

# How to 3D Print a Photo-realistic Banana for Scale

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## **Abstract**

The public availability of Three Dimensional printing has been one of the more interesting developments of the last decade. The flood of open source files and opportunities is simply astonishing. However, it is relegated to very minimalistic colour choices and, for the most part, plastic. This project dares to break the bonds of plastic, and dives into a new medium; paper. In the use of paper we have gained the remarkable ability to print photo-realistic images into every layer of the object. This project focuses on new hardware approaches, fresh printing abilities, and above all, thinking beyond the metaphorical, plastic, box.

# **1 Concept**

This project attempts to create a 3d printer for use in the realm of theatre. Such a printer would be used to create scenic design models and props in a cost and time effective manner. In the printing of scenic models a small version of the set could be created rapidly with photo-realistic rendering without the pain and hassle of traditional methods such as foam core modeling. This printer could also be used in the realm of props. Unfortunately due to time, budgeting and material constraints traditional 3d printers cannot be used to make props. This printer looks to solve that problem by creating a simple, cost effective and photo-realistic model of a prop with good durability. By combining the steps of construction and painting the 3d printing method proposes a quick and artistic method of turning the ideas in a prop-master's head into the magic of theatre.

## **1.1 Inspiration**

The inspiration of this device was the MCOR Iris, a commercial 3D printer. The MCOR Iris is a very large 3D printer that boasts ICC color mapping and accuracy, but at a hefty price tag. This project looked to create a cost-effective alternative that provides similar output for non-commercial use.

## **1.2 Goals of the Project**

The main goal of this project is to create a 3D printer from existing technologies. The idea is to shape hardware to work with open-source software to create a product that is both effective and cost-effective. Side goals include investigating color options, providing automatic feed for the paper, testing the product in a theatrical example, and then make our technology available in the spirit of open-source.

# **2 Hardware**

The initial hardware used was the Cricut cutting device. We completely switched out the motherboard of the Cricut as well as some of the motor components. Figure 1 shows the original hardware after some light deconstruction.

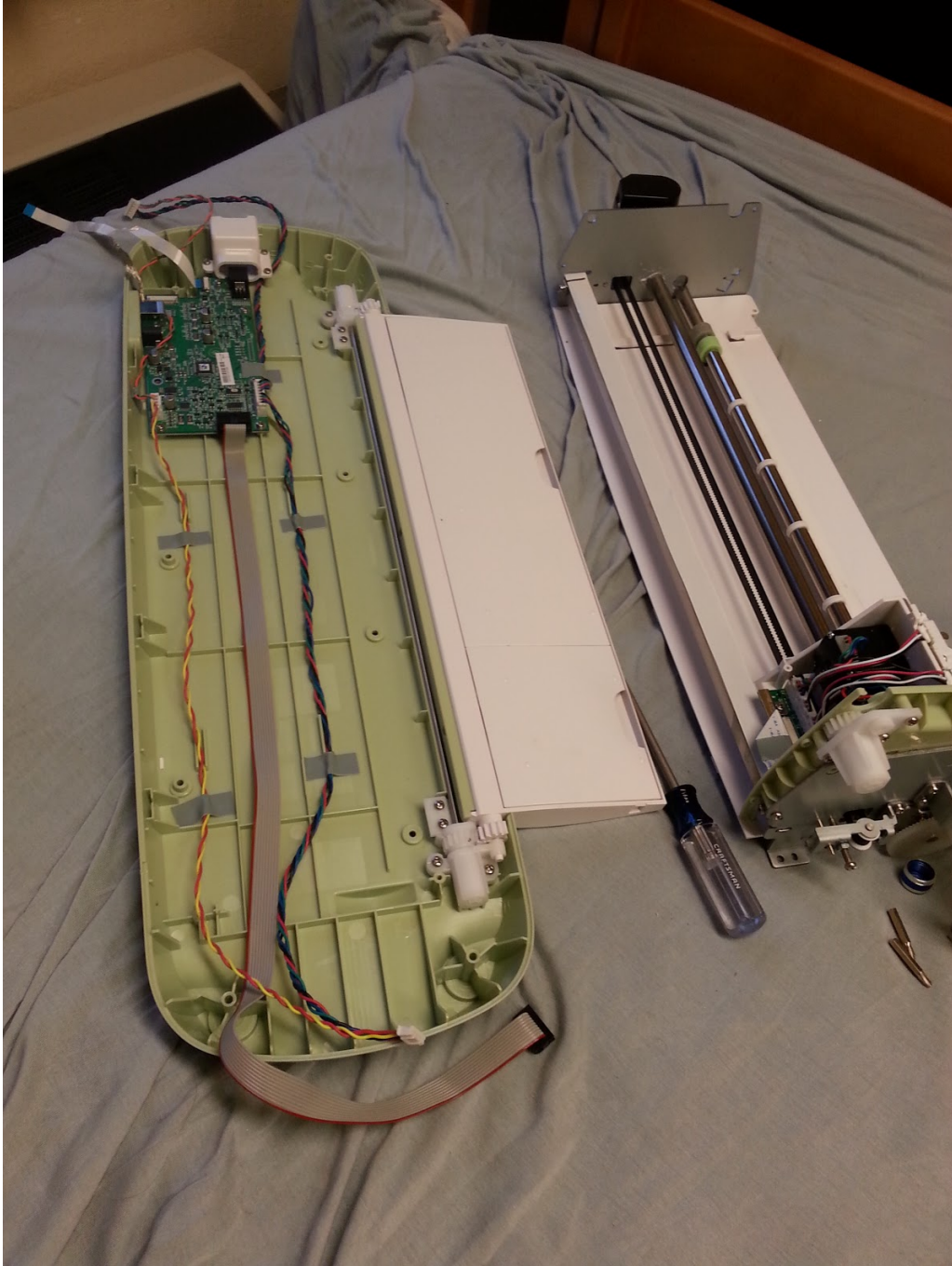


Figure 1: Cricut Original Hardware

Figure 2 shows the original motherboard placed over the base of the new motherboard, which will be revamped to better fit the new demands for the device.





We combined this hardware with an Arduino Mega 2560, a 5 volt power supply, 3 H-Bridge motor drivers, 2 standard electric motors with linear encoders, and 2 stepper motors with limit switches. All of the additional hardware allowed us to completely switch out the motherboard that controls the cutting pen. Figure 3 shows the new motherboard setup.

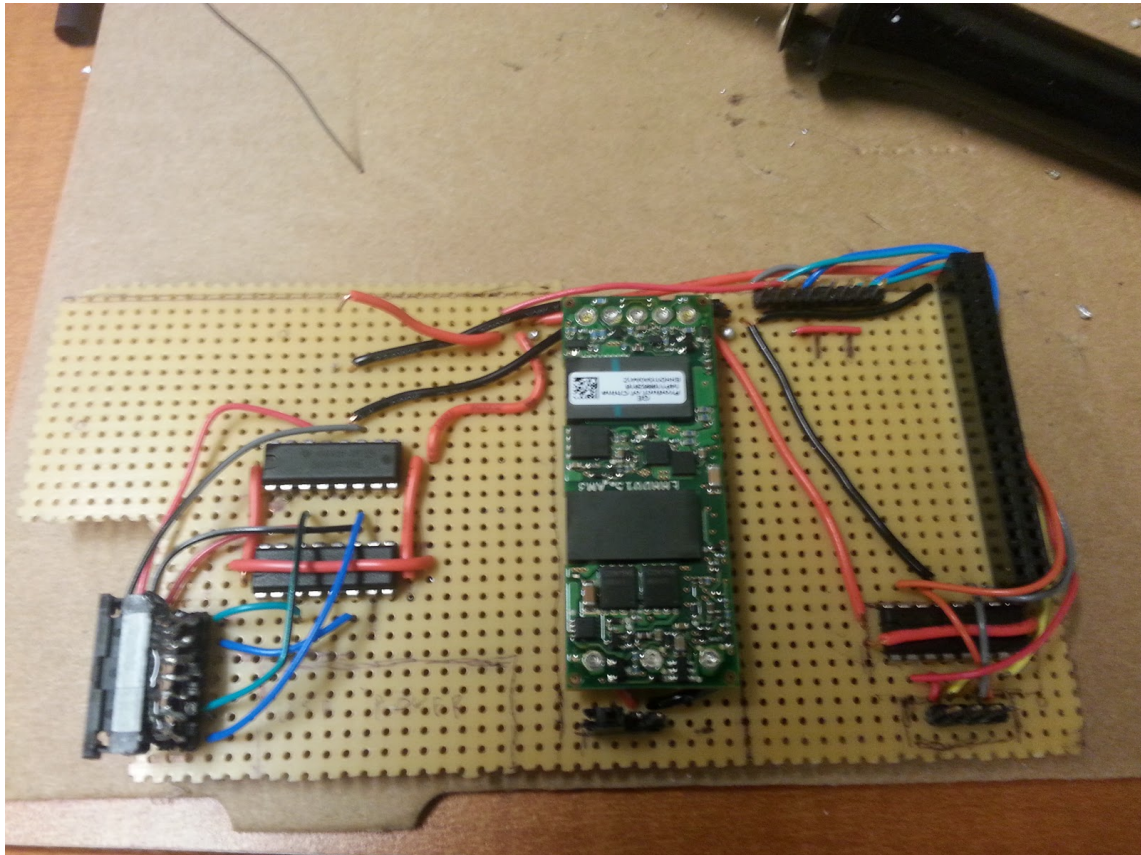


Figure 3: The New Motherboard

The new motherboard allows us to handle the new input from the software, and control the changes to the motor. It is given instructions by the Arduino Mega. The Arduino forms the bridge between the demanding software of the project and the hardware.

### 3 Software

The software of the project takes the image and slices it into layers through a program in Sketchup. Those layers are translated into SVG files that are then sent to the Arduino Mega using a Processing program that send the information over serial port. The information received by the Arduino are interpreted into commands for the motor drivers that move the blade and the mat into different orientations to create the cuts. Various cuts are strung together to create the layer.

### **3.1 Sketchup**

We modified an open-source ruby plug in called slicer-5. Slicer-5 was optimized and subsequently programmed to output SVG files from sketchup, a non-native function. Once a 3D model is created in sketchup, it is a simple matter of a few clicks and some Processing time to change the 3D model into several layers, represented by SVG files. These files can then be sent to the printer.

### **3.2 Processing**

The next step of the process is handled by a Processing program. The user loads a program to communicate over a serial port to the Arduino Mega, which then sets the modified Cricut into action. Each line of each file is sent individually as a command to move the pen or set the depth of the pen, or to send it to a home position. The program waits for a response and then sends the next line of code.

### **3.3 Arduino**

The Arduino accepts SVG files line by line. The lines consist of commands and some setup codes we created to control the machine. The codes provide homing functions, mode functions and directional instructions that the Arduino parses into motor commands, moving the cutting blade in the correct pattern. The code is built from four different open source libraries from Arduino that combine to interpret motor commands from the line output of the Processing program. Several existing Arduino 3d printer control programs were considered and used as examples. However, the unique nature of the hardware demanded more flexibility than those programs could offer, and it was decided that a scratch built program would be more useful.

## **4 Current Status**

The device currently moves and accepts commands. However, the project is far from its original goals. There is no color for the device. Gluing capabilities were also unable to be fully explored within the context of the hardware at hand. The 3D modeling software has a memory leak that has proven to be problematic. Also, with the update to Arduino, the code controlling the Mega needs to be revisited.

Ultimately, this project hit the limit of the hardware that was worked with. The Cricut device has limitations that require new hardware to bypass. One of the major issues with the Cricut is the way the cutting blade is arranged in its holder. When the blade changes directions the cutting blade spins in its holder, creating an offset in the cutting pattern. Though this problem can be approached purely in software, we would like to investigate possible hardware changes to improve the existing design.

An update in hardware also allows another problem to be solved: the mat. Currently, the cutting blade only moves across one axis, with a mat controlling the second axis. The next level of design would incorporate the cutting carriage moving over a stack of paper in at least two dimensions, allowing easier positioning of layers. The new “cutting mat” would be provided by the previous layer of paper. The carriage would also incorporate the print heads, glue distributing device and method for placing each new layer of paper.

## **5 Conclusion and Final Thoughts**

In Conclusion, this project did not fully achieve the initial goals. Our tool exists, but it does not have the development that we had hoped. The approach we took with hardware proved to be more difficult than anticipated, and we now look to different hardware to breathe new life into the project.