CNC Based 3D Printer using Arduino

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ABSTRACT

This is a research paper on 3D printing which has become a notable topic in today's technological discussion. In this paper, we will look at additive manufacturing or 3D printing. We will firstly define what we mean by this term and what is so significant about it. We will delve a bit into the history. Then we shall see about the process of 3D printing and the materials used in the manufacture of 3D printed objects. We shall also see the advantages of 3D printing as compared to conventional methods of manufacturing. We shall observe the numerous applications it is being out to use today. Finally the future potential of this technology is outlined.

Keyword : - *3D,CNC ,Printing, FDM, RepRap, Modeling .*

1. INTRODUCTION

3D printing or additive manufacturing (AM) is any of various processes for making a three-dimensional object of almost any shape from a 3D model or other electronic data source primarily through additive processes in which successive layers of material are laid down under computer control. A 3D printer is a type of industrial robot.
Early AM equipment and materials were developed in the 1980s. In 1984, Chuck Hull of 3D Systems Corp invented a process known as stereo lithography employing UV lasers to cure photopolymers. Hull also developed the .STL file format widely accepted by 3D printing software, as well as the digital slicing and infill strategies common to many processes today. Also during the 1980s, the metal sintering forms of AM were being developed (such as selective laser sintering and direct metal laser sintering), although they were not yet called 3D printing or AM at the time. In 1990, the plastic extrusion technology most widely associated with the term "3D printing" was commercialized by Stratasys under the name fused deposition modeling (FDM). In 1995, Z Corporation commercialized an MIT-developed additive process under the trademark 3D printing (3DP), referring at that time to a proprietary process inkjet deposition of liquid binder on powder. AM technologies found applications starting in the 1980s in product development, data visualization, rapid prototyping, and specialized manufacturing. Their expansion into production (job production, mass production, and distributed manufacturing) has been under development in the decades since. Industrial production roles within the metalworking industries achieved significant scale for the first time in the early 2010s. Since the start of the 21st century there has been a large growth in the sales of AM machines, and their price has dropped substantially

1.1 Existing System

As the various additive processes matured, it became clear that soon metal removal would no longer be the only metal working process done through a tool or head moving through a 3D work envelope transforming a mass of raw material into a desired shape layer by layer. The 2010s were the first decade in which metal end use parts such as

engine bracket and large nuts would be grown (either before or instead of machining) in job production rather than obligately being machined from bar stock or plate. It is still the case that casting, fabrication, stamping, and machining are more prevalent than AM in metalworking, but AM is now beginning to make significant inroads, and with the advantages of design for additive manufacturing, it is clear to engineers that much more is to come.

1.2 Proposed System

A model of the object to be printed must be created in a 3D art program. Information from the model is then sent to the printer. People can create their own unique object designs or they can download designs from websites. Some companies print 3D objects for people. Some of these companies also let people create their own online store to sell objects that they've designed. A pen that creates 3D objects is available for purchase and costs considerably less than a printer. People are finding creative uses for the pen. It's an interesting device for creating three dimensional art and sculpture, although the resulting objects don't look like those created by a printer..

2. WORKING

3D printer is basically a CNC based machine, CNC stands computer numerical control it is automation of machine tools which are control by pre-programmed command in computer. 3D printer works in 3 dimensional movement i.e. X-axis, Y-axis and Z-axis. X&Y axis are responsible for the movement of the Heat end/ nozzle and Z axis is used to move the platform /Heat Bed. Working of 3D printer starts with creating a 3D model,3D printable models may be created with a computer-aided design (CAD) package or via a 3D scanner .The (Fuse Deposition Modeling) FDM method is used for printing 3D printers that run on FDM Technology build parts layer-by-layer from the bottom up by heating and extruding thermoplastic filament.

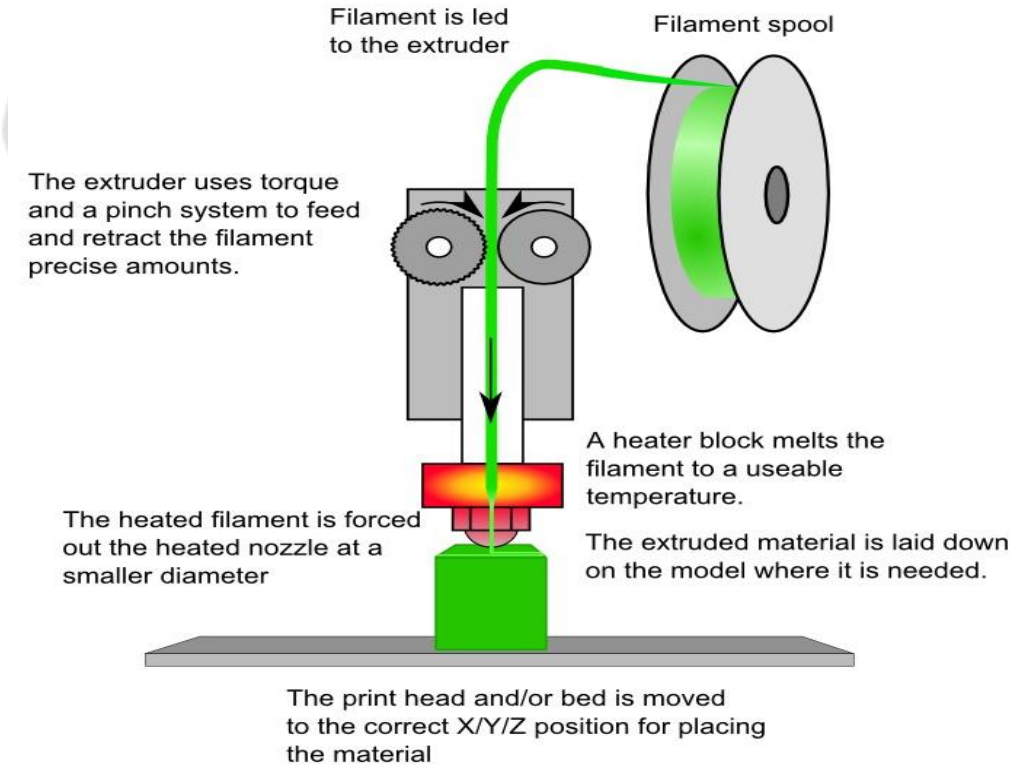

Fig -1: FDM

The process is simple:
1. Pre-processing: Build-preparation software slices and positions a 3D CAD file and calculates a path to extrude thermoplastic and any necessary support material.
2. Production: The 3D printer heats the thermoplastic to a semi-liquid state and deposits it in ultra-fine beads along the extrusion path. Where support or buffering is needed, the 3D printer deposits a removable material that acts as scaffolding.
3. Post-processing: The user breaks away support material or dissolves it in detergent and water, and the part is ready to use. Printing material used for printing the object are PLA and ABS this material is passed to nozzle through extruder to print the object. The heating point for material ranges from 175 degree to 275 degree Celsius.
A typical 3D printer is very much like an inkjet printer operated from a computer. It builds up a 3D model one layer at a time, from the bottom upward, by repeatedly printing over the same area in a method known as fused depositional modeling (FDM). Working entirely automatically, the printer creates a model over a period of hours by turning a 3D CAD drawing into lots of two-dimensional, cross-sectional layers—effectively separate 2D prints that sit one on top of another, but without the paper in between. Instead of using ink, which would never build up to much volume, the printer deposits layers of molten plastic or powder and fuses them together.

2.2 Block Diagram

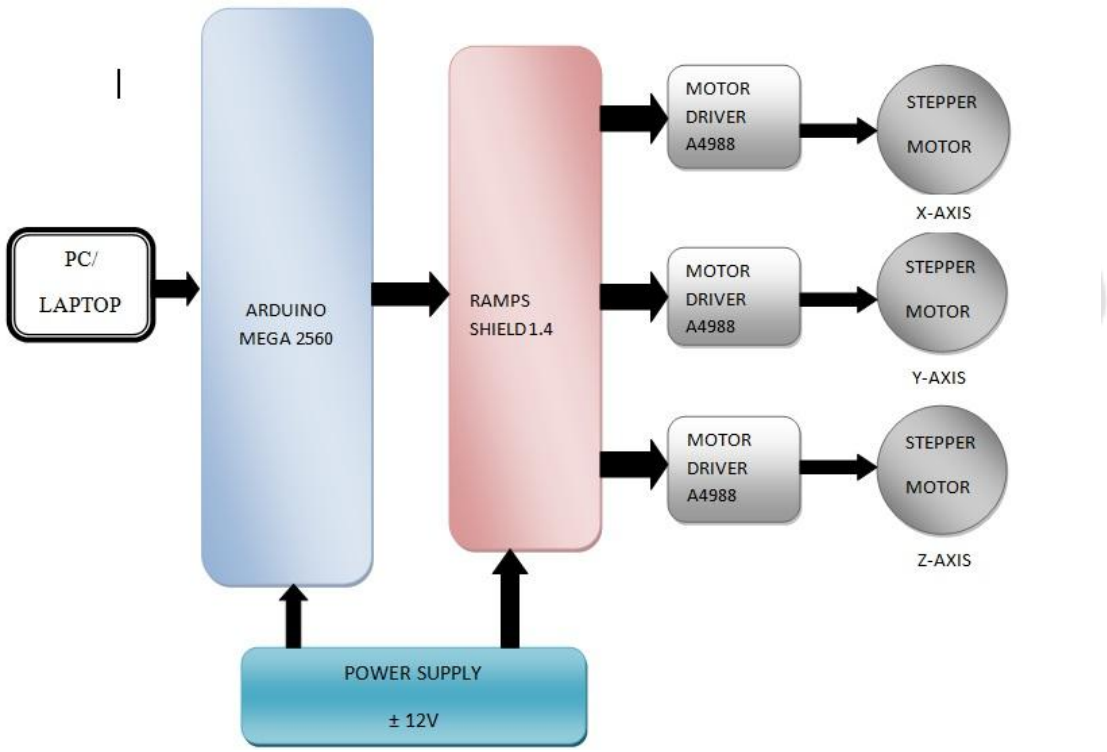

Fig -2: Block Diagram

3. SYSTEM REQUIREMENT

3.1 Hardware Requirement

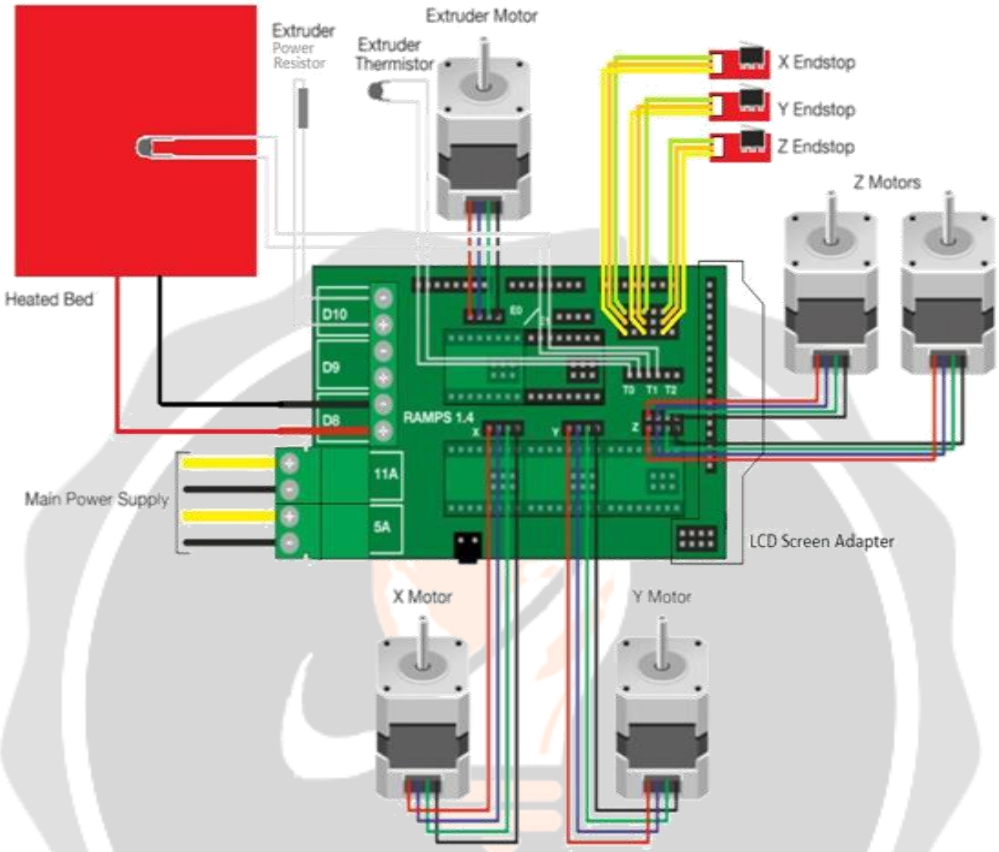

Fig -3: Circuit Diagram

Table -1: Components List

Components	Voltage	Description
Arduino Mega 2560	5V	54 digital input/output pins, 16 analog inputs, 4 UARTs, a 16 MHz crystal oscillator.
RAMPS 1.4 Shield	12V-24V	3 MOSFETs for heater / fan outputs and 3 thermistor circuits., Heated bed control with additional 11A fuse, Fits 5 stepper driver board
NEMA 17 Stepper Motor	12V-24V	The dimension labeled "length" is 38 mm. The output D-shaft has a 5 mm diameter with a section that is flattened by 0.5 mm. This shaft works with our 5 mm universal mounting hub.
E3D Hot-end	12V	In general the E3D –v6 hot-end is highly tolerant of most printing condition and is designed to accept the vat majority of filaments on the marker.

A4988 Stepper Motor Drivers	3.3V-5V	Low RDS(ON) outputs Automatic current decay mode detection, Mixed and Slow current decay modes
End stop	5V	These End Stop Switches are used to sense the endpoints on all the axis in a 3D Printer.

3.2 Software Requirement

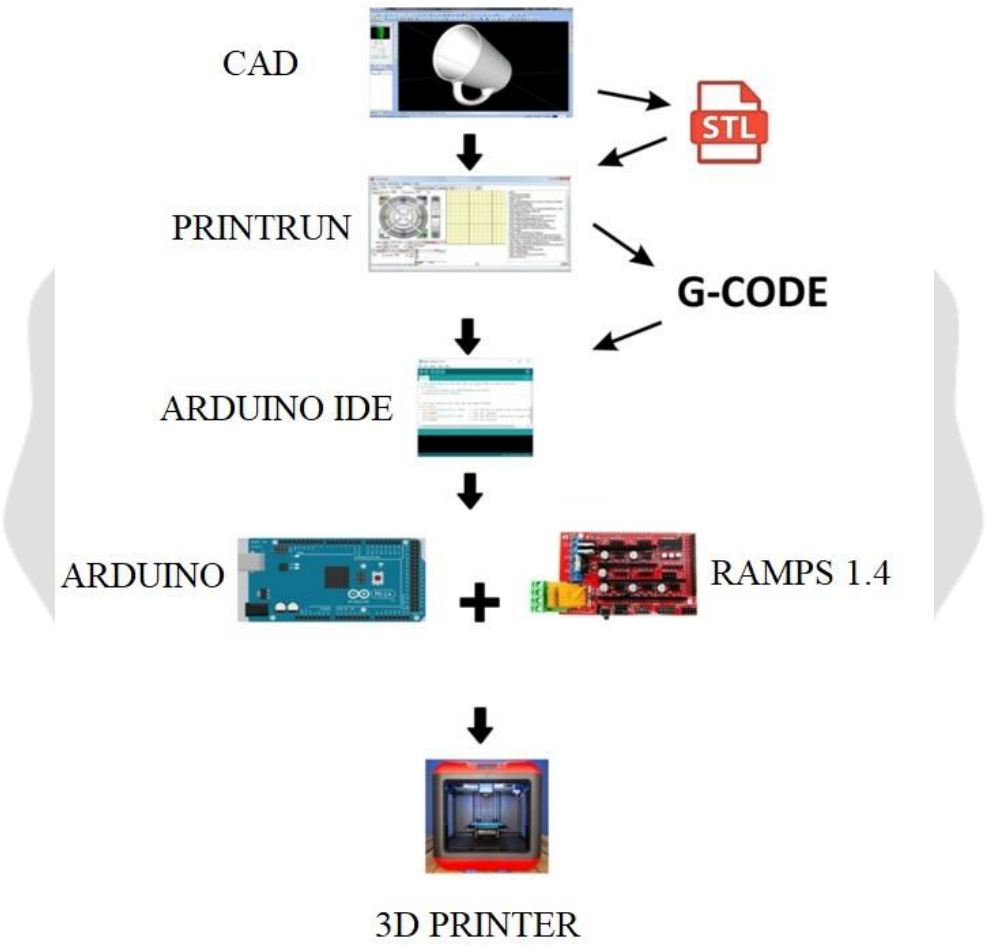

Fig -3: Flowchart

We make the 3D model of required object by using CAD software and convert it into .STL file. An STL file is a triangular representation of a 3D surface geometry.
This .STL file is opened in PRINTRUN software to convert in G-CODE file format. This G-CODE file is moved to Arduino board .The Arduino the assembled instructions to Ramps 1.4.RAMPS 1.4 controls the motor that operates the machine. Thus the machine prints the object.

4. CONCLUSIONS

The world is forever changing with the help of 3d printing. The use of 3D printing for medicinal purpose today is beyond astonishing but what the future holds is unknown, however it is certain that additive layer manufacturing will be a large corporate in solving our problems.3D printing really is limitless and only the surface has been scratched, there is still much more to be uncovered. As shown in throughout the web page. 3D printing bones is still new and continuously improving and adjusting but it has already enhanced the life of many patient around the world and more specifically in Australia. It is evident that more funding and research put into 3D printing, the further 3D printing will take us. 3D is forever unpredictable. "If a picture is worth a thousand words A prototype is worth a thousand picture."There are currently world changing application for 3D printers being developed for the future. Such development include printing edible food as well as fully functional limbs and exoskeletons. These developments, if achieved could positively affect the lives of millions of people.

This report and project has given me the opportunity to gain valuable knowledge about this exciting, growing innovation and I look forward to one day using the technology.

In conclusion, the emergence of 3D printers has made a large impact on the world today and inevitably on our future.

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