CG1111 Engineering Principles and Practice I

The A-maze-ing Race Project

Specifications for the Challenges

1. Light Challenge

   Using the light sensor on your mCore (with the protective plastic cover in place), your mBot shall interpret the light challenge according to the voltage read from the light sensor as follows:

Voltage Range	**Interpretation**
$0.0\ V \leq V_{Light} < 1.3\ V$	No Action
$1.3\ V \leq V_{Light} < 2.6\ V$	Turn Right
$2.6\ V \leq V_{Light} < 3.9\ V$	Turn Left
$V_{Light} \geq 3.9\ V$	Go Straight

2. Sound Challenge

   The audio sound signal will be within the fourth octave (C4-B4). It is corrupted with a high frequency noise, and you shall design a bandpass filter (consisting of both high-pass and low-pass filters) to suppress the audio sounds outside the desired band. The amplitude of the audio sound represents the direction the mBot shall turn.

   The team needs to take the following steps for the sound challenge:

   a. Download the two sample audio sound files ("Sound Challenge Loud.wav" and "Sound Challenge Mild.wav") from the IVLE project folder. One audio sound is louder than the other (when played at the same volume setting).

   b. Analyze the sample audio files to identify the frequency of the noise present in the signal.

   c. Design a bandpass filter for your audio processing circuit to suppress the sounds outside the fourth octave. For the high-pass filter, design the circuit such that the cut-off frequency is around 100 Hz. For the low-pass filter, design the circuit such that there is at least 20 to 26 dB attenuation of the high frequency noise.

   d. Include a variable resistor in your opamp circuit design so that the gain is adjustable. Using the sample sound challenge setup in the lab, increase the gain in your circuit such that when the **louder** sound (i.e., "Sound Challenge Loud.wav") is played, the output of your opamp is on the verge of saturation, but not saturated (like Week 11 Studio 2).

e. Once your amplification is properly tuned, your mBot shall interpret the sound challenge according to the voltage amplitude as follows:

Voltage Range	**Interpretation**
$0.0\ V \leq V_{Sound} < 1.0\ V$	No Action
$1.0\ V \leq V_{Sound} < 2.3\ V$	Turn Right
$V_{Sound} \geq 2.3\ V$	Turn Left

Notes:

(i) When mounting your breadboard with the audio processing circuit on top of your mBot, ensure that it does not cover the light sensor on your mCore.

(ii) Ensure that the overall height of your mBot (including the wires) is less than 16 cm.

3. End of Maze

At the end of the maze, there will also be a black line. Upon decoding that no action needs to be taken for both the light challenge and the sound challenge, the mBot shall interpret this as the end of the conquest, and play a celebratory tone of your choice.