

Universal Circuit Fabricator

Project Proposal

Senior Design 1

EEL4914

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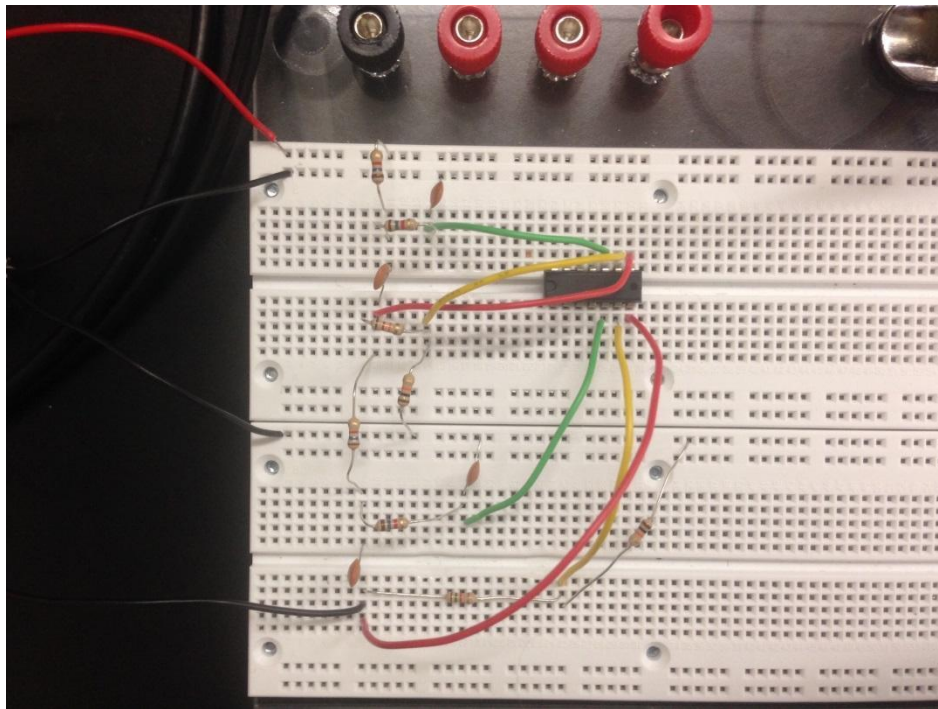
1. Project Description

The Universal Circuit Fabricator is created for the desire to make prototyping circuits more accessible and customizable for the general public. The typical design process starts with a simulation of a circuit that always works as intended in the theoretical environment of the simulation program. Next in the design process is prototyping the circuit, which typically takes place on a breadboard. Breadboard circuits are hard to visualize and debug due to the mess of jumper wires crossing over the design. Our project aims to streamline the prototyping process in an elegant and easy to understand way. The Universal Circuit Fabricator will act like a desktop printer and allow you to print homemade circuit traces to different materials, like paper or fabric. Our design will mimic the function of a typical inkjet printer, but instead of using typical ink to print words and symbols, we will use an electrically conductive ‘ink’ to print traces to any material. Our goal is to remove the frustration and hassle of debugging a complicated breadboard prototype of the circuit. The printed prototype can then be tested to ensure correct functionality before ordering a fully manufactured PCB board.

On the software side, we plan to implement basic communication between a microcontroller and the inkjet printer head that will draw wire traces to our substrate of either paper or fabric. The inkjet head will be controlled using a breakout board called *InkShield* for the Arduino microcontroller. The microcontroller will also control two stepper motors for motion in the x and y axis. The printer will print the wire traces and leave open gaps for discreet circuit components to be tested just as they would on a breadboard.

2. Motivation

Circuit prototyping should not be a frustrating process!



Being Electrical Engineering students nearing graduation, we feel that prototyping and testing circuits is an important skill that we will use in our careers. One of the most frustrating aspects of our circuit design labs was the breadboard prototype. We never struggled to correctly simulate the circuit in the lab using a computer program, but when we went to build the circuit using real parts and a breadboard we found ourselves spending most of our time debugging the jumper wires instead of actually testing the circuit.

Our motivation in creating the Universal Circuit Fabricator was to enable Electrical Engineering students to spend their time in the circuit design laboratory wisely. By eliminating the errors that we made in our breadboard designs, future UCF EE students can spend less time debugging a breadboard and more time understanding the circuit design concepts that they need in the future.

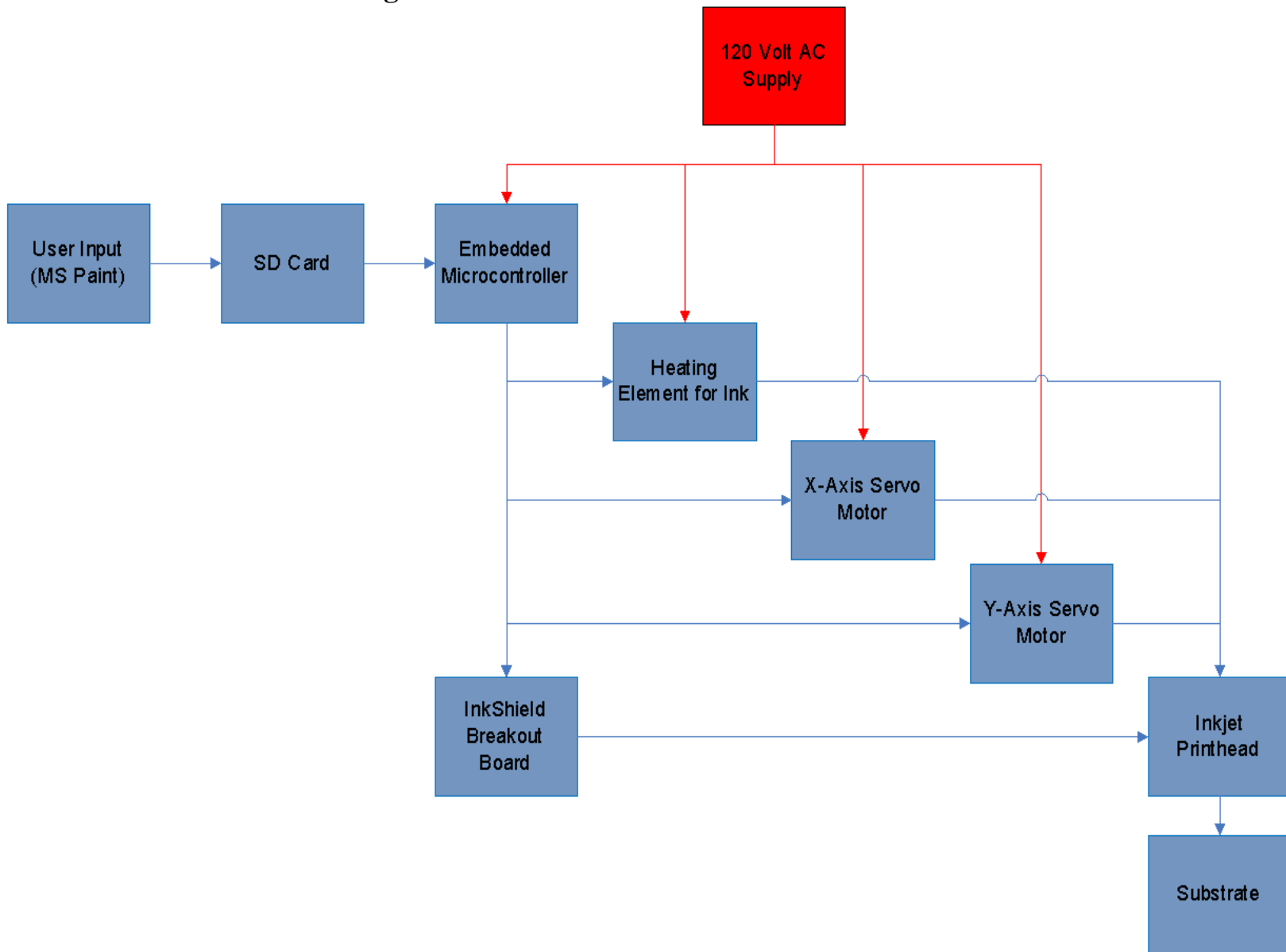
Our ultimate goal is to have a few of these printers in UCF circuit design lab rooms. This would benefit both the students and the University. Students would be able to understand design

concepts and this technology could be a bragging point for UCF to show off how great their Electrical Engineering program really is!

3. Project Specifications and Requirements

- Estimated weight between 5 and 10 pounds
- Maximum printing area – 5x5 inches
- Operating voltage – 120V AC
- Arduino Microcontroller
 - Serial Communication
 - InkShield Breakout Board
 - SD card integration for design storage
- Inkjet Material – Conductive Ink (Silver, Gallium/Indium, or Charcoal based carbon)
- Stepper Motors to move the inkjet print head in both the x and y axis

4. Block Diagram





5. Project Budget and Financing

The Universal Circuit Fabricator is approximated to cost \$360. Currently to be funded by the team members, unless a sponsor is found. Therefore, the group members will evenly distributed the costs necessary for completion of the project amongst themselves. Some of the parts utilized might be recycled from other devices that the team members currently own, to be able to reduce the cost of the project. The conductive ink is very difficult to put a price on. There are so many variation of inks that it all depends on what we find to be the best fit for the project.

Items	Price
(Stepper Motor) NEMA 17	15 each
Components to control motors	10-20
Arduino InkShield	60
Arduino Uno	provided by team member
Conductive Ink	20-100
Power supply	35-40
Frame & Case	100
Wiring & Circuitry	75
Total	\$300-420

These values are not set in stone, and will change depending on what specifications are required to satisfy the project. Therefore the total cost of the project is only an estimate.

6. Project Milestones

ID		Task Name	Duration	Start	Finish
1		Research	11 days	Sat 9/6/14	Tue 9/16/14
2		Ink Type Research	9 days	Sat 9/6/14	Sun 9/14/14
3		Gallium/Indium Ink Productio	2 days	Sat 9/6/14	Sun 9/7/14
4		Gallium/Indium Ink Testing	1 day	Mon 9/8/14	Mon 9/8/14
5		Silver Flake Ink Production	2 days	Tue 9/9/14	Wed 9/10/14
6		Silver Flake Ink Testing	1 day	Thu 9/11/14	Thu 9/11/14
7		Charcoal Ink Production	2 days	Fri 9/12/14	Sat 9/13/14
8		Charcoal Ink Testing	1 day	Sun 9/14/14	Sun 9/14/14
9		Substrate Type Research	2 days	Mon 9/15/14	Tue 9/16/14