Curious Circuits

PID TRAINER KIT – KIT 5

User Manual

Description

This document is the instruction manual for the use of the PID Trainer Kit -Kit 5.
This kit is to be used for the course CKRE140 at Ryerson University.
r0.1-2022-01-11

Curious Circuits
info@curiouscircuits.com

Table of Contents

PID Trainer Kit – Kit 5 User Manual

Introduction

This document is the instruction manual for the use of the PID Trainer Kit -Kit 5. This kit is to be used for the course CKRE140 at Ryerson University.

The kit comes with many parts, and they are used to build the Motion Trainer and Temperature Trainer. Both trainers use a L298N motor driver board along with accessories such as the 12V power supply and hookup wires.

It is important to note the there is NO microcontroller board with this kit. It is assumed that the user has a microcontroller board from previous courses. Please consult with your instructor if you are unsure about the microcontroller.

Temperature Trainer User's Guide

The goal of the Temperature Trainer is to practice designing control techniques to control temperature precisely.

The Temperature Control Board uses of a mini 12V incandescent bulb as a heat source. The board also has a thermistor as a temperature sensor. After screwing the bulb, the thermistor should be bent over such that it makes good contact with the bulb.

The bulb is powered by the included L298N Motor driver board and the 12V power supply.

Temperature Trainer Connections

When making electrical connections between various components can be done with the provided female-female jumper wires. Double sided male headers are also included to convert any jumper to a male-female.

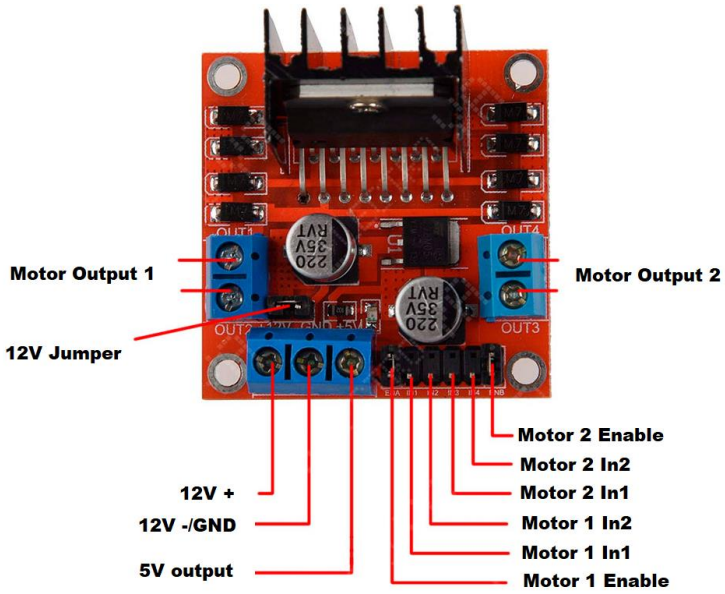
Temperature Control Board Pinout

Pin	Function
Vcc	5V logic – Connect to 5V/Vcc on microcontroller board
GND	Ground pin – Connect to GND pin on microcontroller board
S	Analog output – Connect to any analog input pin on microcontroller board
Bulb	Bulb pins should be connected to the motor out on motor driver board. Polarity does not matter

L298N Motor Driver Pinout

The L298N motor driver board can control two motors. This can be used in Temperature Trainer module to drive the 12V incandescent bulb.

- The board included has a pre-installed pig tail attached to the screw terminals on 12V + and GND.
- There is an additional GND pin that should be connected to the GND on the microcontroller board.
- Motor Output 1 has pre-soldered header pins that can be connected to the Bulb pins of the Temperature Controller Board. Note that polarity is arbitrary.
- 5V output is not need. The microcontroller should be powered by USB power.
- Motor1 Enable has a jumper that enables it when in place. Do not remove the jumper.
- Motor 1 In1 is the only pin that is required to control the power of the bulb. In1 should be connected to the pulse width modulation (PWM) output from the microcontroller.



Motion Trainer – Parts List

A x 1

B x 1

C x 1

D x 1

E x 1

F x 1

G x 1

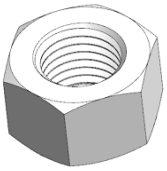
H x 2

I – Motor Hub x 1

J – Output Wheel x 1

K – Pololu Motor 37D 19:1 x 1

L – M3x12mm x 12



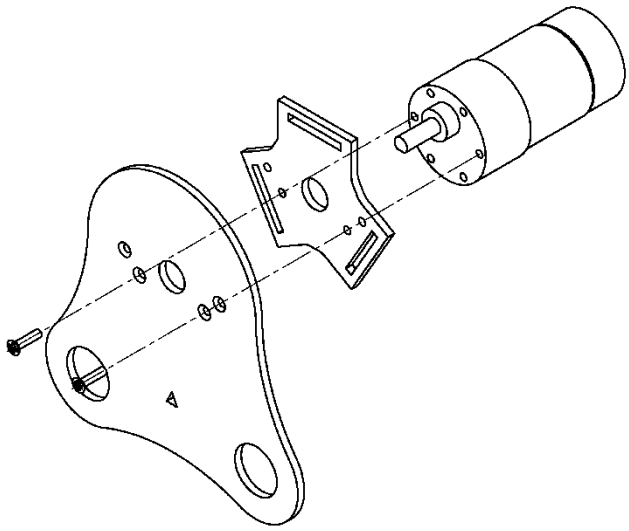
M – M3 Nut x 8

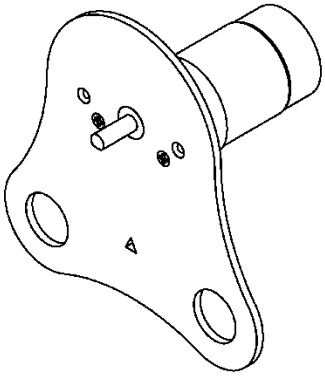
N – Spacer x 4

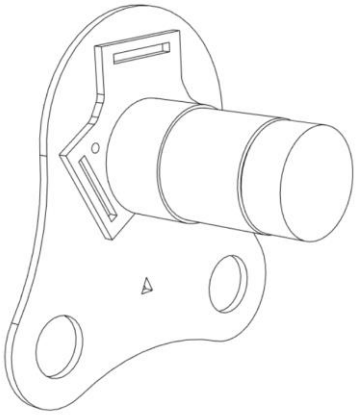
Motion Trainer Assembly

Step 1

Parts: A x 1; C x 1; K x 1; L M3x12mm x 2

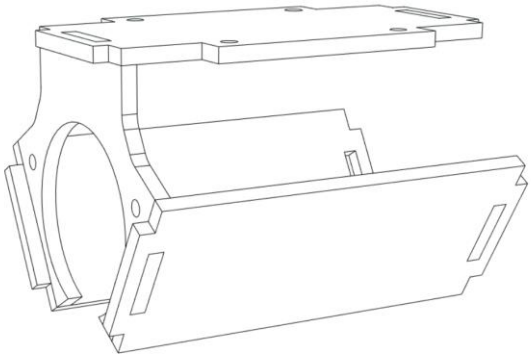


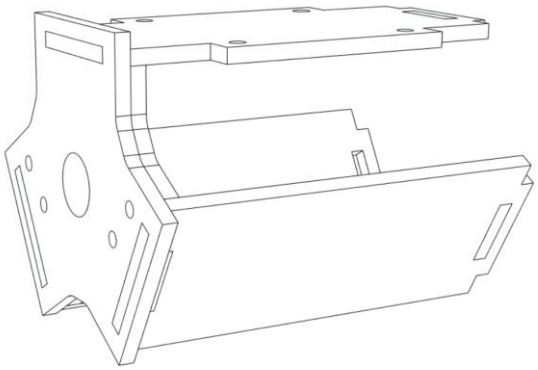


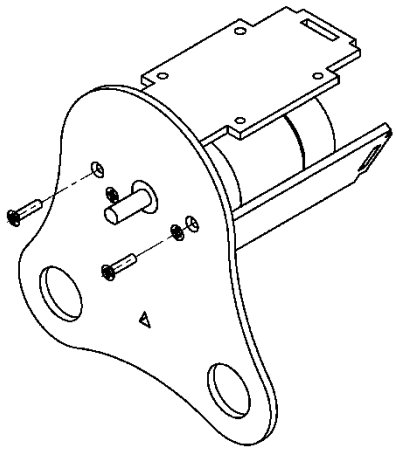


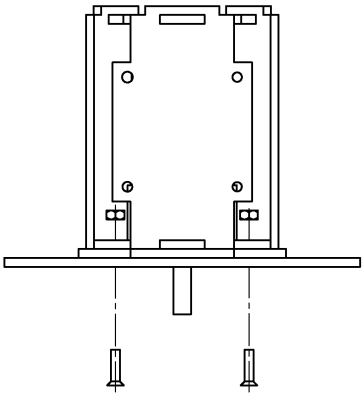
Step 2

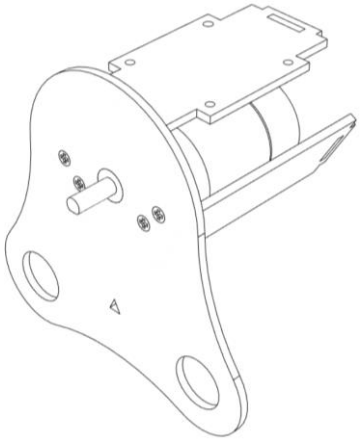
Parts: D x 1; G x 1; H x 2; L – M3x12mm x 2, M – M3 Nut x 2

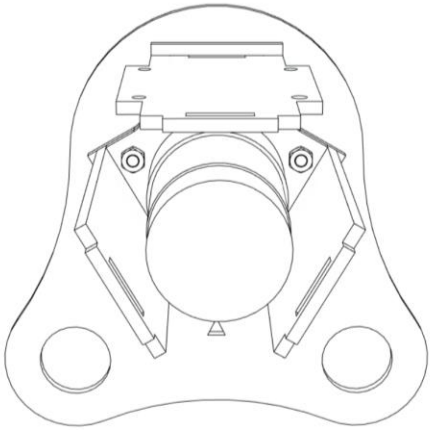






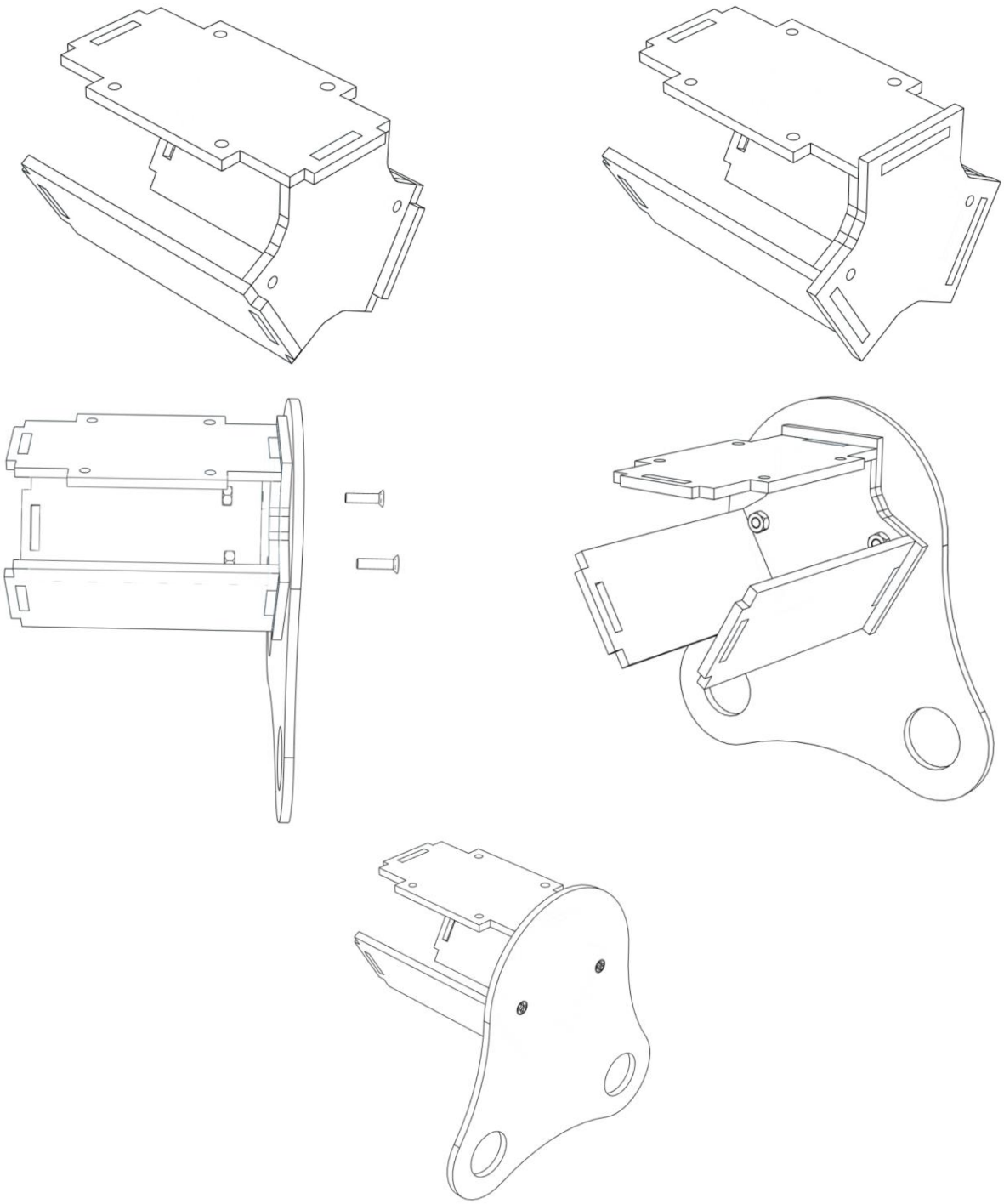






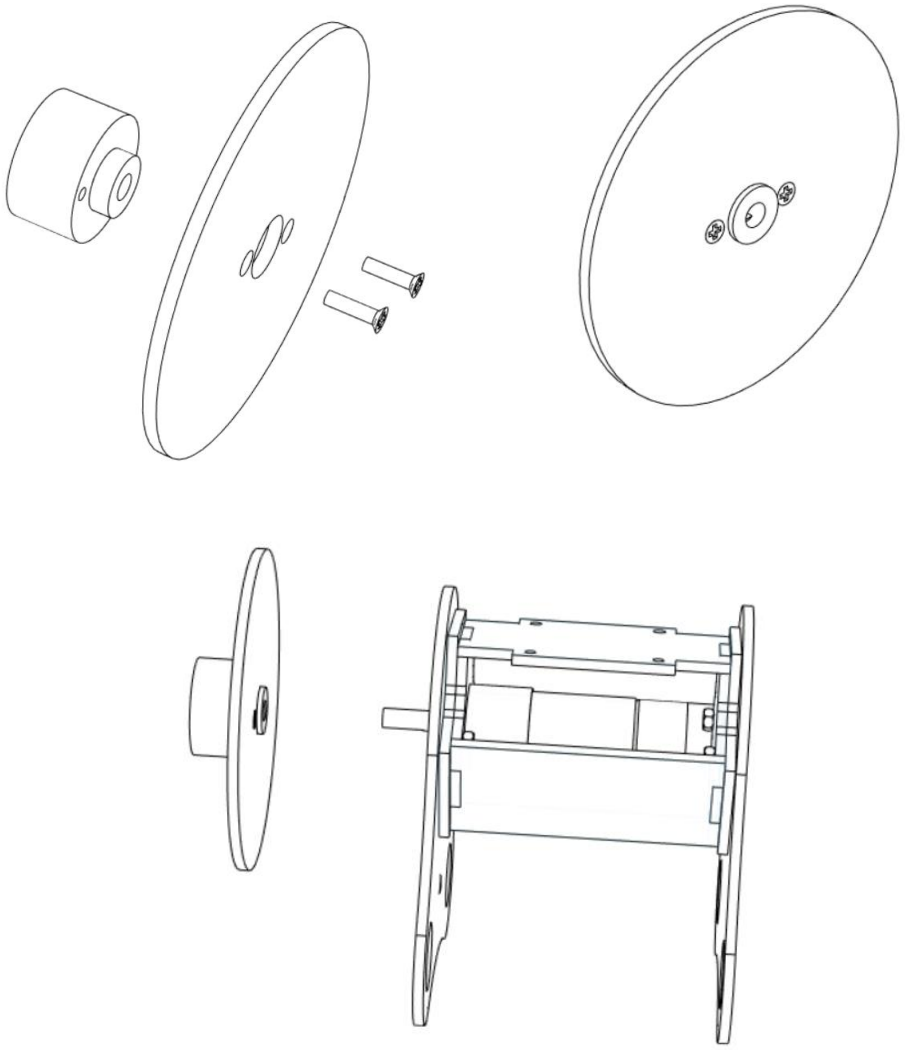
Step 3

Parts: E x 1; F x 1; B x 1; L – M3x12mm x 2, M – M3 Nut x 2

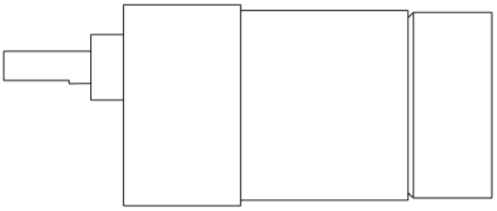


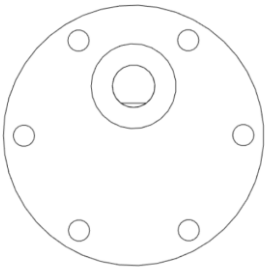
Step 4

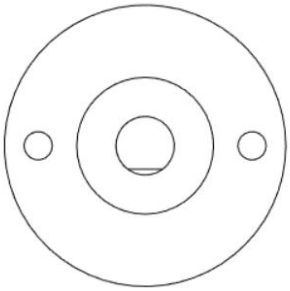
Parts: I x 1; J x 1; B x 1; L – M3x12mm x 2



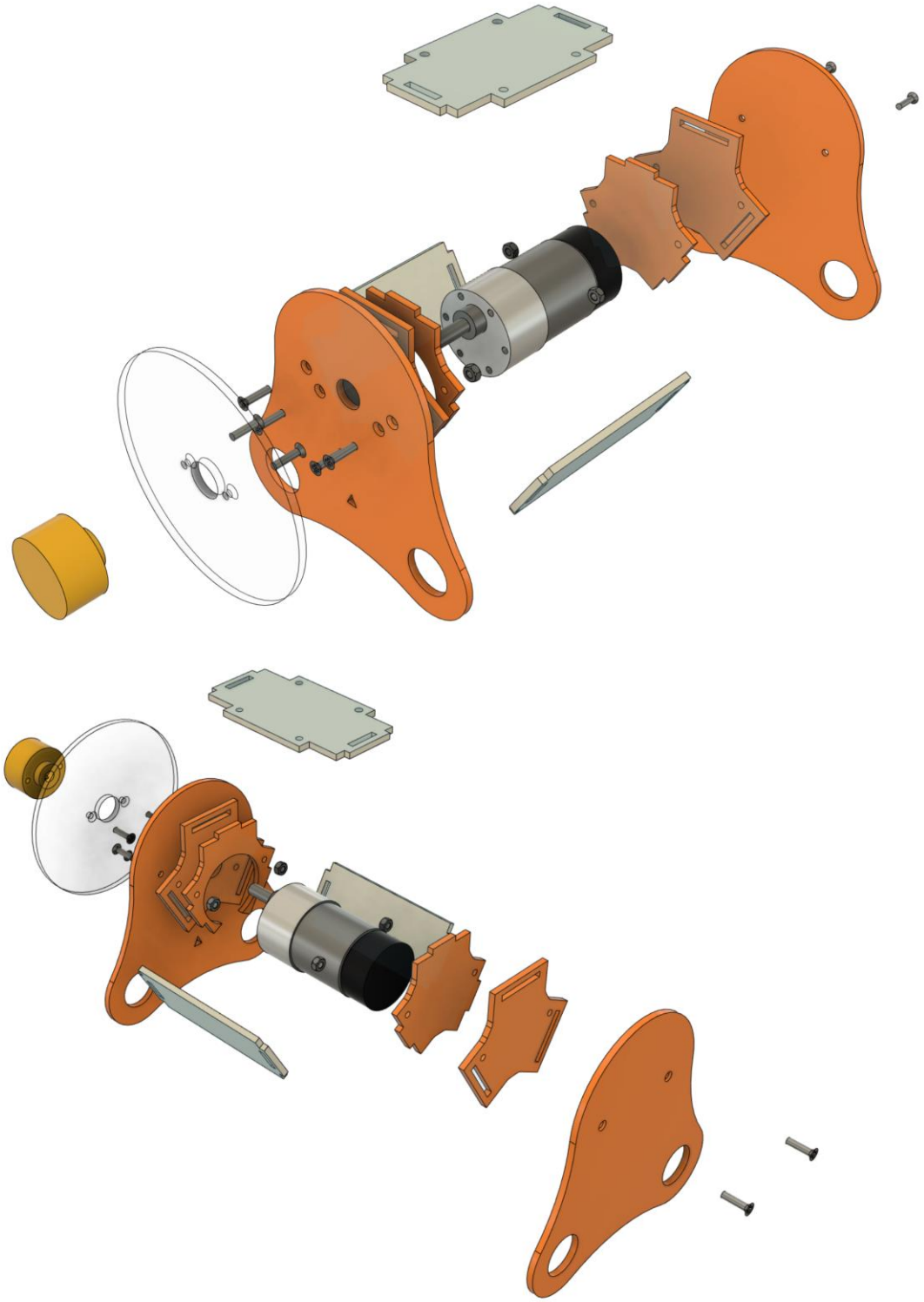
NOTE that the Pololu Motor has a D-Shaft while the motor hub also has a flat part that mate with it. Do not try to jam the motor hub onto the shaft if the alignment is off.



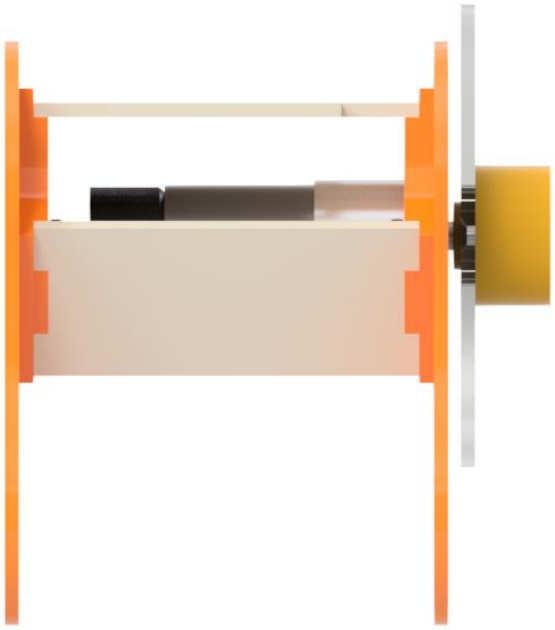




Exploded views



Assembled views



Optional mounting

The user may choose to mount the L298N motor driver on the Motion Trainer. Part G has 4 mounting holes. User may use the included standoffs, M3 screws and nuts to mount the motor driver there.

Another optional is in Step 3 of the assembly guide. Part G and the 2 parts H's can be mounted in any of the 3 slots. It does not affect the operation which ever way these panels are mounted.

Motion Trainer User's Guide

The goal of the motion trainer is to practice learning how develop position and velocity control of motors. Both position and velocity control can be done by using a motor with an encoder attached.

The Motion Trainer utilized the Pololu 37D Metal Gearmotor. The configuration of the motor has gearbox with a ratio of 18.75 to 1. The encoder is a two-channel Hall effect encoder with the 64 Count Per Revolution (CPR). Coupled with the 18.75 gear ratio, the final output shaft will have 1200 CPR. Follow the link to the Pololu's website for detailed information on the motor and its operation.

To drive the motor, the kit includes a L298N motor driver board. The motor driver board take controls signals from a microcontroller (microcontroller not included in kit) and drive the Pololu Motor. The whole system is powered by a 12V DC power adapter.

The output wheel (Part J) has markings at 5-degree increments. The front panel part A has a triangle cut-out that can be used as an indicator to know how many degrees the wheels has turned.

Motion Trainer Connections

When making electrical connections between various components can be done with the provided female-female jumper wires. Double sided male headers are also included to convert any jumper to a male-female.

Pololu 37D Metal Gearmotor Pinout

Color	Function
Red	motor power (connects to one motor terminal)
Black	motor power (connects to the other motor terminal)
Green	encoder GND
Blue	encoder Vcc (3.5 – 20 V)
Yellow	encoder A output
White	encoder B output

L298N Motor Driver Pinout

The L298N motor driver board can control two motors. For the Motion Trainer, we are only using one output.

- The board included has a pre-installed pig tail attached to the screw terminals on 12V + and GND.
- There is an additional GND pin that should be connected to the GND on the microcontroller board.
- Motor Output 1 has pre-soldered header pins that can be easily connected to the Pololu's motor.
- 5V output is not need. The microcontroller should be powered by USB power.
- Motor1 Enable has a jumper that enables it when in place. Do not remove the jumper.
- Motor 1 In1 and In2 pins can be used to control both the speed and direction of the motor. It is recommended that In1 should be connected to the pulse width modulation (PWM) output from the microcontroller, and In2 should be connected to a digital output that controls the direction of the motor.