Control & Automation Engineering Department

KON309E Microcontroller Systems - Experiment 6

Aim: Visualizing a sinusoidal wave using LEDs and changing its frequency with a potentiometer.

In this experiment, you will be visualizing a sinusoidal wave using 4 LEDs. Each LED will represent a different sampling point for the sinusoidal wave. You will generate **PWM** signals for the LEDs and their brightness values will be updated according to their sampled values. You can use the below formulation, where b_i represents the brightness values **(duty cycle)** of the ith LED and t is the current time in terms of seconds.

$$b_1 = \frac{\sin(2\pi \times freq \times t - 1.5a) + 1}{2}$$

$$b_2 = \frac{\sin(2\pi \times freq \times t - 0.5a) + 1}{2}$$

$$b_3 = \frac{\sin(2\pi \times freq \times t + 0.5a) + 1}{2}$$

$$b_4 = \frac{\sin(2\pi \times freq \times t + 1.5a) + 1}{2}$$

You should find the current time using a timer. For example, you can increment a value that holds the current time by Δt with a timer that fires an interrupt every Δt seconds.

Since the LEDs represent different sampling points, each brightness values use different phase values. You can use adjust the phase values as long as the final result is visually satisfactory. See the Fig. 1 for the different sampling points.
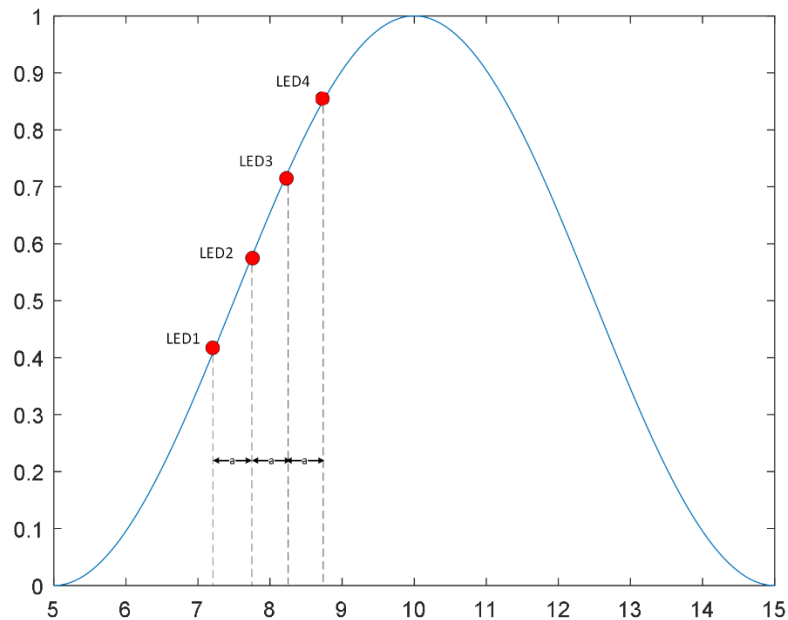

Figure 1. Different Sampling Points

Using a **potentiometer**, you will also adjust the frequency value ($freq$) between an interval of $[freq_1, freq_2]$. You will basically read an **analog signal** generated by the potentiometer and map the read value to the defined interval. You can set the initial frequency and the boundary frequency values however you want.

Note: You can use more than 4 LEDs for better resolution.

Please consider the following steps when preparing your reports.

1. Describe the experiment **in your own words**.
2. Add your main codes as screen shots.
   - Don't forget to comment your codes **in your own words** explaining how each line of code works.
3. Add a photo of your whole circuit.
4. Take a video of your system while running, upload it on YouTube, Drive, etc. and include the link on your report.