[[1]](#footnote-1)

Hardware and Software in 3D Printers

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*Abstract*— Current hardware control systems used to manage and synchronize printing operations.

***Index Terms*— Light-curing resins, three dimensional printer, Digital light process.**

# INTRODUCTION

The control hardware and software both determine the precision of the print. The software breaks down the CAD model into slices and generates a series of steps for the hardware controls.

# Discussion

## Video output

Digital Light Processing manufacturing uses a projector to cure a liquid resin. The B9 Creator uses the video output from a dedicated host PC to power the projector. The supported video output for the B9 includes VGA and HDMI. Sedgwick printer supports VGA output only . By using a 1024x768 projector the precision is only slightly hindered by a lower resolution projector. Despite a lower resolution projector than the B9 Creator, Sedgwick can still provide a high quality 3d print.

The EnvisionTEC Perfactory4 printer uses an even higher resolution than the B9 and Sedgwick. Supporting a 1920x1200 resolution, Perfactory4 is extremely precise. The high resolution creates a beautiful print with crisp corners and smooth sides, but at an extremely high cost.

## I/O support

Input and output support of the microcontroller powers the motors used to drive the build table and send feedback to the software. The B9 Creator is supported by and Arduino controller connected to a dedicated PC via USB . The software running on the PC slices the CAD file and generates a proprietary code to be run on the Arduino. Then the image output from the PC to projector is synced with motion of the build table. The rest of the output is done by the PC. After each layer of the model is processed the video output will send the signal to the projector to display the next layer, allowing the resin to cure.

## G-code

Initially used to control machining tools, G-code is a programming language used to interface the controller and hardware. Instructions from the software produce the G-code, which tells the controller what action to execute. Some actions include setting coordinates, controlled movements, rapid movements, move to origin, arc (counter)clockwise, and more. This language has been adapted for use with 3d printers and is the standard control instructions. The syntax for G-code is as follows:

|  |
| --- |
| G1 F1500  G1 X90.6 Y13.8 E22.4 |

**\*\*\*\*\*\*\*Figure: XXX**

This operation instructs the hardware to move to position X-90.6, Y13.8, extrude resin at a feed rate of 1500mm/minute and extrude 22.4mm of resin. \*\*\*\*\***Figure XXX** is configured for use with a FDM printer, however it can be adapted for a PAM system with software modifications and produce the same print.

## Controller Firmware

There are a few firmware's for the Arduino that interpret the G-code and send the commands to the hardware. A very popular firmware for the Arduino is Sprinter. The supported features of Sprinter include SD card support, extruder speed control, movement speed control, constant and exponential acceleration, and heated build platforms. It is also compatible with a variety of different Arduino shields, but are only used in FDM systems.

Marlin firmware is forked from Sprinter and has the same functionality and more. The functionality added from Sprinter is support for higher step rates, look ahead (for corners), temperature sampling, and EEPROM error reporting. Like Sprinter many of the additional features only apply to FDM systems, but it still supports PAM systems as well.

# Acknowledgment

# References

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| [1] | "B9 Creator," 2013. [Online]. Available: http://b9creator.com/faqs/what-controls-the-printer-hardware/. [Accessed 15 April 2014]. |
| [2] | "Sedgwick 3D DLP Printer ready to print," 2014. [Online]. Available: http://sedgwick3d.com/p/9/sedgwick-3d-dlp-printer-ready-to-print. [Accessed 16 April 2014]. |
| [3] | "Perfactory 4 with ERM," 2014. [Online]. Available: http://envisiontec.com/products/perfactory-4-standard-with-. [Accessed 15 April 2014]. |
| [4] | "G-code RepRap," 2014. [Online]. Available: http://reprap.org/wiki/G-code#Unbuffered\_M\_and\_T\_commands. [Accessed 17 April 2014]. |
| [5] | "Sprinter," [Online]. Available: http://reprap.org/wiki/Sprinter. [Accessed 17 April 2014]. |
| [6] | "Marilin," 2014. [Online]. Available: http://reprap.org/wiki/Marlin. [Accessed 17 April 2014]. |

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