Institute of Information and Communication Technology
M. Sc. Engineering Program, April 2023

ICT 6641	***Advanced Embedded System Design Lab***
Expt. #4	***Controlling Motor Drives***

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Introduction: This experiment will explore how to control DC, Stepper and servo motors which are used for various applications.

Lab components required: STM32 blue pill board, ST-Link V2 module, power supply, one DC motor, one Stepper motor, one Servo motor, one DC supply, a driver for the DC motor, a driver for the Stepper motor and one Oscilloscope.

Part#4A: Controlling a DC motor

The objective of this experiment is to learn how to change the speed of a DC motor and also how to change the direction of rotation of a DC motor. Connect your Blue pill and DC motor according to the following diagram. Use a 12V supply (from the laboratory's power supply) for the DC motor. Change appropriate value in the related register for increasing or decreasing the speed of the motor (by changing the duty cycle of the PWM signal generated) and the appropriate values (1/0) to two pins to change the direction of rotation of the motor (by changing the switch positions of the H-bridge).

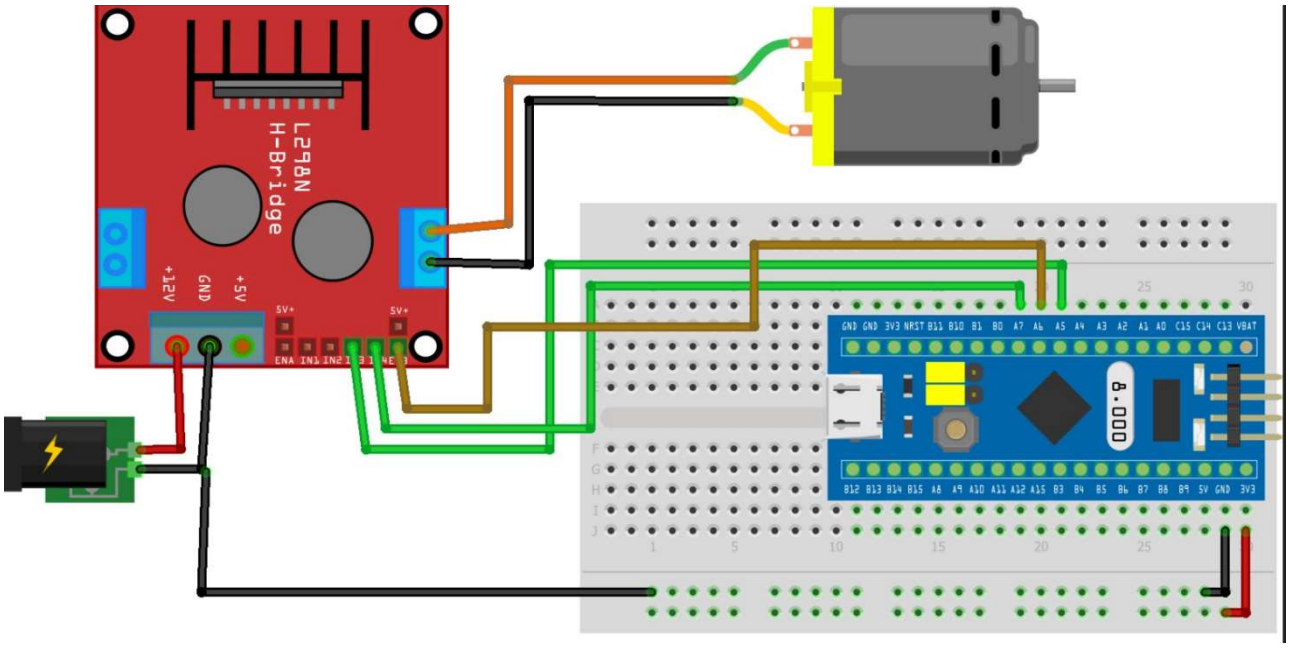

Fig 1: Connection Diagram for Part#4A.

Procedure:

1. Open STM32 CubeIDE and create a project.
2. Set PA5 and PA7 pins as output pin.
3. Set The RCC External Clock Source and Set the system clock to be 72MHz
4. Configure TIM3 peripheral to operate in PWM mode (see the next page).

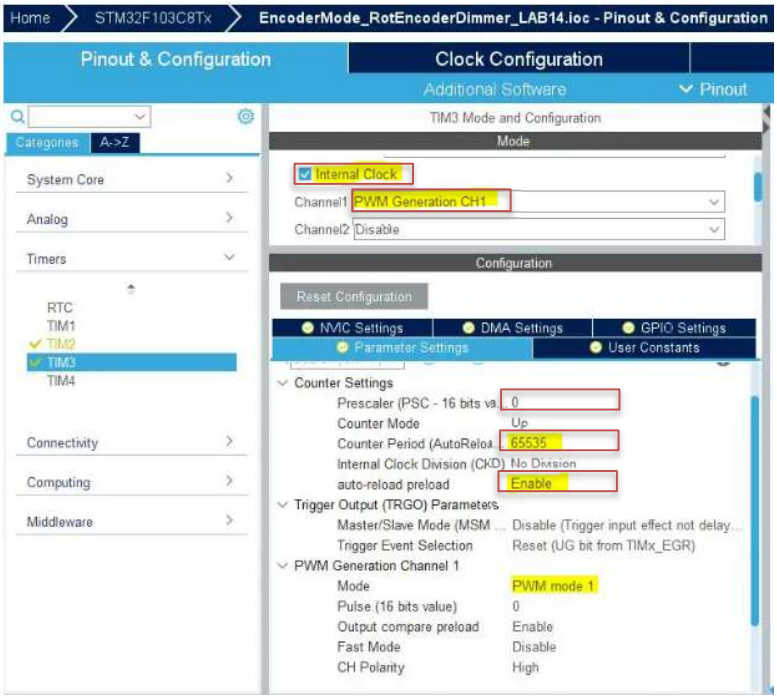

Fig. 2: Configuration setup for the Timer (TIM2) to be used for Part#4A.

The settings are Internal Clock (tick on the check box), Channel1: PWM Generator CH1, Prescalar:0 Counter Period (auto…): 65535 and auto-reload preload: Enable.

5. Note that the pin PA6 is the output pin for the PWM signal (for CH1 of TIM3).
6. Save the project (Ctrl+S) and the initialization code will be generated.
7. Add the appropriate portions of the codes from the supplementary document.
8. Compile the code and check if there is any error. If any try to correct it.
9. Power up the setup.
10. Run and download the program to the Blue Pill using ST-Link module.
11. Observe for rotation of motor.
12. Change the related OCR register value (TIM3->CCR1) and see change in PWM signal (by using an oscilloscope) and the change in speed.
13. Minimum speed may be obtained by putting the CCR value at around 14000 and maximum at 65000.
14. Verify the output wave shape (as seen from oscilloscope) against the calculated value using the CCR and ARR registers' content.
15. Now keeping CCR value at one number, change the ON/OFF status of the two pins (PA5 & PA7) going to the driver (IN1 and IN2)..
16. Try to explain all the modifications you made and observation you noted.

Part#4B: Controlling a Stepper motor

The objective of this experiment is to learn how to change the position of a stepper motor. Connect your Blue pill and the stepper motor along with its driver according to the following diagram.

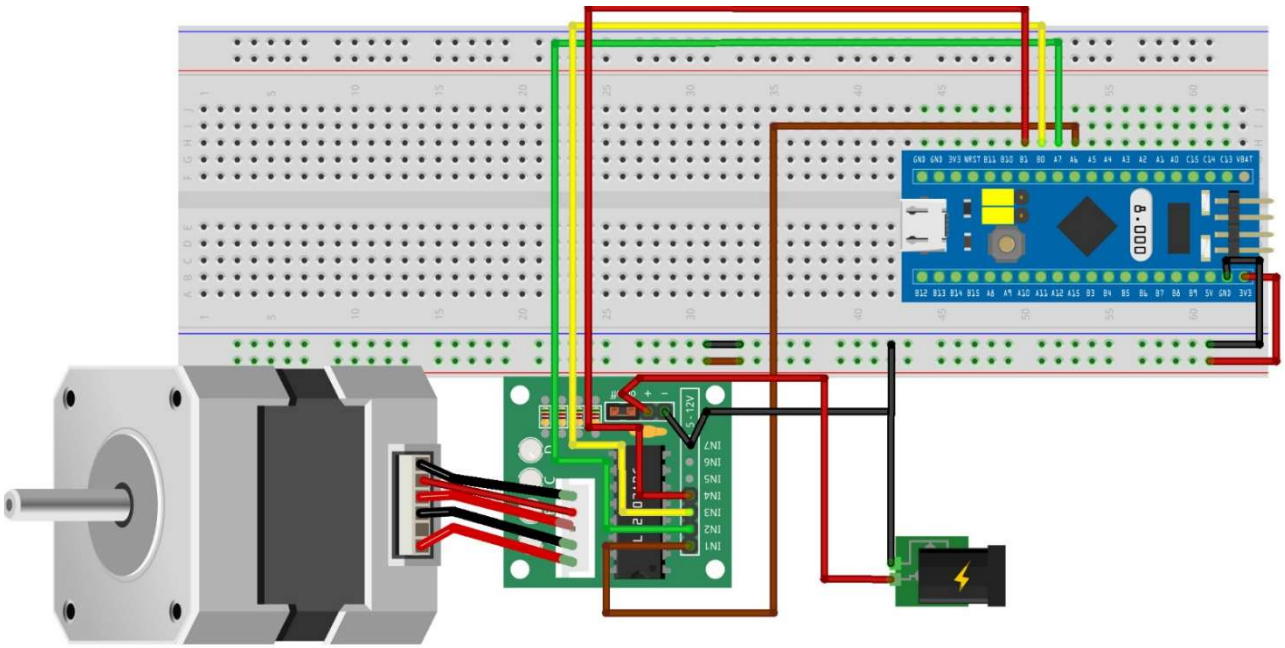

Fig 3: Connection Diagram for Part#4B.

Procedure:

1. Open STM32 CubeIDE and create a project.
2. Set PA3, PA4, PA5 and PA6 as output pin.
3. Set The RCC External Clock Source and Set the system clock to be 72MHz.
4. Save the project (Ctrl+S) and the initialization code will be generated.
5. Add the appropriate portions of codes from the supplementary document.
6. Compile the code and check if there is any error. If any try to correct it.
7. Power up the setup.
8. Run and download the program to the Blue Pill Module using ST-Link module.
9. Then modify the code in the while loop to set the motor position at a certain specific rotor angle.
10. Try to explain your observations.

Part#4C: Controlling a Servo motor

The objective of this experiment is to learn how to change the position of a servo motor. Connect your Blue pill and the servo motor according to the following diagram. The colours of the terminals of the servo motor is shown in Fig. 5.

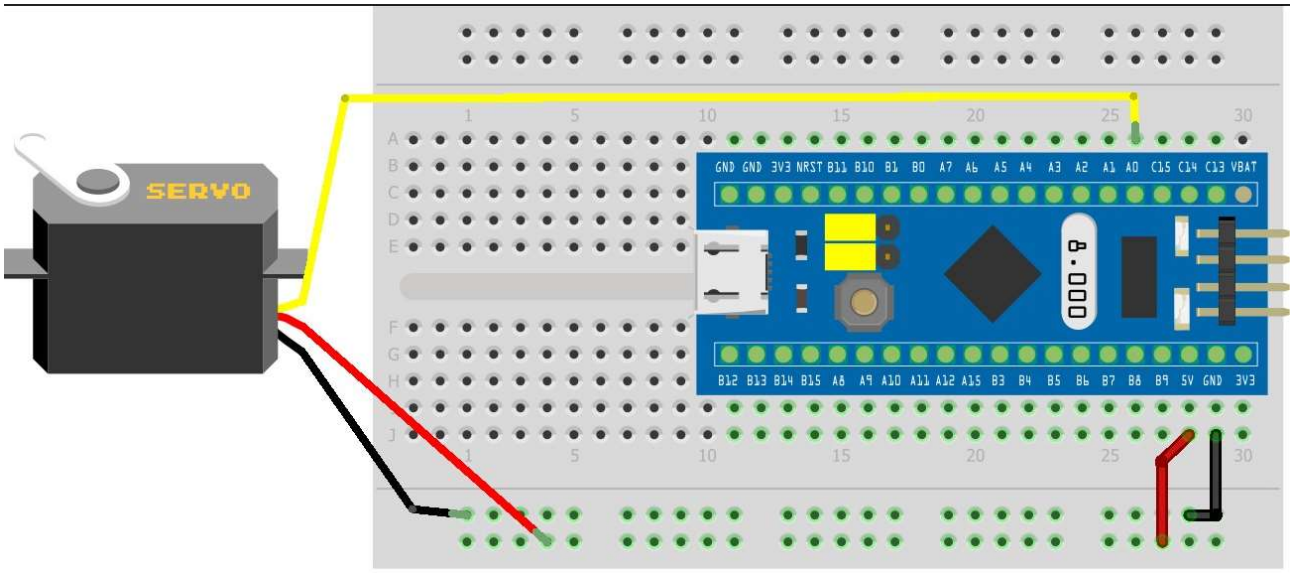

Fig 4: Connection Diagram for Part#4C.

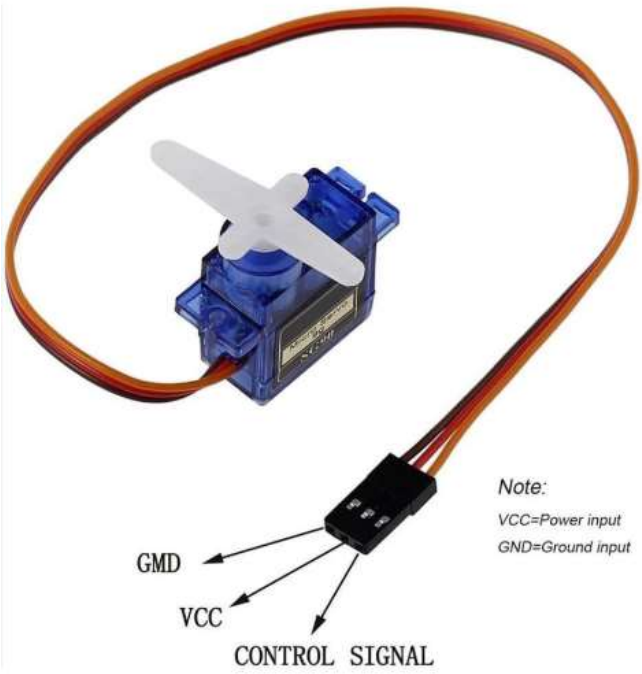

Fig. 5: Colour code for the Servo motor terminals

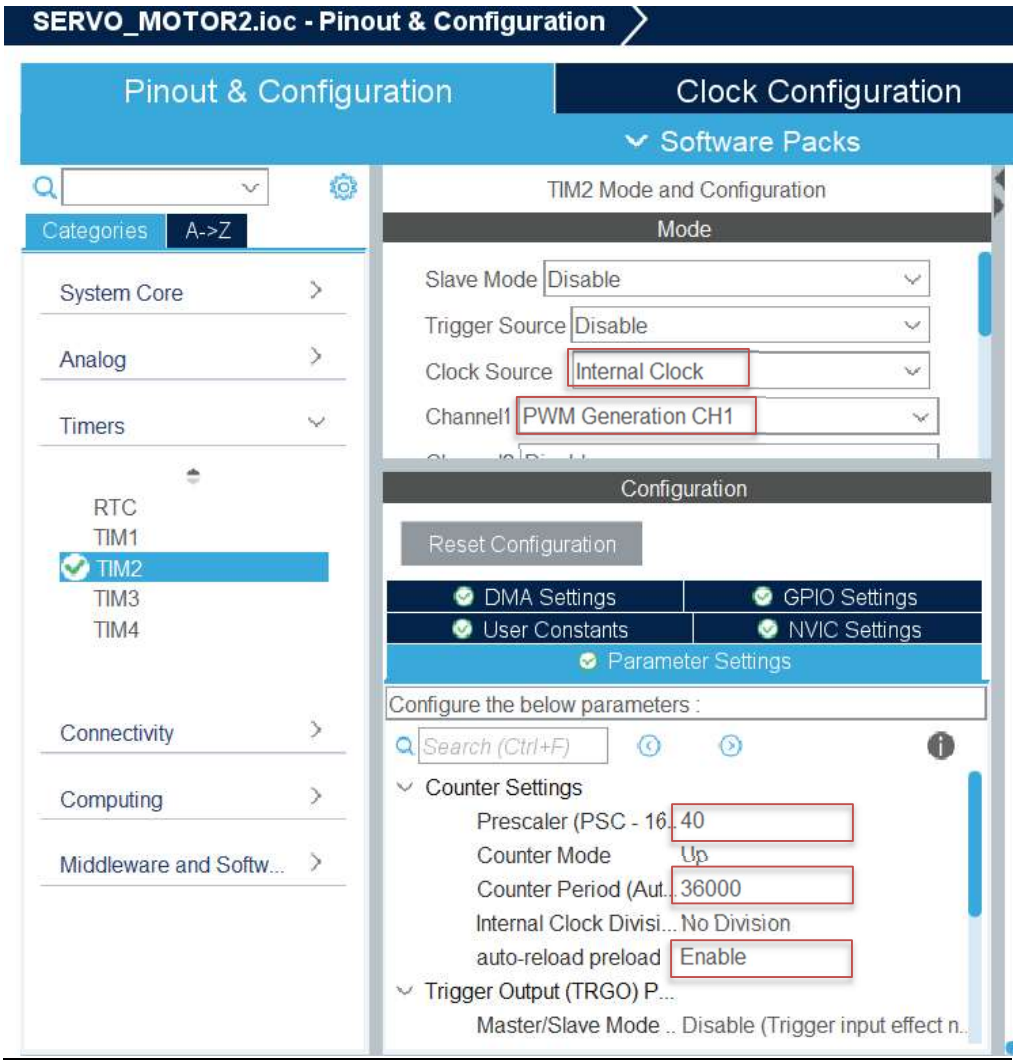

Fig. 6: Configuration setup for the Timer to be used for Part#4C.

The settings are Clock Source: Internal Clock, Channel1: PWM generator CH1, Prescaler: 40 Counter Period (auto…): 36000 and auto-reload preload: Enable.

Procedure:

1. Open STM32 CubeIDE and create a project.
2. Set The RCC External Clock Source and Set the system clock to be 72MHz
3. Configure Timer2 peripheral to operate in PWM mode (see above, Fig. 6).
4. Note that the pin PA0 is the output pin for the PWM signal (for CH1 of TIM2).
5. Set The RCC External Clock Source and Set the system clock to be 72MHz.
6. Save the project (Ctrl+S) and the initialization code will be generated.
7. Add the appropriate portions of code from the supplementary document.
8. Compile the code and check if there is any error. If any try to correct it.
9. Power up the setup.
10. Run and download the program to the Blue Pill using ST-Link module.
11. Observe that for minimum angle the value of CCR is 1000 and for maximum, it is 4000.
12. For the generated PWM signal generated, observe the pulse width of the ON time and time period.
13. Verify these values against the timer setting you made during configurating of the peripherals.
14. Then modify the code in the while loop to set the motor position at a certain rotor angle.
15. Try to explain your observations.

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