Efficient DC Motor Control System

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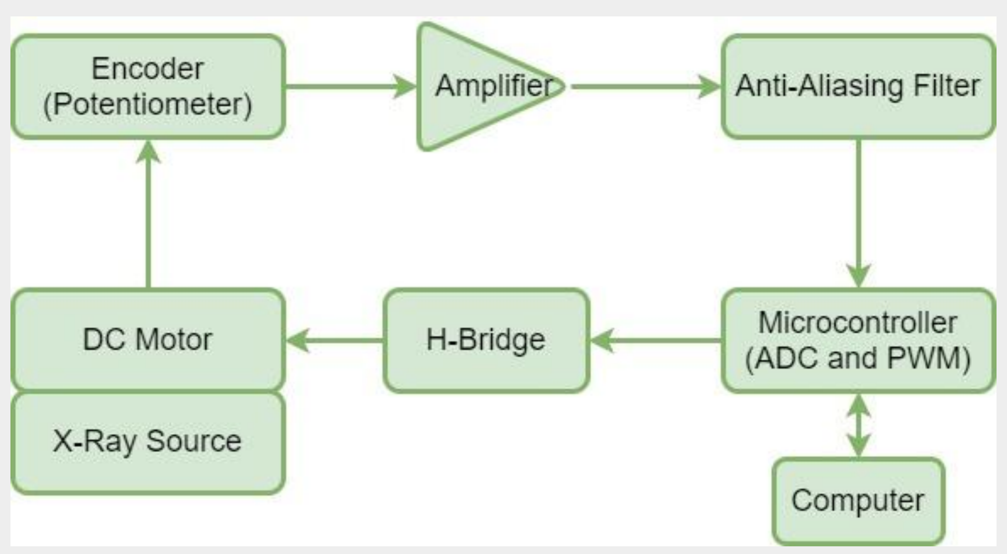
Abstract

The purpose of this project is to design an efficient motor control system, so the motor would rotate 360 degrees in three seconds while stopping and starting every 100 milliseconds. Total cost for the system should be less than 500 dollars.

System Block Diagram



Bill of Materials

- 12-V, 80-RPM Gear DC Motor
- 6639S-1-203 Potentiometer
- STM32G071 Microcontroller
- BD6222HFP-TR H-Bridge IC
- AD8561ARMZ Amplifier IC
- MCP2221 USB-to-UART Serial Converter
- UA78M33CKVURG3 Voltage Regulator

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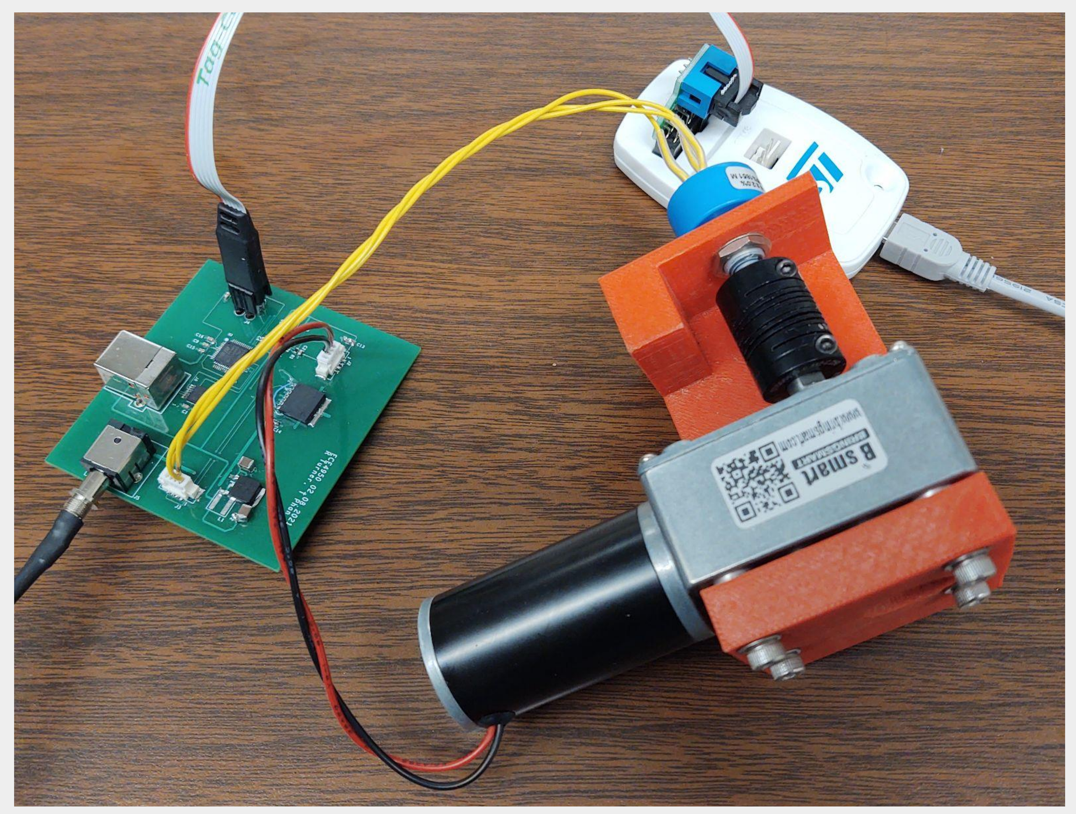
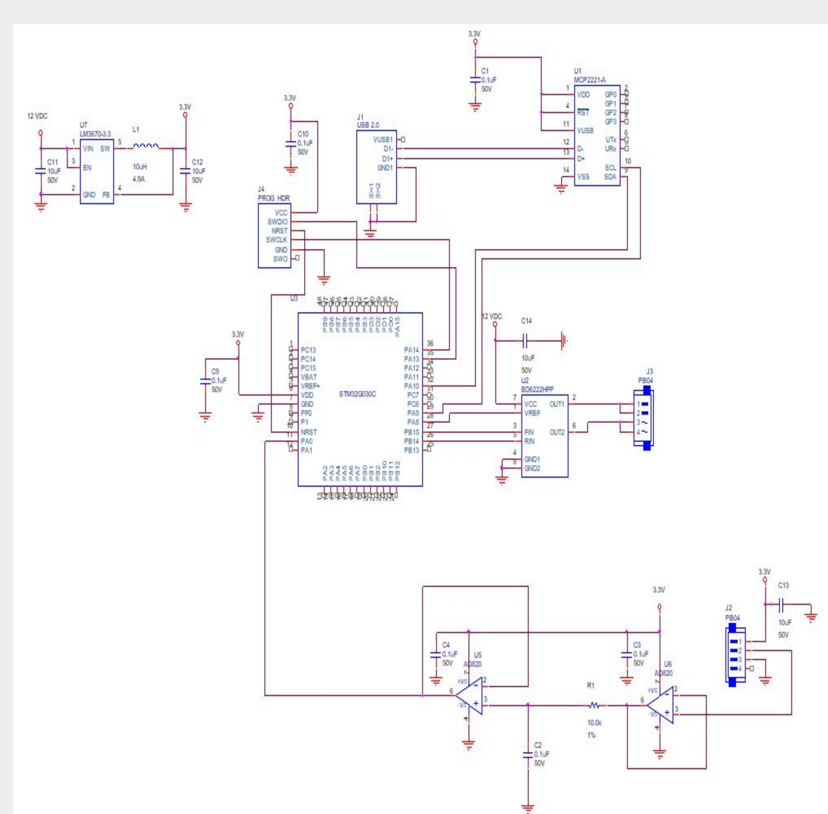
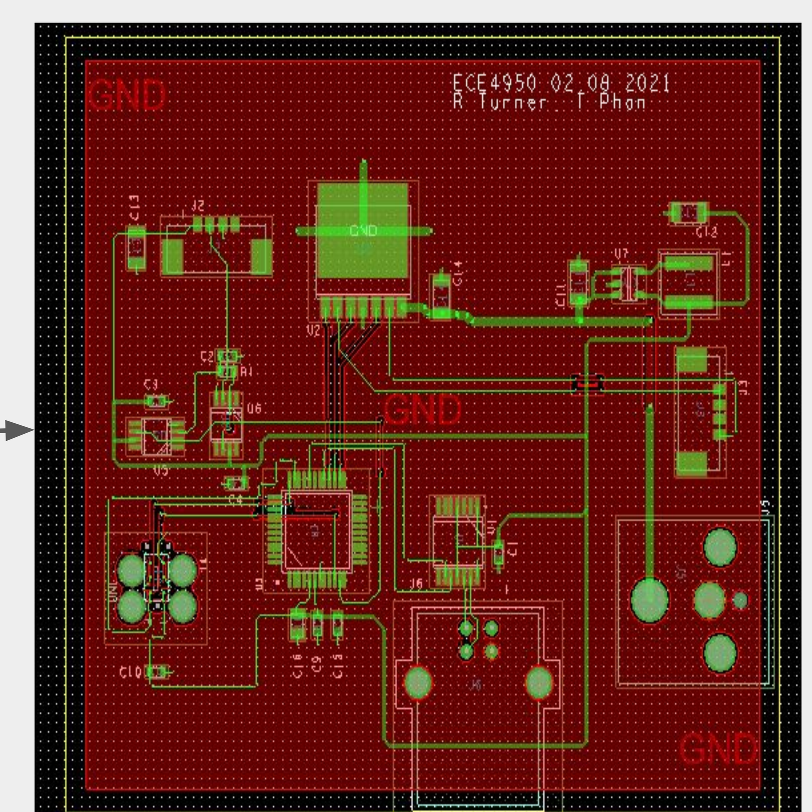
Final Design

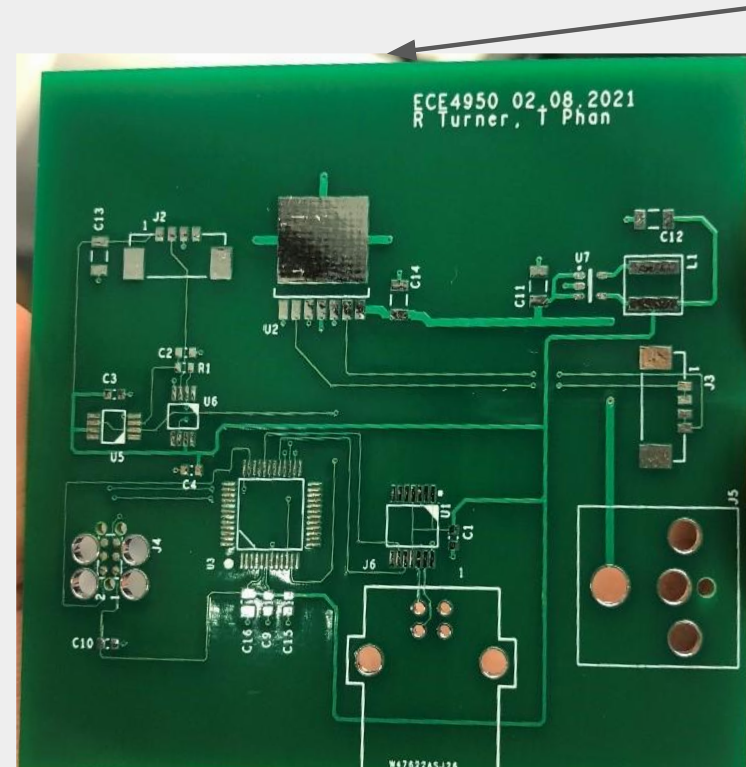


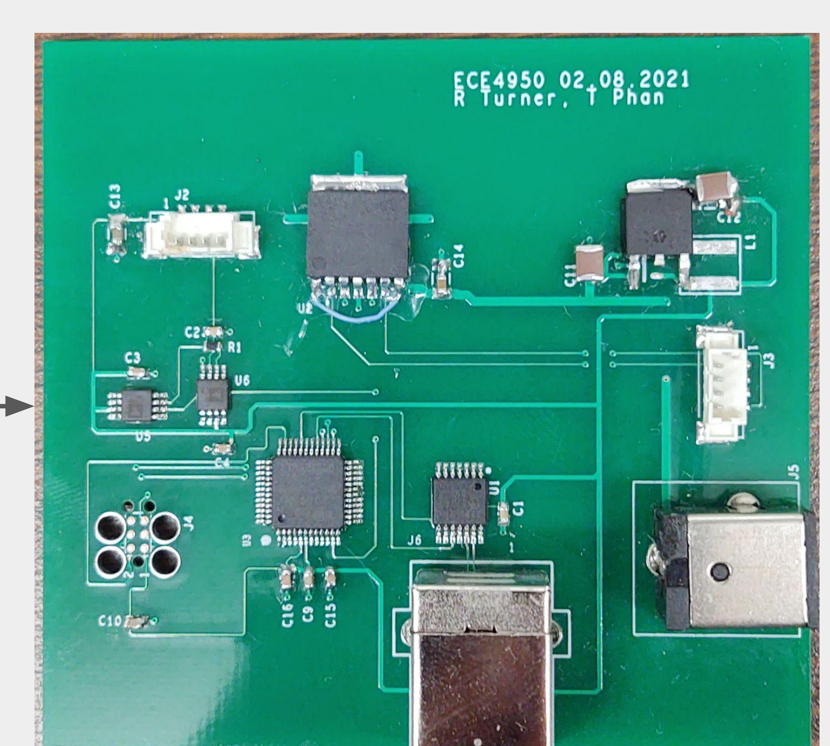
A shaft coupling is used to couple the motor and the potentiometer. The wires (yellow and black/red) have connectors crimped to them, so the motor and the encoder (potentiometer) can be connected to the board. The microcontroller is programmed with a special programming port on the board that is connected to the computer. Power is supplied via a cylindrical port that provides the board with 12V and a voltage regulator brings the voltage down to 3.3V for some of the components.

Printed Circuit Board (PCB) Design



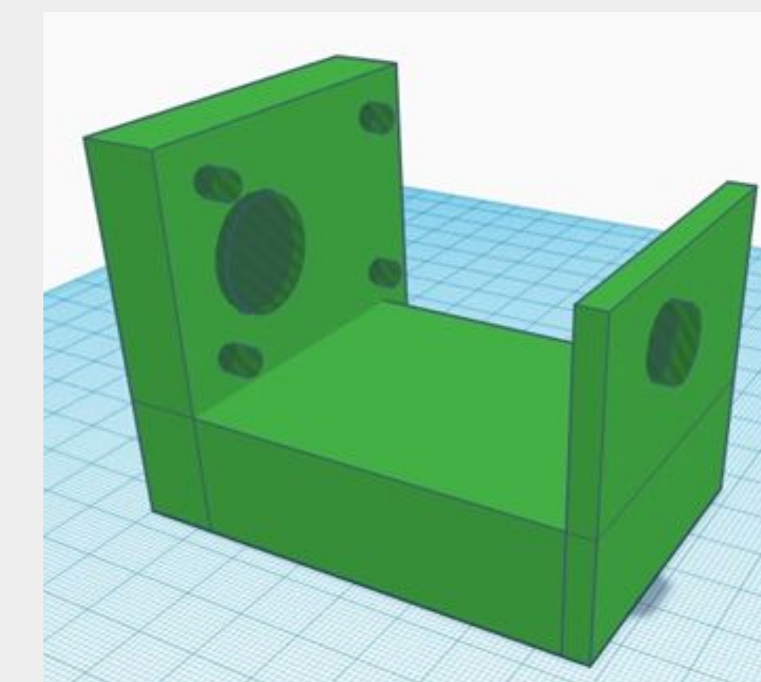




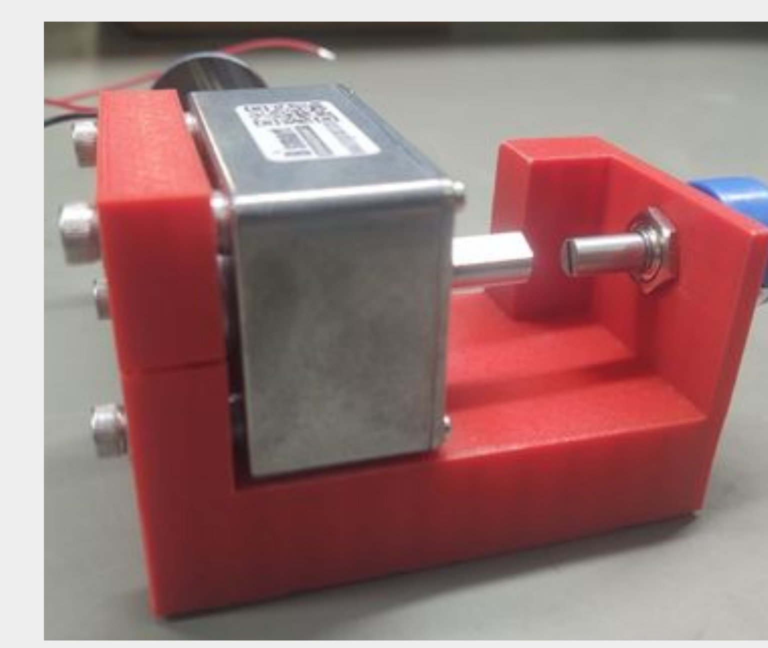


The schematic was designed using the OrCAD Capture application. Some capacitors were added between the power sources and the ground to avoid instability of the power supply. A voltage regulator was added into the schematic since some of the components require power supply voltage of less than 12 volts.
After the schematic was finalized, the board layout was designed using the Allegro application.
The board was ordered from PCBWay, out of China, in a quantity of ten since this was the same price as ordering one.
After the boards arrived, all of the components were soldered onto the board.

Holder Design



The holder was designed using a free software called TinkerCAD. After two iterations and working through issues with 3D printing, the final version of the holder was printed.



Conclusion

All the parts used were picked out with cost savings in mind to minimize the cost of the final system. The holder was designed with a modelling software and then 3D printed. The PCB was designed using OrCAD Capture and Allegro. Pulse width modulation was then programmed in C language to regulate the rotation of the motor. The final design was successfully built for less than $200. A possible improvement is to develop a mobile application to control the system through electronic devices.