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Design of CNC Machine Based Laser Engraver with Arduino UNO

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Abstract: ***Now a day's technology is increased in rapid growth the usage and implementation of CNC system in industries and colleges but at greater cost. According to our idea on fabrication of compact and cheap cost CNC Engraver is introduced to reduce complexity, cost and manpower. This paper discusse the design and implementation of two dimensional CNC routerwhich can engrave 2D & Gray scaled images or pictures with help of high watt burning laser module on surface which can be a paper, wood, leather, plastic, foam. This paper proposes the technique used to develop a Computer Numeric Controlled Laser Engraver. The specialty of this machine is the user can modification the tool simply whenever he/she desires to perform several operations like an engraving object (Materials-Acrylic, MDF board, Foam sheets, etc.,) and conjointly turn out a 2D drawing for specific object in A5 size sheet.***

Keywords: Computer Numerical Control (CNC), Integrated Development Environment (IDE), G Code, Laser Engraver, Arduino UNO

I. INTRODUCTION

The CNC stands for Computer Numerical Control used in the manufacturing sector that involves the use of computers to control machine tools. Tools that can be controlled in thismanner include lathes, mills, routers and grinder's .On the surface, it may look like a normal PC controls the machines, but the computer's unique software and control console are whatreally set the system apart for use in CNC machining. Under CNC Machining, machine tools function through numerical control. A computer program is customized for an object and the machines are programmed with CNC machining language (called G-code) that essentially controls all features like feed rate, coordination, location and speeds. With CNC machining, the computer can control exact positioning and velocity. CNC machining is used in manufacturing both metal and plastic parts. Inspiring from this CNC technology and revolutionary change in the world of digital electronics & Microcontroller, we are presenting here an idea of "Arduino Based CNC Machine Controller". The idea behind this project is to make a small two Axis, CNC router which can engrave 2D and Gray scaled images or pictures with help of high watt burning laser module on surface which can be a paper, wood, leather, plastic, foam etc. It uses two stepper motors as linear actuators on each axis X, Y. The brain behind the system will be AVR ATMEGA 328 Based control unit with Arduino programming structure. Arduino is today's most popular open source hardware prototyping platform. Arduino will receive the G-Code over serial port from the G-code interpreter& sender utility tool running on PC and will give the actuation commands to the stepper motor controller.

II. METHODOLOGY

The CNC 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 operation.

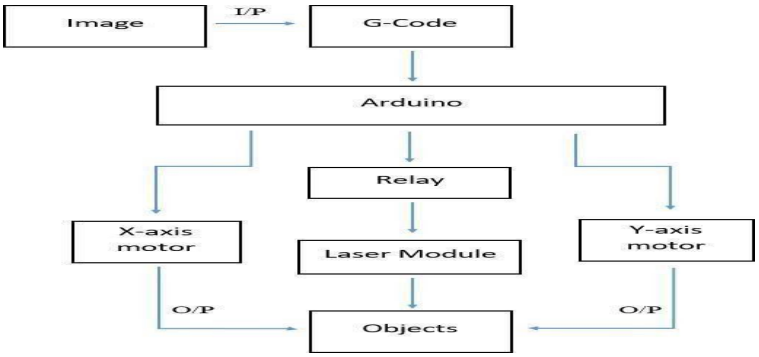


Fig.1: Block diagram of CNC based laser engraver

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A. Arduino UNO Microcontroller

Arduino Uno is a microcontroller board base on ATmega328. It has 14 digital I/O pins and 6 analog input pins. Out of the 14 pin, 6 I/O pins can be used as PWM outputs. Arduino Uno is an advanced microcontroller that used as the learning kit for building devices Arduino Uno microcontroller supports the C and C++ programming language which has been learn during last few year. . It is easy to upload a program inside the microcontroller compare to the traditional microcontroller. With Arduino, user can directly write the coding inside it with just a laptop that done Arduino software installation and an USB cable.

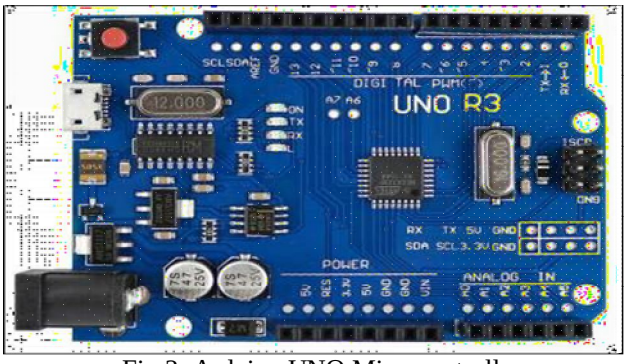


Fig.2: Arduino UNO Microcontroller

B. Motor Driver Shield

L293D shield is a driver board based on L293 IC, which can drive 4 DC motors and 2 stepper or Servo motors at the same time. Each channel of this module has the maximum current of 1.2A and doesn't work if the voltage is more than 25v or less than 4.5v. So be careful with choosing the proper motor according to its nominal voltage and current. For more features of this shield let's mention compatibility with Arduini UNO and MEGA, electromagnetic and thermal protection of motor and disconnecting circuit in case of unconventional voltage raise.



Fig.3: 1293d motor driver shield

C. LASER Module

Laser engraving module is made of high quality aluminum and rubber material, which is not easy to deform, durable for a long time use. In AliExpress, you can also find other good deals on module! You can shop for laser engraver module at low prices. You can use the filters for free return of laser engraver module



Fig.4: Laser Module

D. Arduino IDE Software

The Arduino IDE software is open source which allow user to download the software through the IDE official website. The setup of Arduino Uno is simple. Once finish download and installed in the computer, the Arduino Uno microcontroller can be connected using the USB cable to power it. One external file, grbl required add on the Arduino IDE software before uploading the code to the microcontroller. The grbl library file contains coding to functions the CNC machine which is open source file.



Fig.5: Arduino IDE Software

III. IMPLEMENTATION

The laser Engraving is to engrave a specific picture or logo on a selected material. Put the image which is to be engraving into the software, Software generates G code for relative image. then it is send to microcontroller ATMEGA328. The arduino can be programmed with arduino software (IDE). Stepper motor drivers, laser driver will move according to the signals specification and laser starts to engrave on the object.

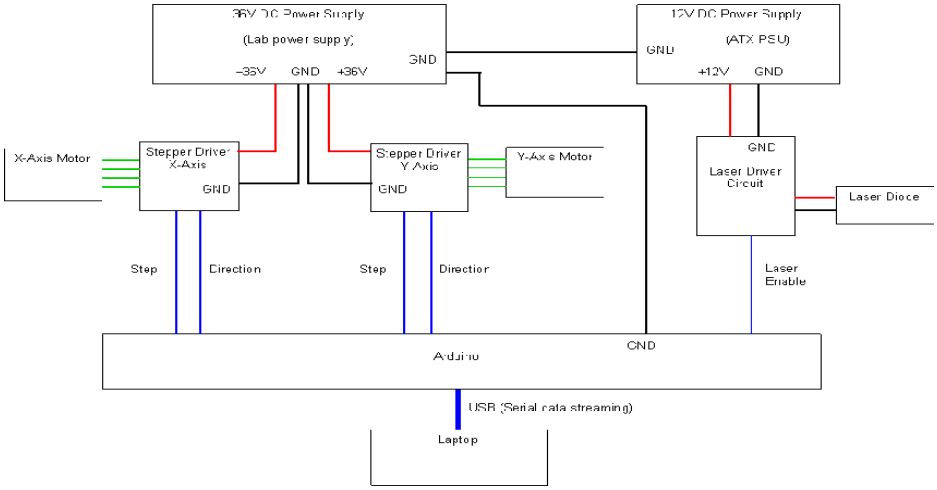


Fig.6: Circuit connection of CNC based laser engraver

IV. FLOWCHART

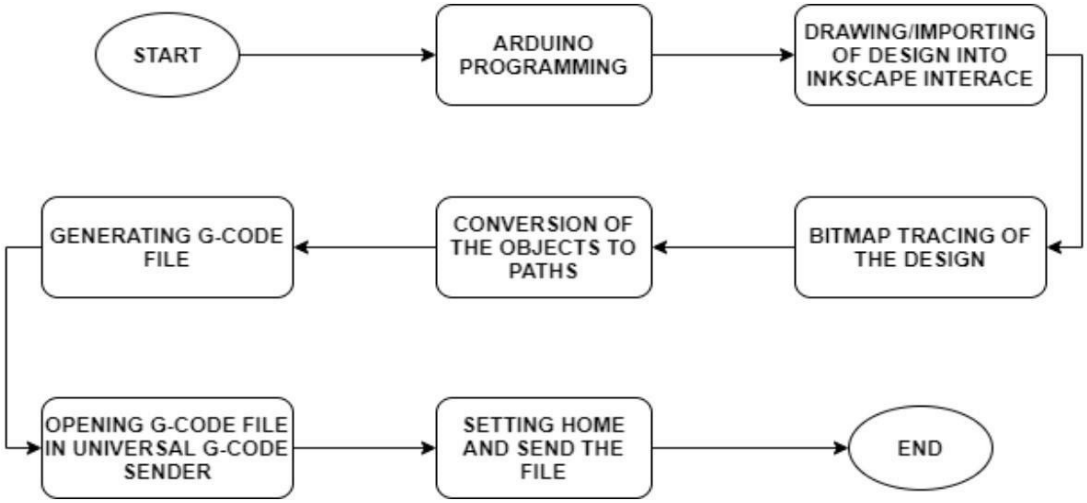


Fig.7: Flowchart of CNC based laser engraver

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V. RESULTS

Designed the laser engraver to engrave a specific picture or logo on a selected material.

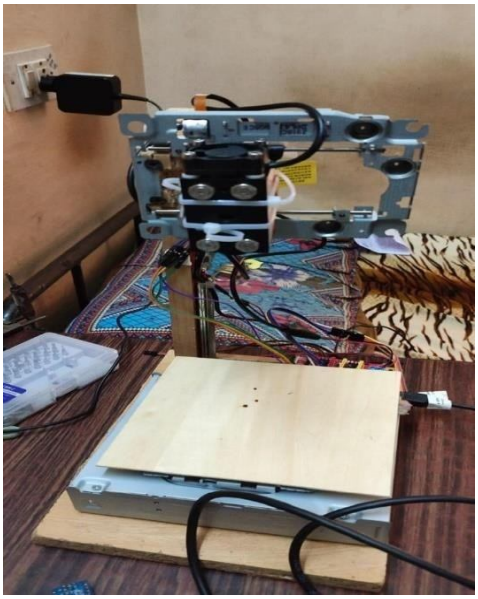


Fig.8: CNC based laser engraver Hardware module

A. Design Steps

1) Put the image which is to be engraving into the software.
2) Software generates G code for relative image. then it is send to Microcontroller-ATMEGA328.
3) The arduino can be programmed with arduino software (IDE).
4) Stepper motor drivers, laser driver will move according to the signals specification and laser starts to engrave on the object.

B. Engrave a Image

Original image firstly imported to the Inkscape software and traced into Bitmap. Once done tracing the image, the image then been created a path for the image and exported as a gcode format file. The gcode file then open using Universal G-Code Sender to perform drawing.



Fig.9(a): Original import image (Square)

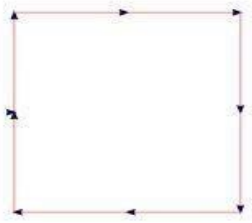


Fig.9(b): gcode file image (Square)

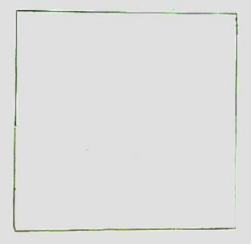


Fig.9(c): Engraved image (Square)

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VI. CONCLUSIONS

By using CNC controllers, there is a remarkable increase in the quality of products as well as it offers high flexibility. It increases the productivity and reduces the lead time. This collaboration of hardware with G-code & M-code gives better productivity and reduces the work load.G-code & M-code make easy to find the information of locations of all stepper motor moving, as the status of our moving moter are directly seen on computer. Making a small machine brings a flexibility to do work and also decrease the cost of making prototypes, make it useable for cutting paper, polystyrene and thin sheets.

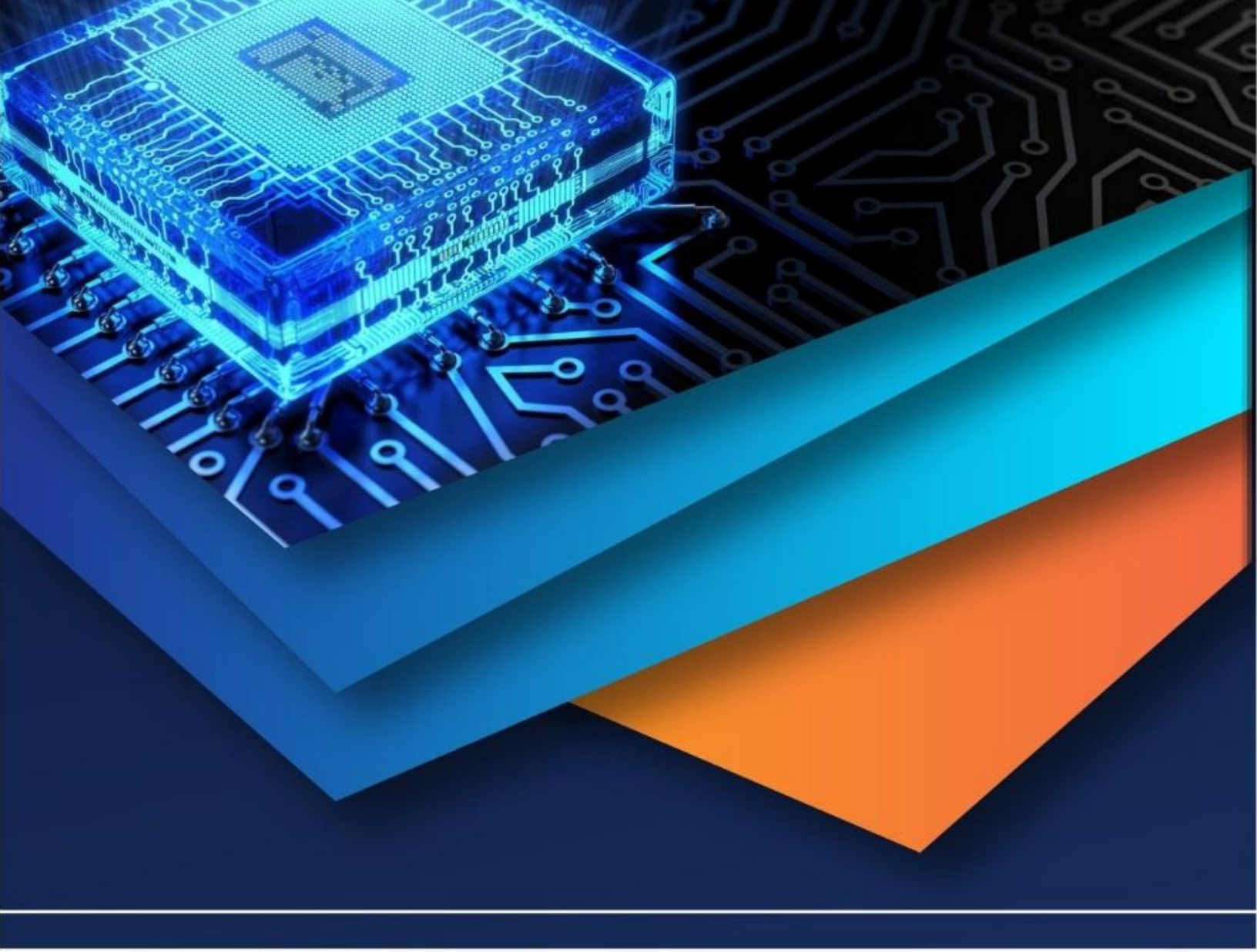
VII. ACKNOWLEDGMENT

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