

EECS 388 Lab #5

Servo Motor Control

In this lab, we will control a small servo motor using PWM. In the case of an RC car, a servo motor is typically used to control the steering of the car.

Part 0: Setup the project

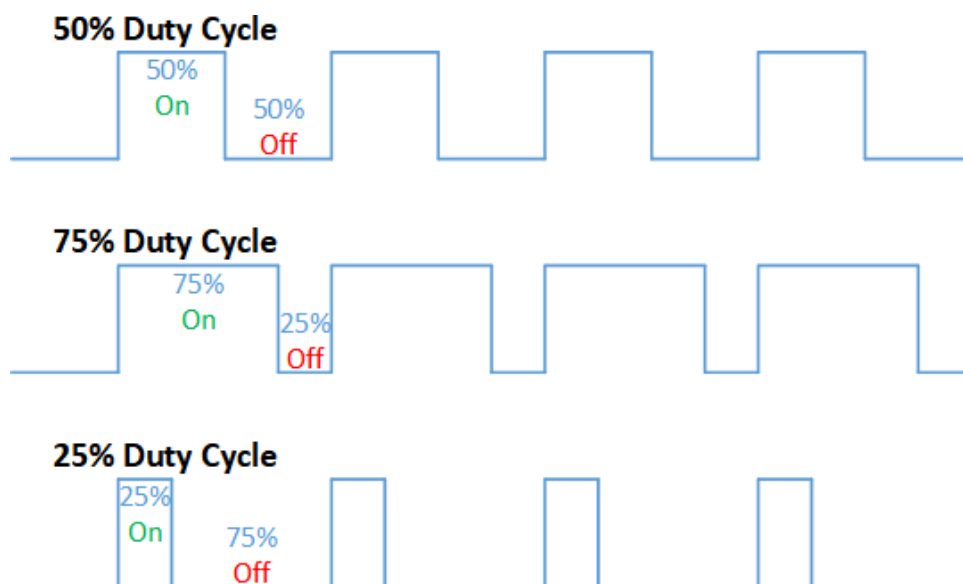
Sign into Canvas and inside the "Files" section, go to the "Source Codes" folder. Click on the lab05.tar.gz file to download the source code for lab 5. Extract the file to your PC.

After that, add this folder to the VS Code workspace (like the previous labs).

Part 1: PWM and servo motor

Pulse-width modulation (PWM) is a way to encode analog signals using digital outputs. Although a digital output can be either on or off at a time, by altering the durations of on and off, we can encode an arbitrary analog signal.

In the diagram below assume the On value is 5V. If the digital output is On for 50% of the duration (top figure), its voltage is rated as 2.5V on average. If the duty cycle is 75%, its voltage is 3.75V on average. If the duty cycle is 25%, its voltage is 1.25V on average.

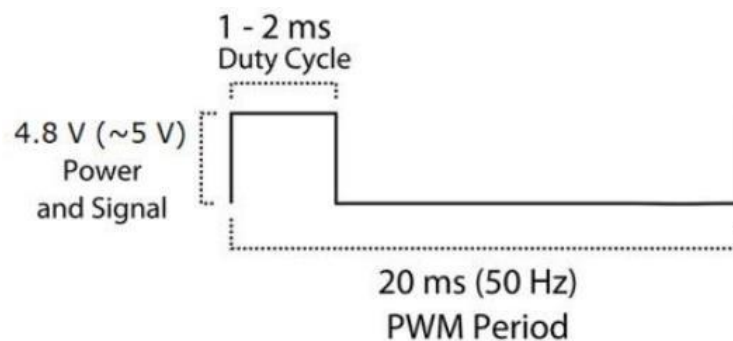


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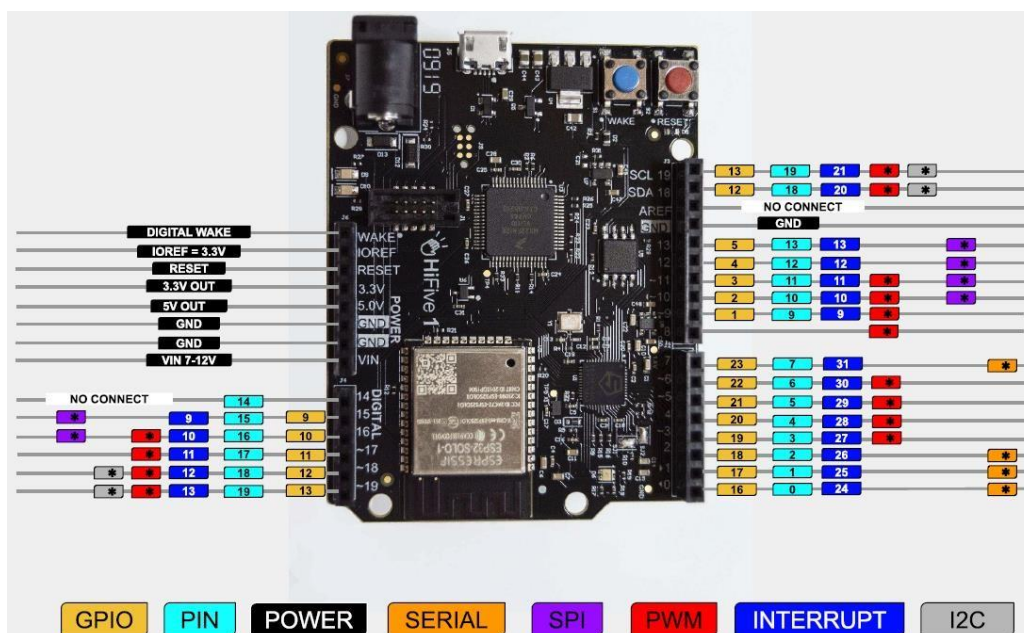
PWM has a wide variety of applications, one of which is servo motor control. In this lab, we use PWM to control a small servo motor (see docs/sg90_microservo_datasheet.pdf).



A servo motor receives a PWM signal whose value represents the desired angle of the servo motor. The PWM value ranges may vary depending on the specific servo, but most RC servo motors, including the one we use in this lab, operate between **544 us** (0 degrees) to **2400 us** (180 degree) duty cycle at a 20 ms period (50 Hz).



Connect the servo motor's Vcc (red, center), ground (brown), and PWM (orange) to the HiFive1 board's 5V, GND, and PIN 19 (gpio 13) lines, respectively.



Part 2: Servo control programming – 100 pts

For this lab, you will need to use two provided library functions: `gpio_write` and `delay_usec`. The `delay_usec` function is similar to `delay`, except the input is in micro-seconds instead of milliseconds. (See the code in `eeecs388_lib.c`). Using these functions, you should output the ON signal (5V) for a specific duty cycle duration, followed by the OFF signal for the remainder of the PWM period. This will create a pwm signal, which controls the servo motor's angle.

The project code you downloaded already includes the basic skeleton of the program, which will sweep different angles, remaining at each angle for about a 1 second duration.

You will need to complete the `servo()` function in the `eeecs388_pwm.c` to complete the lab. For the demo, you need to show that after running your code, the servo motor rotates by fixed amounts, going from 0 degrees to 180 degrees, then cycles back to 0 degrees and repeats the rotations.

Submission:

Go to the "Assignments" section of the Canvas and submit your modified `eeecs388_pwm.c` file to the Lab05 submission link. Also make sure that you have shown your completed work to your respective GTA for demo.

Screenshots/PDF/Text files will NOT be allowed/graded as submission. You need to submit modified `eeecs388_pwm.c` file only.