Preface

About SunFounder

SunFounder is a technology company focused on Raspberry Pi and Arduino open source community development. Committed to the promotion of open source culture, we strive to bring the fun of electronics making to people all around the world and enable everyone to be a maker. Our products include learning kits, development boards, robots, sensor modules and development tools. In addition to high quality products, SunFounder also offers video tutorials to help you build your own project. If you have interest in open source or making something cool, welcome to join us! Visit www.sunfounder.com for more!

About the Smart Car Kit V2.0 for Arduino

This smart car can go forward and backward, and turn left and right. Controlled by the SunFounder Uno board, it can realize IR remote control, line following, hand following, obstacle avoiding, etc.

This car kit is a great platform for you to get started with robotics. After assembling the car based on the instructions in this booklet, you will learn how to operate the smart car through 6 experiments corresponding to the aforementioned movements. Furthermore, you can extend more functions or build your own robot based on what's learnt.

Note:

Go to **LEARN** -> **Get Tutorials** -> **Smart Car Kit V2.0 for Arduino** on our website www.sunfounder.com to view the related code and other materials. Please read this manual carefully before experiment. You are suggested to follow this guide to assemble the smart car model and carry out each experiment taking the wiring steps with diagrams. Then, with the knowledge needed, you may be able to DIY another car!

Free Support

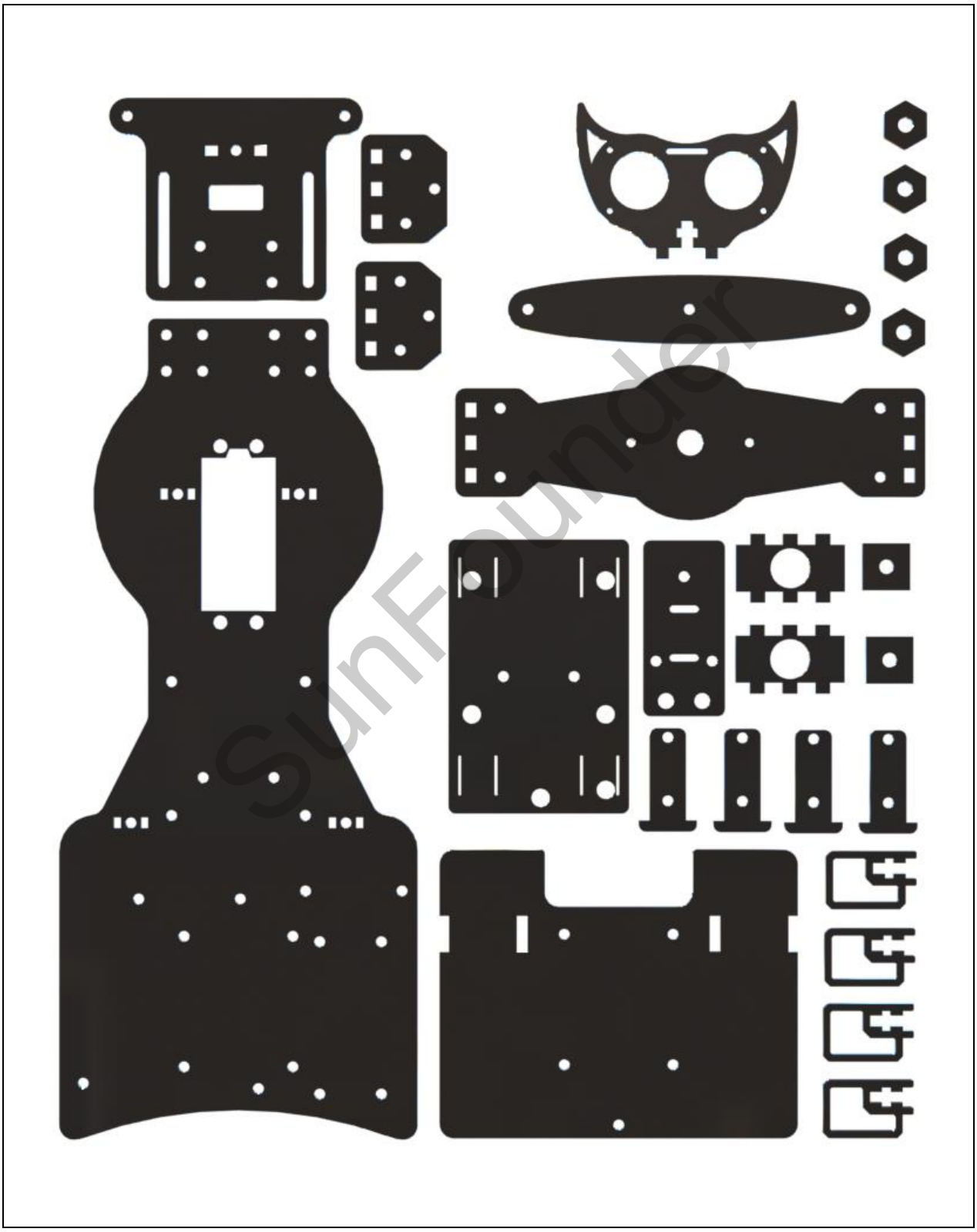
If you have any **TECHNICAL questions**, add a topic under **FORUM** section on our website and we'll reply as soon as possible.

For **NON-TECH questions** like order and shipment issues, please **send an email to service@sunfounder.com**. You're also welcomed to share your projects on FORUM.

Contents

Components List

Acrylic Plate



Mechanical Fasteners

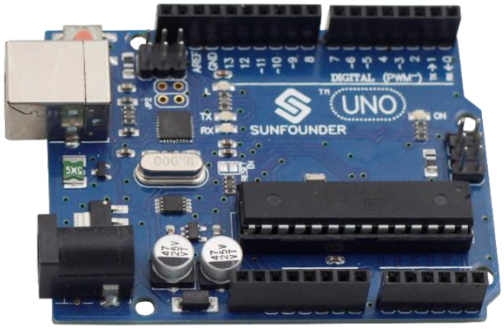
Component	Name	Qty.
	M1.5*8 Screw	6
	M3*12 Countersunk Screw	4
	M3*6 Screw	18
	M3*8 Screw	40
	M3*10 Screw	10
	M3*28 Screw	6
	M4*10 Screw	8
	M4*20 Screw	4
	M3*10 Copper Standoff	16
	M3*13 Copper Standoff	6
	M3*25 Copper Standoff	6
	M3*30 Copper Standoff	4
	M3*35 Copper Standoff	4
	M4*30 Copper Standoff	4
	M1.6 Nut	6
	M3 Nut	17
	M4 Nut	4
	M3 Self-locking Nut	2
	M4 Self-locking Nut	4

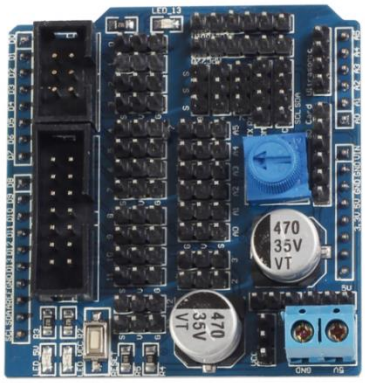
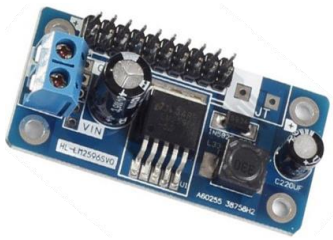
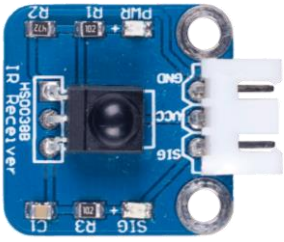
	F694ZZ Flange Bearing	4

Power Accessories

Component	Name	Qty.
	Tower Pro MG995 Micro Servo	1
	Gear Motor	2
	Driven Wheel	2
	Driving Wheel	2

Electronic Accessories

Component	Name	Qty.
	SunFounder Uno	1

	Sensor Shield	1
	DC Motor Driver Module	1
	Step-down DC-DC Converter Module	1
	Switch Module	1
	HC-SR04 Ultrasonic Module	1
	Line Follower Module	1
	IR Receiver Module	1

	IR Remote Controller	1
	18650x2 Battery Holder	1
	Ribbon (13cm)	2
	USB Data Cable (1m)	1
	12cm Male-to-Male Jumper Wire	6
	10cm Male-to-Female Jumper Wire	2
	10cm Female-to-Female Jumper Wire	10
	25cm 3-pin Anti-reverse Cable	1
	25cm 4-pin Anti-reverse Cable	2

Tools

Component	Name	Qty.
	Cross Screwdriver	1
	Cross Socket Wrench	1

	Heat Shrink Tube	1

Self-provided Components

The following components are not included in this kit.

Component	Name	Qty.
	18650 3.7V Rechargeable Li-ion Battery	2

Note:

1. You are recommend to use 18650 batteries **without** a protective board. Otherwise, the car may be cut power and stop running because of the overcurrent protection of the protective board.
2. For unprotected batteries, please purchase those with the anode bulged out (as shown below), so that it can ensure the well connection with the battery holder.

3. If you only have batteries with the protected board, it's ok. To use it, you can remove the board on the cathode. But you should operate with care to avoid any hurt; Since the metal shell is connected to the cathode for most batteries, please don't use screw driver or other metal objects to remove, or the battery may get shorted and be burnt if the shell is connected to the positive pole accidentally.

Introduction to the Smart Car V2.0 for Arduino

The smart car is a great platform for you to get started with robotics. According to the instructions in this manual, you will learn not only how to assemble a robot car but also play the smart car through 6 experiments. After mastering every experiment, you can extend its functions or build your own platform based on our smart car platform.

With the modules and sensors added, the smart car can go forward, go backward, and turn left and right. Besides, it can realize IR remote control, line following, hand tracking, obstacle avoidance, etc. Many boards and sensors are used in this project such as the sensor shield, motor driver module, step-down DC-DC converter module, switch module, ultrasonic ranging module, photosensitive module, obstacle avoidance module, and line follower module. Different modules are used to achieve corresponding functions. And the car is controlled by SunFounder Uno board. Next let's first check these modules in detail.

Get Started

Note:

Before starting your own project, you must download the **Smart_Car_V2.0_for_Arduino.zip** package on our website by visiting **LEARN -> Get Tutorials -> Smart Car Kit V2.0 for Arduino** and unzip it.

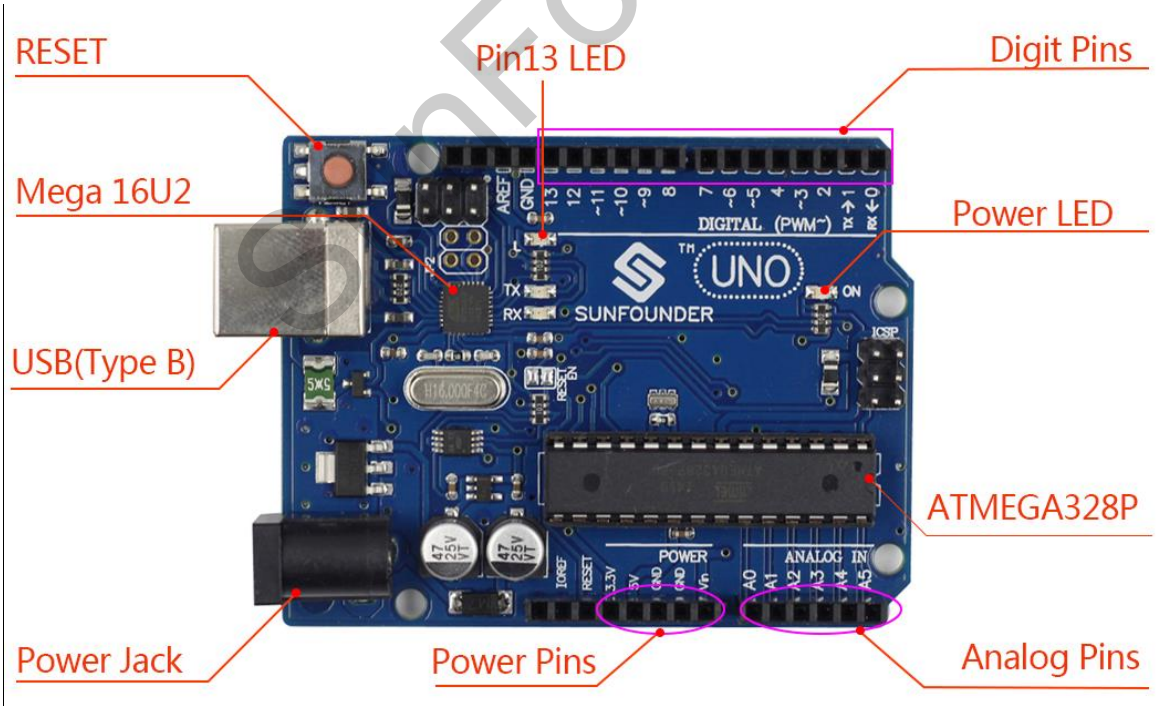
Arduino

Description

Arduino is an open source platform that applies simple software and hardware. You can get it in a short even when you know little of it. It provides an integrated development environment (IDE) for code editing and compiling, compatible with multiple control boards. So you can just download the Arduino IDE, upload the sketches (i.e. the code files) to the board, and then you can see experimental phenomena. For more information, refer to http://www.arduino.cc.

Arduino Board – SunFounder Compatible

In this kit, the SunFounder Uno R3 board is used and it is completely compatible with Arduino Uno Board.



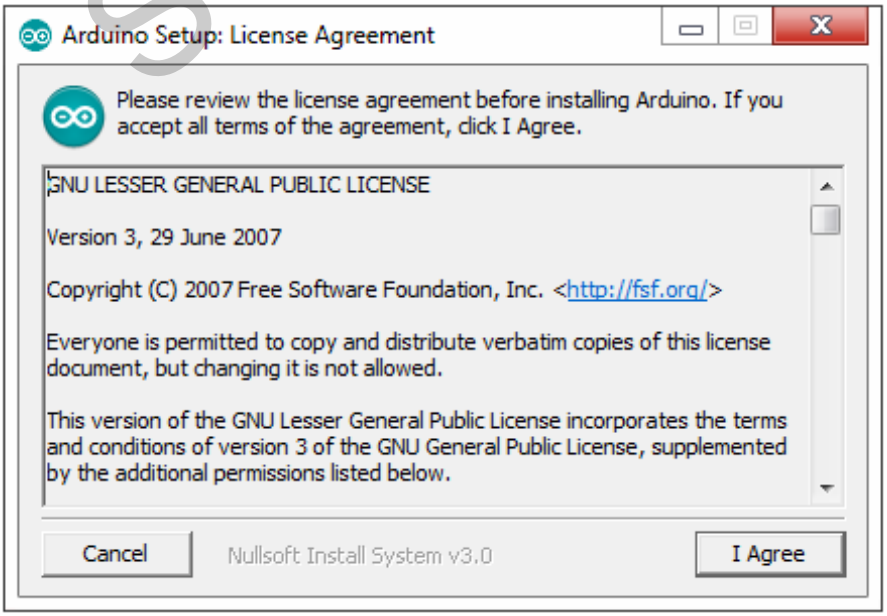
Install Arduino IDE

The code in this kit is made based on Arduino, so you need to install the IDE first. Skip it if you have done this.

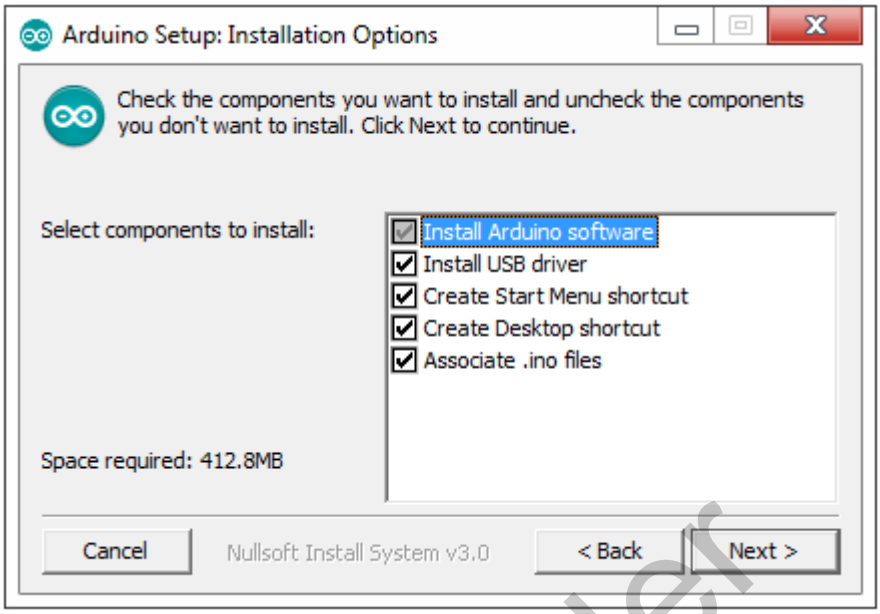
Step 1: Go to the arduino.cc website and click **Software**. On the page, check the software list on the right side under **Download the Arduino Software**.

Find the one that suits your operation system and click to download. There are two versions of Arduino for Windows: Installer or ZIP file. You're recommended to download the former.

Step 2: Double click the .exe file and the following window will show up. Click **I Agree**. The following interface will show up.

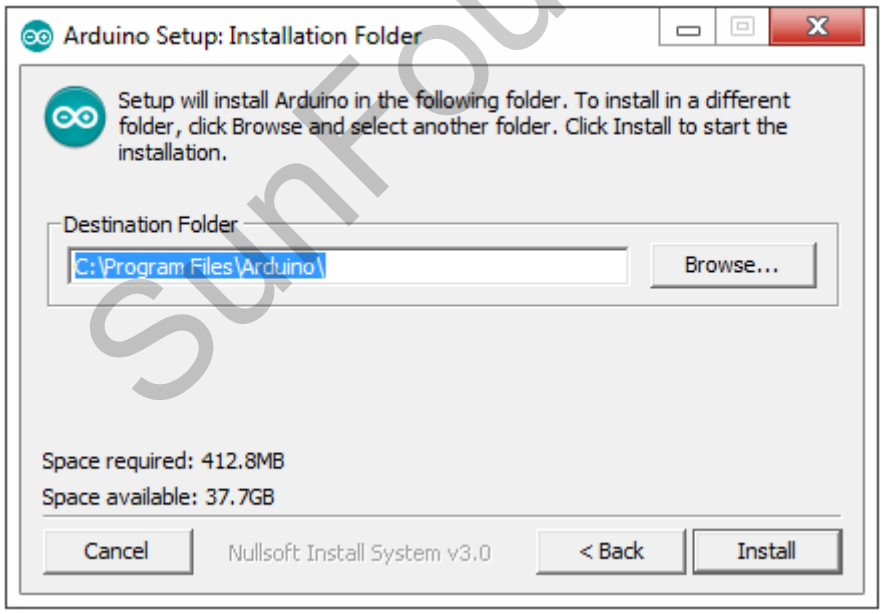


Next.

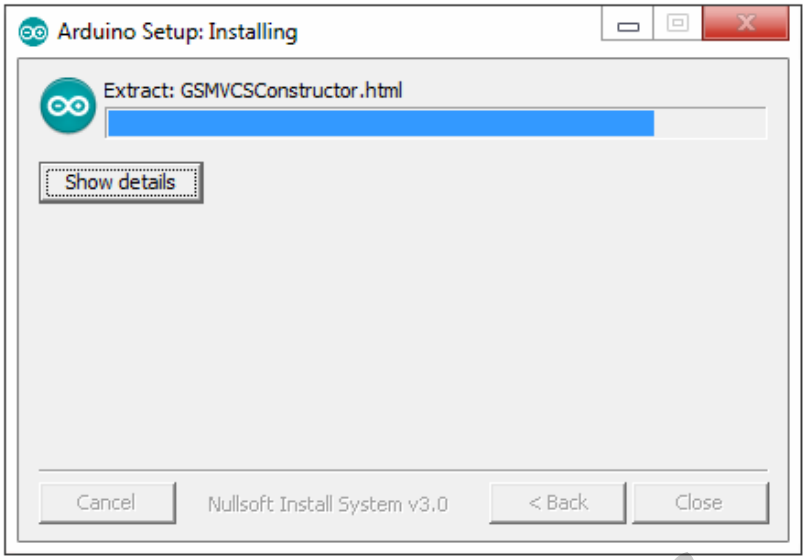


Click **Browse** to choose the installation path or enter a directory at the **Destination Folder**.

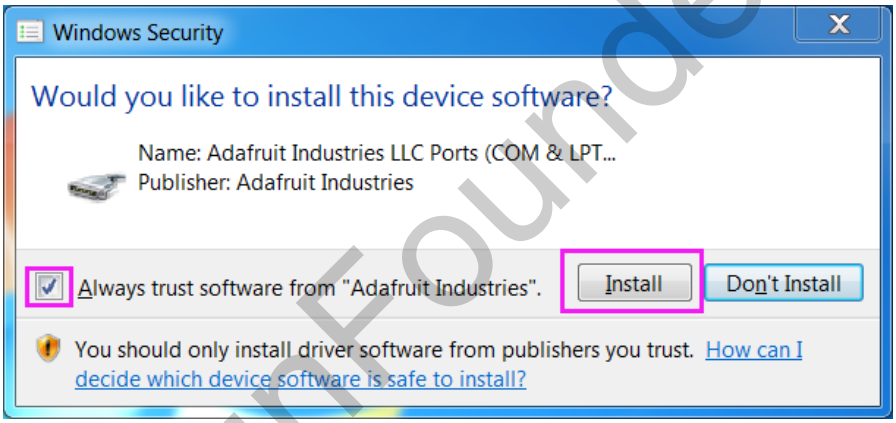
Click **Install.**



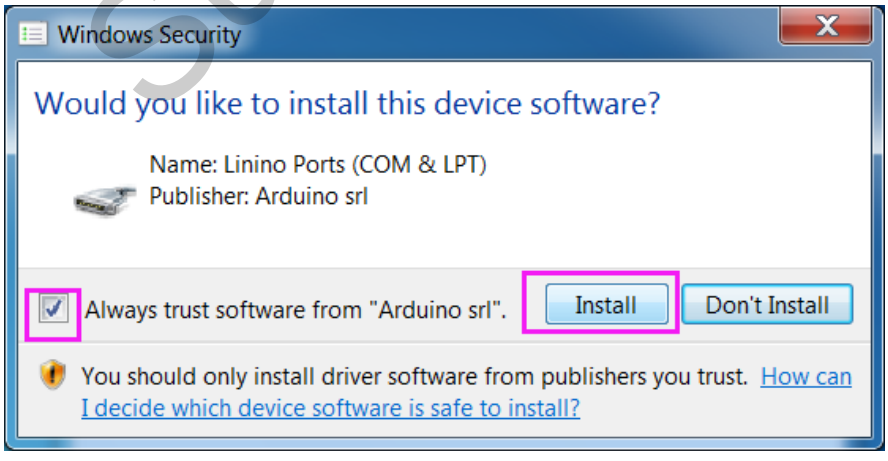
The following interface will show up. (After the installing progress bar goes to the end, the **Close** button may be enabled for some PC. Just click it to complete the installation.)



Then a prompt appears. Select Always trust software for "Adafruit Industries" and click **Install**.



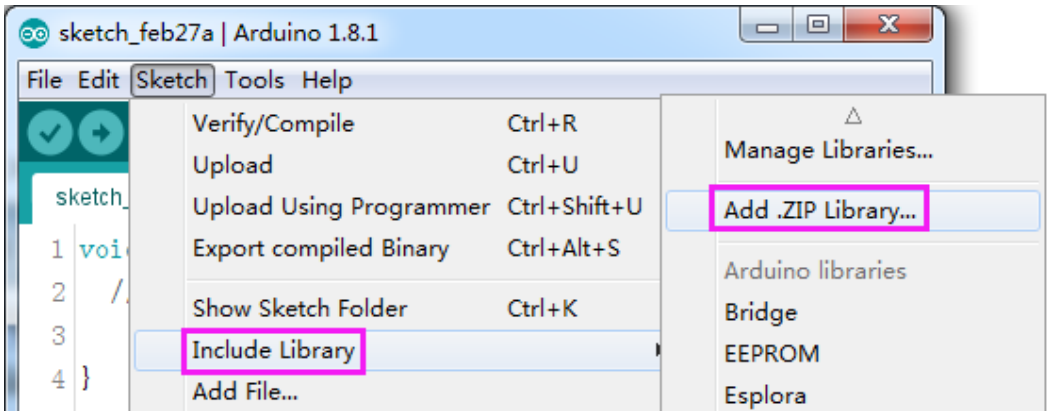
Select Always trust software for "Arduino srl" and click **Install**.



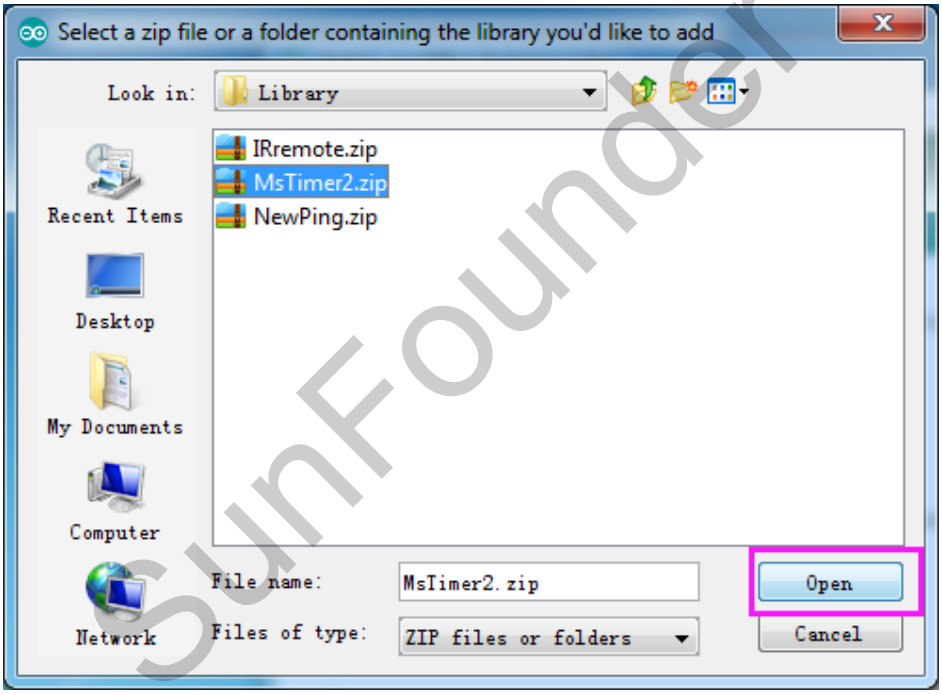
After the installation is done, click **Close**. Then an Arduino icon will appear on the desktop:

Add Libraries

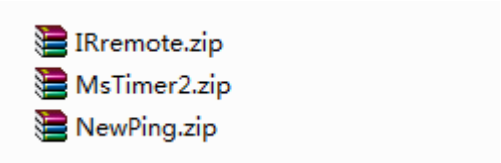
1) Select **Sketch** -> **Include Library** -> **Add ZIP Library.**



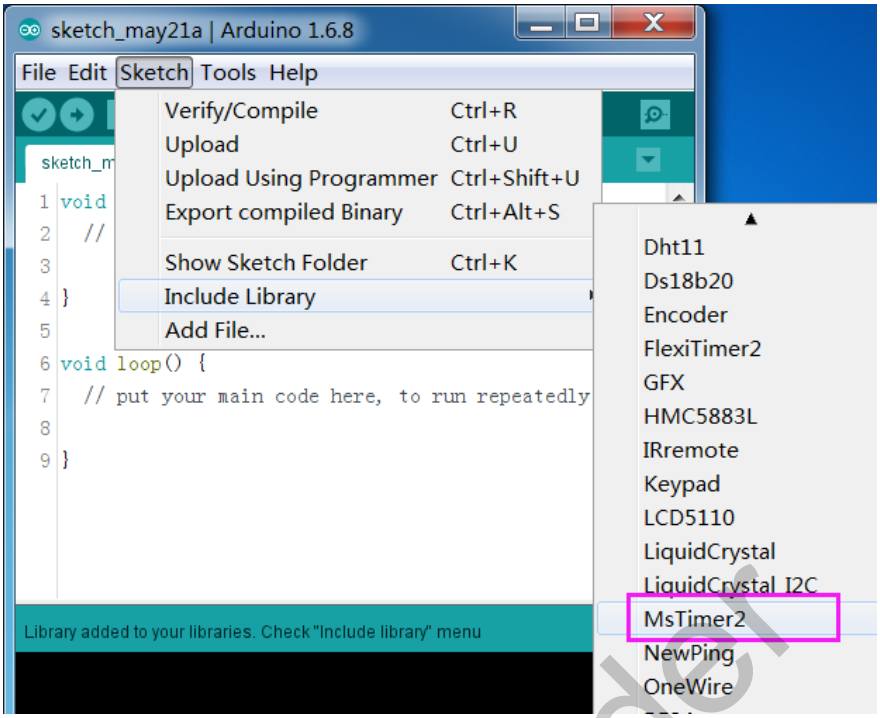
2) Find the file ***MsTimer2.zip*** under ***Smart Car V2.0 for Arduino\Code\Library***. Click **Open.**



3) Similarly, add ***IRromte.zip*** and ***NewPing.zip*** under ***Smart Car V2.0 for Arduino\Code\Library*** to library.

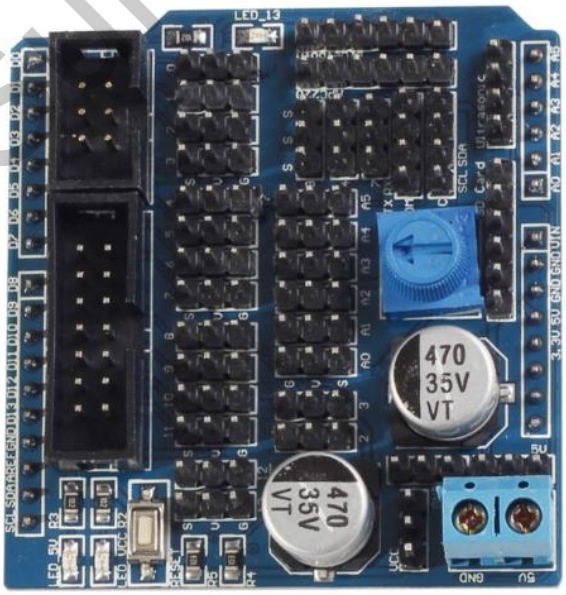


4) Then you'll be prompted by Library added to your libraries. Check "Import libraries". You also can see the libraries just imported have appeared on the list by going to **Sketch**->**Include Library**->**MsTimer2**.

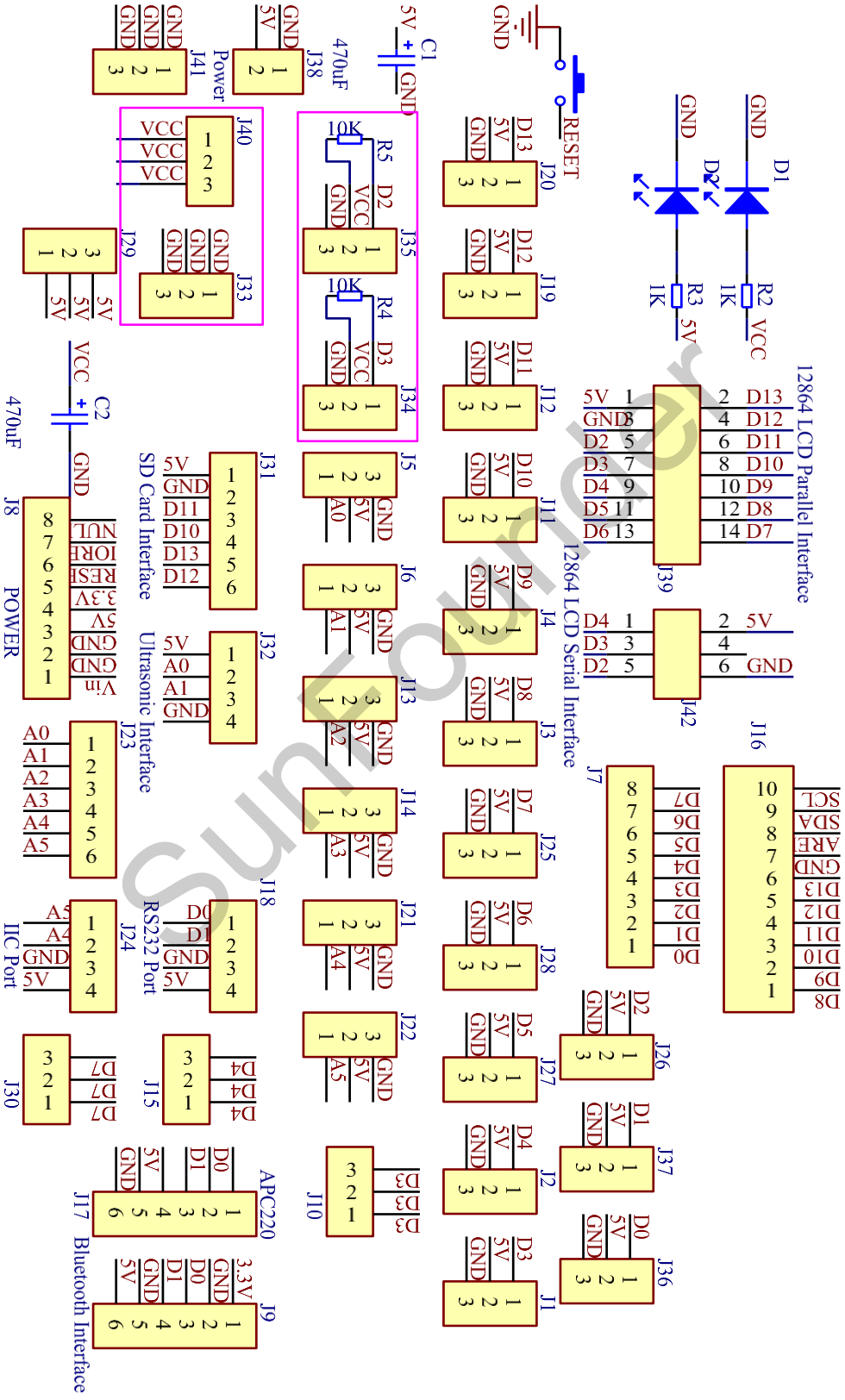


Sensor Shield

It is convenient to place components on a breadboard. However, you need to have some electronic foundation to build various kinds of circuit. By using this sensor shield, you only need to wire components to the shield with some jumper wires, and then you can build your own project quickly. The sensor shield is one of the most common Arduino peripheral devices, as shown below:



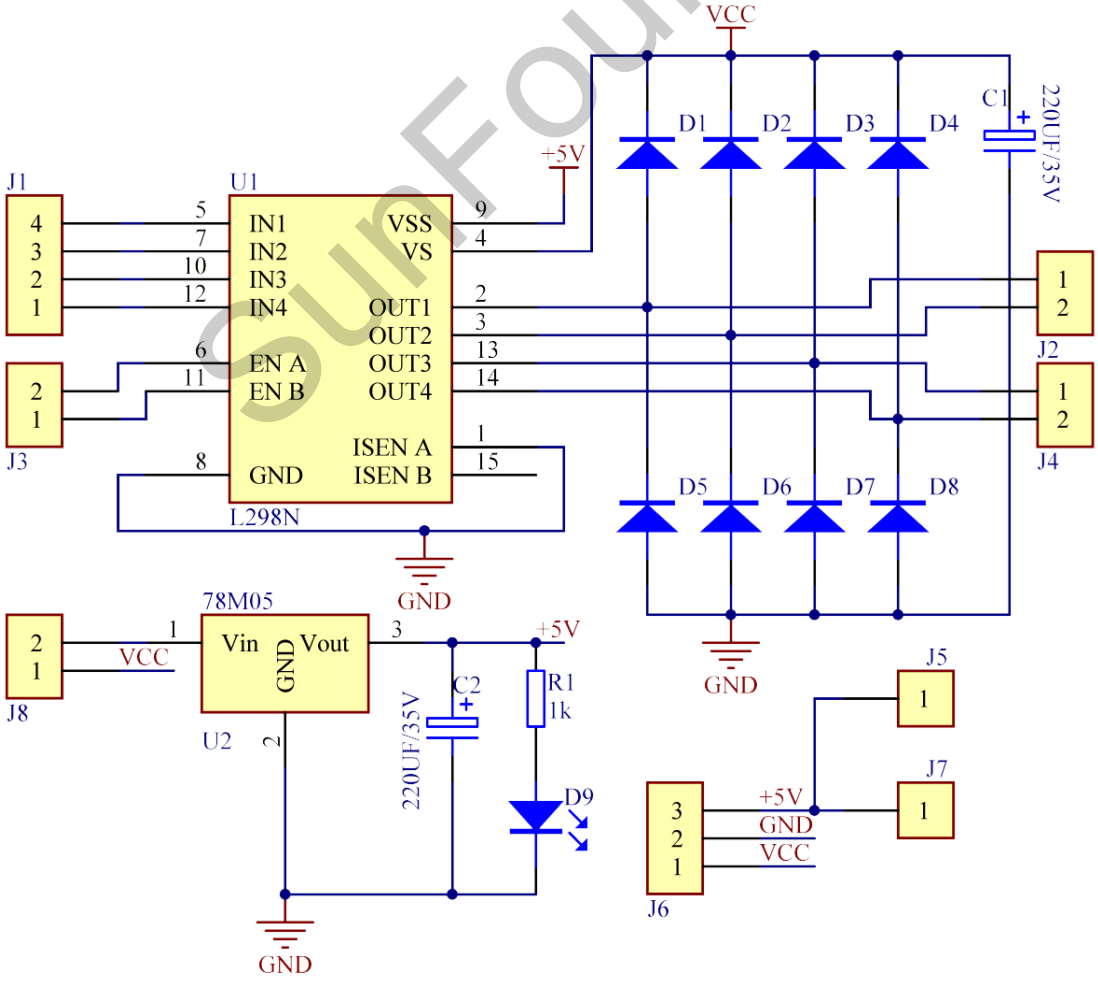
Its schematic diagram is as shown below: note that VCC only supplies power to the devices connected to D2 (hooked to the black servo) and D3. Other components are powered by 5V.



Motor Driver Module

The motor driver module is used to drive two motors to rotate. The driver chip used here is L298N.

Its schematic diagram is as shown below:



L298N is a high voltage, large current driver chip manufactured by ST, which uses a 15-pin package.

Its main features are as follows:

- High operating voltage, which can be up to 40 volts.
- Large output current - the instantaneous peak current can be up to 3A.
- With 25W rated power.
- Two built-in H-bridge, high voltage, large current, full bridge driver, which can be used to drive DC motors, stepper motors, relay coils and other inductive loads.
- Using standard logic level signal to control.
- Able to drive a two-phase or four-phase stepper motor, and two-phase DC motors.

Its pin functions are as shown below:

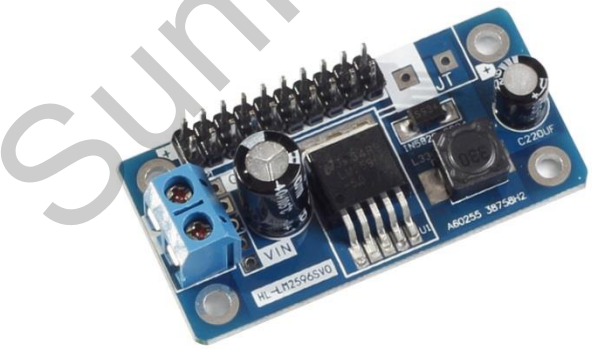
Pin	Name	Description
1 15	Sense A Sense B	The sense resistor is connected between this pin and ground to control the current of the load.
2 3	Out 1 Out 2	Outputs of the Bridge A; the current that flows through the load connected between these two pins is monitored at pin 1.
4	Vs	Supply Voltage for the Power Output Stages. A non-inductive 100nF capacitor must be connected between this pin and ground.
5 7	Input1 Input2	TTL Compatible Inputs of the Bridge A.
6 11	Enable A Enable B	TTL Compatible Enable Input: the L state disables the bridge A (enable A) and/or the bridge B (enable B).
8	GND	GND
9	Vss	Supply Voltage for the Logic Blocks. A100nF capacitor must be connected between this pin and ground.
10 12	Input3 Input4	TTL Compatible Inputs of the Bridge B.
13 14	Out 3 Out 4	Outputs of the Bridge B. The current that flows through the load connected between these two pins is monitored at pin 15.

The driver module can drive two motors. The enable terminals ENA and ENB are effective at high level. The control mode (high/low level) and state of motor A are as shown below:

ENA	IN1	IN2	State of Motor A
0	X	X	Stop
1	0	0	Brake
1	0	1	Rotate clockwise
1	1	0	Rotate counterclockwise
1	1	1	Brake

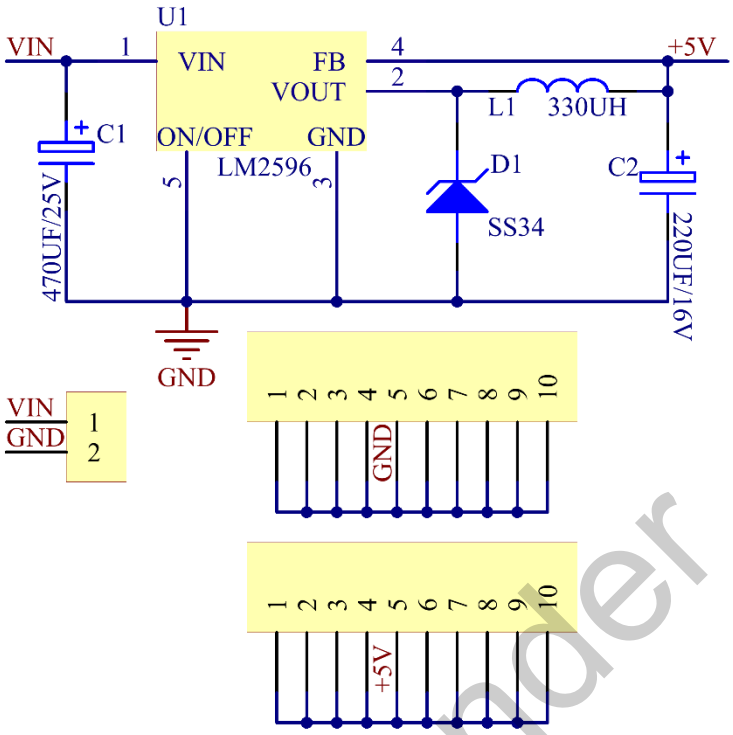
If you want to regulate the speed of motor A by PWM, you need to set IN1 and IN2, confirm the rotational direction of the motor, and then output PWM pulses for enabled terminals. Please note that the motor is in the free stop state when the signal of enabled terminal is 0. When the enabled signal is 1, if IN1 and IN2 are 00 or 11, the motor is in brake state, and the motor stops rotating. If IN1 is 0 and IN2 is 1, the motor A rotates clockwise; if IN1 is 1 and IN2 is 0, the motor A rotates counterclockwise. This is the control method for motor A. The control method for motor B is the same as that for motor A.

Step-down DC-DC Converter Module



The DC-DC module is used to reduce the input voltage and output a stable 5 volts voltage. Here the LM2596 switching voltage regulator is used to regulate the voltage.

The corresponding schematic diagram:



The LM2596 regulator is a monolithic integrated circuit ideally suited for easy and convenient design of a step−down switching regulator (buck converter). It is capable of driving a 3.0A load with excellent line and load regulation. It is internally compensated to minimize the number of external components to simplify the power supply design.

Since LM2596 converter is a switch−mode power supply, its efficiency is significantly higher in comparison with popular three−terminal linear regulators, especially with higher input voltages. The LM2596 operates at a switching frequency of 150 kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. It is available in a standard 5−lead TO−220 package with several different lead bend options, and D2PAK surface mount package.

Features

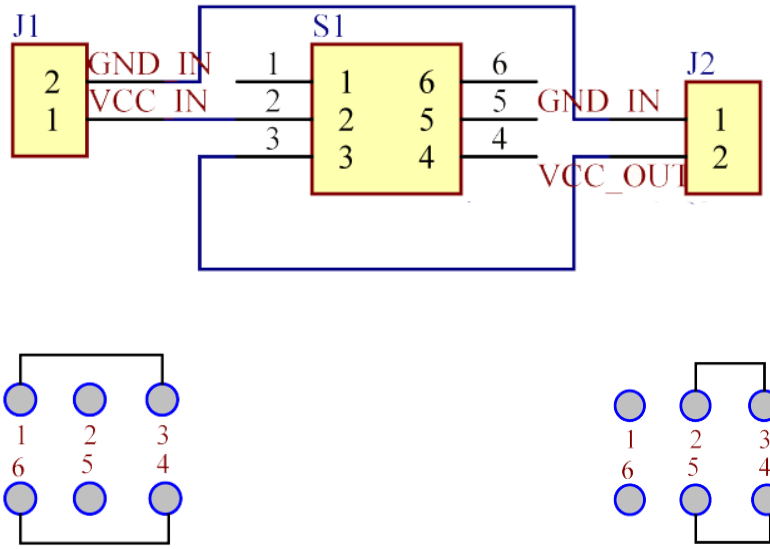
- Fixed Output Voltage: 5V
- Guaranteed 3.0 A Output Load Current
- Wide Input Voltage Range up to 40 V
- 150 kHz Fixed Frequency Internal Oscillator
- TTL Shutdown Capability
- Low Power Standby Mode, typically 80 μA
- Thermal Shutdown and Current Limit Protection

Its pin functions are as shown below:

Pin	Name	Description
1	VIN	This is the positive input supply for the IC switching regulator. A suitable input by pass capacitor must be present at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.
2	GND	Circuit ground
3	OUTPUT	Internal switch. The voltage at this pin switches between (+V IN − V SAT) and approximately −0.5V, with a duty cycle of approximately V OUT /V IN. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be kept to a minimum
4	Feedback	Senses the regulated output voltage to complete the feedback loop
5	ON/OFF	Allows the switching regulator circuit to be shut down using logic level signals thus dropping the total input supply current to approximately 80 μA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of 25V) shuts the regulator down. If this shutdown feature is not needed, the ON /OFF pin can be wired to the ground pin or it can be left open; in either case the regulator will be in the ON condition

Switch Module

The switch module is used to turn on/off the power. A self-locking switch is used. It is a single-pole double-throw switch. When the button is not pressed, pin 1 and 3 are connected, and pin 4 and 6 are connected, as shown in figure (a). When the button is pressed, pin 2 and 3 are connected, and pin 4 and 5 are connected, as shown in figure (b).



(a) When the button is NOT PRESSED **(b) When the button is PRESSED**

Ultrasonic Module HC-SR04 Distance Sensor

The ultrasonic ranging module HC-SR04 provides 2cm-700cm non-contact measurement function, and the ranging accuracy can reach 3mm. Stable signal can be ensured within 5m, and signal gradually fades beyond 5m till disappearing at 7m position.

The module includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

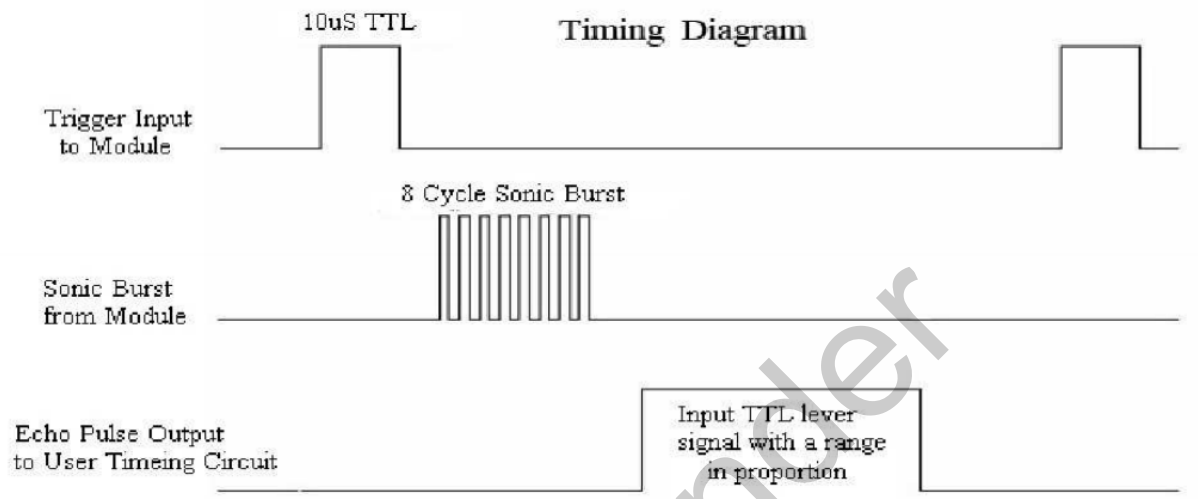
1) Using IO trigger for at least 10us high level signal;
2) The module automatically sends eight 40 kHz square waves and detect whether there is a pulse signal sent back.
3) If there's a signal sent back, output a high level through pin ECHO; the time duration is the time from sending the ultrasonic to the returning.

Thus, test distance = (high level time × velocity of sound (340M/S) / 2.

The timing diagram is as shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8-cycle burst of

ultrasound at 40 kHz and raise its echo. The echo is a distance object that is pulse width and the range in proportion .You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Thus,

uS / 58 = centimeters or uS / 148 =inch; or: the range = high level time * velocity (340M/S) / 2;
You're recommended to use over 60ms measurement cycle, in order to prevent conflicts between trigger signal and echo signal.



Line Follower Module

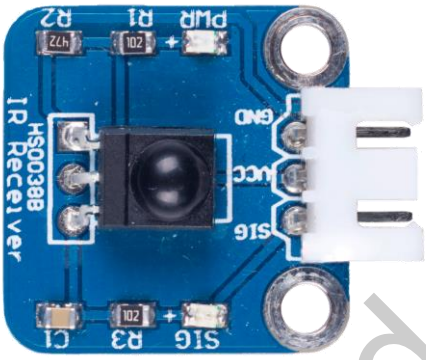
The TCRT5000 infrared photoelectric switch adopts a high transmit power infrared photodiode and a highly sensitive phototransistor. It works by applying the principle of objects' reflecting IR light – the light is emitted, then reflected, and sensed by the synchronous circuit. Then it determines whether there exists an object or not by the light intensity. It can be used to easily identify black and white lines.

In other words, the different conduction levels of the phototransistor when it passes over black and white lines can generate different output voltages. Therefore, all we need to do is to collect data by the AD converter on the STM8S105C4 and then send the data to the master control board via I2C communication.

This module is an infrared tracking sensor one that uses a TRT5000 sensor. The blue LED of TRT5000 is the emission tube and after electrified it emits infrared light invisible to human eye. The black part of the sensor is for receiving; the resistance of the resistor inside changes with the infrared light received.

Supply Voltage: 5V; PCB Dimensions: 124 x 30 mm

IR Receiver Module



The infrared-receiver module uses the HS0038B as the infrared receiving head which receives infrared signals and can independently receive infrared ray and output signals compatible with TTL level. It's similar with a normal plastic-packaged transistor in size and it is suitable for all kinds of infrared remote control and infrared transmission.

Features

- High protection ability against EMI.
- Circular lens for improved reception characteristics.
- Line-up for various center carrier frequencies.
- Low voltage and low power consumption.
- High immunity against ambient light.
- Photodiode with integrated circuit.
- TTL and CMOS compatibility.
- Long reception distance.
- High sensitivity.
- Pb free and RoHS compliant.

Servo

Servo is a set of automatic control system composed of DC motors, reduction gear set, sensors and control circuits. The output shaft can be rotated to a certain angle by sending signals. The servo can only rotate in a certain range, for example, 0-180°. It cannot rotate in

circle continuously like DC motor. The servo enables you to easily rotate an object in a certain angle, so it is widely used in model planes and robot joints.

Only the MG995 SG90 Micro Servo is used in this kit, which is assembled on the front chassis of the car for steering structure.

Car Assembly

Front Wheels

1. Fasten the bearing, the following acrylic plates and driven wheel with an **M4*20 screw** and an **M4 self-locking nut**. Tighten the screws with the Cross Socket Wrench and the Cross Screwdriver.

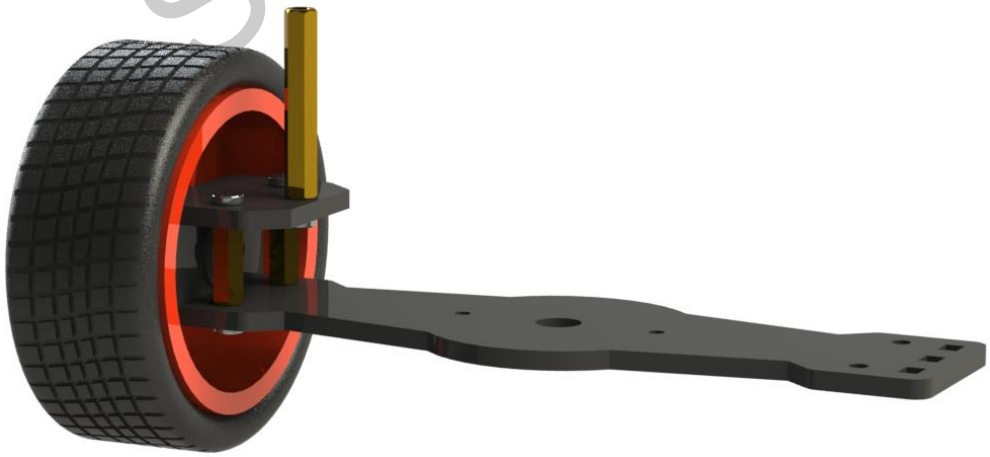
2. After assembly, it is as shown below:

3. Do not over tighten the nuts so that the wheel can spin smoothly.

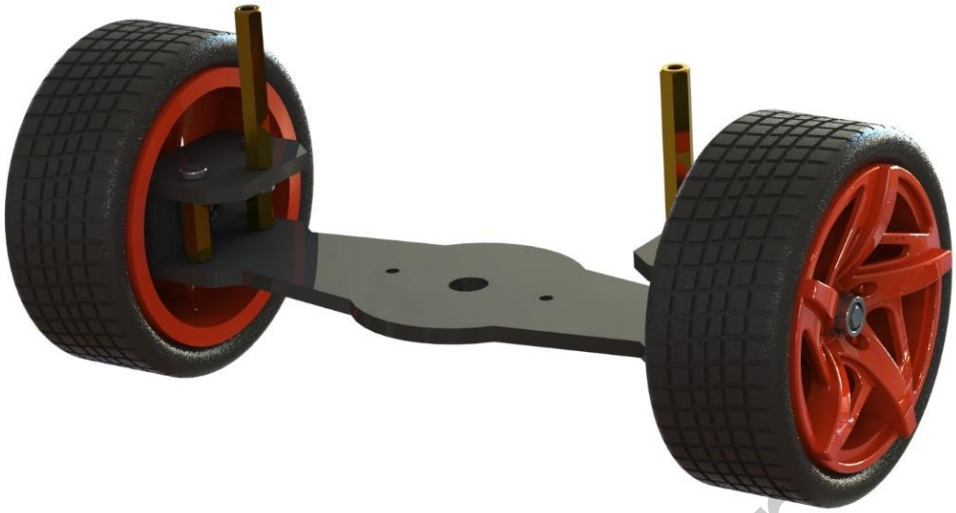
Deflecting Plate + Front Wheels

1. Fasten the following acrylic plates and the assembled front wheel with **M3*8 screws** and **M3*13 copper standoffs**. And fasten an **M3*8 screw** and an **M3*35 copper standoff** to the smaller acrylic plate.

2. After assembly, it is as shown below:



3. Connect another front wheel, as shown below:

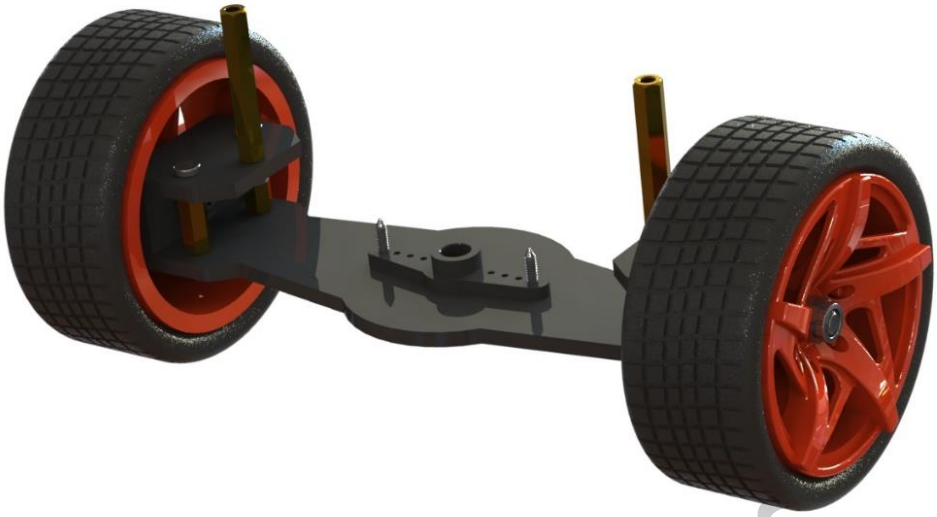


Note: After assembly is done, rotate the two wheels. If they cannot spin smoothly, loosen the M4 nuts with the wrench and the screwdriver.

Deflecting Plate + Rocker Arm

1. Fasten the following rocker arm of the SG90 servo to the deflecting plate with servo screws.
   Packaged with the servo, the servo screws are within the longer four of five screws.
   The rocker arm is packaged with the servo together.

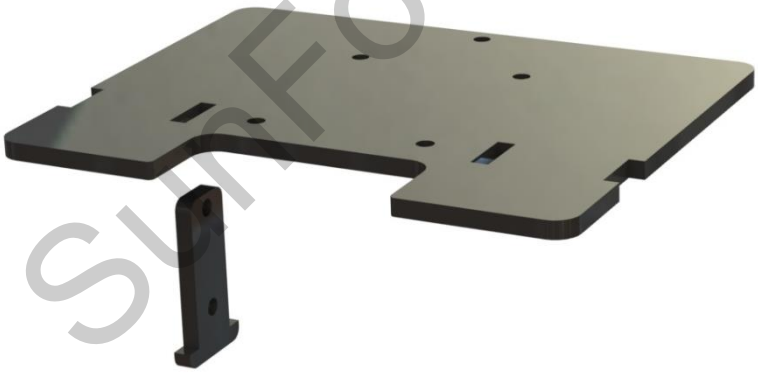
2. After assembly, it is as shown below:



Note: The screw is quite sharp at the end, so be careful to assemble in case of getting hurt.

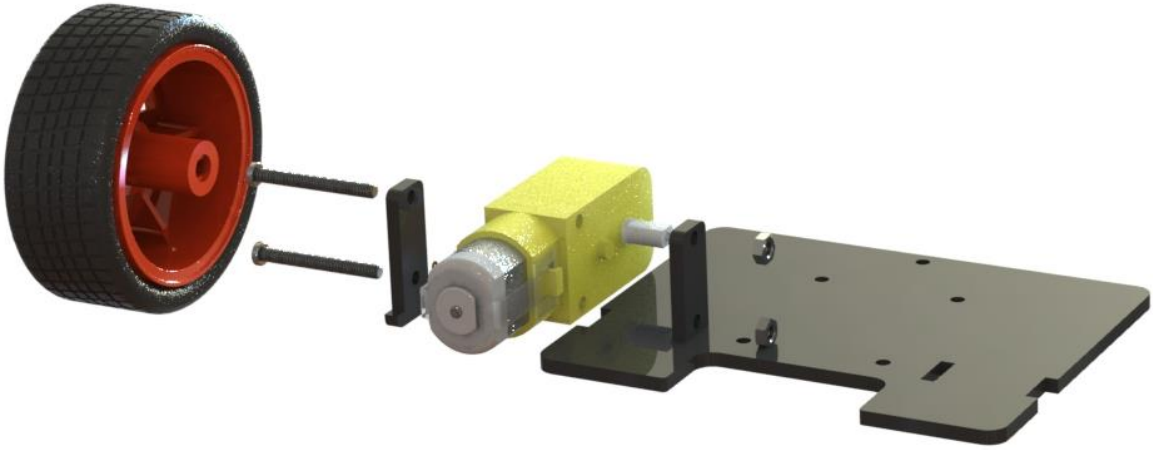
Rear Lower Plate + Rear Wheels

1. Assemble the following acrylic plates together.

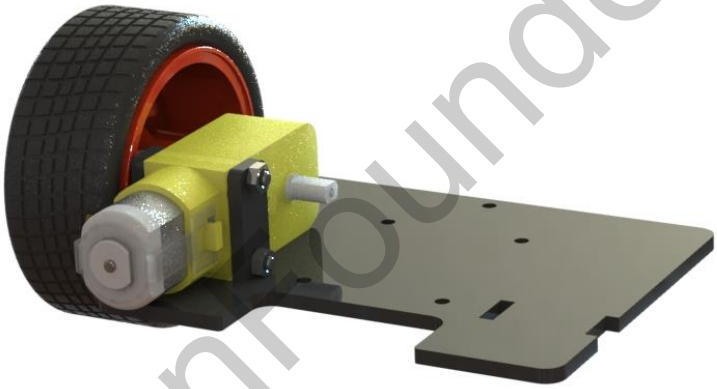


2. After assembly, it is as shown below:

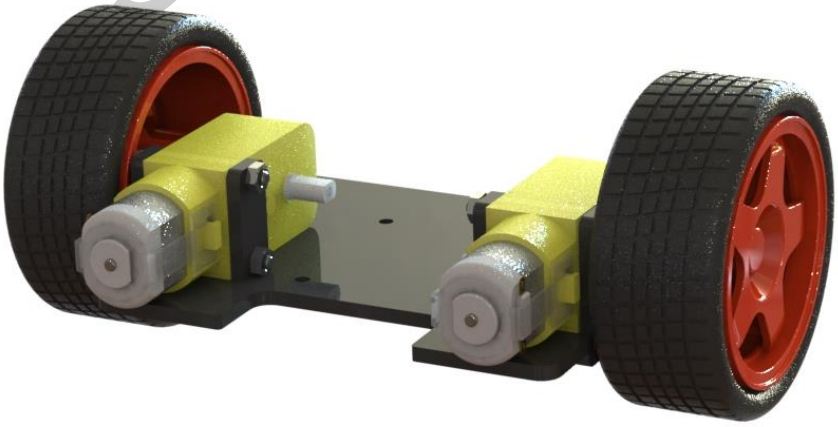
3. Fasten the following acrylic plates and gear motor with **M3*28 screws** and **M3 nuts**. Assemble the driving wheel to the motor.



4. After assembly, it is as shown below:



5. Connect the other driving wheel, as shown below:

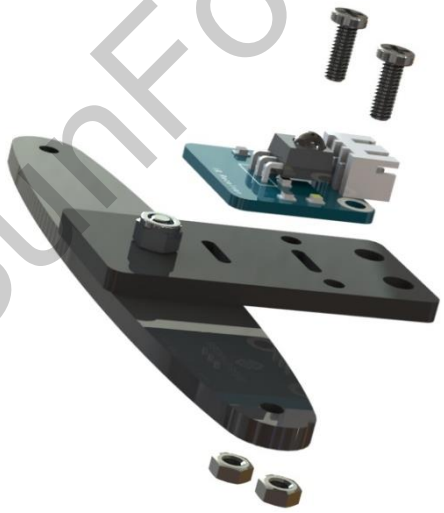


Deflecting Top Plate

1. Fasten the following acrylic plates with an **M3*10 screw** and an **M3 self-locking nut**. Tighten them with the cross wrench and the screwdriver (do not over tighten them).

2. After assembly, it is as shown below:
   Do not over tighten the screws so that the acrylic plate can move smoothly.

3. Mount the IR Receiver module with **M3*8 screws** and **M3 nuts**

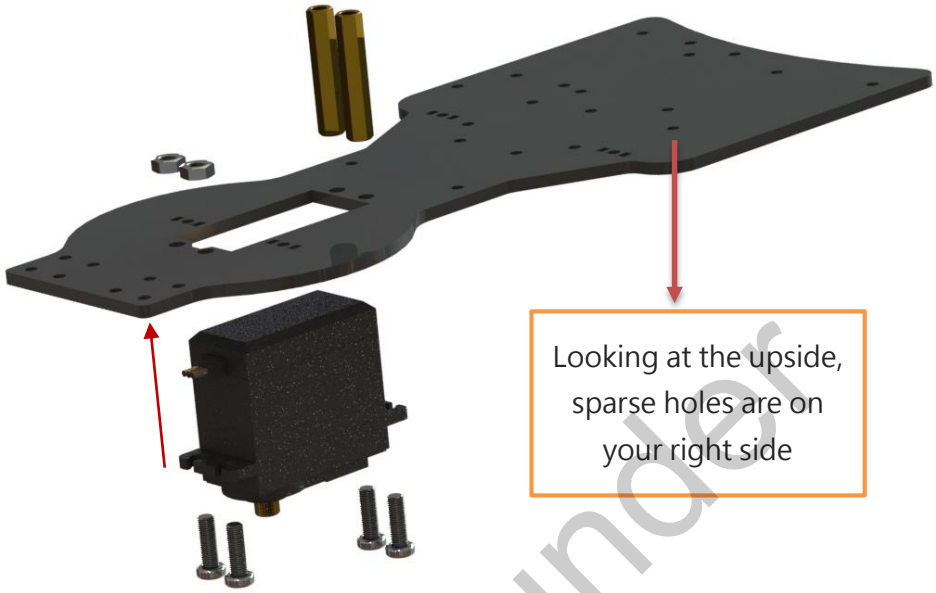


4. After assembly, it is as shown below:

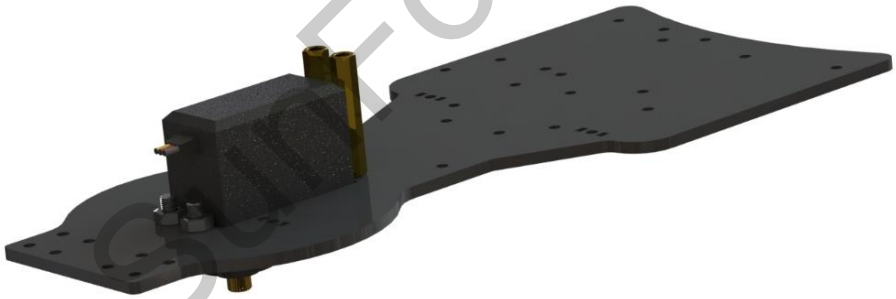
Servo + Chassis + Battery Holder

1. Fasten the following acrylic plates, the chassis and the servo with **M4*10 screws**, **M4 nuts** and **M4*30 copper standoffs**.

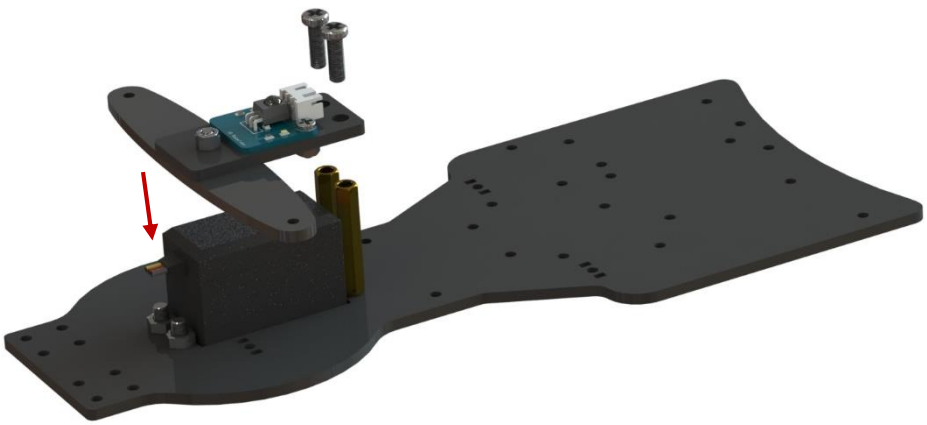
   Note: You can tell the bottom and upside of the Chassis according to the holes distribution.



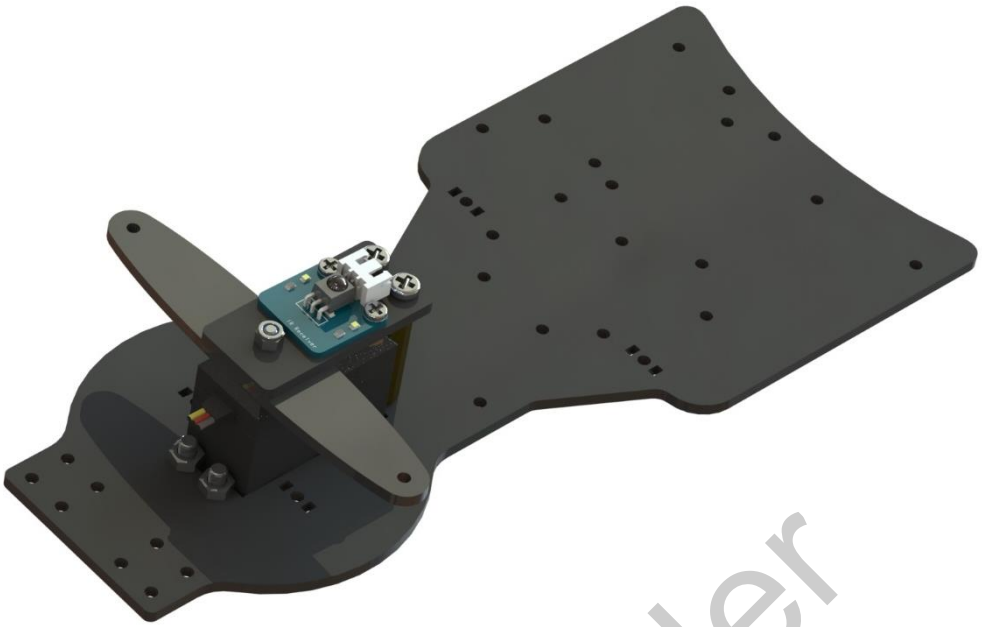
2. After assembly, it is as shown below:



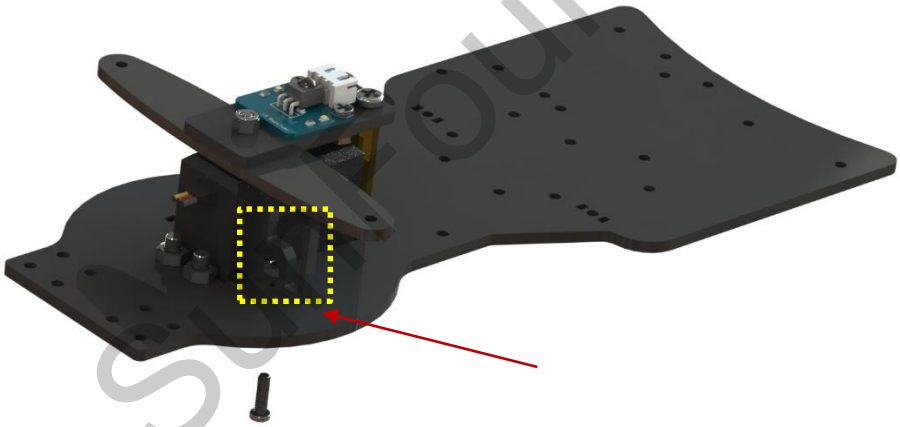
3. Fasten the Top Plate with M4*10 screws:



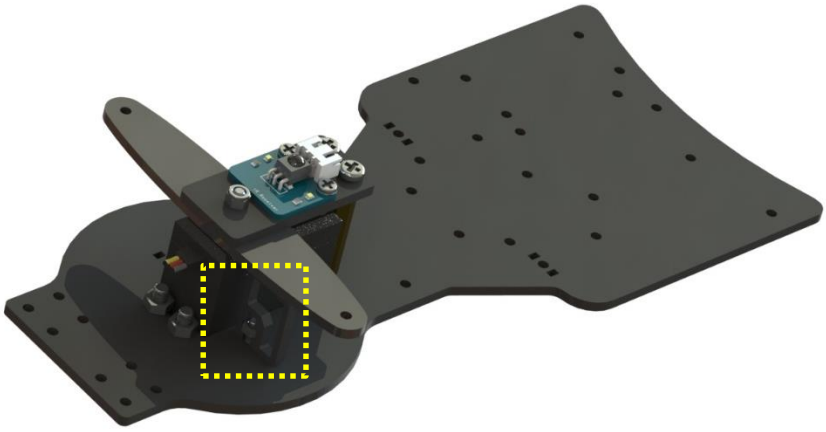
4. After assembly, it is as shown below:



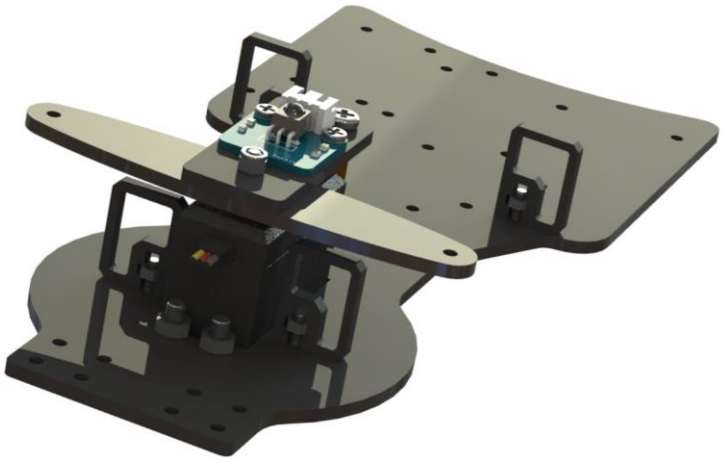
5. Fasten the acrylic plate for wire organizing to the chassis with an **M3*10 screw** and an **M3 nut**.



6. After assembly:

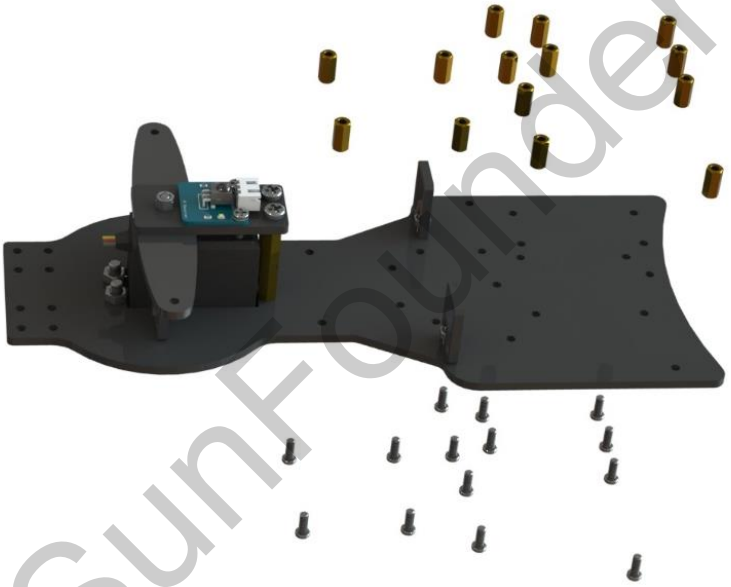


7. Connect similarly the other 3 acrylic plates symmetrically.



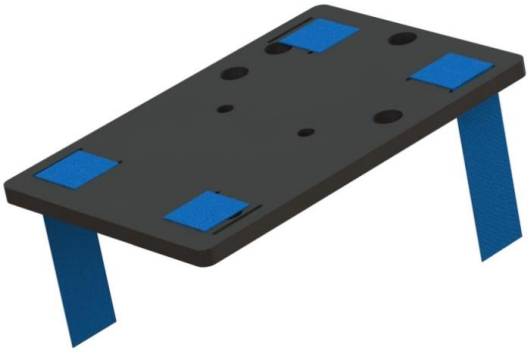
8.

9. Fasten the chassis with **M3*8 screws** and **M3*10 copper standoffs**.



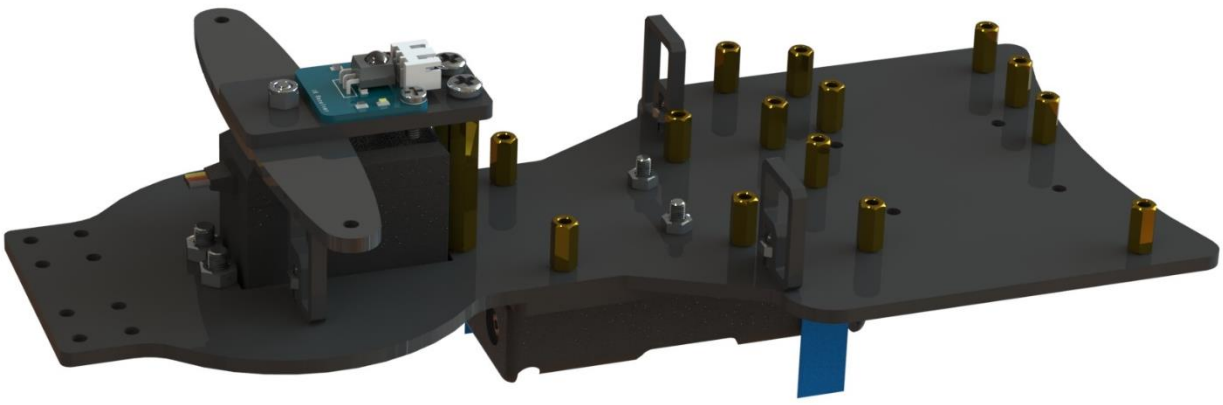
10. After assembly, it is as shown below.

11. Cross the ribbon through the following acrylic plate. Please note that one side of the ribbon should be longer and the other is shorter.
With the ribbon, you can remove the batteries easily. Also you can skip this step.



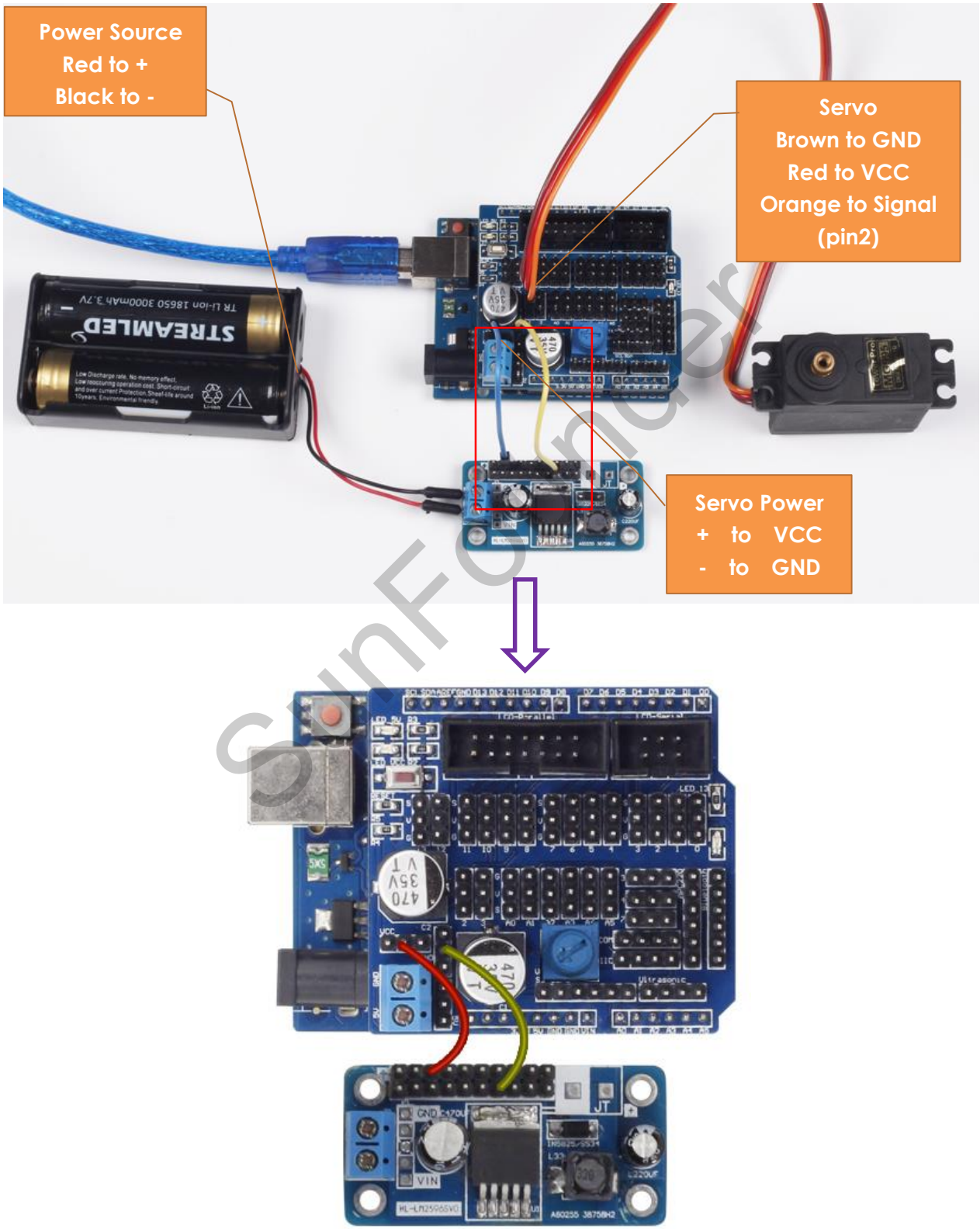
12. Fasten the chassis and the battery holder with **M3*12 countersunk screws** and **M3 nuts**.

13. After assembly it's as follows:

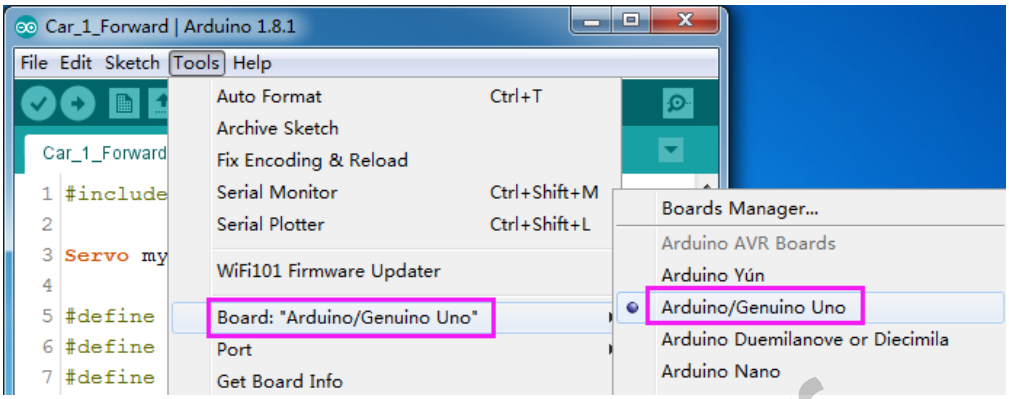


Adjust the Servo

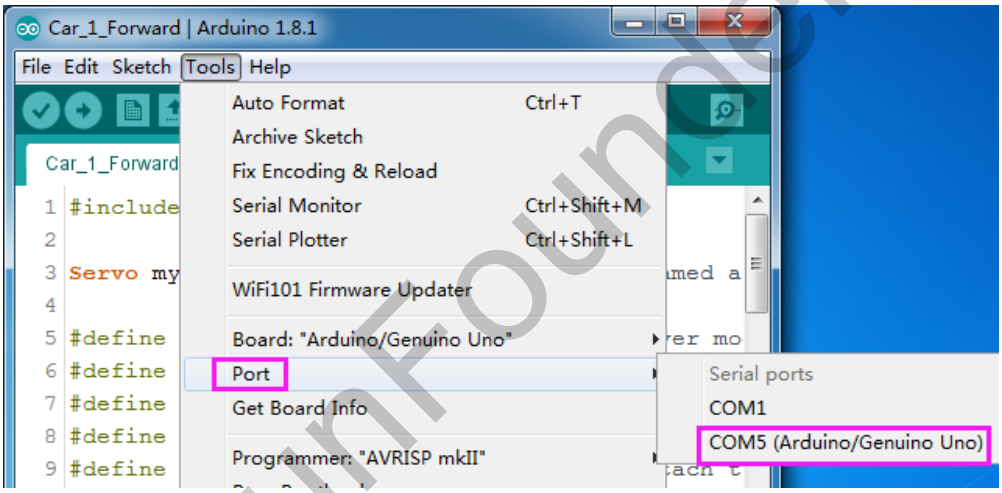
1) Connect the servo to the pin 2 of the sensor shield, and the wiring should be as shown below:



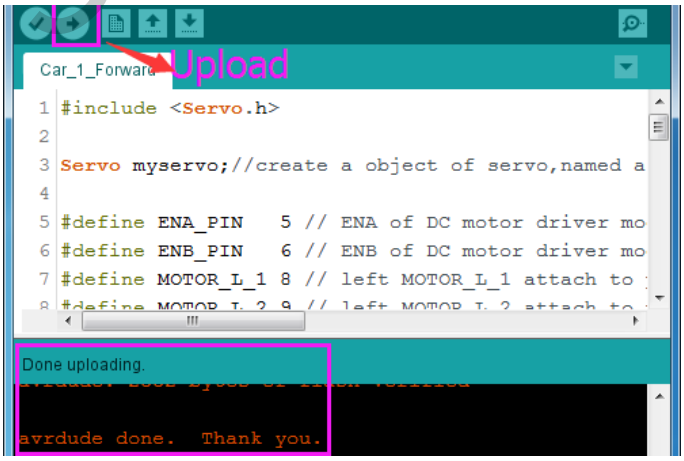
2) Connect the SunFounder Uno board to your computer via a USB cable. Open the file *Car_1_Forward.ino* under the path *Smart Car V2.0 for Arduino\Code\Car_1_Forward*. Before uploading the sketch to the board, you need to select the right **Board** and **Port** through **Tools** -> **Board** -> **Arduino/Genuino Uno**.



3) Then click to **Tools** -> **Port** -> **COM5** (your port may be different)



4) Click the **Upload** icon. The code is uploaded successfully when you are prompted "Done Upload" at the bottom.



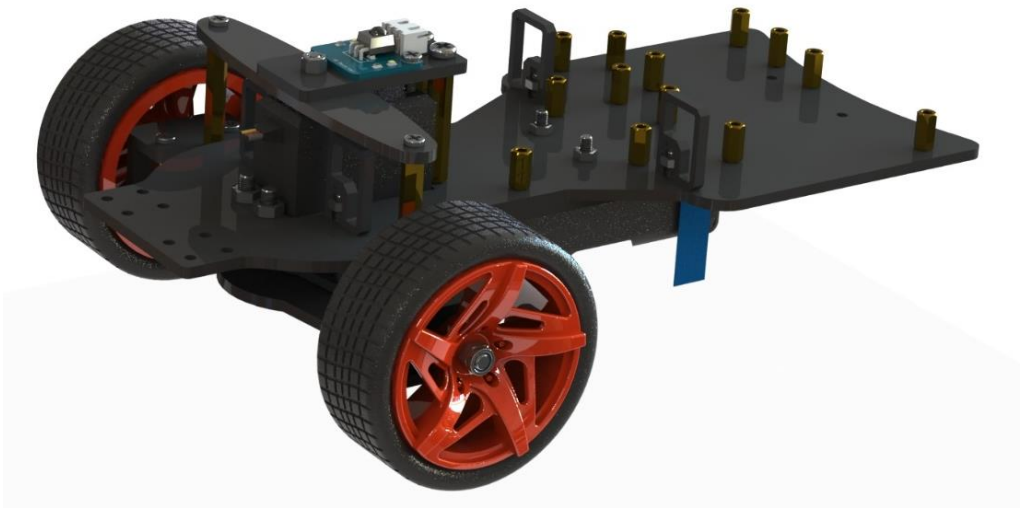
5) After uploading the code successfully, you can hear a sound of the gear moving when the servo rotates. It means the adjustment succeeds. DO NOT plug out the servo wire yet. Keep it power on, and let's move on to the next step.

Chassis + Deflecting Plate

1. Keep the servo power on, fasten the following acrylic plates with **M3*8 screws** and servo screw packaged with the servo among the shorter ones in black.

Note: The central vertical lines of the Chassis and Deflecting Plate should be perpendicular, otherwise the front wheel will not be able to go straight as you control. If it's not well assembled, you should reinsert instead of rotating the servo shaft to adjust, since the servo has been calibrated to 90 degrees. If there is just a little deviation from the right position of the rocker arm, it can be fine tuned by code.

2. After assembly, it is as shown below:

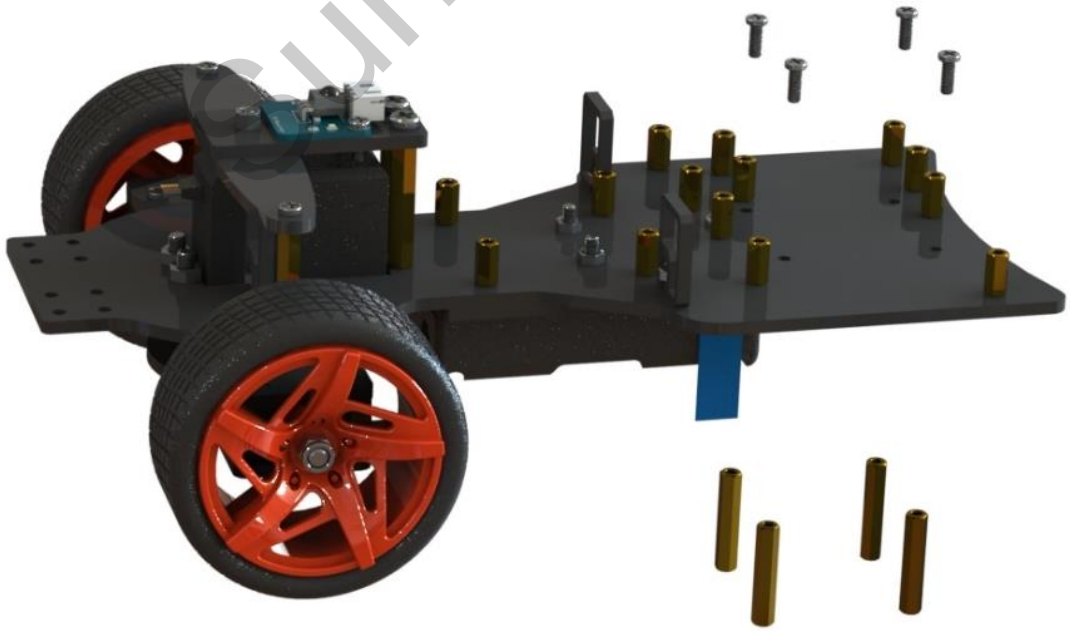


3. The bottom view:

Now, you can remove the servo wires.

Chassis + Driven Wheels

1. Fasten the Driven Wheels with **M3*8 screws** and **M3*25 copper standoffs**.



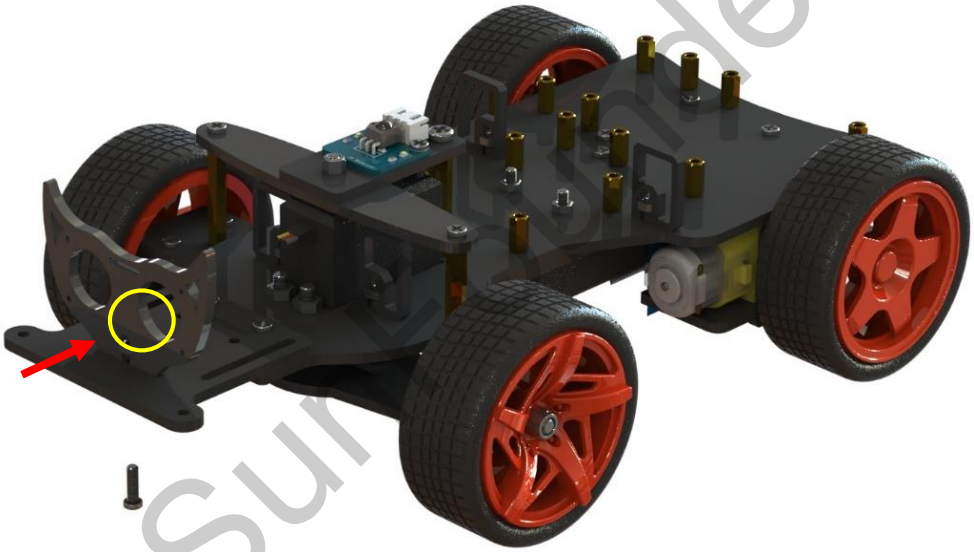
2. Fasten the Driven wheels and Chassis with **M3*8 screws.**

3. After assembly, it is as shown below:

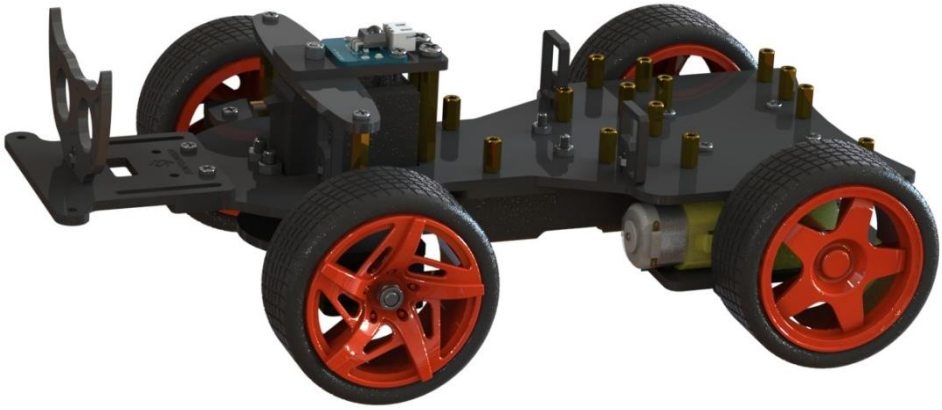
4. Mount the following acrylic plate on the car with **M3*10 screws** and **M3 nuts**.

5. After assembly, it is as shown below:

6. Then assemble the ultrasonic fixing plate to the car with an **M3*10 screw** and **M3 nut.**



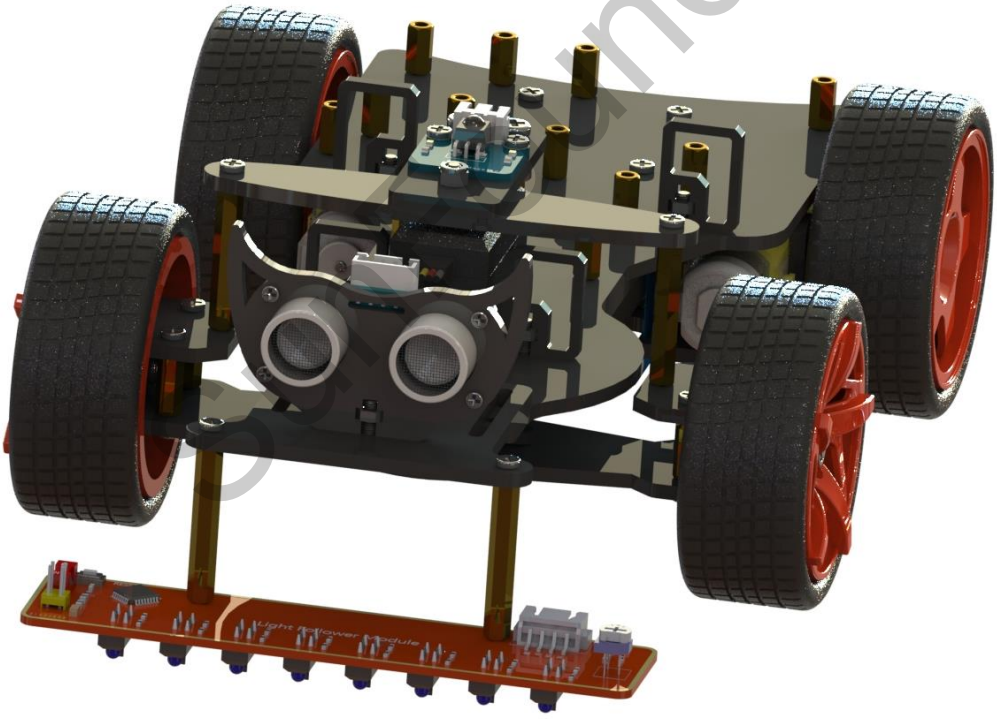
7. After assembly, it is as shown below:



IR Receiver + Ultrasonic + Line Follower

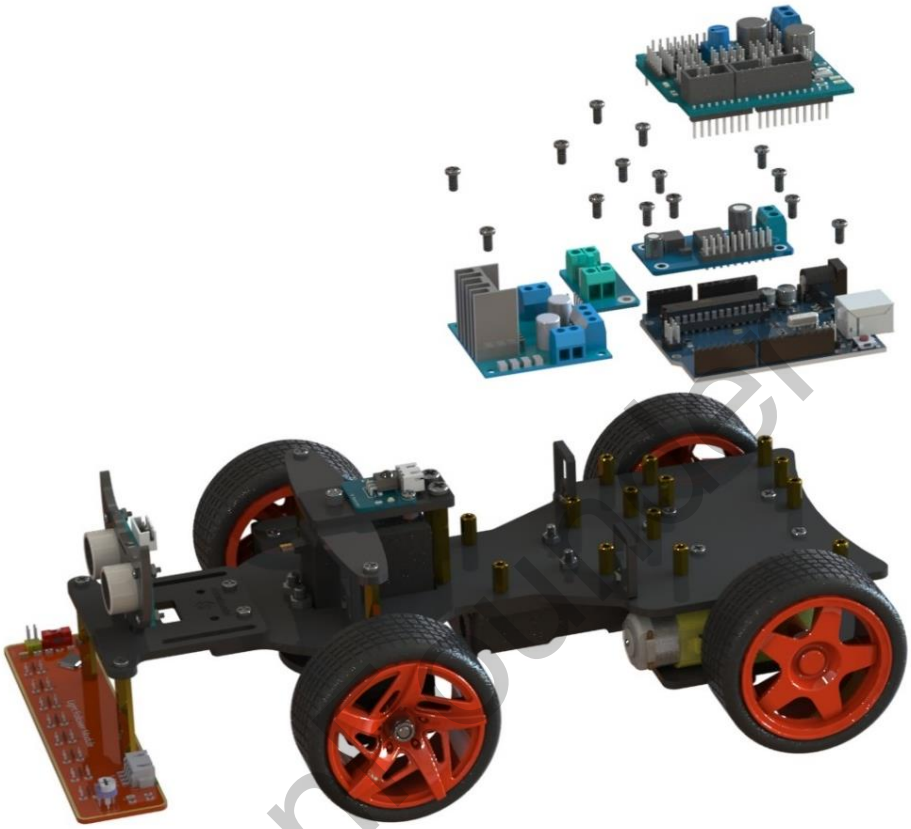
1. The ultrasonic module with **M1.5*8 screws** and **M1.6 nuts**, while the line follower with **M3*8 screws** and **M3*30 copper standoffs**.

2. After assembly, it is as shown below:

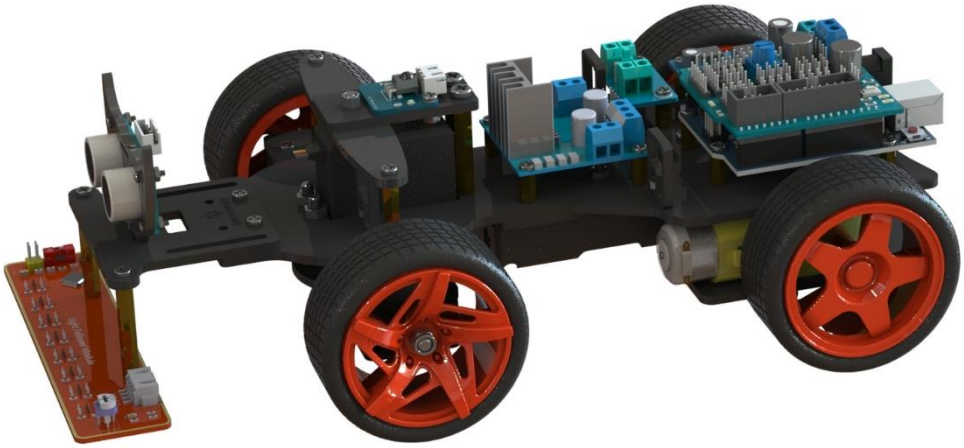


Other PCB Assembly

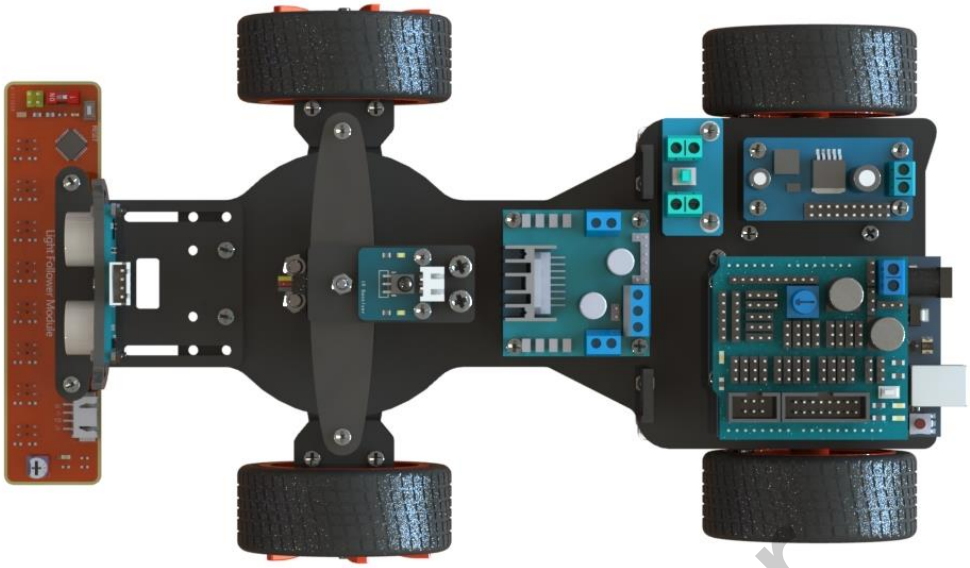
1. Assemble the DC Motor Driver Module, the Switch Module, the Step-down DC-DC Converter Module, and the SunFounder Uno board with **M3*6 screws**, and then plug the sensor shield into the Uno board, as shown below:



2. The assembly should be like this:



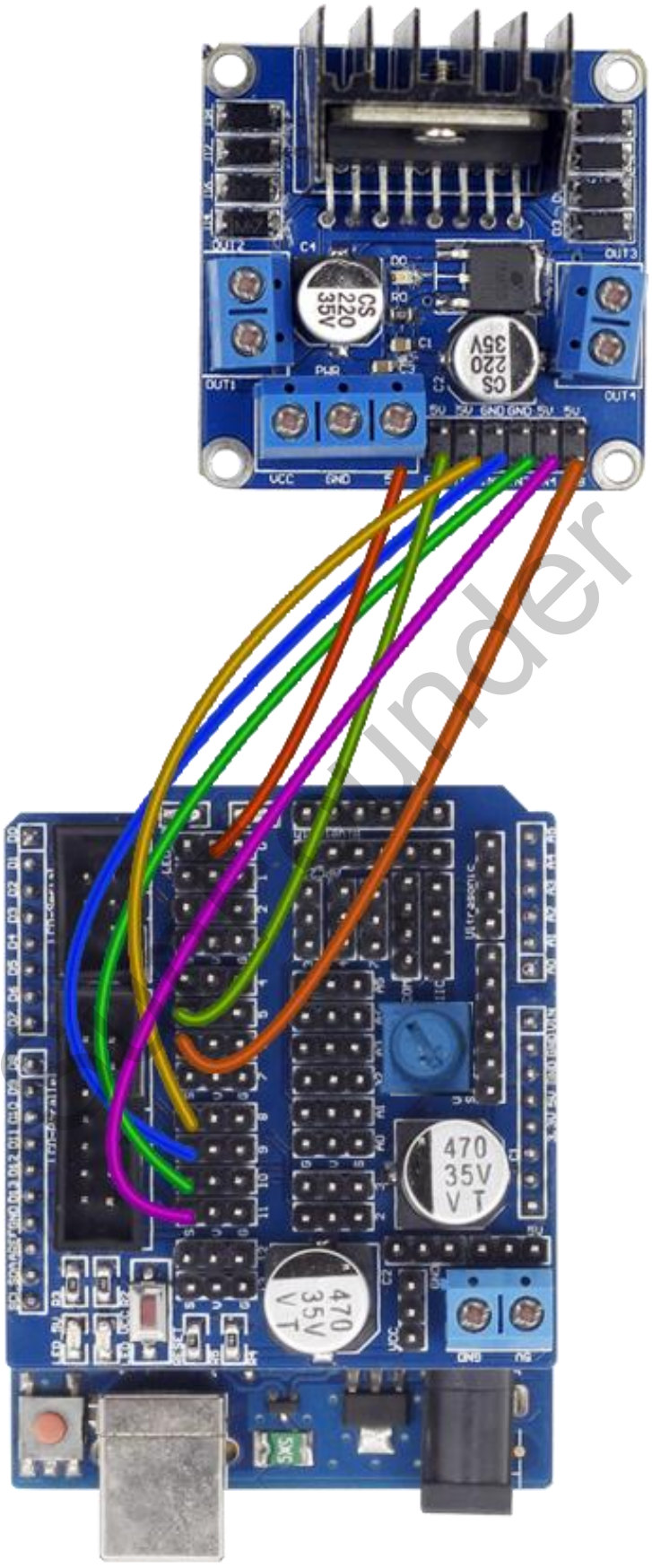
The top view:



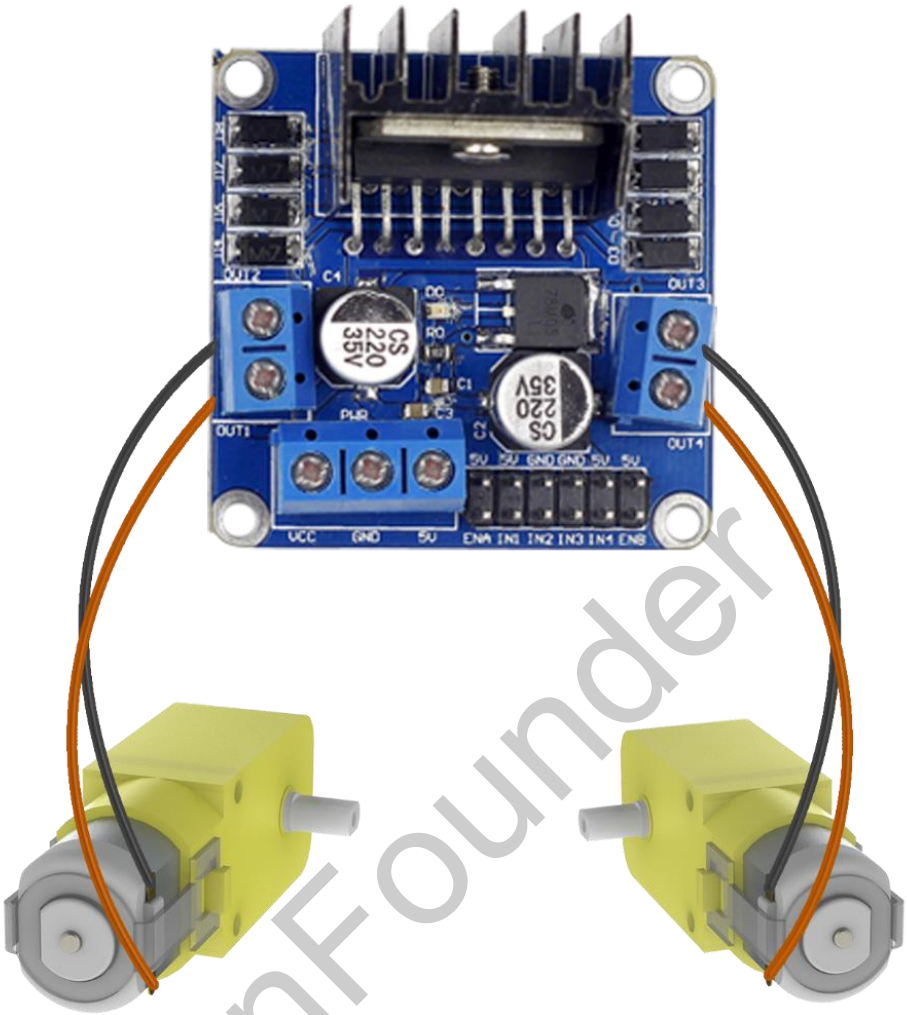
Circuit Building

1) Connect the motor driver module and sensor shield:

Motor Driver Module	Sensor Shield
5V	5V
ENA	5
INT1	8
INT2	9
INT3	10
INT4	11
ENB	6



2) Connect the motor driver module and two motors:

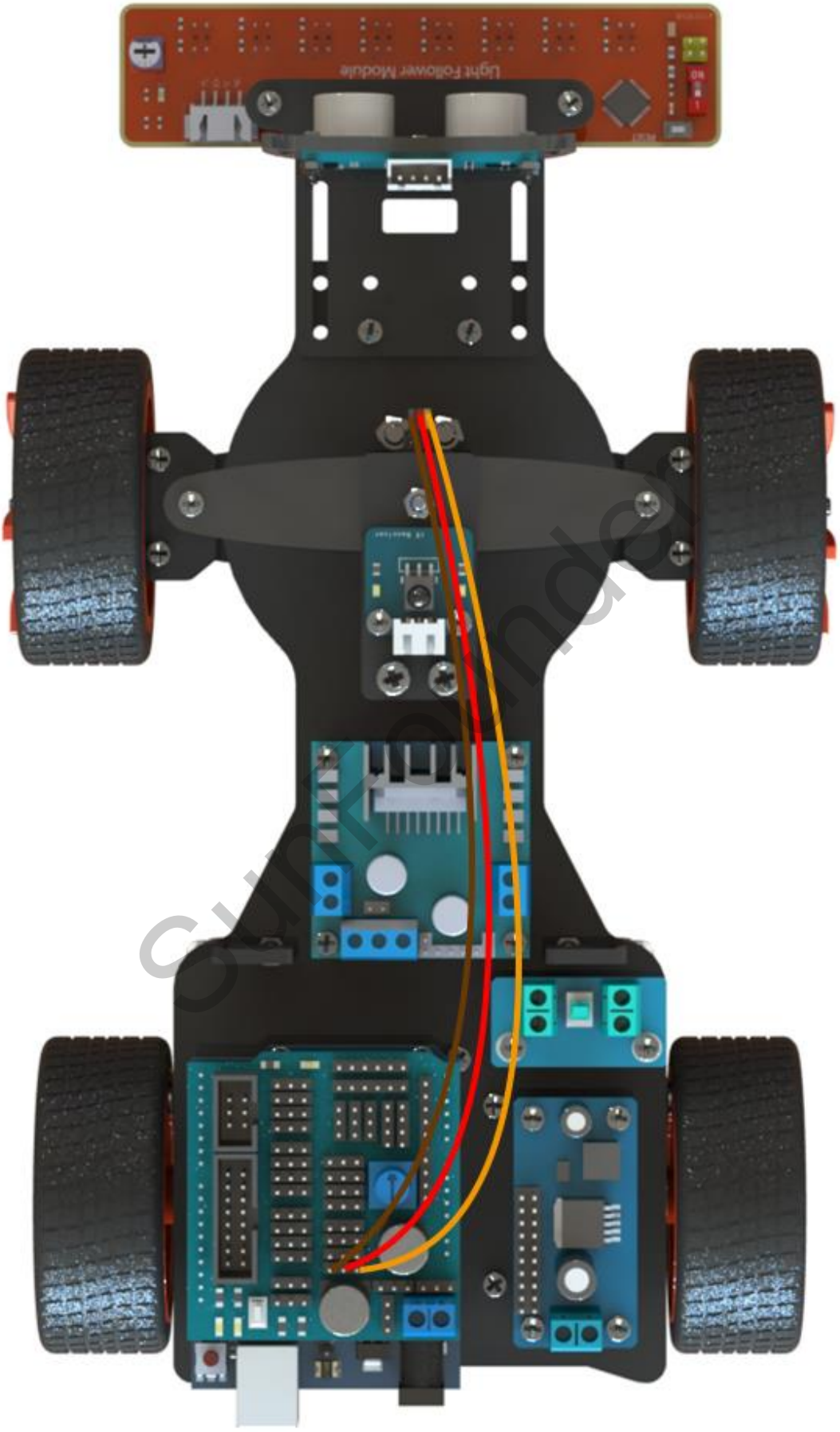


Note:

Please pay attention to that diagram. Each gear motor has two wiring terminals. You should wire them correctly. The wiring will affect the rotational direction of the gear motors. If you do not know how to distinguish, you can try wiring them randomly first. Then burn the code under the path **Smart Car V2.0 for Arduino\Code\ *Car_1_Forward*** to the board to see whether the car moves forward. If it does, you've wired them correctly. If not, you may need to change the wiring until the car moves forward.

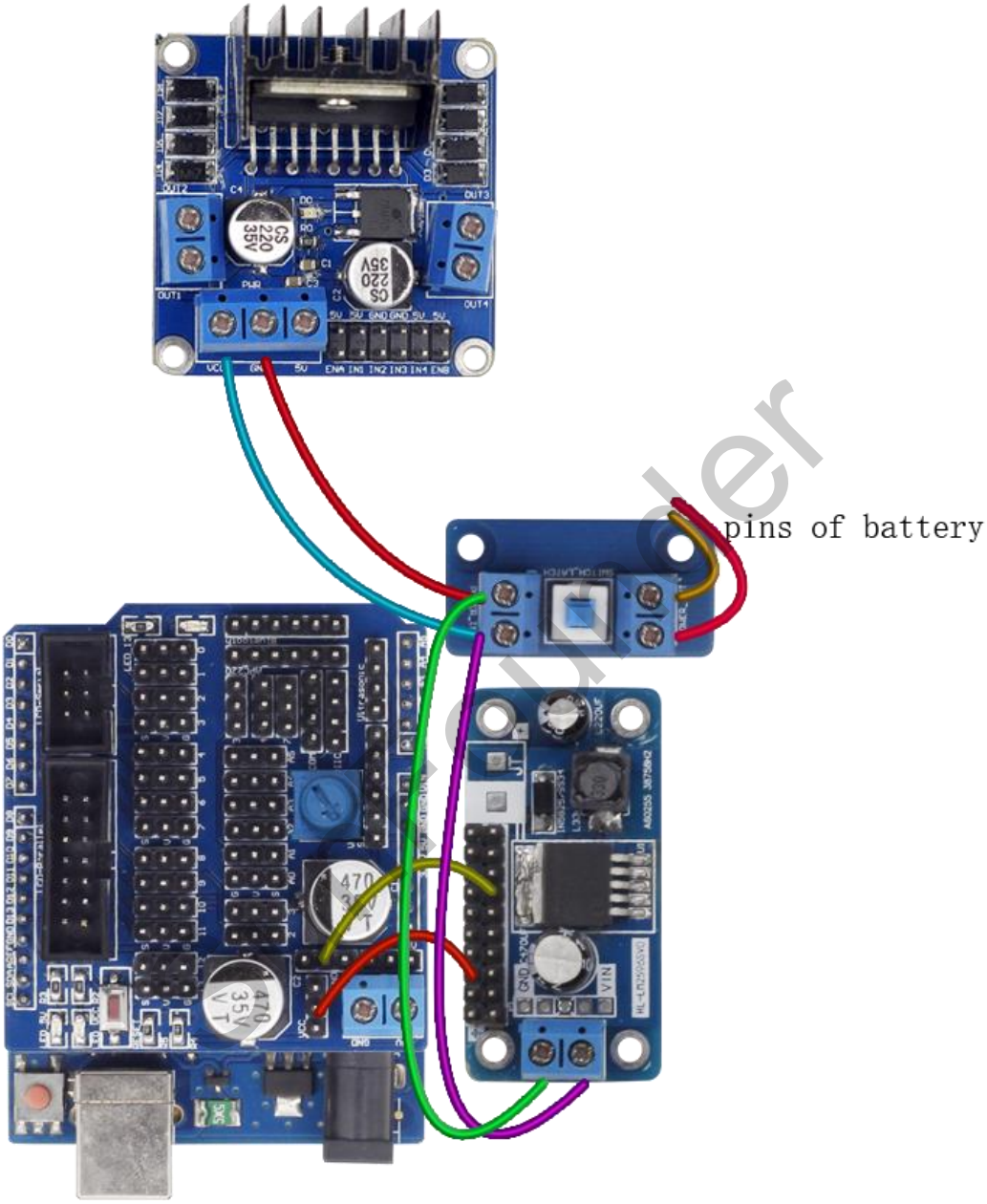
3) Connect the sensor shield and the servo:

Servo	Sensor Shield
+ (Red Wire)	5v
- (Brown Wire)	GND
Signal Output (Orange Wire)	2



4) Connect the step-down DC-DC converter module and switch module:

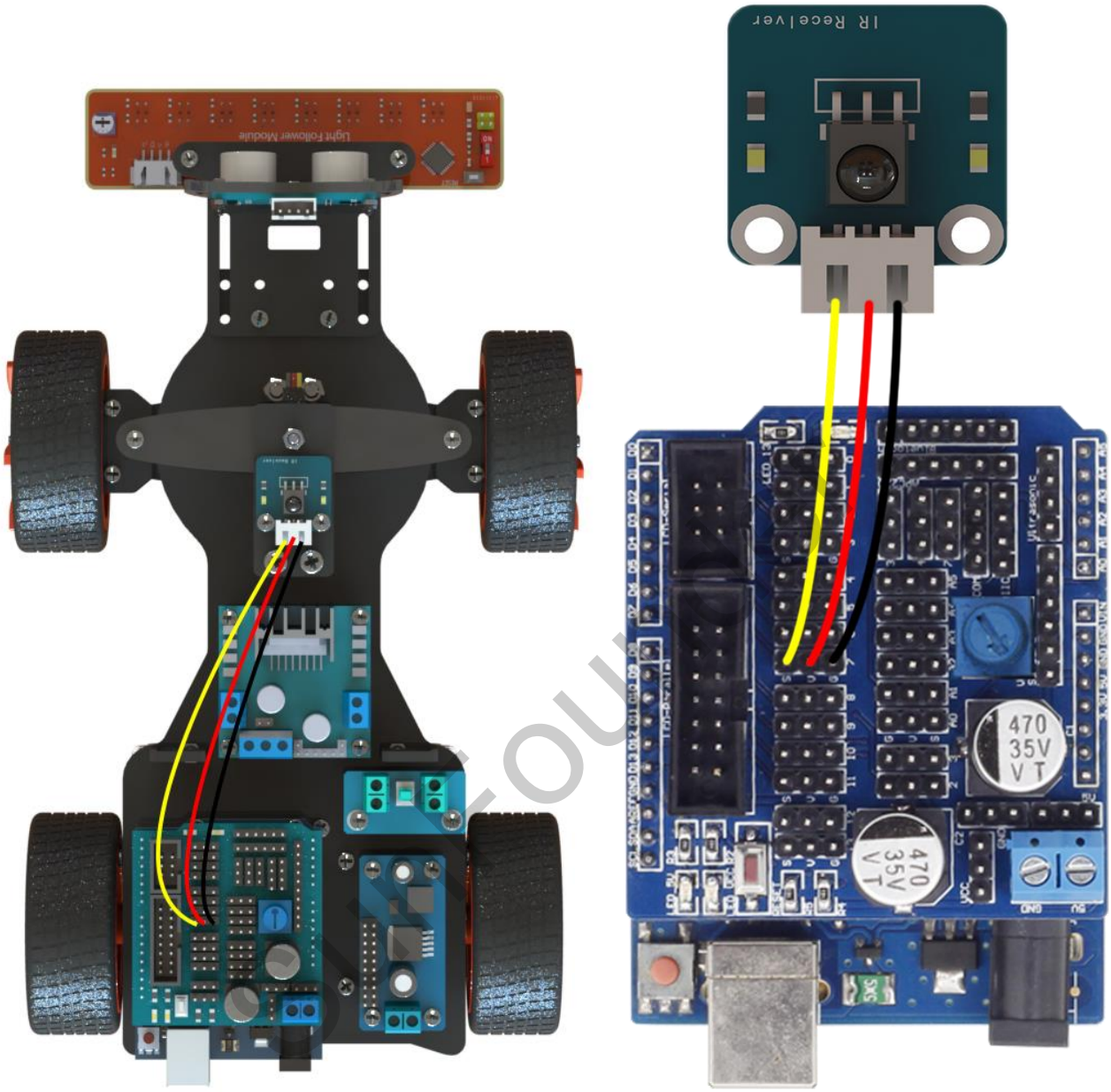
Note: The two pins of the battery holder should not be in contact; otherwise it will cause a short circuit and the battery will be burnt.



5) Connect the IR receiver module and the sensor shield:

IR Receiver Module	Sensor Shield
SIG (yellow)	7
GND (black)	GND
VCC (red)	5V

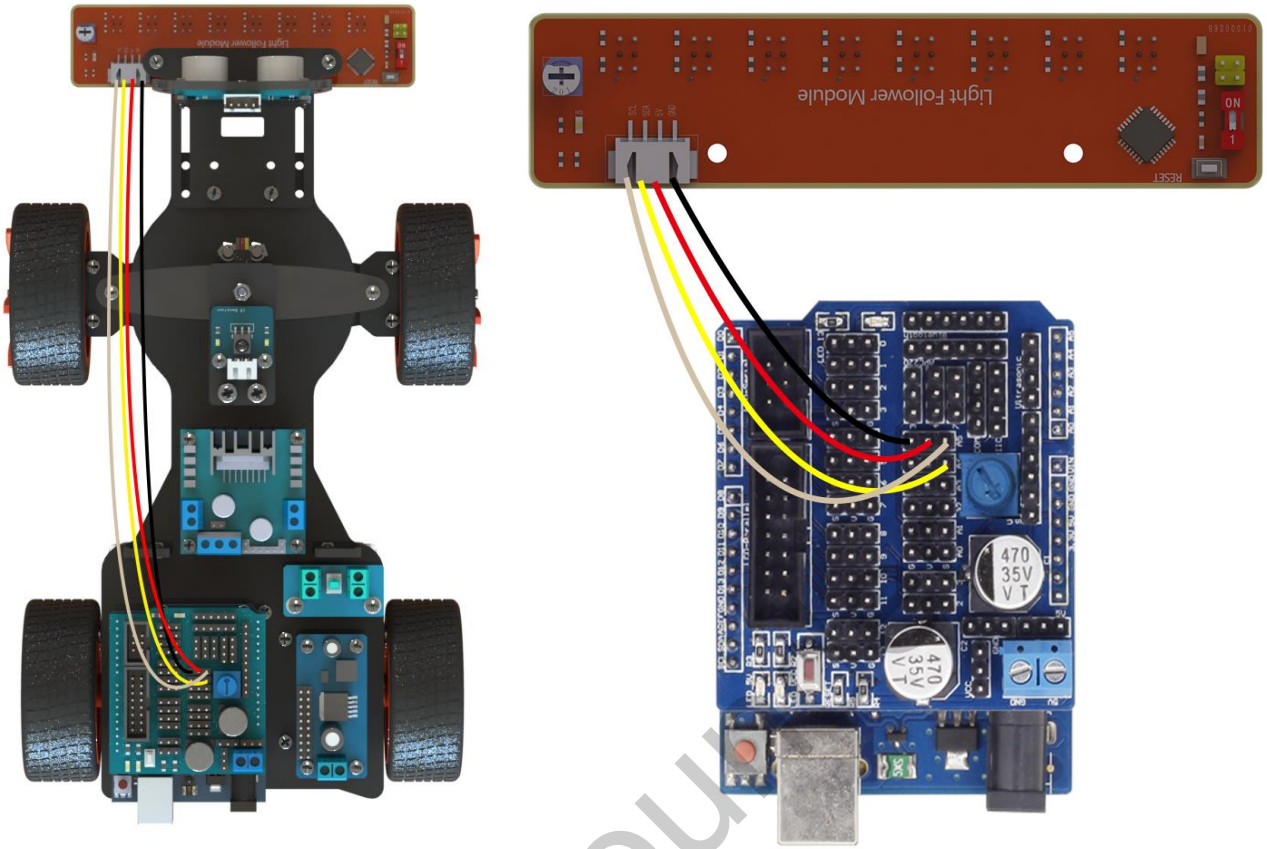
The wiring connection is shown as below:



6) Connect the line follower module and the sensor shield:

Line Follower Module	Sensor Shield
GND (black)	GND
VCC (red)	5V
SDA (yellow)	A4 (SDA)
SCL (white)	A5 (SCL)

The wiring connection is shown as below:



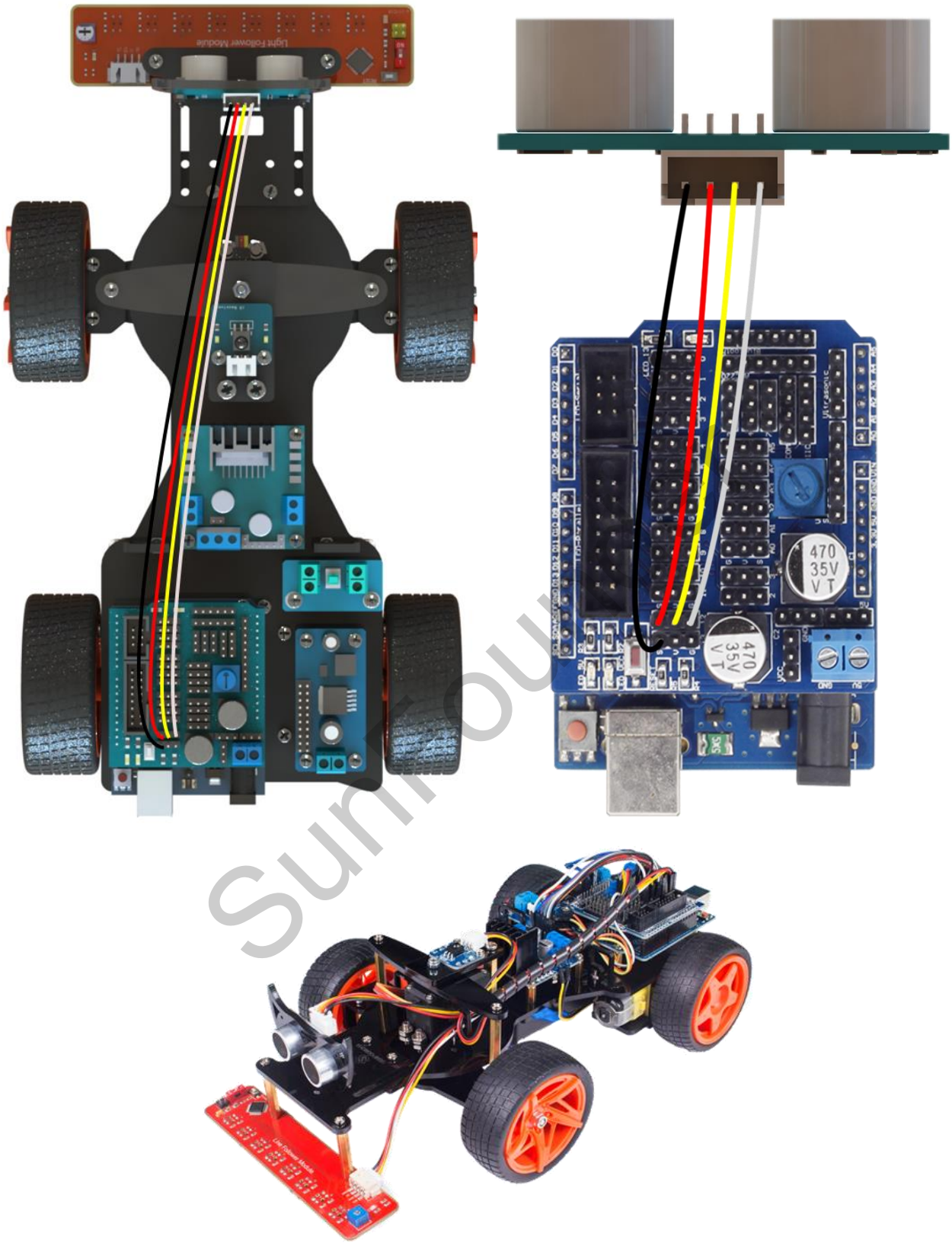
7) Connect the ultrasonic module and the sensor shield:

Ensure it's powered off, insert a 4-pin anti-reverse cable to the ultrasonic module, and connect the pins as follows:

Note: Pay attention to the wires. The anti-reverse cable's **red** and **black** wires do **NOT** connect to the anode and cathode!!!

HC-SR04 Ultrasonic Module	Sensor Shield
GND (white)	GND
VCC (yellow)	5V
ECHO (red)	12
TRIG (black)	13

The wiring connection is shown as below:



After the assembly and circuits are finished, if you feel the wires are too messy, you may wrap them with the heat shrink tubing so the car can look more adorable with neat wiring. Now let's get started!

Experiments

Experiment 1 Going Forward and Backward

In this experiment, the car begins to walk, but it is just the simplest movements: going forward and backward and then stopping. This is the first and most important step for car walking. The subsequent experiments are all based on this experiment.

Experimental Principle

The batteries output 7.2V to the switch module. When you press the button of the switch module, 7.2V will be input to the step-down DC-DC converter module which then outputs 5V after lowering the voltage. 5V is input to the sensor shield to supply for the servo. The MG995 servo at the front is to control the direction the car walks in. In this experiment, the car keeps walking straight forward/backward. The motor driver module is used to drive the two gear motors connected to the rear wheels of the car, which drive the wheels accordingly. Thus, the car begins to walk.

Experimental Phenomena

When you press down the button of the switch module, the car starts to go straight. 2 seconds later, it starts to go backwards and then stops after another 2 seconds. If you press down the button for a second time, the car will start to walk again. If you want to change the time the car walks, you can modify the sketch as you like.

Experiment 2 Turning Right and Left

The principle for this experiment is the same as those for the first experiment. Only a turning function is added.

Experimental Principle

Change the rotational angle by sketch to make the car turn.

Experimental Procedures

Connect the SunFounder Uno board to your computer. Upload the sketch under the path *Smart Car V2.0* for *Arduino\Code\Car_2_Turn*, and then remove the USB cable. Press down the button on the switch module, and the car will start running.

Experimental Phenomena

When you press down the button on the switch module, the car will go forward. 1 second

later, it turns right, and then goes forward for 1 second again. Then it turns left. 1 second later, the car goes forward for 1 second and then goes backward. Two seconds later, it stops.

Experiment 3 IR Remote Control

Experimental Principle

The IR remote control sends data signals, and the IR receiver module receives data signals. When a button is pressed, a corresponding string instruction will be sent out from the remote controller, and the receiver module would send a signal to turn on the corresponding function once it receives the instruction. For example, press 2, and a string will be sent, thus the car will just go forward because the string means to drive the car to do so in the code.

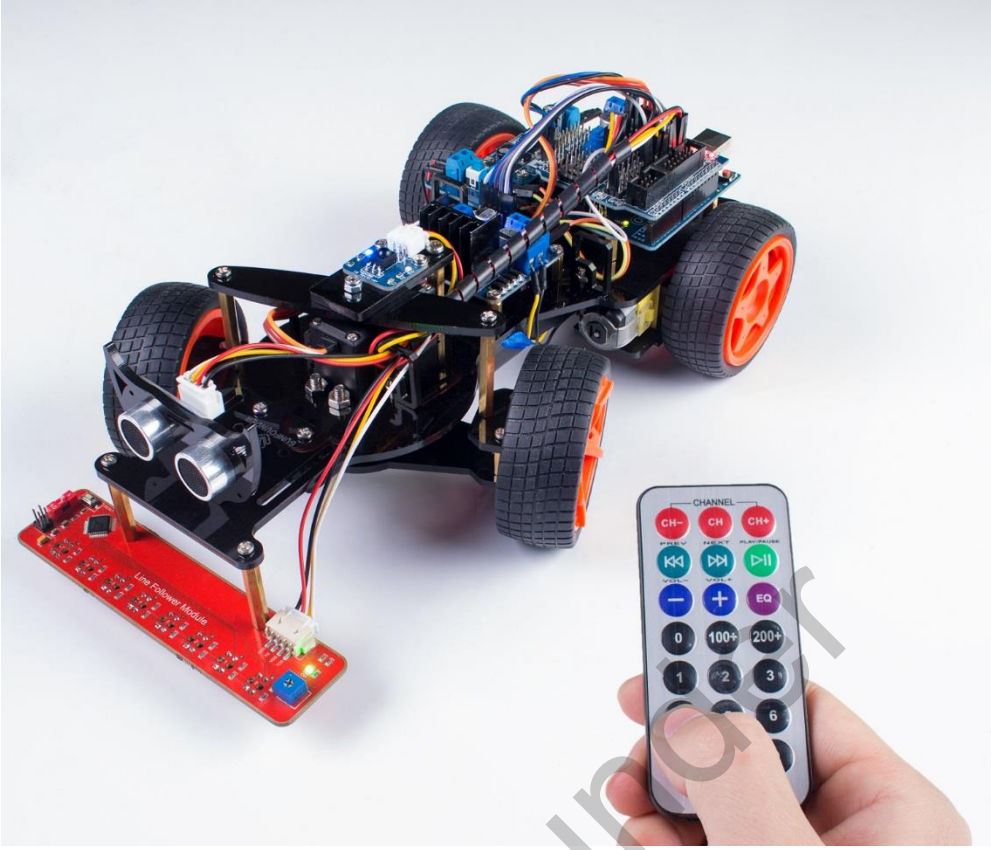
Experimental Procedures

Connect the SunFounder Uno board to your computer via a USB cable. Upload the sketch under the path *Smart Car V2.0 for Arduino\Code\ Car_3_Remote*, and then remove the USB cable. Press the button on the switch module.

Press the buttons below, and the car will act accordingly: (just press, no need to hold)

Press a key of the controller	Arduino Smart Car will
2	Go forward
8	Go backward
4	Turn left
6	Turn Right
5	Stop

Experimental Phenomena



Experiment 4 Line Following

Experimental Principle

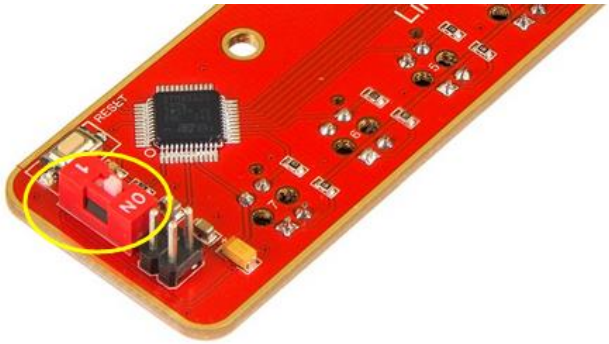
The line follower module is an 8-channel IR sensor one. It will send different signals when it detects the black line and white surfaces. When a certain sensor detects a black line, the corresponding signal will be generated and then passed to the car, thus the car would turn its direction accordingly to follow the line by servo rotation.

Experimental Procedures

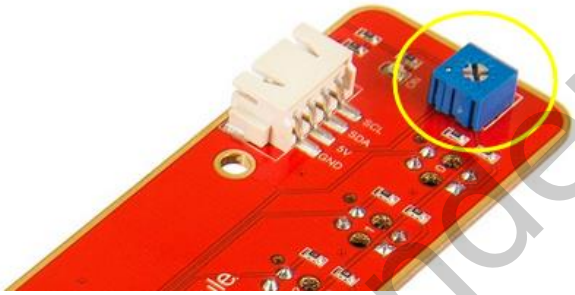
Connect the SunFounder Uno board to your computer. Upload the sketch under the path *Smart Car V2.0 for Arduino\Code\Car_4_LineFollowing*, and then remove the USB cable. Pressed the button on the switch module.

Notes:

1. If the surrounding is too dark, you can turn on the LED built in the module as shown below (no need to turn on normally).

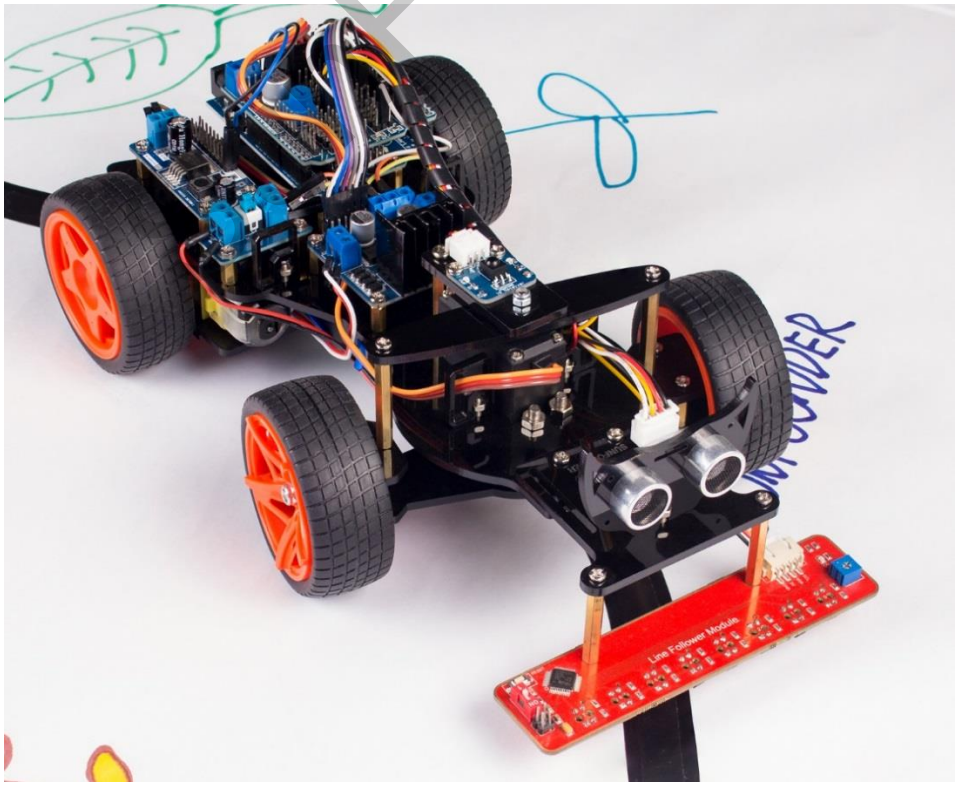


2. If the front wheels do not turn when you place the car above the black lines, but it does when the module is tilt closer to the line, in other words there signal of black line detection is too weak, just adjust the potentiometer below to try. Normally you don't need to adjust.



Now draw a black line on a large white board, start the car and it will go following the line.

It will stop when no black line is detected, so for better performance you can draw a closed path like a number 8-shaped route or a circle.



Experiment 5 Hand Tracking

Experimental Principle

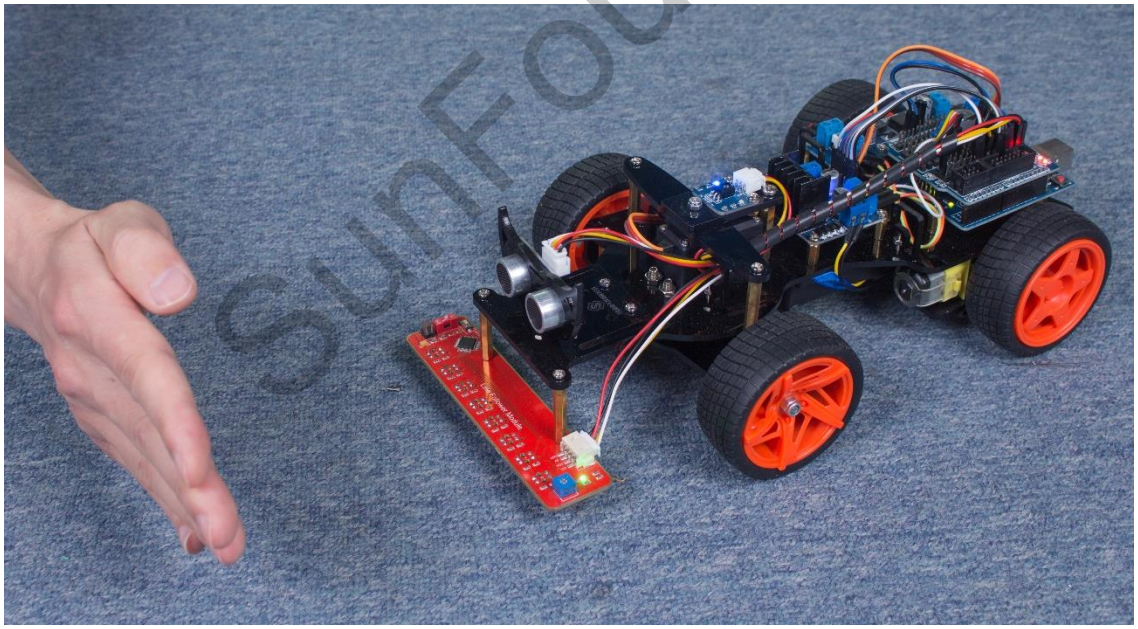
The principle of this experiment is based on ultrasonic distance measurement. The car receives the distance data from the ultrasonic module, and then the program will drive the car to take actions according to the code for different distance ranges.

Experimental Procedures

Connect the SunFounder Uno board to your computer with a USB data cable. Upload the corresponding sketch under path *Smart Car V2.0 for Arduino\Code\ Car_5_HandTracking*, and then remove the USB cable.

Experimental Phenomena

Turn on the car, keep your hand moving 0 to 10cm in its front, and then the car will move accordingly: looks like you push it, it runs backward when your palm approaches; when your hand is 10 to 25cm ahead, move back from the car and it will move forward. When you take the hand away, it will stop. **Note**: The car can only move forward or backward, and cannot turn directions in this experiment.



Experiment 6 Obstacle Avoidance

The wiring for this experiment is based on Experiment 5, so after the last experiment, just turn it off. Connect the SunFounder Uno board to your computer with a USB data cable. Upload

the sketch under *Smart Car V2.0 for Arduino\Code\Car_6_AvoidObstacle*, and then remove the USB cable.

Experimental Principle

The principle of this experiment is similar to that of experiment 5, and the difference is when it detects an obstacle 30cm ahead, it will turn right to avoid.

Note: DO NOT increase the car's speed too much, in case that the sensor in the front may be damaged due to great inertial effect upon stop. Besides, the ultrasonic can only detects the obstacle in front of the car, that is, the car will turn right every time it detects an obstacle 30cm in front.

Experimental Phenomena

Turn on the switch. When the car detects an obstacle in front (within 30cm), it will turn right to avoid it; when there is no obstacle ahead, it will just move forward.

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