3D PRINTING CLUB

INFINITE PRINTER PROJECT

PROJECT REPORT

TEAM MEMBERS

FIROZ P S | CE19B048 | firozfazil76@gmail.com

- Likes to play games
- Watches travel vlogs
- Loves to design
- Expresses it through 3D modeling and illustrations
- Planning to get into a good consulting firm

PAVITHRAMOHAN | ME19B061 | me19b061@smail.iitm.ac.in

- A creative thinker
- Motivator
- Likes to swim
- Loves to cook and also a foodie
- Change ambassador

HARSHITH KUMAR | ME19B094 | me19b094@smail.iitm.ac.in

- Likes to play sports
- Watches movies
- Plays video games

ATISH GAYKAR | ED19B046 | atishgaykar7@gmail.com

- Interested in automotives
- Planning a career towards that
- Likes to go out and roam
- Enjoys his time spending with friends
- Loves to sleep too

SANTHI PRASANNA **AE19B045** **sanpr03@gmail.com**

- Interested in improving technology in defense, spacecraft
- Foodie
- Loves to paint and does craft works
- Web Series addict

KOUSHIK ABHIRAM **CE19B008** **abhiramch02468@gmail.com**

- Likes to hang out with friends
- Movies and series addict
- Explores new places and new food items
- Has interest in coding
- Enjoys team projects

ARAVIND CHOW**DARY** **CE19B099** **aravindrocks369@gmail.com**

- Interested in designing and coding
- Sleeps a lot and a foodie
- Roams a lot with friends
- Loves nightlife
- Likes working in a team

SOHANA PREETH **ME19B008** **sohanabandi@gmail.com**

- Reads a lot of books
- Watches movies
- A foodie
- Loves to solve new problems or challenges

BHARATHI VEERASANKAR **BS19B031** **bharathiveerasankar@gmail**.com

- Likes cooking
- Enjoys painting
- Watches series
- An average bookworm
- Loves to read classics and Russian literature

INDEX

OVERVIEW OF THE PROJECT

Ever since the 3D printing technology was invented, everyone was so fascinated about it. From reducing costs to increasing efficiency to spurring innovation, many people are excited about the impact that 3D printing will have on the future of manufacturing. However, the truth is, it already has made a significant impact on the industry.

It has been inspirational to see the evolution of 3D printing and to see manufacturers across all industries work together to shape the industry and economy. However, the capabilities of 3D printing are limited due to various reasons, one of them is the restrictions on the build volume. The variety of products that can be printed are limited by these constraints.

The infinite 3D printer has an ability of printing infinitely in one or more directions, thereby, making the printer more usable to print a wide variety of parts, of any length. Usage of a conveyor belt as the bed rather than a static bed reduces the manual effort needed and increases the production rate.

Our project is to build an infinite printer which is low cost and efficient. Two models, of similar kinds of projects, are used for reference in building our printer. Detailed analysis, of all parts of the printer, is done for both the models and the modified features are included in our build.

BRIEF HISTORY

3D Printing was only an idea in the 1980s. In 1981, Hideo Kodama of the Nagoya Municipal Industrial Research Institute in Japan discovered a way to print layers of material to create a 3D product. Unfortunately, Kodama was unable to get his patent for the technology approved. Finally in 1986, an American engineer named Charles Hull created a prototype for a process called stereolithography (SLA). Hull used photopolymers, also known as acrylic-based materials, to evolve from liquid to solid using ultraviolet lights. Hull is commonly referred to as “the father” of 3D printing.

With the foundation of the technology already created, in the 1990s, companies began experimenting, expanding and, ultimately, commercializing 3D printing. However, the technology was still cost prohibitive. As a result, adoption was limited to high-cost, low-volume product production. Thus, it became a natural fit for prototyping new products in the aerospace, automotive and medical industries.

2005 marked the year that 3D printing went on the path to becoming more mainstream. Many of the early patents began to expire, and inventors and entrepreneurs sought to take advantage.When the FDM patent fell to the public domain in 2009, more companies were able to create a variety of 3D printers and the technology became more accessible. 3D printing began making mainstream headlines, as concepts such as 3D printed limbs and 3D printed kidneys were fascinating and potentially powerful.

As the cost of 3D printers continued to decline, in 2010s, the demand for the technology began to soar, and they became more commonplace in the home and in businesses.People were now free to make and create new products on their own, without relying on companies or technology firms. This empowering shift is fueling The Maker Revolution, which values creation and focuses on open-source hardware.

BACKGROUND WORK DONE

- Analyzed various models of infinite printers and differences between conventional printer and infinite printer.
- Prepared the BOM for two models (Hackaday and NAK) according to Indian market and also replicated the CAD files.
- Looked into the firmwares and compatible controller boards.
- Pros and Cons regarding Conveyor belt mechanism, extruder inclination, frame orientation and other mechanical aspects were studied.
- Build space dimensions, components like nozzle, extruder, motors, and drivers were finalized, suitable rods, ball bearings, pulleys, motors, etc. were chosen for conveyor.
- CAD model considering all the above aspects was designed.
- Developed techniques to reduce the wastage of material for the adopted build space.
- We made into the finals in an innovation challenge organized by Auroma innovate with our idea multi material infinite 3d printer which is a step ahead of infinite 3D printer.

FIRMWARE

Firmware, is the bridge between the hardware and software of a computer system. When your 3D printer software (like Repetier Host, Cura or OctoPrint) sends G-code to your 3D printer, the firmware translates the G-code commands into specific electrical signals that are sent to the motors, heaters, fans and other components on the 3D printer.

We will be using Marlin 2.0 firmware with settings for CoreXY and software end stop for Z. Marlin can run almost any 3D printer with the exception the 3D printer must have an Arduino on board it. Minor changes need to be made to the firmware because the x-axis is a conveyor belt, it needs to be able to move "infinitely" in this direction. We can "reset" the X-value with "G92 X0", so it will start again at position 0, regardless of the previous position or count.

KINEMATICS OF THE PRINTER

Idea behind choosing Cartesian Build:

In Cartesian build all motors can work independently and have the simplest system among other builds, for instance Delta printers rely on spherical coordinates and because of that to move along a single line you have to follow complex paths for each motor. Thus by choosing a Cartesian system for our project makes things simpler.

In our Project we are using a Cartesian build which has individual stepper motors controlling 3 degrees of freedom of the printer, 2 for the extruder motion and 1 for conveyor belt. In this build we have 1 stepper motor guiding the motion along inclined Z axis and 1 for motion along X direction and 1 for conveyor belt Y axis.

Each stepper motor is rigidly in contact with Lead screw arrangement, hence both have the same rotary motion. Lead screw converts the rotary motion to linear actuation, so 1 revolution of the motor corresponds to a linear pitch (8mm) in the lead screw. Extruder setup is joined to the lead screw through the frame. For the Conveyor belt motion 1 stepped motor is directly joined to the axis of the cylinder on which the belt runs, through some ball bearings.

Velocities of Extruder:

Pitch of the Lead screw = 8mm
Average velocity of Stepper motor () = 2900RPM
1 Revolution of stepper equivalent to 8mm pitch in lead screw
Time period of 1 Revolution = T

T = 2=0.02sec
Velocity of Extruder along X direction = Vx
Vx = PitchT = 386.6mm/sec

For inclined Z axis,
Velocity of Extruder vertical to the print bed = Vz1
Velocity of Extruder horizontal to the print bed = Vz2

Vz1=Vxcos(45)=273.41mm/sec
Vz2= Vxsin(45)=273.41mm/sec

HACKADAY MODEL

DESCRIPTION:

3D printing has the potential to democratize manufacturing. Since 3D printers are easy to use and low cost, they allow anyone to make incredibly complex things. The technology has opened up new doors to makers and hackers.

However the capabilities of 3D printers are limited by requirement of human operation. Therefore, the purpose of this project is to build a fully autonomous 3D printer. A 3D printer that can print a continuous stream of parts without user interaction. The finished machine is capable of independently ejecting and starting print jobs. Additionally, the 3D printer's conveyor belt mechanism allows it to make infinitely long prints. The Automatic Infinite 3D Printer (i3D) allows any small business, organization, and person to leverage the power of a factory.

BOM:

https://docs.google.com/spreadsheets/d/1BDI0ikldU4Bmr3j6-9P4A-wu2XGgvdup-vBwgx8_Dik/edit?usp=sharing

CAD FILE:

https://a360.co/2Avasf2

NAK MODEL

BOM:

- General parts BOM including bars and extrusions - https://docs.google.com/spreadsheets/d/1hB1N3bMQy4oyiEpYa6kWzU-z3_Pffgjl65vruX6uFWI/edit?usp=sharing
- BOM of other parts - https://docs.google.com/spreadsheets/d/1IlmA0AjtIttQRZ6b1jSweibUifNarNksC72ddTGKDDM/edit?usp=sharing

CAD FILES:

FILES	LINKS
Extrusion templates	https://github.com/NAK3DDesigns/White-Knight/tree/master/Extrusion%20tem plates
Fusion 360 files	https://github.com/NAK3DDesigns/White-Knight/tree/master/Fusion%20360% 20files
Printer STLs	https://github.com/NAK3DDesigns/White-Knight/tree/master/Printer%20STL's
Tools STLs	https://github.com/NAK3DDesigns/White-Knight/tree/master/Tools%20STL's
STL files (squire files)	https://github.com/NAK3DDesigns/White-Knight/tree/master/Squire%20Files/STL%20Files
Fusion 360 files (squire files)	https://github.com/NAK3DDesigns/White-Knight/tree/master/Squire%20Files/Fusion%20360%20files

REFERENCES/BIBLIOGRAPHY

- References for preparing BOM are provided there itself.
- CAD files for the NAK model are shared as links from the website.
- Hackaday model: https://hackaday.io/project/114738-automatic-infinite-3d-printer
- NAK model: https://www.thingiverse.com/thing:3324280
- Firmware and controller board suitable for infinite printer : https://m.all3dp.com/2/5-fantastic-3d-printer-controller-boards/
- Several other websites related to 3D printing such as All3DP, Matterhackers, etc.