



CyberCamp at UNK

Lego Mindstorms EV3

What you will learn with this tutorial...

You are going to build a race robot to compete with your colleagues! This project will be divided in two parts: the design and the installation, configuration and construction of the controller for your robot. This guide will give you an overview about the Lego Mindstorms, and will teach you how to install and configure the controller for your robot. Instructors will guide you in the design process. Let's start!

1 Definition

Lego Mindstorms EV3 is a robotics kit developed by Lego, that aims to teach robotics in a simple and easy way. It's being used a lot by schools and universities, and by people that enjoy developing robots as their hobby as well.

It's basically composed by a lot of Lego pieces (used to create the desired design), motors (used to move the robot), by a set of sensors (among them: infrared, color, gyroscope, touch, etc.), and by the brick, that is the "brain" of the robot (it is responsible for connecting the motors, sensors and store the programs the robot should execute).

Your instructor will show you all these components, so you get to know them. However, for our race robot, we are not going to use the sensors. We will use the Lego pieces to build it, two motors, and one brick.

The **brick** is composed by a screen, 4 ports built to manage sensors, and other 4 ports built to manage the motors.

You can check some details of the brick below.



Figure 1: EV3 Brick

As you can see, it has a screen and buttons for interaction. On the bottom side part it has 4 ports (**1, 2, 3, 4**), you connect the **sensors** in these 4 ports. On the top side part it has 4 more ports (**D, C, B, A**), where you connect the motors of your robot. It also has a **PC** port, responsible for connecting the brick to the computer. We will not see this here, but you can create programs for your robot on your computer and upload them to your brick through a cable connected to this port of the brick and to a USB port of your computer.

Now it's up to you!

Your job now, with the help of the instructors, is to build a robot to compete on a race. Feel free to use whatever components you want. Remember, however, that we are not using sensors here, we will control our robot through our smart phones, you will need some motors, general pieces and one brick. ***Hint: If you are confused, use the little book that comes together with the Mindstorms kit to have an idea of how to build your robot.*** After your robot is built go to the next section, we will learn how to connect a smart phone to our robot and create the program responsible for moving it.

2 The Lego commander app

Lego has a smart phone and tablet app where you are able to connect to a brick and control your robot. It can be installed on iOS and Android devices.

This app comes with some already made programs that control some robots whose design you can find on line. However, we will later in this guide develop our own simple program responsible to control our 2 motor race robot.

Let's go through the steps to install the software using the Android platform:

1. Open the **Play Store**;
2. On the search box, search for “*ev3 commander*”;
3. Tap on the first result;
4. Tap on install.

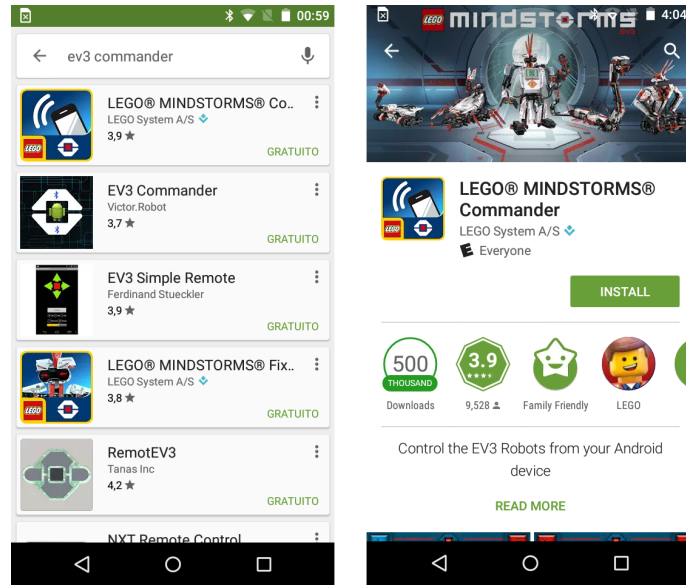


Figure 2: Lego commander app installation

That's it! When the installation is completed an icon to launch the application will be created on your device. Next step is to connect the brick with your phone.

3 Connecting to the brick

The brick will be connected to the phone through bluetooth. The first step is to activate the bluetooth connection in the brick. To do so:

1. Press the button in the middle of the panel to turn on the brick;
2. Use the right button of the panel to navigate to the tab whose icon is a wrench and press the middle button to select it;
3. Use the down button, navigate to *Bluetooth* and select it;
4. Using the up and down buttons, navigate and mark the options *Visibility* and *Bluetooth*. Leave the option *iPhone/iPad/iPod* unmarked, since we are going to use Android;
5. Navigate and select the confirmation icon. The bluetooth configuration on the brick is done.



Figure 3: Brick bluetooth configuration steps

Once the brick is ready to be connected, we need to pair the Android device. Open the Lego commander app on the smart phone or tablet. Then follow these steps:

1. Tap the bluetooth icon on the top left of the screen;
2. Tap the bluetooth icon that will show up at the bottom left of the screen;
3. In this moment, the device will search for the brick. Wait until it finds it. When you see **EV3** on the list of devices, tap over it;
4. Your brick then will show a message asking if you want to connect to the Android device. Select the positive option, and then accept the passkey **1234**;
5. A program will be loaded automatically on your commander app. Tap on the red x at the top left corner, since this is not the program we will be executing.



Figure 4: Commander app bluetooth configuration steps

That's it! The connection is done. Now we just need to create the program to control our robot.

4 Creating the controller program

Let's create the simple program that will control our race robot.

1. Swipe the screen all the way to the left until you get to the option entitled **CUSTOM ROBOT**. Select it;
2. Tap on any “+” sign of the screen;
3. We will select a **JOYSTICK** to control our robot. This is the first option. Select properly the left and right motor ports. By default they spin to the left, if you want to change the direction tap the little slide bar below the ports to change the spinning to the right. When you are done tap the “+” button to add it to your program;
4. Last thing to do is to connect the program to the brick. Tap the little wrench button at the bottom right of the screen. Since we already configured the connection it will connect automatically. Once the connection is done you will be able to control your robot through the joystick.

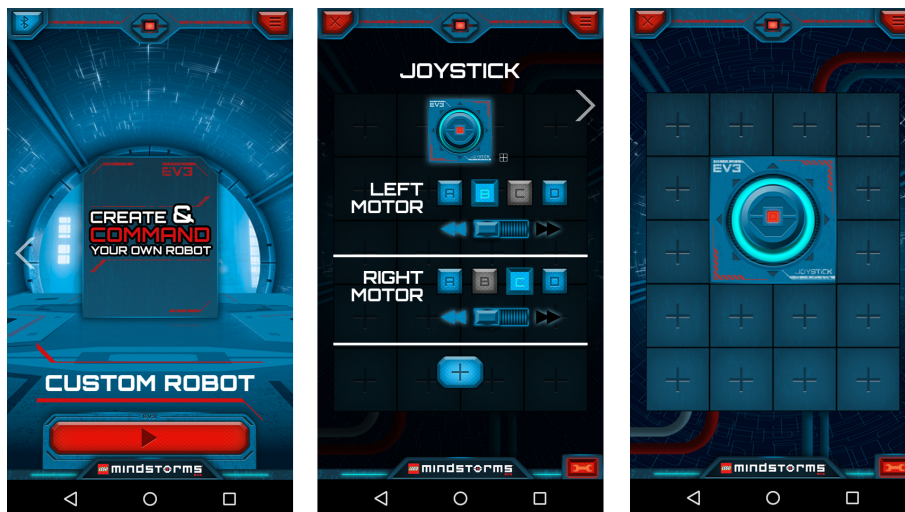


Figure 5: Program creation steps

You just finished to create a simple custom program to control your robot. Have fun!