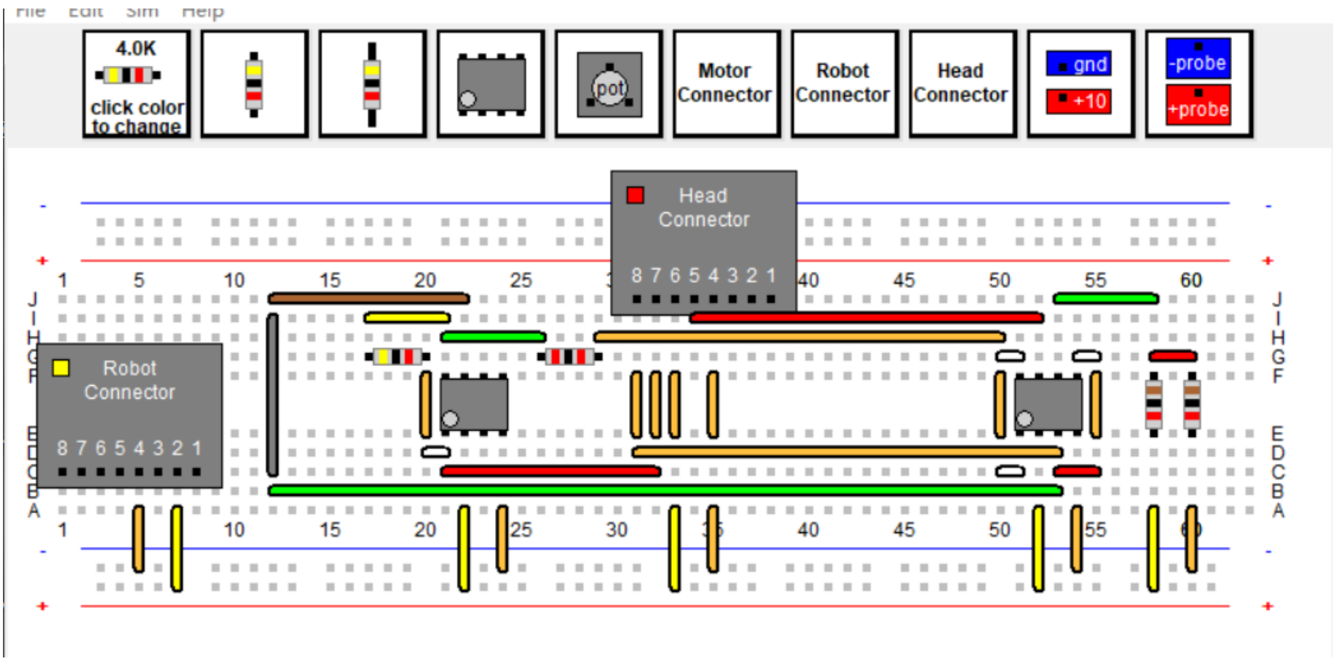
Problem Wk.8.4.4: Light Seeker Design

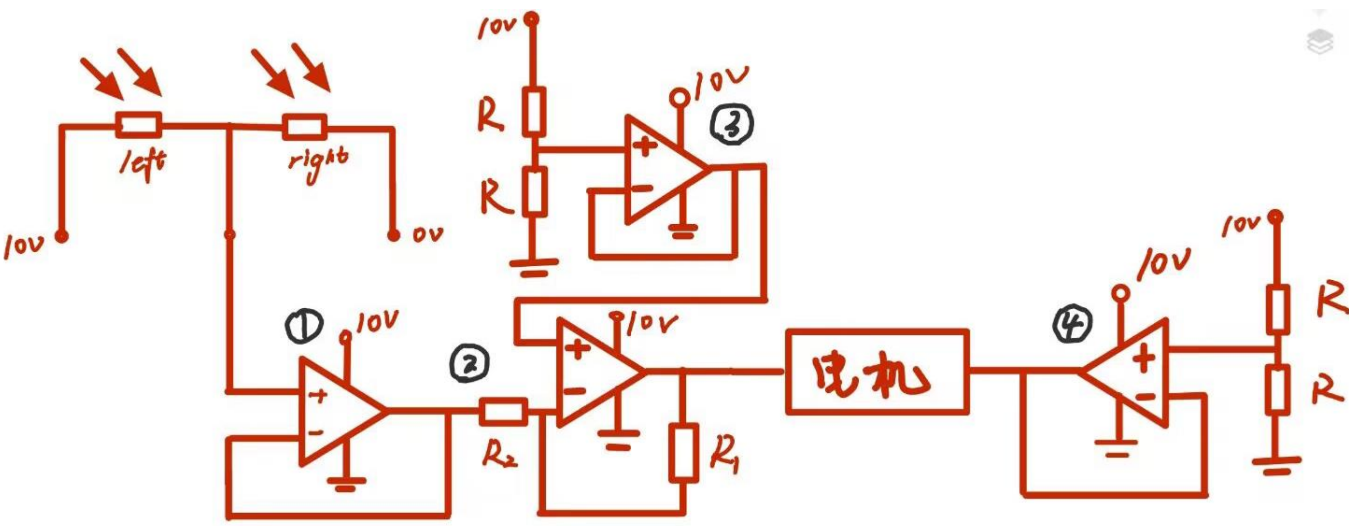
Read the handout for Homework 3 before doing this tutor problem.

Circuit diagram

Upload a PDF file containing your detailed, legible, and complete circuit diagram for your light seeker controller design. This circuit diagram should include your light sensor, as well as any other components (eg the motor) necessary to make a functional system. Make sure that the design can be adjusted to handle the range of gains that we might need, given any measurement for k_s.

Please double-check that your file is a valid PDF before uploading. You will be able to check that the file is correctly uploaded.



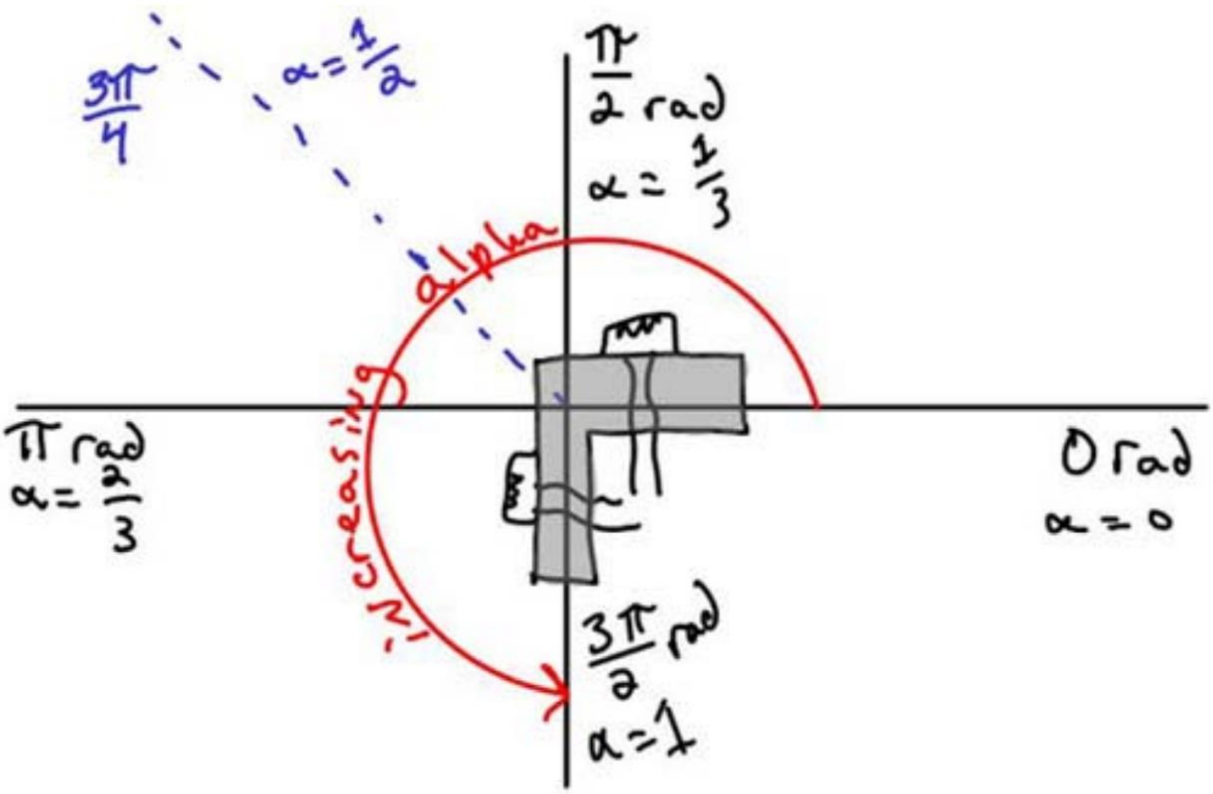


CMax code

Paste the CMax circuit representation (contents of your *.cmax file) for your light seeker reference design **with gain (k_c) 2** in the following box. You can access the code by selecting `File → View Code...` from CMax's menu. The plots you see when `check`ing your circuit are the result of running the `eyeServo1.py` simulation file.

Note that your CMax code **will not be automatically graded**, so a green check does not necessarily imply a correct submission; it simply means we ***received*** your submission. Please carefully double-check your plots (which are reproduced when you click `check`) to make sure they are accurate.

If you are confused about what angles and alpha values to expect, you may find this diagram useful.



CMax code

Circuit Code

```
#CMax circuit
wire: (20,12)--(20,9)
resistor(1,0,2): (58,9)--(58,12)
resistor(1,0,2): (60,9)--(60,12)
wire: (60,16)--(60,19)
wire: (58,8)--(60,8)
wire: (58,16)--(58,20)
wire: (20,13)--(21,13)
wire: (22,16)--(22,20)
wire: (24,16)--(24,19)
opamp: (51,12)--(51,9)
wire: (58,5)--(53,5)
wire: (54,8)--(55,8)
wire: (55,9)--(55,12)
wire: (54,16)--(54,19)
wire: (52,16)--(52,20)
wire: (53,14)--(55,14)
head: (38,5)--(31,5)
wire: (33,9)--(33,12)
wire: (33,16)--(33,20)
wire: (35,9)--(35,12)
wire: (35,16)--(35,19)
wire: (31,13)--(53,13)
wire: (31,9)--(31,12)
wire: (32,9)--(32,12)
wire: (53,15)--(12,15)
wire: (12,14)--(12,6)
wire: (12,5)--(22,5)
wire: (32,14)--(21,14)
robot: (8,14)--(1,14)
wire: (7,16)--(7,20)
wire: (5,16)--(5,19)
wire: (34,6)--(52,6)
wire: (51,8)--(50,8)
wire: (50,9)--(50,12)
wire: (50,14)--(51,14)
wire: (17,6)--(21,6)
opamp: (21,12)--(21,9)
wire: (50,7)--(29,7)
resistor(2,0,2): (26,8)--(29,8)
wire: (26,7)--(21,7)
resistor(4,0,2): (17,8)--(20,8)
```

Discussion

Explain the key elements in your design. Does your design include a buffer on the signal from the eyes? Explain why you do or do not need it? How did you implement the gain k_c? Why did you choose that implementation?

We need four integrated operational amplifiers in our design. The integrated operational amplifier ① connected to the output end of the optical sensor is used as a buffer circuit to stabilize the output voltage of the optical sensor and prevent the influence of subsequent circuits on the output voltage.

Integrated operational amplifier ② receives the output voltage of integrated operational amplifier ① and achieves the gain k_c.

Integrated operational amplifier ③ delivers a stable voltage of 5V.

Integrated operational amplifier ④ delivers a stable voltage of 5V.

Integrated operational amplifiers ①, ③, and ④ are buffers that stabilize the input voltage without interference from subsequent circuits.
We can change the gain k_c by changing the resistance of R_1 to change the ratio of R_1 to R_2.

$$k\_c = \frac{R_1}{R_2}$$

As k_s approaches 4, the ideal magnification of k_c will be less than 1. So we chose a reverse op amp instead of a non-reverse op amp.
The output voltage of the integrated operational amplifier 2 needs to be raised because the output voltage is theoretically negative and the actual minimum value is 0. We increase the output voltage by connecting the input to 5V in the same phase.

What do the simulations tell you about the circuit's performance, in reference to the design goals described in the HW3 handout?

We found that the analog circuits respond about six orders of magnitude faster than the softw are that the robot's brain runs, but with a significantly increased level of complexity. T herefore, in the actual engineering design, the two characteristics should be selected accordin g to different objectives.