App Inventor + IoT:
Lego EV3 robot Button control

Introduction

This tutorial demonstrate how to control your Lego EV3 robot with buttons. There are five buttons to make robot moving forward, backward, right-turn, left-turn and stop. You can also drag the slider to adjust motor power.

Notice: You don't have to write any program for EV3, just power it on and pair with your Android phone. App Inventor's EV3 components can talking with Lego EV3 brick with a special protocol called Lego EV3 Direct Command. These commands are actually byte arrays which can be executed directly by Lego EV3 brick. Lego EV3 components are developed by CAVEDU Education and merged to official AI2 in 2016.

- Source .aia
- Reference: Sensor Panel of Lego EV3 Robot

Basic dual-wheel robot platform

Please assemble you robot like Figure 1. If your robot is somehow different, don't worry, just make sure the two motors (attach to port B and C) are on the opposite side of robot. This kind of robot base is called **differential drive platform**. Because robot's behavior can be easily adjusted according to the motor speed. For instance, robot will go forward with both motors moving at same speed; and will turn right with left motor moving a little slower than right motor.

This robot need no sensors. Power on your EV3 and pair it with you Android phone (default key: 1234). You can check whether robot's EV3 is on by the Bluetooth icon at the upper-left screen corner.

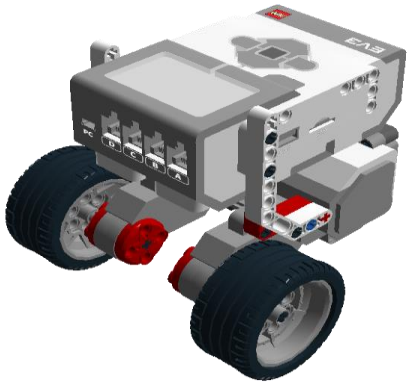
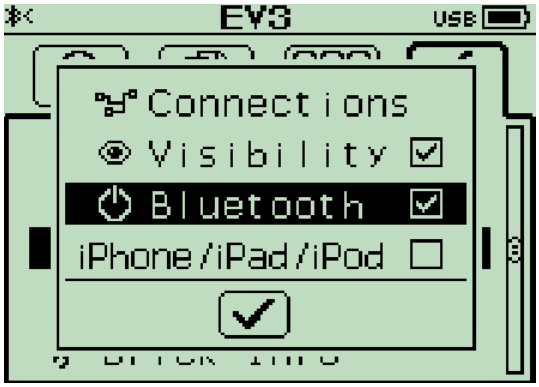


Figure 1a. dual-wheel robot platform

Figure 1b. Use tracks to make your robot cooler (Image source: Lego.com)



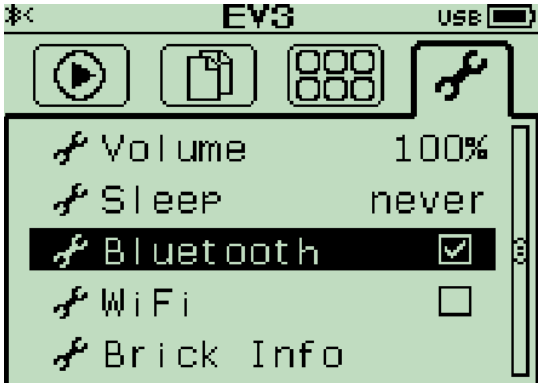


Figure 1c, 1d. Check EV3 Bluetooth is turned on.

App Inventor

Designer

Please add these components and place them as shown in Figure 2. Details please refer to Table 1.

For connection, a **ListPicker** is used to selected paired Bluetooth device, your Lego EV3 in this case. A **Disconnect** button to close the Bluetooth connection with Lego EV3.

You can see there are five buttons to make robot move forward, backward, turn left, turn right and stop. We also add a slider to adjust motor power (0~100). Please add more interesting moves to your robot~

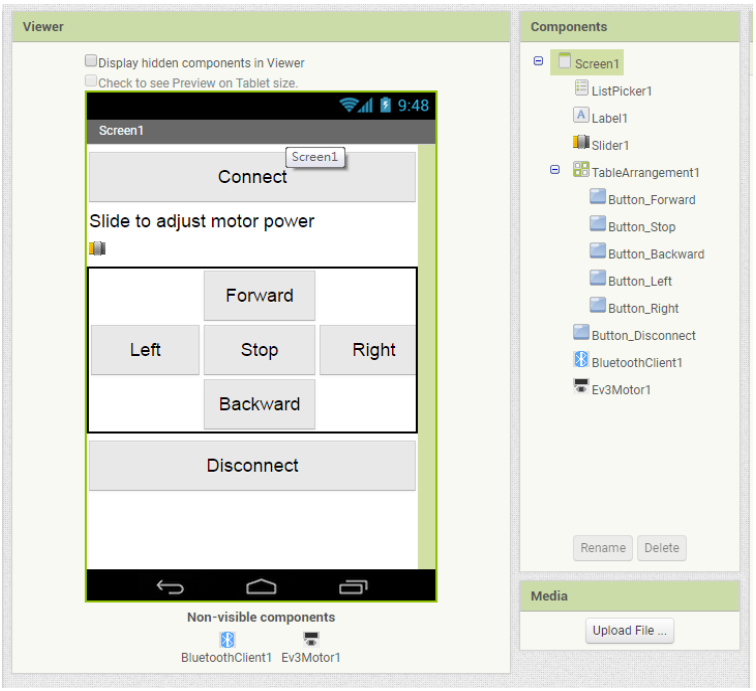


Figure 2. Designer

Table 1. Required components of this project

Name	Palette	Settings	Description
ListPicker1	User Interface	set Text to “**Choose your EV3**”	
Label1	User Interface	set Text to “**Slide to adjust motor power**”	

Slider1	User Interface		
TableArrangement 1			
Button_Forward	User Interface	set Text to “**Forward**”	Click to make robot go forward.
Button_Backward	User Interface	set Text to “**Backward**”	Click to make robot go backward
Button_Left	User Interface	set Text to “**Left**”	Click to make robot turn left.
Button_Right	User Interface	set Text to “**Right**”	Click to make robot turn right.
Button_Stop	User Interface	set Text to “**Stop**”	Click to make robot stop.
Button_Disconnect	User Interface	set Text to “**Disconnect**”	Click to disconnect from EV3 brick.
Ev3Motor1	LEGO® MINDSTORMS®	set BluetoothClient to **BluetoothClient1**	Control and get status of Ev3 Motor, MotorPorts is **BC**.
BluetoothClient1	Connectivity		Communication between AI2 and Lego EV3 brick

Blocks

STEP1 Initialize:

First we use a variable (power) to represent motor power, with initial value 100. We will set it’s value in **Slider.positionChanged event** to further control motor power.

In **ListPicker1.BeforePicking** event, we have to set its element to **BluetoothClient1.AddressAndNames**. After that we can connect(**BluetoothClient1.Connect**) our paired EV3 in **ListPicker1.AfterPicking**

event. If connect successfully, Listpicker will be set to unable, but other button will be set to enabled for user to operate. (Figure 3).

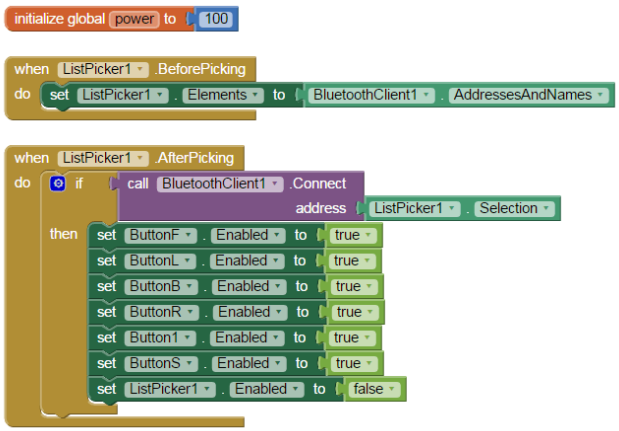


Figure 3. Initialize and connection

STEP2 Forward and Backward button:

Except for Button Stop, other four buttons will call Ev3Motors1.**RotateSyncInDuration** command when clicked, with different **turnRatio** and **power**. Take **Button_Forward** for instance, we have these parameters: **power** variable, **2000**(millisecond), **0** (means two motor with same speed and true (break when execution complete).

Notice that every time you click the button will let robot do something for 2 seconds, you can modify the **millisecond** field or change to **RotateSyncIndefinitely** command. It will let your robot more gentle。

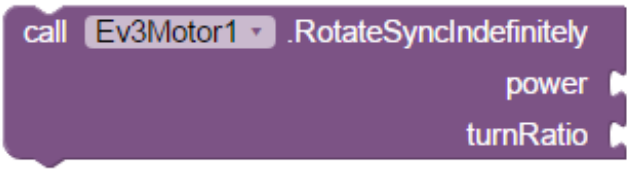


Figure 4. **RotateSyncIndefinitely** command

As for **Button_Backward**, we simply multiply variable **power** with -1 to make motors turn in the opposite direction (same power). Your robot will then move backward (Figure 5).

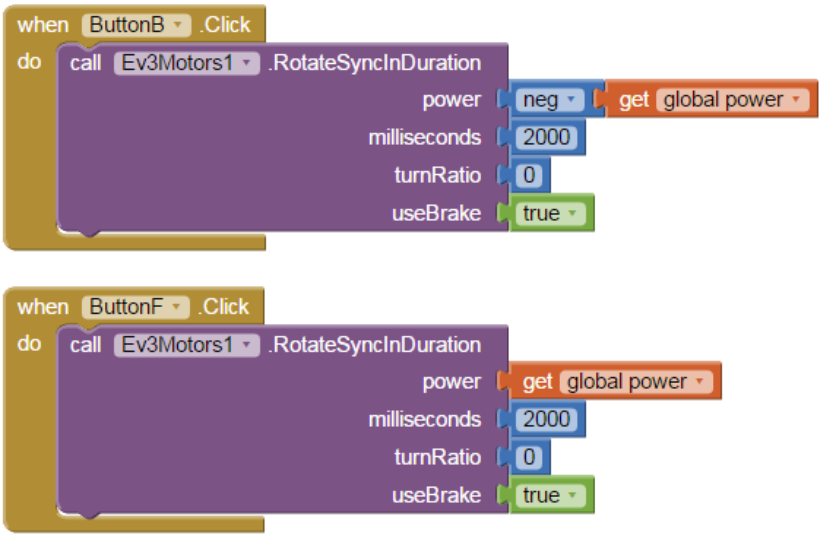


Figure 5. Forward and backward.

STEP3 Left, Right turn and Stop buttons:

Button_Left and **Button_Right** are almost the same idea, but this time we set **turnRatio** to -200 (turn left) and **200** (turn right). You can set **turnRatio** to higher value(max is 100) to make a sharper turn.

Finally click **Button_Stop** to stop the robot, you can use **RatateSync** command with 0 power to achieve the same effect. (Figure 6).

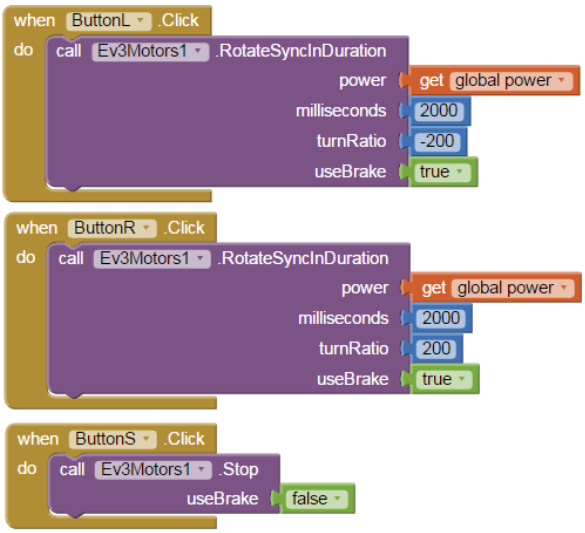


Figure 6. Turn left, right and stop.

STEP4 Slider to control motor speed

In **Slider1.positionChanged** event, we set power variable to slider's thumb position, therefore the motor power is changed as well (0~100).

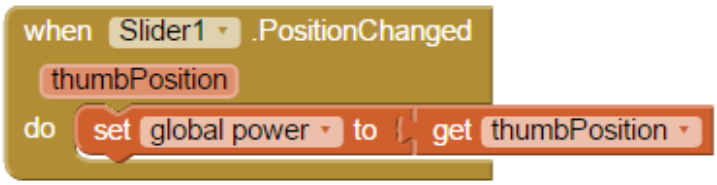


Figure 7. set power variable to slider's thumb position.

STEP5 Disconnect:

When **Button_Disconnect** is pressed (**Button_Disconnect.Click** event), we ask **BluetoothClient** to disconnect from EV3 brick, set all buttons and listpicker to original status, waiting for next connection. Like Figure 7.

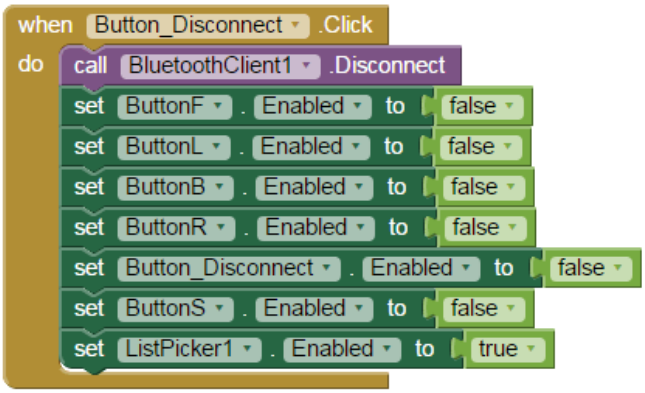


Figure 8. Disconnect from Bluetooth device

Play

You must pair with your EV3 robot first, then press its power button and check EV3's BT is switched on. Press the [**Choose your EV3**] listpicker and choose the name of the paired EV3, then all the control button will be enabled to click. Please click each button to see how robot moves and also drag the slider to adjust motor power. You can build a maze and see who is the best maze conqueror in the class!!

Connect your EV3

App starts up like Figure 9, please click **Connect** ListPicker and select your EV3 (figure 10). Click and connect successfully, you can click five buttons in the middle of the app to control your robot. Enjoy~

Click Disconnect button to close Bluetooth connection with EV3,

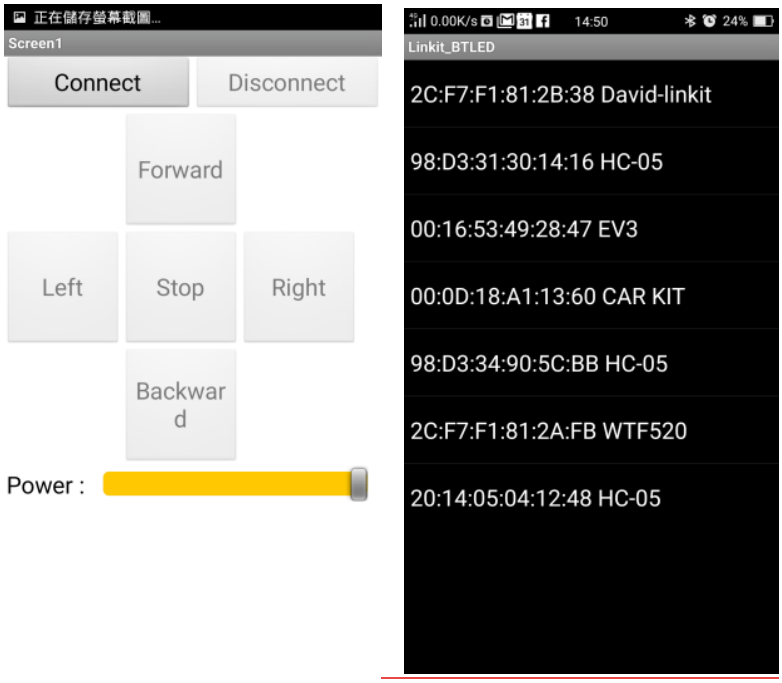


Figure9. 10 Start screen and select EV3