, is termed as LCA.
- Low cost automation (LCA) is one solution especially for medium and small scale industries who find it difficult to implement automation.
- LCA involves the introduction of standard equipment, mechanisms and devices to convert manual operations to automatic ones by making use of parts or sub-assemblies of old unutilized machines, mechanisms, systems which are available free or at very lower cost.
- The steps to achieve LCA are described below:

1. Design the machine, system, mechanism as per the requirement.
2. Decide upon the parts, sub assemblies, sub systems required.
3. Check for the above requirements from old unutilized machines, mechanisms, systems, if they are available.
4. Inspect the parts, sub-assemblies, subsystems available and see that they meet the design requirements.
5. Use them for developing new machine, system, mechanism.
6. Due to use of parts of old unutilized machines, mechanisms, systems the overall cost of development of new systems will be very low. Thus automation is possible at lower cost.

Common areas in the manufacturing process for LCA application are machining, cold extrusion, grinding, material handling, quality inspection, dimensional accuracy, surface finishing and assembly and packaging. Besides, areas like storage systems, Handling Systems, Assembly Lines, Production Lines, production cells, Machines, Computers, Controllers, Software etc can also be considered for LCA.

CHAPTER 3: SCOPE OF THE PROJECT

Machine tools are considered a strategic industry segment. It is part and parcel of manufacturing in several fields and branches. At the same time, automation in manufacturing is the use of machines so that manufacturing processes can be carried out with minimal human intervention. The Project is based on mechanical parts and motions with electrical connections. The future is full of automation. So the project is a semi-automatic project in which minimum human intervention is required. The conventional drilling machine used has a complex construction and is quite expensive. It also occupies large space and is fixed to a particular occupied space. To overcome this, we have developed a system which has automation in the form of robotics. The cost of the system is low and also is simple in construction, which would be easy to machine a work piece.

Project Objectives:

A project objective describes the desired results of a project, which often includes a tangible item. The project objectives this project involves two set of objectives.

The project, Robotic Assisted Drilling Machine has the following objectives:

Primary Objectives:

1. To enhance portability.
2. To bring cost effectiveness.
3. To involve automation for the assistance of the system.

Secondary Objectives:

1. To decrease the usage of electricity.
2. To have less human intervention.
3. To save time.

Project Features:

The project, Robotic Assisted Drilling Machine has the following features:

1. It has simple construction.
2. It has less number of parts.
3. The overall weight of the project is low.
4. It has a power efficient system.
5. The drill sizes of the machine are more.
6. It involves a semi-automatic robot, which provides assistance to the drilling machine for picking up the work piece.
7. It is portable.
8. It requires less intervention of the workers.

Project Cost:

Cost estimation may be defined as the process of forecasting the expenses that must be incurred to manufacture a product. These expenses take into a consideration all expenditure involved in a design and manufacturing with all related services facilities such as pattern making, tool, making as well as a portion of the general administrative and selling costs.

Purpose of Cost Estimation:

1. To determine the selling price of a product for a quotation or contract so as to ensure a reasonable profit to the company.
2. Check the quotation supplied by vendors.
3. Determine the most economical process or material to manufacture the product.
4. To determine standards of production performance that may be used to control the cost.

Types of Cost Estimation:

1. Material cost
2. Machining cost

Material Cost Estimation

Material cost estimation gives the total amount required to collect the raw material which has to be processed or fabricated to desired size and functioning of the components.

These materials are divided into two categories:

1. Material for fabrication:
   In this the material in obtained in raw condition and is manufactured or processed to finished size for proper functioning of the component.

2. Standard purchased parts:
   This includes the parts which was readily available in the market like Allen screws etc. A list is forecast by the estimation stating the quality, size and standard parts, the weight of raw material and cost per kg for the fabricated parts.

Machining Cost Estimation

This cost estimation is an attempt to forecast the total expenses that may include manufacturing apart from material cost. Cost estimation of manufactured parts can be considered as judgment on and after careful consideration which includes labour, material and factory services required to produce the required part.

Procedure:

The general procedure for calculation of material cost estimation is after designing a project,

1. A bill of material is prepared which is divided into two categories.
   a. Fabricated components
   b. Standard purchased components
2. The rates of all standard items are taken and added up.
3. Cost of raw material purchased taken and added up.

SR.NO.	COMPONENTS	COST
1.	WOOD	500
2.	BEARINGS	60
3.	RACK AND PINION GEAR	260

4.	SPUR GEAR	210
5.	TORQUE MOTORS	250
6.	DC MOTORS	150
7.	DRILL BIT	130
8.	DRILL CHUCK	150
9.	PVC PIPE	50
10.	SWITCHES	80
11.	MDF (WOOD)	200
12.	WOOD FABRICATION	70

TOTAL COST = COST OF COMPONENTS + OTHER COST =2200/-

CHAPTER 4: METHODOLOGY

The methodology is the collection of processes, techniques and procedures of a system. The methodology of the project consists of the following phases:

1. Research
2. Design
3. Purchasing
4. Fabrication
5. Assembling
6. Finishing
7. Testing
8. Final Presentation

1. Research:

Research is "creative and systematic work undertaken to increase the stock of knowledge, including knowledge of humans, culture and society, and the use of this stock of knowledge to devise new applications. The complete scope, design and operations of the project was made based on the research made on the existing machines used, their operations, their usages, their problems and were evaluated to make a complete image of the project. The research was done on several aspects such as the construction of the project, the parts to be used, and the motions for the movement of parts of the project.

2. Design:

A design is a plan or specification for the construction of an object or system or for the implementation of an activity or process, or the result of that plan or specification in the form of a prototype, product or process. The design of the project was made with respect to the size, ease of operations, and number of parts required and overall ergonomics and aesthetics of the machine. The design has the following aspects:

1. Size:

The size of the project is kept low so that it is movable by keeping the construction simple and size of the parts small. The ergonomics of the machine are as well comfortable for a worker to work.

2. Ease of operations:

The operations to be performed should have less noise and should have effortless operations. So the operations performed on the machine require less effort and produce less noise. The quality of the drill may change with respect to the force applied to drill, size of the drill and also to the material of the work piece used, due to its some limitations. But with the appropriate material of work piece to be used on the machine and the force used to drill, the quality achieved will be excellent. The controls, switches of the machine are placed in a convenient manner, so that the machine can work with a single worker with the worker having comfortable position of him with respect to the machine.

The main structure of the project involves two main components which have a design change. This design change has been made keeping in mind the durability of the machine, at the same time keeping small in size.

The two following components are:

1. <u>C-Pillar</u>:

The c-pillar is the main structure of the project where the majority of the work is done. It is a vertically placed c structure consisting of four pillars with an upper part holding the four pillars in place and having space in between for the motor to fit in. The upper part of the c-pillar is holding the mechanism of entire drilling process which includes mainly the bearings, gears, motor and the drill chuck. The shape “C” we have chosen because it would have rigidity and durability to hold on to the forces exerted during the process of drilling.

2. <u>Robotic Arm</u>:

The robotic arm will be used as a form of automation and as assistance to the main system. So the robotic arm will be small in size as well and will be placed in front of the c-pillar for its operations to be performed. The robotic arm will be made of links which will in square shape which will help to hold the load and easily perform its function.

3. <u>Purchasing</u>:

The purchasing of the parts of the project has been made from several markets. The number of parts is less with their costs low. The lists of the following parts are as follows:

i. Wood
ii. MDF (Wood)
iii. L-clamps
iv. Screws
v. Bearings
vi. Motors
vii. Wires
viii. Switches
ix. Gears
x. Iron Rods
xi. Fasteners
xii. PV Pipe
xiii. Drill Bits
xiv. Drill Chuck
xv. Chuck Key
xvi. Fevi Flex
xvii. Araldite
xviii. Nails

4. <u>Fabrication:</u>

The fabrication of the required parts which are purchased, has been made according to the design of the project which has been decided earlier. The following parts have been fabricated:

1. <u>Wood</u>:

- The Base of the project which will have on it all the elements of the project.
- The four pillars required for the c-pillar.

- The upper base part of the c-pillar which will hold on to the motions of the drilling machine.

2. MDF (Wood):

- The joints and the parts required for the robotic arm.
- The rotating base of the robotic arm.
- The material required for the finishing of the project.

3. PVC Pipe:

The fabrication to the respective length and diameter required for the motor to fit in.

4. Iron rods:

These were fabricated to required diameters to fit into the bearings and into the gears.

5. Assembling:

The assembling of the project is done with the three main elements of the project. The three main elements are as follows:

i. Base
ii. C-Pillar
iii. Robotic Arm

The assembling of the project includes the following procedures for the parts of the project to be a single part of the project:

1. Gluing of the Parts:

- The rack and the motor housing
- The bearing housing and the upper base
- The joints of the robotic arm

2. Addition of Nails:

- The bearing housing and the upper base
- For the finishing of the project.

3. Screwing of the parts:

- The c-clamps for the pillars of c-pillar
- The c-clamps for the base and the pillars of the c-pillar.
- The robotic arm and the base.

6. Finishing of the Project:

The finishing of the project includes the assembling of the entire project with all the parts and elements of the project. The finishing of the project has been made with the parts and pieces of MDF for the required elements of the project which are assembled.

The assembling of the project mainly includes:

- Joining all parts.
- Finishing of any of the leftover part.
- Fixing of all the screws and nuts.
- Assembling of the base with the C-Pillar and the Robotic Arm.

7. Testing:

Testing is the process of evaluating a system or its components with the intent to find whether it satisfies the specified requirements or not. Testing is executing a system in order to identify any gaps, errors, or missing requirements in contrary to the actual requirements. The testing of the project has been done in which the results, faults of the project have been evaluated. The trial and tested method is used extensively for testing as this was the only method we d with as it was a new machine with new design.

CHAPTER 5: DETAILS OF THE DESIGN, WORKING AND PROCESSES

A design is a plan or specification for the construction of an object or system or for the implementation of an activity or process, or the result of that plan or specification in the form of a prototype, product or process. 'Design' can be referred to an object's aesthetic appearance as well as its function.

Machine design focuses on the basic principles of the following three areas:

- Mechanical behaviour includes statics, dynamics, and strength of materials, vibrations, reliability, and fatigue.
- Machine elements are basic mechanical parts of machines. They include gears, bearings, fasteners, springs, seals, couplings, and so forth.
- Manufacturing processes include areas such as computerized machine control, engineering statistics, quality control, ergonomics, and life cycle analysis.

Design Drawings

The design drawings of the project are been made with the help of the software's that are used in designing process. The following software's have been used for designing the project:

- CAD
- CREO

CAD-Computer Aided Drafting:

Computer-aided design (CAD) is the use of computers to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations.

CAD is used as follows:

1. To produce detailed engineering designs through 3-D and 2-D drawings of the physical components of manufactured products.
2. To create conceptual design, product layout, strength and dynamic analysis of assembly and the manufacturing processes themselves.
3. To prepare environmental impact reports, in which computer-aided designs are used in photographs to produce a rendering of the appearance when the new structures are built.

CAD systems exist today for all of the major computer platforms, including Windows, Linux, UNIX and Mac OS X. The user interface generally centres on a computer mouse, but a pen and digitizing graphic tablet can also be used. View manipulation can be accomplished with a space mouse (or space ball). Some systems allow stereoscopic glasses for viewing 3-D models. In our olden days, engineers, designers and draughts men were struggling to produce and submit engineering drawings in their scheduled times. It was mainly due to tremendous efforts they had taken to produce both new drawings or edited/updated drawings. Every line, shapes, measurements, scaling of the drawings - all made them headache to the design / drafting field. All these difficulties and pressures over-ridden by Computer Aided Design Drafting (CAD Drafting) technology.

CREO or PTC CREO:

Creo is a family or suite of Computer-aided design (CAD) apps supporting product design for discrete manufacturers and is developed by PTC. The suite consists of apps, each delivering a distinct set of capabilities for a user role within product development.

Creo runs on Microsoft Windows and provides apps for 3D CAD parametric feature solid modelling, 3D direct modelling, 2D orthographic views, Finite Element Analysis and simulation, schematic design, technical illustrations, and viewing and visualization.

Creo Elements and Creo Parametric compete directly with CATIA, Siemens NX/Solid edge, and Solid works. The Creo suite of apps replaces and supersedes PTC's products formerly known as Pro/ENGINEER, Co Create, and Product View. Creo has many different software package solutions and features. Creo Illustrate is a good example.

PTC began developing Creo in 2009, and announced it using the code name Project Lightning at Planet PTC Live, in Las Vegas, in June 2010. In October 2010, PTC unveiled the product name for Project Lightning to be Creo. PTC released Creo 1.0 in June 2011.

Creo apps are available in English, German, Russian, French, Italian, Spanish, Japanese, Korean, Chinese Simplified, and Chinese Traditional. The extent of localization varies from full translation of the product (including Help) to user interface only.

Creo is part of a broader product development system developed by PTC. It connects to PTC's other solutions that aid product development, including Wind chill for Product Lifecycle Management (PLM), Math cad for engineering calculations and Arbortext for enterprise publishing software.

Procedure and considerations followed for the designing of the C-Pillar and its components

1. Recognition of need:

The entire drilling components and procedures will be carried out on the C-Pillar.

The C-Pillar is involved or is being designed for the following purposes:

- To carry out the Drilling Process.
- To guide the drilling mechanism.
- To handle all the components of the system.
- To be the main structure of the process.
- To provide ease of operation in drilling mechanism.

2. Mechanism

The main structure i.e. C-Pillar would not have any mechanism as it will be the frame of the entire process.

The Drilling components would have the following mechanism.

- The Drill Bit along with the motor holder would have a vertical motion.
- The vertical motion of the drilling motor would be made by the rack and pinion mechanism which will be fixed and moved with the help of shafts having rotating mechanism.

3. Modification

There are some parts where modifications have been made:

1. Bearing Housing:

Instead of using the conventional Bearing Housing which is made up of steel, we utilised the wood and have made a bearing housing with our own design for the bearings to held up.

2. Motor Holder:

The motor holder in the markets is used of steel. Here also we have designed our own motor holder. We have used the PVC Pipe for the motor holder with the suitable diameter and length.

4. Material:

The complete C-Pillar is made up of wood to make sure it will be light, compact and rigid.

Wood Used: Plywood

Characteristics of Plywood:

- High Strength and Dimensional Stability. Plywood derives its structural strength from the timber from which it is manufactured.
- High Impact Resistance.
- Water and Chemical Resistance.
- Flexible
- Fire Resistance
- Sound and Thermal Insulation.

5. Suitable Designs and Drawings:

Layout of the Project:

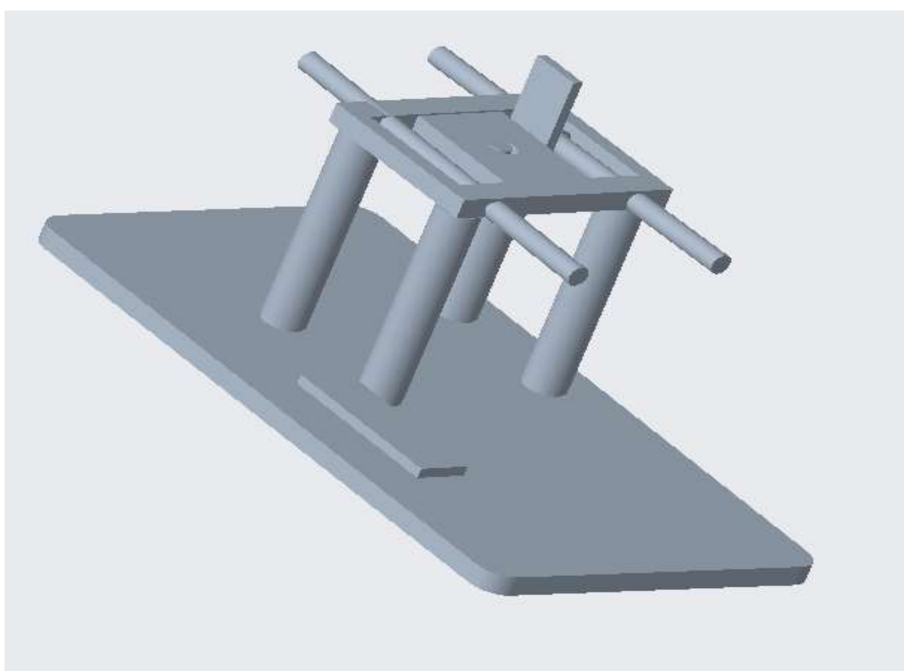

Figure 5.0- Layout of the Project

i. A Picture of the C-Pillar with the base:

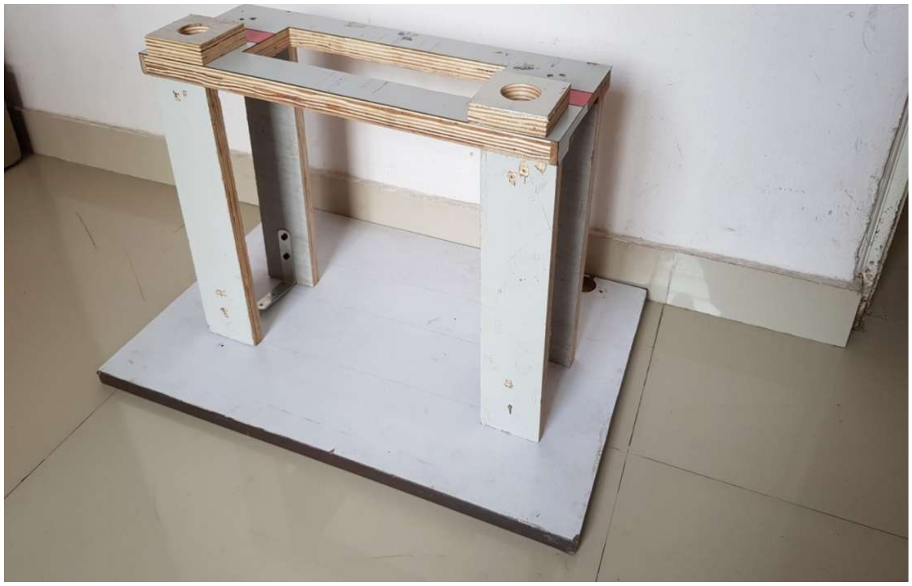

Figure 5.1- C-Pillar

ii. Dimensions of Upper Base of C-Pillar:

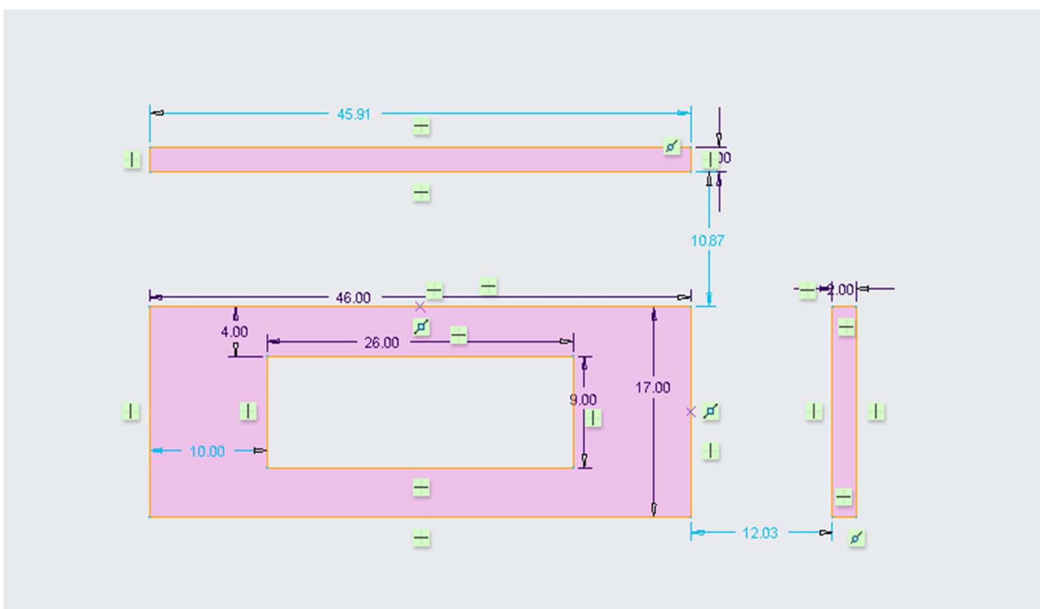

Figure 5.2- Upper Base Dimensions

iii. Dimensions of Pillars of C-Pillar:

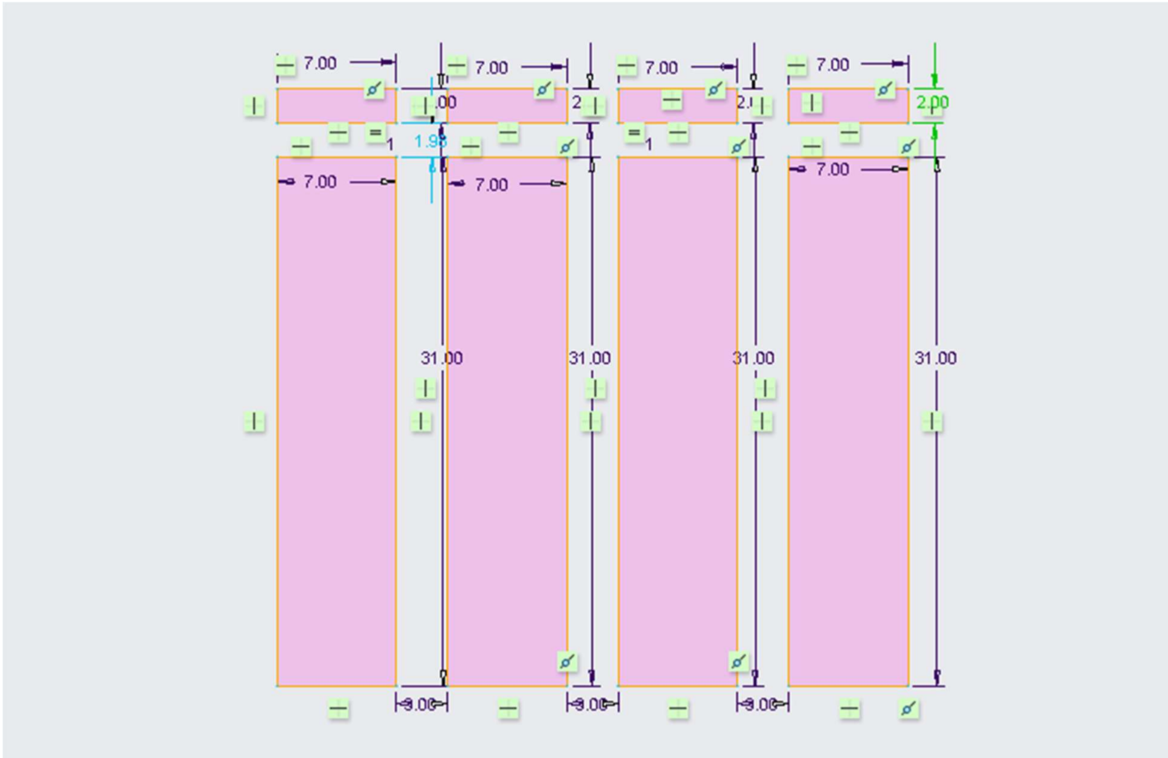

Figure 5.3- Pillars Dimensions

iv. Dimensions of the base:

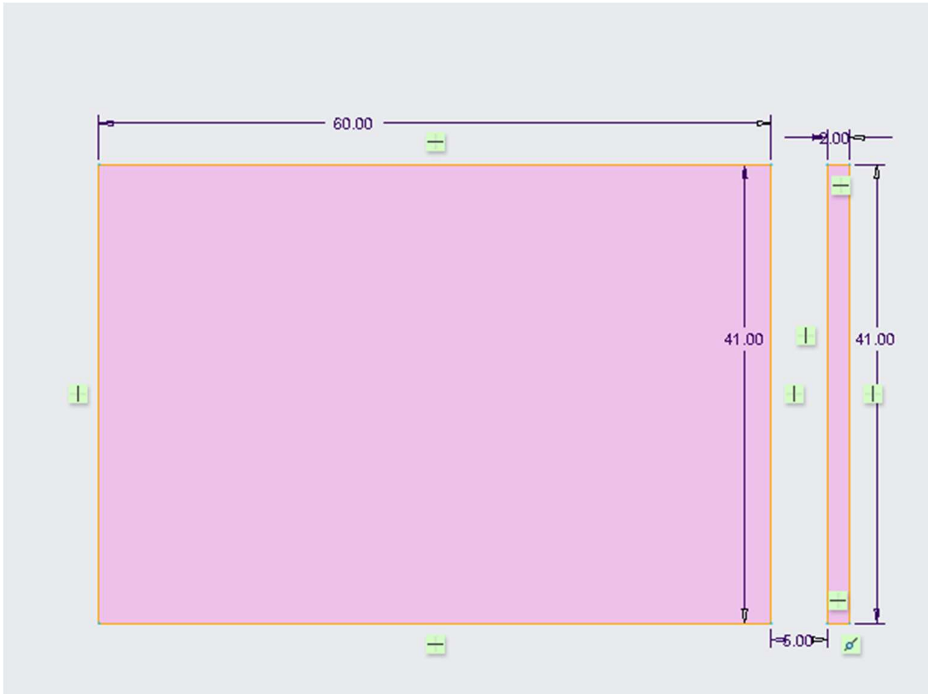

Figure 5.4- Base Dimensions

v. <u>A Picture of the motor holder</u>:

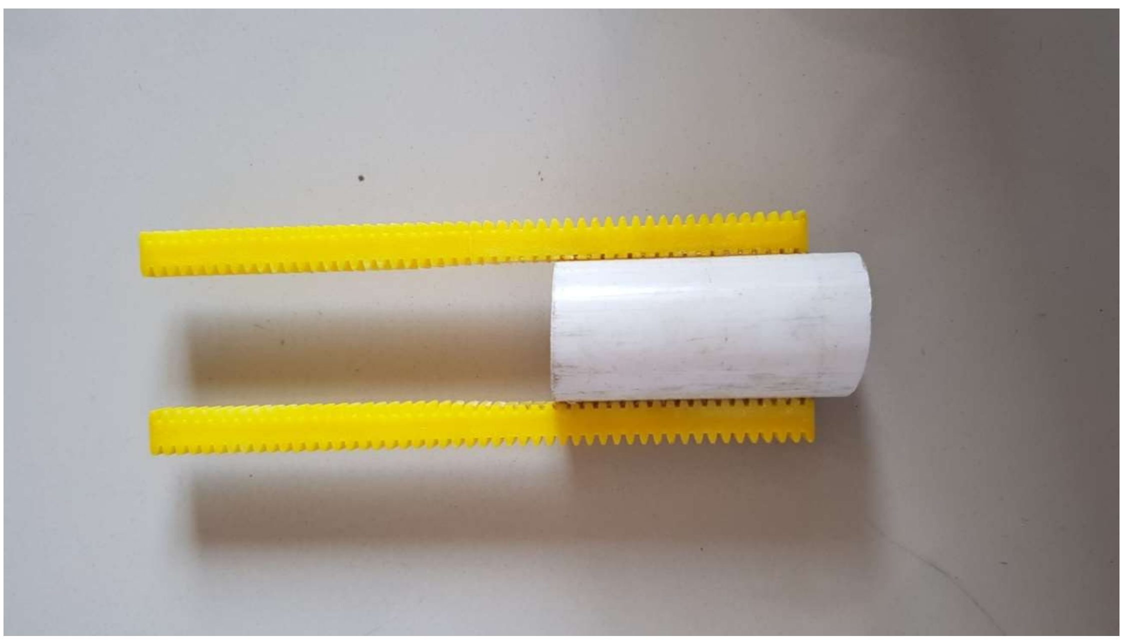

Figure 5.5- Motor Holder

vi. <u>Dimensions of the motor holder</u>:

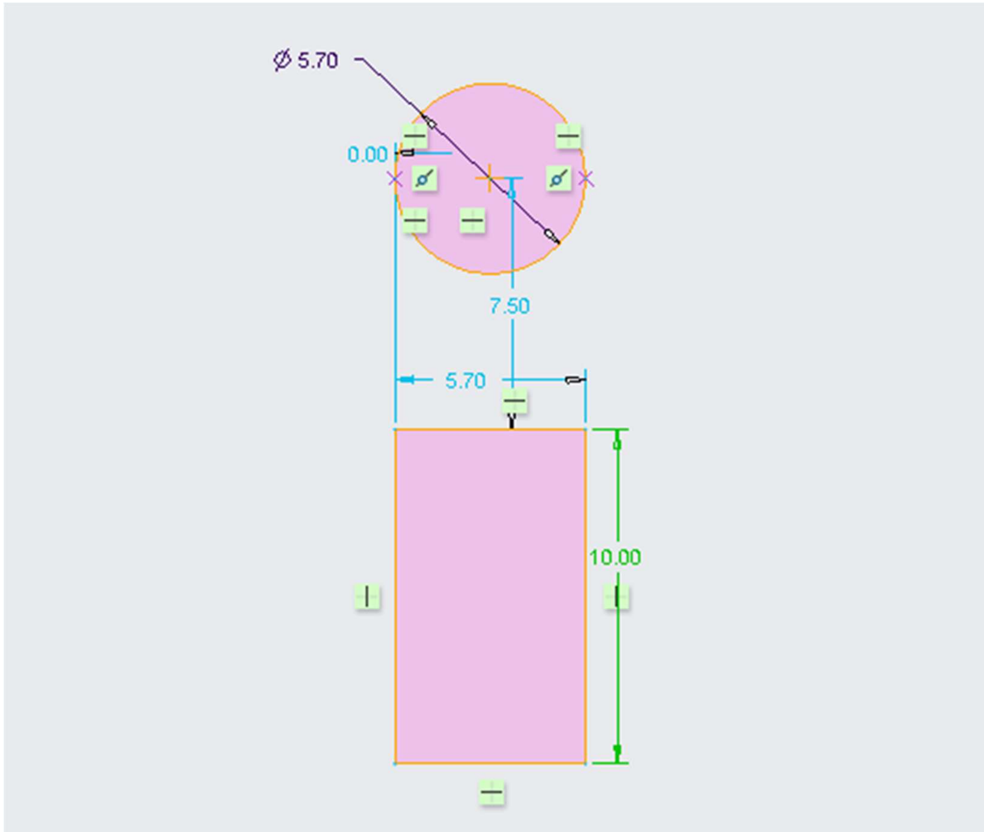

Figure 5.6- Motor Holder Dimensions

vii. A picture of Bearing Housings:

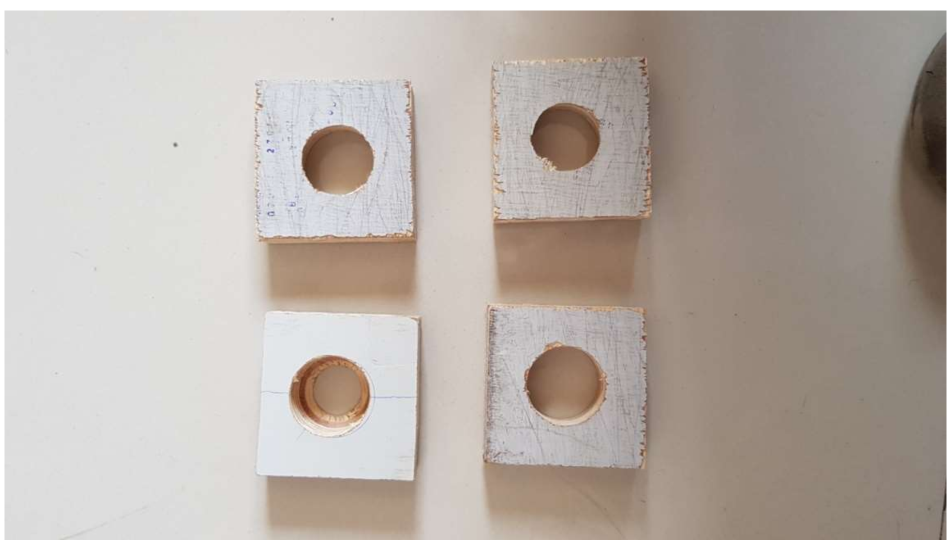

Figure 5.7- Bearing Housings

viii. Dimensions of the Bearing Housings:

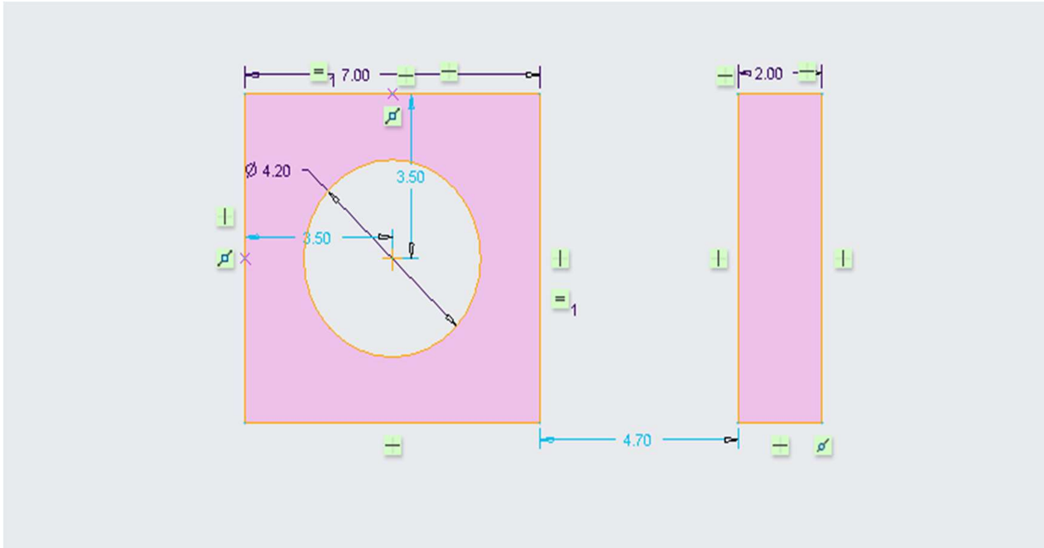

Figure 5.8- Bearing Housings Dimension

Procedure and considerations followed for the designing of the Robotic Arm and its components

1. Recognition of need:

The assistance to the drilling components and the picking of work piece will be made by the Robotic Arm.

The Robotic Arm is involved or is being designed for the following purposes:

- To assist the drilling machine.
- To pick up the work piece from the work piece.
- To reduce human intervention.

2. Mechanism

The Robotic Arm would have the rotating as well as horizontal and vertical mechanism.

The Robotic Arm would have the following mechanism.

- The Base of the robotic arm will have rotating mechanism.

- The Joints of the robotic arm will have horizontal and vertical movements as per the requirements of lifting the work piece.

3. Modification

There are some parts where modifications have been made:

1. Joints:

The joints we designed on our own keeping in mind that the joints should be light in weight and their shape should handle the load and also not interrupt in the operation.

2. Base

The base has been designed in such a way that it will have a rotating movement and it will handle the load of the joints of the arm and also the lifted work piece.

4. Material:

The joints and base of the robotic arm is made up of wood to make sure it will be light, compact and able to lift the load.

Wood Used: MDF

Characteristics of MDF:

- MDF has economic value to common people as it is cheaper at cost and inexpensive. So, they are within everyone's reach to purchase.
- MDF saves trees as it is recycling process.
- It is easy to take any colour where wood takes long tenure for staining different colours
- MDF does not have knots or kinks which disturbs the smooth surface.
- MDF is resistant to some insects as some chemicals are used for the processing of MDF.
- It can be painted or stained and given a look just the same as real wood. So, it can replace the place of wood furniture.
- Depiction on MDF is easier than on wood.

- To provide MDF a look like real wood veneers, laminators may easily be attached to it.
- The solid, dense, flat, stiff MDF is a good choice instead of wood.

5. <u>Suitable Designs and Drawings</u>:

i. <u>A picture of the Robotic Arm</u>:

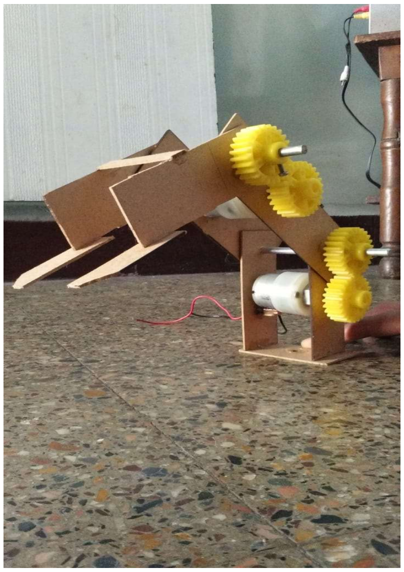

Figure 5.9- Robotic Arm- 1

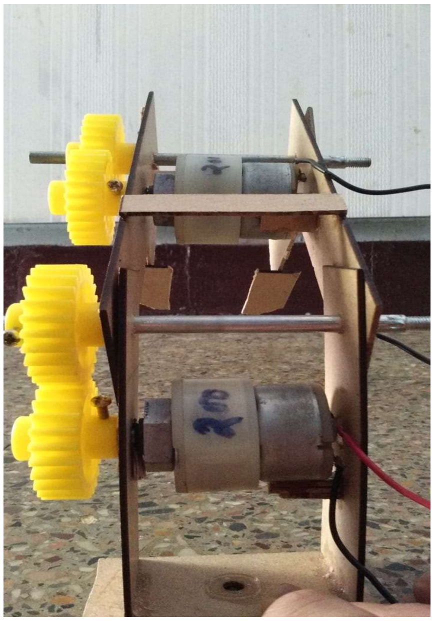

Figure 5.10- Robotic Arm- 2

ii. A picture of the joints of the robotic arm:

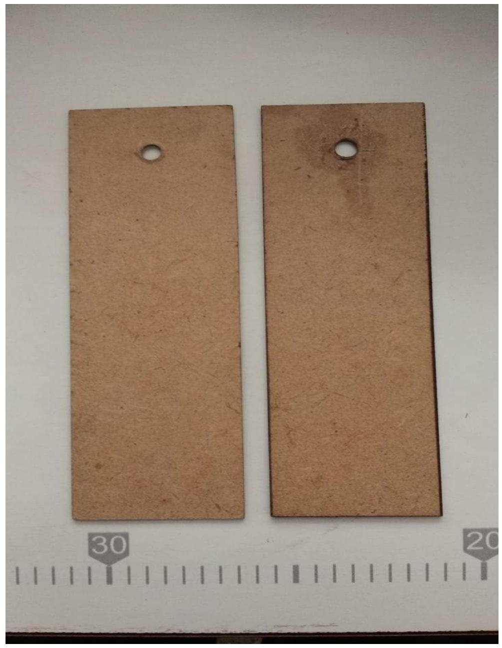

Figure 5.11- Joints

iii. Dimensions of the joints of the robotic arm:

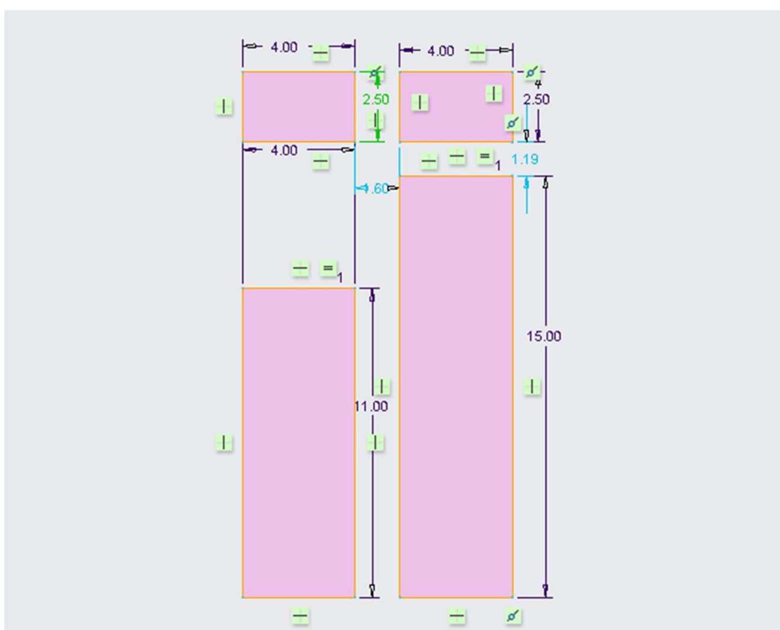

Figure 5.12- Joints Dimensions

Components:

The C-Pillar and drilling mechanism consists of many components which help in the mechanism. It consists of the following components:

Figure 5.13- Components

i. L-clamps
ii. Screws
iii. Bearings
iv. Motors
v. Wires
vi. Switches
vii. Gears
viii. Iron Rods
ix. PVC Pipe
x. Drill Bits
xi. Drill Chuck
xii. Chuck Key
xiii. Nails

1. L-Clamps:

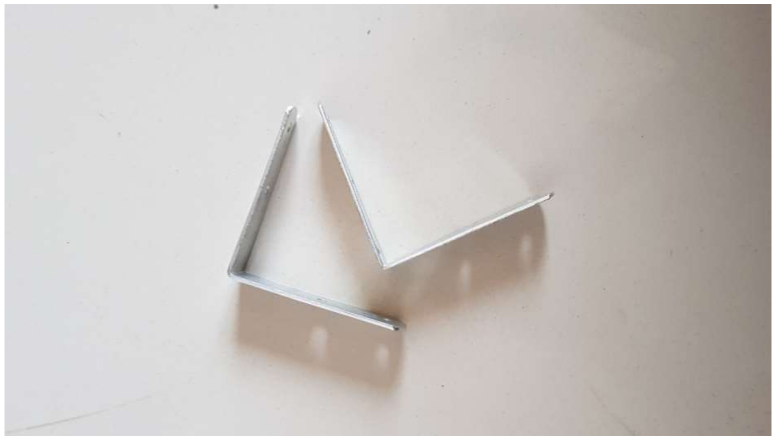

Figure 5.14- L-Clamps

A clamp is a fastening device used to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure. These clamps are used to join two parts from the two corners of the two parts, so that they can be held together.

2. Screws:

Figure 5.15- Screws

A screw is a type of fastener, in some ways similar to a bolt (see Differentiation between bolt and screw below), typically made of metal, and characterized by a helical ridge, known as a male thread (external thread). Screws are used to fasten materials by digging in and wedging into a material when turned, while the thread cuts grooves in the fastened material that may help pull fastened materials together and prevent pull-out. There are many screws for a variety of materials; those commonly fastened by screws include wood, sheet metal, and plastic. We have used these to join the c-joints. Also for the motors and for wiring purposes.

3. Bearings:

Figure 5.16- Bearings

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts. The term "bearing" is derived from the verb "to bear" a bearing being a machine element that allows one part to bear (i.e., to support) another. The simplest bearings are bearing surfaces, cut or formed into a part, with varying degrees of control over the form, size, roughness and location of the surface. Other bearings are separate devices installed into a machine or machine part. The most sophisticated bearings for the most demanding applications are very precise devices; their manufacture requires some of the highest standards of current technology. The Bearings have been primarily been used in the motion to provide movement to the drilling motor. The shaft which is connected to the gear is connected to the bearing. The bearings are to the C-Pillar with the help of bearing housing which is made up of wood.

Standard Bearing Size Used:

Bearing Type: Ball

Bearing Series: 6004

Bearing Internal Diameter (in mm): 20

Bearing Outer Diameter (in mm): 42

Bearing Width (in mm): 12

4. Motors:

The motors used in the project are of mainly two types:

- DC Motor
- Torque DC Motor.

DC Motor

Figure 5.17- DC Motor

The DC Motor is primarily used as the motor for the drilling purpose as the drilling motor. This motor is being used because it is having high rotational RPM which will be very helpful for our project to drill the work piece. A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. 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 motor 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 windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. 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.

DC Motor Specifications:

- Rated Voltage Current : DC 12V
- No Load Current: 0.2Amps (Max ~1.2 Amps)
- No load Power Consumption: 2.4 Watts (Max ~15 Watts)
- No Load Speed: 5500 RPM
- Motor Shaft Diameter: 3.17mm
- Mounting Screw Hole Diameter : 3mm
- Distance between Screw Holes: 25mm
- Diameter of the Motor: 36mm
- Length of the Motor (Body): 50mm
- Length of Shaft: 16mm
- Main Colour : Silver Tone
- Material : Metal- Aluminium
- Net Weight : 150gm
- Cylindrical shape and with 3mm diameter shaft and 2 pin connectors.

- Great replacement for the rusty or damaged DC motor on the machine.
- Comes with magnetic shield.

<u>Torque DC Motor</u>

Figure 5.18- Torque DC Motor

The torque DC Motor is used only in the Robotic Arm for the joints and for the rotation of its base. This motor is being used because it is having high torque which will be very helpful for our project to lift the work piece. A torque motor is a specialized form of DC electric motor which can operate indefinitely while stalled, without incurring damage. In this mode of operation, the motor will apply a steady torque to the load (hence the name). A torque motor that cannot perform a complete rotation is known as a limited angle torque motor. Brushless torque motors are available; elimination of commentators and brushes allows higher speed operation.

A brushed DC electric motor is an internally commutated electric motor designed to be run from a direct current power source. Brushed motors were the first commercially important application of electric power to driving mechanical energy, and DC distribution systems were used for more than 100 years to operate motors in commercial and industrial buildings. Brushed DC motors can be varied in speed by changing the operating voltage or the strength of the magnetic field. Depending on the connections of the field to the power supply, the speed and torque characteristics of a brushed motor can be altered to provide steady speed or speed inversely proportional to the mechanical load. Brushed motors continue to be used for electrical propulsion, cranes, paper machines and steel rolling mills. Since the brushes wear down and require replacement, brushless DC motors using power electronic devices have displaced brushed motors from many applications.

Torque Motor Details:

- High Torque
- Rated Voltage Current : DC 12V
- No Load Current: 0.2Amps (Max ~1.2 Amps)
- No load Power Consumption: 2.4 Watts (Max ~15 Watts)
- No Load Speed: 5500 RPM
- Motor Shaft Diameter: 3.17mm
- Mounting Screw Hole Diameter : 3mm
- Distance between Screw Holes: 15mm
- Diameter of the Motor: 26mm
- Length of the Motor (Body): 30mm
- Length of Shaft: 16mm
- Main Colour : Silver Tone
- Material : Metal
- Net Weight :130gm

5. Wires

Figure 5.19- Wires

The wires have been used to connect the motors, switches to the battery for the correct working of these elements. A wire is a single, usually cylindrical, flexible strand or rod of metal. Wires are used to bear mechanical loads or electricity and telecommunications signals. Wire is commonly formed by drawing the metal through a hole in a die or draw plate. Wire gauges come in various standard sizes, as expressed in terms of a gauge number. The term 'wire' is also used more loosely to refer to a bundle of such strands, as in "multi stranded wire", which is more correctly termed a wire rope in mechanics, or a cable in electricity.

6. Switches

Figure 5.20- Switch

The switches are used to switch on and off the motors in the project. a switch is an electrical component that can disconnect or connect the conducting path in an electrical circuit, interrupting the electric current or diverting it from one conductor to another. The most common type of switch is an electromechanical device consisting of one or more sets of movable electrical contacts connected to external circuits. When a pair of contacts is touching current can pass between them, while when the contacts are separated no current can flow.

Switches are made in many different configurations; they may have multiple sets of contacts controlled by the same knob or actuator, and the contacts may operate simultaneously, sequentially, or alternately. A switch may be operated manually, for example, a light switch or a keyboard button, or may function as a sensing element to sense the position of a machine part, liquid level, pressure, or temperature, such as a thermostat

7. Gears

Figure 5.21- Pinion Gear

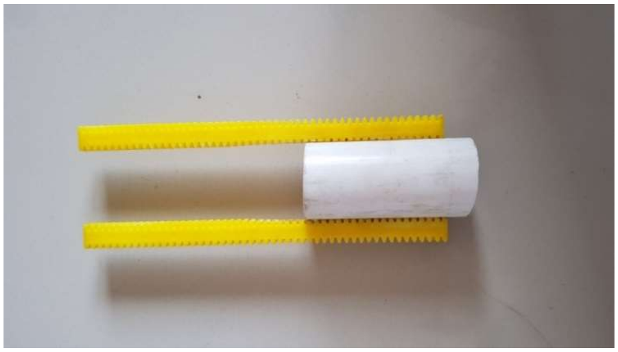

Figure 5.22- Rack Gear

The gears used in the project are mainly rack and pinion gears and spur gears. The combination of rack and pinion gears is on either sides of the motor holder for the vertical movement of the motor holder with the rack attached to the motor holder and pinion attached to the shaft connected to the bearings. The spur gears are used along with the motors in the robotic arm to mesh with each other and to lift the work piece.

A gear or cogwheel is a rotating machine part having cut teeth or, in the case of a cogwheel, inserted teeth (called cogs), which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission. A gear can mesh with a linear toothed part, called a rack, producing translation instead of rotation.

The gears in a transmission are analogous to the wheels in a crossed, belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage.

When two gears mesh, if one gear is bigger than the other, a mechanical advantage is produced, with the rotational speeds, and the torques, of the two gears differing in proportion to their diameters.

Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially. Though the teeth are not straight-sided (but usually of special form to achieve a constant drive ratio, mainly in-volute but less commonly cycloid), the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears mesh together correctly only if fitted to parallel shafts. No axial thrust is created by the tooth loads. Spur gears are excellent at moderate speeds but tend to be noisy at high speeds.

A rack and pinion is a type of linear actuator that comprises a circular gear (the pinion) engaging a linear gear (the rack), which operate to translate rotational motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly. Driving the rack linearly will cause the pinion to be driven into a rotation. A rack and pinion drive can use both straight and helical gears. Helical gears are preferred due to their quieter operation and higher load bearing capacity. The maximum force that can be transmitted in a rack and pinion mechanism is determined by the tooth pitch and the size of the pinion. Rack and pinion combinations are often used as part of a simple linear actuator, where the rotation of a shaft powered by hand or by a motor is converted to linear motion.

The rack carries the full load of the actuator directly and so the driving pinion is usually small, so that the gear ratio reduces the torque required. This force, thus torque, may still be substantial and so it is common for there to be a reduction gear immediately before this by either a gear or worm gear reduction. Rack gears have a higher ratio, thus require a greater driving torque, than screw actuators.

8. Iron rods

Figure 5.23- Iron Rods

The Iron Rods are used in the project as the shaft required for the pinion gears in the drilling mechanism. These we have taken it from scrap, so these are not at all costly.

9. PVC Pipe:

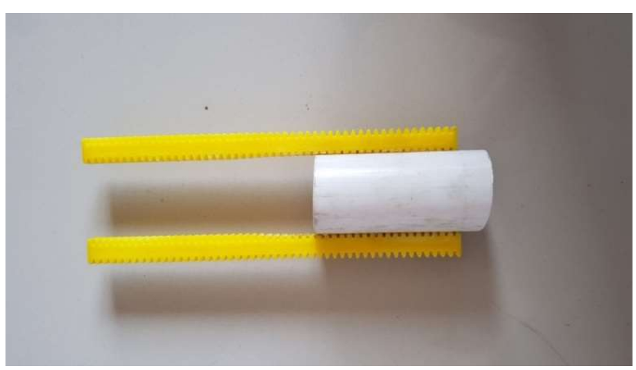

Figure 5.24- PVC Pipe

The PVC Pipe is used in the project as the casing of the motor holder of the drilling motor. The motor holder in the markets is used of steel. So we have used the PVC Pipe for the motor holder with the suitable diameter and length.

10. Drill Chuck:

Figure 5.25- Drill Chuck

A chuck is a specialized type of clamp used to hold an object with radial symmetry, especially a cylinder. In drills and mills it holds the rotating tool whereas in lathes it holds the rotating work piece. On a lathe the chuck is mounted on the spindle which rotates within the headstock. For some purposes (such as drilling) an additional chuck may be mounted on the non-rotating tailstock.

A drill chuck is a specialised self-centring, three-jaw chuck, usually with capacity of 0.5 in (13 mm) or less and rarely greater than 1 in (25 mm), used to hold drill bits or other rotary tools. This type of chuck is used on tools ranging from professional equipment to inexpensive hand and power drills for domestic use; it is the type a person who does not normally work with machine tools is most likely to be familiar with.

Some high-precision chucks use ball thrust bearings to reduce friction in the closing mechanism and maximize drilling torque. One brand name for this type of chuck, which is often generalized in colloquial use although not in catalogue, is Super Chuck.

A pin chuck is a specialized chuck designed to hold small drills (less than 1 mm (0.039 in) in diameter) that could not be held securely in a normal drill chuck. The drill is inserted into the pin chuck and tightened; the pin chuck has a shaft which is then inserted into the larger drill chuck to hold the drill securely. Pin chucks are also used with high-speed rotary tools other than drills, such as die grinders and jig grinders.

11. Drill Bits:

Figure 5.26- Drill Bits

Drill bits are cutting tools used 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 work piece, typically by rotation. The drill will grasp the upper end of a bit called the shank in the chuck.

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. There are also certain specialized drill bits that can create holes with a non-circular cross-section.

While the term drill may refer to either a drilling machine or a drill bit while in 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.

Drill bit 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 aluminium 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.

The diameter-to-length ratio of the drill bit is usually between 1:1 and 1:10. Much higher ratios are possible (e.g., "aircraft-length" twist bits, pressured-oil gun drill bits, etc.), but the higher the ratio, the greater the technical challenge of producing good work.

The best geometry to use depends upon the properties of the material being drilled. The following table lists geometries recommended for some commonly drilled materials.

12. Nails:

Figure 5.27- Nails

In woodworking and construction, a nail is a small object made of metal which is used as a fastener, as a peg to hang something, or sometimes as a decoration. Generally, nails have a sharp point on one end and a flattened head on the other, but headless nails are available. Nails are made in a great variety of forms for specialized purposes. The most common is a wire nail. Other types of nails include pins, tacks, brads, spikes, and cleats.

Nails are typically driven into the work piece by a hammer or pneumatic nail gun. A nail holds materials together by friction in the axial direction and shear strength laterally. The point of the nail is also sometimes bent over or clinched after driving to prevent pulling out.

<u>Working</u>:

The working of the project is quite simple, rather we have kept it simple to keep minimum procedures with maximum operations.

The following is the systematic working of the project:

- The worker will keep the work piece on the work table of the C-Pillar.
- Then the worker would set the work piece under the drilling machine according to the drill bit.
- After the work piece is set, then the drilling machine has to be set.

- To set the drilling machine, first the main power switch should be made on.
- Then the switch connected to the motor should be made on.
- The drilling motor will start; the drill chuck along the drill bit will start to rotate at a fixed RPM.
- Then the tool feed will be given with the rack and pinion mechanism, provided by the worker.
- The required hole will be made into the work piece by the mechanism of the tool feed.
- After the hole is made into the work piece, the robotic arm comes into the picture.
- The worker will give the command to the robotic arm by the switch located on the base.
- Then the worker has to give a definite direction in which the robotic arm shall move.
- The robotic arm will hold the work piece with its gripper and the place it to the other side.
- The cycle will repeat according to the number of work pieces.

Process Sheet

The operations performed in fabrication for achieving the expected design are as follows:

1. Cutting
2. Drilling

1. Cutting:

Cutting is the separation or opening of a physical object, into two or more portions, through the application of an acutely directed force. Cutting is manufacturing by removal of material. Particles of material, the chips, are mechanically removed from the raw material or from an unfinished part by cutting edges of a tool. The tool has one or several cutting edges, which can be geometrically defined by number, shape, and position (cutting by geometrically defined cutting edges), whereas in abrasive processes the separation of chips takes place by numerous cutting edges which have to be statistically described and which are randomly distributed inside the tool. Cutting has been at the core of manufacturing throughout history. For metals many methods are used and can be grouped by the physical phenomenon used. It is the process of producing a work piece by removing unwanted material from a block of metal, in the form of chips.

2. Drilling:

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multi-point. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work-piece, cutting off chips from the hole as it is drilled.

In rock drilling, the hole is usually not made through a circular cutting motion, though the bit is usually rotated. Instead, the hole is usually made by hammering a drill bit into the hole with quickly repeated short movements. The hammering action can be performed from outside the whole (top-hammer drill) or within the whole (down-the-hole drill, DTH). Drills used for horizontal drilling are called drifter drills.

In rare cases, specially-shaped bits are used to cut holes of non-circular cross-section; a square cross-section is possible.

Wood being softer than most metals, drilling in wood is considerably easier and faster than drilling in metal. Cutting fluids are not used or needed. The main issue in drilling wood is ensuring clean entry and exit holes and preventing burning. Avoiding burning is a question of using sharp bits and the appropriate cutting speed. Drill bits can tear out chips of wood around the top and bottom of the hole and this is undesirable in fine woodworking applications.

The ubiquitous twist drill bits used in metalworking also work well in wood, but they tend to chip wood out at the entry and exit of the hole. In some cases, as in holes for rough carpentry, the quality of the hole does not matter, and a number of bits for fast cutting in wood exist, including spade bits and self-feeding auger bits. Many types of specialised drill bits for boring clean holes in wood have been developed, including brad-point bits, Forstner bits and whole saws. Chipping on exit can be minimized by using a piece of wood as backing behind the work piece, and the same technique is sometimes used to keep the hole entry neat.

Holes are easier to start in wood as the drill bit can be accurately positioned by pushing it into the wood and creating a dimple. The bit will thus have little tendency to wander.

PROCESS SHEET

PART NAME : C-Pillar
MATERIAL : Wood
QUANTITY : 1

Sr. Number	OPERATION	MACHINE	TIME
1)	Cutting the material as our required size.	Wood Cutter	05 Minutes
2)	Cutting the pillars according to our dimensions	Wood Cutter	10 Minutes
3)	Cutting the upper base with a hollow square in between	Wood Cutter	20 Minutes
4)	Cutting the PVC Pipe to the required dimensions	Wood Saw	20 Minutes

PART NAME : Robotic Arm

MATERIAL : Wood

QUANTITY : 1

Sr. Number	OPERATION	MACHINE	TIME
1)	Cutting the material as our required size.	Wood Cutter	05 Minutes
2)	Cutting the joints according to our dimensions	Wood Cutter	10 Minutes

3)	Cutting the base with a hole in between	Wood Cutter	20 Minutes
4)	Cutting the gripper to the required dimensions	Wood Saw	20 Minutes

Work Processing Photos

Figure 5.28- Project Work Photo-1

Figure 5.29- Project Work Photo-2

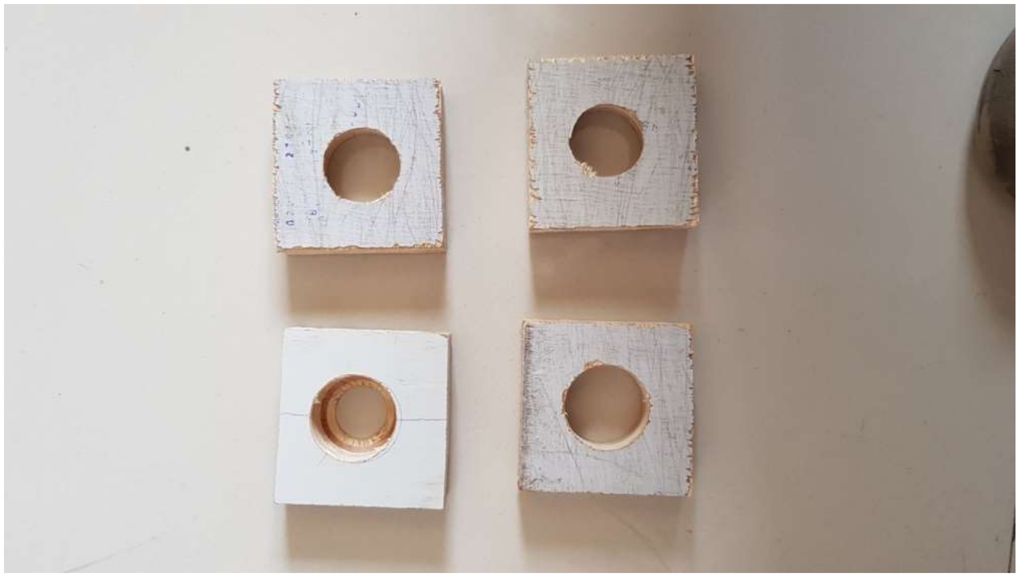

Figure 5.30- Project Work Photo-3

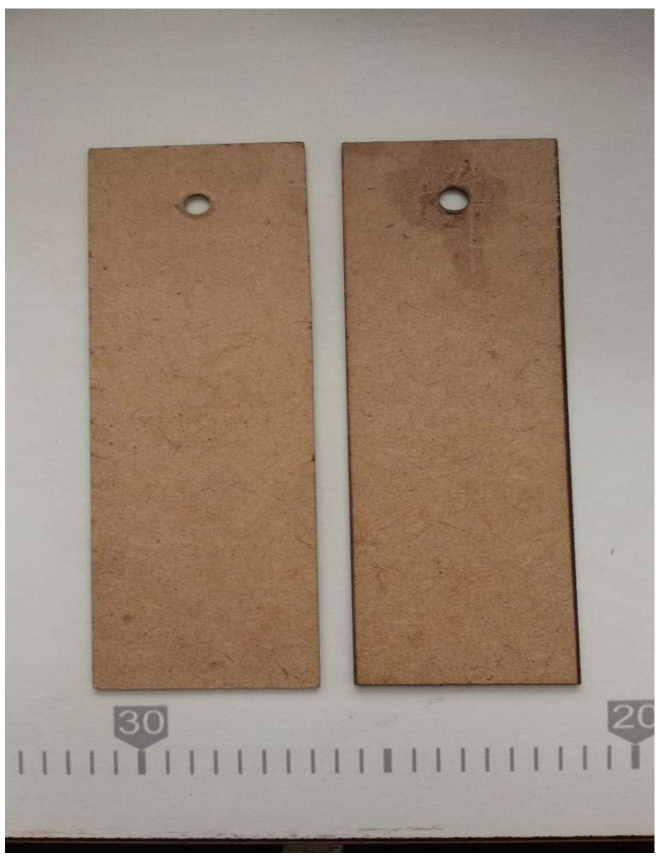

Figure 5.31- Project Work Photo-4

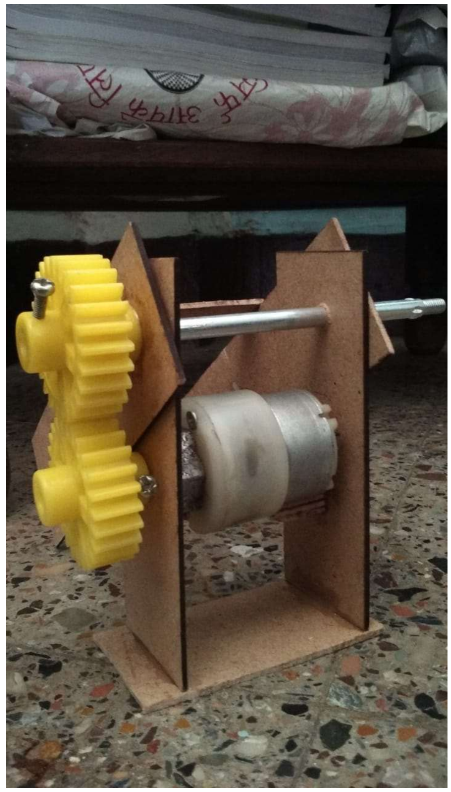

Figure 5.32- Project Work Photo-5

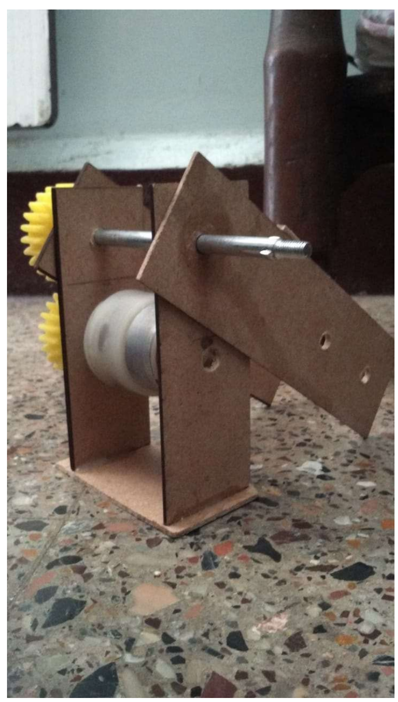

Figure 5.33- Project Work Photo-6

REFRENCES AND BIBLIOGRAPHY

The following are the references of the project:

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