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# Design & CNC Machining

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ABSTRACT:

Nowadays, CNC machining is found in many industries to aid production as it streamlines the manufacturing process and CNC machining is absolutely essential for manufacturing and it is important. Some major benefits of CNC machining in manufacturing are: Greater Efficiency,More Accuracy,Fabrication.The aim of the project is to manufacture a design profile by using CNC machine. The profile design is needed to write a CNC program based on labels the label mode of program is selected because the programming is too easy even for complicated shapes. CNC's had made revolutionary changes with in the manufacturing sector in before days achieving productivity up to the desired level was not possibilities due to lots of drawbacks like complication of shapes and sizes, lack of skilled labors, lots of wastages and scraps due to unexpected mistakes and low-quality levels and accuracy. By using CNC this all draw backs can be overcome and this was our small contribution to show the performanceof CNC.

Initially we got trained about the CNC programming and operations for the period of 3 months so during the training we decided to do a project on CNC as our Final Year Project for B.TECH, we planned a profile to be manufactured which would be tough to achieve it by conventional machining process and we designed to make use of aluminum material as a work piece of dimension, after the basic selections and decisions the preparation of an program (based on labels) will be done and we will go for simulation and verify it thoroughly whether the profile achieved by simulation is matching to the designed after lots of observation we will go for manufacturing the profile in CNC machine available at the source place and we hope to achieve the results will be smooth finished surface with high rate of accuracy with less machining time which directly increases the productivity and the process will be economical when compared to the normal conventional machining process.

## INTRODUCTION:

Conventional Computer numerically controlled (CNC) machining is a technology which has been in existence for some decades and is reaching what appears to be an apex, much in tune to the long history of machine tool evolution. This is important as one may realize that while it is an integral step to the industry of tomorrow, it is the culmination which has set the manufacturing industry in an entirely new direction.

Understanding and applying this concept as a company is as important as understanding and applying the knowledge as a machinist. Making use of techniques and procedures which maximize the benefit of conventional CNC machining will add value to the machinist, and company, while ensuring that he or she is well-desired in a competitive economy (Engineers edge.).

Development of Computer Numerically Controlled (CNC) machines is an outstanding contribution to the manufacturing industries. It has made possible the automation of the machining process with flexibility to handle small to medium batch of quantities in part production.

Initially, the CNC technology was applied on basic metal cutting machine like lathes, milling machines, etc. Later, to increase the flexibility of the machines in handling a variety of components and to finish them in a single setup on the same machine, CNC machines capable of performing multiple operations were developed.

To start with, this concept was applied to develop a CNC machining center for machining prismatic components combining operations like milling, drilling, boring and taping. Further, the concept of multi-operations was also extended for machining cylindrical components, which led to the development of turning centers.

## THEORY:

To better understand the problems involved to successfully use your Rhino data for a CNC-controlled machining or cutting type operation, you need to understand the CNC process and how it works.

**NC – Computer Numerical Control** – Taking digitized data, a computer and CAM program is used to control, automate, and monitor the movements of a machine. The machine can be a milling machine, lathe, router, welder, grinder, laser or water jet cutter, sheet metal stamping machine, robot, or many other types of machines. For larger industrial machines, the computer is generally an on-board dedicated controller. But for more hobbyist types of machines, or with some retrofits, the computer can be an external PC. The CNC controller works together with a series of motors and drive components to move and control the machine axes, executing the programmed motions. On the industrial machines there is usually a sophisticated feedback system that constantly monitors and adjusts the cutter's speed and position.

**Desktop CNC** – There are many smaller modelmaker-hobbyist style desktop CNC machines. In general, these are lighter weight, less rigid, less precise, slower, and less expensive than their industrial counterparts, but can do well for machining objects out of softer materials such as plastics, foam, and wax. Some desktop machines may run a lot like a printer. Others have their own closed command system and perhaps even dedicated CAM software. A few will also accept standard G-code as input. Some industrial standarddesktop machines do exist with dedicated controllers for doingprecise small work.

**CAM (Computer Aided Machining or Manufacturing)** – Refers to the use of various software packages to create tool paths and NC code to run a CNC controlled machine, based on 3D computer model (CAD) data. When the two are used together, this is generally referred to as CAD/CAM. Note: CAM does not actually run the CNC machine, but just creates code for it to follow. It is also not an automatic operation that imports your CAD model and spits out the correct NC code. CAM programming, like 3D modeling, requires knowledge and experience in running the program, developing machining strategies, and knowing what tools and operations to use in each situation to get the best results. While there are simple programs that for the inexperienced user to get started without too much difficulty, more sophisticated models will take an investment in time and money to become proficient.

**NC Code** – A special relatively simple computer language that a CNC machine can understand and execute. These languages were originally developed to program parts directly at the machine keyboard without the aid of a CAM program. They tell the machine what moves to execute, one by one, as well as controlling other machine functions such as spindle and feed speeds, coolant. The most common language is G-code or ISO code, a simple alphanumeric programming language developed for the earliest CNC machines in the 70s.

**Post-processor** - While G-code is considered the standard, each manufacturer can modify certain parts such as auxiliary functions, creating a situation where G-code made for one machine may not work for another. There are also many machine manufacturers, such as Heidenhain or Mazak, that have developed their own programming languages. So, to translate the CAM software's internally calculated paths into specific NC code that the CNC machine can understand, there is a bridge software piece software called a post processor. The post-processor, once configured correctly, outputs the appropriate code for the chosen machine, so that in theory at least, any CAM system can output code for any machine. Post processors may be free with the CAM system or added cost extras.

## CNC Programming Language

CNC machine was first made by making command language to move motor with G Code language. The first G-Code was created in 1950 designed by the Massachusetts Institute of Technology at MIT Servomechanisms Laboratory. CNC coding standards in Europe use the ISO 6983 standard, although in other countries use other standards, such as DIN 66025 or PN-73M-55256, PN-93 / M55251 in Poland.

## Shifting Trend of Conventional Machines Usage with CNC Machines

As time goes by, the growth of the manufacturing industry is very rapid. This causes the need for conventional machinery is reduced, because it is considered unable to meet the needs of high productivity and high precision. As well as the more varied models and types of workpieces with difficulty levels ofhigh workmanship that is not possible to be done with conventional machines.

The presence of CNC machines cannot be denied is one of the best solutions to meet those needs. Because CNC machines can do complex work with high precision and constant results.

## Mechanical System.

The mechanical system of the CNC milling machine is the same as the conventional milling consisting of the x, y, z axis. Each axis moves in sliding translation by using a linear rail in motion using a screw. In the milling machine may consist of several variations of movement on the y-axis, either by using a moving work table or with a fixed (silent) work table but a moving x-axis supporting pole.

In this study using linear ball bearing guide because by using this type of mechanism each axis can move more precise and lightweight. For driving it using lead screw because of its small size so cannot use ball screw.

## Motor Driver

There are types of motor driver:

- Servo Motor

Servo motors have a better character than the steeper motor. Because the servo motor is a motor with a close loop system. With such a system the motion of the motor rotation is more precise and the energy released is directly proportional to the rate of rotation. However the drawback is the price for an expensive servo motor. So it is lesseconomical.

- Steeper Motor

Steeper motor has a large torque character at low rotation but the higher the rotation then the torque decreases. System that works on steeper motor is open loop system. So it needs the additional encoder or sensors in each axis. However steeper motor lately more in demand because of the more affordable price of servo motors. For now there are many options motor driver with a higher level of accuracy with micro steep, so for the level of precision is not too different from servo motors.

Each motor has advantages and disadvantages respectively, in this study we use steeper motor to drive the three axis with the reason that the price is cheaper than servo motors.

## METHODOLOGY:

This project has been classified into the followingmodules for successful execution

- Mechanical System & Design
- Electronics and Control Module
- Software Module

How this system works is quite a simple procedure. The machine operator inputs the G and M code into the GUI (Graphic User Interface) which then sends the G and M code to the software which interprets the code and sends the signals to the electronic driver. The driver then runs the motors which are connected to the lead screws that are responsible for the movement of the tool.

## Literature Review:

The CNC machine tool structure design includes the design of supporting structure, design of various component like head stock, guide ways, saddle, rib-stiffener structure, etc. There are few works have been done by the previous researchers for the design of machine tool bed. So, the full system is divided into different individual components. Every individual component having functional as well as a design requirement. In this review, the research works in the area of machine tool structure and its components-parts have been presented. This may be helpful to people who are working in this area.

S.S. Abuthakeer et al. discussed about the functional requirement of machine tool which are high static stiffness and damping. They suggested that the composite material of steel and polymer concrete can be used for replacement of conventional cast iron for bed structure. Experimental modal and static analysis proved that steel-polymer composite is suitable for replacement of cast iron.

B. Malleswara et al. analyzed the machine tool bed for static and dynamic loading. For machine tool bed, the stiffness and rigidity can be improved by better structural design. Author optimized the machine tool bed using Opti struct and analyzed in ANSYS workbench. Study shows that, machine structural behavior can be influenced by adding ribs at the suitable locations.

P. Mohanram et al. presented that material distribution plays an important role in the structural strength and by utilizing proper material at required place can increase static stiffness with lower mass. They modified the existing supporting structure by adding vertical ribs and analyzed both structures. Study shows that Vertical ribs in the machine tool structure can be useful in improving the static and dynamic behavior of machine tool.

## Computer Numerical Control Systems Market Research:

**CNC Metal Cutting Machine Market Outlook - 2026:**

The development of NC machine tools has continued for over fifty years in the manufacturing industry. Currently, the technology is reasonably mature and different companies have developed their unique strengths on different products. Europe isthe largest machine tool manufacturer in the world.

Furthermore, increase in trend of adoption of CNC metal cutting machine has been witnessed in the automotive industry, owing to its advantage over conventional machines in terms of working efficiency and speed. The strong growth of automobile industry, supportive government regulations, and increase in R&D expenditure among the key players in CNC metal cutting machine market are some of the major factors that offers lucrative growth opportunities for the market players during the forecast period. For instance, in May 2018, DMG MORI Co., Ltd. has developed NHX 4000/5000 third generation horizontal machining center. The machine is suitable for mass-production of high rigidity parts and precise components for automotive and aerospace industries.

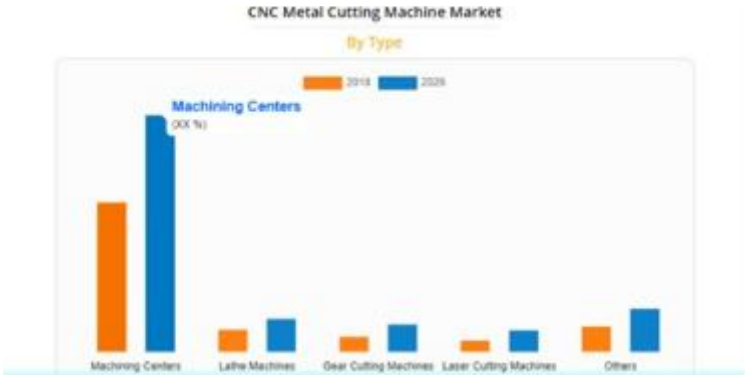


Figure 1. Market Research of CNC

**GRINDING: CNC** grinding machines use a rotating grinding wheel to remove material. The objective is to give a high precision finish to a metal part.

**ROUTING: CNC** routers are seemingly similar to CNC milling machines. Here also the rotating piece is the cutting head. The main difference lies with the materials suitable for cutting.

**DRILLING**: While milling equipment can also produce holes, drills are meant for only that job.

## Types of CNC Machine:

CNC is widely used to automate a variety of different fabrication methods. These include:

- Laser cutters
- Plasma cutters
- Water jet cutters
- Flame cutters
- Press brakes
- Milling machines
- Turning machines
- Routers
- Electrical discharge machines, etc.Following are the types of CNC machine:

❖ Lathe CNC machine
❖ Milling CNC machine
❖ Drilling CNC machine
❖ Grinding CNC machine
❖ Laser cutting CNC machine
❖ Plasma cutting CNC machine
❖ Electric discharge CNC machine
❖ Router CNC machine
❖ CNC machine with automatic tool changes
❖ 3-D printer

- ❖ 5-axis CNC machine
- ❖ Pick and place machine.

## PROPOSED METHOD:

**CNC Machine-Input, Process, Output**

A CNC production facility needs three pieces of equipment.

**A Computer**

The computer is used to draw the design. However, the designis only a picture and the CNC machine cannot use this to manufacture the product. The computer software must also convert the drawing into numbers (coordinates) that the CNC machine can use when it starts to cut and shape the material.

**An Interface**

A computer cannot be directly connected to a CNC machine.The computer is connected to an interface. This converts thesignals from the computer to a form that the CNC machine understands. The signals are in the form of digital signals when they are sent to the CNC machine.

**CNC (Computer Numerical Control) Machine** Thesignals from the interface control the motors on the CNC machine. The signals determine the way the vice moves. The vice moves in three directions X, Y and Z.
(Horizontally, vertically and depth). The signals also controlthe speed of the cutting tool.

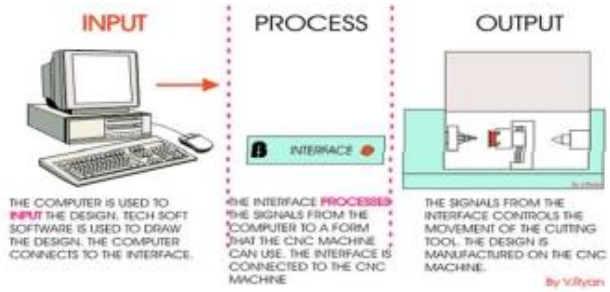


**Figure *2.*** Working Principle of CNC

## DATA COLLECTION:

Data collection is done by studying an existing CNC machine to determine the main components used and the main workings of the machine. Which is useful in designing and manufacturing prototype portable CNCmilling machine that will be made.

What problem does our solution solve?

- CNC Machine Data Collection & Analysis
- Local & Remote storage backup & security
- Asset Management

QRM+: IT environmental monitoring

- Safety Surveillance

Surveillance Station: Professional Video Management System.

## SYSTEM DEVELOPMENT:

The pieces of equipment's used at this work are the machining center Discovery 760, Romi, Brazil, the high- speed machining center LPZ 500, MAP Werkzeugmaschinen GmbH, Germany, the laser interferometer 5528A from Hewllet-Packard®, USA, and the data acquisition board CP5511 SIEMENS AG, Germany. LPZ 500 is a five axes simultaneous machine, however, for the present experiments, it was operated using only three Cartesian axes X, Y and Z. The board CP5511 performs the communication between the personal computer and the CNC machine-tool by means of the OPI (Operator Panel Interface) with 1.5 Mbps speed. The next topic presents the system development.

## EXPERIMENTATION AND FABRICATION:

**Aim:** The aim of the project is to manufacturea Static ROBO Design Assembly profile by using CNC machine.

Overview of CNC Milling Process:

Like most conventional mechanical CNC machining processes, the CNC milling process utilizes computerized controls to operate and manipulate machine tools which cut and shape stock material.

In addition, the process follows the same basic production stages which all CNC machining processes do, including:

- Designing a CAD model
- Converting the CAD model into a CNC program.
- Gathering all machine equipment, tools and raw materialrequired.
- Setting up the CNC milling machine.
- Executing the milling operation.

Softwares used:


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## DESIGN:

CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and create a database for manufacturing.

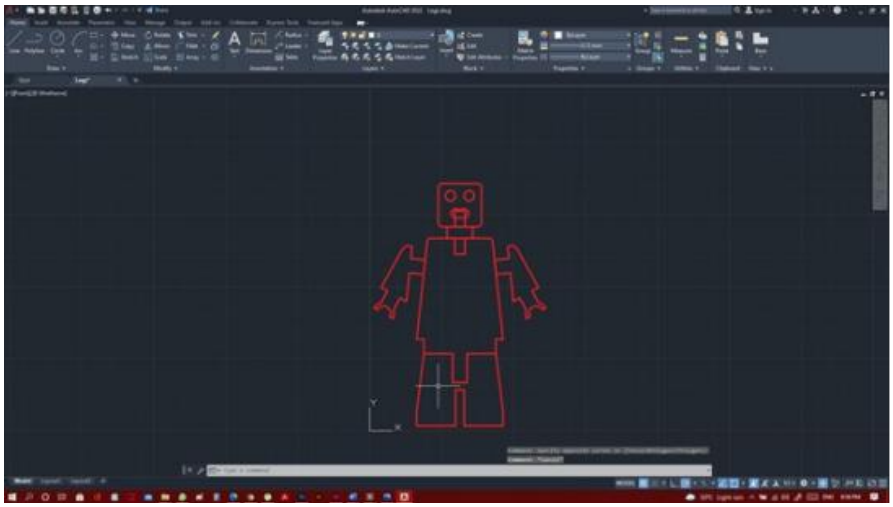

**Figure 3.** Design of Static Robot Model

## MODEL:

CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and create a database for manufacturing.
Rendered model of static robo.

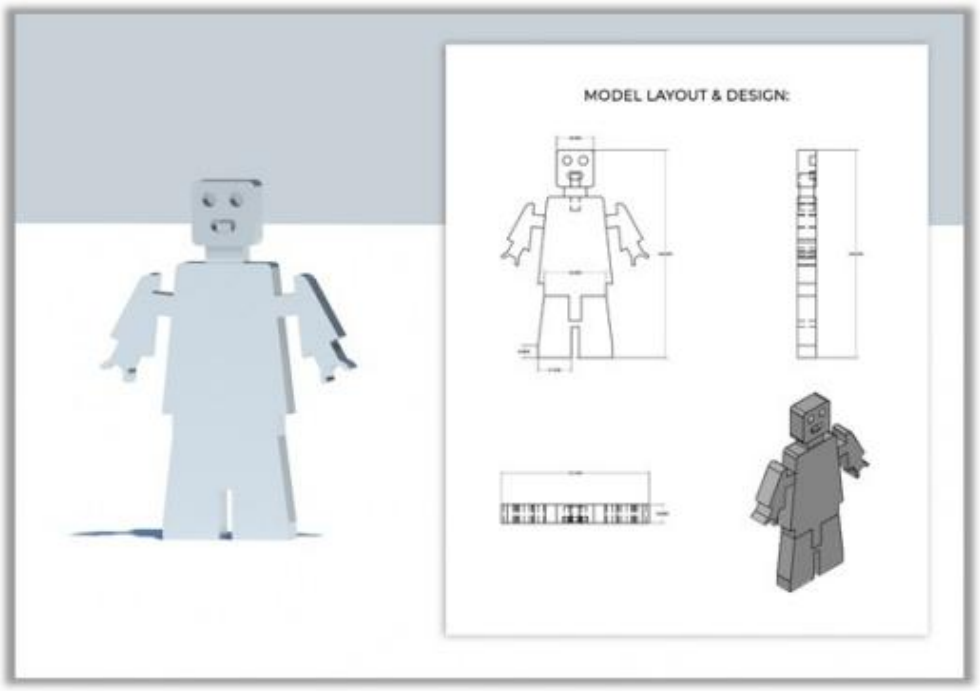


**Figure 4.** Rendered Design of Static Robot Model

## CONCLUSION:

Gone are the days of the gritty factory environment. Today, CNC machinists combine elements of mechanical design, technical drawings, mathematics, and computer programming know-how in a clean, professional environment.
So, we decided to manufacture with all your support and guidance a Static Robo model based on CNC Manufacturing process to explore the fast, accurate, and adaptable features of it. From this project, we hope to explore the best manufacturing method for industries.
What we can conclude from this report is we able to study the meaning of CNC which stands for Computer Numerical Control. The computer has a very unique software unlike the software in the normal computer because this software is specially designed for CNC machine. The use of CNC machine is to produce an object that has a very complex design like cars, components, accessories and many more. The advantages of using this CNC machine is the machine is very accurate measuring so it will not have error in measuring the object unless the user enters the wrong measurement. The code that uses in CNC computer is called g-codes. At first look, it's very complicated to study but once you expert on coding the g-codes your works will be easy and fast. They have many types of CNC machine but in this report, we only do research on two types only. Milling and turning type. Milling type is the most commonly used processes in industry and machine shop today for machining parts to precise sizes and shapes.

**REFERENCES:**


- Benhabib, Beno. (2003). Manufacturing: Design, Production, Automation, and Integration. New York:Marcel Dekker.
- https://www.autodesk.in/
- http://www.helmancnc.com/cnc-programming-for-beginners-a-simple-cnc-programming-example/

- IGIAT- CNC USER MANUAL
- IGIAT- AUTOCAD USER MANUAL & PRACTICESSINUMERIC 808D SIMULATIONSOFTWARE GUIDE
- PODWORKS ONLINE CNC Video Tutorials.
- Siemens YouTube CNC Video Tutorials.
- https://new.siemens.com/global/en/markets/machinebuilding/machine-tools/cnc4you/808d-on-pc.html
- https://www.thomasnet.com/articles/custom-manufacturing-fabricating/understanding-cnc-machining/
- Brown & Sharpe, automatic screw machine handbook: Brown and Sharpe speeds and feeds chart,Brown, & Sharpe.
- Automatic screw Machine handbook: Brown and Sharpe speeds and feeds chart.
- Church, E. L. (1988). Fractal surface finish. Applied Optics, 27(8), 1518-1518-1526.
- David M Anderson. (2004 CIM Press).
- Design for manufacturability & concurrent engineering; how to design for low cost, design in highquality, design for lean manufacture, and design quickly for fast production Davim, P. J. (2001).