Interchangeable CNC Milling With 3D Printing Machine

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Abstract- *New methodology for 3D machining process by CNC milling or 3D printer, in order to optimize the finishing of metric surface obtained from point clouds that generated by 3D scan using stereo-photogrammetry. Based on the final parameters of the milling cutter or extruder, we developed an application of algorithms directly on the point clouds without going through triangulation, using B-spline interpolation, avoiding "polyhedral conformation" of the result. This methodology is tested on the reproduction of an ornamental panel of the roshan element as a complementary technique for heritage conservation.*

Keywords- CNC-Milling; NURBS Modeling; B-Spline interpolation; 3D printing.Cultural heritage; Reverse engineering; The roshan; ; stereo photogrammetry; Rapid Prototyping;

I. INTRODUCTION

In modern world we required small parts but precise and compact machinery which can be used for different purpose but give same accuracy as big one. It is possible by using latest technology and changing of controlling system but first we have to understand what is CNC Milling and 3D Printing.

CNC Milling is a specific form of computer numerical controlled (CNC) machining. Milling itself is a machining process similar to both drilling and cutting, and able to achieve many of the operations performed by cutting and drilling machines. Like drilling, milling uses a rotating cylindrical cutting tool. However, the cutter in a milling machine is able to move along multiple axes, and can create a variety of shapes, slots and holes. In addition, the work-piece is often moved across the milling tool in different directions, unlike the single axis motion of a drill.

3D Printing, also known as additive manufacturing (AM), refers to processes used to create a three-dimensional object in which layers of material are form under computer control to create an object. Objects can be of almost any shape or geometry and typically are produced using digital model data from a 3D model or another electronic data source such as an Additive Manufacturing File (AMF) file. Stereo lithography (STL) is one of the most common file types that 3D printers can read. Thus, unlike material removed from a stock in the conventional machining process, 3D Printing or AM builds a three-dimensional object from computer-aided design (CAD) model or AMF file by successively adding material layer by layer.

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CNC Milling devices are the most widely used type of CNC machine. Typically, they are grouped by the number of axes on which they operate, which are labeled with various letters. X and Y designate horizontal movement of the work-piece (forward-and-back and side-to-side on a flat plane). Z represents vertical, or up-and-down, movement, while W represents diagonal movement across a vertical plane. Most machines offer from 3 to 5 axes, providing performance along at least the X, Y and Z axes. Advanced machines, such as 5-axis milling centers, require CAM programming for optimal performance due to the incredibly complex geometries involved in the machining process. These devices are extremely useful because they are able to produce shapes that would be nearly impossible using manual tooling methods. Most CNC Milling machines also integrate a device for pumping cutting fluid to the cutting tool during machining.

II. LITERATURE REVIEW

D P S pranav [01], proposed a method to re-use old computer parts that should be easily accessible to make an affordable CNC/3D printer. 3D printers are commercially

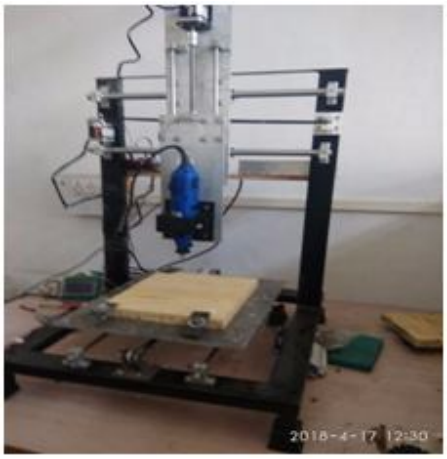
available and range from some tens of thousands to lakhs of rupees. In this project, the aim is to make a 3D printer for enthusiasts who are not willing to shell out a fortune for a 3D printer. CNC stands for Computerized Numerical Control and it's a method that allows computers to automate machines.

Gerald C [02],Technical progress in the open-source self-replicating rapid prototype (Riprap) community has enabled a distributed form of additive manufacturing to expand rapidly using polymer-based materials. However, the lack of an open-source metal alternative and the high capital costs and slow throughput of proprietary commercialized metal 3-D printers has severely restricted their deployment

JACOB BAYLESS [03],Current manufacturing techniques can be divided into three categories: Additive, subtractive, and deformation. Deformation manufacturing is the process of bending, stretching, or moulding a solid block of material to form a desired part. Subtractive manufacturing, such as milling, lathing, or laser-cutting, begins with a bar, rod, or sheet of material and cuts it into the desired (smaller) shape. Additive manufacturing, however, builds a part by successively adding and fusing raw material to a work piece; examples include laser sintering of metal powder, electron beam melting, and 3D Printing. 3D Printing comprises many techniques, but they all share the common feature of a print head that selectively deposits material in the required geometry, layer by layer, to build up a 3D shape.

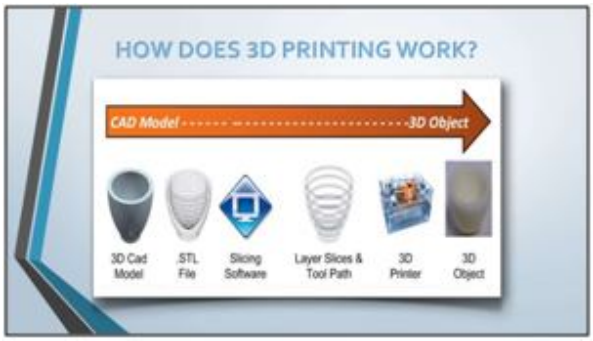
III. 3D PRINTING

Additive Manufacturing refers to a process by which digital 3D design data is used to build up a component in layers by depositing material. The term "3D Printing" is increasingly used as a synonym for Additive Manufacturing. However, the latter is more accurate in that it describes a professional production technique which is clearly distinguished from conventional methods of material removal. Instead of milling a work piece from solid block, for example, Additive Manufacturing builds up components layer by layer using materials which are available in fine powder form. A range of different metals, plastics and composite materials may be used.



3.1 Working of 3D Printer

The basic working principle of 3D printer is to print the object layer by layer fill the targeted object design and to finish the printer has a frame structure and three axis x y and z axis that moves left to right front to back and up and down. The component called extruder which is responsible for feeding the plastic to print and melt the plastic. In this way the process started with the designing object specifically a 3D object and ended with the generating the same 3D object same object in frontoureyes



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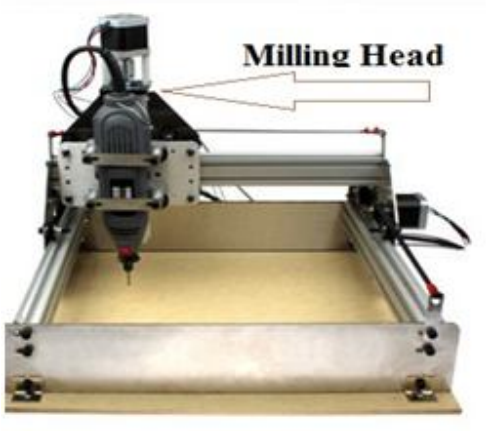
machining. Milling itself is a machining process similar to both drilling and cutting, and able to achieve many of the operations performed by cutting and drilling machines. Like drilling, milling uses a rotating cylindrical cutting tool. However, the cutter in a milling machine is able to move along multiple axes, and can create a variety of shapes, slots and holes. In addition, the work-piece is often moved across the milling tool in different directions, unlike the single axis motion of a drill.



3.3 Working of CNC Milling

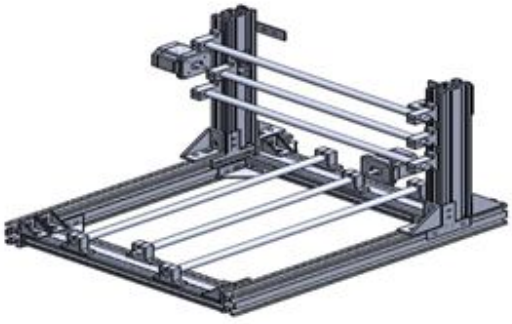
Milling is a cutting process that uses a milling cutter to remove material from the surface of a work piece. The milling cutter is a rotary cutting tool, often with multiple cutting points. As opposed to drilling, where the tool is advanced along its rotation axis, the cutter in milling is usually moved perpendicular to its axis so that cutting occurs on the circumference of the cutter. As the milling cutter enters the work piece, the cutting edges (flutes or teeth) of the tool repeatedly cut into and exit from the material, shaving off chips from the work piece with each pass. The cutting action is shear deformation; material is pushed off the work piece in tiny clumps that hang together to a greater or lesser extent (depending on the material) to form chips.

3.3 Base Frame

A frame made from rectangular and square stainless steel tubes.

The frame is composed by 11 stainless steel parts (for dimensions consult the 3d open design).

- Four rectangular tubes on the bottom of the chassis
- Four square tubs positioned vertically
- Three rectangular tubes on the top frame



3.4Arduino

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board

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IV. SOFTWARE

Now that you have a background on the electronic hardware, the steps of 3D Printing software can be introduced. 3D Printing software allows you to create, view, and alter 3-D images, converts the image into instructions for the printer, and "slices" the file into horizontal pieces that the printer will understand the printer deposits plastic in horizontally. The workflow for turning an idea into a 3D print can be summed up as creating a model, slicing, and printing. At each step, there are multiple software solutions to choose from. In general, for 3D Printing software can be broken down into 3 different areas, CAD tools, CAM tools, and firmware for electronics.

4.1 CAD Tools

Computer Aided Design, or CAD, tools are used to design 3D parts for printing. CAD tools allow you to easily change and manipulate parts based on parameters. One of the techniques used in solid modelling CAD tools is called Constructive Solid Geometry, or CSG. Using CSG, parts can be represented as a tree of Boolean Operations performed on basic shapes such as cubes, spheres, cylinders, and pyramids to create complex surfaces

4.2 CAM Tools

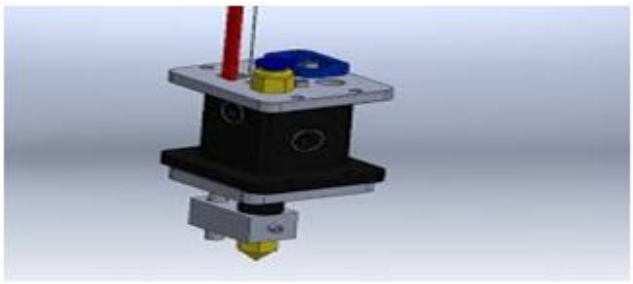
The next step in the software process is using Computer Aided Manufacturing, or CAM, tools to translate CAD files into a machine-friendly format used by the 3D printer’s electronics. In order to turn a 3D part into a machine friendly format, CAM software needs an STL file. The machine friendly format that is used for printing is called G-code. G-code tells the printer where to move the print head and when to extrude plastic, by creating a list of commands that will adjust the acceleration of the motors. This is one of the most critical phases because of its careful balance between quality, speed, and amount of filament used.

4.3 Interchangeable Head

4.3.1 3D Printer Extruder

The extruder of a 3D printer is the part of the printer that does the actual printing; it can be likened to the print head of a typical inkjet printer in that it moves back and forth to deposit the material. The extruder is typically made of two main parts: the extruder body and the hot end.

The extruder body can look very different depending on the printer. Most off the shelf printers use a direct drive system where the extruder stepper motor directly drives the plastic filament into the hot end; these extruders typically use the smaller 1.75 mm filament. Another common extruder system uses gears to drive the filament into the hot end; these are usually found on DIY. Printers that use the larger 3mm filament.



4.3.2 CNC Head Or Spindle

In machine tools, a spindle is a rotating axis of the machine, which often has a shaft at its heart. The shaft itself is called a spindle, but also, in shop-floor practice, the word often is used metonymically to refer to the entire rotary unit, including not only the shaft itself, but its bearings and anything attached to it (chuck, etc.).

A machine tool may have several spindles, such as the headstock and tailstock spindles on a bench lathe. The main spindle is usually the biggest one. References to "the spindle" without further qualification imply the main spindle. Some machine tools that specialize in high-volume mass production have a group of 4, 6, or even more main spindles. These are called multi-spindle machines

V. APPLICATION

- In small scale industry where cost of instrument is important and also place & order quantity is low.
- For small scale replica & Prototype making Due to its high precision.
- Because of its user-friendly interference it is used for educational purpose.
- It is used to make any type of pattern model of any object
- It is used in aerospace small plastic spare parts
- It used for personal work purpose because of its simple
- Interference

VI. CONCLUSION

This project describes the design of a very low budget 3D Printer as compare to other 3D printer. In this project the 3D printer combines with CNC Milling. 3D Printing process allows the creation of parts and or tools through additive manufacturing at rates much lower than traditional machining. This project gives both the facility of 3D Printing and CNC in same machinery with simple interference, low cost and precision of 10 microns. By using Arduino control system which requires very simple programing coding after that it is ready to work. But this machine required the technical person to and continues maintenance & lubrication of its parts. Although it very useful for education purpose or house work purpose due to its advantages.

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