

ELEC 3040/3050 Final Project Specification – Spring 2017

Implement an embedded digital controller for dc motor speed and a digital stopwatch, and demonstrate using the STM32L100C Discovery Board, lab dc motor, and *Waveforms* Static I/O tool.

Specifications:

- Full credit is 25 points (requirements a-e).
- The extra credit (option f) is worth 20% more, or 5 points.

Points	Requirements description
5	a) The desired speed must be selected from a 16-key keypad.
5	b) The system must demonstrate ten (10) different non-zero speeds, in addition to a “stop” condition. You may select any ten non-zero DESIRED speeds, eg. They could be evenly spaced between the minimum speed at which the motor can be reliably operated and the motor’s “full speed,” which is defined to be the no-load speed with 9 Vdc applied voltage.
5	c) The sampling period for the system must be $10\text{ ms} \pm 1\ \mu\text{s}$.
5	d) The measured steady-state speed of the motor must be within 5% of the desired speed, whether the motor is under load or not. The test load will be a single turn of string around the motor pulley, with a 15 gram washer weighting the free end. The reference speed for this test will be 50% of motor full speed.
5	e) A two-BCD-digit stopwatch, comparable to the one in Lab 6, should display times from 0.0 to 9.9 seconds, and run concurrently with the motor speed controller. Two unused keypad buttons should initiate the start/stop and reset functions. Motor controller and stopwatch functions should not interfere with each other.
5	f) Extra credit (20% more): The system meets requirements (a)-(d), AND the closed-loop step response settling time is one-half the open-loop settling time. Overshoot must be less than 10%. The step change will be from 40% to 50% of motor full speed. This test will be conducted with no shaft loading.

(Notes on next page)

Notes:

- Requirement (a) means the keypad interface must work.
- Requirement (b) can be achieved without motor speed feedback. Ten different speeds must be demonstrated, but there is no specification on steady-state accuracy.
- Requirement (c) means timer interrupts must work.
- Requirement (d) means feedback is implemented, and the PWM signal automatically adjusted so that motor speed is within 5% of the desired value. A nice transient response is not essential.
- Requirement (e) means that a digital stopwatch operates independently of the speed controller.
- Option (f) means a well-tuned feedback system has been implemented.