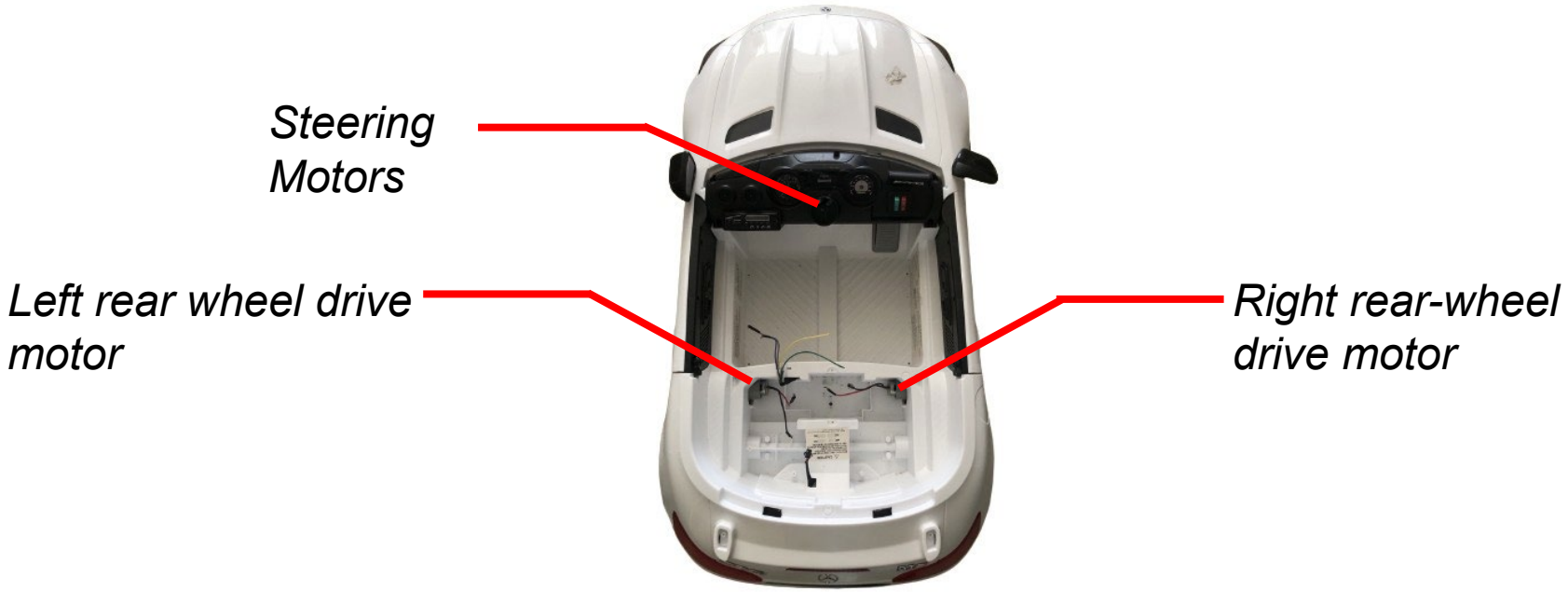
성균관대학교
SUNG KYUN KWAN UNIVERSITY(SKKU)

Future Vehicle Education Workshop – Assembling Hardware

Automation Lab

Hardware - Parts Introduction

- Children's Electric Car
  - Vehicle body
  - Equipped with two rear-wheel drive motors and one steering motor
  - All three motors are DC motors for 12V



Robust steering design

- When turned the steering
  - If the steering motor does not sound for the entire steering radius...
  - Utilize a glue gun on the underside of the vehicle to secure the motor gearbox and rotating axle

Hardware - Parts Introduction

- Battery
  - Power the electric car
  - Support 220V output

Hardware - Parts Introduction

- SMPS
  - Converting 220V AC Power to 12V DC Power

Set to 230V.

LED ON when AC INPUT

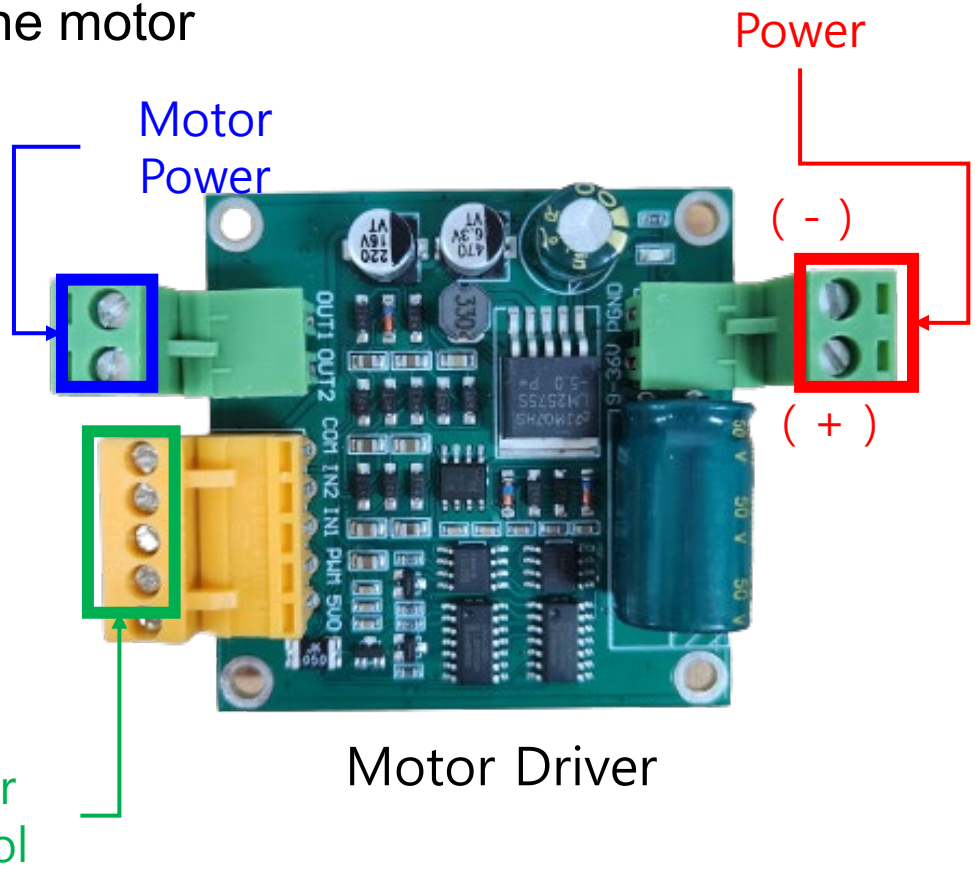
OUTPUT Voltage regulation

DC OUTPUT

AC INPUT

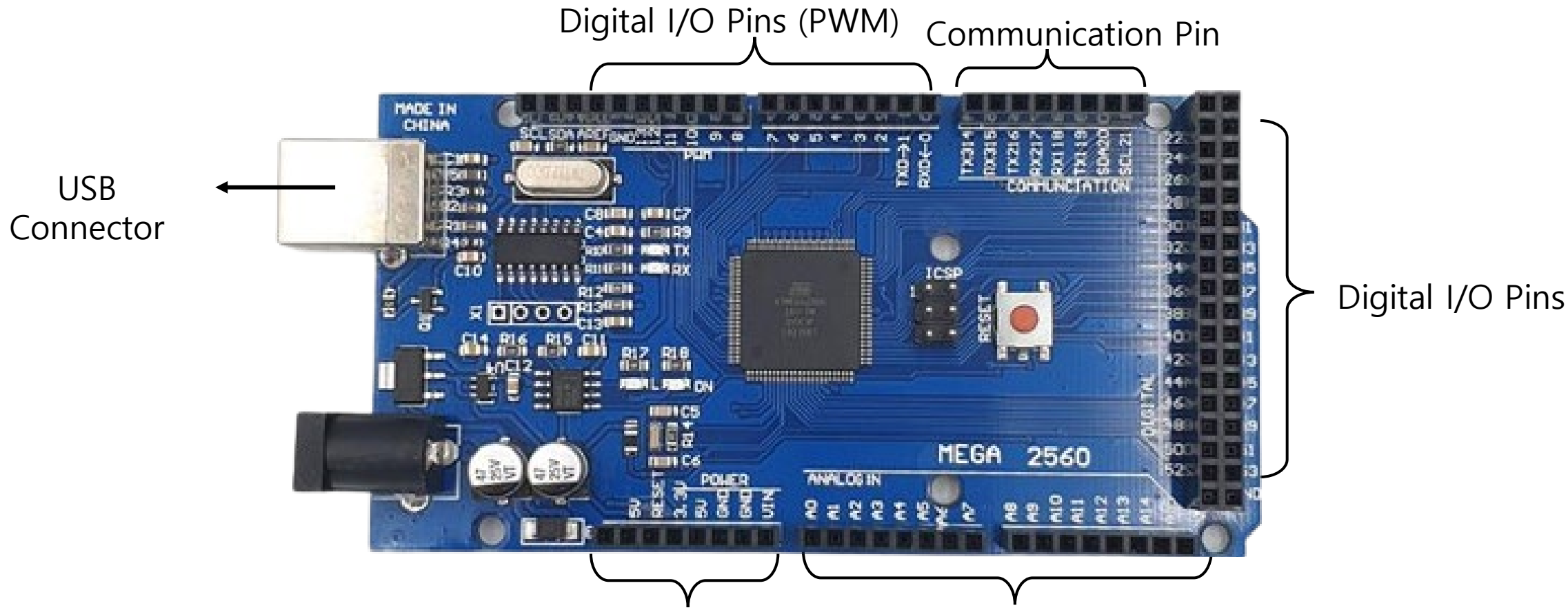
Hardware - Parts Introduction

- Motor Driver
  - Receives the output of the SMPS (12V DC) as the input of the motor driver
  - Receive control signals from Arduino
  - Applying the appropriate output voltage with the motor



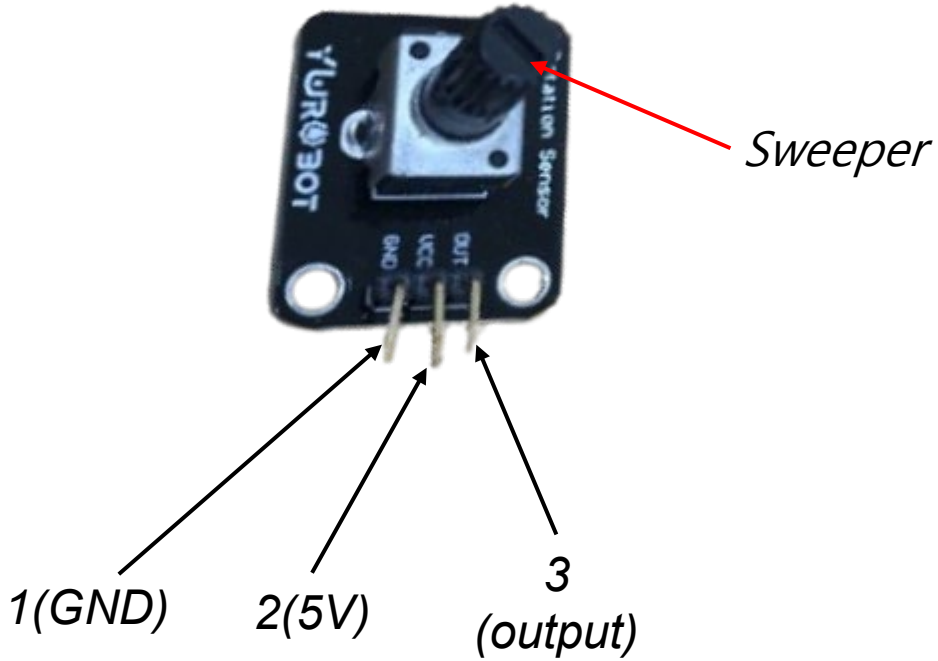
Hardware - Parts Introduction

- Arduino mega 2560
  - Ultra-compact computer to control multiple devices and sensors



Hardware - Parts Introduction

- Variable Resistance
  - Resistance that can change the value of the current flowing through the circuit
  - Output the strength of the resistor as an analog value via the Output pin



Hardware - Parts Introduction

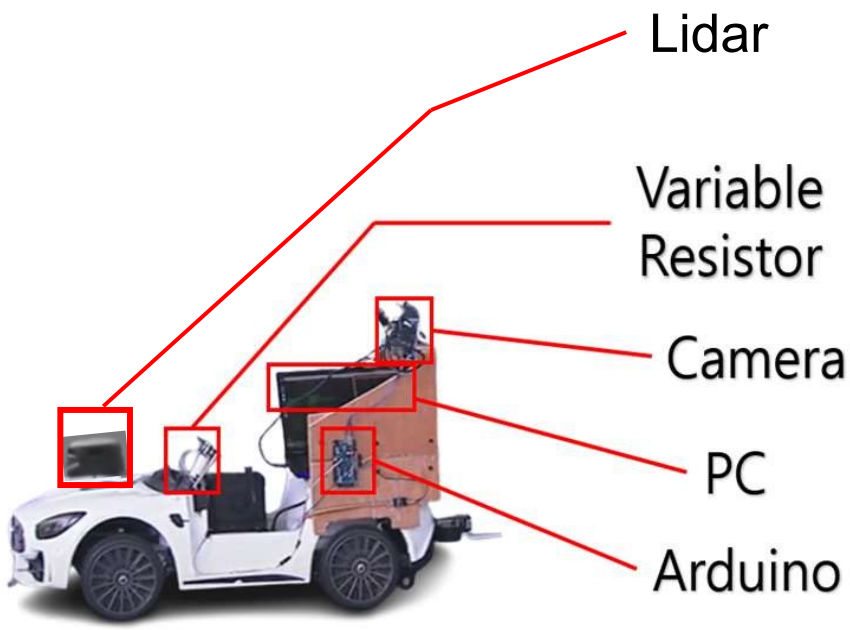
- Camera
  - Sensors to perceive your surroundings
  - Used to recognize lane information, traffic light information, etc.

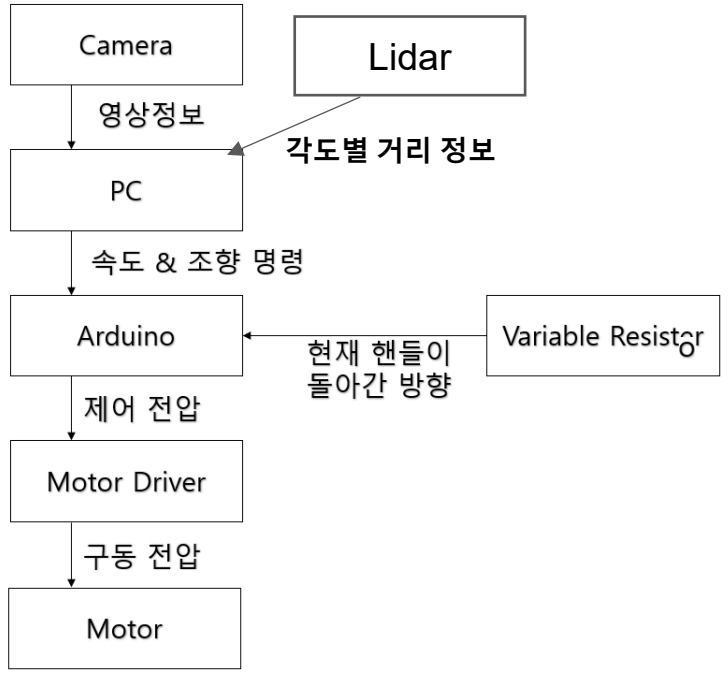
Hardware - Parts Introduction

- LiDAR
  - Sensors to perceive your surroundings
  - Used to recognize obstacle information, etc.

Hardware – Overview of entire system

- Finished vehicle appearance

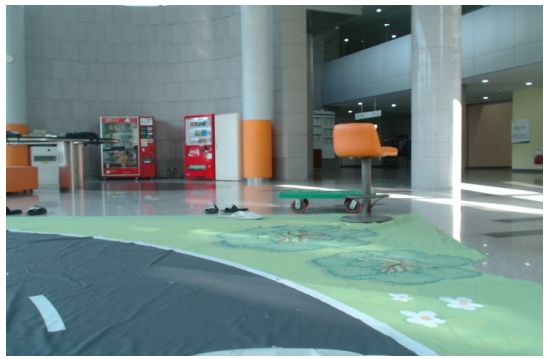




Hardware – Overview of entire system

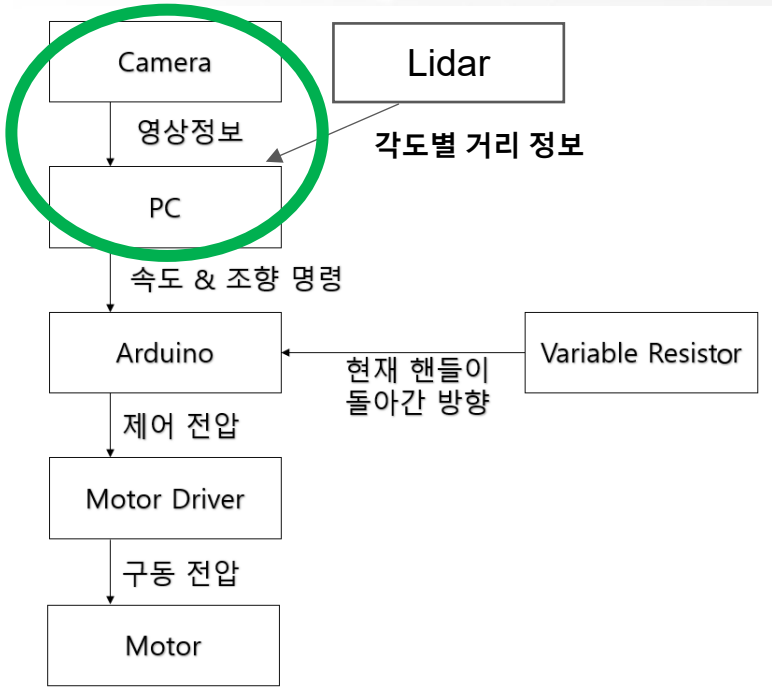
- Camera - PC

camera



Video Information

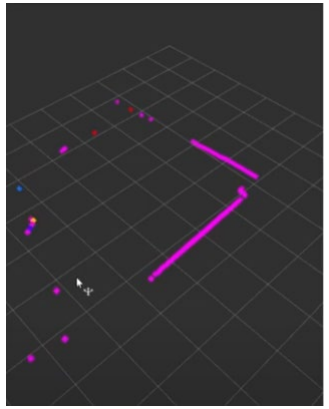
Laptop



Hardware – Overview of entire system

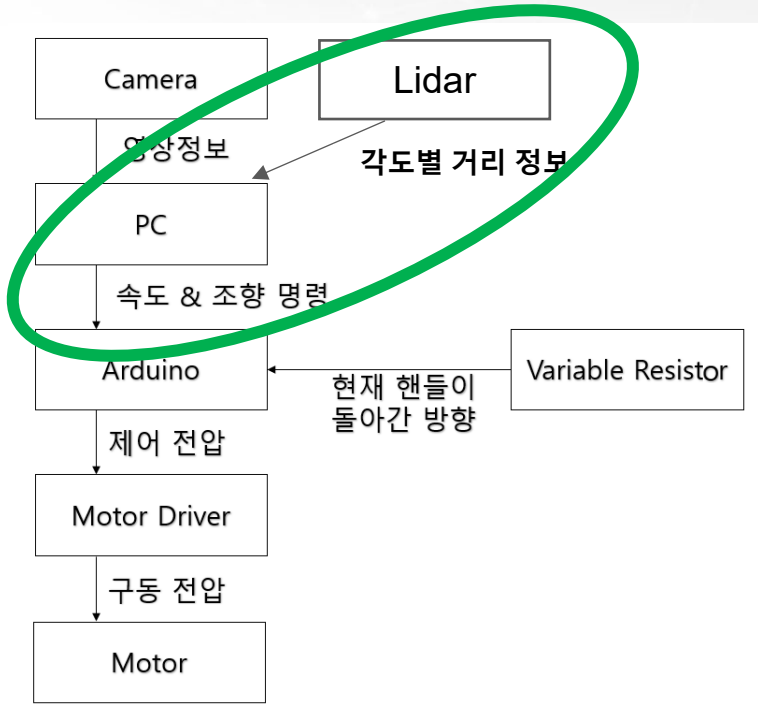
- LiDAR - PC

LiDAR



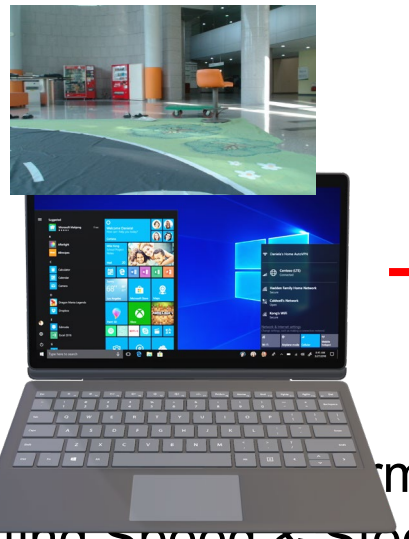
Distance information by angle

Laptop



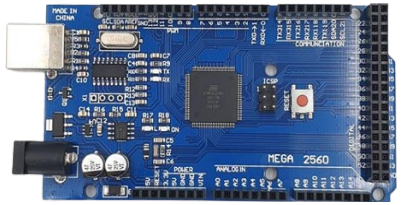
Hardware – Overview of entire system

- PC - Arduino

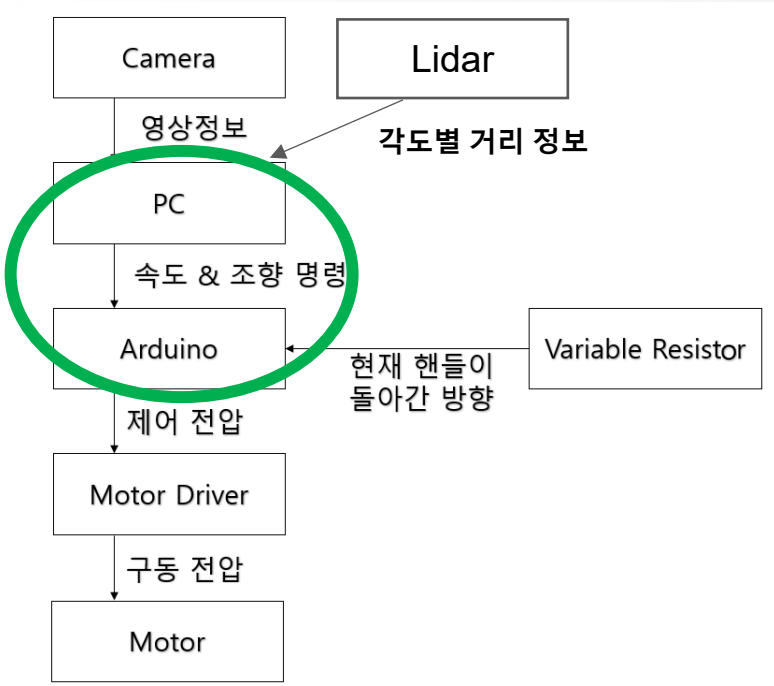


Base mation
Creating Speed & Steering Commands

Speed: Slow
Steering: Left

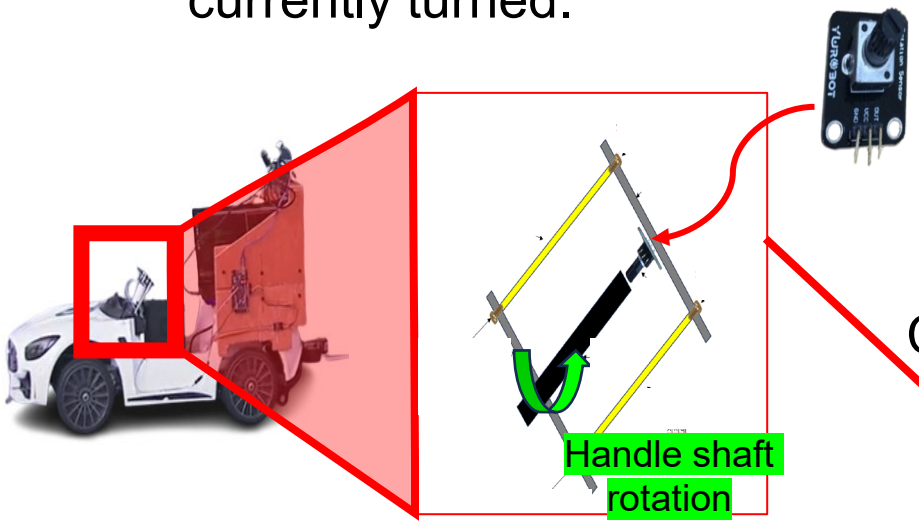


Arduino



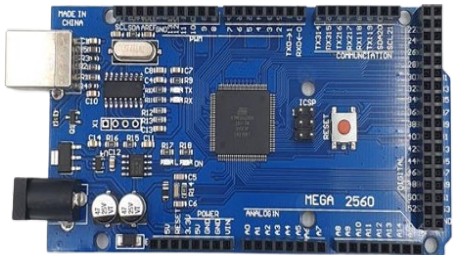
Hardware – Overview of entire system

- Arduino – Variable Resistor
  - Variable resistance is fixed to the axle of the vehicle steering w
  - The variable resistor sends information to Arduino about the di currently turned.

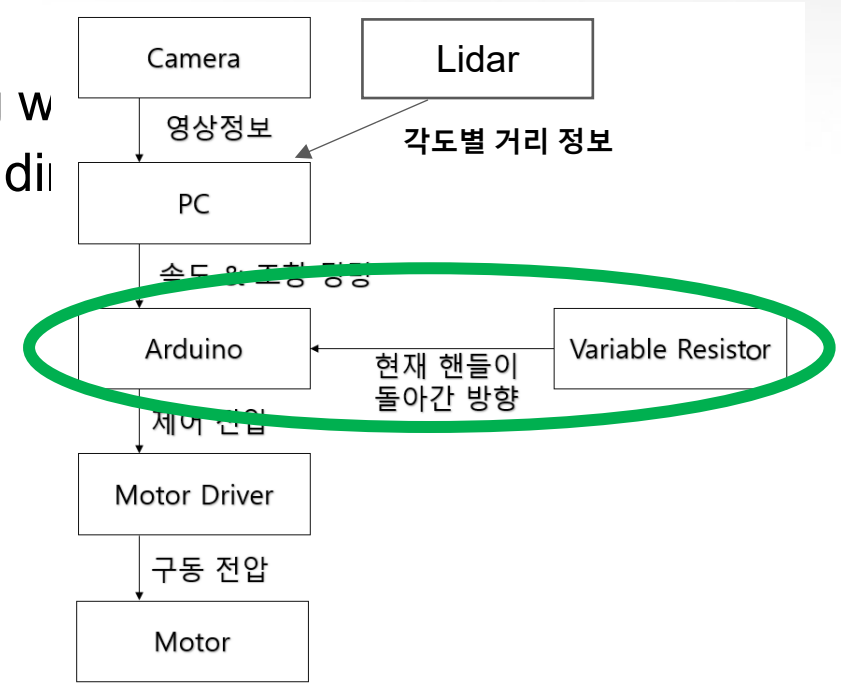


Holding the variable resistor to the handle axis

Current Steering: Straight

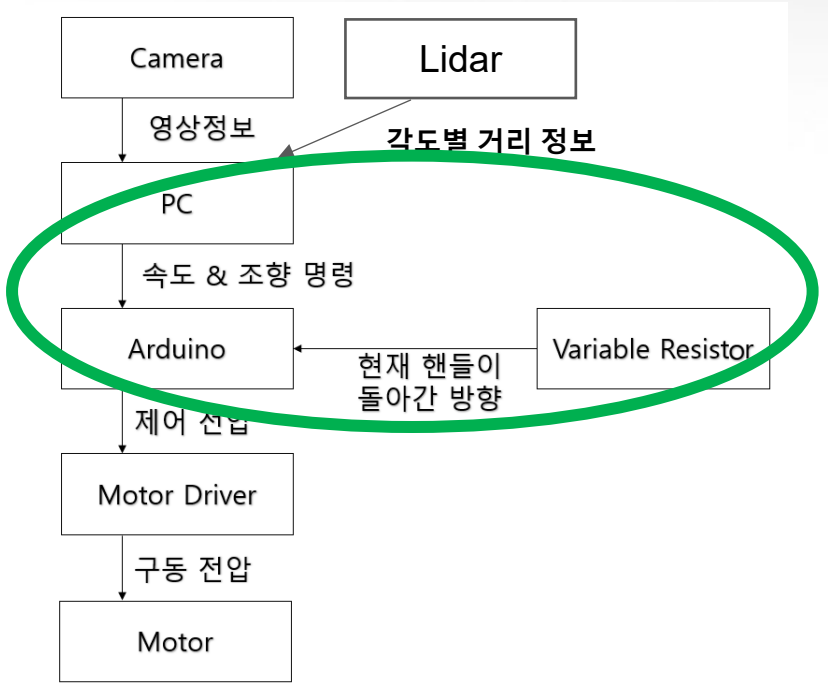


Arduino



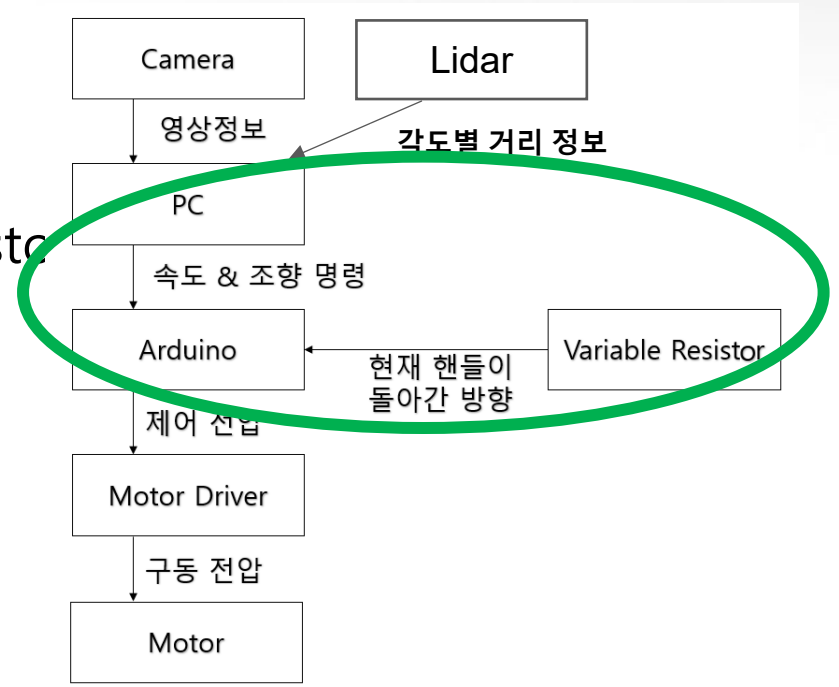
Hardware – Overview of entire system

- Arduino
  - PC로부터 속도 제어명령 받음
  - PC로부터 조향 제어명령 받음
  - 가변저항으로부터 현재 조향 값 받음



Hardware – Overview of entire system

- Arduino
  - Speed control commands from PC
  - Steering control commands from a PC
  - Receiving the current steering value from the variable resisto

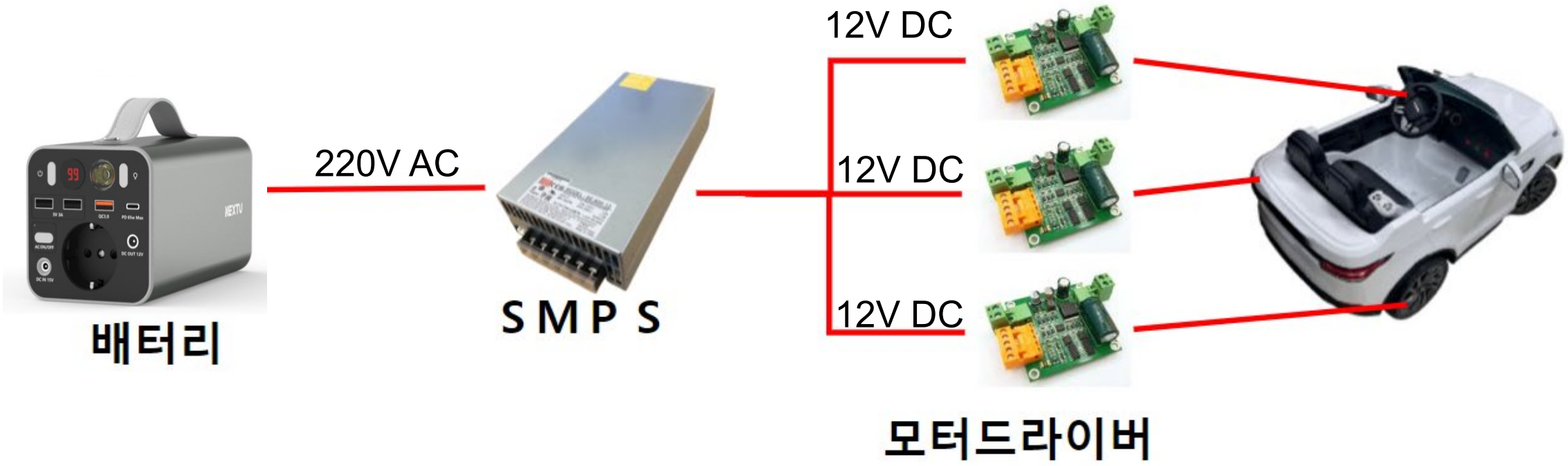


Hardware – Overview of entire system

- Arduino – Motor Driver – Motor
  - Arduino transmits control signals to the motor driver
  - The motor driver receives a control signal from Arduino
  - The motor driver applies voltage to the motor according to Arduino's control signal.

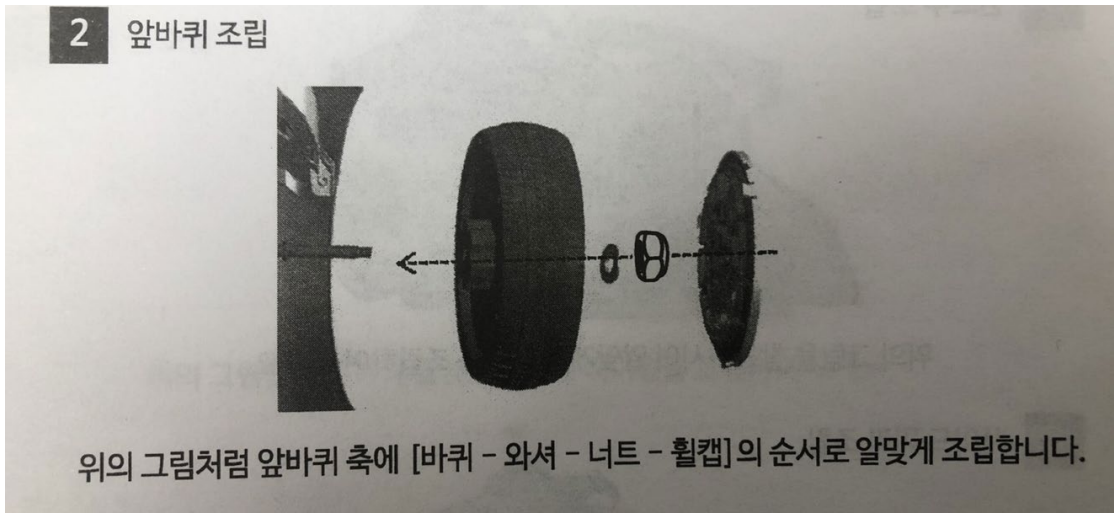
Hardware – Overview of entire system

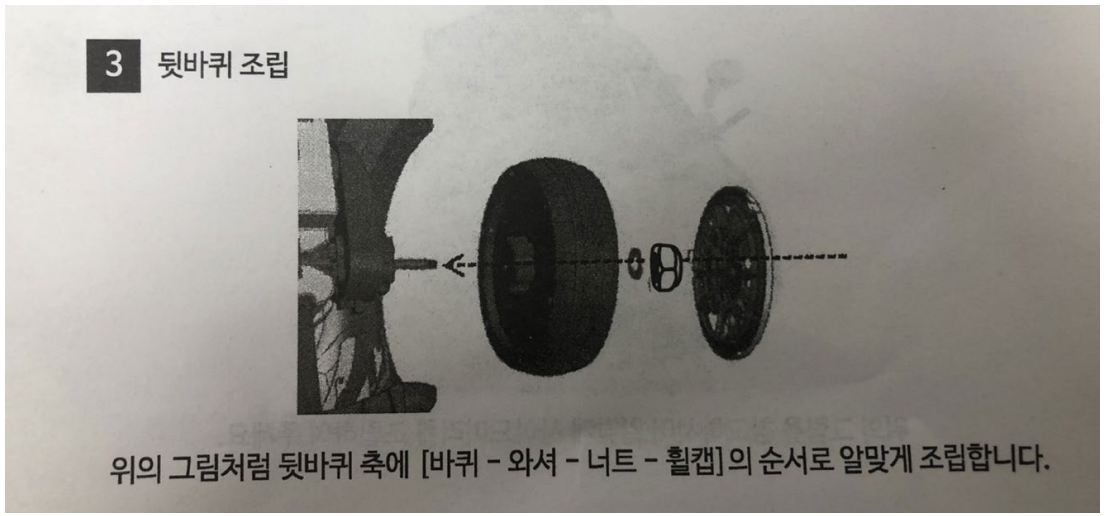
- Power System Configuratio
  - Powered by electricit
  - Connected via battery as below



Hardware – Wheel Combination

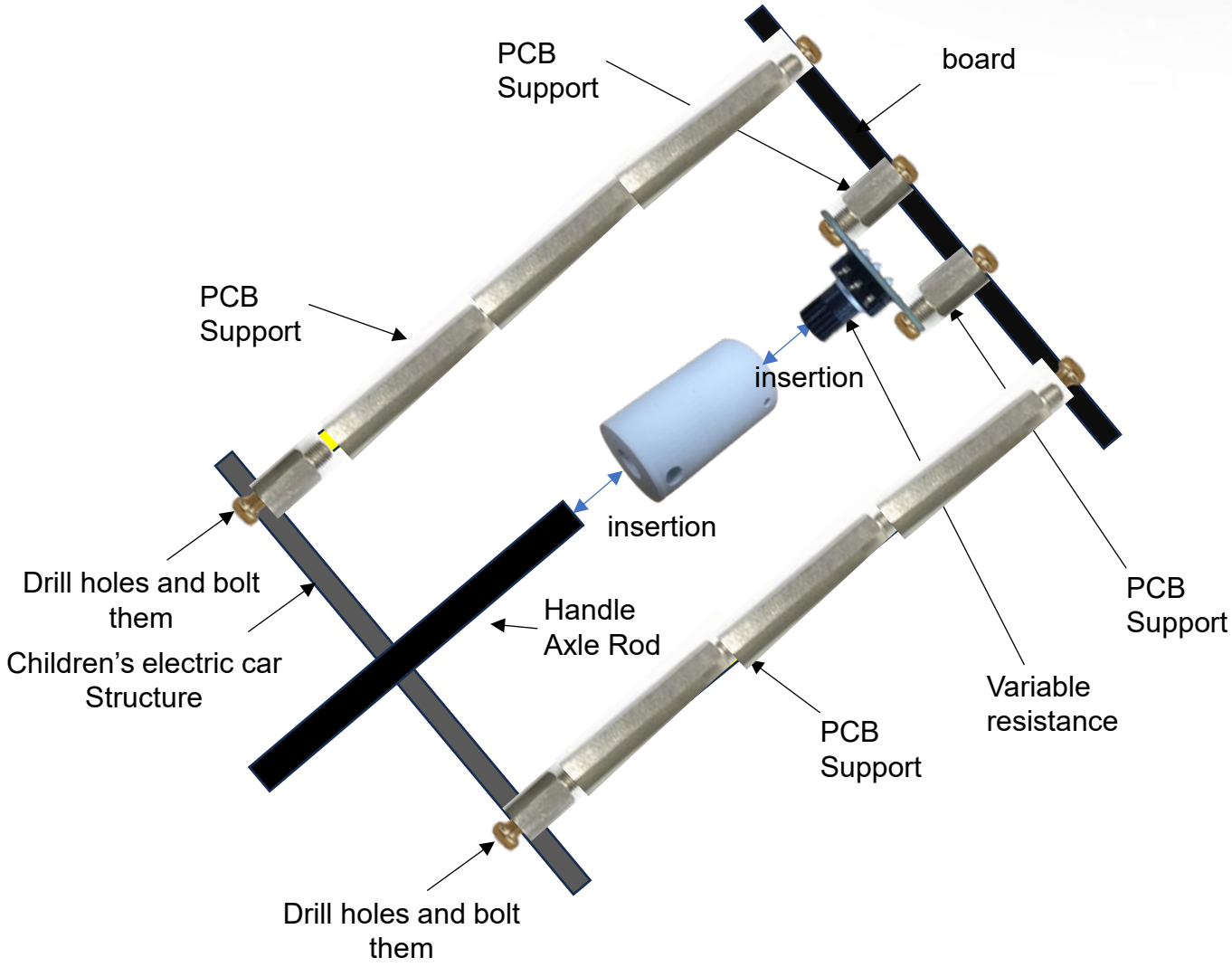
- How to assemble the front and rear wheels





Hardware – Variable resistance fixation on the handle axis

- Summary diagram

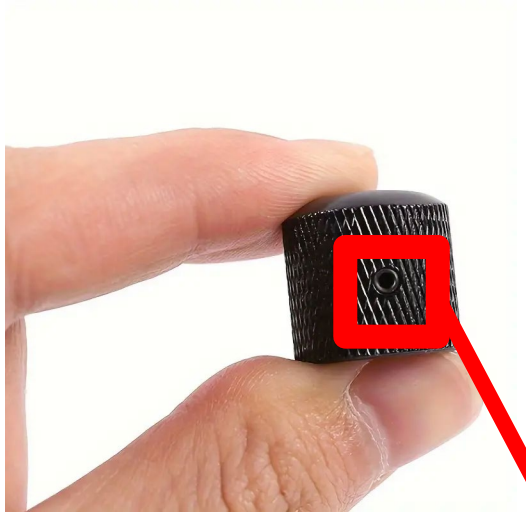


Hardware – Variable resistance fixation on the handle axis

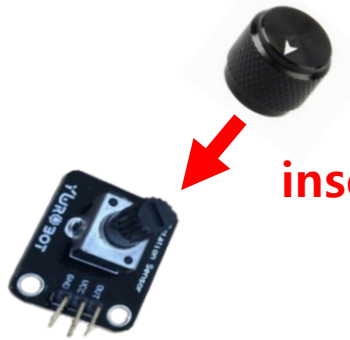
- Removing an Existing Mount

Hardware – Variable resistance fixation on the handle axis

- Variable resistance + metal cap coupling



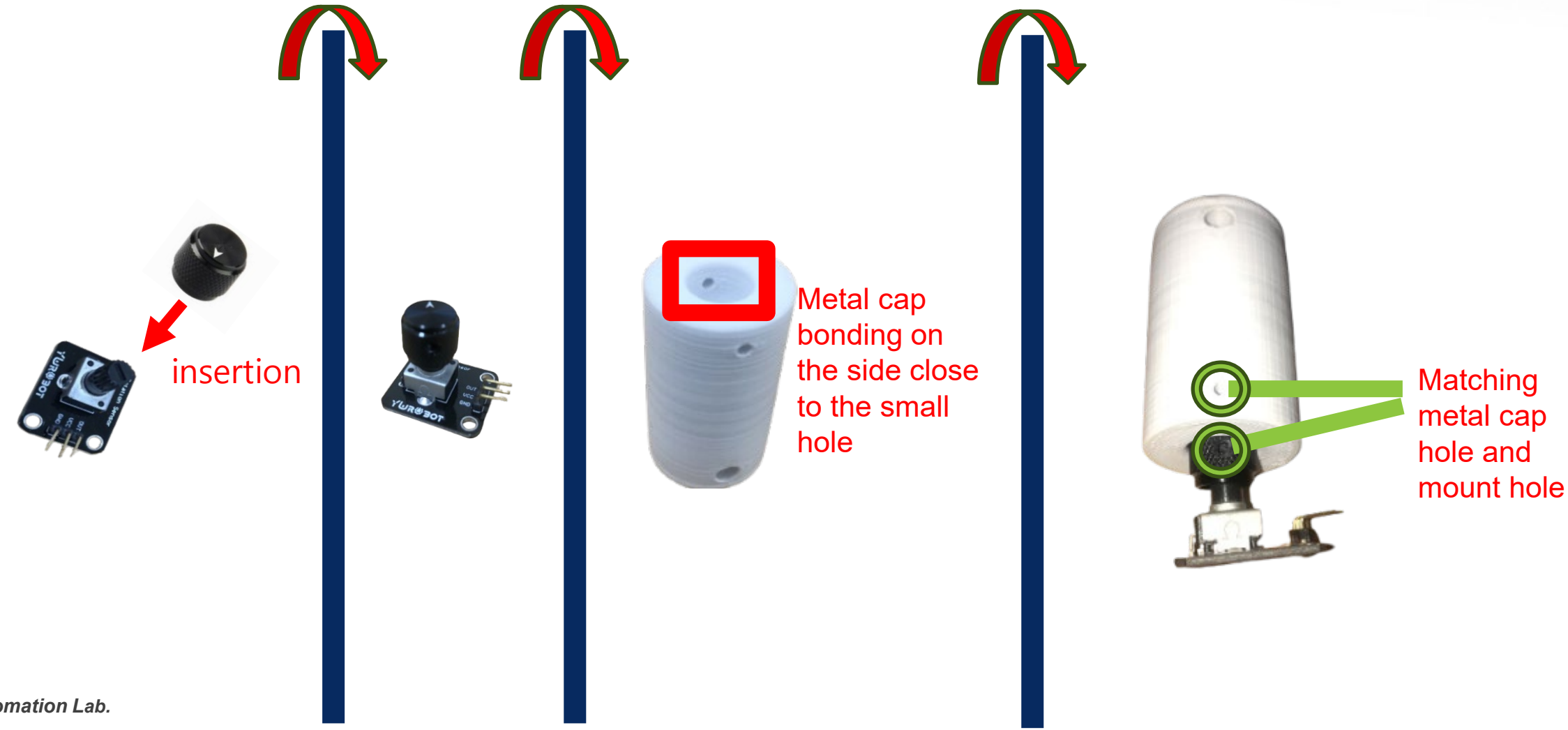
Utilize a hexagonal screwdriver to remove small screws



insertion

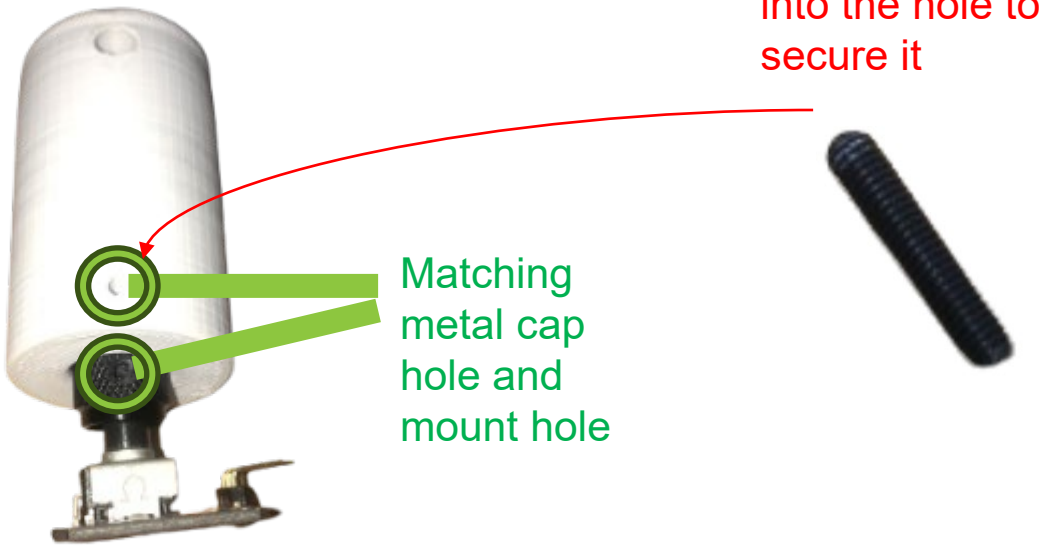
Hardware – Variable resistance fixation on the handle axis

- Variable resistance + Metal Cap+ 3D Printing Mount combination



Hardware – Variable resistance fixation on the handle axis

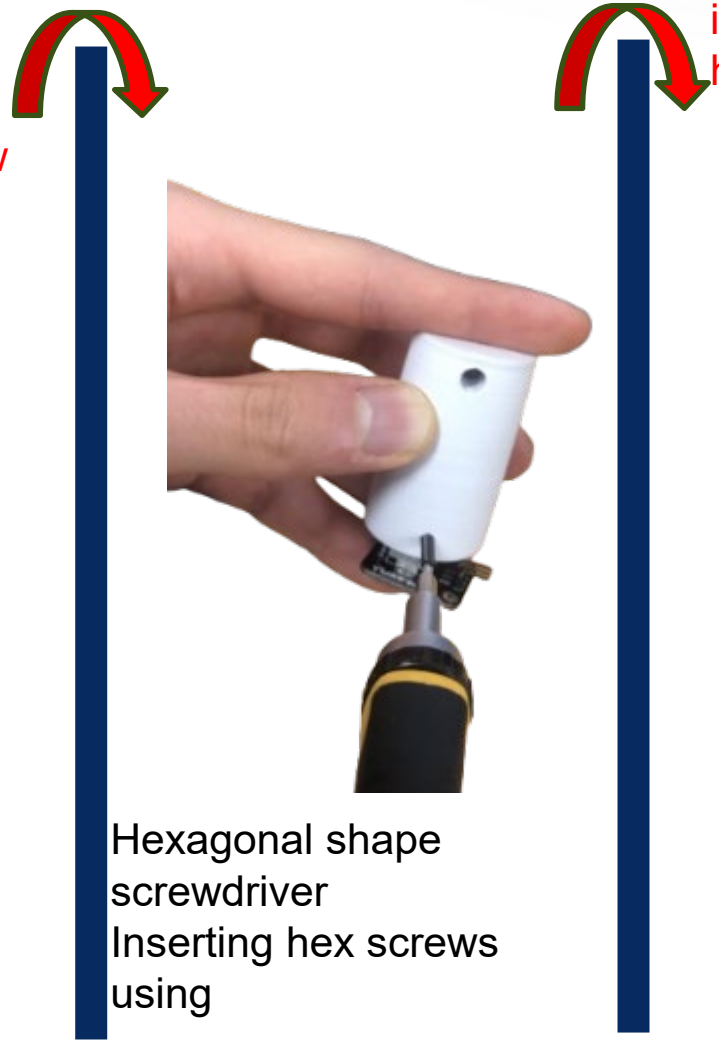
- Variable resistance + Metal Cap+ 3D Printing Mount combination



Inserting a hex screw into the hole to secure it

Matching metal cap hole and mount hole

Be careful not to forcibly turn the hex screw without properly matching the metal cap hole and the mount hole, as the metal cap will break.



Hexagonal shape screwdriver Inserting hex screws using

The hex screw sticks out very slightly, and it is well enough to hold

Inserted Finished Appearance

Hardware – Variable resistance fixation on the handle axis

- Variable resistance + Metal Cap+ 3D Printing Mount combination

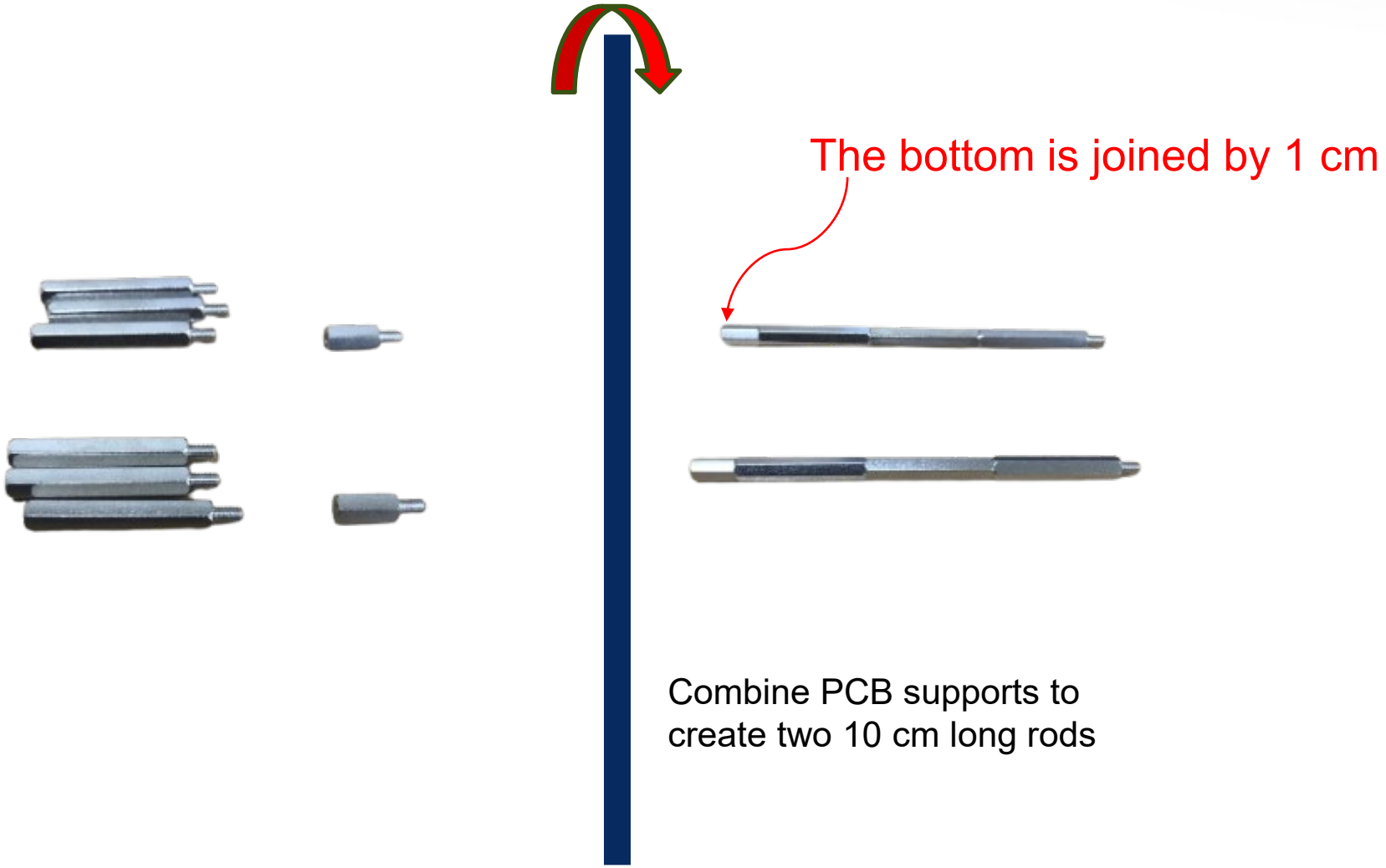
Insert 2 1cm PCB supports from top to bottom

2 nuts joined from bottom to top

1cm PCB Support Combined Appearance

Hardware – Variable resistance fixation on the handle axis

- Coupled to the body with variable resistance



Hardware – Variable resistance fixation on the handle axis

- Coupled to the body with variable resistance
  - Subtracting the front structure of the vehicle

Using a Screwdriver
Don't lose the screw you removed

Hardware – Variable resistance fixation on the handle axis

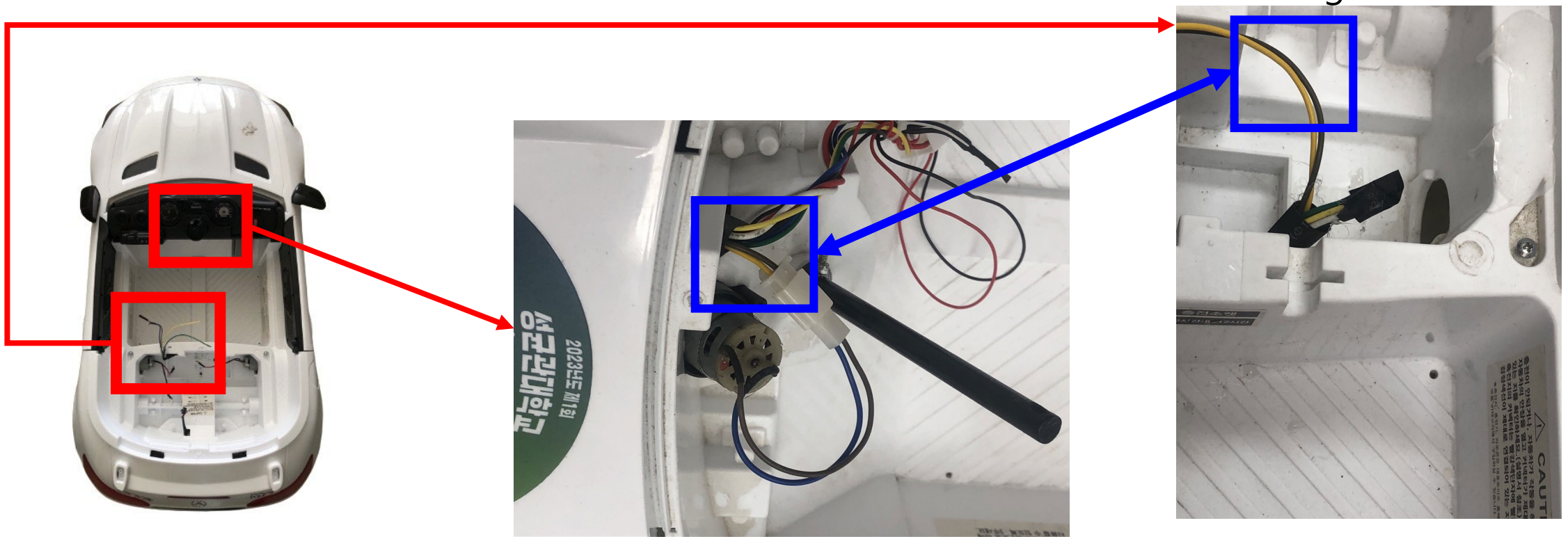
- What to check in advance for the subsequent process
  - Check the color of the steering motor connection line

<Check the line color>

This line connects to the rear of the vehicle

Hardware – Variable resistance fixation on the handle axis

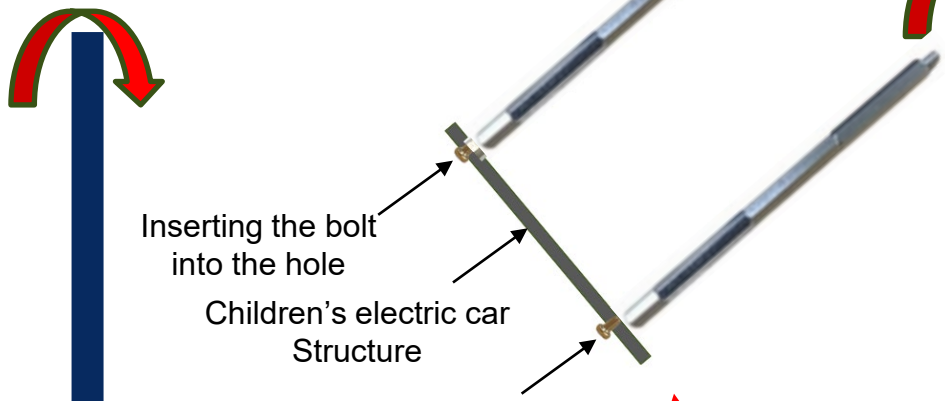
- Check list
  - The wire connected to the steering motor at the front is connected to the rear of the vehicle
  - Determine which line at the rear of the vehicle is connected to the steering motor



Hardware – Variable resistance fixation on the handle axis

- Coupled to the body with variable r

If there is a hole in the structure



If there are no holes in the structure or if the holes are too large and loose

Ask a teaching assistant to drill a hole

Hardware – Variable resistance fixation on the handle axis

- Coupled to the body with variable resistance
  - PCB Support Fixation and Recombination

Using a Screwdriver

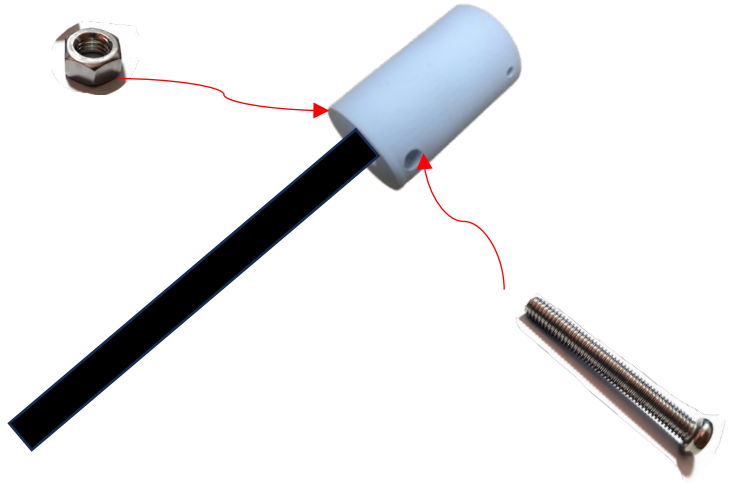
Hardware – Variable resistance fixation on the handle axis

- Coupled to the body with variable resistance
  - Attach the mount to the vehicle steering wheel axle

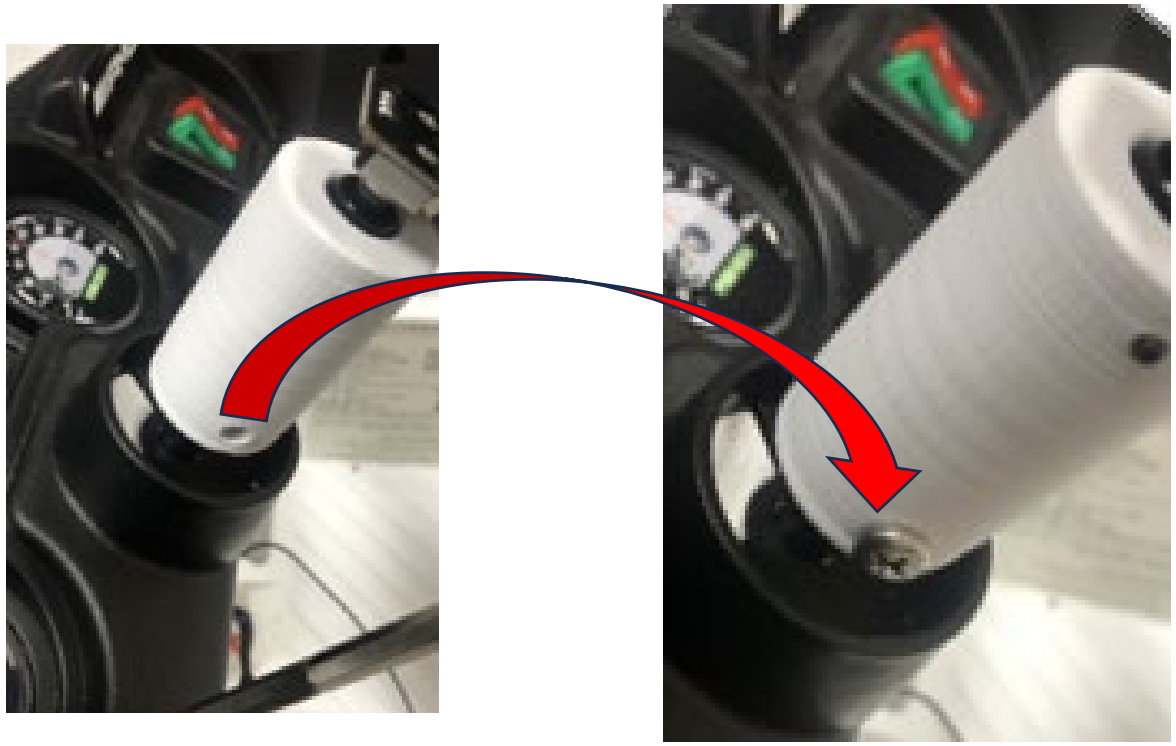
Matching mount hole and handleshaft hole

Hardware – Variable resistance fixation on the handle axis

- Coupled to the body with variable resistance
  - Put the top plate on top and secure it with bolts and nuts



Large bolts and nuts secure the mount

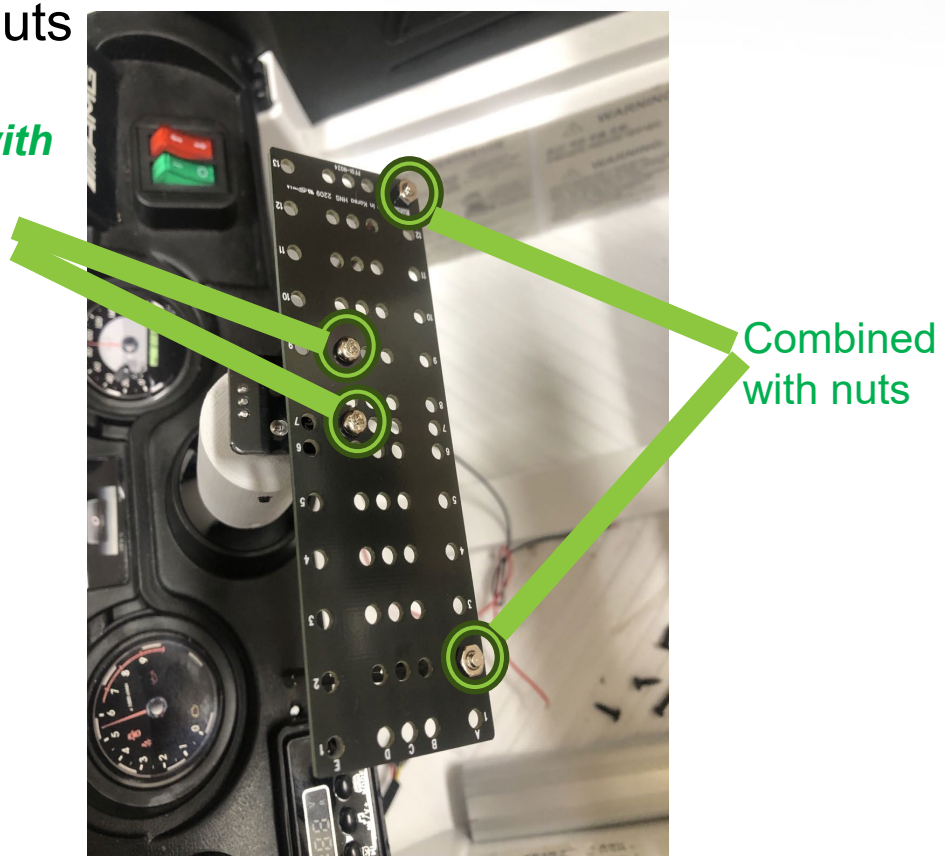


Hardware – Variable resistance fixation on the handle axis

- Coupled to the body with variable resistance
  - Put the top plate on top and secure it with bolts and nuts

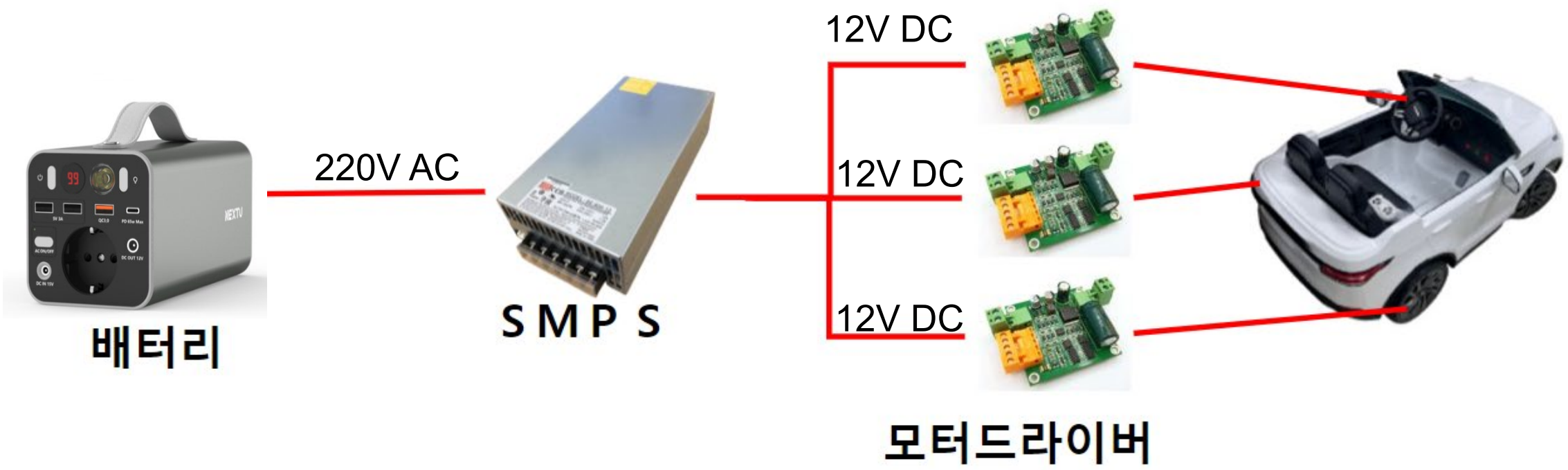
Top Plate Bonding

Combined with bolts



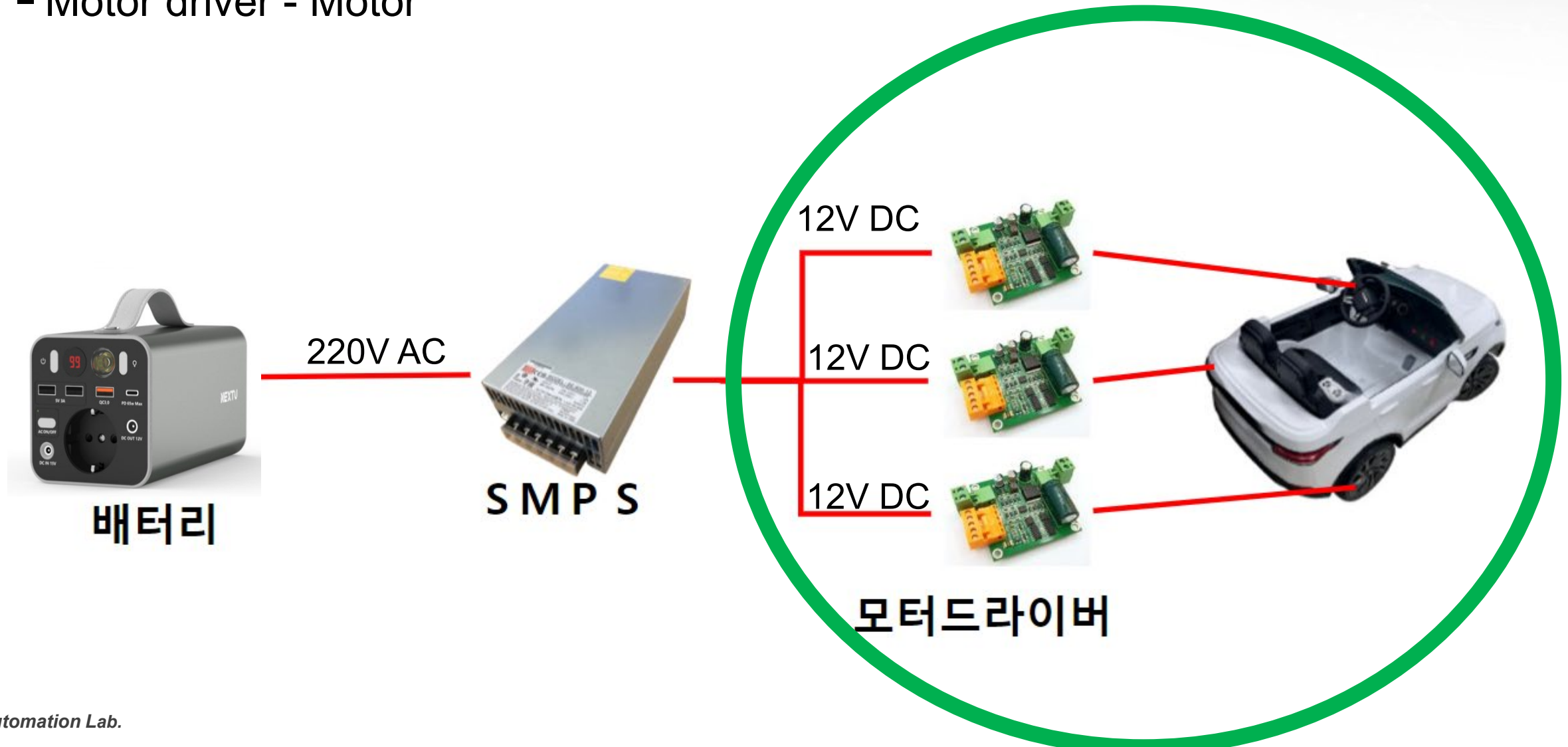
Hardware – Power Supply Connection

- Power System Configuratio
  - Powered by electricity
  - Connected via battery as below



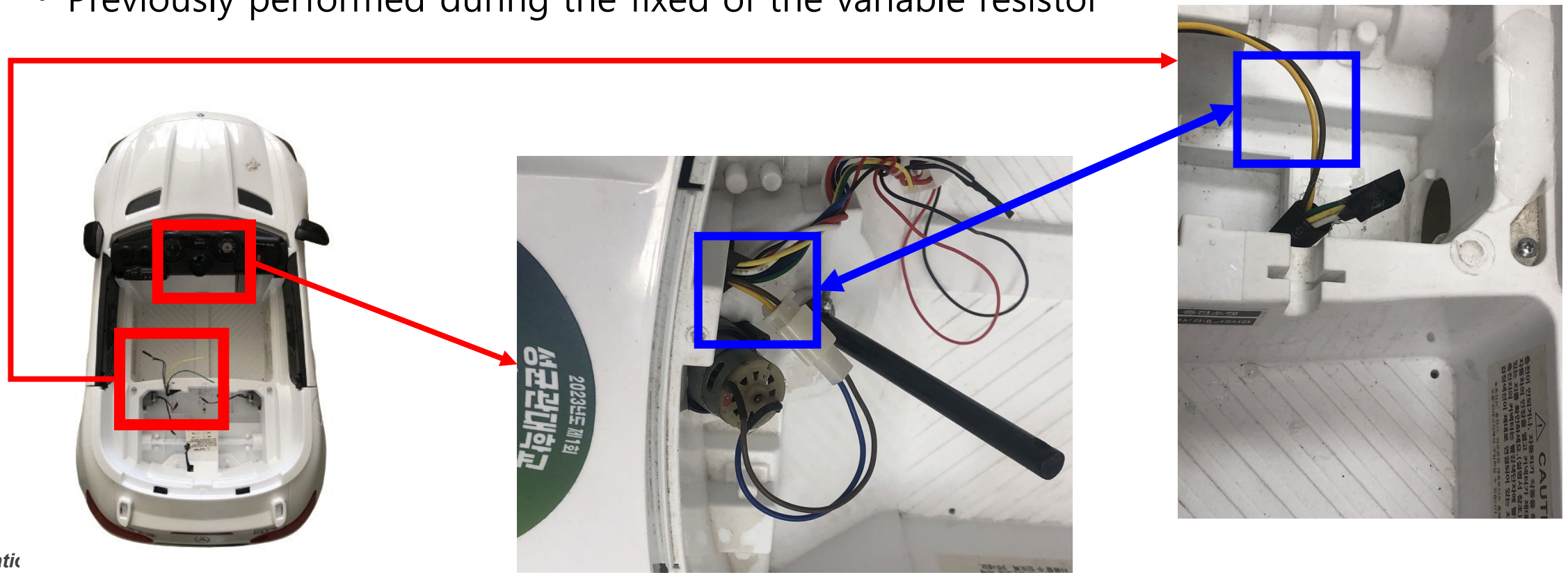
Hardware – Power Supply Connection

- Motor driver - Motor



Hardware – Power Supply Connection

- Motor driver - Motor
  - The wire connected to the steering motor at the front is connected to the rear of the vehicle
  - Determine which line at the rear of the vehicle is connected to the steering motor
  - Previously performed during the fixed of the variable resistor

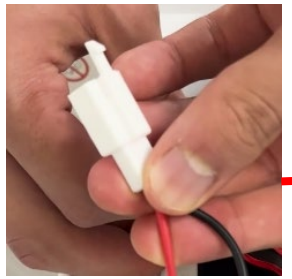


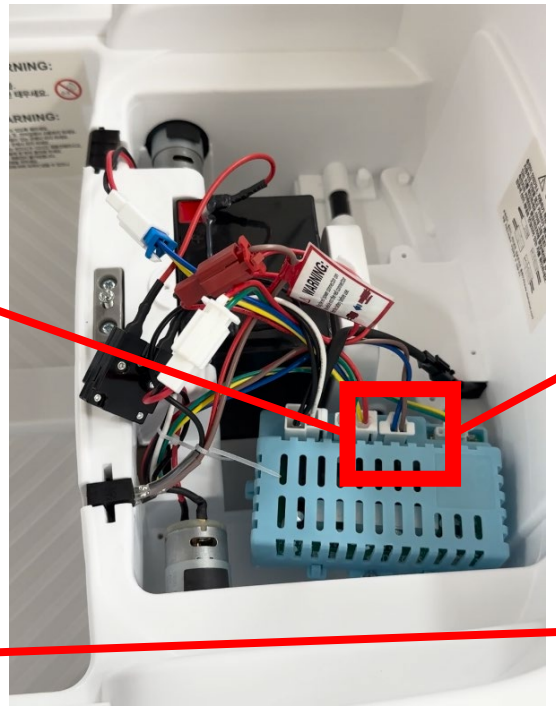
Hardware – Power Supply Connection

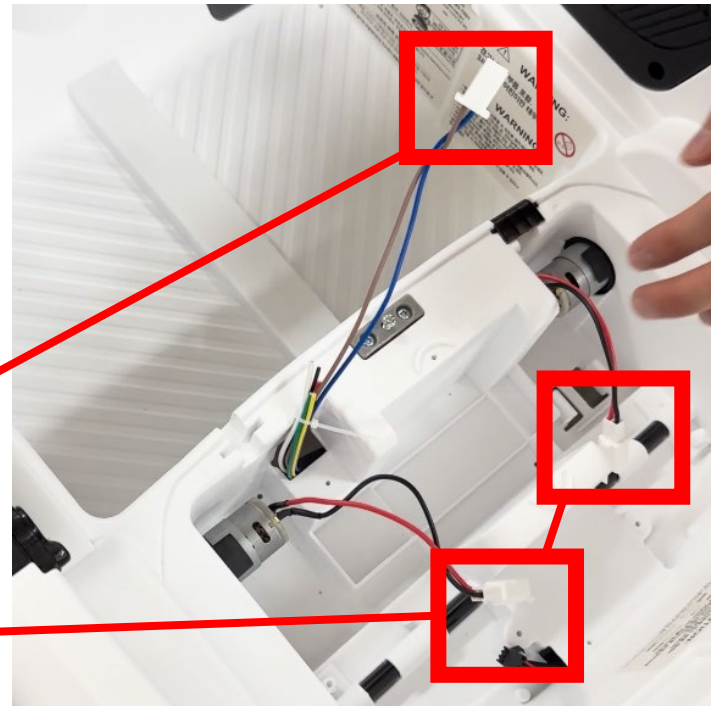
- Motor driver - Motor
  - Leaving the wire connected to the rear wheel motor
  - Leaving a line connected with the steering motor
  - Remove the rest

Wire connected to steering motor

Lines connected to the rear wheel motor

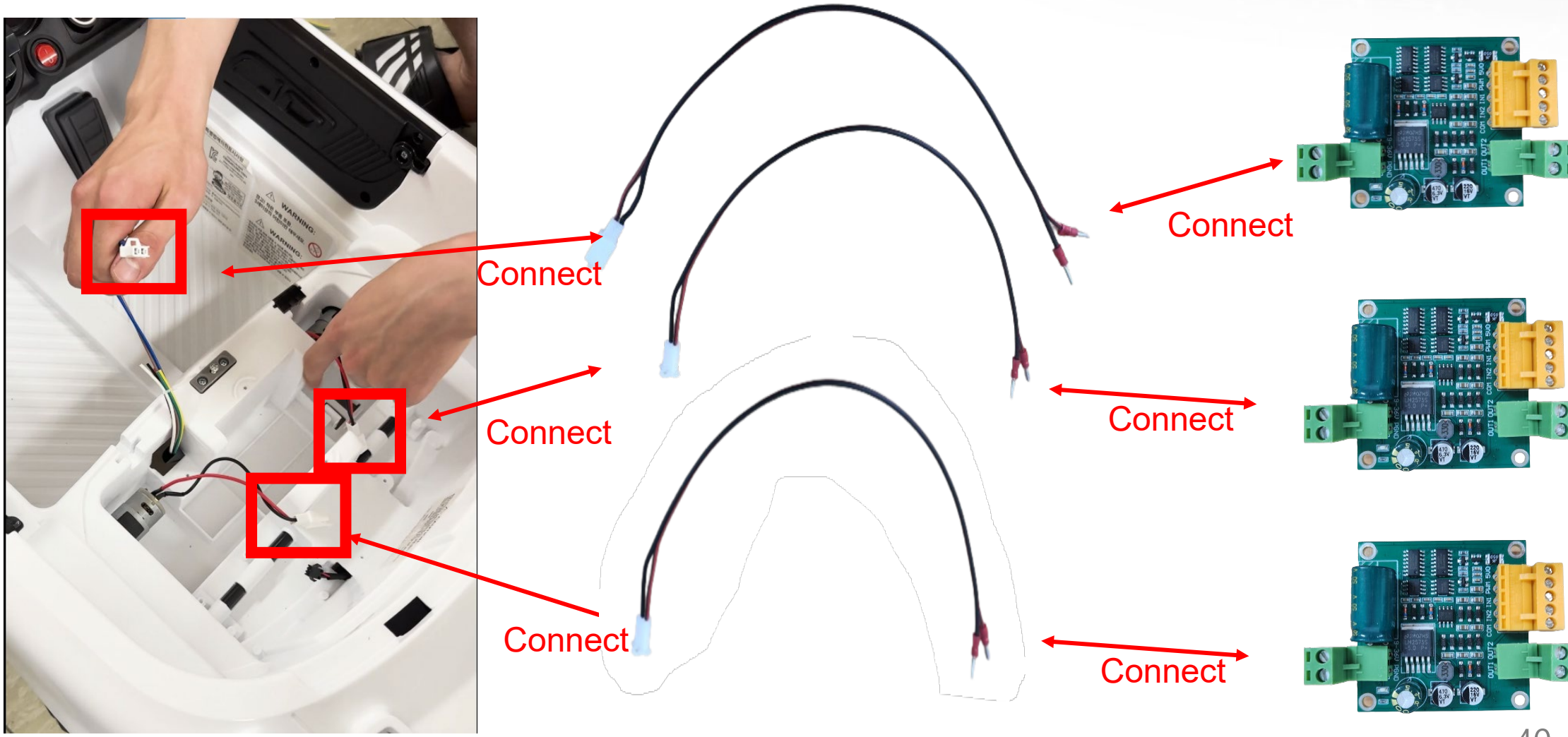






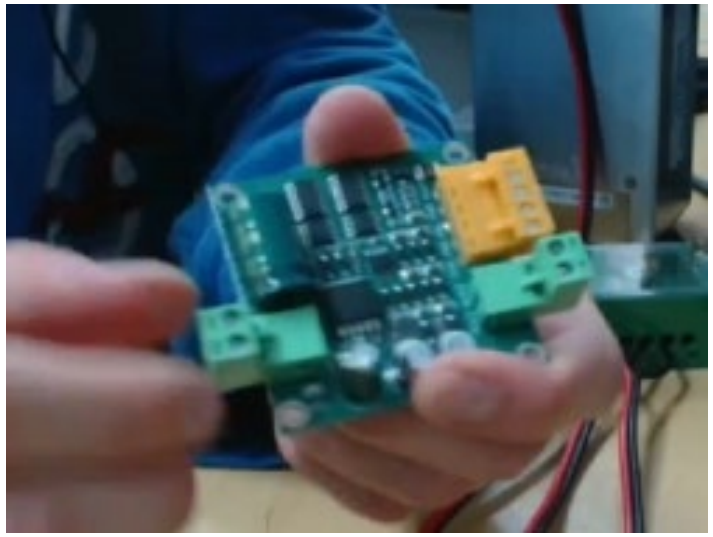
Hardware – Power Supply Connection

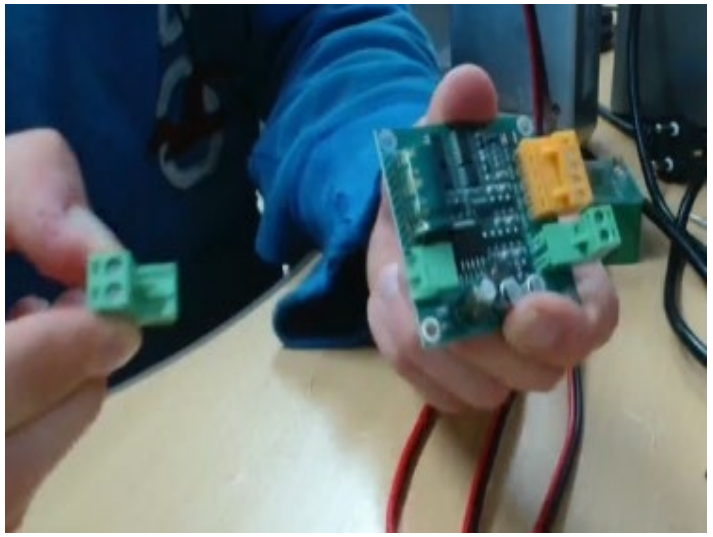
- Motor driver - Motor



Hardware – Power Supply Connection

- Motor Driver – Motor
  - Disconnect the connector

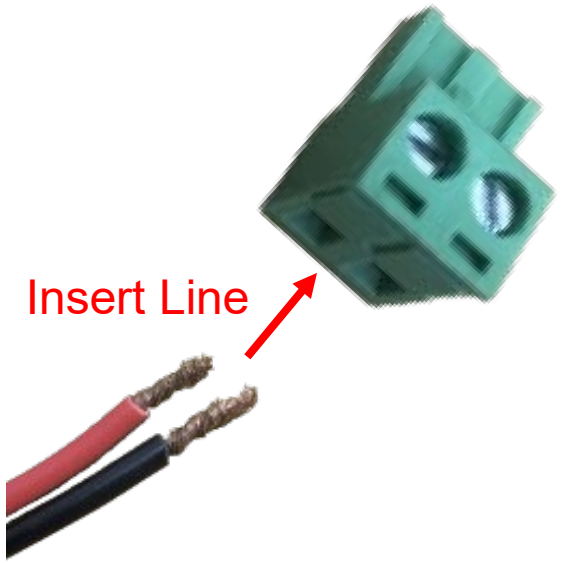


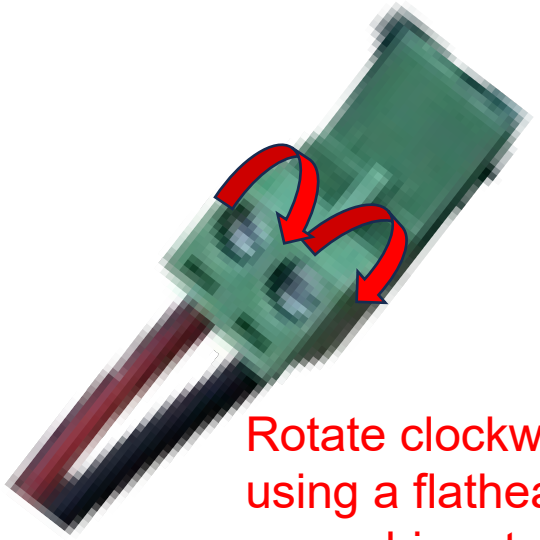


Hardware – Power Supply Connection

- Motor Driver - Motor

Rotate counterclockwise using a flathead screwdriver

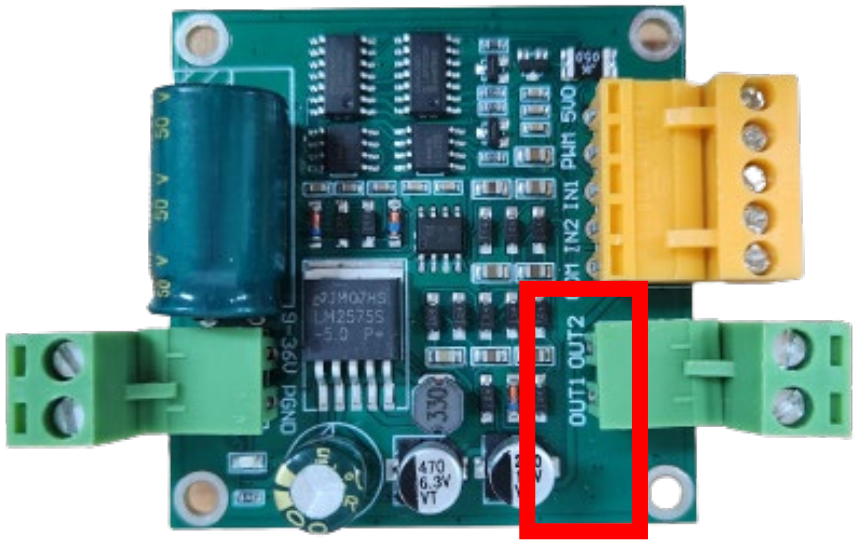




Rotate clockwise using a flathead screwdriver to secure

Hardware – Power Supply Connection

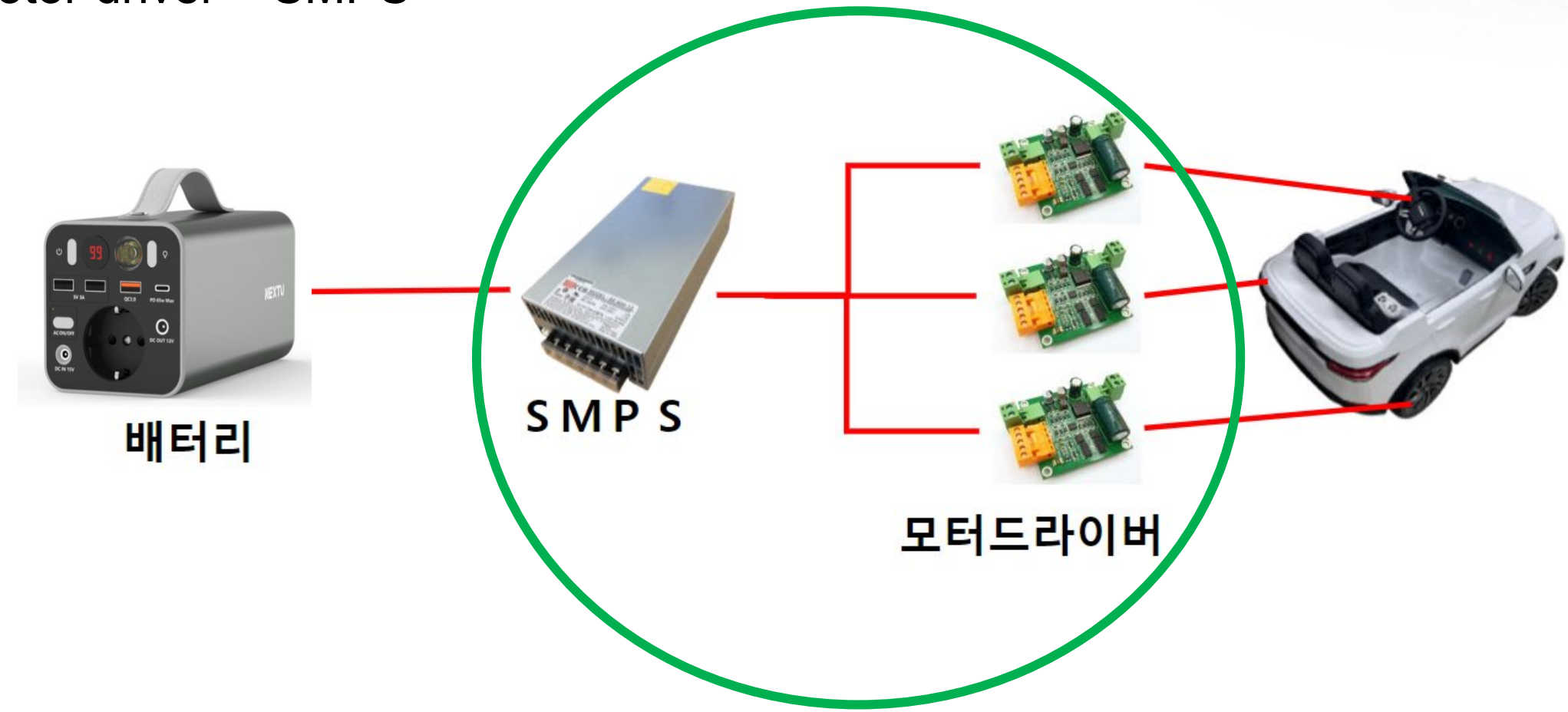
- Motor Driver - Motor



The motor should be connected to OUT1 and OUT2.
PGND, should not be connected to 9-36V.

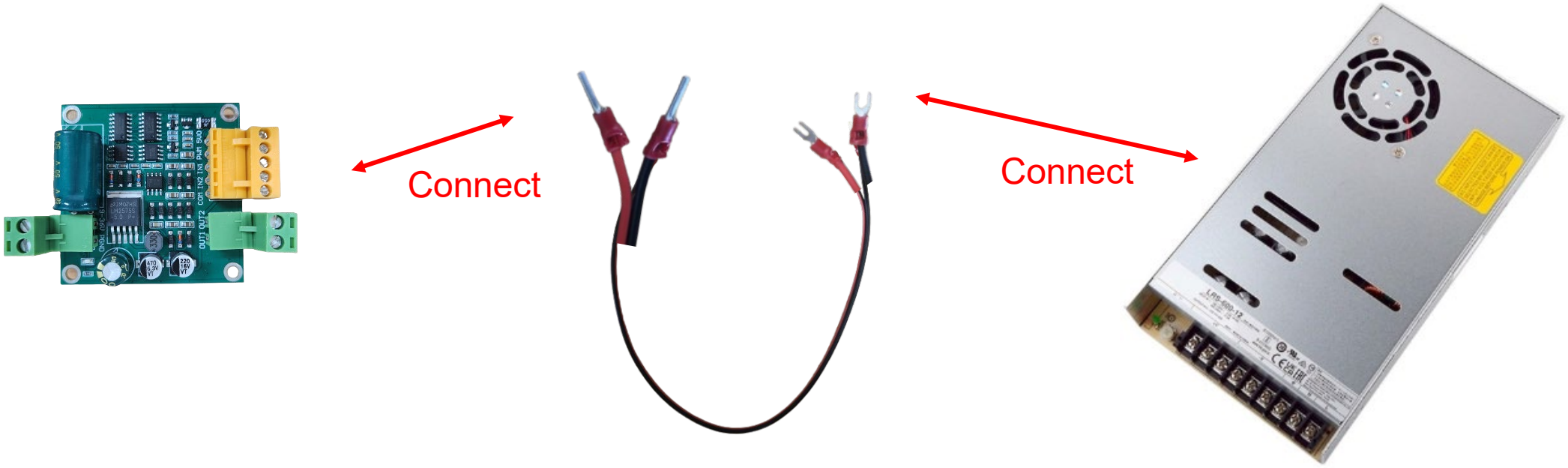
Hardware – Power Supply Connection

- Motor driver – SMPS



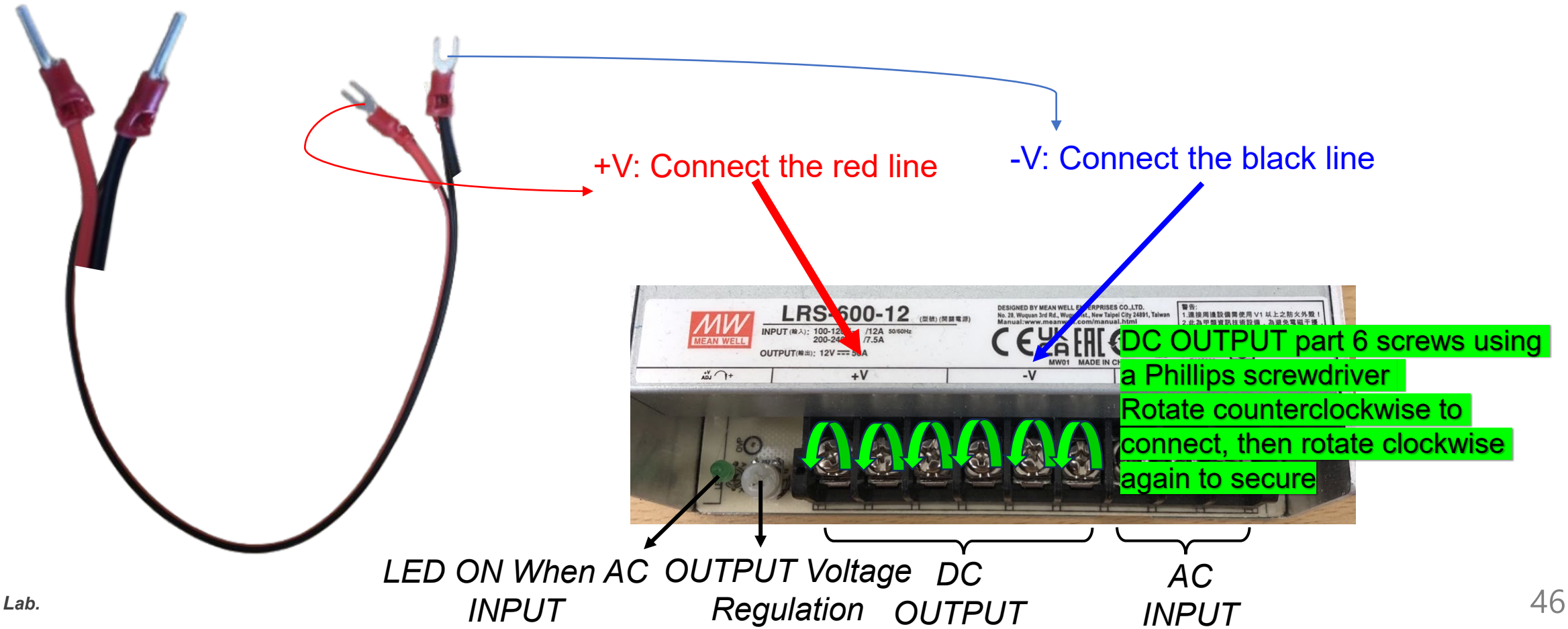
Hardware – Power Supply Connection

- SMPS – Motor driver



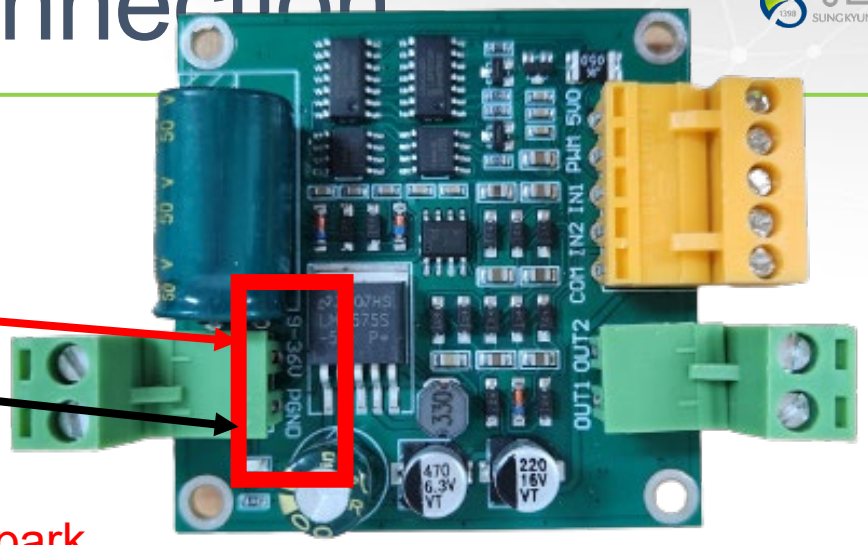
Hardware – Power Supply Connection

- SMPS – Motor Driver

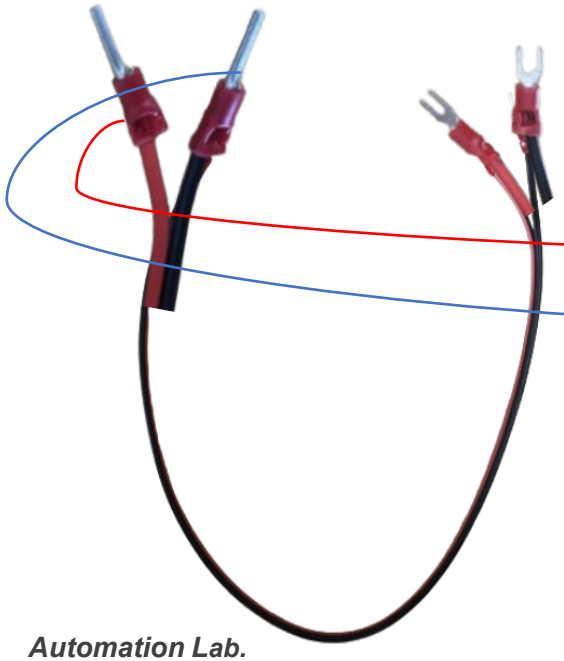


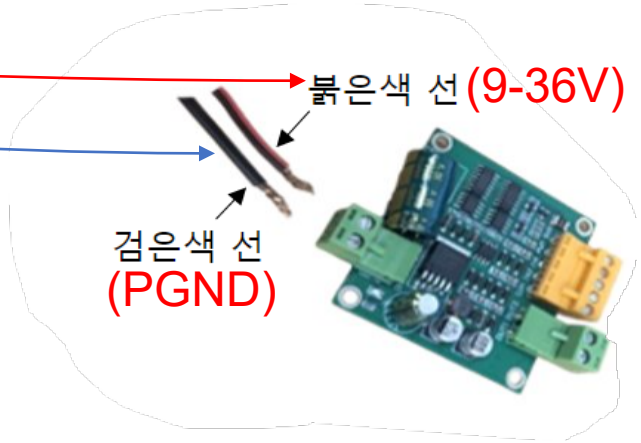
Hardware – Power Supply Connection

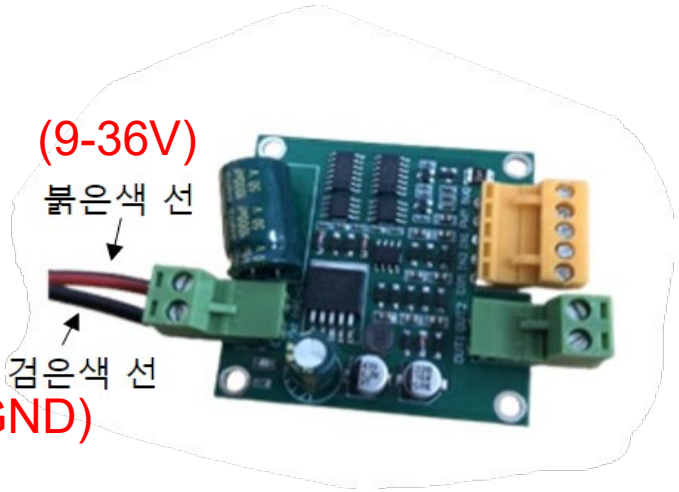
- SMPS – Motor Driver
  - Red Line: 9-36V
  - Black Line: PGND



If the position of each color changes, the motor driver will spark and malfunction!
Be sure to check the letters 9-36V, PGND.



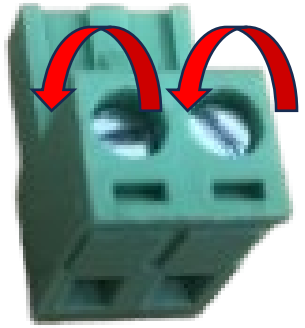


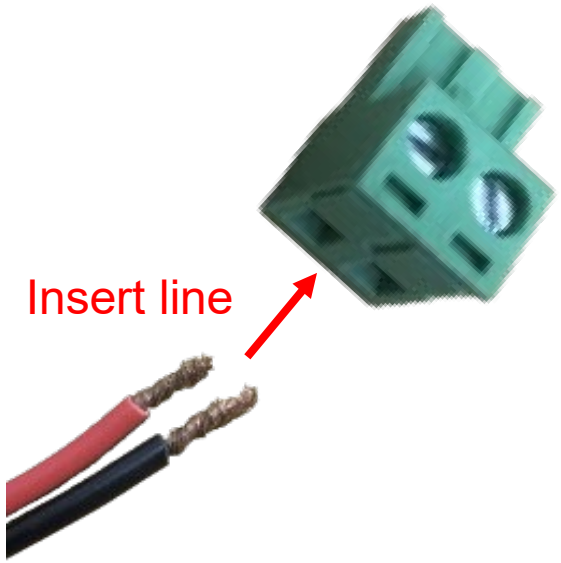


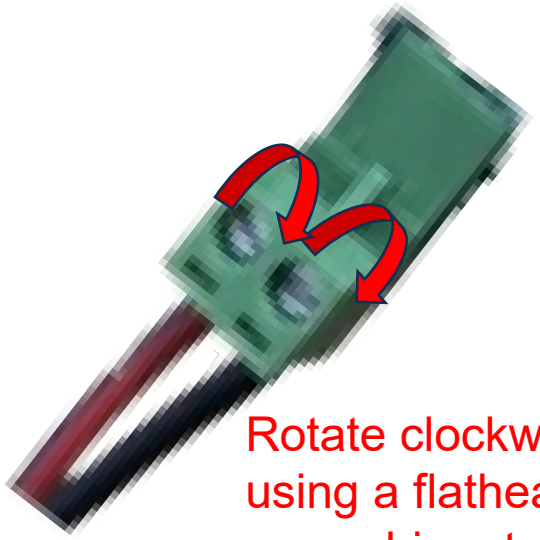
Hardware – Power Supply Connection

- SMPS – Motor Driver

Rotate counterclockwise using a flathead screwdriver



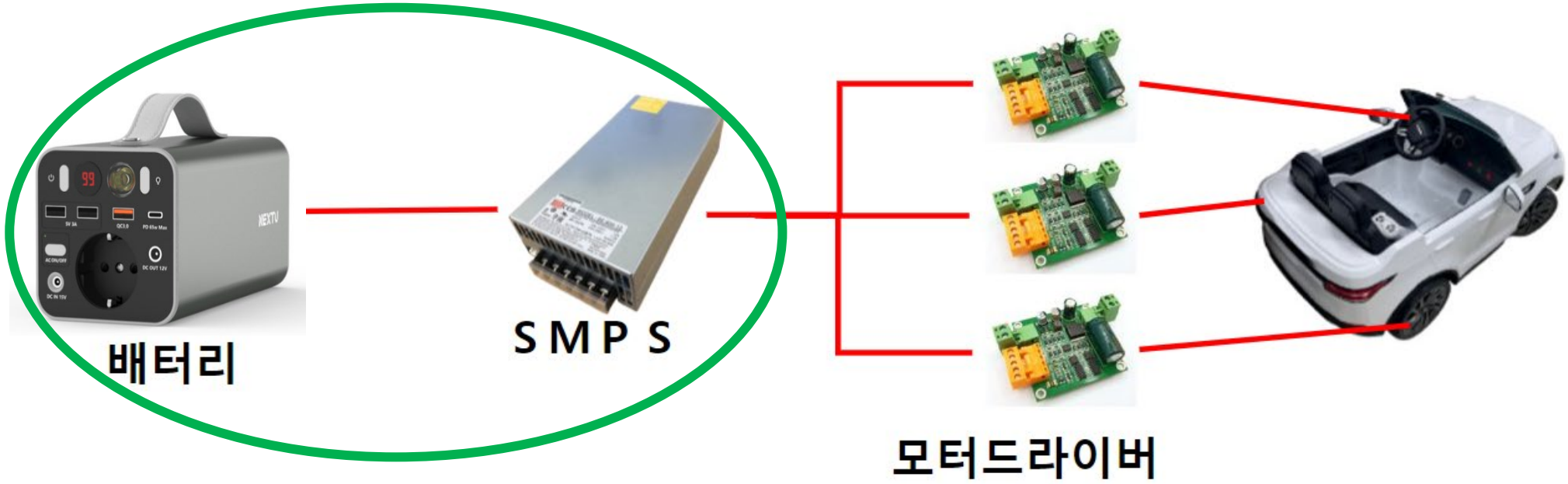




Rotate clockwise using a flathead screwdriver to secure

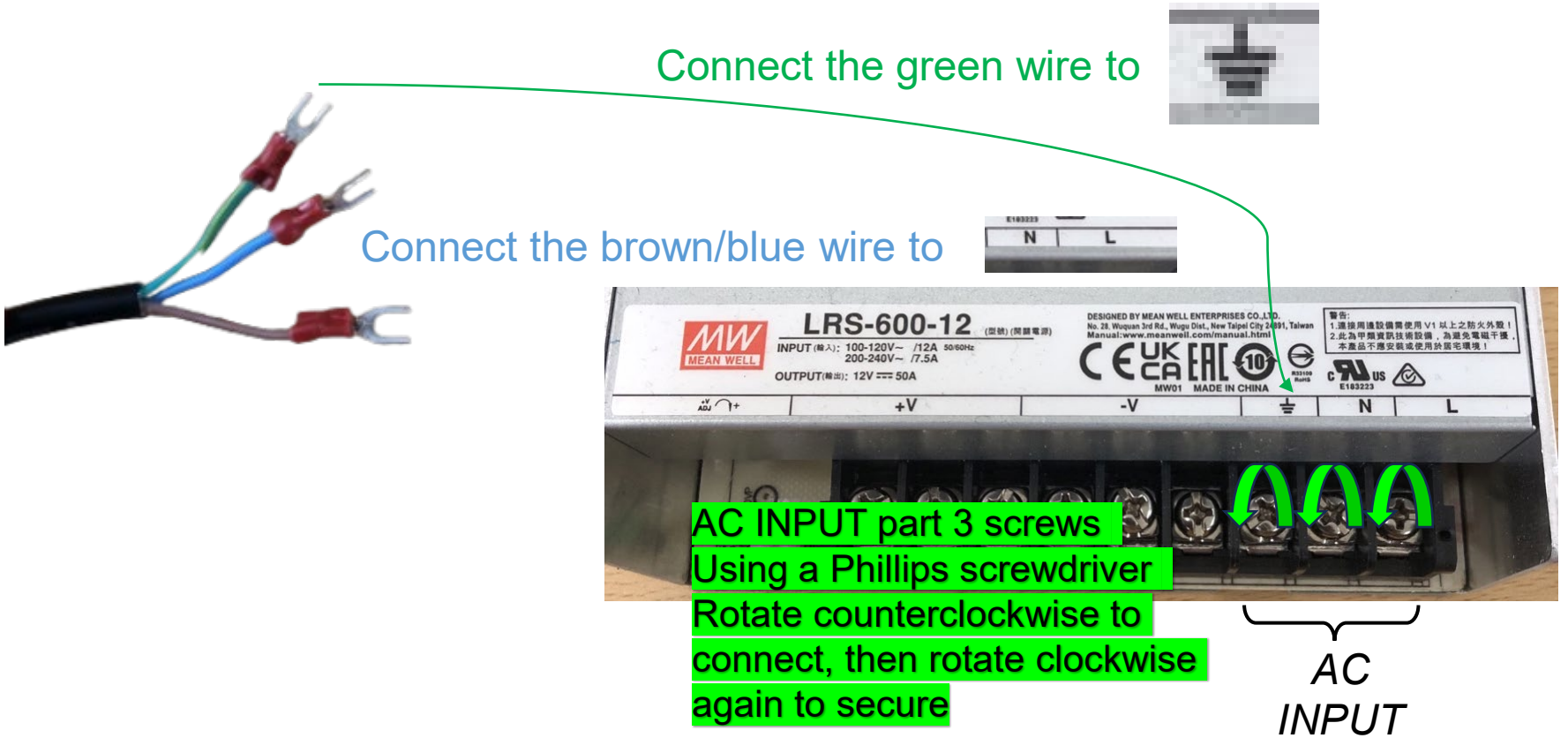
Hardware – Power Supply Connection

- Battery - SMPS



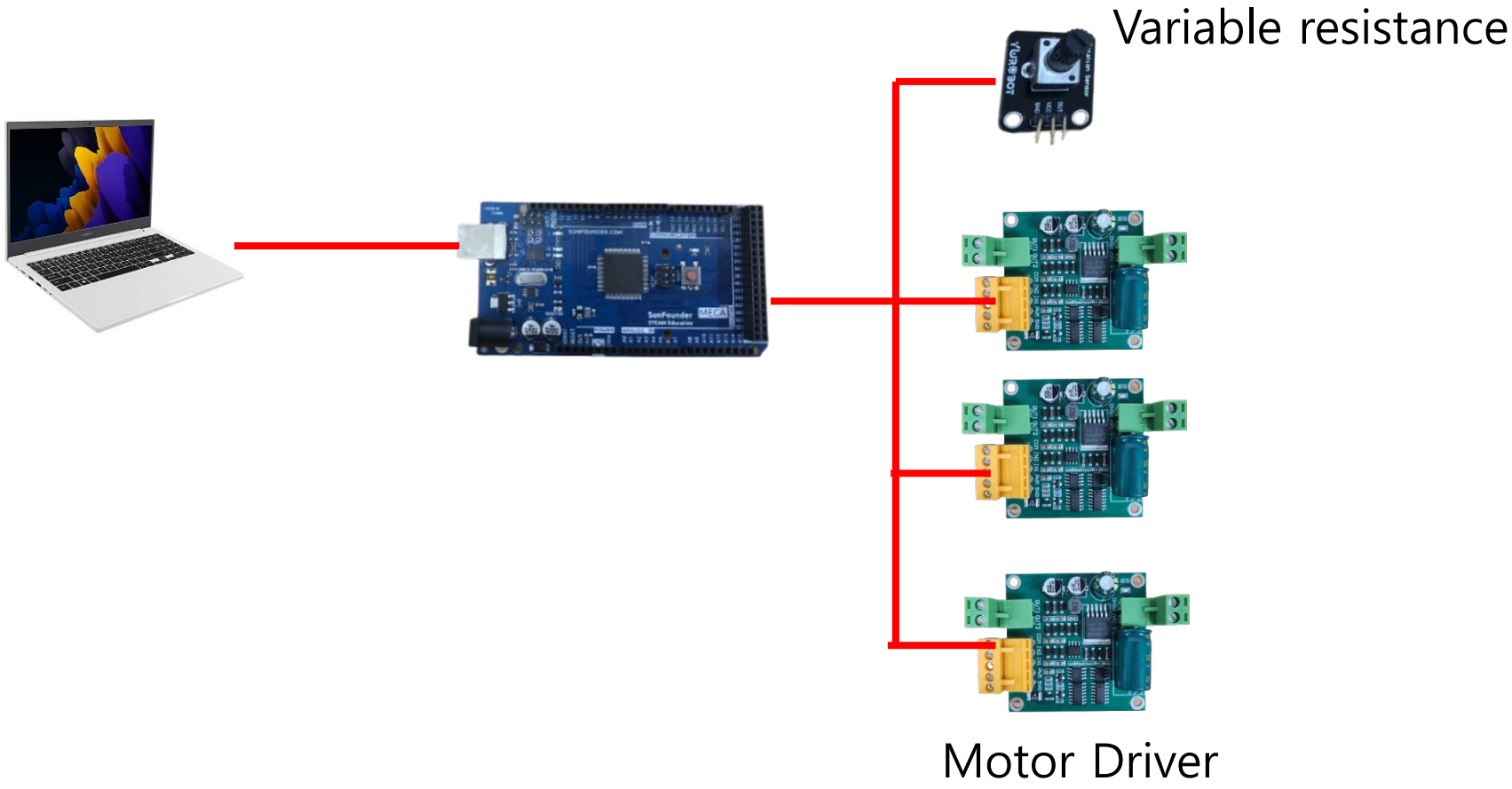
Hardware – Power Supply Connection

- Battery - SMPS



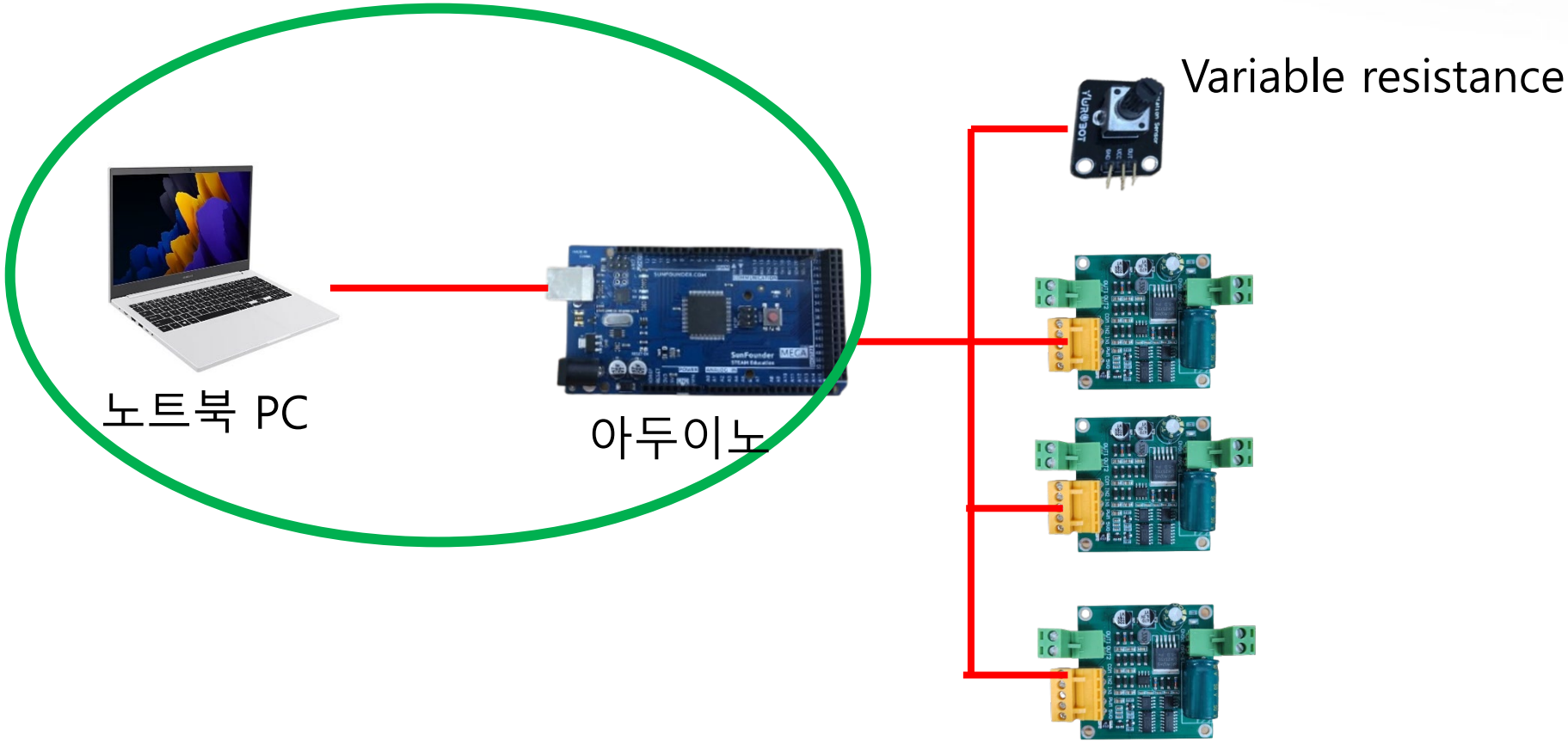
Hardware – Control Unit Connection

- Connecting the Control Unit



Hardware – Control Unit Connection

- Laptop – Arduino

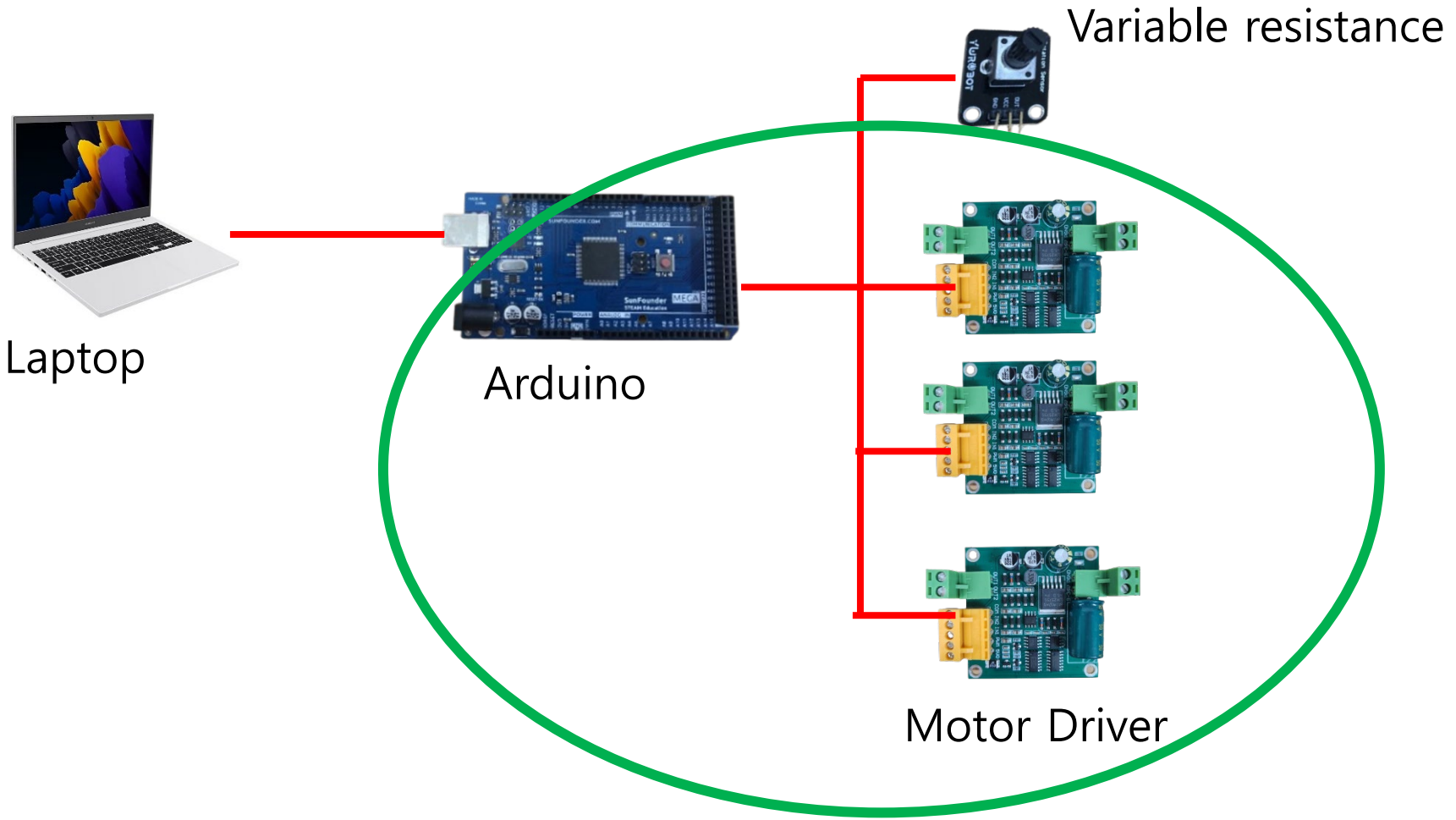


Hardware – Control Unit Connection

- Laptop – Arduino
  - Connect using a USB serial cable

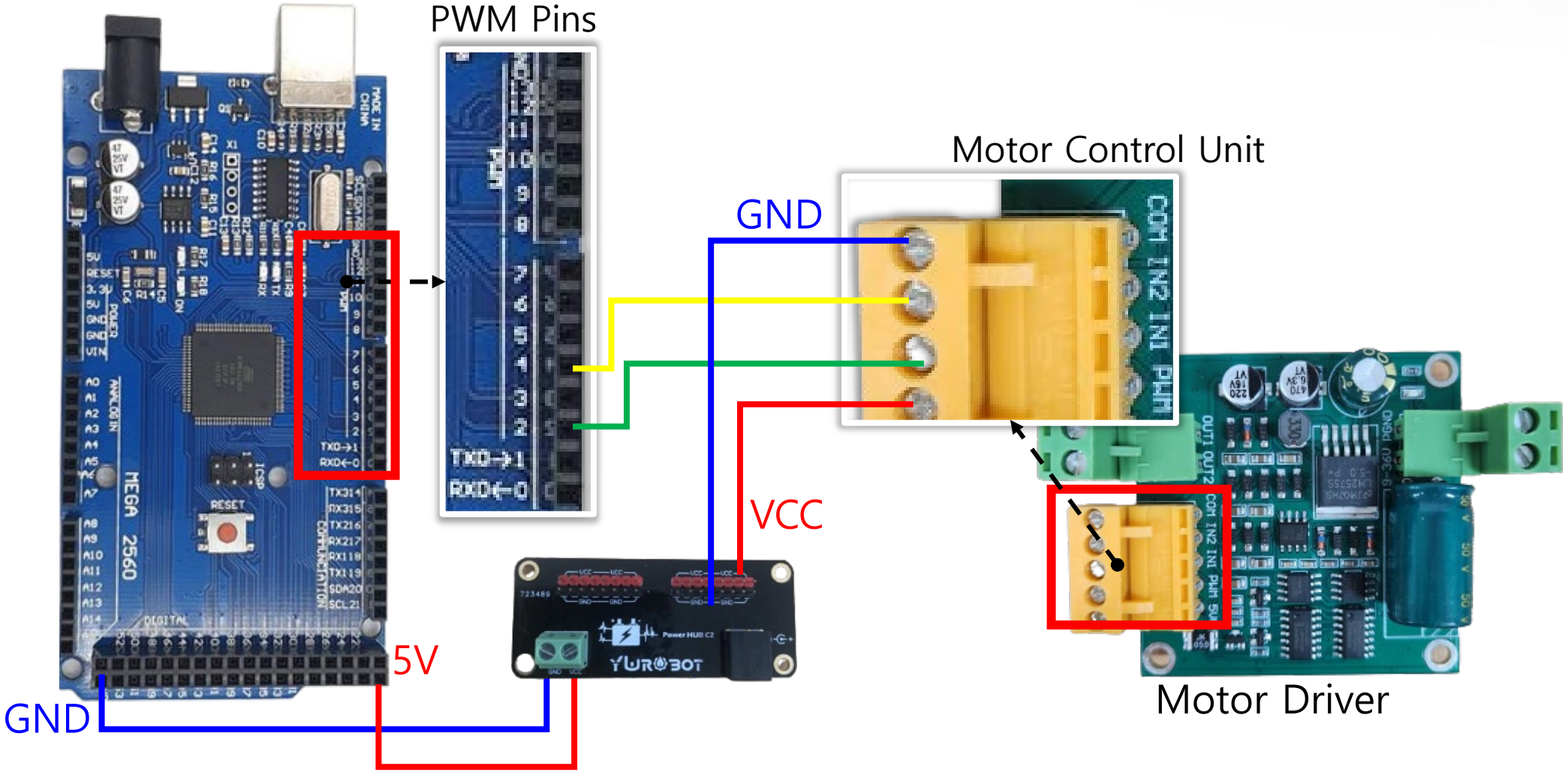
Hardware – Control Unit Connection

- Arduino - Motor Driver



Hardware – Control Unit Connection

- Arduino – Motor Driver

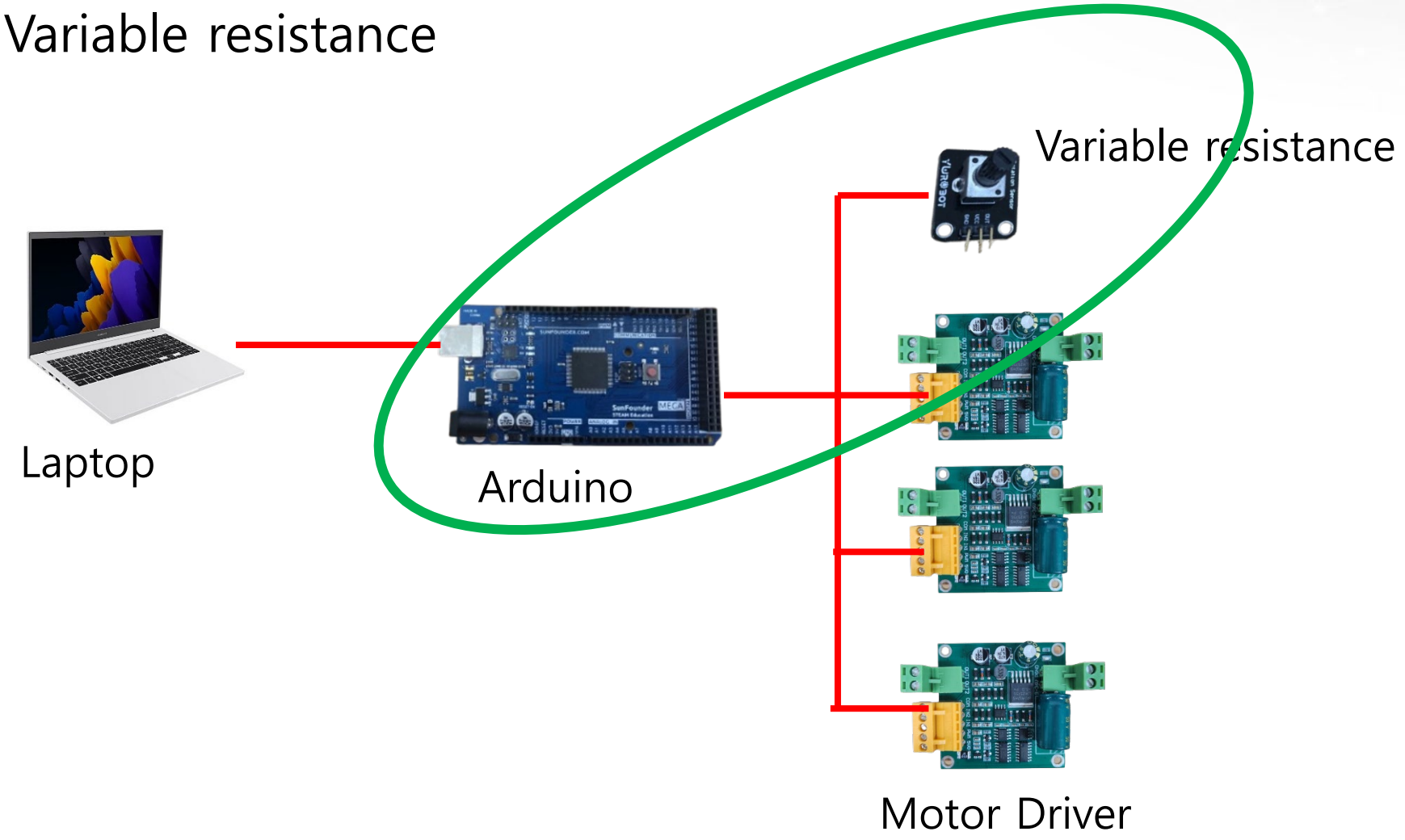


Hardware – Control Unit Connection

- Arduino – Motor Driver
  - Connect using jumper lines
  - Left rear wheel motor driver IN1 – connected to Arduino pin 6
  - Left rear wheel motor driver IN2 – connected to Arduino pin 7
  - Right rear wheel motor driver IN1 – connected to Arduino pin 4
  - Right rear wheel motor driver IN2 – connected to Arduino pin 5
  - Steering motor driver IN1 – connected to Arduino pin 2
  - Steering motor driver IN2 – connected to Arduino pin 3

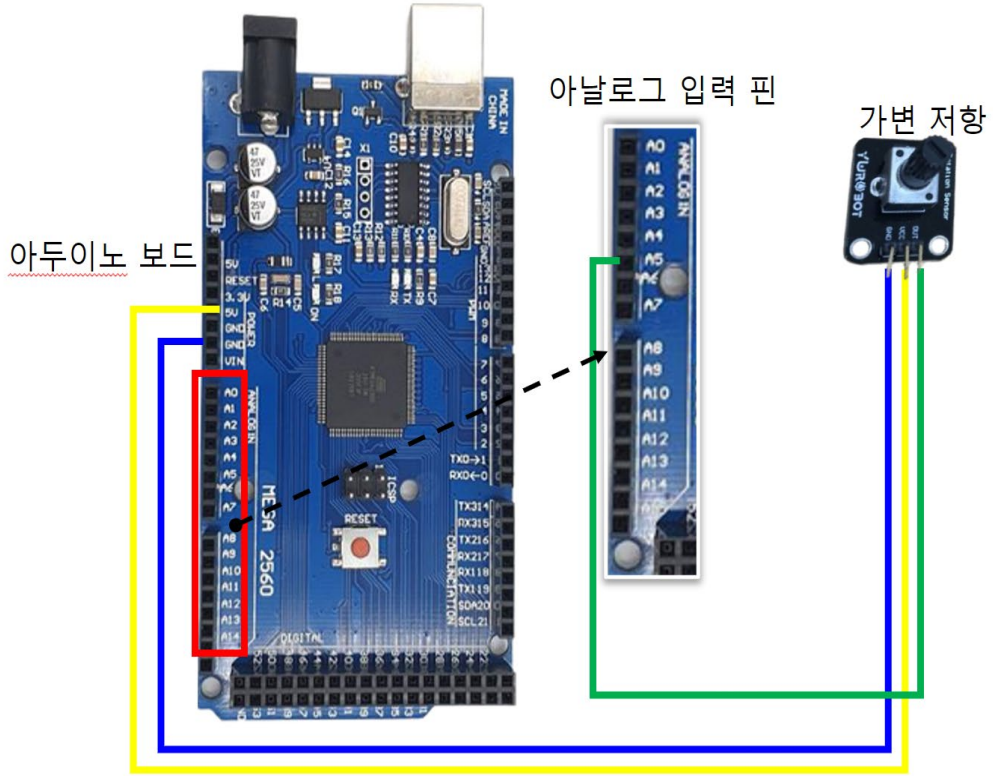
Hardware – Control Unit Connection

- Arduino - Variable resistance



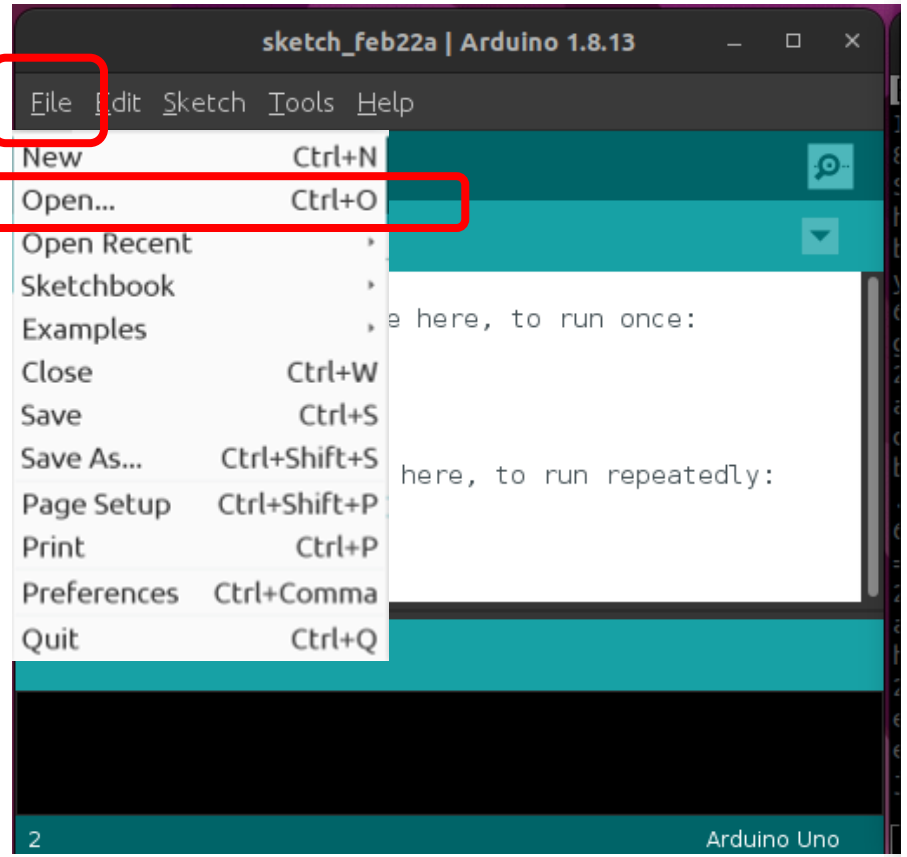
Hardware – Control Unit Connection

- Arduino – Variable Resistance
  - Variable Resistor OUT - Connected to Arduino A2 Pin
  - Variable Resistor VCC - Connecting to Arduino 5V Pin
  - Variable Resistor GND to Arduino GND Pin



Verify motor operation (connection verification)

- Arduino IDE execution
  - Click File -> Click Open
  - Select (ros2_ws/src/control/motor_test/~.ino), click the Open button



Verify motor operation (connection verification)