

## Wood Engraving Using 3 Axis CNC Machine

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### ABSTRACT

*This machine can be used for Cutting, Engraving and Marking on wood, acrylic and PCB objects. Design picture that have been made on the PC sent to the microcontroller using serial communication then CNC perform execution on object according to point coordinates. Drill spindles will create patterns on objects automatically according to the design drawings. After testing, the CNC machine can be used for cutting, engraving and marking on wood, acrylic and PCB to 2D or 3D objects with 98.5% of carving accuracy and 100% of depth accuracy. Though there are several models for plotter, this plotter is designed in economical way. Main advantage of this plotter is we can replace the tool based on any application such as engraving machine, laser cutting machine, painting any surface and drawing purposes. Increase in the rapid growth of Technology significantly increased the usage and utilization of CNC systems in industries but at considerable expensive. The idea on fabrication of low cost CNC Router came forward to reduce the cost and complexity in CNC systems. Inspiring from this CNC technology and revolutionary change in the world of digital electronics & Microcontroller, we are presenting here an idea of “ 3 Axis CNC Machine For Wood Engraving Based On CNC Controller.”*

**Keywords:** CNC, Cutting, Engraving, Marking, Microcontroller.

### 1.INTRODUCTION

Working with automatic electrical and mechanical equipment demands precise, accuracy, speed, consistency and flexibility. In this case it takes the help of embedded computer applications to do the job. The electrical and mechanical equipment combined with microcomputer that has been widely used is a CNC machine (Computer Numerically Controlled). CNC machines are used for mechanical work such as cutting, engraving, drilling and others. The computer technology used to control, parse and execute . certain objects based on user command. In the manufacturing industry, the use of CNC machines greatly affects the increased production . In Indonesia, CNC machines have not been developed so that they are imported directly from other country. This has an impact on the industry that is difficult to develop because the price of CNC machines still expensive. The challenge is how to make CNC machines with good performance but low cost so that it can contribute to the acceleration of domestic manufacture industry. CNC machines are popular and widely used in the industry is a CNC that can form objects on acrylic, glass, wood and plate, mostly using laser, knife, or drill as cutting media. Research on the manufacture of CNC machines and fundamentals of embedded algorithms with the aim of producing high performance CNC machines with low cost has been widely practiced. Therefore in this paper is

discussed a design of cheap 3-axis router CNC machine based on microcomputer as its main control. In this CNC machine mounted spindle drill that can move automatically by stepper motor. This CNC router machine can be used as a tool to form 3-dimensional objects such as cutting, engraving, marking on wooden, acrylic and PCB objects. This paper also discussed in detail the results of testing the CNC performance parameters.



Fig.Sample Image of proposed system

## II. OBJECTIVE

The idea behind fabrication of low cost CNC router is to full fill the demand of CNC routers from small scale to large scale industries with optimized low cost. A major new development in computer technology is the availability of low-cost open source hardware, such as the Arduino microcontroller. An advantage of open source hardware is that a wide variety of ready-to-use software is available for them on the web, therefore the prototyping and development times are drastically reduced. Moreover, a wide range of low-cost interfaces, sensors, and accessories such as Arduino shields are also available. However, for the development of low-cost educational models of CNC machines, such tools may be quite adequate from the viewpoint of machine control. In this paper, the development of a prototype 3-axis CNC Router using Arduino-based control system is presented with following specifications:

- Low cost
- Easily operable
- Easy interface
- Flexible
- Low power consumption

## III. EXPERIMENTAL SETUP

Machine structure is the “backbone” of the machine tool. It integrates all machine components into a complete system. The machine structure is crucial to the performance of the machine tools since it is directly affecting the static and dynamic stiffness, as well as the damping response of the machine tool. A carefully designed structure can provide high stiffness, result in higher operation bandwidth and more precise operation. A small-scale machine tool generally requires even higher stiffness than the ordinary large-scale machine tool since it is usually operated at higher speeds. Granty style closed frame structure is chosen for our experimental setup

which provides a strong ridged structure loop, symmetry, and good thermal stability, which provides better stiffness than the open frame structures generally used for easy access to the work zone, with the same order-of-magnitude in size. Closed frame structures typically are used in precision machines such. Therefore it is much easier to move the tool with respect to a fixed work piece. This structure consumes less material, hence is very less expensive to build. Most machines designed for cutting flat steel plate use a gantry design because it is an easy way to move cutting tools in an Z-X coordinate system. The gantry bridge itself forms the other axis, usually the Y-axis. By motorizing each axis and coordinating the motion of the two axes simultaneously, you can move a torch in any pattern necessary to cut shapes out of steel plate. Thus, a gantry design lends itself to CNC shape cutting, which primarily uses an Z-X coordinate system for programming parts. A gantry cutting machine will ride on some sort of rail system in the Z-axis, either floor mounted, pedestal mounted, or sometimes integrated onto the side of a table. The rails are designed to provide accurate motion for the machine, and are strong enough to support the weight of the entire machine and all of the equipment mounted to it. A gantry cutting machine will also have some sort of guiding system in the X-axis too, which is mounted to the bridge structure itself. The X-axis guiding system will usually be smaller than the Z-axis rails, because they only have to carry the weight of a small carriage and cutting tool, not the entire gantry. Gantry machines may have one tool carriage or many tool carriages. Some times the tool carriages will each have their own drive motor that moves them in the X-axis, and some times there will be only one motor that drives the X-axis, and all of the tool carriages will be connected together by a steel band, tie rod, wire rope, or similar mechanical device.

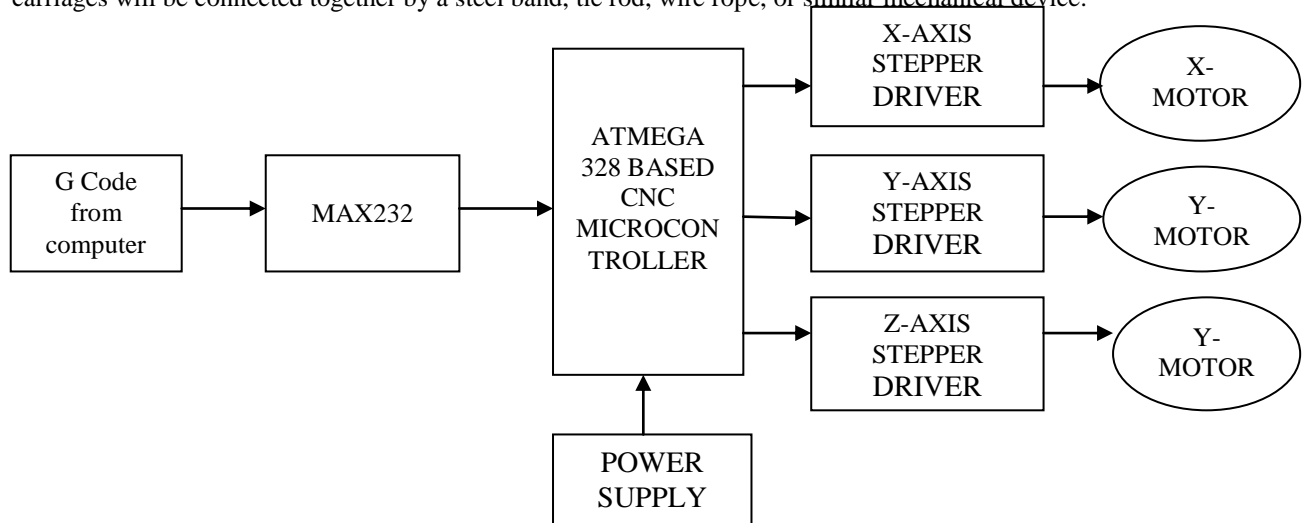


Fig.Block diagram Of Wood Engraving Using 3 Axis CNC Machine

### 3.1 Electrical and Electronic parts:

#### 3.1.1 Microcontroller:

The motion control of the machine is not possible without microcontroller. Here we have used Arduino Uno board with Atmega 328p microcontroller. Atmega 328p is a 32 bit, 24 pin microcontroller programmable with Arduino codes. The Arduino works here as an open source burner which burns the microcontroller with given .hex codes.

### 3.1.2 CNC shield:

CNC shield is a stepper motor driver board which basically receives the signals from the Arduino digital pins and delivers the power to the stepper motors along with the external power. This shield receives an external power source of 24V-4A to run all three stepper motors in 3-axis. The shield is attachable to the Arduino and has 4X8 pin slots for the motor driver.

### 3.1.3 Motor drivers:

There are a lot of motor drivers available to run a stepper motor. The most cheap and simple drivers are H-bridge drivers. But in case of CNC, H-bridge drivers are not compatible due to its less micro-stepping capability. For that reason the software does not support these drivers. That is the reason we have used Polulu drivers with A4988 IC. This is affordable and fully compatible with software as well.

### 3.1.4 Stepper motors:

Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases". By energizing each phase in sequence, the motor will rotate one step at a time. Bipolar stepper motors are more preferable for their higher torque capacity. Here NEMA 17 batch motors have been used. Those are not too expensive but very effective in their position.

## 3.2 Software and Coding System:

The tool chain of CNC-based manufacturing is represented in the fig 1.1. The part to be machined is designed in a computer-aided design (CAD) software, whose output is a drawing in one of many acceptable formats. Most preferable format is .stl format. This drawing is then fed to the computer-aided manufacturing (CAM) software, whose output is the machine-readable code used for numerical control of the machine. Since implementation of the G-code is machine-dependent, it is necessary to test out different choices for an open-source G-code interpreter for the Arduino, so that the correct motions are obtained for the machine axes through the stepper motor driver. We have used grbl, an open-source G-code interpreter or milling controller for the Arduino development board.

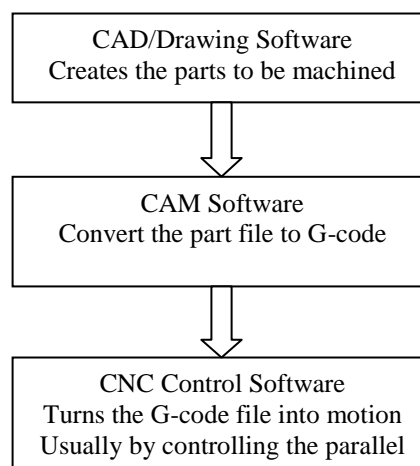


Fig .Flow chart of proposed system

### 3.2.1 CAD Software:

Computer-aided design (CAD) is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design 3D parts for CNC cutting. CAD tools in the truest sense are designed to allow you to easily change and manipulate parts based on parameters. The most widely used interchangeable mesh file format is .STL files are important because, they are used by CAM tools to generate Gcode, OpenSCAD, FreeCAD, HeeksCAD, PTC Creo (formerly PTC Pro/Engineer), Dassault Solidworks, Autodesk Inventor, AutoCAD are some examples of CAD packages.

### 3.2.2 CAM Software:

Computer Aided Manufacturing, or CAM, tools handle the intermediate step of translating CAD files into a machine-friendly format used by the Microcontroller board. CAM software needs an .STL file format from CAD software to generate machine friendly GCODE. Some example packages are like CAD/CAM, G-Simple, FreeMill, Dolphin CAD/CAM, CamBam, Vizion (ArtCam), OneCNC, VirtualGibbs, MasterCAM, BOBCAD-CAM, MeshCAM, VisualMill, TurboCADCAM, DeskCNC, SheetCAM, OneCNC, SprutCam, EdgeCAM, ArtCAM etc.

### 3.2.3 CNC Control Software (GCODE Sender):

Gcode Sender is used to send the G-code files to an integrated hardware interpreter (Atmega 328). Gcode Sender will take a G-code program in file and send it line-by-line to the Atmega-328 microcontroller. The Gcodes will send over the serial ports through USB communication between the computer and microcontroller. Grbl Controller is software that is designed to send GCode to CNC machines is, such as 3D milling machines. It isn't super smart, it just needs to give the user a nice way to get commands down to whatever controller they are using.

## IV. FUTURE SCOPE

It is planned to scale up the prototype CNC machine in terms of size, use more powerful motors, strengthen the frame and worktable with materials like aluminum or cast iron, and augment the CNC control software with software for simulation ahead of actual run. For instructional purposes as well as for more precise operation, it is preferable to build CNC machines with DC or AC servomotors and encoder feedback using PC-based motion controllers. It is planned to implement the multi axis about 4 to 6 axis CNC router. The implementation of 3D printing (Rapid prototyping) technology to the same hardware abstract is ongoing plan for printing 3D models.

## V. CONCLUSION

With the increasing demand for small scale high precision parts in various industries, the market for small scale machine tools has grown substantially. Using small machine tools to fabricate small scale parts can provide both flexibility and efficiency in manufacturing approaches and reduce capital cost, which is beneficial for small business owners. In this paper, a small scale three axis CNC milling machine is designed and analyzed under very limited budget.

## REFERENCES

### Website:

- [1] [www.arduino.cc](http://www.arduino.cc)
- [2] <https://github.com/winder/Universal-G-Code-Sender>
- [3] <http://hacknmod.com/hack/incredible-100-arduino-based-cnc-machine/>

### Papers:

- [1] “Design and Development of a Portable Pantograph for Engraving Letters on Wood  
Open source GCODE interpreter code GRBL controller Firmware Code” By Ben

### Book:

- [1] FABRICATION OF LOW COST 3-AXIS CNC ROUTER, BY, *Dr.B.Jayachandraiah, O.Vamsi Krishna, P.Abdullah Khan, R.Ananda Reddy*. International Journal of Engineering Science Invention, ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726, [www.ijesi.org](http://www.ijesi.org) Volume 3 Issue 6ll June 2014 ll PP.01-10.