The University of Western Australia
School of Engineering
Prof. Thomas Bräunl

Embedded Systems
ELEC3020

Lab Assignment 7 – Motor Control **Points: 10**

TEAMS: This lab will be conducted in teams of 2 students

EQUIPMENT: TTGO controller, motors with encoder, oscilloscope, battery.

For all experiments:

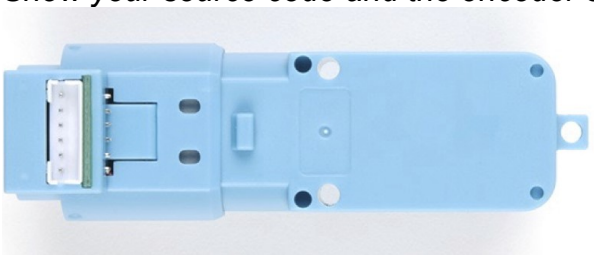
- Display the current encoder value and motor speed on the LCD, using a suitable time interval to see the impulse response of the motor.
- Transfer speed values from TTGO to your PC/Mac and store as a csv-file (insert a comma or newline after each value). Visualize graph using Excel (optional but a good test of skills).

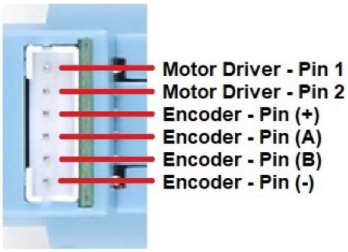
EXPERIMENT 1 Encoder (3 points)

Connect your TTGO contoller to only the Encoder of the motor unit. Make sure to use the **TTGO 3.3V** output to connect to the **encoder** "Pin +" input and TTGO GND to encoder "Pin –". Connect TTGO GPIO 1 and 2 to the encoder inputs "Pin A" and "Pin B" respectively. Use the **TTGO 5V** output **only** for driving the **motor**.

- Connect the motor to the 5V output **via a switch** and let it spin forward and backwards.
- Display the encoder count on the LCD
- How many ticks do you get for one wheel revolution? _____
- Depending on the motor's spinning direrction, the encoder count should increase or decrease.

Show your source code and the encoder setup to the lab demonstrator.





EXPERIMENT 2 Motor PWM (3 points)

Setup the motor drive part:

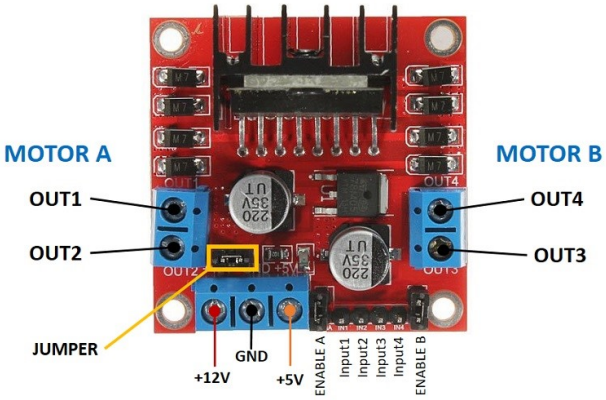
- Connect the external 7.4V battery to 12V and GND of the motor controller.
- Connect the motor pins (Driver Pin 1, 2) to motor controller Out1 and Out2.
- Connect motor controller IN1 to 5V from motor controller and connect motor controller IN2 to GND from motor controller.
- Connect TTGO GPIO pin 3 to the Enable A input of the motor controller.

Write a program on the TTGO to generate PWM output with 10%, 50% and 100%, respectively (switch between using push button).

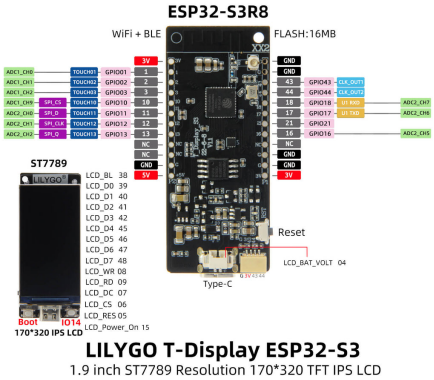
- Display the motor output function pin on the oscilloscope.
- Observe the differences in motor speeds

Show your source code and the encoder setup to the lab demonstrator.

Motor Controller



TTGO

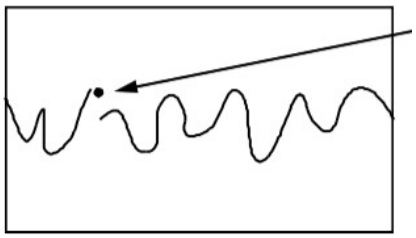


EXPERIMENT 3 Bang-Bang versus P-Controller (4 points)

Write a motor controller in C formaintaining a fixed speed of 140 ticks/sec, irrespective of changing load.

a) **Bang-Bang controller**
b) **P-Controller**

- Follow the algorithm and procedure outlined in the lecture notes.
- Plot speed data in real-time directly onto the LCD screen
- Using serial transfer, send 100 speed data points to your PC using the serial plot functionality of the Arduino library.



Show your source code, motor setup and the generated graph to the lab demonst.

Bonus Points (1-2 points)

Extend the P controller stepwise to a full **PID controller** (P, PI, PID). The program should maintain a fixed speed value of 160 ticks/sec, irrespective of changing load. Conduct the following steps and tune the corresponing coefficients.

- Step A: **P**-Controller (already done in Ex. 3).
- Step B: **PI**-Controller (add integral component); display generated graph.
- Step C: **PID**-Controller (add differential comp.); display generated graph.

Show your source file and the generated graphs to the lab demonstrator.