Department of Electrical Engineering
College of Engineering
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ENRB 603 (Spring 2022) Project (1)

Title: *Digital PID Control*

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- **Problem:**

  It is required to design and implement a motion control system for a stepper motor, using PLC and a suitable driver (optional), as illustrated in the figure. Both speed, rotation direction, and position need to be controlled.

(a)

(b)

(c)

The objective of this report is to fully explain how to control a **NEMA 17** Stepper motor using a ***PLC*** with all external components to be purchased, this report should provide a hands-on guide on how to implement the same project to anyone with amateur experience in ***PLC*** and **Electrical connections.**

Components:

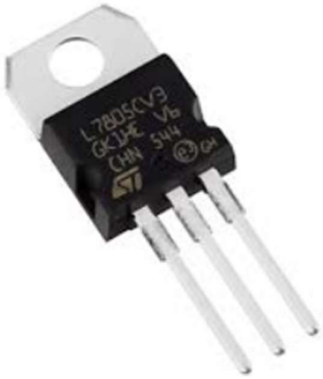
- NEMA 17 Stepper Motor
- DRV8825
- Voltage Regulators **(5V)**
- Breadboard
- Jumper Cables

Figures of Components:

NEMA 17 Stepper Motor:

DRV8825 w/ Heat sink:

Voltage Regulator **(5V):**



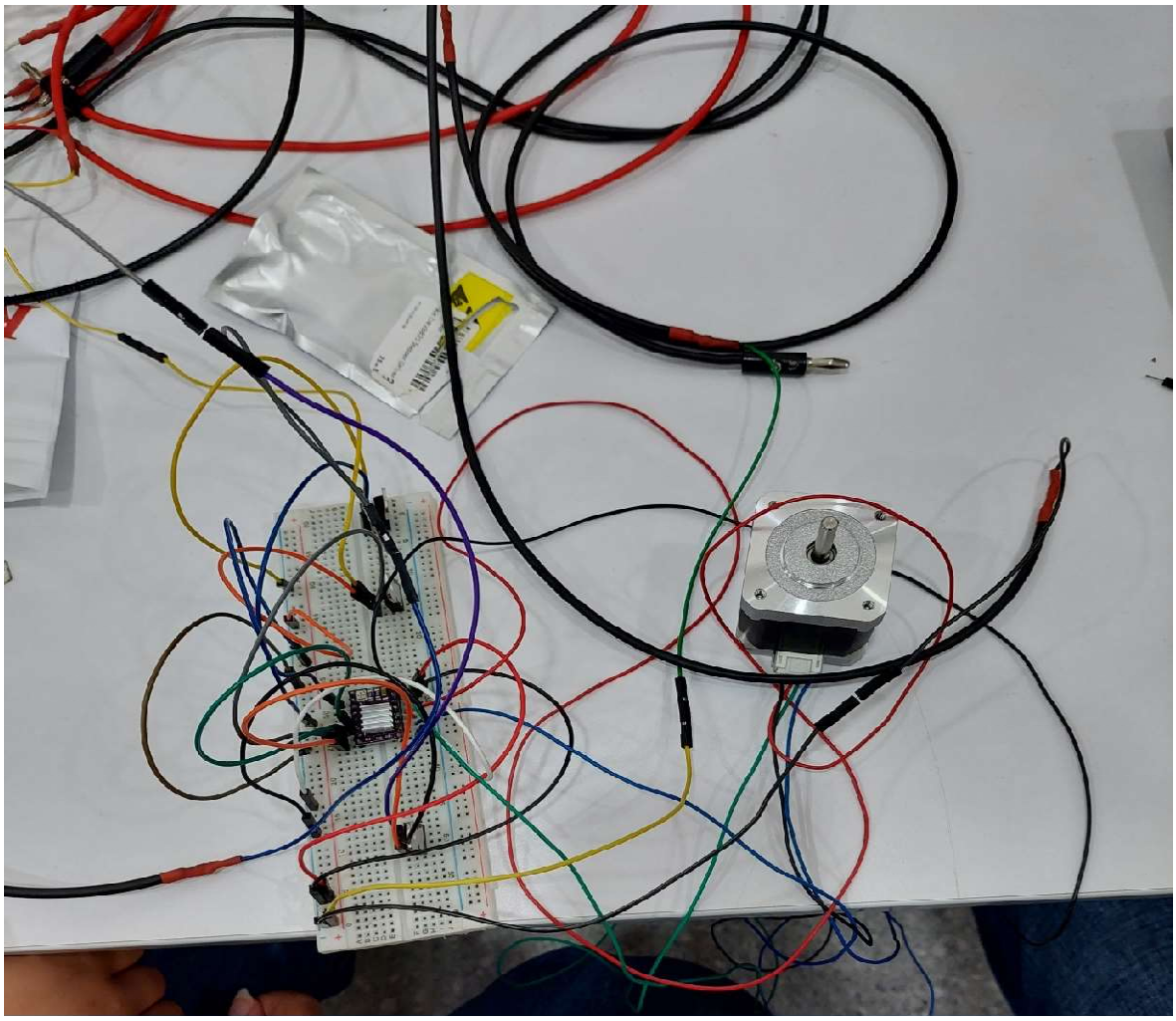
Breadboard:

Jumper Cables:

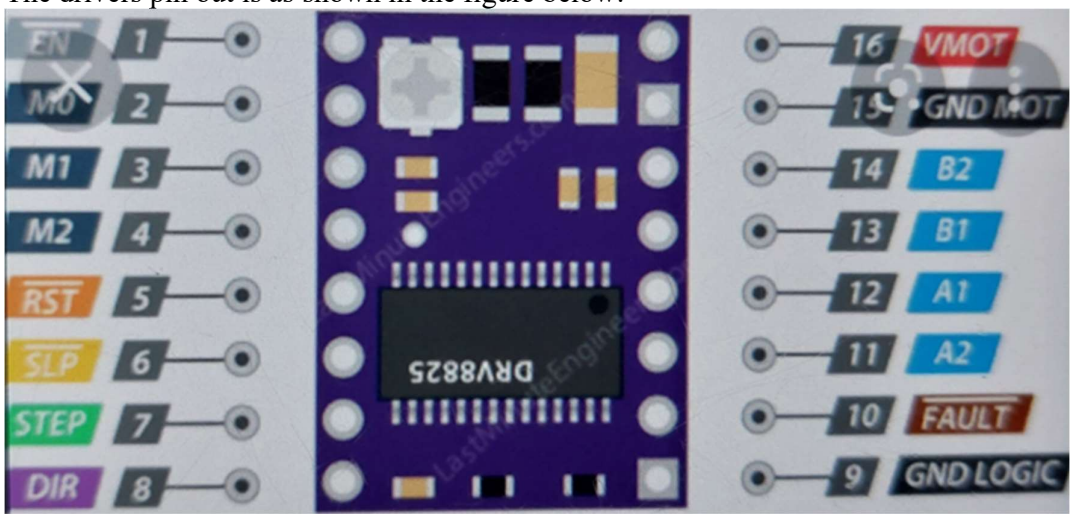
Mode of operation:

The NEMA 17 Stepper Motor requires an external driver **(DRV8825)** to be connected to the PLC I/O Module.

The figure below is the full connections of the Driver with PLC and motor, all details will be explained later on in the report



The drivers pin out is as shown in the figure below:



Notice: The driver only requires 5V, however the PLC Module provides 24V. Therefore, we are required to use the Voltage Regulators.

The driver pins we have used are as follows:

- M0 (2)
- RST (5)
- SLP (6)
- STEP (7)
- DIR (8)
- GND LOGIC (9)
- A2 (11)
- A1 (12)
- B1 (13)
- B2 (14)
- GND MOT (15)
- VMOT (16)

M0 is used to receive a signal from the PLC of value either 0 or 1, 0 sends a signal to the motor to complete a full-step movement. However, 1 sends a signal to the motor to complete a half-step movement.
Notice: It is required to use a voltage regulator before sending the signal to the Driver.

RST is used to receive a signal from the PLC to reset the motor functionality.
Notice: It is required to use a voltage regulator before sending the signal to the Driver.

SLP is used to receive a signal from the PLC to sleep the motor functionality.
Notice: It is required to use a voltage regulator before sending the signal to the Driver.

STEP is used to receive signal that determines the pulses the stepper motor is required to produce movement. **Notice**: It is required to use a voltage regulator before sending the signal to the Driver.

DIR is used to receive a signal from the PLC of value either 0 or 1, 0 sends a signal to the motor to rotate in CW, 1 sends a signal to the motor to rotate in ACW.
Notice: It is required to use a voltage regulator before sending the signal to the Driver.

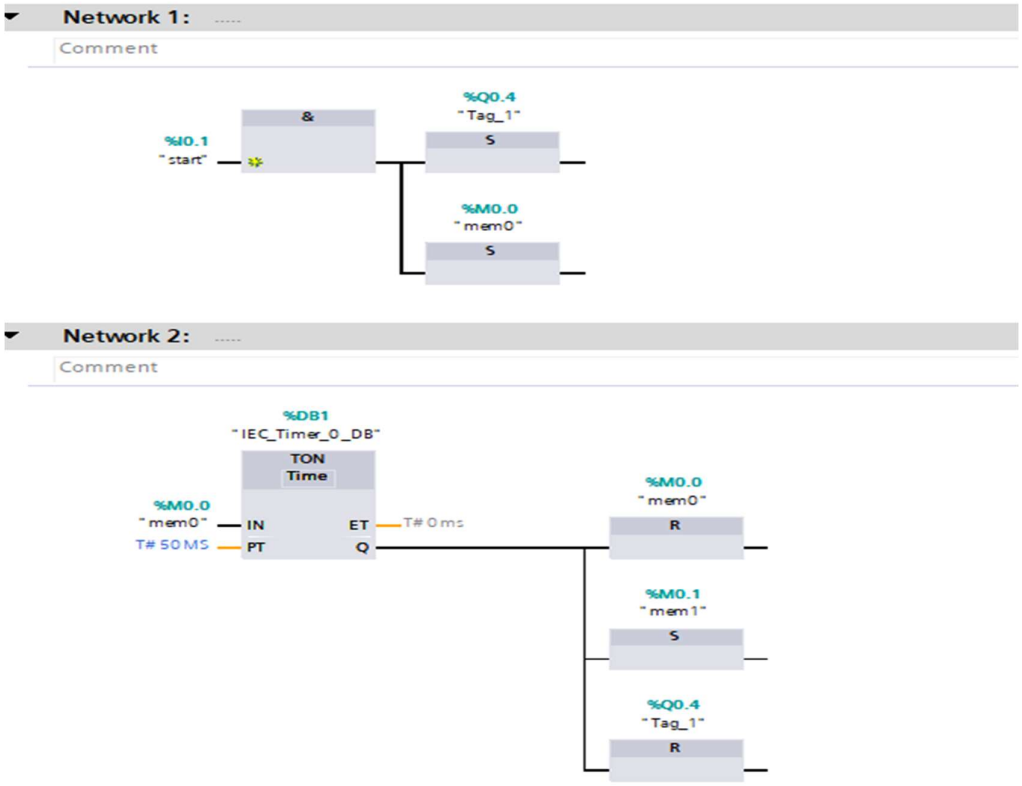
GND Logic is used to connect ground node of the PLC signals

B2, B1, A1, A2 are used to connect the input nodes of the NEMA 17 stepper motor.

GND MOT ground node of NEMA 17 stepper motor.

VMOT NEMA 17 stepper motor voltage input.

PLC Logic:

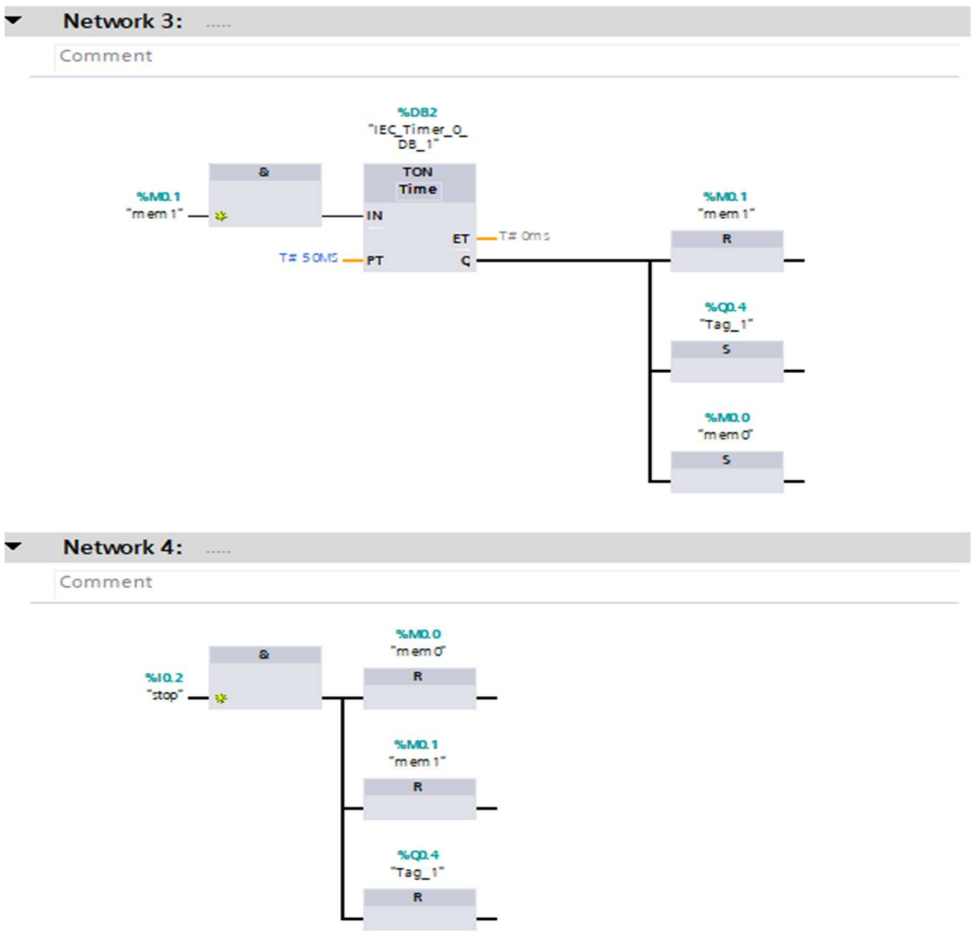


Network 1:

%i0.1 used to start by sending output to **%Q0.4** and saving in memory **%M0.0**

Network 2:

Timer on once **%M0.0** is on, after time ***RESET*** **%M0.0, %Q0.4** and ***SET*** **%M0.1**



Network 3:

%M0.1 sets ***TIMER*** on for 50MS then, ***SETS*** **%Q0.4 %M0.0** and ***RESETS*** **%M0.1**

Network 4:

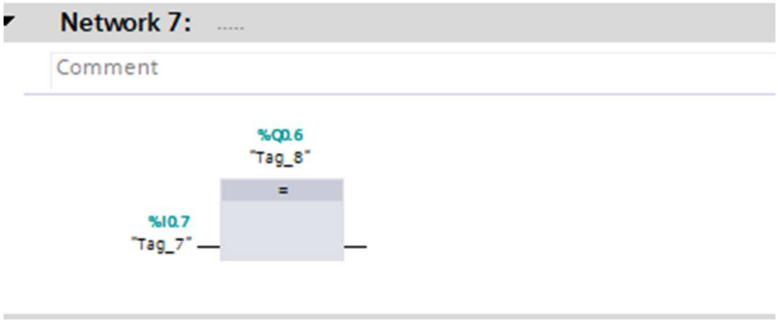
%i0.2 (Stop) ***RESETS*** **%M0.0, %M0.1** and **%Q0.4**

Network 5:

%i0.3 (*Change Direction*) output **%Q0.5**

Network 6:

If both **%Q0.4 & %i0.4** are 1 initiate counter save in **%MW1.0**
When **%MW1.0** count reaches 100 ***RESET*** **%Q0.4, %M0.0, %M0.1**



Network 7:
%i0.7 assigns output **%Q0.6** for use in Driver signal.