Low Cost 3D Printer

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Abstract: **The paper on 3D printer deals with Additive manufacturing, often referred to as 3D printing, has the potential to vastly accelerate innovation, compress supply chains, minimize materials and energy usage, and reduce waste.**

Originally developed at the Massachusetts Institute of Technology in 1993. 3DP technology creates 3D physical prototypes by solidifying layers of deposited powder using a liquid binder. By definition 3DP is an extremely versatile and rapid process accommodating geometry of varying complexity in hundreds of different applications, and supporting many types of materials.

I. INTORDUCTION

Nowadays, RepRap and Arduino communities have had an increasing progress. These terms are demarcated on the Open Source development model; the designs produced by these projects are released under the GNU General Public License, which promotes free universal access and distribution of it, allowing an exponential and rapid improvement.

RepRap project uses Fused Additive manufacturing (FDM) technology, term used to refer to processes that make solid objects from 3D computer models. In particular, the object is created by printing thin layers of fused plastic on top of one another.

The objectives of this philosophy are the creation of 3D printers which are capable of self-replicating and use an Open Source software for everyone. Currently, printer's control is realized by two printed circuit boards (PCB); one board is a microcontroller (Arduino) and the other contains the power electronics.

As regards of Arduino, it is an electronic platform whose purpose is having an easy-to-use hardware and software.

BLOCK DIAGRAM
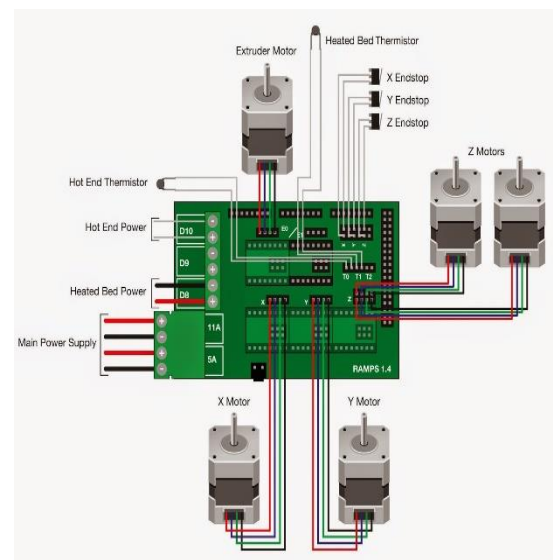
II. WORKING

CAD: First step in 3D printing is to design a digital 3D model. Which is nothing but a process of developing a mathematics representation of any surface of an object in three dimension via specialized software. Here we are using CAD (computer aided design) tool to develop such model.

Design slicing: design slicing is the process where the 3d model will slicing vertically into many layers so that the printing process will be easier. These layers will be printed one atop the other until the 3D object is done. This can done using software called slic3r. It is an open source software. The slicing consist of many parts namely

- Skirt: It is an outer boundary which is not actually a part of 3D model that we wish to print, but it is important in printing process because any unwanted previously used ink will be used to print this outer boundary so that the quality of the print can be maintained.

III. FLOW CHART
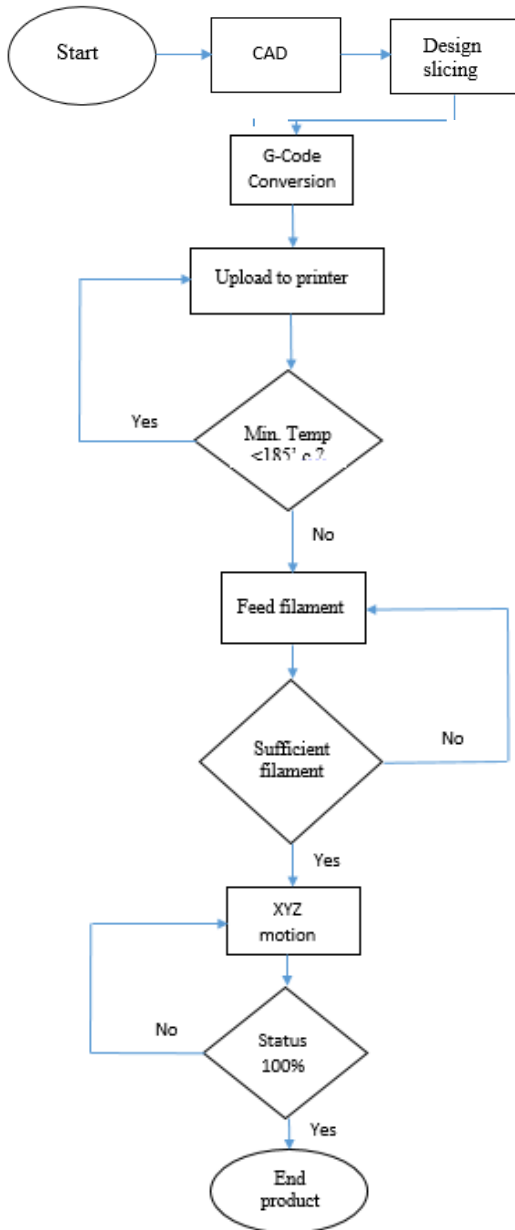
- Rafts: This can be very useful when the desired model has few parts that are in contact with the print bed. It gives good adhesion between the model and print bed.
- Brim: Brim is similar to rafts but it can be found at the outer shell of the model. It is also used for the adhesion purpose.
- Outer shell: A model must have a stronger shell. The number of layer for the shell can be defined using slic3r. Also the number of bottom and top layer can be defined using this software.
- Infill: it refers to the structure that is printed inside an object. It is extruded in a designated percentage and pattern, which is set in the slicing software. There are many types of infills such as honeycomb structure, rectilinear, line, Hilbert curve, Archimedean chords and Octagram spiral.

G-Code conversion: It is used mainly in computer-aided manufacturing to control automated machine tools. Slic3r software is responsible for conversion of 3D model into G-Code format. Arduino is very much compatible with the G-Code and controlling X, Y&Z motion. The "how" is defined by g-code instructions provided to a machine controller (industrial computer) that tells the motor where to move, how fast to move, and what path to follow.

Generally it is a code telling a machine to what type of action to perform, such as

- Rapid movement (transport the tool as quickly as possible in between cuts)
- Controlled feed in a straight line or arc.
- Series of controlled feed movement that would result in hole being boredom, a work piece cut (rooted) to a specific dimension, or a profile (contour) shape added to the edge of a work piece.
- Set tool information such as offset.
- Switch co-ordinate systems.

Upload to printer: The printer consist of both Arduino and ramps which makes 3D printing possible. The ramps 1.4 shield is mounted on top of the Arduino board. The Arduino is then connected to pronterface. Pronterface is an interfacing software which is used to upload G-code into printer and it is also used to monitor the status of the printer such as hotend temperature, motor rotation, step size etc.
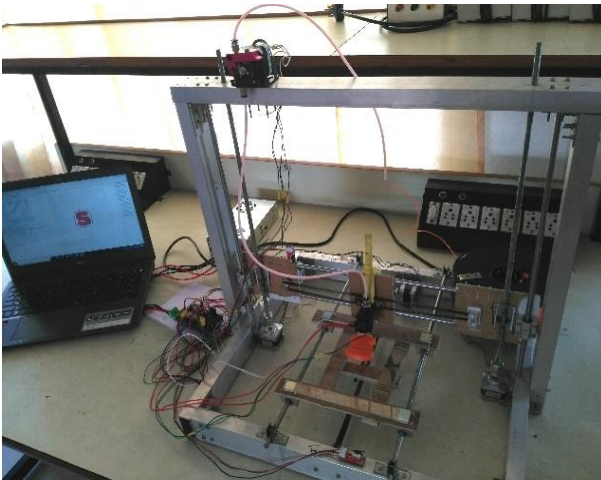
Min temp <185' C? **:** After uploading code to the printer foremost step is to check whether hotend has minimum temperature to melt the ink. Since we are using PLA filament, it requires minimum temperature of 185 degree Celsius if temperature is not met the printer will shut down automatically and wait for hotend to reach minimum temperature.

Feed filament: After reaching required temperature, extruder will feed the filament in sufficient manner. If the material fed into the hotend is not sufficient for printing, printer will wait for the more material. The extruder is composed of Stepper motor, Drive gear, Reduction gear (wade system)

XYZ motion: When the sufficient amount of temperature and filament is fed, then printer will take control over the motion of X, Y & Z motors and hotend will print the model as per the G-Code instruction. In 3D printer 5 stepper motors are needed to do the specific function, four of them are used for moving the X, Y&Z direction of the printer. Fifth one is needed for working of extruder. In pronterface window we can continuously monitor the status of the printer such as estimated time, elapsed time, and remaining time.

Status 100%: Printer will continuously check for 100% completion of the print, after completion of printing the printer will automatically terminate itself.

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IV. WORKING MODEL

CONCLUSION AND FUTURE SCOPE

The model can be improved to the level where the waste plastic bottles and other plastic materials can be recycled and used as a printing material instead of using readymade filaments which is eco-friendly and causes the considerable decrease in the environment pollution.

The considerable nature of 3D printing, creating a part layer by layer, instead of subtractive methods of manufacturing lend themselves to lower costs in raw material.

With so many potential benefits of 3D printing, there's no surprise that this method is making its way through a diverse number of industries and quickly becoming a favourite tool of progressive marketers.

Medicine is perhaps one of the most exciting areas of application. Beyond the use of 3-D printing in producing prosthetics and hearing aids, it is being deployed to treat challenging medical conditions, the breakthroughs in this area are rapid and awe-inspiring.

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