MULTI TOOL CNC STATION

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ABSTRACT

There has been a high increase in demand of customized mechanical parts in recent years and in upcoming years the demand will rise to a further extent. Considering these demands and using CNC technology we have came up with a "multi tool CNC station" where the demand of customers are fulfilled and the costing is lowered. On this station multiple tasks can be performed on a single platform and the need for multiple stations is reduced to one. Traditionally all CNC systems have been standalone system. But we have developed a system where all these CNC tasks are performed on a single station and the space and costing for the station is reduced. As per traditional CNC machines required huge space for a single setup and cost of it would go higher in terms of setup of all the CNC tools (for eg: a 3-D extrusion setup requires around 1 lakh rs., laser engraving setup requires the same amount. Thus making it huge sum). This makes the traditional system unaffordable and useless at prototyping stages.

Therefore, as per increasing demand in multitasking systems which can reduce the space and cost constraints we can also save valuable resources and develop a cost effective multi tool CNC station.

Keywords—Multi tool CNC, 3Dprinter, laser engraver.

INTRODUCTION

Cheng-Tiao Hsieh has developed a system in which 3D printer and laser engraver are fixed [1].This system is only used for two methods.E. Canessa, C. Fonda, and M. Zennaro developed low cost 3D printer with better printing quality[2] .The multi tool CNC station provide carriage on which multiple tool can mount like 3d printer, laser, milling tool, drilling tool. The Multi Tool CNC Stations are used for performing various tedious manual jobs on a single platform with highest accuracy using CNC computing. Additionally, these systems can be used for small-scale manufacturing.

Nowadays 3-D printing has became a DIY task due to cost-effective hardware and low space utility design of 3-D printers. In early CNC setup the machines were huge and required a lot of space and every machine had a specific set of intruction to be performed. The multi tool CNC

has compacted this design and now every intruction that required a specific machine and room, is allocated in a single machine and its carrrier. In multi tool CNC station there is a single carrier which is placed at a fixed point, there are integrated tools which can be mounted and dismounted on the carrier. For eg: 3-D printing and Laser engraving.

Traditionally all prototyping was done using standalone system i.e. a different setup for every specific operation like extrusion, drilling, milling, laser engraving, etc. this process gets very complicated in case the parameter are to be changed frequently. Also the availability of all the required tools sometimes becomes an issue. In multi tools CNC we can change the tools as per requirement.

3-D printer is based on a additive manufacturing technology. For 3-D printing we use FDM (Fuse diffusion modelling) technique in which filament is unwound from a coil and supply to the nozzle head which heatsup to a melting point of filament and deposit the filament layer by layer according to the G-code (which gives x,y,z positions) and builds the object. The filament used for 3-D printing is ABS and PLA. For the bed leveling we use proximity sensor. The sensor is used to detect the location of the bed i.e: z=0. We use CURA 2.7 and SCAD as a software tool for 3-D printing and INSCAPE for laser engraving.

Furthere sequence followed by methodology,3D printer, inductive proximative sensor, cura software, laser engraving.

METHODOLOGY

The multi tool CNC setup consist a modular carriage mounted on a 3-axis (Cartesian) moving setup using NEMA 17 bipolar stepper motors. The board used for controlling the whole setup is MKS GENv1.4 board. The board is a general purpose breakout board which is specially designed for 3-D printers but can be also used for other applications too.

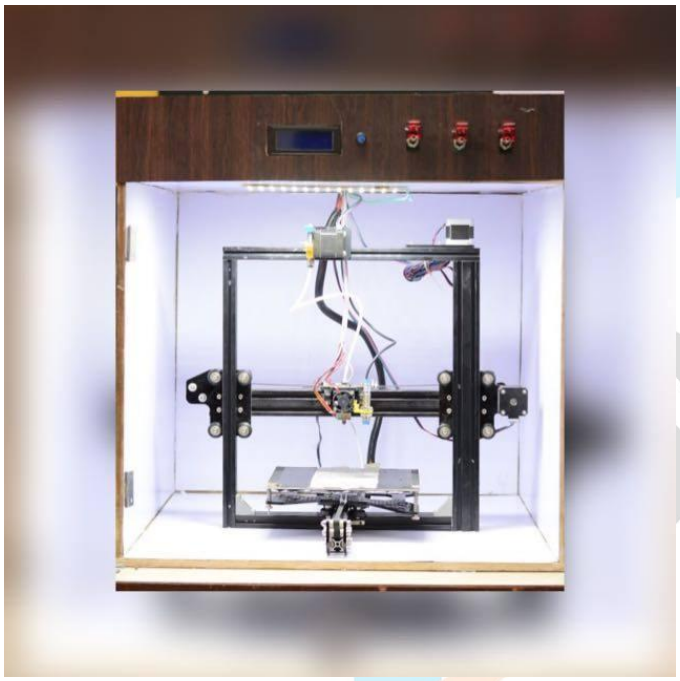

FIGURE 1. Multi tool CNC station

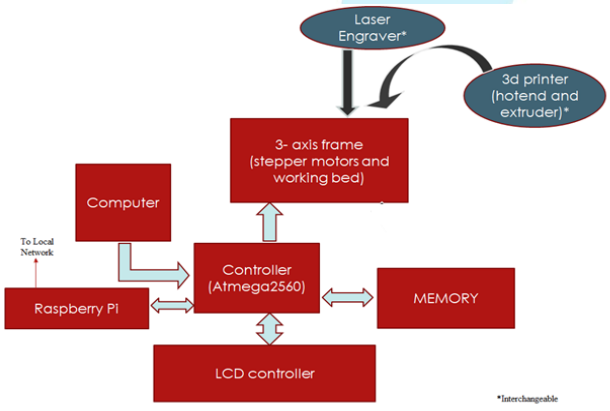

FIGURE 2. Block diagram of multi tool CNC

The multi tool setup consists of a modular head which helps in easily interchanging the modular tools specifically designed for the setup. The modular carriage is mounted on a 3-axis (cartesian) moving setup using NEMA 17 bipolar stepper motors. The whole setup is controlled using MKS GENv1.4 board. This is a general-purpose breakout board which is specially designed for 3d printers but can be configured for other applications too. A computer may or may not be connected to the setup. A computer can be used to directly print and monitor jobs although the setup can work even in the absence of a computer. A single board computer (raspberry pi) is used to provide the setup with its own computer rathe1r than dedicating a laptop or pc for the job. Also, the raspberry pi can be connected to the local network for remoted control. The jobs can be monitored using the camera connected to the raspberry pi. The setup also has a smart LCD controller to control the system in real time. As mentioned above ,we used computer to build 3D objects in software like CAD and it is given to the computer. There are different methods to give input to the controller like raspberry pi or we can store different designs into the memory card. And whenever required we can print the object using LCD control.

LCD control has command over all the processes. LCD control is to control the temperature of extruder to selection of material to print. Like PLA material requires 210 degree Celsius and for ABS it is 240 degree Celsius. The knob on the LCD control used to select different designs from memory card. If we have to pause the printing in-between we can do it and resume it whenever we want. Also we can control axes of CNC, so that we can make perfect alignment of all three axes.

The 3 axes frame is designed so that we can mount any tools on it including extruder. In our project we are combining 3D printer, laser engraving, milling, drilling etc.(multiple tools). So that our frame has mobility to do multiple task. The whole process can be monitories using raspberry pi camera so that the user need not to stand there while printing the object.

3-D Printer

The 3-D printer design is based on Fused Deposition Modeling (FDM)[1] which uses hotend to heat up the filament deposited on the bed layer by layer until a part is completed. Position of x,y,z axes are provided by the G-code. A FDM machine always requires critical conditions to obtain the high quality printed parts. To maintain the quality of printed part we develop a enclosure for the entire setup. We use proximity sensor for auto bed leveling i.e. If the thickness is too large it will cause the printed part a trouble to stick on the bed and If the thickness is too small it will stop the melting filament flowing out from the nozzle. The height of the touch probe is usually lower than that of the nozzle during auto bed leveling process. The sensor is used to detect the location of the bed i.e. Z=0. The inductive proximity sensor is treated as the end stop on z axes. The sensor has four wires and is controlled by the Arduino. we used cura 2.7 and SCAD for making objects as software tools. cura is a 3D printer slicing application (G- code). The filament used in 3-D printing are ABS(Acrylonitrile butadiene styrene)[2] and PLA(Polylactic acid)[2] which are degradable. Temperature for ABS (240 deg.celcius) and for PLA(210 deg.celcius).

Inductive proximity sensor

It is used to detect the presence of nearby metal objects. The sensing range of an inductive proximity sensor depend on the type of metal. The inductive sensor consist of induction coil which generates the magnetic field. Initially current through coil is minimum, but as any conductive material comes in contact with magnetic field current through coil increases. This current value changes with conductivity of material.

Cura 2.7

Cura 2.7 is used for slicing of the 3d object. Here we can also change the dimensions of the object and also select the speed of printing, infill quantity and it also provide the support for the object if necessary.

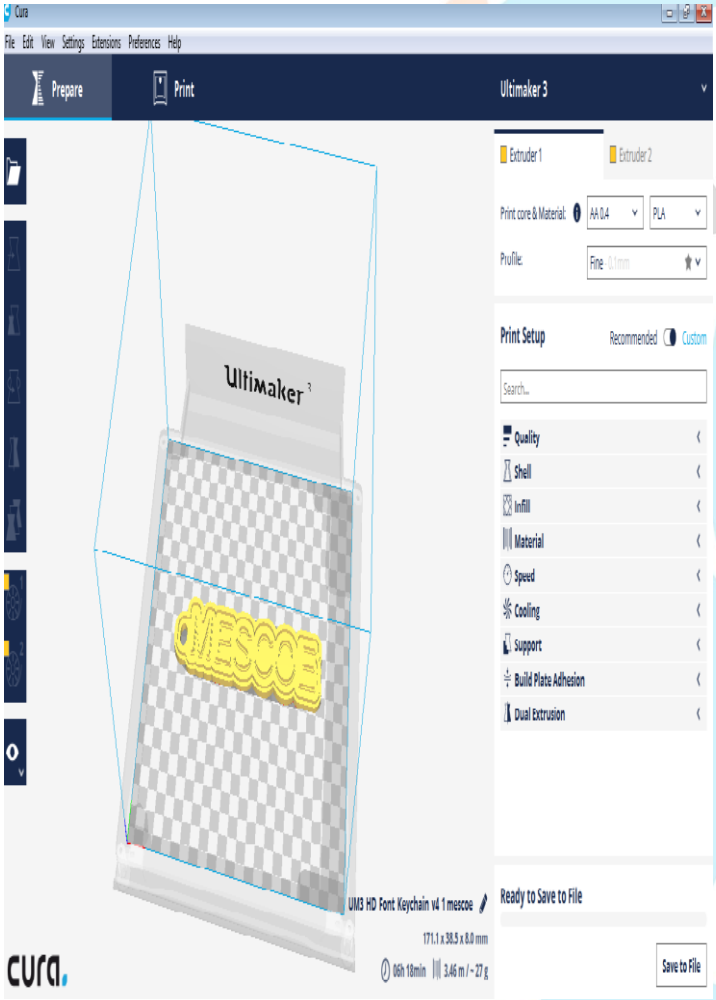

FIGURE 3. cura software

The design flow of 3D printer shows step by step execution of creating 3D object. it start with creating 3D object using CAD software then it requires to convert into 3D printer compatible format. Once the 3D printer get starts all axies are alline (x,y,z) and setting the temperature of extruder and bed and run .stl file using marline OS .

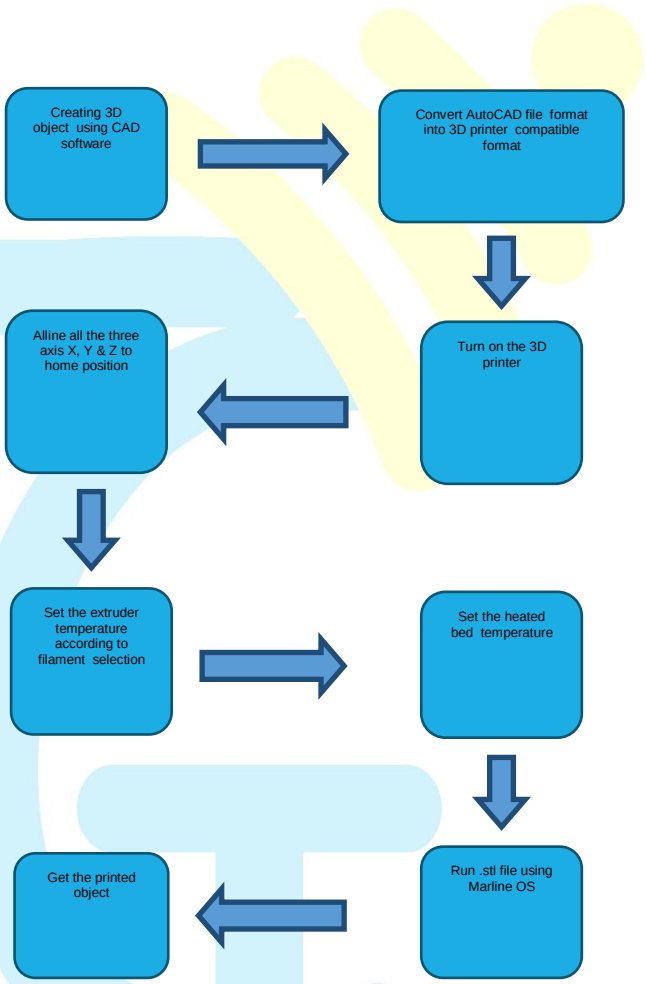

FIGURE 4.Design flow of 3D printer

Laser engraving

FIGURE 5. Laser with Laser mount

Within these couple of years laser technology was developed very successful and rapidly. Its applications are widely in various fields like medicine, science ,military and industry[1]. The laser used is 405nm wavelength and of 1000mW. As the size of the wood changes focal point of laser change with it. We generate the executable code using INSCAPE software. INSCAPE is a free and open source vector graphics editor. It can be used to create or edit vector graphics such as diagrams, line arts, logos and complex paintings.

FIGURE 6.Engraved object

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