



Mini laser cutting machine

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Abstract: In our project, efforts have been made to develop a working machine of laser cutting and engraving machine. The laser beam is used to cut or engrave. The burnt area looks different from the surrounding surface. In our machine laser beam penetrates through the surface This can be done by extending the beam on a particular area for a long time, the duration is dependent on the properties material to be cut. This machine proves beneficial in various department as it has similar characteristics of rapid prototyping machine. It can cut out foam sheets, Aluminum Foil, thin sheets of Plywood, etc. depending on the intensity of the Laser, to produce desired shapes and patterns. Our aim is to build a CNC machine based on a laser engraver or laser cutting, that contains lesser number of parts and it is easy to use. Arduino can be used as a microcontroller. The software allows to control the laser engraver machine, based on the design of model of the processed product, generating, and sending a G code to the machine through the USB port.

Keywords: laser, cutting, engraving, CNC Machine, Arduino.

I. INTRODUCTION

Computer numerical control is an advanced automation technique used to control the motion and operation of machine tools. CNC Machines work on the program's commands written using computers in coded formats. Products manufactured by the CNC machines are precise in their dimensions. Inspired by the CNC technology and the advancements in the field of digital electronics and microcontrollers we are presenting in this paper an approach to the development of a mini laser engraving or cutting machine constructed on the basis of CNC technology controlled by the Arduino platform. The machine is an intelligent laser engraving system powered by a microprocessor. In the process of laser engraving, a laser beam physically destroys the material's surface to disclose a cavity that, when viewed, exposes an image. High heat is produced by the laser beam during the engraving process, effectively causing the material to vaporize. This creates a cavity on the workpiece surface that is noticeable and used for cutting. At present, a low-cost, mini-CNC laser engraving and cutting machine has been developed. Open-source microcontroller platform Arduino is used for control of the motors, and open-source software is used for executing the G codes for laser engraving or cutting.[1]

II. METHODOLOGY

The Mini laser cutting machine is constructed in four stages: (a) convert the selected image into G-code, (b) Programming the Arduino for CNC operation, (c) design the shapes to be cut on interface using Inkscape software and (d) design the machine setup to start the engraving operations as shown in figure 1.[2]

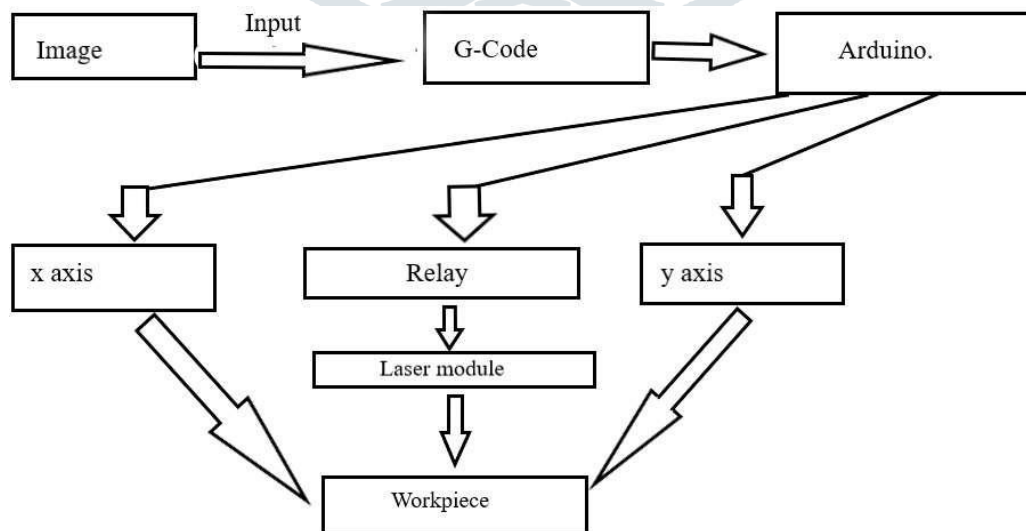


Fig. 1 Block diagram of mini laser cutting machine.

III. COMPONENTS AND DESIGN

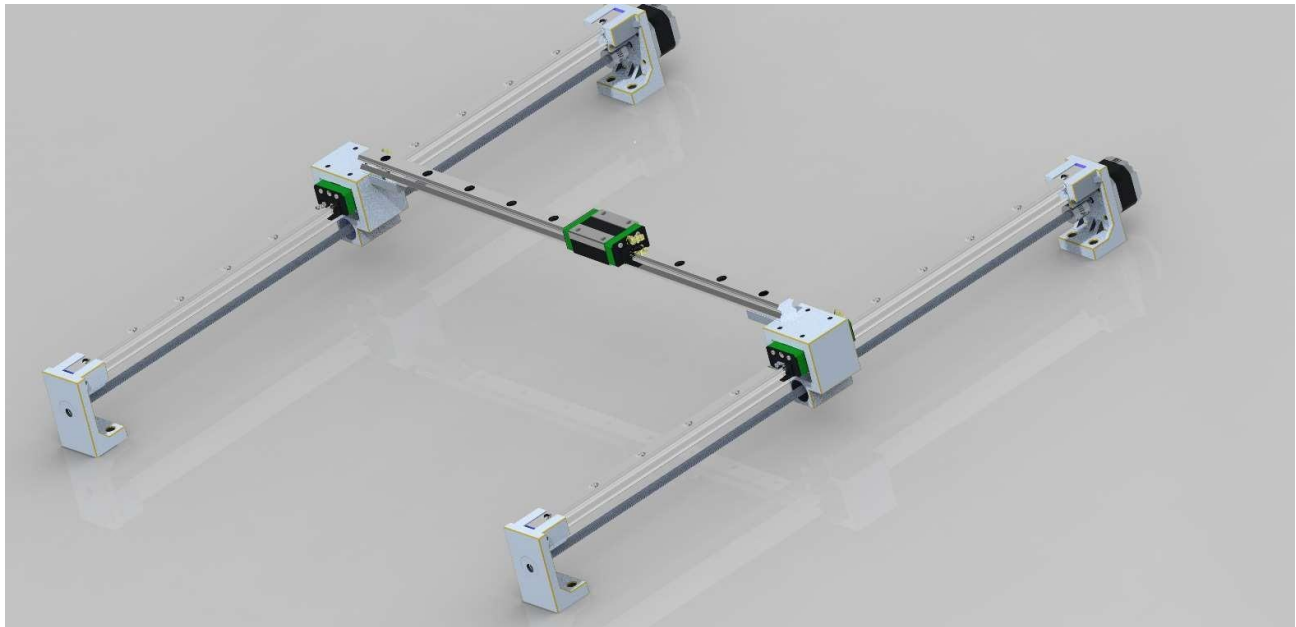


Fig.2 Assembled View (3D) of the Mechanical frame of the Machine.

The mechanical frame of machine consists of 3 rails with length 600mm and 700mm, Stepper motors, bearing, lead screw with nut, slider block, flexible coupling, sliding block and bearing blocks which holds rail and other components. Which are shown in figure 2.



Fig.3 flexible coupling

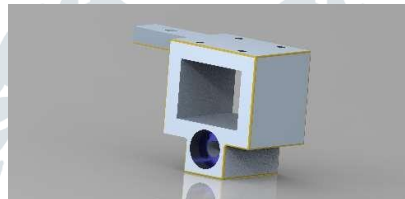


fig.4 sliding block



fig.5 Stepper motor

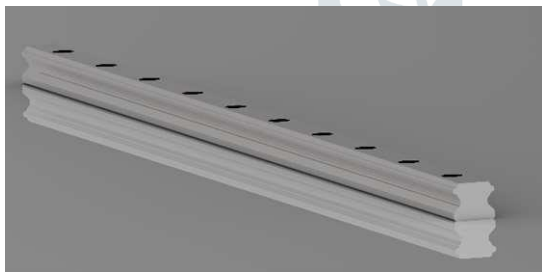


Fig.6 Rail

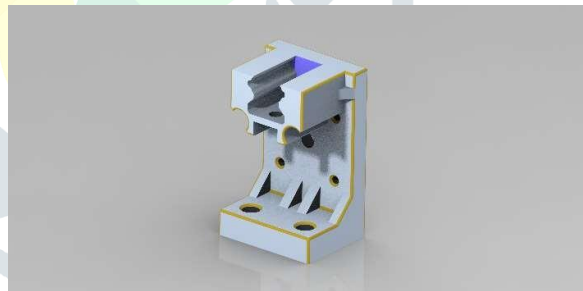


Fig. 7 Bearing block

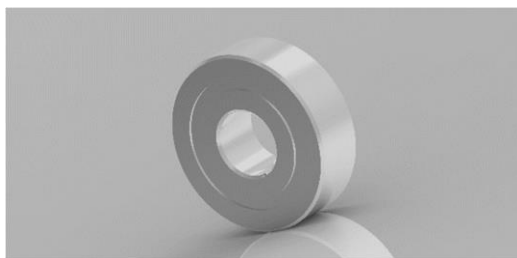


Fig.7 Bearing

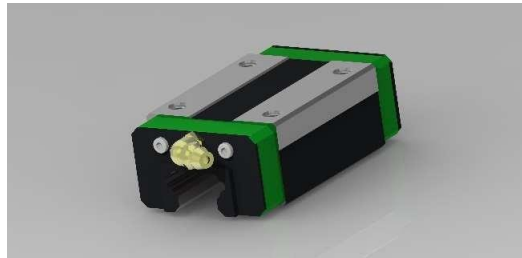


fig. 8 Slider block

IV. SOFTWARE

Universal G-code Sender is a Java based GRBL compatible cross platform G-Code sender. Use this program to run a GRBL controlled CNC machine. To run simply unzip the .zip file and double click the .jar file. On some platforms, the start script should be run. simply start sending Grbl some G-code commands, and it will perform them for you. Or, you can type \$ to get some help on what some of Grbl's special commands are or how to write some of your machine settings into Grbl's EEPROM memory. When have started to feel comfortable with G-code/CNC and you are ready to run a whole G-code program, we recommend that you use one of the many great GUIs that users have written to stream your G-code programs to Grbl and to fully harness all Grbl's capabilities.[3]

The open-source software known as the Arduino IDE is used to create and upload code to Arduino boards. For different operating systems, including Windows, Mac OS X, and Linux, the IDE program is appropriate. The programming languages C and C++ are supported. Integrated Development Environment (IDE) is used here. Sketching is a common term for the programming or coding done in the Arduino IDE. To upload the sketch created in the Arduino IDE software, we must link the Genuino and Arduino board with the IDE. The drawing is stored with the .ino file extension. It has a code editor with tools for text copying, pasting, searching, replacing, automatic indenting, brace matching, and syntax highlighting. It also offers straightforward one-click compiling and uploading tools for Arduino programmes. A hierarchy of operating menus, a message area, a text terminal, a toolbar with buttons for typical operations, and other features are also included. The Arduino IDE has specific code organisation guidelines to support the languages C and C++.

A software library from the Wiring project, which offers numerous standard input and output operations, is provided by the Arduino IDE. For the sketch to start and the main program loop, user-written code only needs two fundamental functions, which are combined with a program stub main() to create an executable cyclic executive program using the GNU toolchain, which is also distributed with the IDE. The executable code is transformed by the Arduino IDE's use of the software avrdude into a text file with hexadecimal encoding, which is then loaded into the Arduino board by a loader program in the firmware of the board.

V. OPERATION BETWEEN HARDWARE AND SOFTWARE OF MACHINE

The image is sent to the Inkscape software was traced into Bitmap image and exported as gcode file. After done export the gcode file, the Universal G-Code Sender software was opened. The software then required to connect to the hardware using baud rate with value of 115200. Once the hardware connected, the gcode file can be opened and sent to the hardware. The Arduino Uno microcontroller will enable the CNC shield and the CNC shield will send instruction to the motor driver according to the commands in the gcode file. The stepper motor then will perform the drawing.[4]

The human-machine interface (HMI) and input/output (I/O) control of a hardware-based CNC controller are both handled by the CNC software. Different software-based CNC systems have different prices, types, features, and uses. Using embedded computer software that has been preprogrammed, computer numerical control (CNC) is a manufacturing process that automates the control, movement, and accuracy of machine tools. In the CNC system, both software and hardware are present. The software is used by the operator to program and monitor the machine tool. The NC program is a set of instructions that informs the machine how to use the parts. The program is read by hardware and tells the machine how to operate. CNC Processing- Since production is software-based, CNC machines can manufacture parts that are almost impossible to produce by hand or traditional machining methods. Eliminating the factor of human error means that it can be cut precisely every time, greatly reducing the chance of error, reducing product waste, and ensuring quality.

The positioning datum, clamping method, tool, cutting method, etc. can all be made simpler in a typical machining process, but the data processing process is more complex, and these factors must be taken into full account. The CNC machining process can have several schemes that can organize various machining parts and machining equipment as the main line while still executing the same duties. The procedure has a variety of traits. This is how the CNC machining process differs from the conventional machining process.

VI. OBJECTIVE

The present inspection was done out to study and design the compact sized CNC laser cutting machine using Arduino and to imitate the machine on a virtual platform and make it usable for cutting purpose for small scale industries.[5]

Laser cutting machine compact in size makes it easy to carry from place to place. As machine is compact in size hence, power consumption of machine is low. Due to limited parts and machine being compact in size reduces manufacturing cost.

VII. CONCLUSION

We can see that all the production-based industries wanted low production cost and high work rate which is possible through the utilization of multi-function operating machines which will consume less power as well as less time, since this machine provides working in different environments reduced the time consumption up to the appreciable limit. This project is a combined effort and the goal of this project is to design a cost-effective mini laser cutting machine that would help the small-scale industry. Arduino-based mini laser cutting machine is build under a very limited budget. By using CNC controllers, there is a remarkable increase in the quality of products as well as it offers high flexibility. It increases productivity and reduces lead time. This collaboration of hardware with G-code & M-code gives better productivity and reduces the workload. G code & M-code make it easy to find the details of position of all stepper motor under working conditions, as the details of motor in working conditions can be directly seen on the computer.

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