Mechatronics Intro Project

LED Circuit, Schematic, and PCB Design

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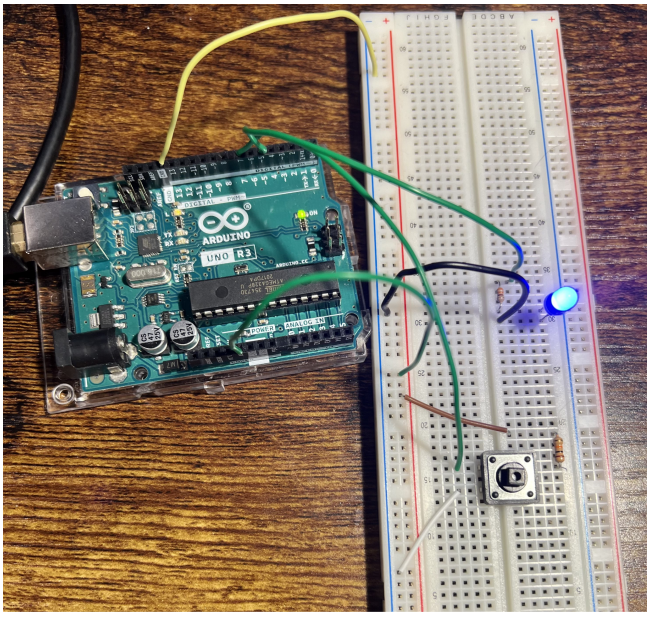

Figure 1.0 Prototype circuit with LED and push button on Arduino

At the beginning of the project I was tasked with creating a LED circuit with a separate push button circuit to toggle the LED on and off as well as allow the circuit to receive input from a serial monitor. Beginning with an Arduino Uno R3 development board I constructed a basic LED / resistor circuit on digital pin 5 output of the arduino in order to use PWM output functionality, which enables the LED to have varying duty cycles and thus controllable output brightness. Attached to digital pin 7 was the push button that allows user input to toggle the LED ON/OFF state. In order to ensure input is correct, I implemented a pull up resistor attached to 5V that would set digital pin 7 input to high if the button is not pushed with the other end of the button grounded producing a low / zero input if the button was pressed.

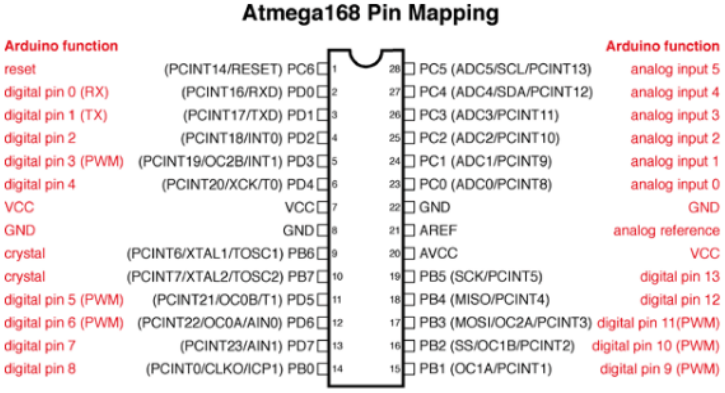

Figure 1.1 Red text displays the arduino pin functionality with each Atmega pin

After verifying proper configuration I began programming the Atmega using Arduino IDE. I began by initializing data direction for the LED output and Button input as well as setting the proper baud rate for serial monitor communication. Following this my program would first check if the LED needed to be toggled on/off by reading a low input from digital pin 7, indicating the button is pressed. If so the LED fades up to the proper brightness (initially 100%) using the analogWrite function that would set PWM output on digital pin 5. With a boolean variable representing the ON and OFF states set when the button is pressed. IF the LED is in the ON state, Arduino serial functions are used to read available input from the Serial Monitor that is then stored in an int variable (character converted to int value) to compare with each brightness case A 0%, B 20% , C 40%... F 100% and the status case '?' outputting the brightness level to the serial monitor. In order to set the correct percentage I used analogWrite 250 as the case for 100% brightness with 0-250 in increments of 50 as the duty cycle for each case. This is because the brightness remains constant, but by causing the LED to be on for 50 ticks out of the maximum 255 (the maximum value of the counter) it creates the illusion of a lower brightness, in this case 20%.

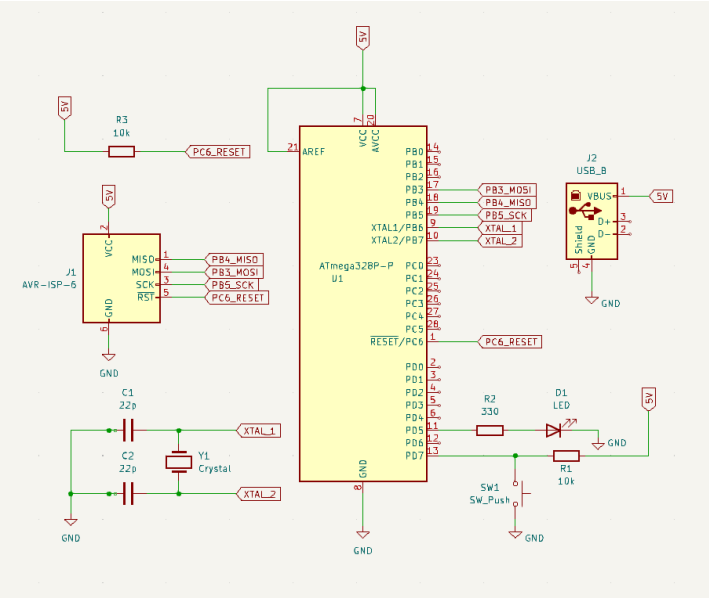

Figure 1.2 Final Schematic

After completing the circuit I began designing the schematic and PCB for the board and its components. For the schematic I had to select the proper component from the KiCad library, assign a PCB footprint, and properly connect everything together on the schematic and add traces between pins on the PCB with ground plates on each layer. I made use of the DCR in order

to test if my board was configured properly and exported files to test on JCLPCB's website to make sure everything was valid and used the 3D viewer to show the board with the available components. The PCB part of the project was definitely the largest learning curve for me as I had never designed a PCB before; but throughout the project I used forums and tutorials available online in order to troubleshoot. I know my code and design could be optimized especially with the PCB footprint but I was definitely trying to absorb all of the information at once. I enjoyed picking up a new skill with PCB design, and I am excited to work on more design projects in the future.

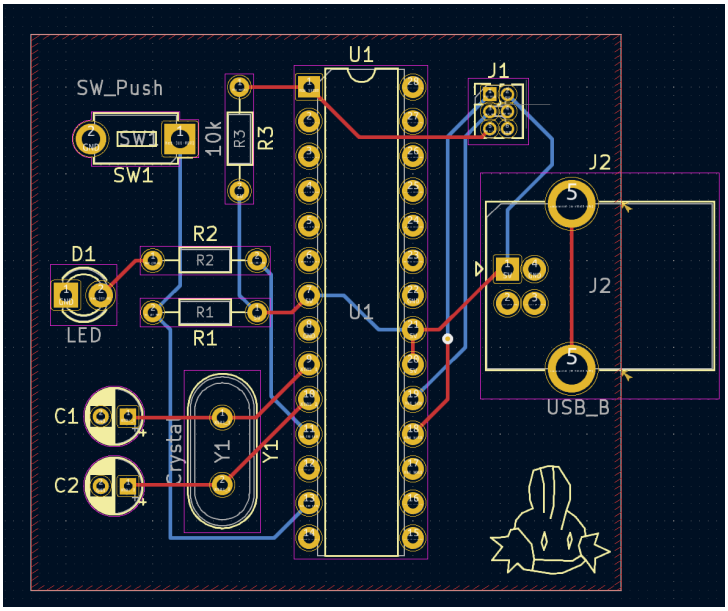

Figure 1.3 PCB in KiCad (Featuring Mudkip)

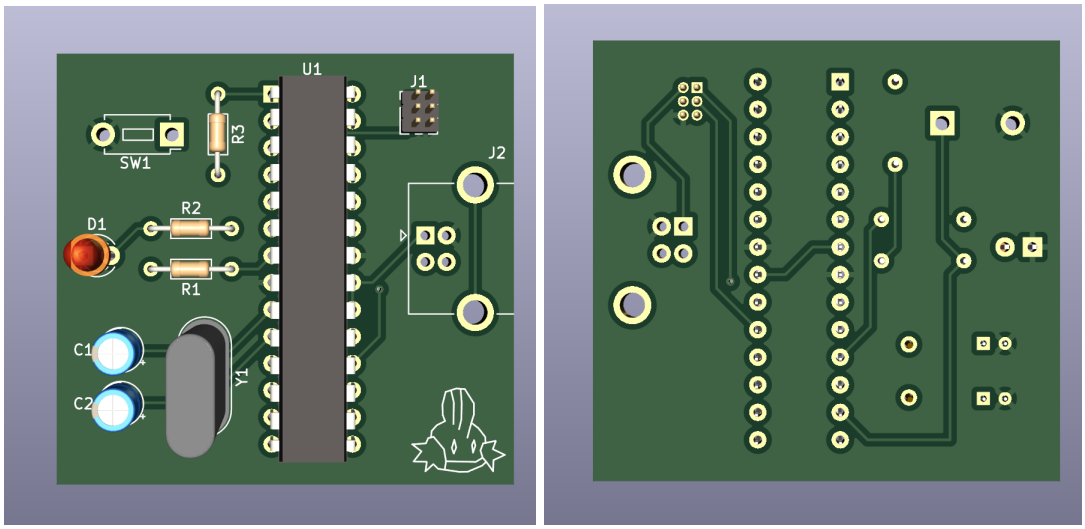

Figure 1.4 3d view of the final PCB

Bill of Materials

Part Name	Number Used	Price (Excludes Shipping)	Digikey Link
Printed PCB 2 layer board 40.64x43.18mm	1	$2	ORDER FROM JCLPCB
Atmega328p Microcontroller	1	$2.97	https://www.digikey.com/short/dqcp9h0t
AVR-ISP-6 PIN	1	$0.95	https://www.digikey.com/short/9m4tv8h3
22pF Capacitors THT	2	$0.29	https://www.digikey.com/short/8q4283r2
AT-16.000MAGE-T Crystal	1	$0.27	https://www.digikey.com/short/dftpqhw4
330 Ω Resistor	1	$0.10	https://www.digikey.com/short/0rf7pnz5
10kΩ Resistor	2	$0.10	https://www.digikey.com/short/9f4j8cdw
LED	1	$0.10	https://www.digikey.com/short/8fmnm88d
Push Button	1	$0.29	https://www.digikey.com/short/bph8dpth
USB B Receptacle	1	$0.72	https://www.digikey.com/short/wmbf8jd3
FINAL UNIT	1	$8.18	DNA

Figure 2.0 Bill of Materials with digikey links.

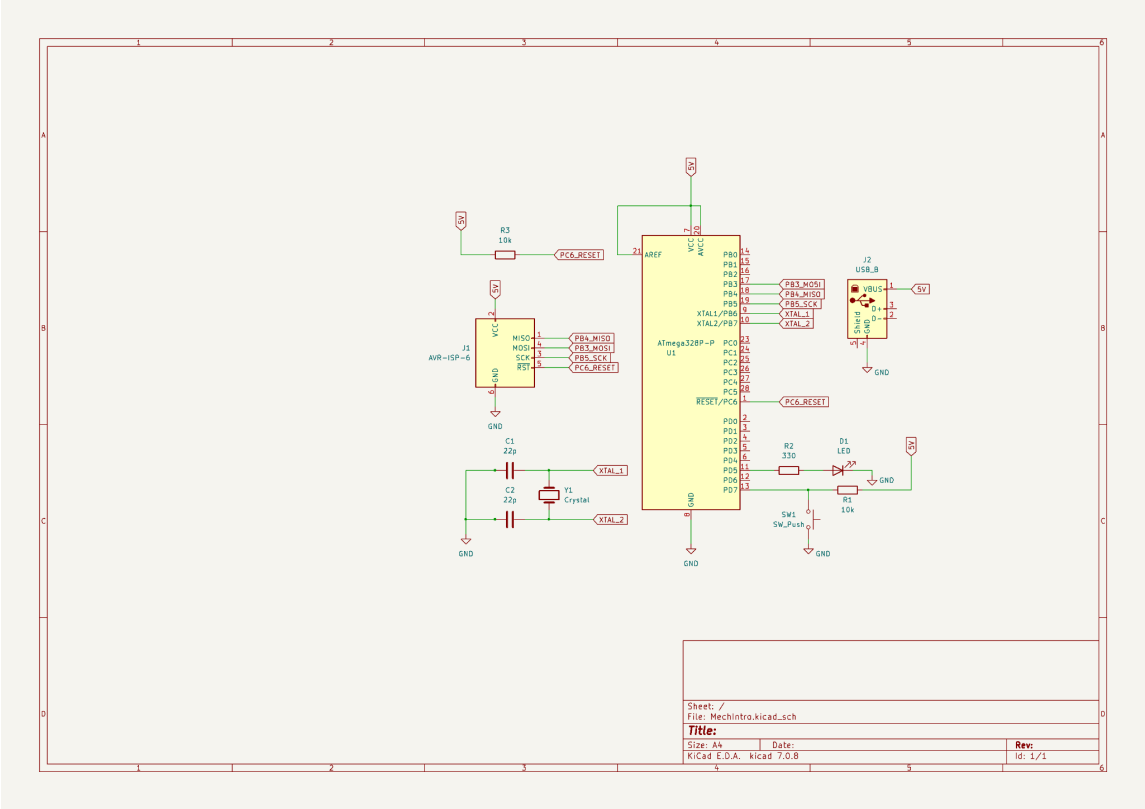

Figure 2.1 Full Size Picture of Schematic