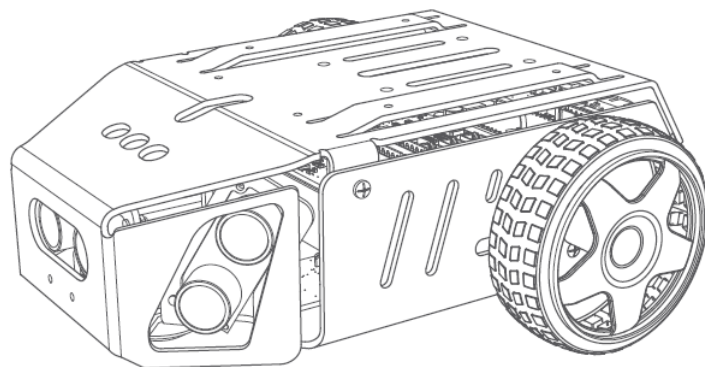


CoSpaceRobot

CoSpace Autonomous Driving 2021

Real Robot User Guide



VRBot-D1

Contents

1. Robot Structure	2
1.1 Controller Board.....	2
1.2 Interface Description	2
1.3 Buttons	3
1.4 LED Indicators	4
1.5 Sensors and Motors	5
1.6 Batteries	6
2. Work With VRBot-D1.....	6
2.1 Equipment and software.....	6
2.2 Robot Version.....	7
2.3 Insert Batteries.....	7
2.4 IR Sensors Calibration	8
2.5 Program the VRBot-D1	9
2.6 Connect with VRBOT-D1	11
2.7 Upload AI to the Real Robot VRBot-D1.....	11
2.8 Real Robot Run	13
2.9 VRBot-D1 Live Sensors' Feedback.....	14
Appendix 1: VRBot-D1 Specifications.....	16
Appendix 2: VRBot-D1 Control Board Layout.....	17
Appendix 3: Black Line Tracking Program	17

1. Robot Structure

1.1 Controller Board

VRBot-D1 control board is Arduino compatible. It has the similar capacity as the Arduino Mega2560. The VRBot-D1 control board has integrated with motor drive, geomagnetic sensor, light sensor, button module, LED module, infrared tracking port, ultrasonic sensor port, USB, Xbee, bluetooth, serial port and so on. The VRBot-D1 control board is also equipped with two expansion ports for the additional components such as external LEDs.

Refer to appendix for the VRBot-D1 control board Layout.

1.2 Interface Description

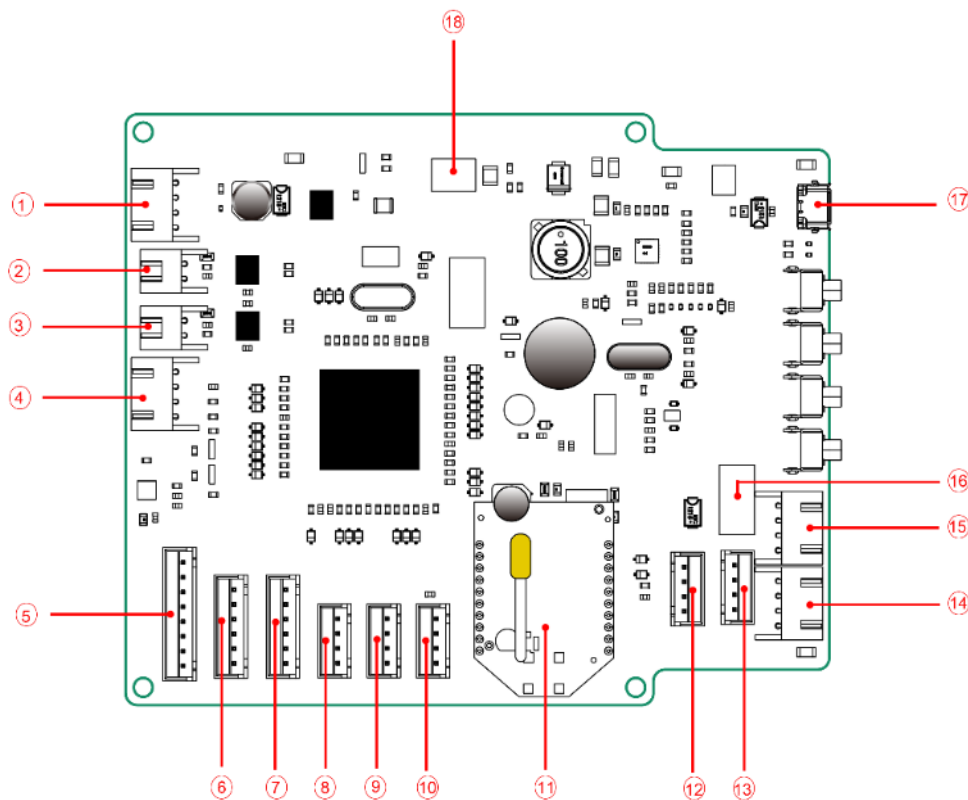


Fig. 1 – 1: VRBot-D1 control board interface

No.	Description
1	Encoder interface, connect to the right motor on the VRBot-D1 chassis
2	Motor interface, connect to the right motor on the VRBot-D1 chassis
3	Motor interface, connect to the left motor on the VRBot-D1 chassis
4	Encoder interface, connect to the left motor on the VRBot-D1 chassis
5	Infrared sensor interface, connect to VRBot-D1 infrared tracking sensor
6	Color sensor interface, connect to the right color sensor on the VRBot-D1 chassis
7	The left color sensor interface, connect to the left color sensor on the VRBot-D1 chassis
8	Ultrasonic sensor interface, connect to the ultrasonic sensor on the right side of VRBot-D1
9	Ultrasonic sensor interface, connect to the ultrasonic sensor on the front of VRBot-D1
10	Ultrasonic sensor interface, connect to the ultrasonic sensor on the left side of VRBot-D1
11	Xbee interface,
12	Reserved servo interface
13	Bluetooth interface, which is UART interface.
14	Reserved servo interface
15	Reserved serial interface, which is UART interface
16	Wifi interface, which is UART interface
17	USB interface, which is standard Micro-USB interface
18	Power interface, connected to battery on the VRBot-D1 chassis

1.3 Buttons

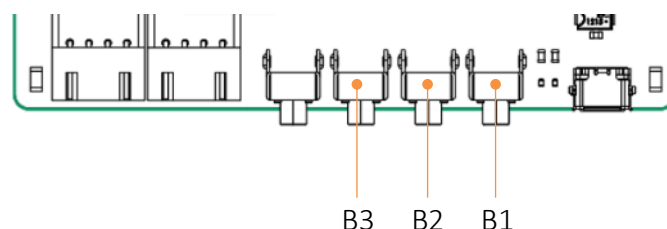


Fig. 1-2: Buttons

No.	Description
B1	Toggle button, for start or stop VRBot-D1 When you need to stop VRBot-D1, you need to press and hold this button for about 3 seconds.
B2	Press this button to activate the sensors on and run the program.
B3	Press this button to pause the robot movement.

1.4 LED Indicators

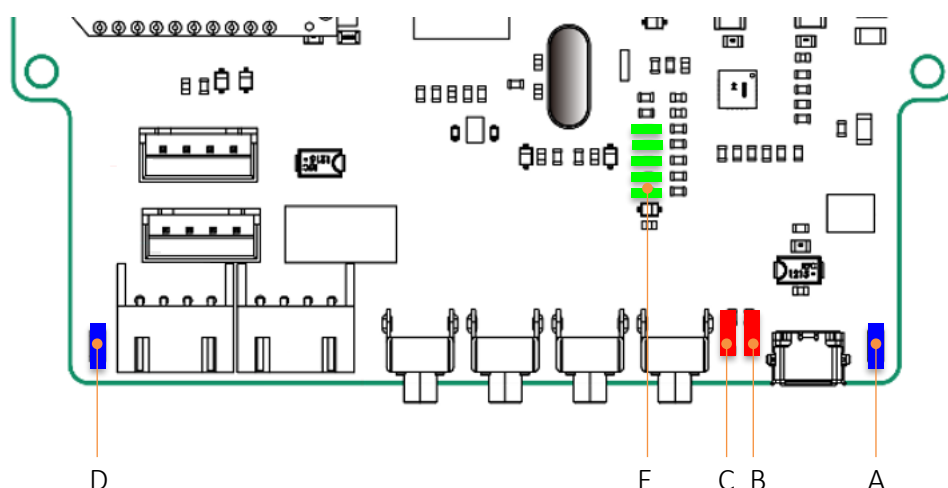


Fig. 1-3: LEDs

No.	Colour	Description
A	Blue	<ul style="list-style-type: none"> ON – power on OFF – power off
B	Red	<ul style="list-style-type: none"> ON – VRBot-D1 is charging OFF – VRBot-D1 is not charging
C	Red	<ul style="list-style-type: none"> ON – VRBot-D1 battery voltage is low OFF – VRBot-D1 battery voltage is normal.
D	Blue	This is a programable LED. User can program this LED in CoSpace Autonomous Driving Simulator. Variable name: LED_1.
E	Green	<ul style="list-style-type: none"> 5 LEDs are used to indicate VRBot-D1 battery status. For example, 3 LEDs are lit up means that the battery remaining is above 60%.

1.5 Sensors and Motors

The VRBot-D1 Robot consists of:

- 6 Infrared sensors
- 3 Ultrasonic sensors
- 2 RGB Colour sensors
- 1 Gyro sensor
- 1 LED (Extendable)
- 2 DC motors

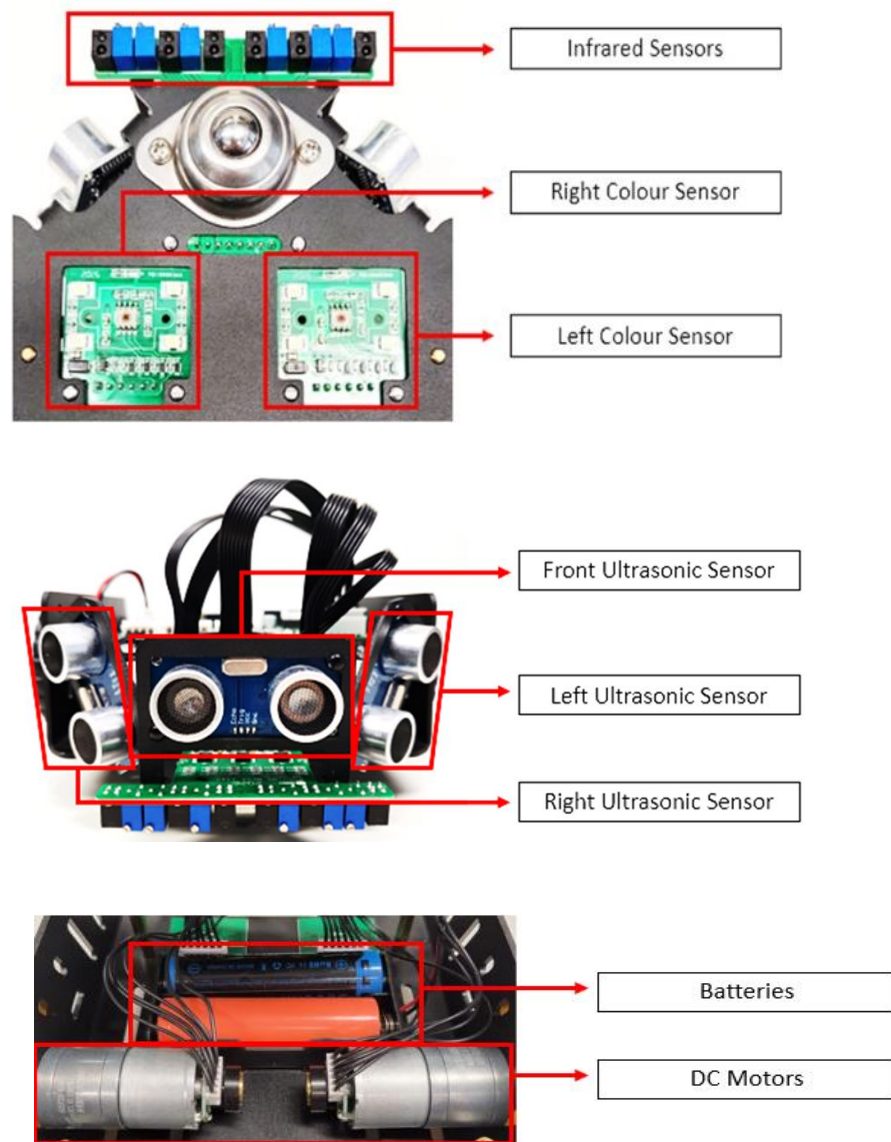


Fig. 1-4: Sensors and Actuators

In the CoSpace Autonomous Driving, only 6 Infrared sensors, front ultrasonic sensor, right RGB colour sensor, a gyro sensor, two DC motors, and one LED indicator are used.

1.6 Batteries

Only Li-ion rechargeable battery 18650 type (Voltage: 3.7v) is supported.



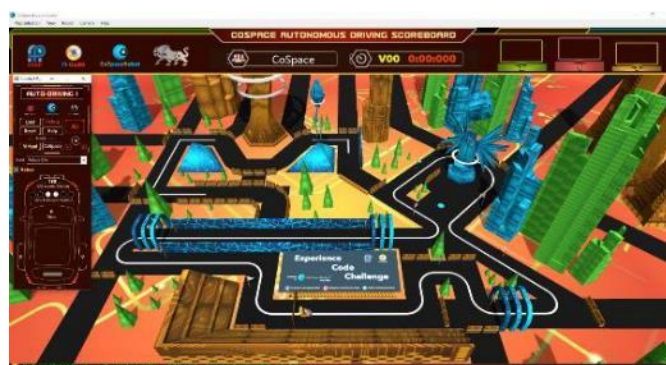
Fig. 1-5: Batteries

2. Work With VRBot-D1

2.1 Equipment and software

You need to have the following ready in order to work with real robot VRBot-D1.

- 1) VRBot-D1 with front ultrasonic sensor and 6 IR sensors, and left RGB sensor connected
- 2) A micro-USB cable
- 3) A screwdriver
- 4) CoSpace Autonomous Driving simulator



2.2 Robot Version

Make sure you are having VRBot-D1 2021 version.



Fig. 2-2: VRBot-D1 2021

2.3 Insert Batteries

- 1) Only the Li-ion rechargeable battery of 18650 type (3.7 volts) is supported. Please do not use different type of batteries for replacement.
- 2) Insert 2 Li-ion rechargeable batteries (type 18650, 3.7 volts) into the VRBot-D1. When placing the batteries in the battery holder, please make sure that the polarity must be correct.
- 3) Connect the 2 pin molex connector of the batteries to the power supply socket on the control board.

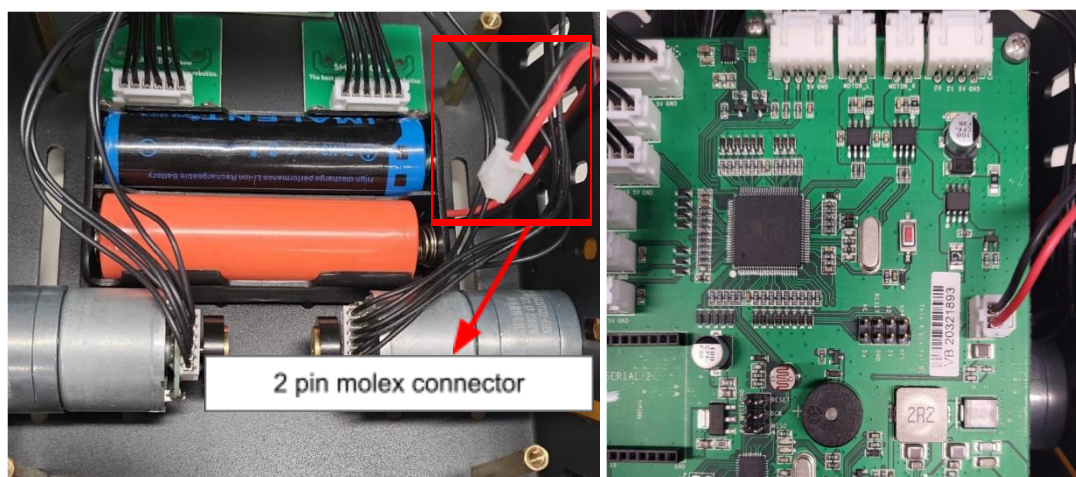


Fig 2-3: VRBot-D1 Battery

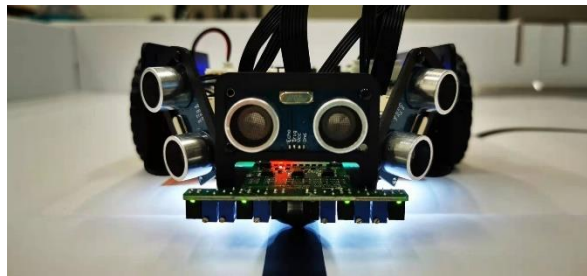
2.4 IR Sensors Calibration

- 1) Place the VRBOT-D1 on a black line. Switch on the power.



Fig 2-4: Place the robot on a black line

- 2) Move the VRBOT-Q1 slowly to the left and right of the black line and monitor each IR sensor.
 - When IR is on the black line, IR sensor should be OFF.
 - When IR is on the white line, IR sensor should be ON.



- 3) If the IR does not follow the pattern as stated, make necessary adjustment on each potential meter next to the respective IR sensor until it appears correct.

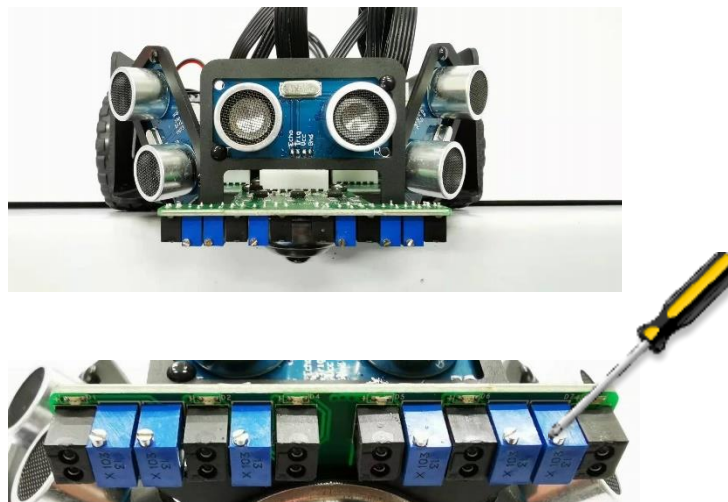


Fig 2-5: IR sensor calibration

2.5 Program the VRBot-D1

- 1) Launch the CoSpace Autonomous Driving Simulator – FirstSteps
- 2) Choose any virtual environment. We use the “Future City” for illustration.



Fig 2-6: Future City

- 3) Click on “AI” button to launch AI panel

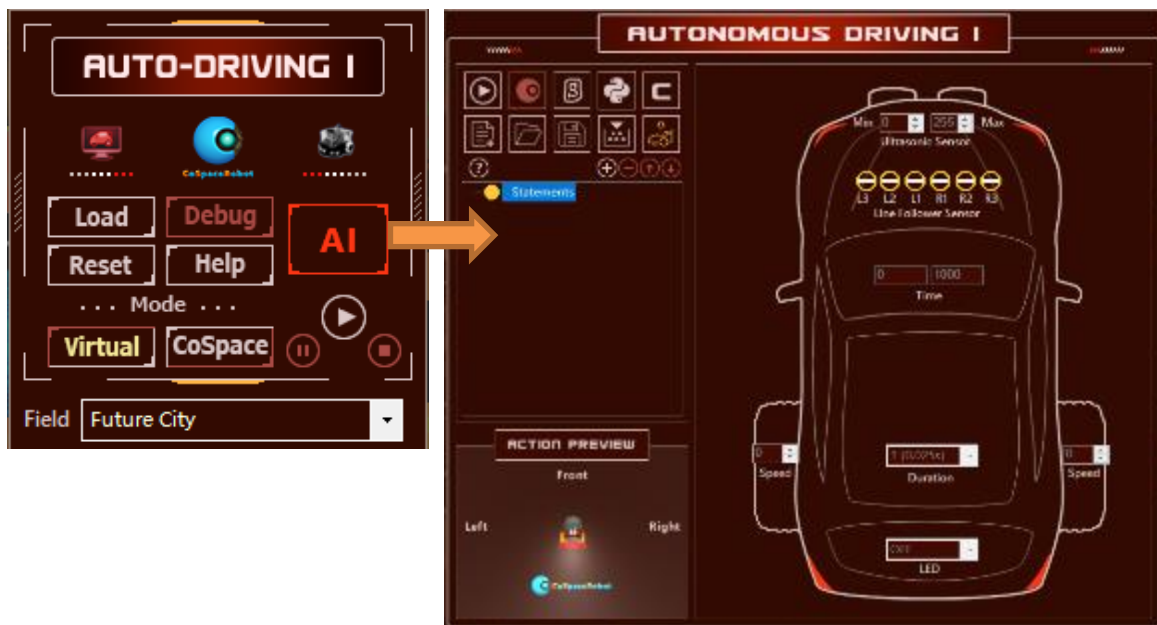


Fig. 2-7: Opening the AI program panel

- 4) Creates a new project with the following:
 - Team ID : CS0001
 - Team Name: Team CoSpace
 - Project Name: VRBot-1

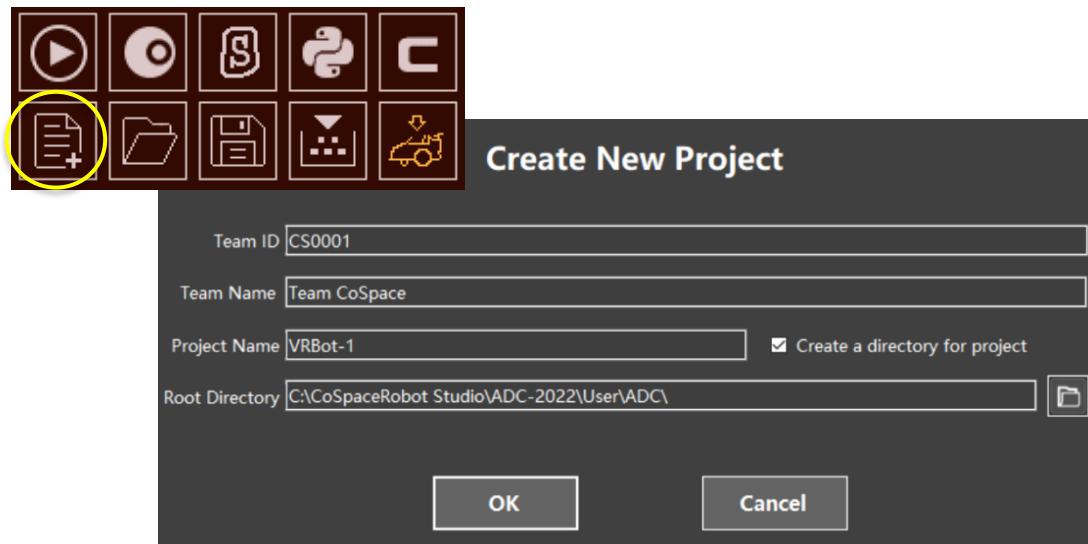


Fig. 2-8: Create a new project

5) Write a line following program

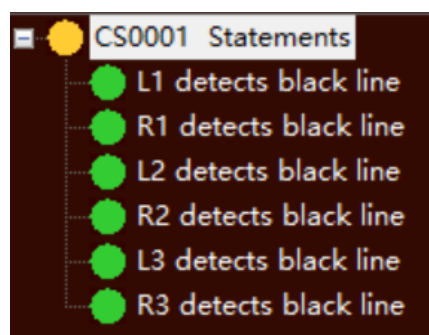



Fig. 8-2: Create a new project

Refer to Appendix 3 to detailed statement

6) Click on  to Save and build the program. Make sure the building process is correct.

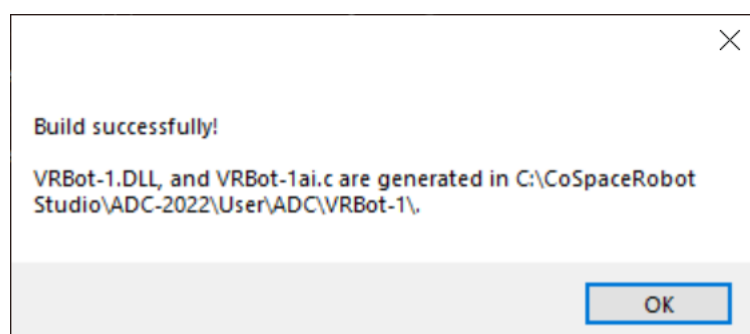


Fig 2-9: Build successfully

2.6 Connect with VRBOT-D1

Connect the VRBot-D1 with laptop using the mico-USB cable. If this is the first time linking the VRBot-D1 with your laptop, please make sure the laptop is connected with internet.

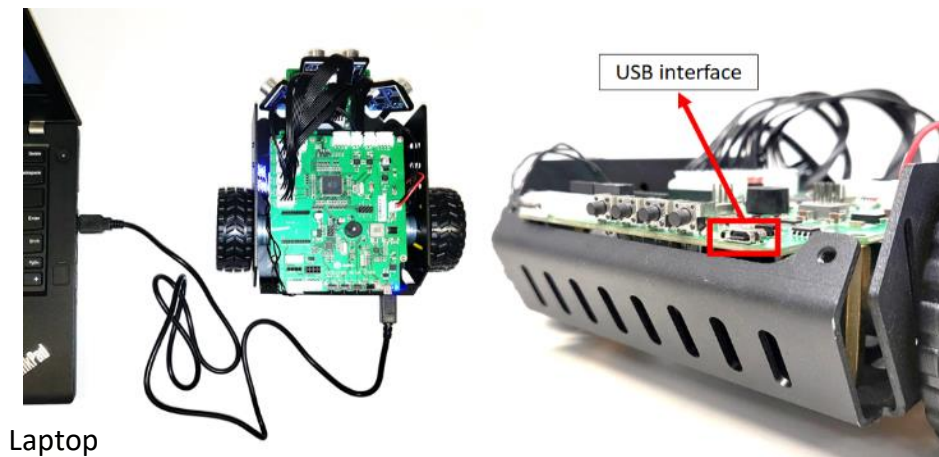


Fig 2-10: Link with real robot VRBot-D1

Since the laptop is connected to laptop via USB, you do not need to turn on the robot power.

2.7 Upload AI to the Real Robot VRBot-D1

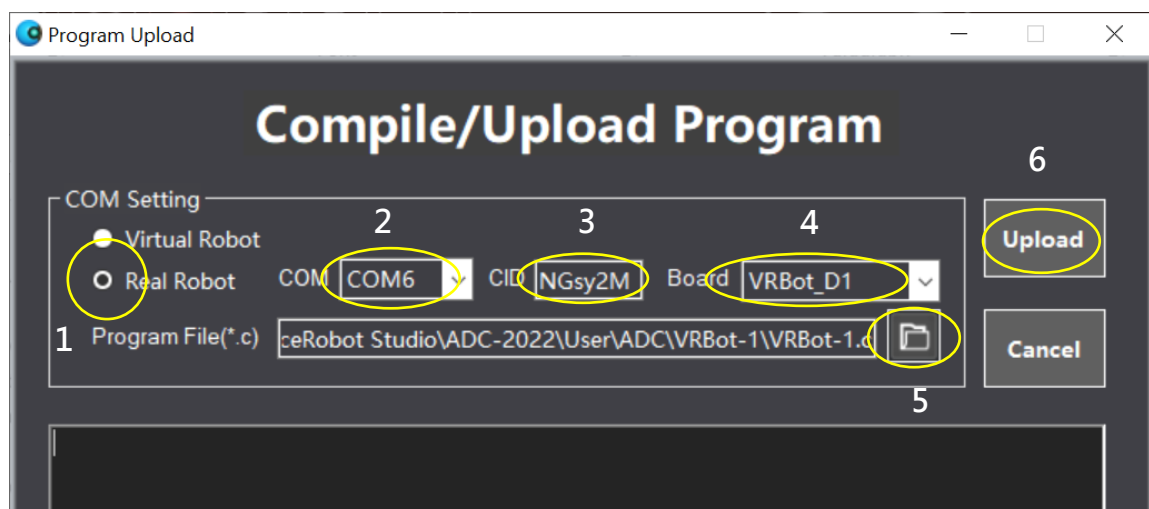
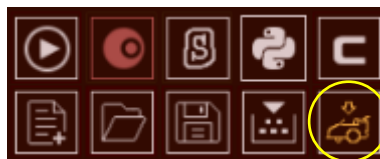



Fig 2-11: Upload the code to a real robot

1. Click on Real Robot radio button;
2. Confirm the communication port
3. Product ID is shown
4. VRBot-D1 is selected
5. If you have external C code to be loaded to the real robot, click on  to select. Otherwise, just use the default.
6. Click on upload button.

Once the program is successfully uploaded, the VRBot-D1 will output a “Beep” sound. The “uploading” process may take about 1 minute.

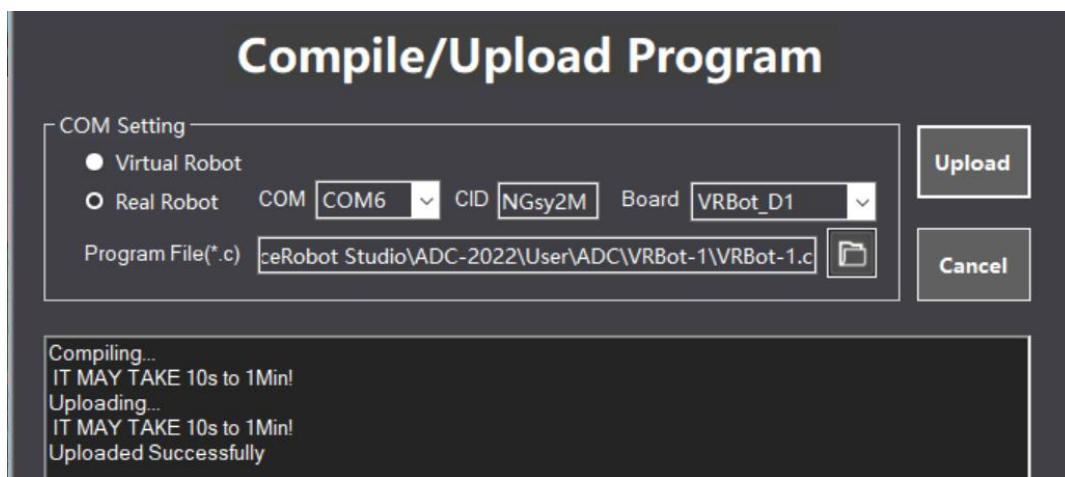
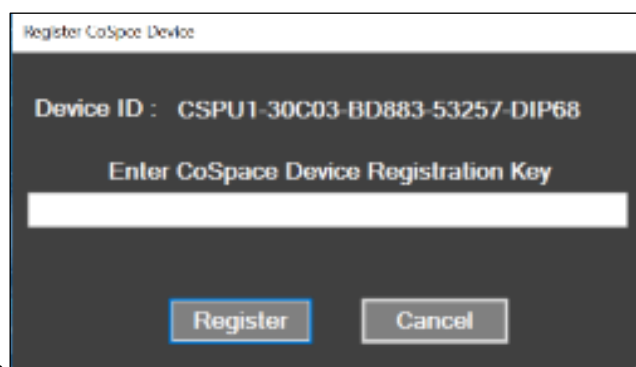


Fig 2-12: Upload the code to a real robot

Upon the successful uploading, you can place the real robot on the black line and monitor the robot performance.

- If the VRBOT-D1 cannot be connected successfully, it could be due to the Arduino Driver issue. Hence, you need to install the Arduino Driver (www.arduino.org.cn/downloads) .

If following window will appear, please connect your laptop to internet and give a try. If problem persists, contact support@cospacerobot.org for this case.

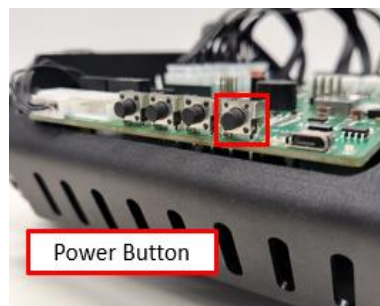


2.8 Real Robot Run

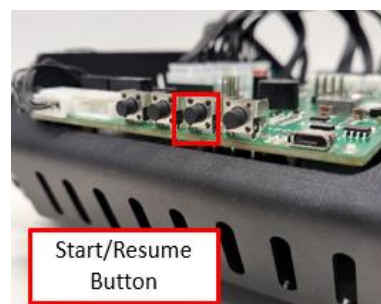
- 1) Detach the VRBot-D1 from USB.
- 2) Place the VRBot-D1 on a black line



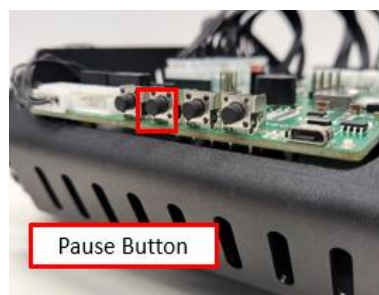
- 3) Press button "B1" to turn on VRBot-D1



- 4) Press button "B2" to start



- 5) Monitor the robot's performance. You can also pause robot motion if necessary.



2.9 VRBot-D1 Live Sensors' Feedback

The live sensors' feedback can be monitored from the Auto-driving control panel.

- 1) Connect the VRBot-D1 with laptop using the micro-USB cable.

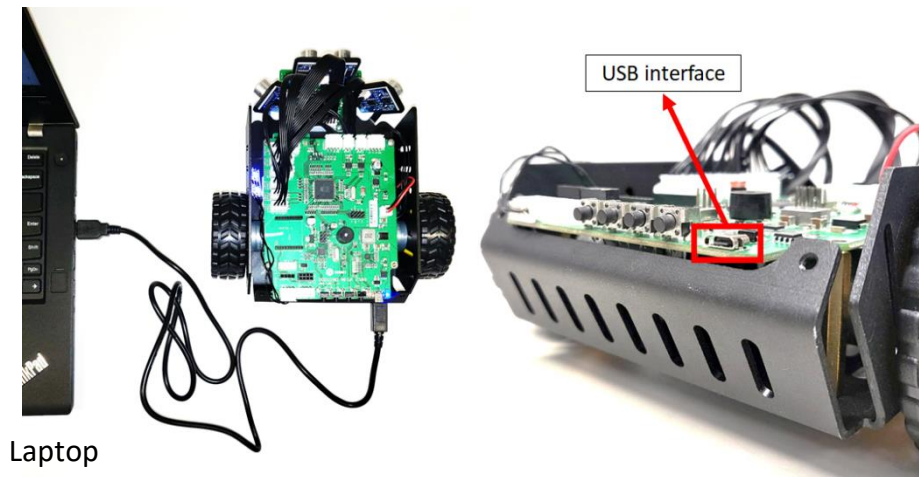


Fig 2-13: Link with real robot VRBot-D1

- 2) Launch the CoSpace Auto-Driving, FirstSteps and double click on the "Real Robot".

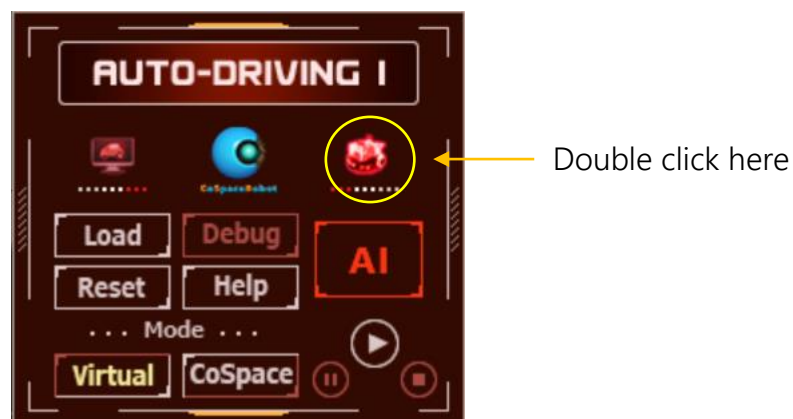


Fig 2-14: To connect the VRBOT-D1 with CoSpace server

- Since the robot is already registered, the following window will appear.

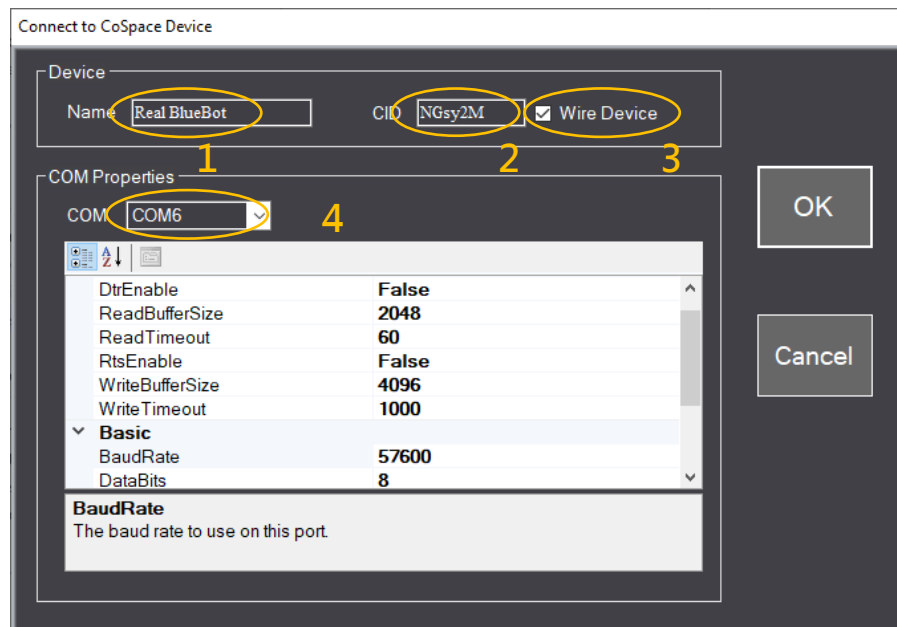
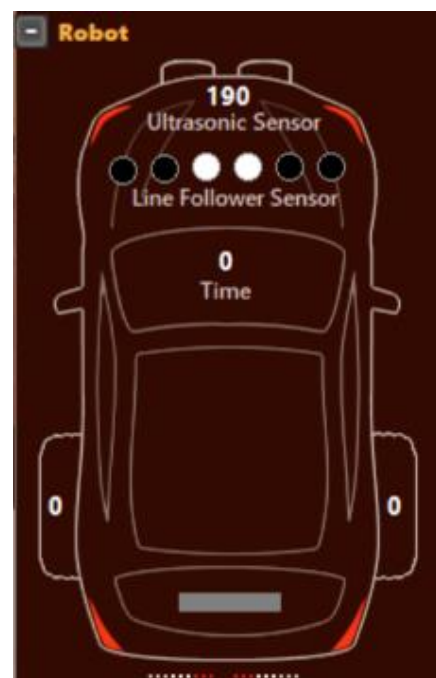


Fig 2-15: Communication Configuration

1. Real robot name. It cannot be changed.
2. VRBOT-Q1 serial number.
3. If “Wire Device” is checked, the VRBOT-Q1 is directly connected with CoSpace Auto-Driving, FS platform. In this case, the Serial number of the VRBOT-Q1 will be automatically detected.
4. VRBOT-Q1 is connected with Laptop via COM port.

After confirmation, click on “OK” to quit. Now you can monitor the sensor feedback on control panel while the robot is moving. Kindly note that the robot needs to remain connected with the laptop.

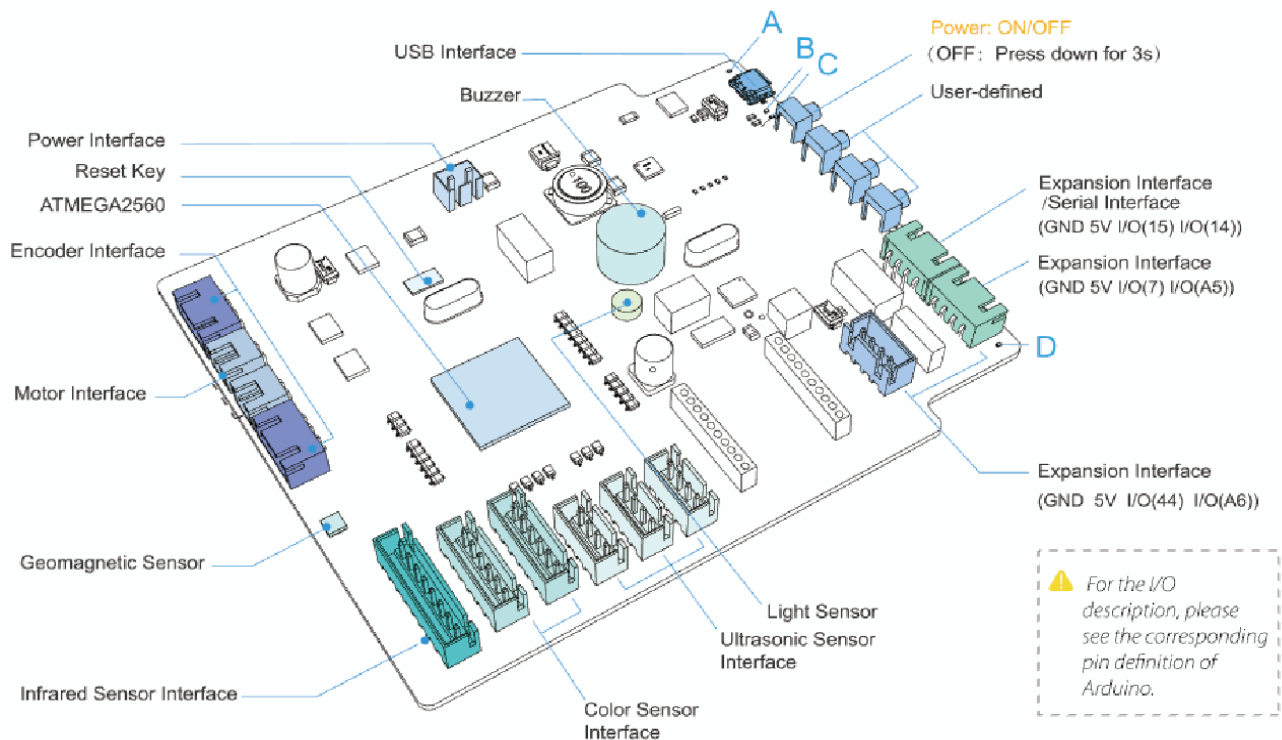
If Auto-Driving U19 simulator is used, you can monitor the left RGB colour sensor value and gyro scope sensor value.



Appendix 1: VRBot-D1 Specifications

Specification	
Operating Voltage	7.4V
Control Board	DuDuino Mega2560 (Compatible with Arduino Mega2560)
MPU	Atmega2560
Battery	18650 Li-ion rechargeable battery
Ultrasonic Measurement Range	30mm-1000mm
Robot Dimension	195mm x 172mm x 79mm
Weight	810g
Maximum Load	500g
Tire Diameter	67mm
Operating Environment	0°C-40°C
Programming Software	CoSpace challenge platform, Arduino IDE
Communication Interface	USB communication / Serial communication
Expansion Interface	4PIN general I/O interface x 2
Sensor	Ultrasonic sensor x 3 / Color sensor x 2 / Infrared sensor / Geomagnetic sensor x 1 / Light sensor x 1
Motor Parameters	Reduction ratio: 48:1 Voltage: 7V No-load current : 150mA Stall current: 700mA Maximum rotate speed: 200r/m Encoder resolution ratio: 585pulse/r

Appendix 2: VRBot-D1 Control Board Layout



Appendix 3: Black Line Tracking Program

Statement	IR Sensor Settings	Left Wheel	Right wheel
L1 detects black line	⊗ ⊗ ● ⊗ ⊗ ⊗	30	30
R1 detects black line	⊗ ⊗ ⊗ ● ⊗ ⊗	30	30
L2 detects black line	⊗ ● ⊗ ⊗ ⊗ ⊗	10	30
R2 detects black line	⊗ ⊗ ⊗ ⊗ ● ⊗	30	10
L3 detects black line	● ⊗ ⊗ ⊗ ⊗ ⊗	-10	30
R3 detects black line	⊗ ⊗ ⊗ ⊗ ⊗ ●	30	-10
Duration		0. 025 Seconds	
LED	Self-defined		