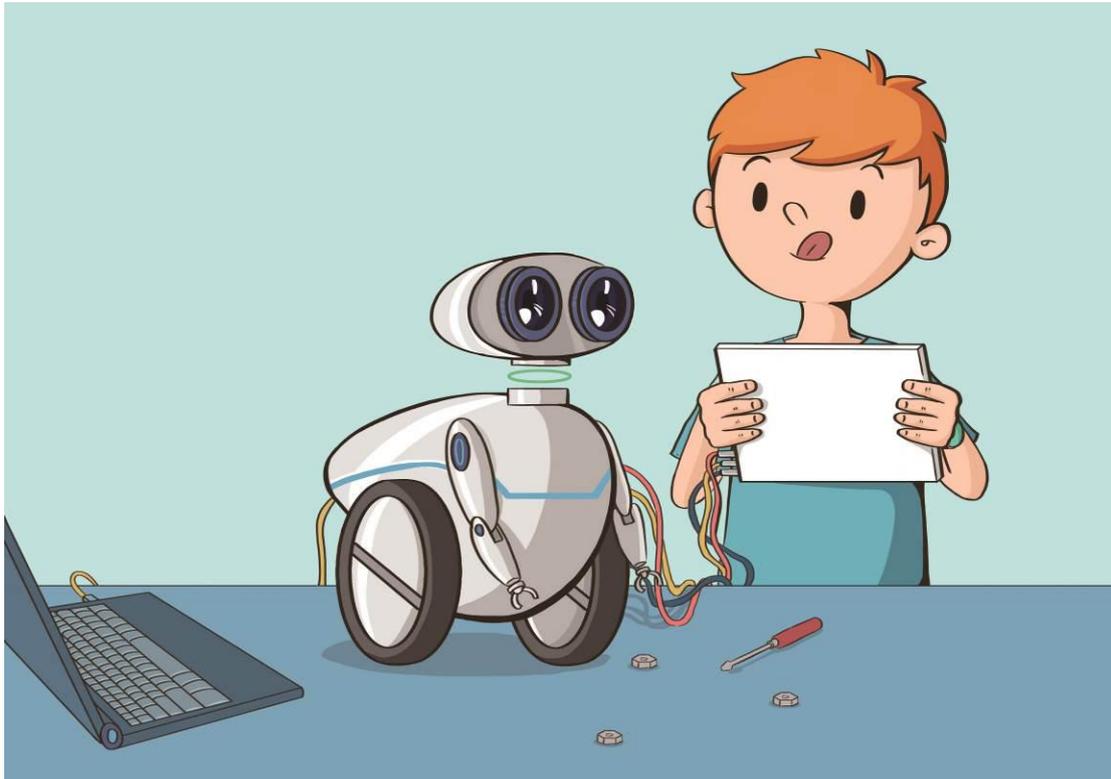# Friends

Rex was the prototype of the assistant robot that Mark took over and developed two years ago. The artificial intelligence of the robots was depended on the storage capacity of the database, therefore overlarge database at that time made the robot perform slowly. The artificial intelligence and processing speed of robots couldn't meet Mark's need, hence the whole plan was suspended. Later Mark used a self-developed "gene-tagging algorithm" to simplify the huge database and used a new technology called "non-solid logical structure" to give Rex the unique self-learning ability.

Haha! Rex staggered because he just got his rear wheel removed recently and he is learning how to walk like human.

Learning Objectives

Segway is a new kind of vehicles which uses the gyroscope installed on its body to obtain data of its posture. Then it will use the algorithm stored in the microprocessor to analyze the data, thus to control the motion of motor to keep balance. We will learn how assemble a self-balance robot, how to connect the robot with mBlock, upgrade firmware for the robot in mBlock, and see how the robot keep balance in this chapter.
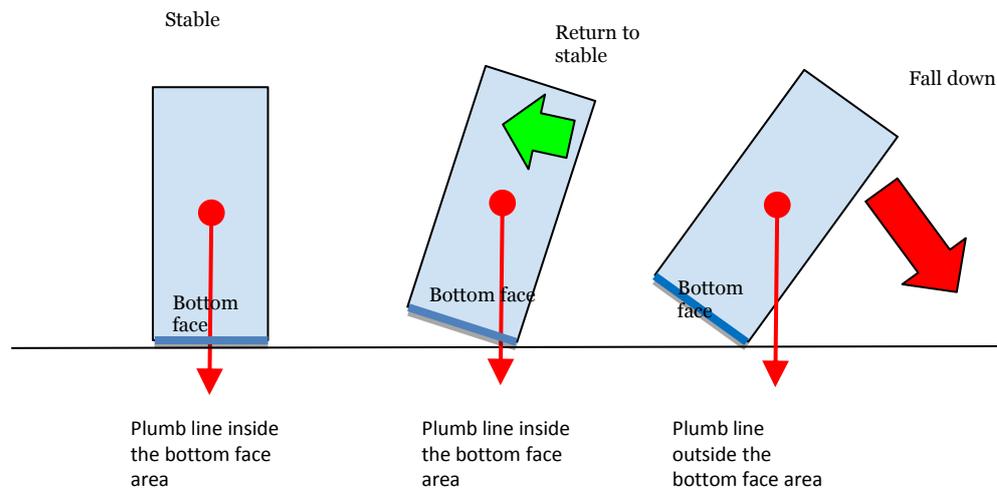

Segway   Source: Wikipedia

Scientific knowledge

Center of Gravity & Balance

Take a point in the object, then divide the object through this point (no matter which direction you divide it from) and the weight of these two part will be totally equal, then we call this point the Center of Gravity. If you want to maintain an object upright and never fall down, you need to keep the plumb line that passes through the center of gravity inside the bottom face area.

Stable

Return to stable

Fall down

Bottom face

Bottom face

Bottom face

Plumb line inside the bottom face area

Plumb line inside the bottom face area

Plumb line outside the bottom face area

However, the two wheels that supports the body of self-balance robot is contacting with the ground at only two points and the contact area (bottom face area) is very small, so it is very difficult for the robot to keep balance.

Stable

Fall down

Fall down

Plumb line inside the bottom face area

Plumb line outside the bottom face area

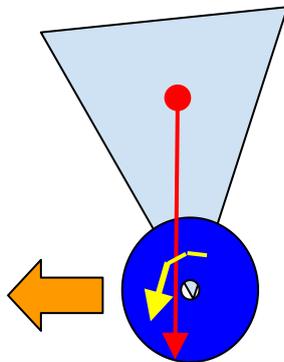Plumb line outside the bottom face area
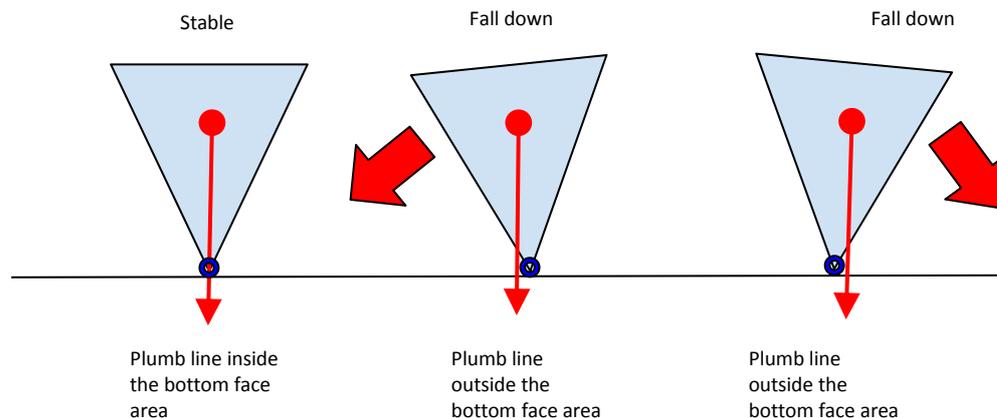
But how does mBot Ranger maintain balance? Let's explain it simply!

When the body of mBot Ranger falls forward
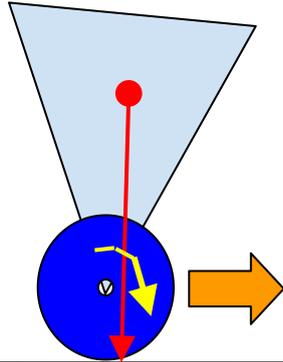
When the body falls forward, the plumb line moves forward. Then the controller commands the wheel to go forward to send the plumb line back to the center of gravity.

When the body of mBot Ranger falls backward

When the body falls backward, the plumb line moves backward. Then the controller commands the wheel to go backward to send the plumb line back to the center of gravity.

Well, it's easy to say but harder to understand. We will make a self-balance robot and obverse how it works. ~ Let's Go!

Assembly Preparation

Learning Task

Assembly Introduction

Assembly Task: Self-balance robot - Nervous Bird

Assemble Nervous Bird

Note: AA batteries are not included.

Connect the left motor and right motor to the corresponding port of Me Auriga.

1:1 M4x8 (2)

(1)

Right motor (M1)

Left motor (M2)

8 **9**

10

1:1 M4x8 (2)

(1) (2)

Wiring of Nervous Bird

(1)

Me Auriga

Me Ultrasonic Sensor

180 Encoder Motor (M1)

180 Encoder Motor (M2)
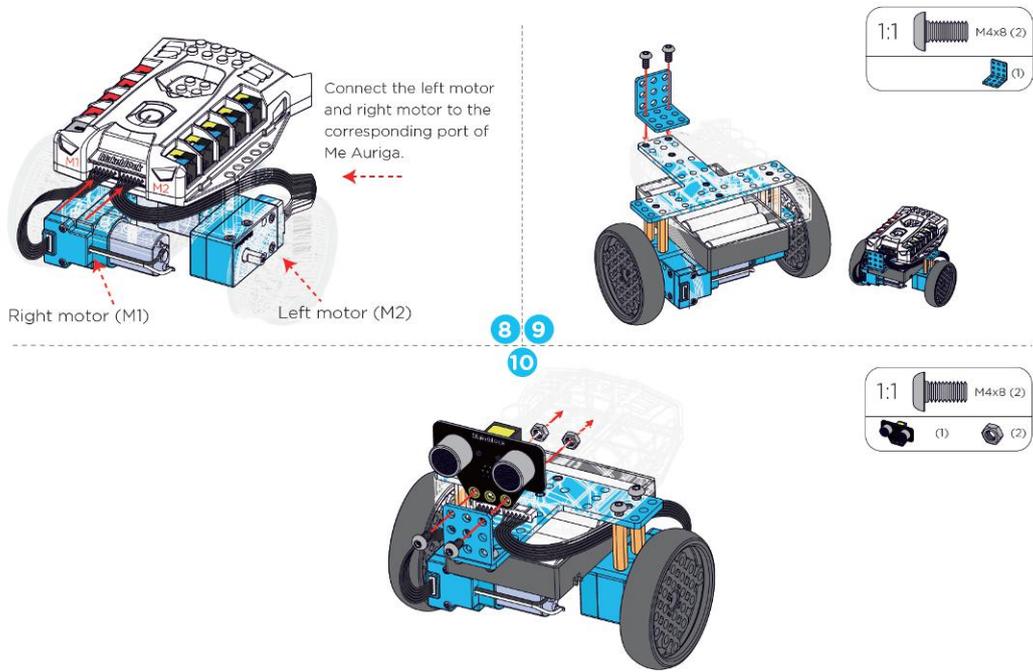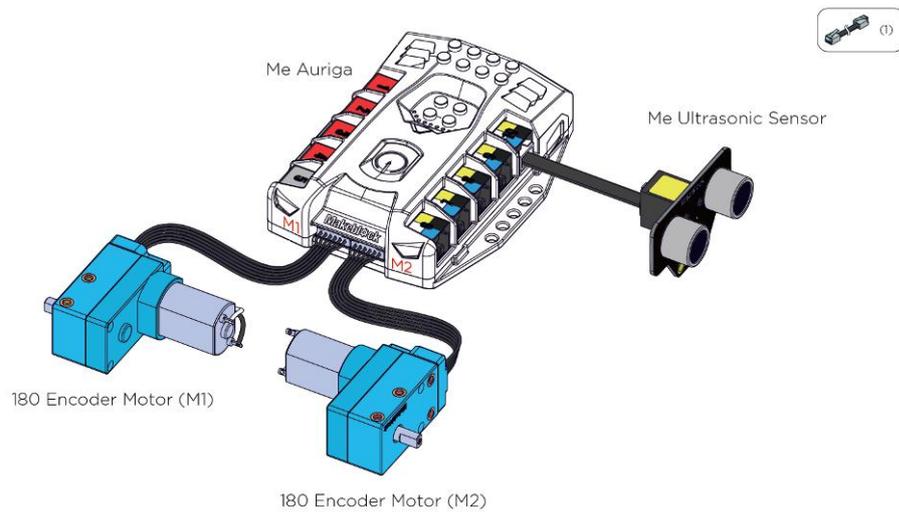
Please follow page 33 for controlling with App

Task

There are various firmwares in drop-down list of "Connect" tab in mBlock, allowing us to download onto the robot and play with the robot directly without writing programs. Now let's learn how to download different firmwares to the robot.
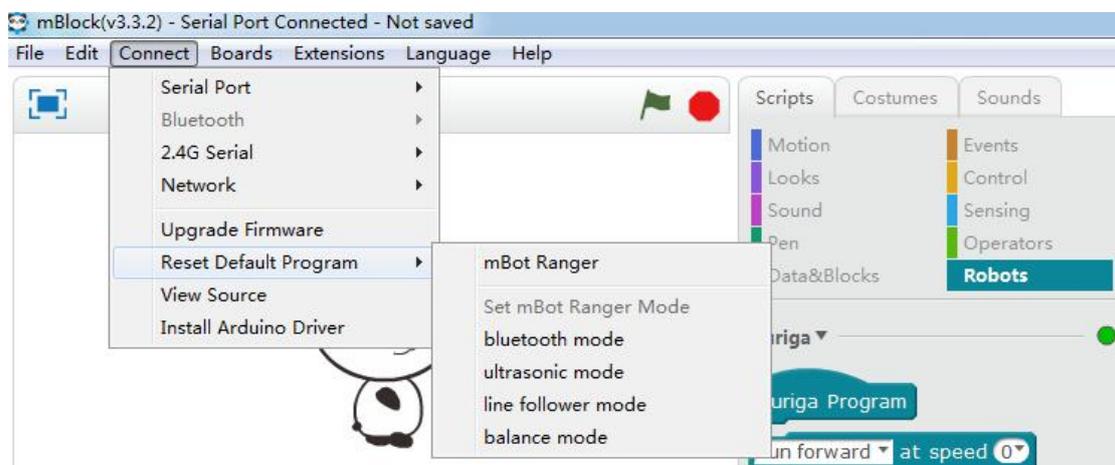
Upgrade Firmware & Balance Mode

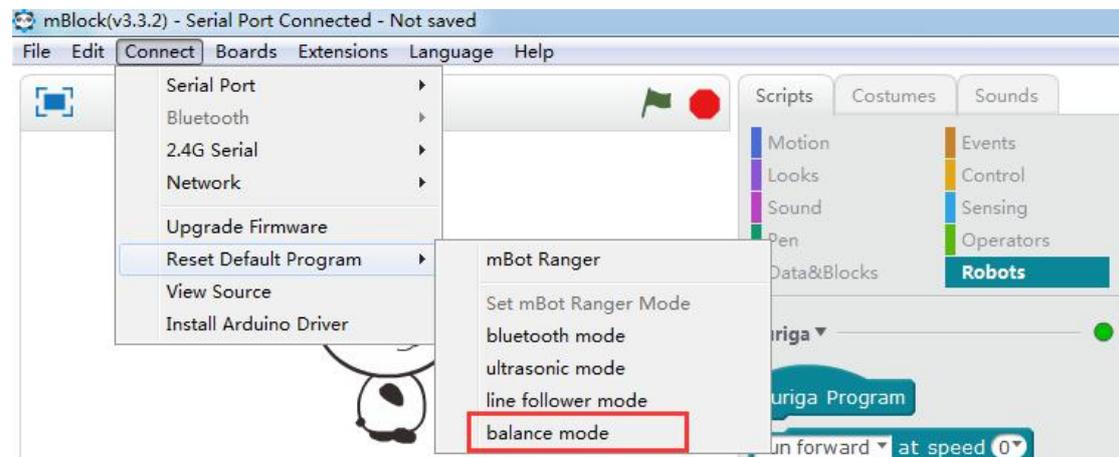Connect Ranger with computer via USB cable (please refer to Chapter 2),

Click 〔Connect〕in mBlock -- > 〔Serial Port〕-- - > (COM xx)
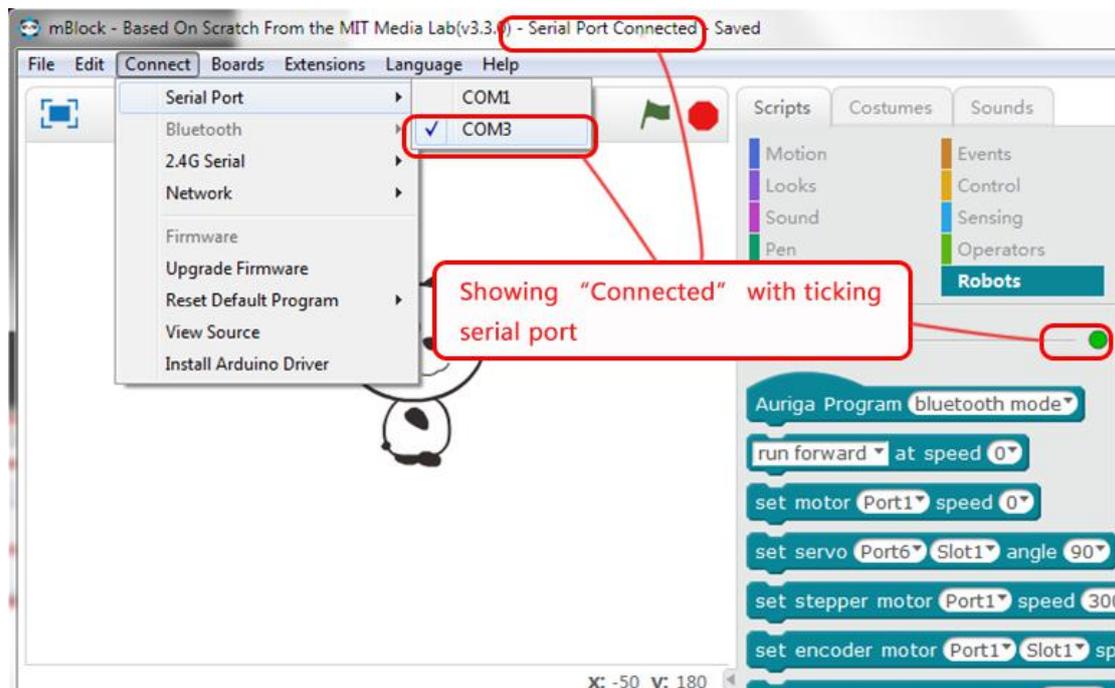
Then click 〔Connect〕--> 〔Reset Default Program〕--> 〔mBot Ranger〕

After upgrading firmware, then set mBot Ranger mode by clicking 〔Connect〕--> 〔Reset Default Program〕--> 〔balance mode〕

Disconnect the robot from computer, then restart the Me Auriga.

After disconnecting the robot from computer, let's get ready to start the self-balance robot.

Note:

Please place mBot Ranger on the floor after powered on and wait 5 seconds for the gyroscope to finish self-correction. Then place the robot upright.

… Then Rex was born!

He can keep balance without the help of external force, such a cutie! Welcome to join our adventure, Rex!

Conclusion of This Chapter

If you are using the mechanical parts of MakeBlock for the first time, have you found that it allows you to build a firm structure with just a few screws? The color-labelled RJ25 cable in the package allows you to connect electronic modules correctly and quickly. Have you noticed those considerate design of the details?
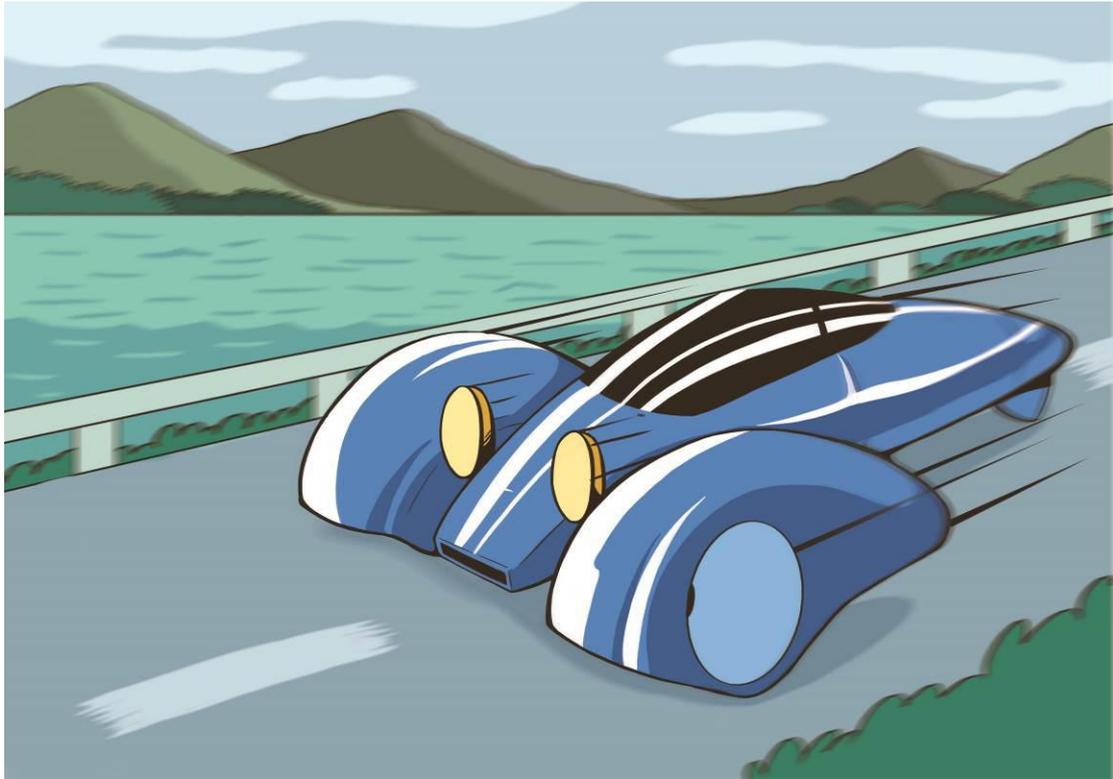
After hearing the brief report from Rex, Mark immediately commanded Rex to follow him, heading to the parking lot.

"Wait for me, I'm still learning how to walk with two wheels, I can't walk fast!" Rex complained, walking staggeringly.

Soon a blue twin-engine sports car appears. This is also one of Mark's proud creations: the car comes with a stylish body design, a powerful engine capable of driving its huge wheels. This guy seems to be heavy, but it can make turns freely with the control system designed by Mark and can also run really fast. No wonder no one can compete with Mark in car racing games so far.

"Go to the IDA immediately!" Mark closed the car door and the car roared away, carrying the Rex to Xingcheng City.