Centre For Innovation

PRINTING CLUB

MOBILE SCARA 3D PRINTER

PROGRESS REPORT FOR THE MONTH OF AUGUST

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OVERVIEW :-

We have researched in detail about the Reprap Helios, noted down all its features, compiled the list of parts that are used in the Reprap Helios, etc. We have also found out where the materials can be bought online and made a rough bill of the materials required for the project. We worked on the kinematics of Reprap Helios and found out about the slicer that is being used and the changes and modifications that are to be made to the slicer to make it mobile. To ideate about implementing swarm technology, some of our team mates started learning machine learning specialisation courses from coursera which would be essential to our project and are also going through several research papers on swarm technology, Chuck based slicing, etc so as to gain knowledge about the project. We have also started creating a fusion 360 model of Reprap Helios from scratch so as to make changes to the already existing model.

THEORY :-

The Reprap Helios 3D printer is a highly printable 3D Printer with a scara arm and no moving steppers. It has the ability to print on nearly any flat surface. It's small, light, fast, precise and offers a very large print area. The design of Reprap is parametric so all the details can be modified .

- It has a very huge print area which is which is five times bigger than a normal 200 x 200 mm printer. It also has a build height of 100mm. Also it's arms are light and are adjustable.
- It prints well at 30mm/sec but it have also printed at 90mm/sec speed with satisfactory results

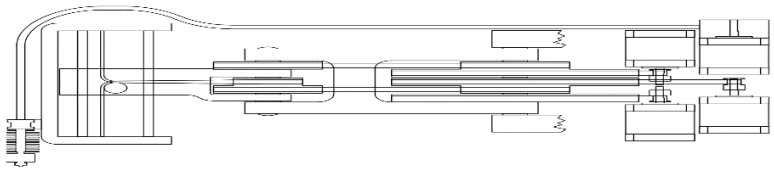
- It features an autobed levelling mechanism and also uses Mini viki LCD Control panel
- Reprap uses Cohesion 3D mini smoothieware compatible controller board
- It has an E3D v6 Lite hot end and uses E3D Titan Extruder and it's completely open source.
- All four motors (400 steps/ rotation) are static while providing a structural support and their own wire management and has very high accuracy and precision.
- It has the same kinetics as Reprap Morgan and could probably print all parts for a self-replication run in one go.
- It is very small compared to other printers and fits in a 200 x 225 x 250 mm box.

- It doesn't require an exclusive print bed , it can print on a tape - covered surface.

Reprap Helios is modified to roll, so it now has an infinite build volume.

The original prototype was created by simply installing the Reprap Helios on the Electric wheel deck. It sits at an angle, so there is no need for a Z- axis. The wheelbase allows you to drive and print indefinitely in one direction. The Z- axis will be more traditional limiting the height of potential components. But being able to print Indefinitely on X and Y axis is still very useful.

The basic layout of the 3D Printer is :-



Firmware :-

The firmware used in Reprap Helios is Heavily modified Smoothieware.

Smoothieware :-

In its most basic form the job of a smoothie is to receive Gcode commands and translate those into actual movement for the printer. It is done through a series of steps :-

- The serial console module reads the serial port (UART or USB). When a line is recognized, it traces all modules that request it by triggering the " on_console_line_received " event.
- The Gcode dispatch module is one of the modules that registers for the " on_console_received event ", so it will be called every time the Serial console module Activates it. It takes a new line and if it recognizes a Gcode command it converts it into a anew Gcode object and triggers the "on_Gcode_received" event. The Gcode object is just a container for the actual string, it only provides helper functions to retrieve the value of that string.
- The robot module listens to this event and is activated. It uses mathematics to cut the requested motion into the line segments and pass them to the planner module. There they are converted into block objects containing speed, direction and acceleration information. The acceleration profile for the planners queue is re- computed to take the new block into account and finally that block is added to the queue.

- As long as there is a block in the planner queue the stepper module will enter the game. It contains two loops :- 1) The stepping loop, which pops new blocks if necessary and sends the step and direction command to the stepper motor drivers to move the motors. 2) The acceleration loop which updates the stepping loop's speed depending on the acceleration profile of the block

Modifications :-

- Lazy arm mode switching (when you get to a place where the current arm mode can't go...switch but don't switch back until you are forced to.)
- Machine coordinate moves when rapidly moving. (Say you move from one side of the build platform to the other. The quickest way is to swing the arm in an arc instead of going in a straight line.)
- Codes for setting machine coordinates
- Homing with a common end stop (accelerometer)
- Incremental bed leveling (The bed is 5 times bigger than a normal 3D printer and you can reach most of it in 2 arm modes so the probing required is 10 more than typical. To combat that , come up with a way to probe as you need wherever you need.

No modifications have been done to the slicer and cura 2.4+ is the slicer that is being used .

The Github Repository for the Reprap Helios 3D Printer is :-
https://github.com/NicholasSeward/proto_RepRap_HELIOS

The parts used in Reprap Helios and the detailed bill of materials can be found in the Below link :-
https://docs.google.com/spreadsheets/d/1zGjLOuwrzqq64jjohoX-Xs2fyfArFVwHeUb2k5kIkIg/edit#gid=0

OBJECTIVES MET IN THE MONTH OF AUGUST :-

- Did a complete analysis on Reprap Helios, the slicer used, the firmware adopted, the modifications made to the firmware, Latest updates and advancements in Reprap, etc.
- Compiled the list of parts that are used in Reprap and also made a detailed bill of the materials required for the project and found out where the materials are available online
- Found out the advantages and disadvantages of Reprap and how to correct the disadvantages.
- Learnt Machine learning and gone through several models on SWARM Technology

- Gone through several research papers on SWARM Technology and chuck based slicing

PROPOSED PLAN OF ACTION FOR THE MONTH OF SEPTEMBER :-

- Continue the Machine Learning course for SWARM Technology
- Continue Reading research papers on SWARM Technologies, Chuck based Slicing, etc.
- Develop a Fusion 360 model of Reprap Helios from scratch

- Continue working on Reprap Helios and search for any latest technologies that could be used for Reprap.

REFERENCES :-

1)https://hackaday.io/project/21355-reprap-helios

2) http://diy3dprinting.blogspot.com/2017/04/amazing-reprap-helios-with-sequential.html

3) https://www.hackster.io/news/rolling-reprap-helios-prototype-has-an-infinite-print-volume-fac68e9df7f9

4) https://www.youtube.com/watch?v=VaZ-skIrfO0&t=47s

5) https://www.youtube.com/watch?v=ph4_6OL1mk4

6) https://github.com/NicholasSeward/proto_RepRap_HELIOS

7) https://duet3d.dozuki.com/Wiki/ConfiguringRepRapFirmwareSCARAPrinter