EE344: Electronic Design Lab
Miniature Programmable Power Supply Unit
Milestone 4: Final Deliverables

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1 Project Details

The objective of the project was to design and develop a compact, programmable power supply capable of producing variable DC voltage from a single input DC supply. The power supply should be designed to be portable, easy to use, and pluggable on a standard breadboard. The power supply uses an appropriate charger to draw power from AC mains and should use the DC voltage provided by the charger to generate a variable DC source.

The power supply has an **input power of 5V 2A** via USB-C of a regular mobile phone charger and must give an **output of 12 - 15V variable, 0.2A max**. The power supply should have a **small display** and a few buttons to interact with it, and the user should be able to vary the output voltages using this button interface.

Various DC-DC converter topologies were explored to determine the most appropriate solution for this project. The team also investigated appropriate solutions for an embedded user interface for programming and monitoring performance.

The team strategized and identified the optimal design based on component availability and integration of various blocks. Once the design was finalized, the team tested and validated the design to ensure that it met the required specifications. Finally, the team made a Printed Circuit Board (PCB) design of the prototype.

Overall, the completed project involved designing and building a compact, programmable power supply that is reliable, versatile, and portable, making it an ideal solution for many portable projects that require a small, versatile power supply.

2 Design

2.1 Block Diagram

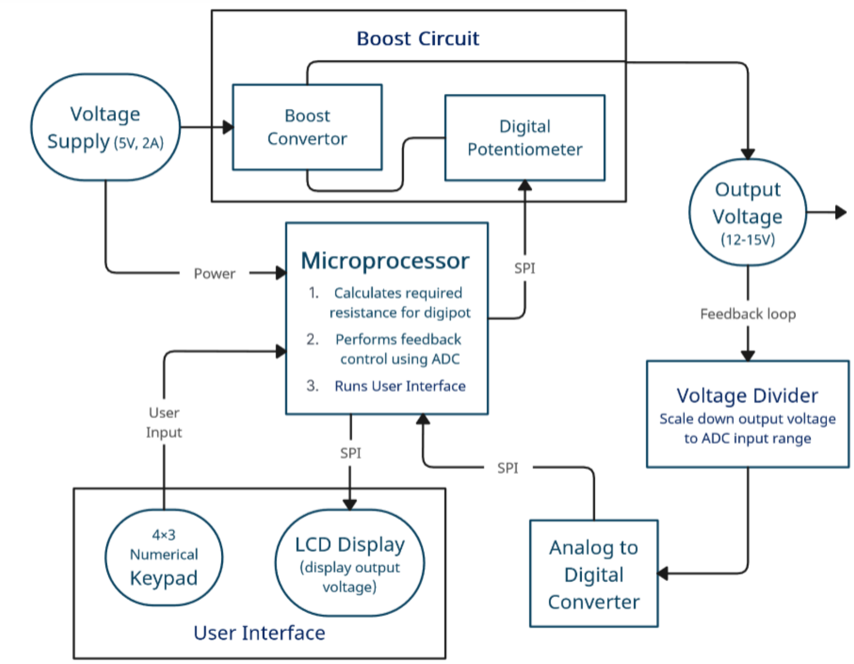

Figure 1: Schematic for the Design

2.2 Schematics

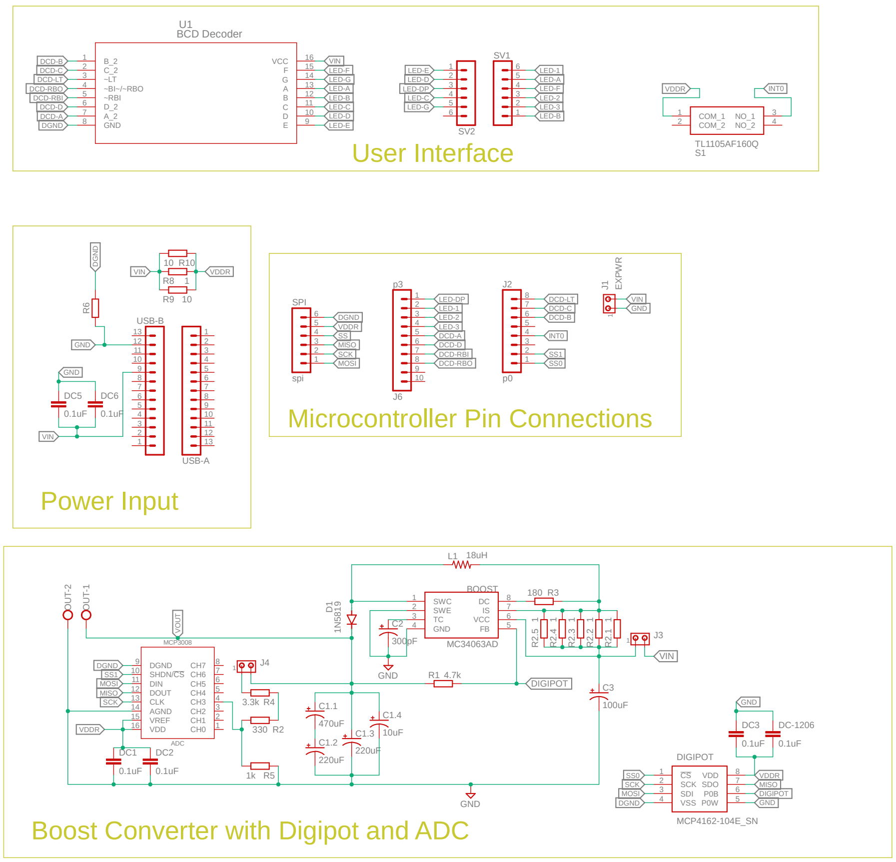

Figure 2: Schematic for the Design

2.3 PCB

2.3.1 Design 1: With Ground Planes and Smaller Trace Widths

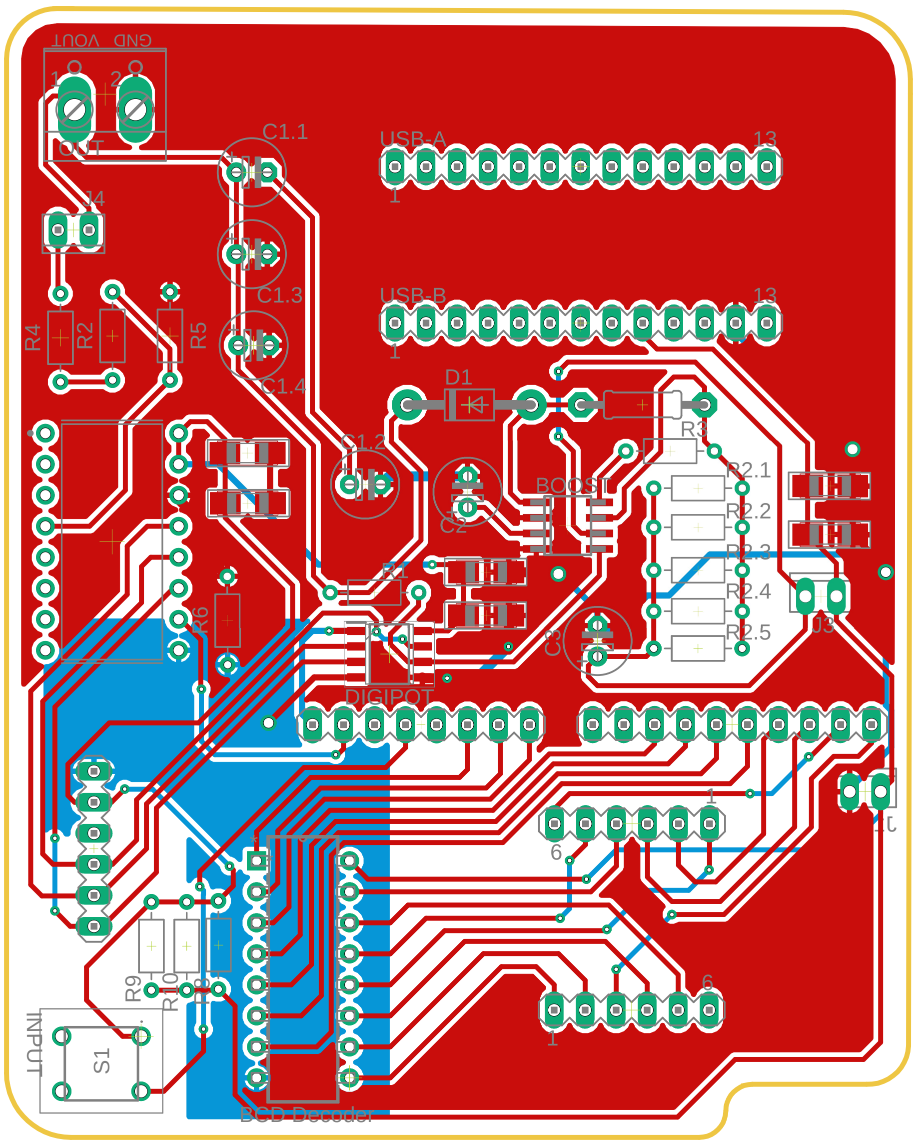

Figure 3: Complete PCB

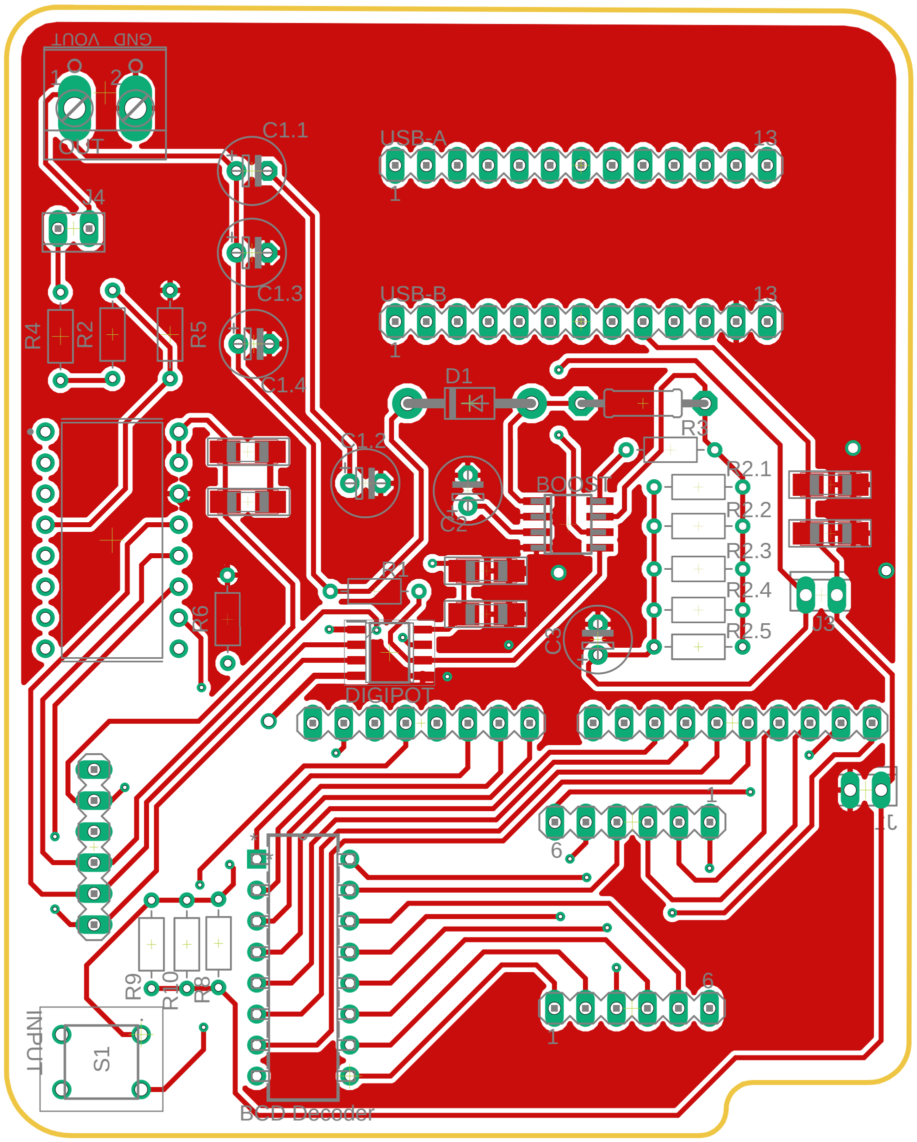

Figure 4: Top Layer of PCB

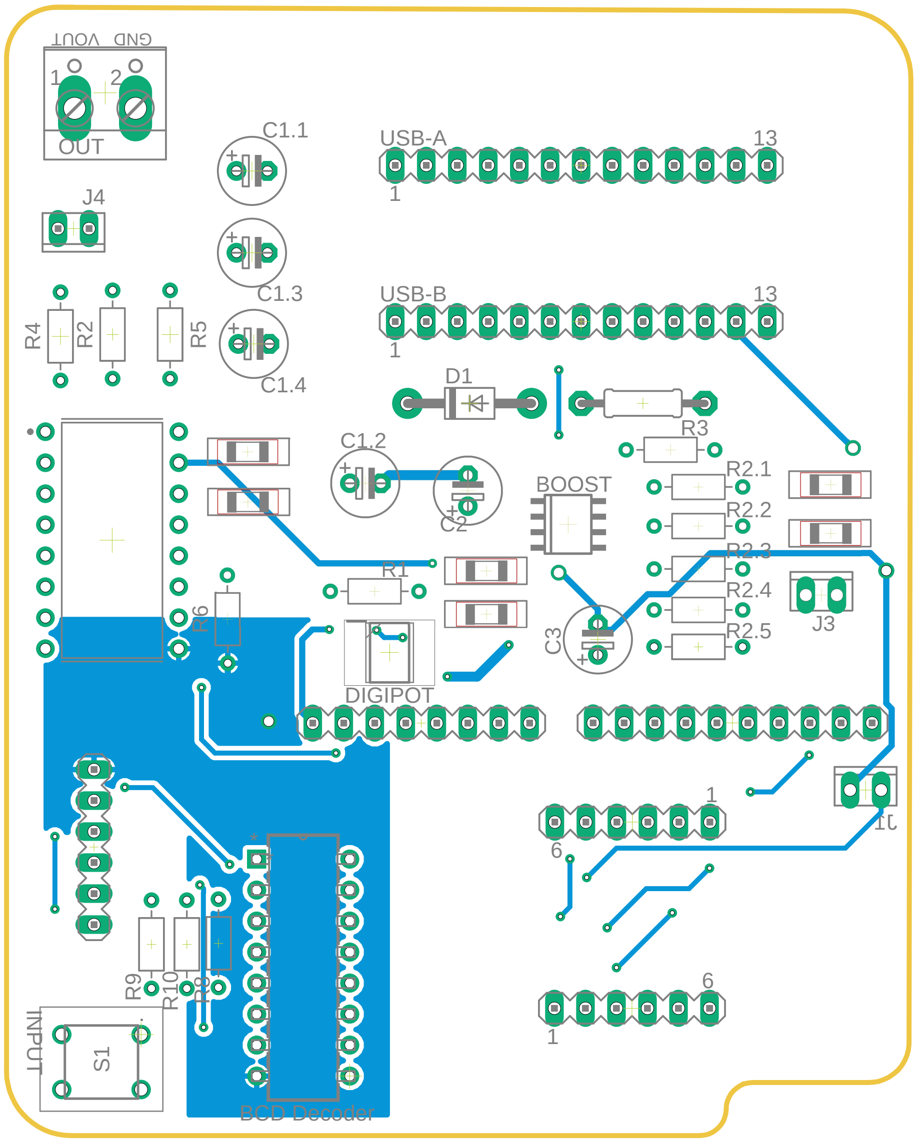

Figure 5: Bottom Layer of PCB

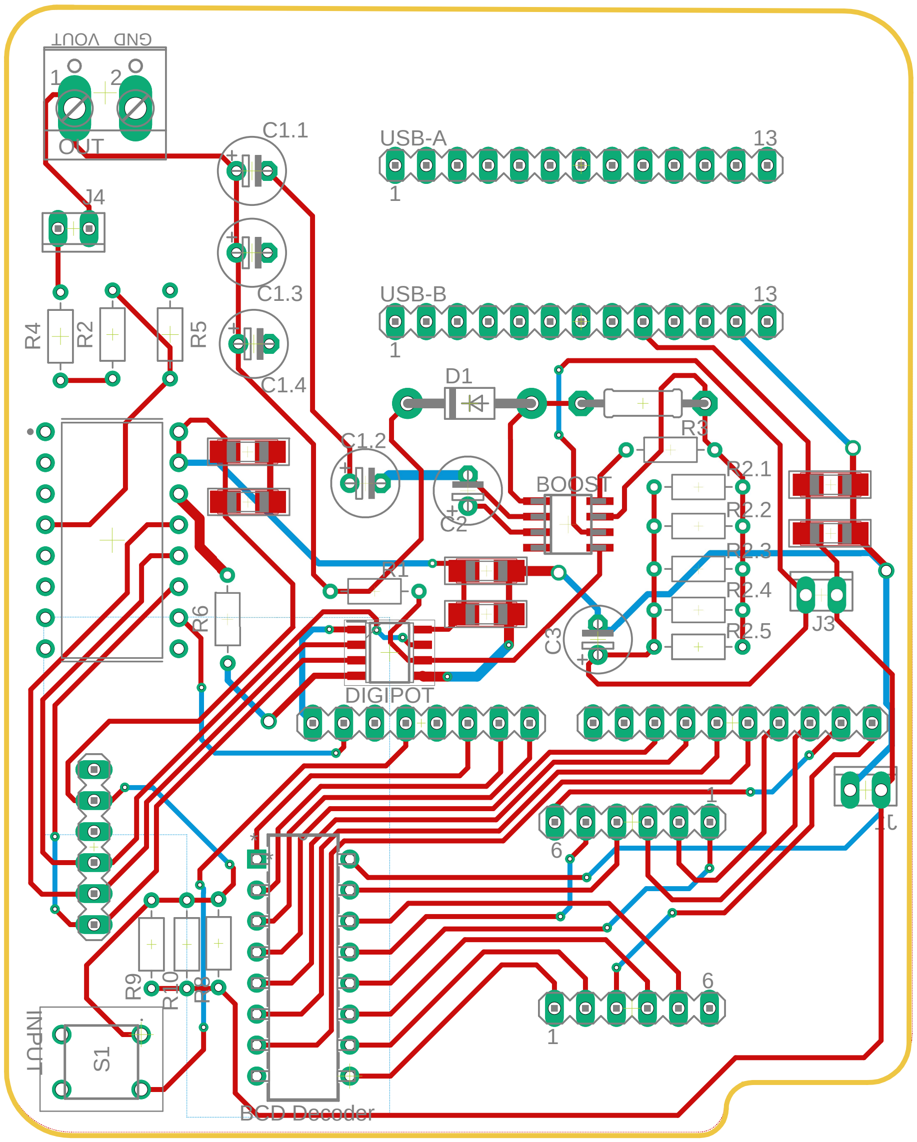

Figure 6: Complete PCB without Ground Planes

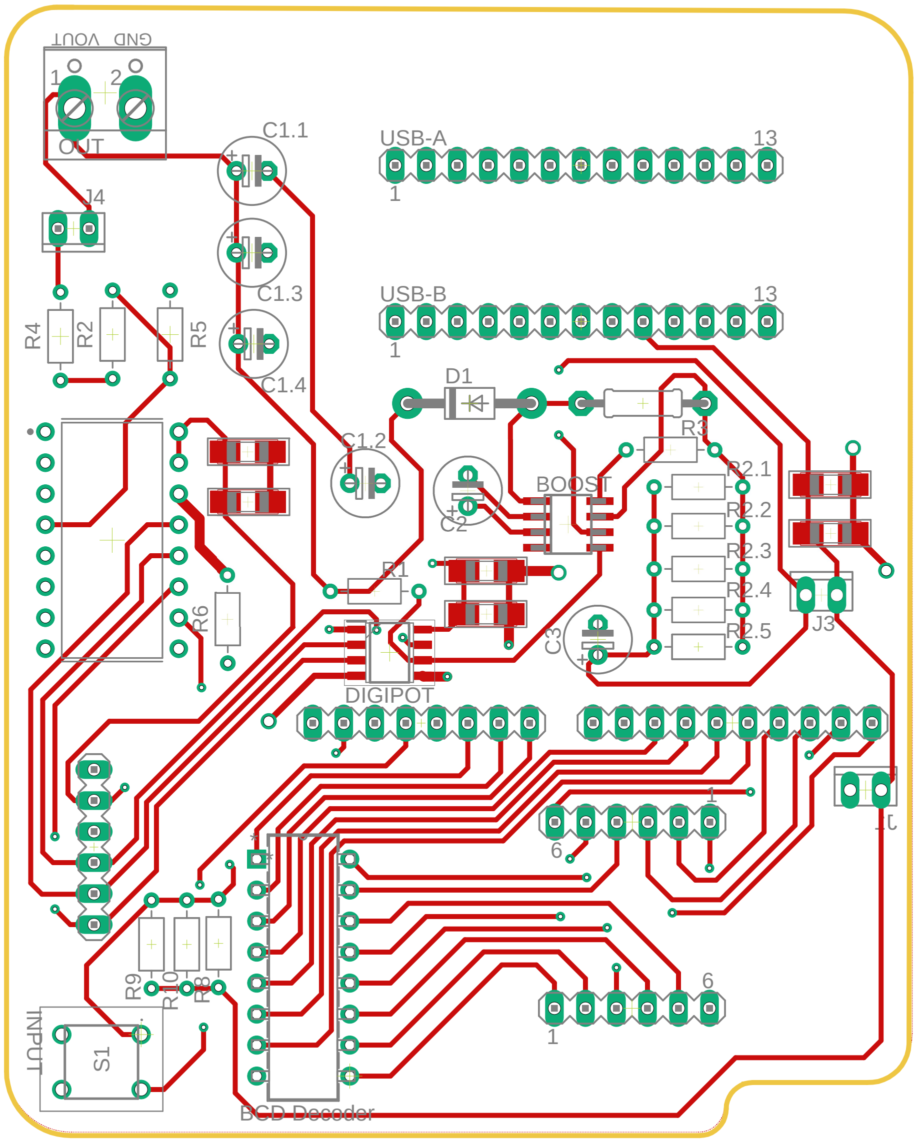

Figure 7: Top Layer of PCB without Ground Plane

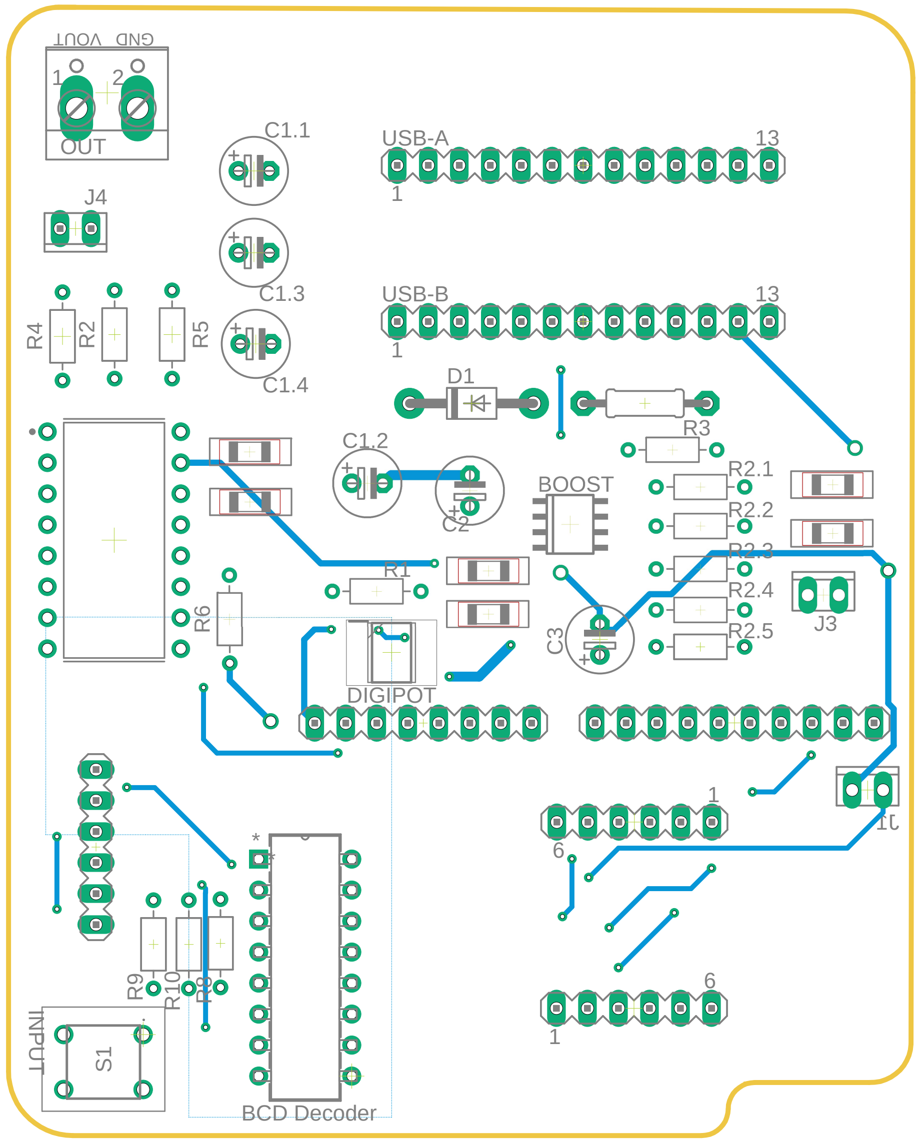

Figure 8: Bottom Layer of PCB without Ground Plane

2.3.2 Design 2: No Ground Planes, Greater Trace Widths

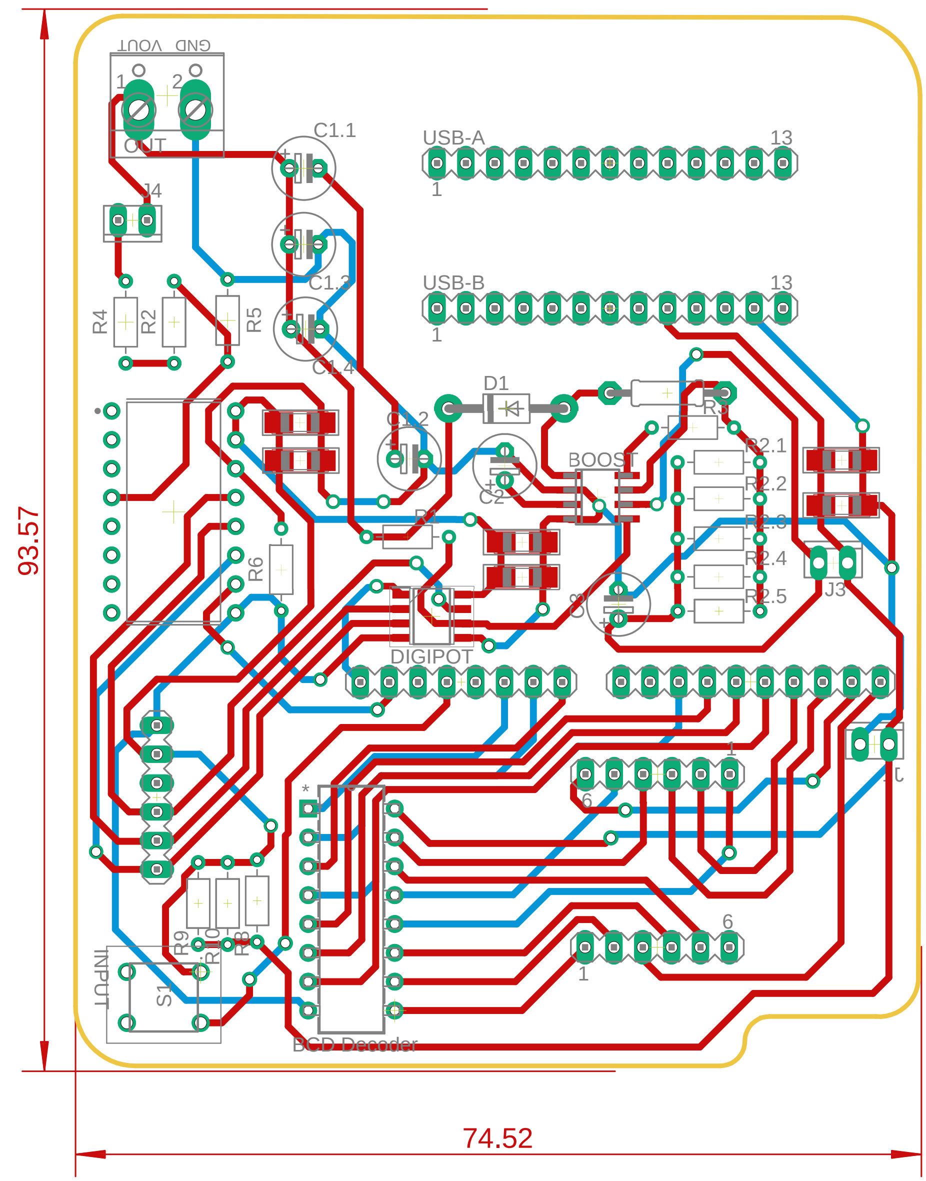

Figure 9: Complete PCB

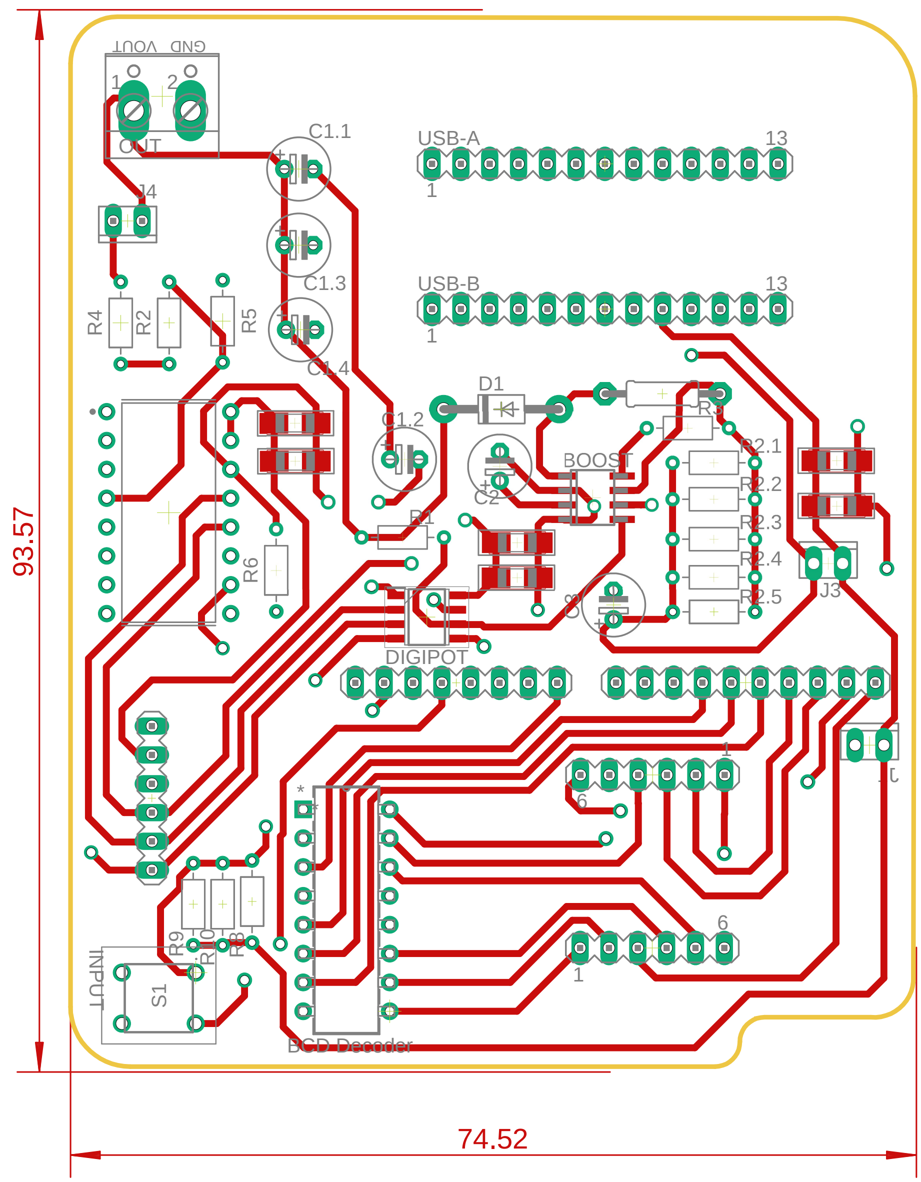

Figure 10: Top Layer of PCB

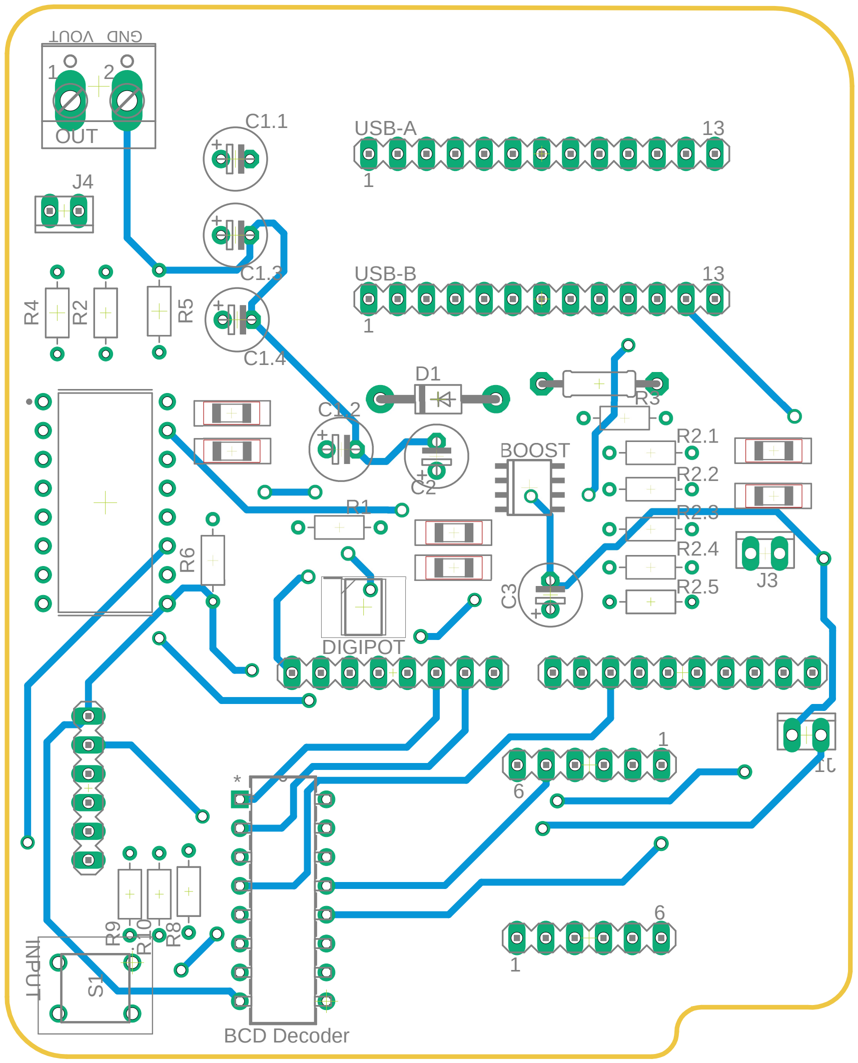

Figure 11: Bottom Layer of PCB

2.4 CAD

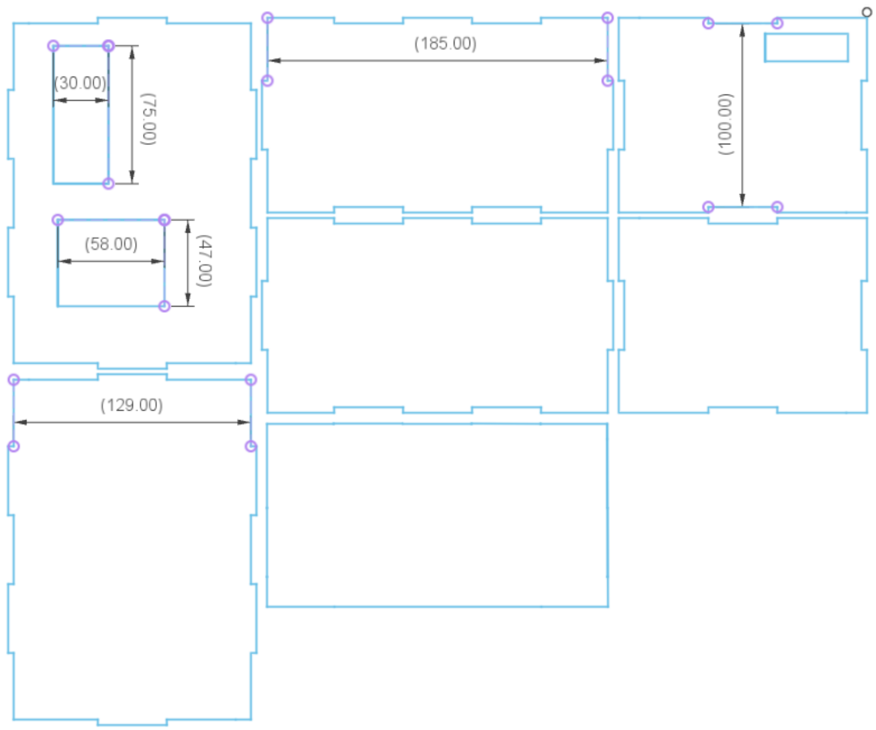

Figure 12: CAD image of the casing

2.5 Bill of Materials

All materials have been returned to WEL lab.

Component Name	Component ID/ Component Value	Quantity
Buck-Boost Converter	MC34063	1
Digital Potentiometer	MCP4161	1
Analog-to-Digital Converter	MCP3008	1
Microcontroller	AT89C5131A-M	1
LCD Display		1
Keypad	MCAK304NBWB	1

Table 1: Materials obtained through WEL

Component Name	Component ID/ Component Value	Quantity	Cost
Resistor	1Ω	10	200
Inductor	$18\mu H$	10	300
Diode	1N5819	10	250
PCB		3	3009

Table 2: Materials paid for by team

3 Results

We first tested the system without any loads and observed almost accurate voltage output with $\pm 0.5V$ fluctuation, which was the error threshold we had expected.

Figure 13: No load test setup

For load testing, we first used low load resistances, which had power requirements of 0.125W. We tested for higher voltage values too, since these resistances draw very low current.

Voltage=	$12V$	$13V$	$14V$	$15V$	$18V$	$20V$
890Ω	15	16	16	17	20	22
$5k\Omega$	2.2	2.5	2.8	3	3.6	3.9
$10k\Omega$				1.77	1.83	1.9

Table 3: Current drawn by load in mA

We further tested with power resistances. Here, the voltage output suffered a little; however, we still had considerable current output.

Voltage=	$12V$	$13V$	$14V$	$15V$
100Ω, 10W	71	72	69	70
100Ω, 5W	57	58	56	54
470Ω, 10W	368	371	367	370

Table 4: Current drawn by load in mA

Hence, our power supply does indeed supply power.

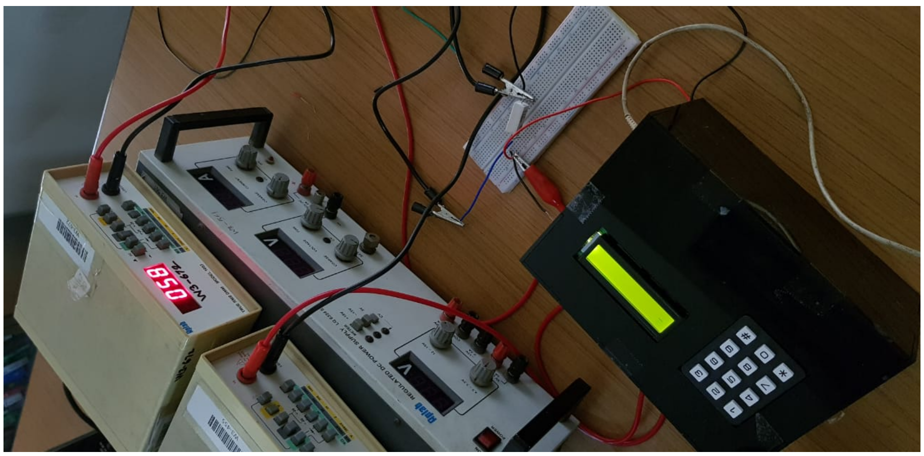

Figure 14: Load test setup

4 Conclusion and Future Work

In conclusion, the project aimed to design and develop a compact, programmable power supply that could produce multiple voltages from a single input supply. While we were able to partially complete the project, we encountered some limitations that prevented us from achieving all the desired objectives.

One of the limitations we encountered was the inability to incorporate a feedback loop. As a result, the power supply only works well for load setup up to a certain limit of power consumption. However, we acknowledge that incorporating a feedback loop would significantly improve the power supply's overall performance.

Additionally, we were unable to use the PCB due to late delivery, which limited our ability to test and validate the design fully. However, we plan to work on this in the future so that our design is even more compact and efficient.

Overall, despite these limitations, we were able to design and develop a power supply that partially met the required specifications. The project highlighted the importance of thorough planning, resource management, and effective communication in achieving successful outcomes in engineering projects. In the future, we plan to build on our learnings from this project and continue to improve our skills and expertise in this area.