1 Noise Canceling Headphones Part 2

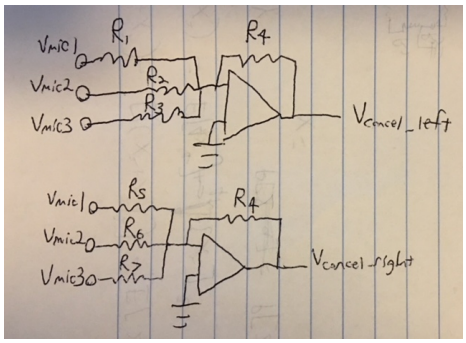
(a)

$$A = \begin{bmatrix} a_{1\text{left}} & a_{2\text{left}} & a_{3\text{left}} \\ a_{1\text{right}} & a_{2\text{right}} & a_{3\text{right}} \end{bmatrix}$$

(b) $\vec{s}_{\text{ear}} = \begin{bmatrix} s_{\text{left}} \\ s_{\text{right}} \end{bmatrix} + \vec{s}_{\text{noise}}$

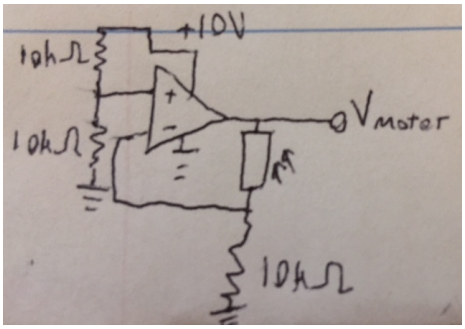
(c)

$$B = -1 \times \begin{bmatrix} a_{1\text{left}} & a_{2\text{left}} & a_{3\text{left}} \\ a_{1\text{right}} & a_{2\text{right}} & a_{3\text{right}} \end{bmatrix}$$



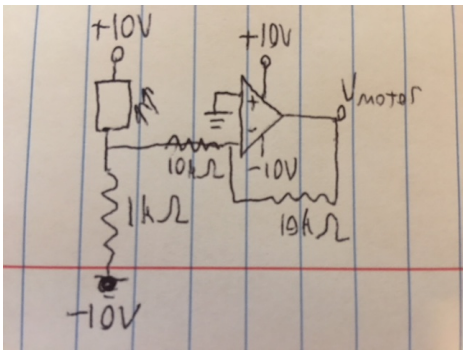
(d) $R_1 = \frac{R_4}{a_{1\text{left}}}, R_2 = \frac{R_4}{a_{2\text{left}}}, R_3 = \frac{R_4}{a_{3\text{left}}}, R_5 = \frac{R_4}{a_{1\text{right}}}, R_6 = \frac{R_4}{a_{2\text{right}}}, R_7 = \frac{R_4}{a_{3\text{right}}}$

2 PetBot Design



(a) $V_{motor} = \left(1 + \frac{R_{\text{photoresistor}}}{10k\Omega}\right) 5V$

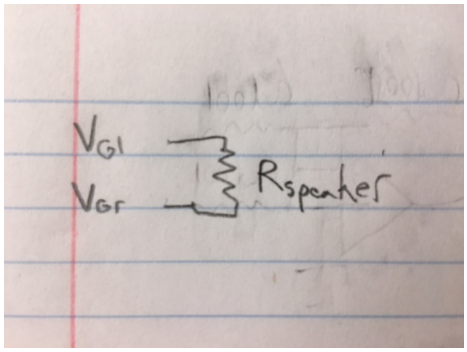
(b) $V_{motor} = 10V - \left(20 \frac{1k\Omega}{1k\Omega + R_{\text{photoresistor}}}\right)$



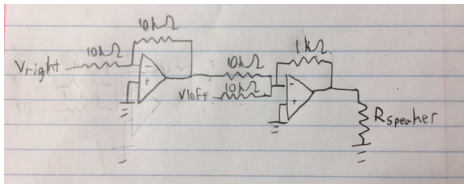
3 Island Karaoke Machine

(a) $v_{speaker} = \frac{2}{5} v_{instruments}$. The voltage does not depend on v_{vocals} and the islanders will only hear the instruments.

(b) see image



(c) replace the $1k\Omega$ resistor with a 500Ω resistor



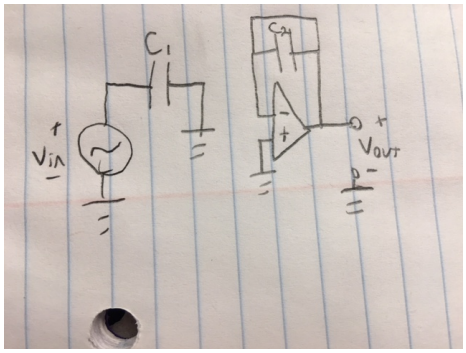
(d) $v_o = -\frac{R_2}{R_1} v_1$

(e) $v_o = \frac{R_4}{R_1} \frac{R_1 + R_2}{R_3 + R_4} v_2$

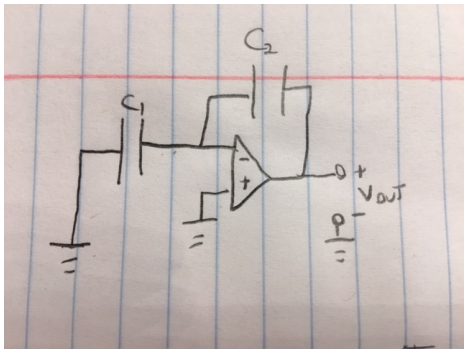
(f) $v_o = \frac{R_4}{R_1} \frac{R_1 + R_2}{R_3 + R_4} v_2 - \frac{R_2}{R_1} v_1$. $R_1 = 1k\Omega, R_2 = 20k\Omega, R_3 = 1k\Omega, R_4 = 20k\Omega$

4 Brain-on-a-Chip with 16A Neurons

(a) (i) $v_{out} = 0\text{V}$

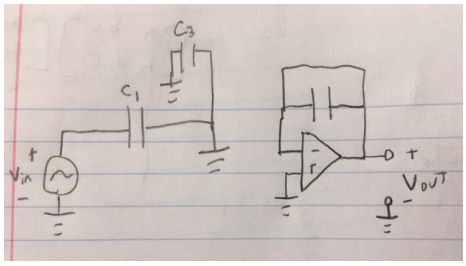


(ii) $v_{out} = v_{in}\frac{C_2}{C_1}$

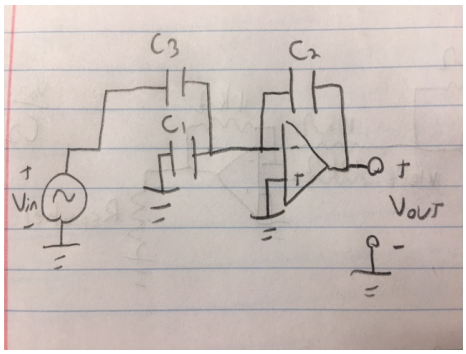


(b) $v_{out} = \max(\min(v_{in}, 1\text{V}), -1\text{V})$. This implements the sigmoid function because it is bounded by -1V and 1V and linear in the region between (though this is technically not the sigmoid function).

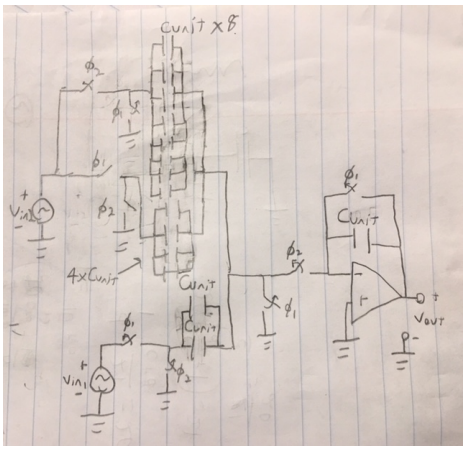
(c) (i) $v_{out} = 0\text{V}$



(ii) $v_{out} = v_{in} C_2 \left(\frac{1}{C_1} - \frac{1}{C_3} \right)$



(d) see image



5 Homework Process and Study Group

I worked on this homework alone.