SC 649

IIT Bombay
Systems and Control Engineering
Embedded Control and Robotics
Mid-Semester Assignment

Deadline
Date: 21.09.2024,
10.59 a.m.

Maximum Marks: 8

Instructions:

- Students should **bring their hardware kit** for the mid-semester exam.
- Submit the answers to this assignment on or before the deadline at 10:59 a.m. on 21.09.2024. This is a strict deadline, and no request for any extension will be entertained.
- Report should contain the aim, results, observations, and conclusion **only for the questions asked**.
- All the results and the associated observations/analysis must be compiled in a pdf file. This pdf and the associated code must also be submitted in a single zip folder on Moodle on the relevant submission link.
  Label this folder in the form: FirstName_RollNumber_SC649_Mid_Sem.
- Please preserve the code and the report till the end of this semester.
- Assumptions made, if any, must be clearly stated and justified.
- The demo and viva are scheduled during the mid-semester exam slot. It will carry 6 marks.
- In the case of group assignments, the contribution of each member of the group should be mentioned in a tabular format at the top. **Note: Every group member should upload their submissions individually.**
- After the end of each question, the numbers to the right, in square brackets, indicate marks allotted to it.

1. Problem Statement

In this assignment, you need to implement a Proportional Integral Derivative (PID) Controller to control the speed (RPM) of a DC motor.

Connect the given components as shown in Figure 1. To implement a closed-loop control, we need to provide the current speed, calculated using encoders, as feedback. The block diagram to implement this controller is shown in Figure 2.

After designing the controller, answer the following questions. You should provide sufficient data in the form of tables or graphs to support your answers.

- What is the effect of changing the values of PID gains, K_p, K_i, and K_d on the output speed?

Question 1 continues on the next page...

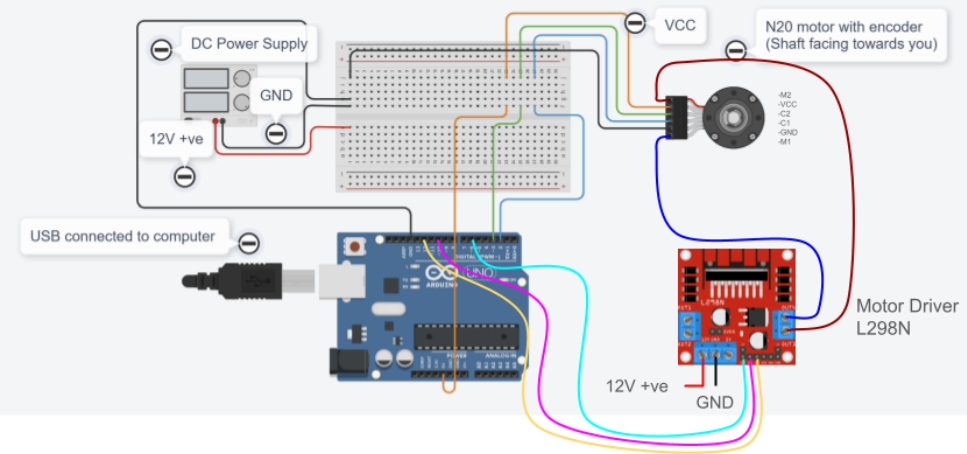

Figure 1: Connection diagram of N20 motor with L298N (motor driver) and Arduino.

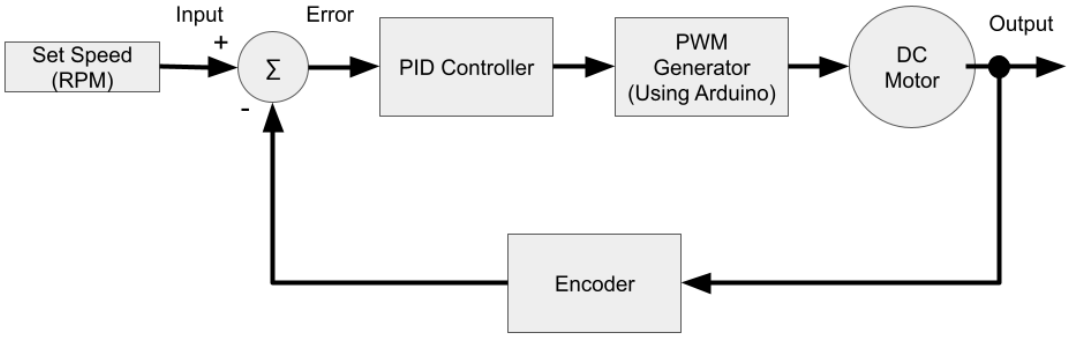

Figure 2: Closed-loop control of DC motor

- What is the effect of changing the setpoint while keeping the PID gains constant?
- What happens when you change the setpoint when the motor is running?
  Hint: You can use the Serial Monitor to provide the setpoint speed as an input.
- What is the effect of changing PWM frequency on motor speed control for constant PID gain values?

[02]

External Resources (for your understanding)

- What Is PID Control? Understanding PID Control, Part 1 by MATLAB link
- Controlling Self-Driving Cars by Aerospace Controls Laboratory at MIT link