Next Generation 3D Printer

Concept Generation and Selection

Fahad Alahmari, Sebastian Arevalo, Brad Evans, Tomas Garcia,
Ben Gouveia, Jake Work

NORTHERN ARIZONA UNIVERSITY®

10/19/15

Novakinetics Aerosystems

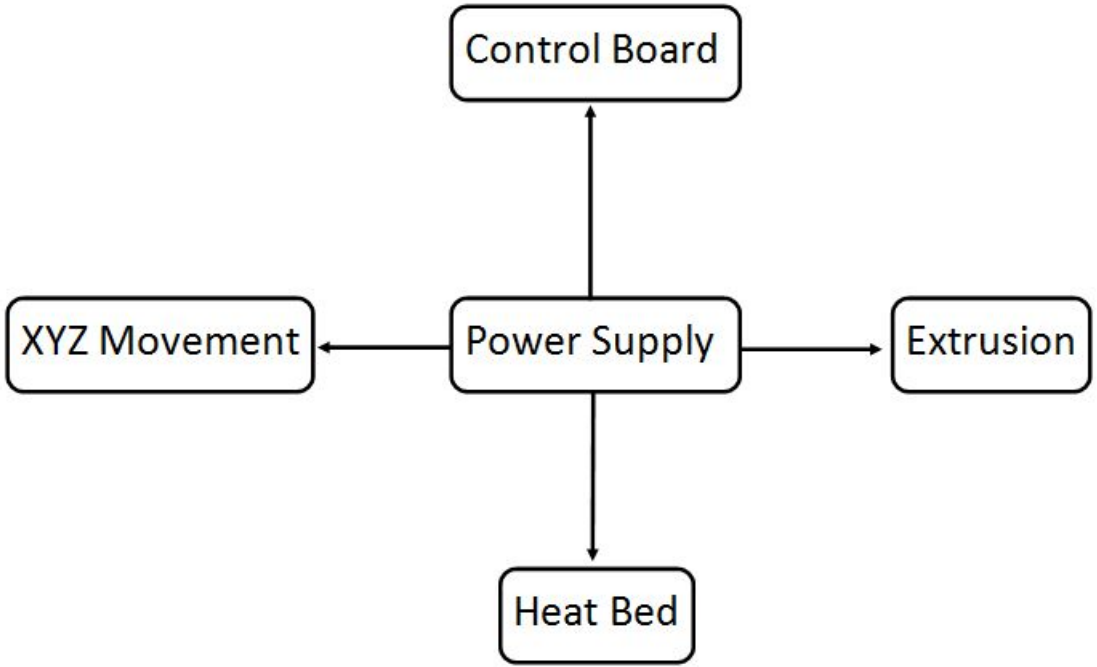
Overview

- Introduction
- Functional Diagram
- Criteria of Functions
- Relative Weights of Criteria
- Concept Generation
- Decision Matrix
- Updated Project Plan
- Conclusion
- References

Introduction

- Novakinetics is seeking a new way to manufacture their products
- The project goal is to aid Novakinetics in optimizing their manufacturing process
- Our team determined that a large scale 3D printer can be used to speed up their manufacturing process
- To achieve this, concepts must be generated for the critical functions of a 3D printer

Functional Diagram



Criteria of Functions

Power Supply

1. Ease of Implementation
2. 120V-240V
3. Cost

Hot End

1. Temperature
2. Nozzle Size
3. Reliability

Control Board

1. Open Source
2. Multiple Motor Drivers
3. Modular

XYZ Movement

1. Torque
2. Resolution
3. Rotations Per Minute (RPM)

Relative Weights of Criteria

Power Supply

Criterion	Relative Weight
Ease of Implementation	0.288
120V-240V	0.462
Cost	0.250

Control Board

Criterion	Relative Weight
Open Source	0.359
Multiple Motor Drivers	0.350
Modular	0.291

Hot End

Criterion	Relative Weight
Temperature	0.301
Nozzle Size	0.365
Reliability	0.334

XYZ Movement

Criterion	Relative Weight
Torque	0.434
Step Angle	0.366
RPM	0.200

Concept Generation - Power Supply

dgcomputers.co.in

ATX Power Supply

- Power Output: 500 W
- 16 AMPS
- 115V - 230V

geeetech.com

LED Strip Power Supply

- Power Output: 480 W
- 10 AMPS
- 115V - 230V

newegg.com

Universal Power Supply

- Power Output: 350 W
- 29 AMPS
- 110V - 220V

Decision Matrix - Power Supply

Power Supply	LED Strip PSU		Universal Power Supply		ATX Power Supply	
	Unweighted Score	Weighted Score	Unweighted Score	Weighted Score	Unweighted Score	Weighted Score
Ease of Implementation (0.288)	7	2.02	9	2.59	6	1.73
Power Output (0.462)	8	3.70	6	2.77	10	4.62
Cost (0.250)	6	1.50	7	1.75	10	2.50
Weighted Totals:	7.212		7.114		8.848	

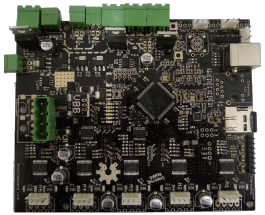
Scale:
1= Worst 10 = Best

Concept Generation - Control Board

panucatt.com

Azteeg X3 Pro

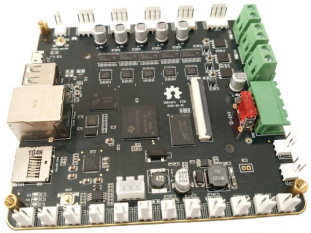
- 8 Stepper Motor Drivers
- 6 Endstops
- 3 Thermistors
- Arduino IDE



smoothieware.org

Smoothieboard

- 5 Stepper Motor Drivers
- 6 Endstops
- 4 Thermistors
- Smoothie Firmware



3dprintboard.com

FastBot BBP

- 6 Stepper Motor Drivers
- 6 Endstops
- 3 Thermistors
- FastBot Firmware

arduino.cc

Arduino Mega

- 4 Stepper Motor Drivers
- 6 Endstops
- 3 Thermistors
- Arduino IDE

Decision Matrix - Control Board

Control Board	Azteeg X3 Pro		Smoothie		Fastbot BBP		Arduino Mega Duet	
	Unweighted Score	Weighted Score	Unweighted Score	Weighted Score	Unweighted Score	Weighted Score	Unweighted Score	Weighted Score
Open Source (0.359)	8	2.87	7	2.51	9	3.23	8	2.87
Multiple Motor Drivers (0.350)	10	3.50	6	2.10	7	2.45	5	1.75
Modular (0.291)	10	2.91	7	2.04	8	2.33	5	1.46
Weighted Totals:	9.282		6.650		8.009		6.077	

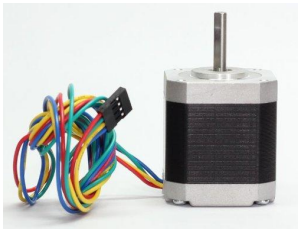
Scale:
1= Worst 10 = Best

Concept Generation - XYZ Movement

reprap.org

RepRap Stepper Motor

- 12V DC
- 1.8 Degree Step Angle
- 200 RPM Max Speed
- 0.48 Newton Meters Torque



deltaprintr.com

Kysan 1124090

- 4.2V DC
- 1.8 Degree Step Angle
- 400 RPM Max Speed
- 0.54 Newton Meters Torque

newegg.com

Nema 17- 42BYGHM809

- 12V DC
- 0.9 Degree Step Angle
- 600 RPM Max Speed
- 0.48 Newton Meters Torque

Decision Matrix - XYZ Movement

XYZ Movement	RepRap Stepper Motor		Kysan 1124090		Nema 17-42BYGHM809	
	Unweighted Score	Weighted Score	Unweighted Score	Weighted Score	Unweighted Score	Weighted Score
Torque (0.434)	8	3.47	10	4.34	8	3.47
Step Angle (0.366)	5	1.83	5	1.83	10	3.66
RPM (0.200)	4	0.80	6	1.20	10	2.00
Weighted Totals:	6.102		7.370		9.132	

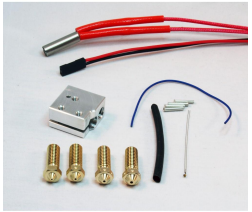
Scale:
1= Worst 10 = Best

Concept Generation - Hot End

filastruder.com

E3D Cyclops

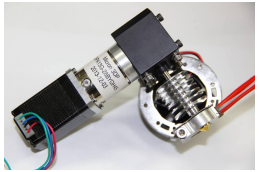
- 0.4mm Nozzle
- Multiple Material Feed
- Max Temp: 290 C



printedsolid.com

E3D Volcano

- Multiple Nozzles
- Up to +/- 0.1mm accuracy
- Max Temp: 290 C



3dprint.com

MICRON3DP

- 0.35mm or 0.5mm Nozzle
- All Metal Hot End
- Max Temp: 400 C

Decision Matrix - Hot End

Hot End	Cyclops		Volcano		Micron 3DP	
	Unweighted Score	Weighted Score	Unweighted Score	Weighted Score	Unweighted Score	Weighted Score
Temperature (0.301)	7	2.11	7	2.11	10	3.01
Nozzle Size (0.365)	6	2.19	10	3.65	5	1.83
Reliability (0.334)	8	2.67	8	2.67	7	2.34
Weighted Totals:	6.969		8.429		7.173	

Scale:
1= Worst 10 = Best

Conclusion

- In order to create the 3D printer, the team had to formulate concepts for each function
- The team created a functional diagram to identify the critical functions of a 3D printer
- Criteria were defined for each function
- The team conducted research for each function to find suitable components
- Using relative weights for the criteria and decision matrices, components were selected
- Given these decisions, the team updated the project plan

References

[1] Novakinetics.com, 'Composite Manufacturing Products', 2015. [Online]. Available: http://www.novakinetics.com/. [Accessed: 20- Sep- 2015].

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[3]'The Free Beginner's Guide To 3D Printing', *3D Printing Industry*, pp. 3-72, 2015.

[4] 3ders.org, 'how to build 3d printer', 2015. [Online]. Available: http://www.3ders.org/3d-printer/how-to-build-3d-printer.html. [Accessed: 18- Oct- 2015].