AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
MECHATRONICS ENGINEERING DEPARTMENT

2nd Semester, 2018-2019

MCT-371: Automatic Control

Project 1 description

Projects Objectives

By the end of these projects, students should be able to apply the theoretical concepts they learned in the course:

1. Construct a closed loop feedback control system for position control systems.
2. Find the system model (using theoretical and experimental approaches)
3. Find the system response in the time and frequency domain.
4. The effect of the PID controller parameters on the system performance
5. The tuning of the controller parameters.

Project #1

The aim of this project is to design a position control system for a geared DC motor. The system should be able to achieve any angular position set point in the range from 0 to 180. The setup of the project will be used as an experimental setup for applying the theoretical knowledge gained in a step-by-step manner throughout the stages of the project.

Layouts

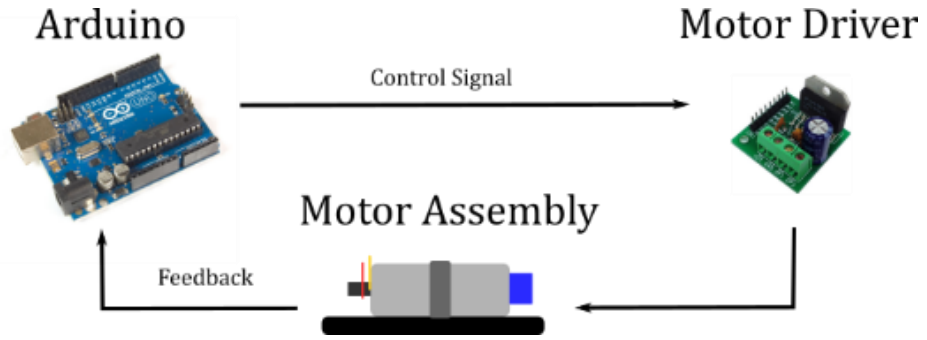

Figure 1: Position Control project layout

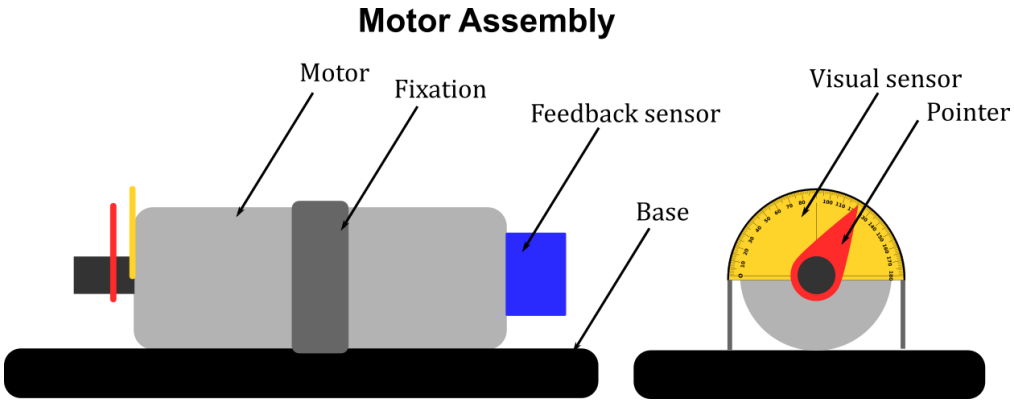

Figure 2: Motor Assembly used in project 1.

The project setup consists of a geared DC motor. Attached to the motor, an angular position sensor for feedback. Figure 1: Position Control project layout Figure 1 and Figure 2 show the complete layout of the project. The controller will be implemented using the Arduino microcontroller. The Arduino will be programmed so that it can read the feedback signal, compare it to the set point and apply different control algorithms to calculate the control signal. Arduino then supplies this signal as an output to the motor driver which control the speed and direction of the motor until it gets to the required position.

Components

- Geared DC Motor.
- Microcontroller (Arduino)
- Motor driver circuit. (H-Bridge)
- Angular Position sensor (Potentiometer\Encoder)
- 2 switches. *
- Potentiometer. *
- Implementation of visual sensor (protractor) and pointer.

* These two components are needed for early stages of the project only.

Stages

Stage 1: Manual Control

In this stage, the group should be able to manually control the position of the pointer to make it reach a certain angle. The project setup at this stage will have the motor assembly, motor driver, potentiometer, and two switches. The potentiometer is used to control the speed of the motor while the one switch is connected to the driver to switch the motor on and off. The other switch is used to change the direction of the motor through the driver.

Deliverables

- Fully implement the motor assembly (without the feedback sensor).
- Motor driver circuit.
- Manually control the angular position of the pointer using potentiometer and two switches as shown in Figure 1.

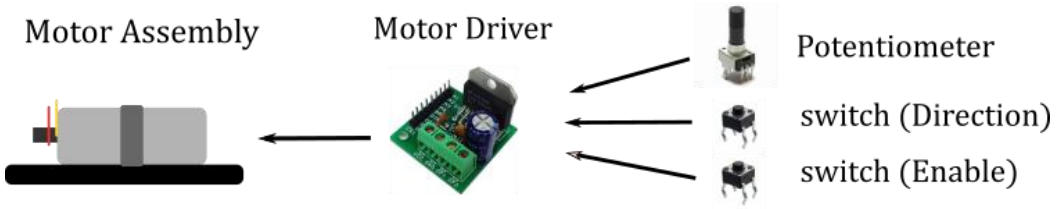

Figure 3: Stage 1 of project 1

Stage 2: System Identification

In this stage, the motor will be controlled through PWM signal from the microcontroller. Also, the feedback sensor will be added to the motor assembly. The feedback sensor should be calibrated to make sure that the microcontroller is reading the actual angular position. Provide the system with sinusoidal inputs with different frequencies and record the input versus the system response. Use the data recorded and MatLab system identification toolbox to find the system model parameters.

Deliverables

- Fully implemented the system as shown in Figure 1.
- Data recorded for inputs and their corresponding system response.
- System identification results.

Stage 3: Add PID Controller

The PID Controller is implemented on the microcontroller. Study the effect of changing each controller parameter on the system response.

Deliverables

- PID implementation on microcontroller.
- Report on the effect of changing each controller parameter on system response. (Use the data measured from your system.)

Stage 4: PID tuning and Final submission

The system is submitted after tuning of PID controller parameters.