

## **DESIGN AND FABRICATION OF 3 AXES PORTABLE SPECIAL PURPOSE ENGRAVING MACHINE**

Harish Mudegonnavar<sup>1\*</sup>, Neelakanthareddy Y B<sup>2</sup>, Siddesh N Bevinahalli<sup>3</sup>

<sup>1</sup> Harish Mudegonnavar Mechanical Engineering, R. T. E. Society's Rural Engineering College Hulkoti, Gadag, Karnataka, India-582205 ([harishsm.mech@gmail.com](mailto:harishsm.mech@gmail.com))

<sup>2</sup> Neelakanthareddy Y B, Mechanical Engineering, R. T. E. Society's Rural Engineering College Hulkoti, Gadag, Karnataka, India-582205

<sup>3</sup> Siddesh N Bevinahalli, Mechanical Engineering, R. T. E. Society's Rural Engineering College Hulkoti, Gadag, Karnataka, India-582205

**ABSTRACT:** This paper presents the work on design and fabrication of a low cost three axis mini portable special purpose engraving machine; using Arduino Microcontroller, stepper motors and GRBL Shield. The present work is an attempt to minimize the overall cost of the computer numeric control machines while maintaining the accuracy of working. The low cost machines will help in the skill development initiative started by Indian government for quality work force. This machine will target the budding entrepreneurs/wood workers to create intricate designs on work pieces at minimum investment, as compared to the existing commercially available CNC milling machines; which are very costly and bulky. The intention is to maintain the same output (in terms of accuracy and repeatability) as that of existing large machines while reducing its size and price. The machine is designed by considering various facets of the machine such as aesthetics, reliability, safety, performance and financial value. In this era of competitive markets, this machine will help the workers in rural areas and will play a crucial role in strengthening their manufacturing capabilities and enhancing the economic development of nation.

### **1.INTRODUCTION**

The manufacturing world has become a high technology with a lot of the things from a huge machine to Nano particle. The work of the fast -growing industrial manufacturing world requires, accuracy and precision to its maximum extent. The requirement of the manufacturing world made to develop the concept of

NC/CNC machines. These machines are the normal traditional machine which is embedded with the computers, electronics and mechatronics devices.

### **Review stage**

The Special Purpose Machines are used to engrave the given work piece of different kind of material such as metal, wood, plastic, ceramics and some more composite materials. It can be automated or semiautomated, in addition to the engraving process the machine is capable of performing all kind of respective machining process such as drilling, milling, individually, the machine consists of major parts like process executer, drivers, electronics and programming. By the results of survey conducted its concluded that the work of the small scale industries meets the accuracy and precession to a certain extent. To overcome the limitation the collaboration of the advanced technology is needed.

By the help of the advanced technology the limitations are resolved and the curiosity of advancement is made live.

### **Final Stage**

The technology is introduced step by step, hence the engraving machine is set as a perfect example for the introduction. The machine can be manipulated depending on the requirement, depending on the technology available. The machine is built in such a way that the cost of the machine lies within the budget of the small scale industry holder. The machine can be advanced by adding the components required, which requires no skilled labour and no large amount of cost for the components.

## **2. DESIGN AND FABRICATION OF 3 AXIS PORTABLE SPECIAL PURPOSE ENGRAVING MACHINE**

This paper presents the work on design and fabrication of a low cost three axis mini portable special purpose engraving machine; using Arduino Microcontroller, stepper motors and GRBL Shield. The present work is an attempt to minimize the overall cost of the computer numeric control machines while maintaining the accuracy of working.

## **3. APPLICATIONS**

- Can be used in the small Scale industries for lighter hard materials machining.
- PCB sketching can be easily done.
- Can be used in the educational institutions.
- Can be used as alternate for the NC machine example.
- By changing the cutting tools, the drilling, milling and engraving can be achieved upon advancement.

#### 4. WORKING

The multi axis engraving machine is embedded with electronics and programming with the reason of controlling and varying the input according to the requirement. Here the input is given through the software using the computer. The software initiates the command by switching the electronics components, motors and spindle. The motors rotates accordingly the command received and so do the spindle

Setting up the electronics:

Initially the Arduino uno (the heart of the machine has to be set up), using the Arduino software and some dependencies from the git hub. to set up the electronics the steps below are to be followed.

- Open the Arduino software connect the Arduino module using the Arduino Cable and install the dependencies required using the GIT HUB Platform.
- Connect the Arduino module and GRBL shield/ CNC shield.
- Attach the drivers to the GRBL shield and connect the motors to the GRBL Shield and the Spindle.
- After adding the dependencies required to the Arduino module, and install the GRBL G code sender. Here the Arduino module acts as the host.
- Load the g code which has to be executed in the console and run the programme.



Fig 1: G-code sender

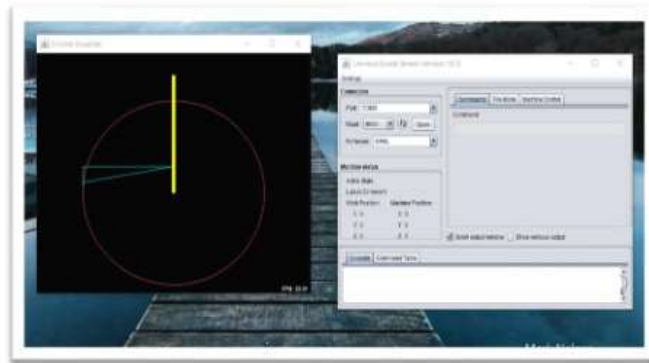


Fig 2: simulation

To get our CNC machines to do exactly what we want, there are quite a few GRBL settings that we can adjust. The only difficulty that is faced by the user will be the adjusting the lead. It can be done by scaling the values and units.

**WORKING COMPONENTS:**

Component	Working
Supporting column	Greatly increase the rigidity and stability of the machine tool to significantly reduce vibrations, tool deflection and, thereby, hold tighter tolerances while enabling the machine to operate at optimum spindle speeds.
Beam	A beam supported on both ends and restrained from rotation.
Lead screw	Lead screw is a type of screw which is used as linkage in machines. It converts rotary motion into linear motion. It has very high frictional losses.
Check nut	It fits to the leadscrew which helps in the motion of the setup along the axes.
Linear bearing	A linear-motion bearing or linear slide is a bearing designed to provide free motion in one direction. There are many different types of linear motion bearings. Motorized linear slides such as machine slides, X-Y tables, roller tables and some dovetail slides are bearings moved by drive mechanisms.
Coupler	The CNC coupler is used to connect the stepper motor shaft to the CNC leadscrew. It is used with our standard stepper motors as well as the hi-torque stepper motors.
Bearing	It is small and suitable for installation with limited space and on thin shafts. It can withstand very high speeds.

## 5. RESULTS

Using the resources available the machine is built and was successful in achieving the motion along all the three axes As compared to CNC the fabricated machine weighs less and is cost effective.

Machines	CNC	Special purpose engraving machine
Cost	22,000 – 200000 INR	15000 INR
Weight	100kg – 2200kg	20 kg

Fig 3: Cost table

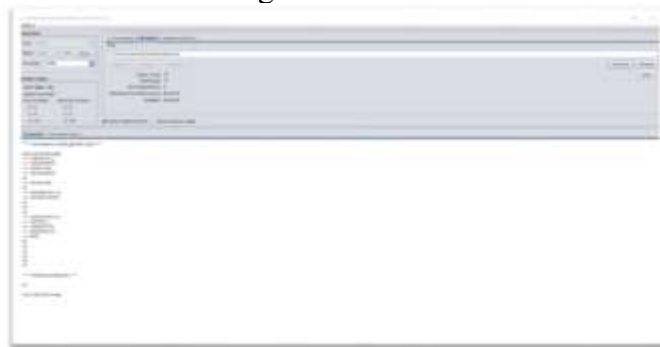


Fig 4: Results of console

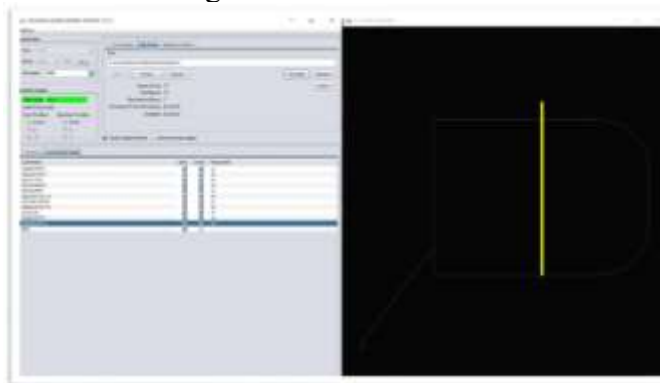


Fig 5: Command table



Fig 6: Simulated workpiece

## **6. LIMITATIONS**

- Limited to soft and lighter hard materials.
- Unable to with-stand the greater loads.
- Complex shapes cannot be machined.
- Labour is always required to change the cutting/engraving tool.

## **7. CONCLUSION AND FUTURE SCOPE**

By using this setup with a combination of G code Arduino software for smooth operation and give better accuracy for engraving process. This setup is used to reduce the process of etching and drilling.

G code makes position from layout design to move with proper position. Whenever require to start and stop whole process will depend on you. By using Arduino nano board, the setup is flexible and reduces workload for making engraved workpiece.

Current system can be improved to reach higher axis speed machining process. Variable spindle speed control mechanism can be easily incorporated to the system. It can be perfect replacement of the CNC when further improved. These machines can be used in the colleges for the demonstrations of the CNC and to teach the students the practice of G code and M code. The soul purpose of the engraving machine is to provide machine which is accurate and time saving, which and be satisfied by the 3 Axis multipurpose engraving machine.

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