INNOVATIVE DESKTOP 3D PRINTING MACHINE

ABSTRACT:

3D printing is a form of additive manufacturing technology where a three dimensional object is created by laying down successive layers of material. It is also known as rapid prototyping, is a mechanized method whereby 3D objects are quickly made on a reasonably sized machine connected to a computer containing blueprints for the object. The 3D printing concept of custom manufacturing is exciting to nearly everyone.

This revolutionary method for creating 3D models with the use of inkjet technology saves time and cost by eliminating the need to design; print and glue together separate model parts. Now, you can create a complete model in a single process using 3D printing. The basic principles include materials cartridges, flexibility of output, and translation of code into a visible pattern.

3D Printers are machines that produce physical 3D models from digital data by printing layer by layer. It can make physical models of objects either designed with a CAD program or scanned with a 3D Scanner. It is used in a variety of industries including jewellery, footwear, industrial design, architecture, engineering and construction, automotive, aerospace, dental and medical industries, education and consumer products.

INTRODUCTION

The present invention generally relates to the advanced manufacturing processes. More specifically, the invention describes about the design and fabrication of an Innovative Desktop 3D Printing Machine working on the principle of Fused Deposition Modelling (FDM). The fabricated 3D Printing Machine belongs to the Desktop category and operates in normal

electrical power supply. The machine is basically developed with the objective of printing Components & parts using ABS as well as PLA Plastics.

BACKGROUND OF THE INVENTION

3D printing, also known as additive manufacturing (AM), refers to processes used to create a three-dimensional object in which layers of material are formed 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. The term "3D printing" originally referred to a process that deposits a binder material onto a powder bed with inkjet printer heads layer by layer.

3D Printing Technology is an appropriate name to describe the technologies that build 3D objects by adding layer-upon-layer of material, whether the material is plastic, metal, concrete or one day…..human tissue. Common to AM technologies is the use of a computer, 3D modelling software (Computer Aided Design or CAD), machine equipment and layering material. Once a CAD sketch is produced, the AM equipment reads in data from the CAD file and lays downs or adds successive layers of liquid, powder, sheet material or other, in a layer-upon-layer fashion to fabricate a 3D object.

3D printable models may be created with a computer-aided design (CAD) package, via a 3D scanner, or by a plain digital camera and photogrammetry software. 3D printed models created

with CAD result in reduced errors and can be corrected before printing, allowing verification in the design of the object before it is printed. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting. 3D scanning is a process of collecting digital data on the shape and appearance of a real object, creating a digital model based on it.

Fused deposition modelling (FDM) is an additive manufacturing (AM) technology commonly used for modelling, prototyping, and production applications. It is one of the techniques used for 3D printing. FDM works on an "additive" principle by laying down material in layers; a plastic filament or metal wire is unwound from a coil and supplies material to produce a part. Thus, FDM is also known as a solid-based AM technology. The technology was developed by S. Scott Crump in the late 1980s and was commercialized in 1990. The term fused deposition modeling and its abbreviation to FDM are trademarked by Stratasys Inc. The exactly equivalent term, fused filament fabrication (FFF), was coined by the members of the RepRap project to give a phrase that would be legally unconstrained in its use. It is also sometimes called Plastic Jet Printing (PJP).

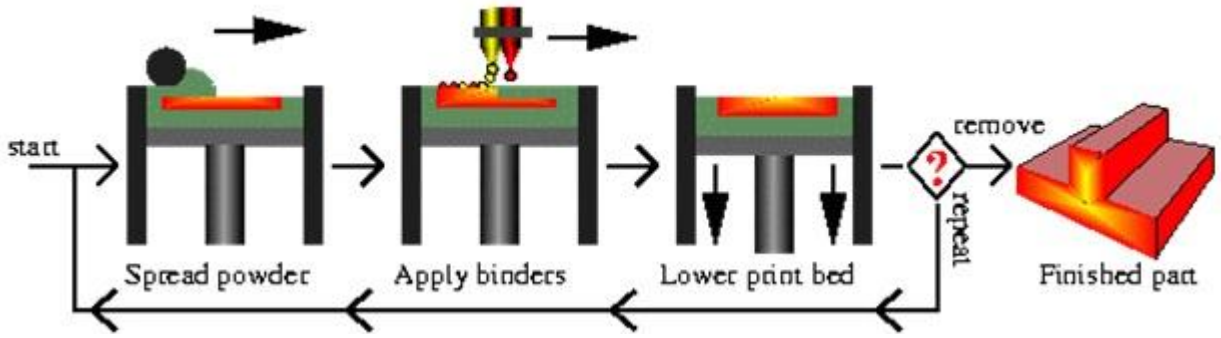
FDM begins with a software process which processes an STL file (Stereo Lithography file format), mathematically slicing and orienting the model for the build process. If required, support structures may be generated. The model or part is produced by extruding small flattened strings of molten material to form layers as the material hardens immediately after extrusion from the nozzle. A plastic filament is unwound from a coil and supplies material to an extrusion nozzle which can turn the flow on and off. There is typically an accurately controlled drive that pushes the filament into the nozzle. The nozzle is heated to melt the material. The thermoplastics

are heated well past their glass transition temperature and are then deposited by an extrusion head.

The nozzle can be moved in both horizontal and vertical directions by a numerically controlled mechanism. The nozzle follows a tool-path controlled by a computer-aided manufacturing (CAM) software package, and the part is built from the bottom up, one layer at a time. Stepper motors or servo motors are typically employed to move the extrusion head. The mechanism used is often an X-Y-Z rectilinear design, although other mechanical designs such as deltabot have been employed. Although as a printing technology FDM is very flexible, and it is capable of dealing with small overhangs by the support from lower layers, FDM generally has some restrictions on the slope of the overhang, and cannot produce unsupported stalactites.

THE ALGORITHM

The algorithm used in the Inkjet 3-D Printing is depicted in the figure mentioned below.



The workflow can be easily understood with the help of the flowchart given below.

A 3-D prototype of a desired object is created in three basic steps and these steps are:

- Pre-Process
- 3-D Printing
- Post-Process

The 3D printer runs automatically, depositing materials at layers ~.003mm Thick. This is roughly the thickness of a human hair or sheet of paper. The time it takes to print a given object depends primarily on the height of the design, but most designs take a minimum of several hours. The average cost for printing a full colour prototype is somewhere between 50 - 100 $.

3D printing has a bright future, not least in rapid prototyping (where its impact is already highly significant), but also in medicine the arts, and outer space. Desktop 3D printers for the home are already a reality if you are prepared to pay for one and/or build one yourself.

3D printers capable of outputting in colour and multiple materials also exist and will continue to improve to a point where functional products will be able to be output. As devices that will provide a solid bridge between cyberspace and the physical world, and as an important manifestation of the Second Digital Revolution, 3D printing is therefore likely to play some part in all of our futures.

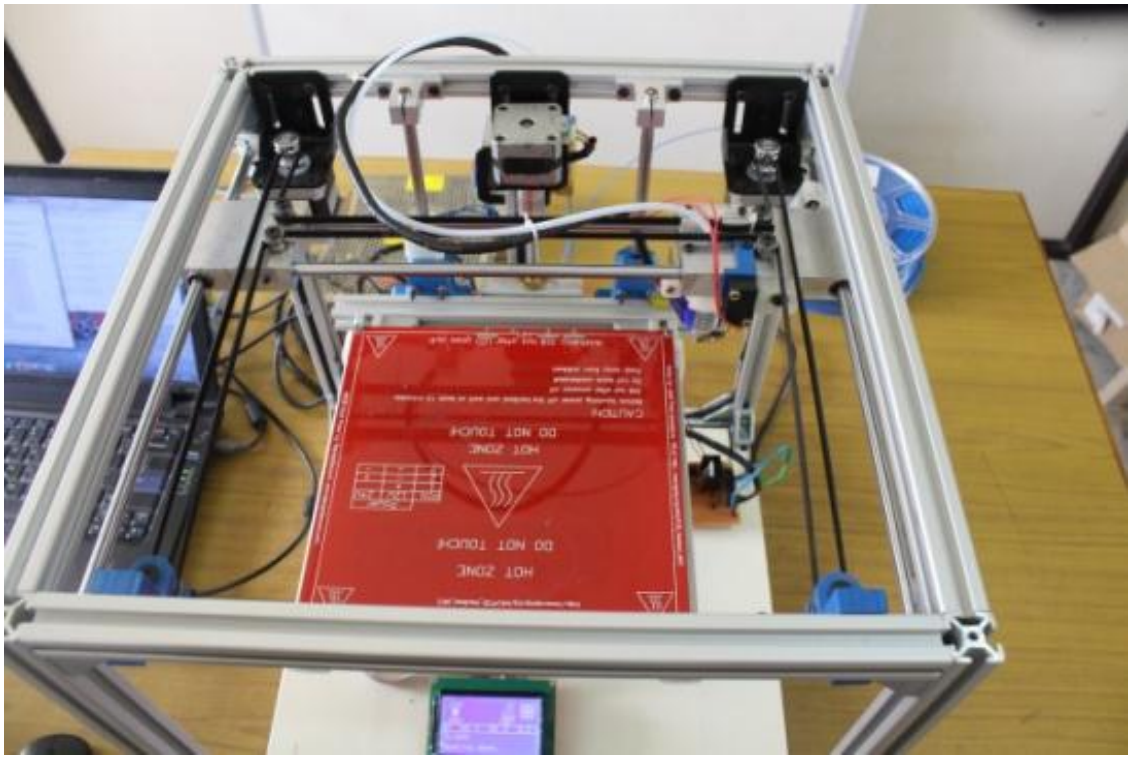
SUMMARY OF THE INVENTION

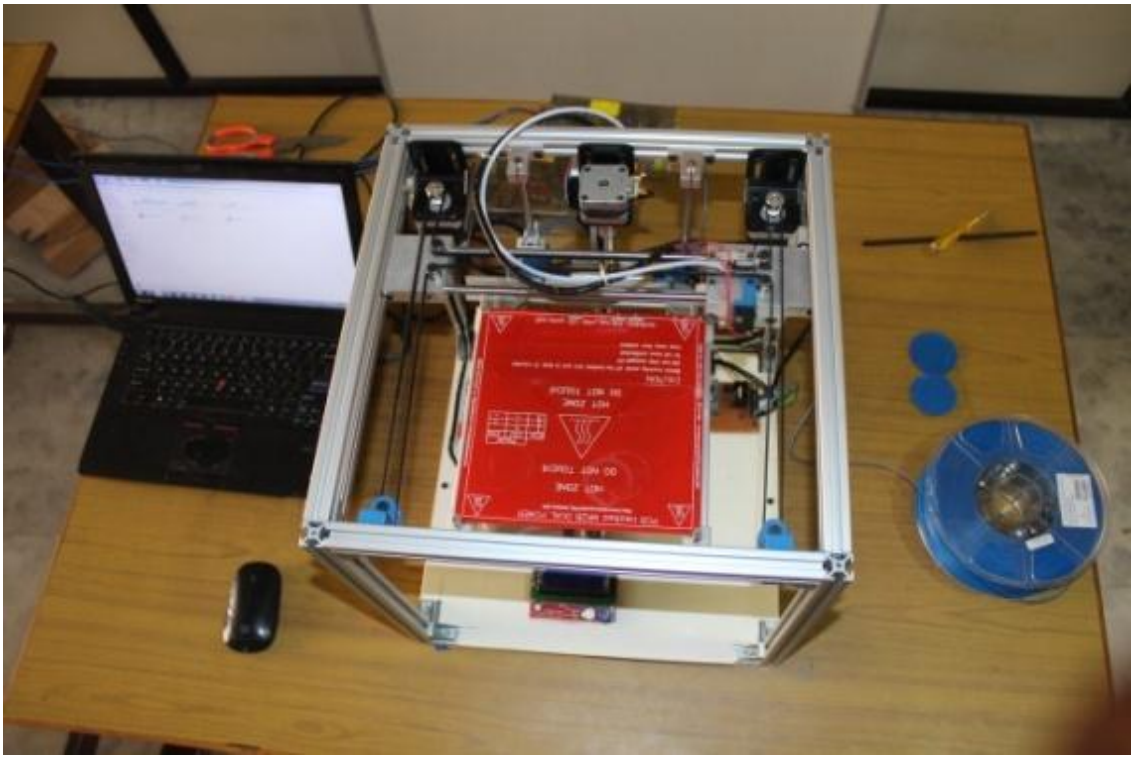
The objective of the present invention is to fabricate an cheaper & cost effective desktop 3D Printing machine with various innovative features including display of temperature, three different axis positions. An FDM based Desktop 3D Printing Machine is designed and developed to be powered by the NEMA 17 stepper motor & Arduino UNO, Nano through which millions of instructions can be given, in high level languages.

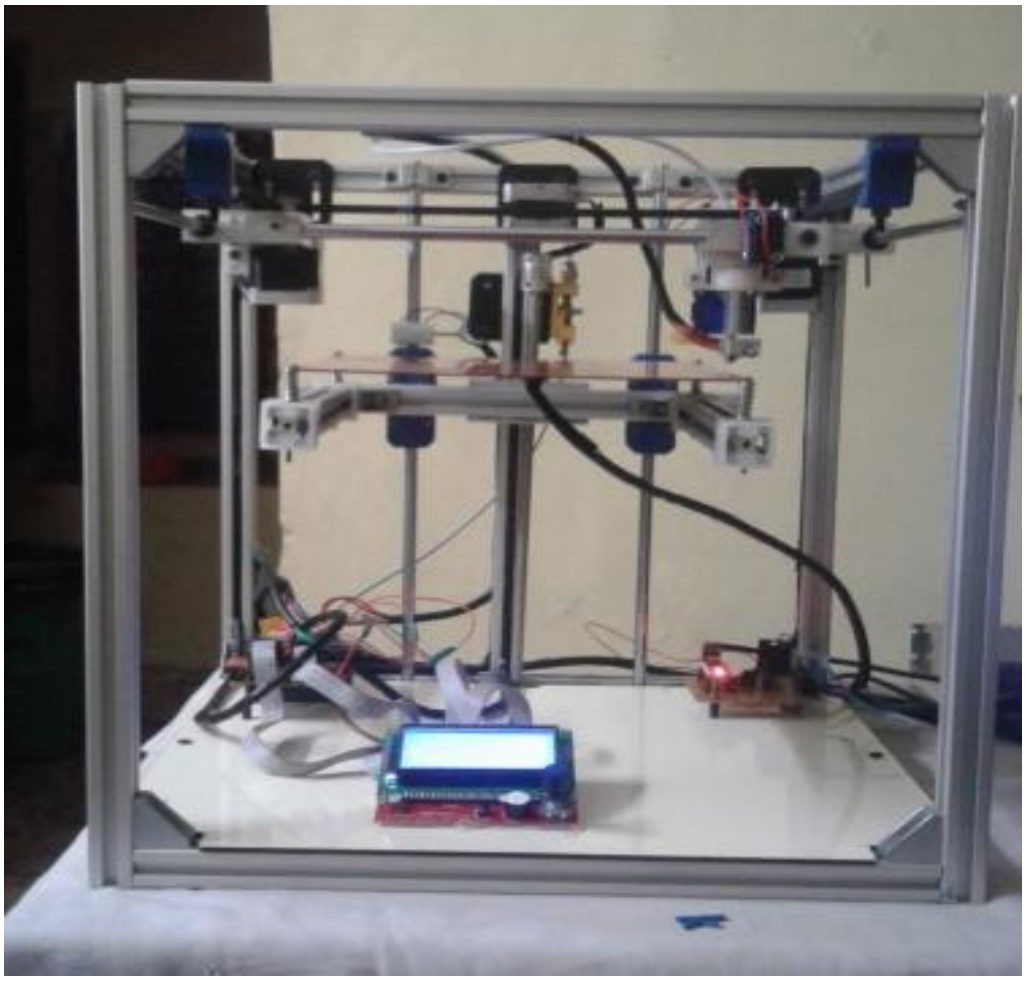
Apart from this, the FDM based Desktop 3D Printing Machine encloses two SMPS (Switch Mode Power Supply) for the purpose of converting AC into required level of DC and to provide

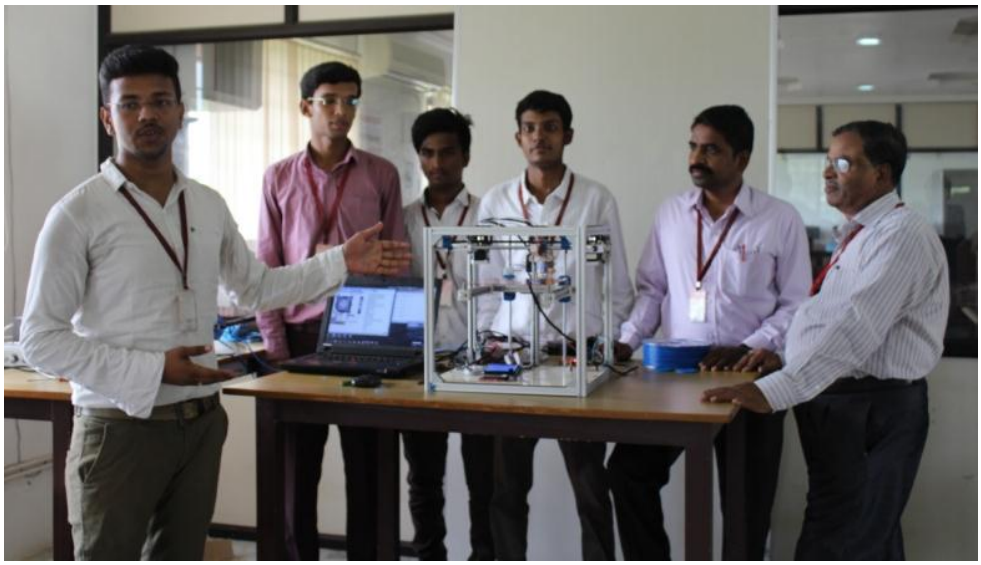
unique uninterrupted power supply. Each SMPS is of different capacity. One SMPS (12V), which powers the Arduino UNO unit and another SMPS (24 V) is connected to the heat bed. Heat beds serve the purpose of dramatically improving the print quality of the 3D Components by keeping the extruded plastic warm and thus preventing warping. The FDM based Desktop 3D Printing Machine comprises of an MK2A type PCB heat bed (110mm x 110mm), due to their great performance and affordability. This particular heat bed has 2 integrated LEDs and an integrated resistor which makes it rather 'plug and play' when compared to other solutions. The heat beds can be simply, cleanly installed & removed due to the additional modification of providing 5 holes for levelling and installing them.

Another innovative feature of the FDM based Desktop 3D Printing Machine is that, the extrusion nozzles are fitted with fins. These fins serve the purpose of dissipating heat in an easy manner. Apart from this, the display screen (monitor) powered by Arduino Uno, serves the function of displaying the variations in the operating temperature (from time to time), positions of the extruder nozzle in three different axes namely, X, Y & Z axis. The entire structure of the FDM based Desktop 3D Printing Machine was supported by means of light weight aluminium frames and the flexible movements of the extrusion head are enabled by means of a movable fixture attached to the shaft carrying the extrusion head unit.


HOT ZONE
DO NOT TOUCH







CENTRE FOR SMART AND ADVANCED MATERIALS

Academic Year 2016-2017

PROJECT MEMBERS DETAIL:

PROJECT OUTCOME:

S.No	Name of The Project	Lab Utilization	Student Participated in the Project
1	Innovative 3D Printing Machine	drilling, lathe, professional tool kit, Aurdino board	Kalyanavardhan K G Gautham N Kalaiarasan S P

Patent Filed

1. FDM based desktop 3D printing machine with core X-Y mechanism & axis position display - E-2/3696/2017-CHE E-3/27994/2017-CHE and E-5/1467/2017-CHE