[[1]](#footnote-1)

The Use of Microcontrollers and Computers in 3D Printers

Nicholas Lowman

*Abstract*— Current hardware control systems used to manage and synchronize printing operations and benefit analysis of said hardware.

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

# INTRODUCTION

Current 3D printers are controlled by some type of computer. Some of the difficulties to consider when choosing a computer are whether or not it is going to be tethered to a PC, the video output compatibility, general I/O support, language library support, and cost. To provide the consumer with the best possible product we must consider the tradeoffs when choosing our system.

The step by step break down of the control system of the printer is first to start the printing process. Next the controller configures the projector to display the image layer to cure the resin. After the resin is cured the controller sends a signal to the build table motor to lift the print out of the resin vat. Then the build table is lowered back into the vat and the process it repeated.

Although the control system may seem easy, choosing the right controller is essential; as we do not want to pay for excess functionality that we do no require.

# Discussion

## Video output

Many of the fused deposition manufacturing (FDM) printers use only a microcontroller for the print process [1]. However our printer uses digital light processing (DLP) and requires a video output. To power the projector and user display we need multiple high definition video outputs. Most microcontrollers are not powerful enough to support multiple video outputs concurrently [2] forcing us to either use multiple controllers or using a computer interfacing with the controls to power the displays.

To keep cost down we need not use multiple controllers, as mostly everyone already owns a PC. Therefore we shall only use one controller tethered to the PC. This can be done by synchronizing the PC and the controller. By sending signals between the controller and PC; the video output and build table will function independently to produce the desired results.

## I/O support

General input and output support required for printing is fairly limited. The only outputs needed by the microcontroller are to power a stepper motor to drive the build table and a resin monitoring system. Because of the limited number of outputs required by the printer; virtually every microcontroller on the market supports our needs [2] [3].

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.

## Cost

The cost of our system is one of the most important aspects to our demographic. We must keep a competitive price for our system in order to make it accessible to the hobbyist and DIYer. By keeping our design modular it can be ran various hardware schemes. This is essential as we don’t want to burden our consumer with purchasing hardware similar to what they own. Arduino is the perfect candidate for this as most hobbyists already own one; and the code can be run on multiple hardware revisions made by the company [4].

## Language Library support

Every PC on the market today is either x86 or 64-bit architecture. These two architecture support nearly every computer language that exist. In our application we need to process image layers from the 3D model and output it to the projector. This is an easy feat for virtually any computer build in the last 2 decades.

As for the Arduino, it supports c/c++ and a large variety of libraries [4]. The libraries allow for easy control over the I/O port, which will allow us to adjust the level of the build table and any other functionality that may arise in the build process.

# Conclusion

In the interest of our consumer demographic it is essential to keep the cost down and modularize the system. It is impractical to force the customer to buy hardware they may already own. Not only does it lower the end products cost, but also allows us to be more flexible in the production of the printer.

# Acknowledgment

# References

|  |  |
| --- | --- |
| [1] | Solidoodle, Cubify Cube, MendelMax, "Best 3D Printers 2014" [online] January 2014, http://www.tomsguide.com/us/best-3d-printers,news-17552.html [Accessed 25 February 2014] |
| [2] | Raspberry Pi, "Video Displays" [online] http://www.raspberrypi.org/faqs#videoDisplays  [Accessed 27 February 2014]. |
| [3] | Digital I/O Pins, "Arduino Mini" [online] http://arduino.cc/en/Main/ArduinoBoardMini#.UxAR54WPMyM [Accessed 26 February 2014]. |
| [4] | Arduino Software [online] http://arduino.cc/en/Main/FAQ#.UxAXK4WPMyM [Accessed 26 February 2014]. |

1. Manuscript prepared February 28, 2014.

   The author is with the Saluki Engineering Company, Southern Illinois University at Carbondale, IL 62901 USA (phone: 618-453-7053; fax: 618-453-7972; email: chancewbaker@gmail.com). [↑](#footnote-ref-1)