



Engineering Design Portfolio

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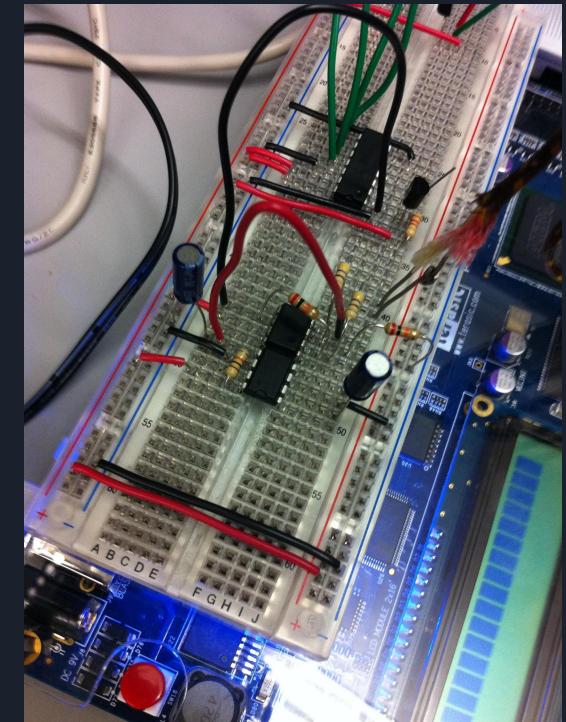
Reflow Oven Controller

Temperature Sensor Circuit Design

Reflow Oven Controller



- ❖ Part of a 6 member team
- ❖ Concentrated work on hardware, and circuit prototyping
- ❖ Designed a circuit attached to a FPGA that controlled an oven's on and off function
- ❖ Reflow soldered Ip51b microcontrollers

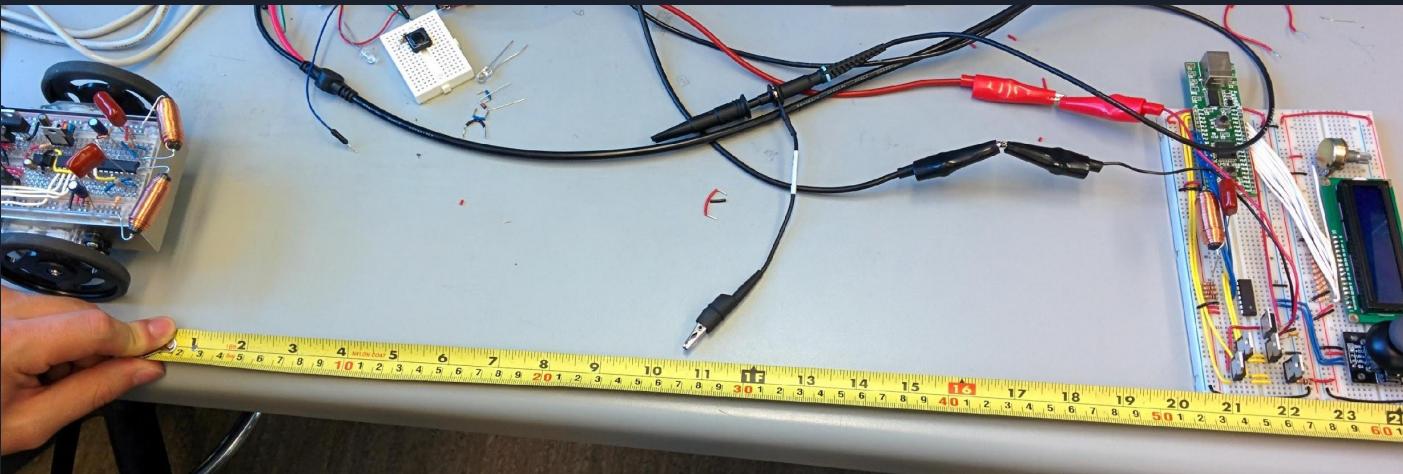
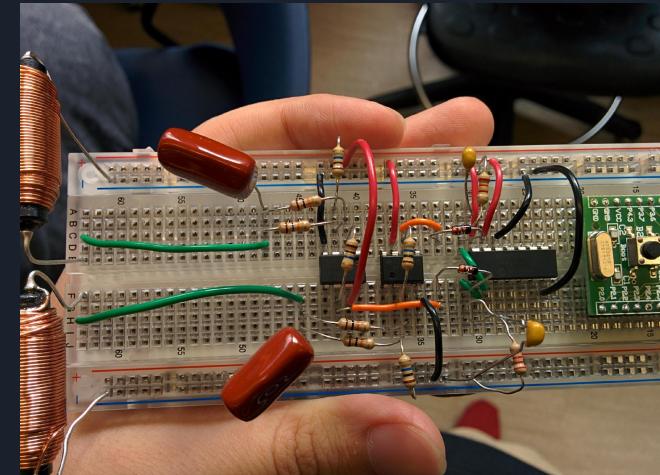


Electromagnetic Tethered Robot

MOSFET Differential H-Bridge Motor Control

Electromagnetic Tether Robot

- ❖ Part of a 6 member team
- ❖ Majority of work done on circuitry and hardware prototyping
- ❖ Bent laser cut sheet metal into a car shaped body
- ❖ Utilized H bridge configuration for motor control
- ❖ Magnetic transmitters from ferrite inductors



Pong Game

VHDL Hardware Design

Pong Game VHDL Hardware Design

- ❖ Worked with a partner in designing a VGA port display Pong game
- ❖ Utilized FPGA for easy prototyping and troubleshooting
- ❖ Added additional challenge to the game that increases speed over time
- ❖ Sample code to the right (VHDL code available upon request)

```
when initial =>
    plot <= '1';
    colour <= "111";--white
    y <= std_logic_vector(temp_y);
    x <= std_logic_vector(temp_x);
    temp_x := temp_x + 1;--continue at this state on clk until condition
    if (temp_x = 155) then
        temp_x := "00000101";--boundary on x
        if (temp_y = 115) then
            goalie1 := "0110110";--54
            forward1 := "0110110";
            goalie2 := "0110110";
            forward2 := "0110110";
            temp_y := "0000101";--5
            state := team1_g;
        else
            temp_y := "1110011";-- 120-5=115
        end if;
    end if;

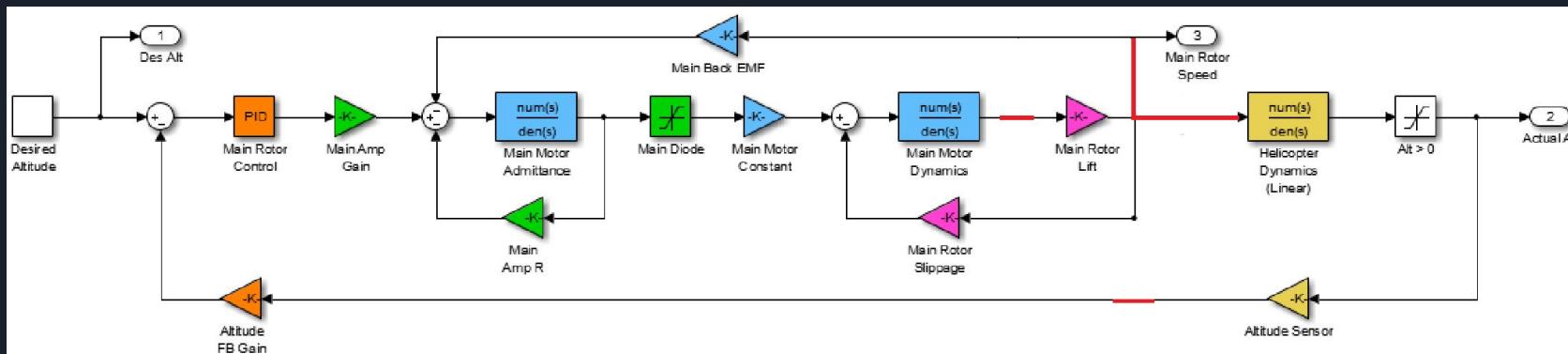
when team1_g =>
    plot <= '1';
    temp_x := "00000101";
    temp_y := temp_y + 1;-- continue until end of y=115
    if (temp_y >= goalie1 and temp_y <= goalie1 + 10 and temp_y < 115) then
        colour <= "001";
    elsif (temp_y >= 115) then
        if (sw(17) = '1') then
            if (goalie1 > 6) then
                goalie1 := goalie1 - 1;
            end if;
        else
            if (goalie1 < 104) then --goalie going down
                goalie1 := goalie1 + 1;
            end if;
        end if;
        temp_y := "0000101";
        colour <= "111";
        state := team1_f;
    else
        colour <= "000";
    end if;
    y <= std_logic_vector(temp_y);
    x <= std_logic_vector(temp_x);
```

Apache Flight Control

MATLAB/SIMULINK DESIGN

Apache Flight Control MATLAB/SIMULINK

- ❖ My partner and I developed and designed a PID controller with a route error average of only 7.08 % from original flight course
- ❖ Determined transfer functions, used root locus, and nyquist criterion to analyze stability positions of the model
- ❖ Simulated entire design and constantly working to decrease the error in the overshoot while keeping constant and consistent stability though its entire flight path
- ❖ Adjusted the PID values capable of handling a marginally stable helicopter system modelled through Simulink



Apache Transfer Functions

- ❖ Closed loop transfer function of the entire system simplified

$$\text{Closed Loop TF: } CL_{sys} = TF4 = \frac{KG}{1 + K * G * H} = \frac{\left(\frac{5.306}{s^4 + 31.33 * s^3 + 221.5 * s^2} \right)}{1 + \left(\frac{5.306}{s^4 + 31.33 * s^3 + 221.5 * s^2} \right)}$$

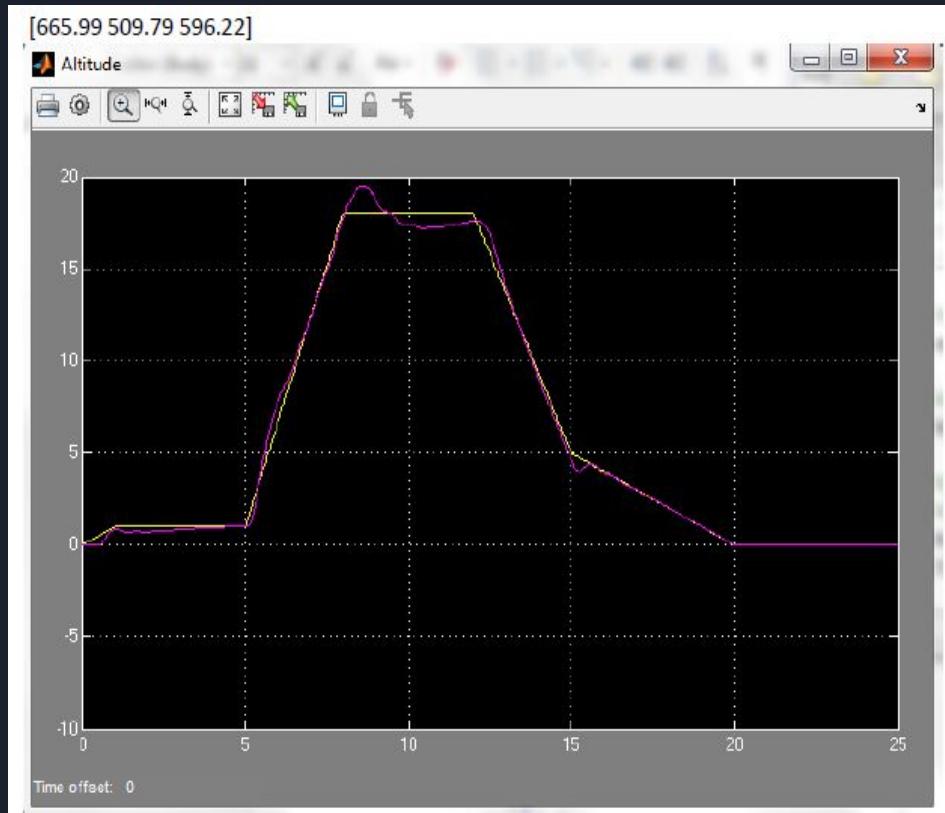
$$CL_{sys} = TF4 = \frac{5.30597014925}{5.30597014925 + (s^4 + 31.3286902287 * s^3 + 221.498901943 * s^2)}$$

$$CL_{sys} = \frac{5.31}{s^4 + 31.3 * s^3 + 222 * s^2 + 5.31}$$

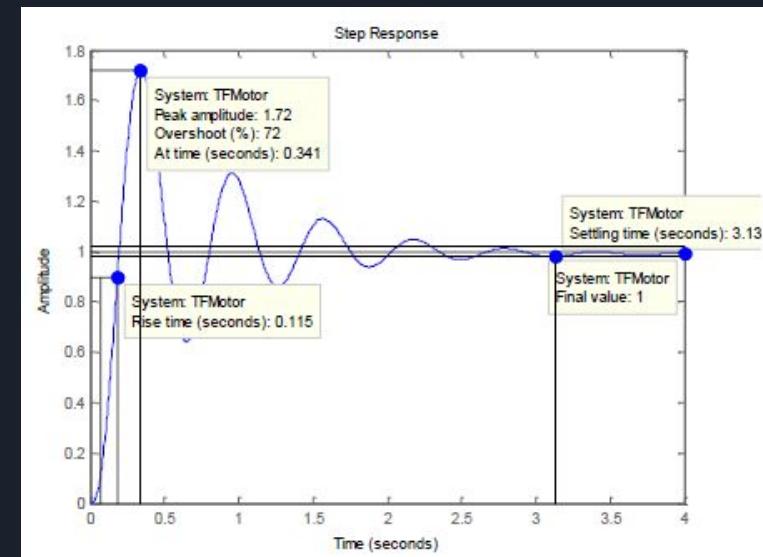
- ❖ Open loop transfer function determined

$$\text{Open Loop TF: } OL_{sys} = K * G * H = \frac{5.31}{s^4 + 31.3 * s^3 + 222 * s^2}$$

Apache Flight Simulations



- ❖ Flight path given in the yellow graph and simulated flight path in the purple
- ❖ Below is the step response of the system using the calculated transfer functions

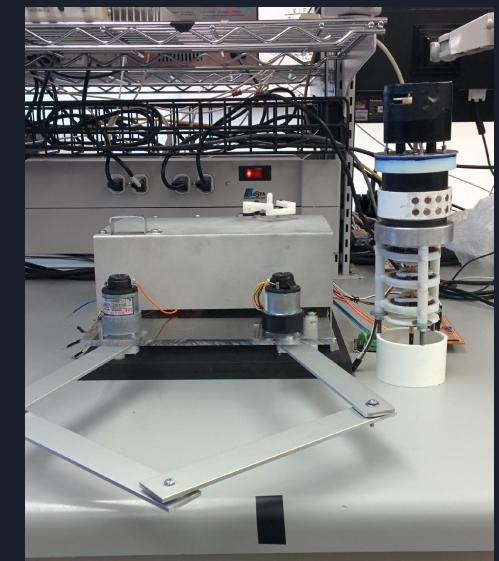


Tele-Operated Master/Slave Robot Arm

Solidworks & Machine Shop Design

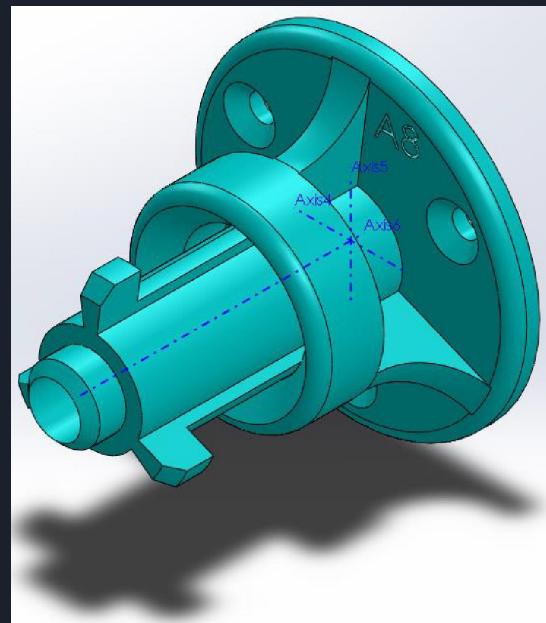
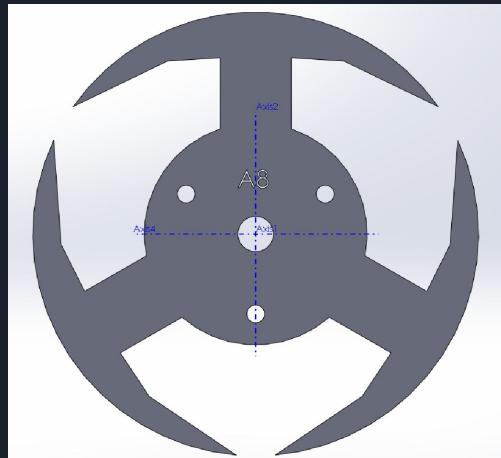
Tele-Operated Master/Slave Robot Arm

- ❖ Worked with 3 other people in designing and building a 5-bar robotic arm
- ❖ Designed and assembled an electric motor from water jet and 3d printed parts
- ❖ Robotic arm is controlled through a master/slave configuration
- ❖ Larger aluminum arms as the slave and a smaller scaled version 3d printed master arm
- ❖ Used simple motors and attached sensors and current drivers in order to build custom servo motors



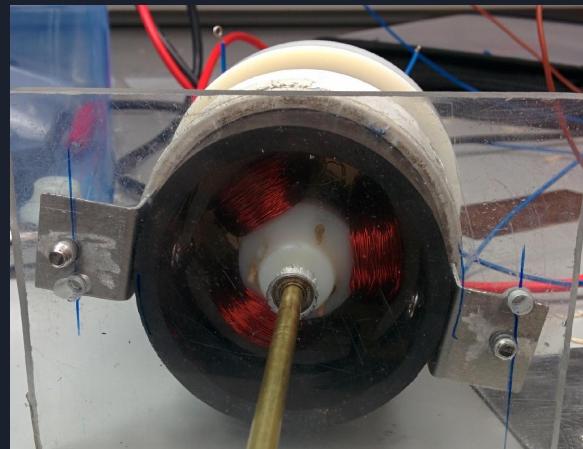
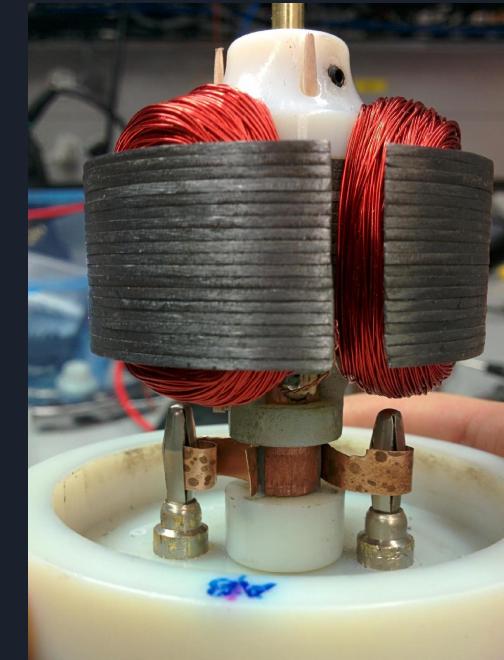
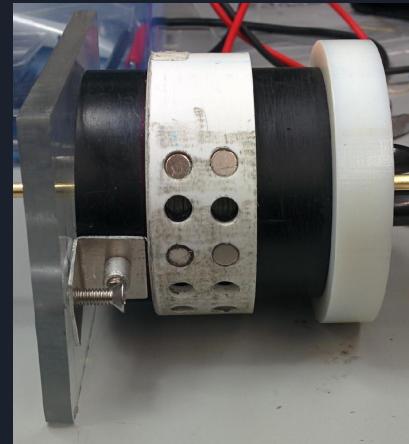
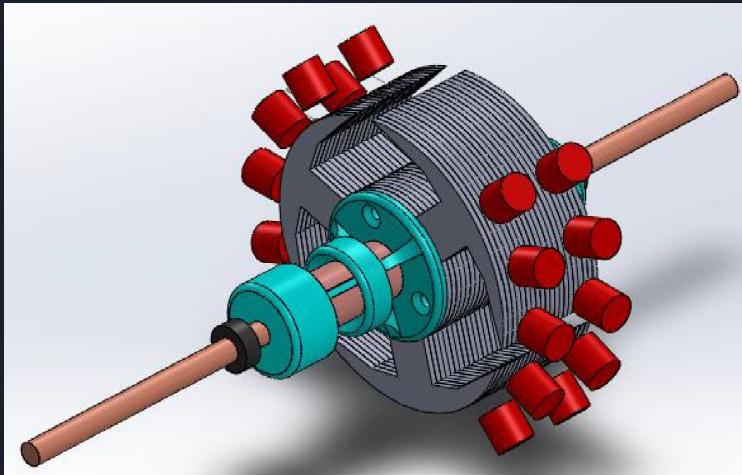
Electric Motor Design

- ❖ Solidworks design of commutator and armature laminations
- ❖ Intricate parts were 3d printed and laminations were water jet cut



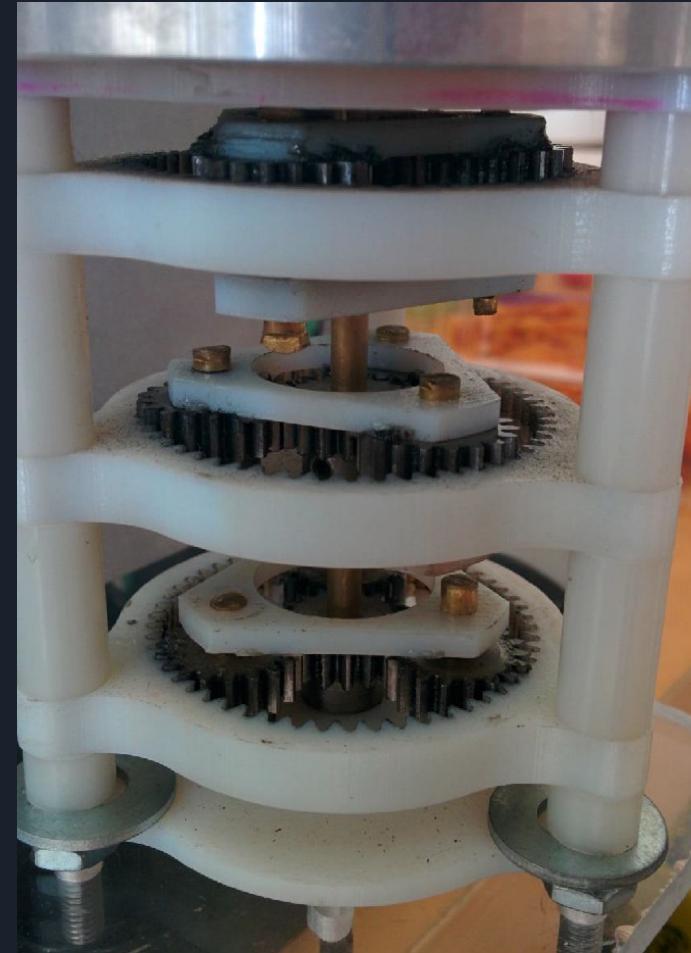
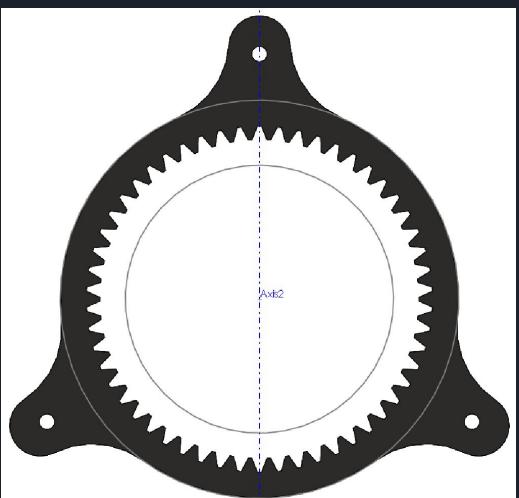
Electrical Motor

- ❖ Finished prototype and assembly of physical test motor



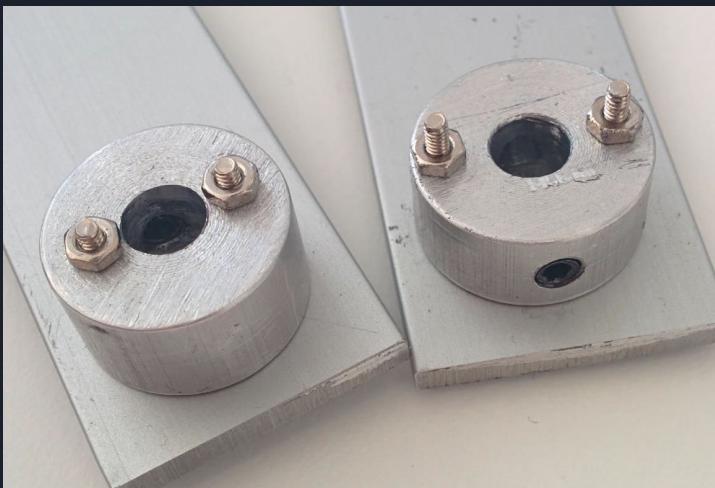
Gearing System

- ❖ A final planetary gearing system designed in Solidworks and 3d printed



5-Bar Arm Robot

- ❖ Created a lifted platform and connected arms in a freely moving attachment
- ❖ Machined custom lock collars for actuators to attach to arms

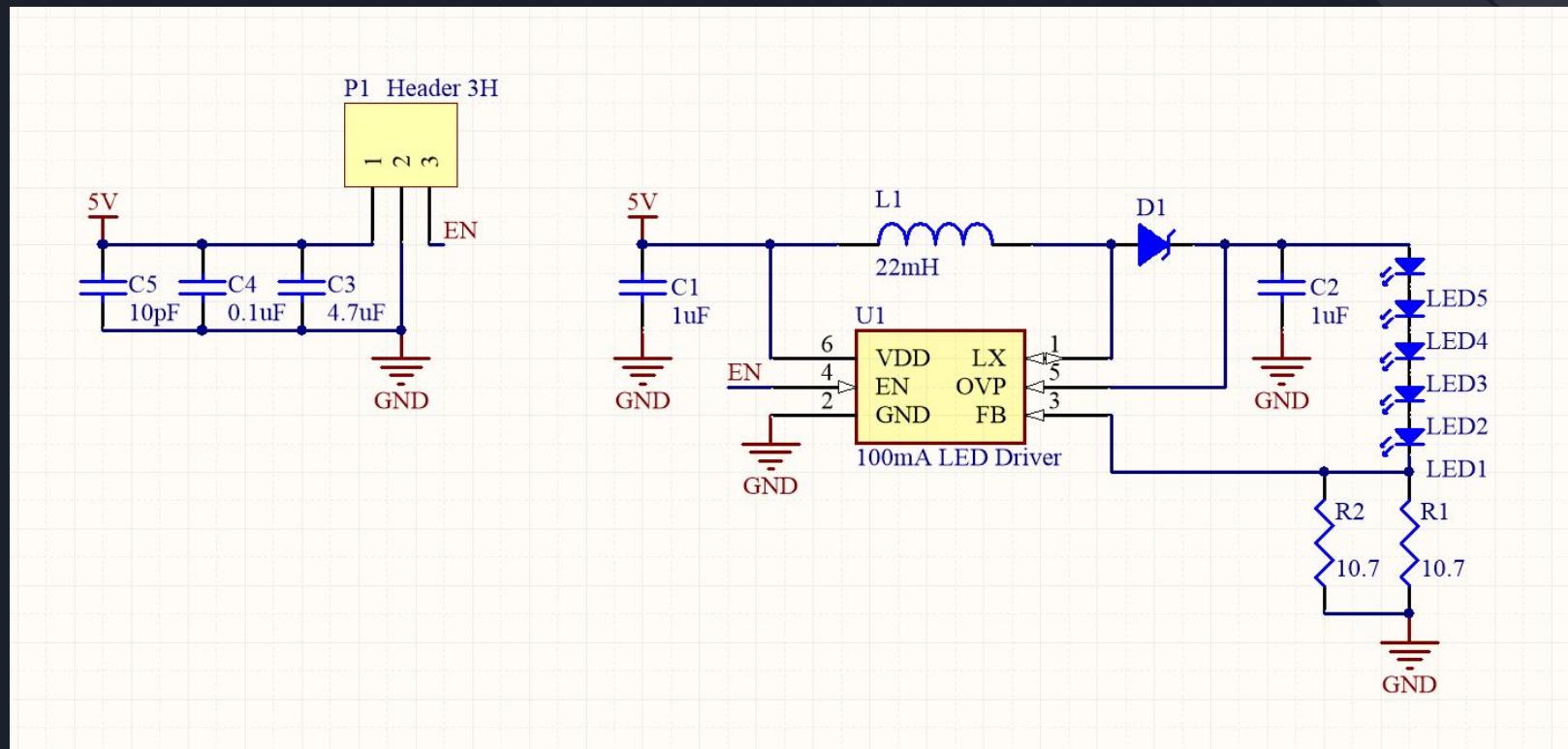


Client: UBC Studios

(Current) Capstone Project: Digital Glass

Project Coordinator / Electrical Hardware Engineer
(Altium PCB Design)

Digital Glass - Current 100mA LED driver circuit schematic



Digital Glass - Current 100mA LED driver circuit PCB

- ❖ Temporary designs of led driver circuit
- ❖ Project completion: April 2018
- ❖ Next steps:
Build on perf-board and test, then order
PCB board and confirm full range of
functionality
- ❖ Next components to design:
Battery charge/protection/boost circuit to
drive this circuit and to power
microcontroller.

