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Another Power Supply in the Wall, ECE342-W23 002-1

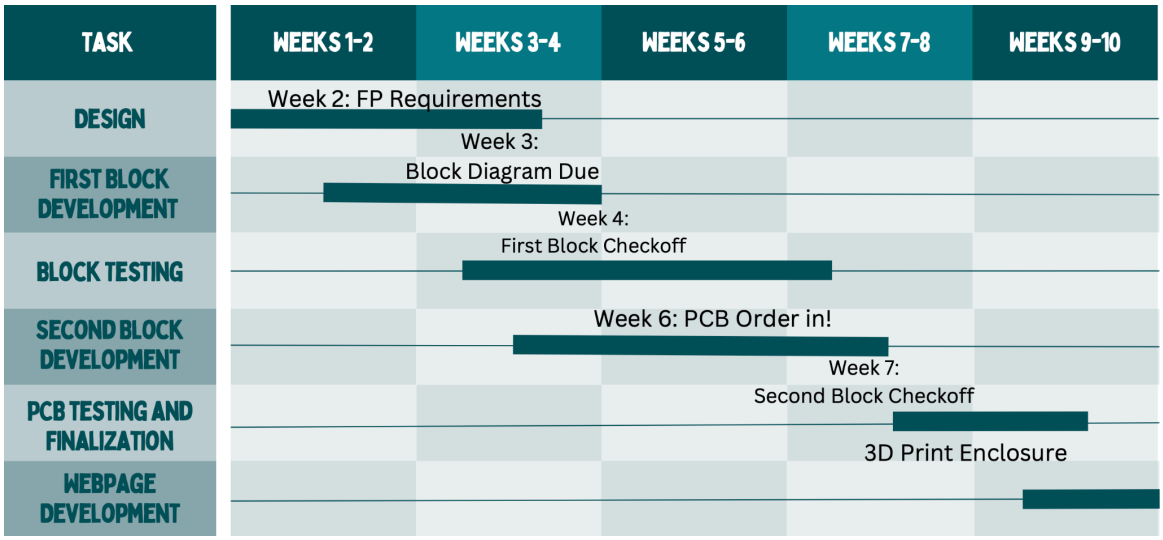
Executive Project Summary:

At the start of the term we were assigned the PC controlled DC power supply. We thought this would be a cool project because one might be able to use it to power a guitar pedal chain, for example, or even use it to do project testing for another assignment that required less than 14V. Our initial thoughts were to use an AC wall outlet as a supply, then step down and rectify that voltage to the desired DC signal. After designing this system, we found that we would actually be taking in a DC input and stepping that down, with the twist of requiring more output current than input. At first we were quite puzzled by this as it seemed to break KCL, but through further investigation we found the Buck Power Converter which, with a constant power in and out, allows for a step down in voltage with an increase in current.

With this major conceptual issue figured out we started onto our project design. This involved separating the project into 6 blocks with interface definitions so that the project could be handled stage by stage rather than as a single unit. Our blocks became: (1) PC graphic user interface (2) Arduino code to handle user input and send PWM signal for desired output voltage (3) the buck converter itself (4) Current and Voltage Sensors (5) Arduino LCD control (6) 3D printed enclosure. Albert had experience coding microcontrollers so he happily accepted the arduino code blocks (2 and 5). Christian had just taken a power electronics course so he took on the buck converter block as well as ventured into the realm of 3D printing (3 and 6). Lane took on the last two blocks of the GUI and Sensors, which required python coding skills as well as testing skills for the sensors. Blocks (1-3) were completed during weeks 3 and 4 and blocks (4-6) were completed during weeks 5 and 6. Although the project was separated into these 6 distinct blocks, the blocks did not handle every aspect of the project. Other issues came up when building each block, so additional parts of the project had to be completed as well, such as the MosFet Driver circuit which had to be included on the PCB.

Working through this project, starting from scratch, and using very few ICs, we learned alot about power conversion, using a microcontroller, building a GUI, 3D printing as well as the system design process as a whole. It was very important to return to our blocks several times and tweak them as we learned things about our design. A great example of this is with the nMos driver circuit for the pMos Buck Converter. With the source of the pMos at 30V, a gate voltage of 30V is required to turn the pMos off and prevent current from running into the buck Converter (This PWM on/off is how the voltage is stepped down). The arduino produces only a 0-5 PWM signal which does not reach that 30V required threshold, therefore an additional nMos circuit is designed (visible in electrical schematic image) in order to drive the pMos on and off. Additionally, the use of the PCB was essential to put the project together as a whole, though this was not a block design so it went under the radar until quite late in the project. Lastly, as a team and team members we learned a lot. While working with a group, tensions can rise due to many factors such as approaching deadlines, yet as long as each member contributes to the project in their own way, using their specific skill set, the group project comes out looking professional and well put together.

On the following page is the rough timeline for how our project went during the 10 week winter term of 2023:



Through this design process we also learned things don't work out just like one would expect so the timeline as well as the project had to be tweaked throughout the term. For example the PCB did not get ordered until week 8 as a result of the additional nMos driver circuit.