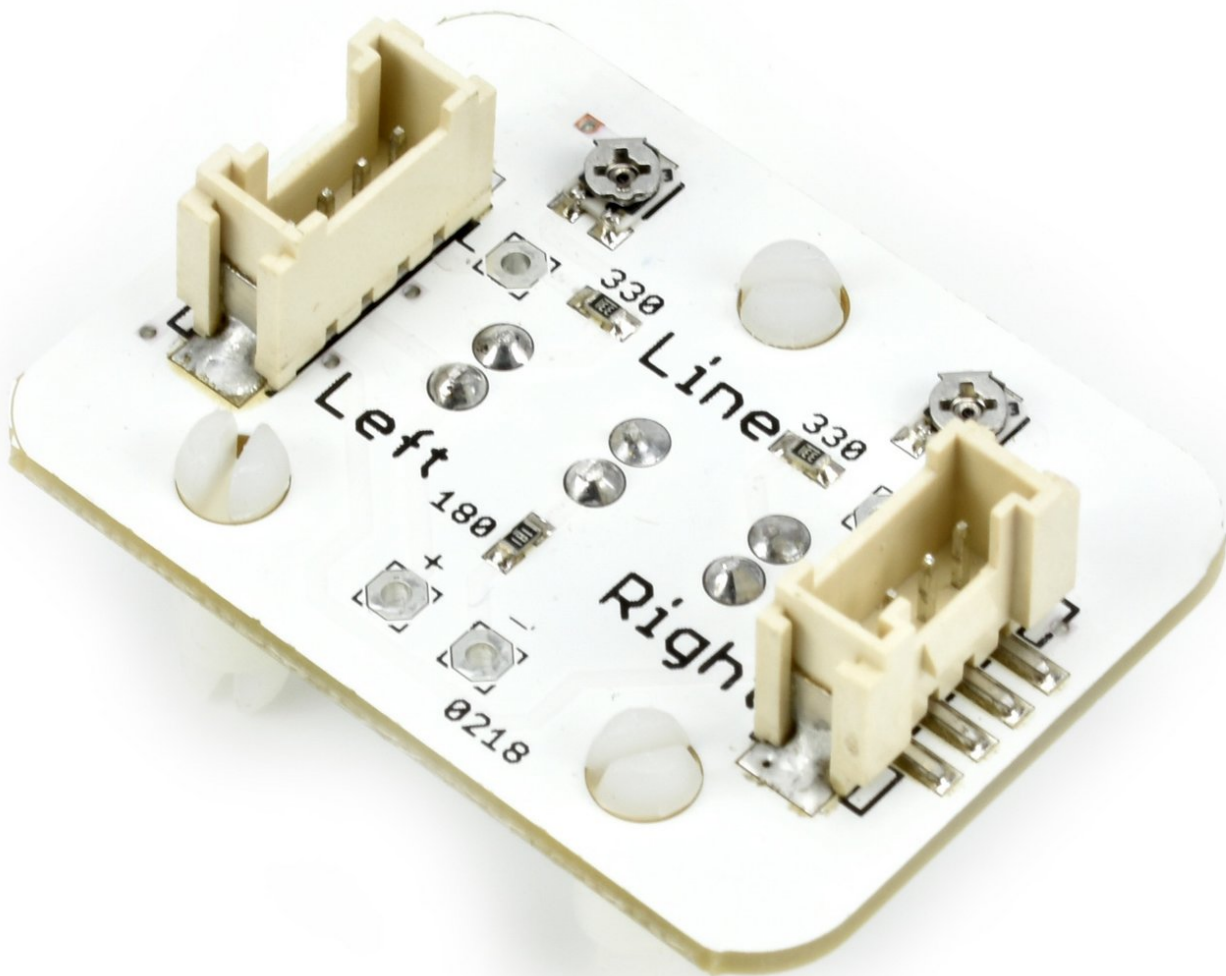


A - Automatic Patrols

We need to patrol the planet to keep it safe, but don't have time to do it ourselves. Learn how to get your robot to steer itself automatically!



INTRODUCTION

We need to patrol the planet to keep it safe, but don't have time to do it ourselves. Learn how to get your robot to steer itself automatically!

Step 1

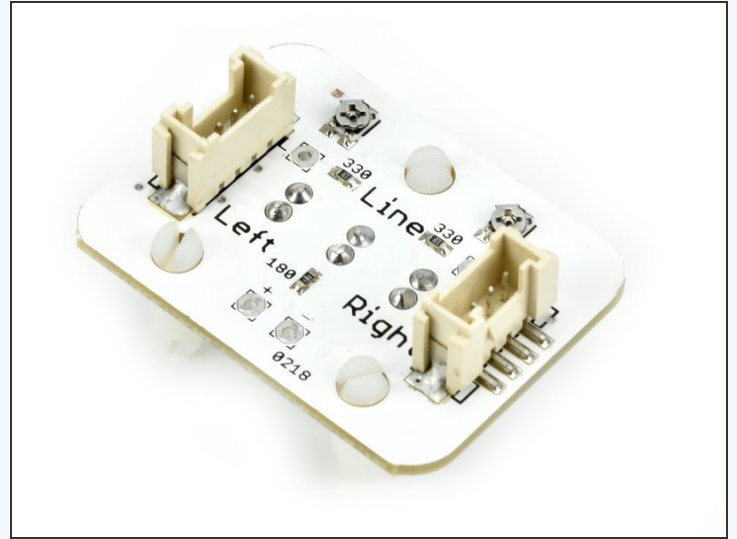
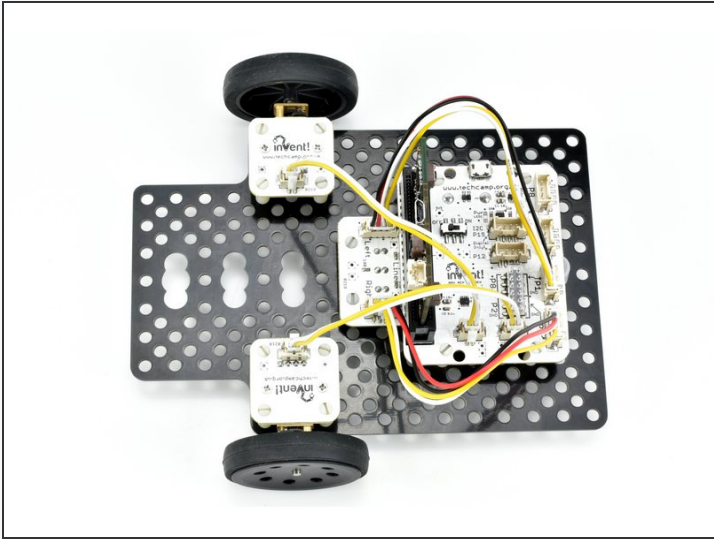
Autonomous Robots

- Autonomous robots are **very important** in advanced factories!
- Watch the video to see some of **Amazon's** autonomous transport robots moving products around the warehouse.
- **Think how many people** would be required to do the job of the robots!



Step 2

Assemble your robot!



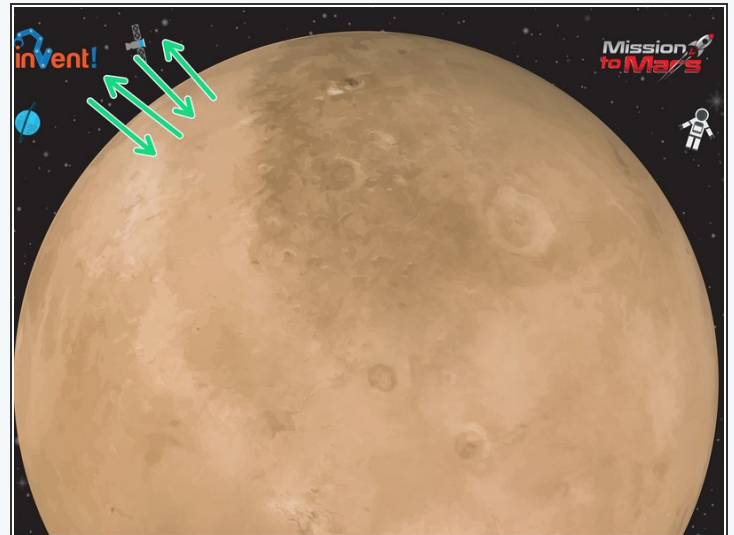
- We're going to make our own autonomous robot to **patrol the outside of the planet.**
- **Assemble** your robot like the picture!
- You will need the **line sensor module** for this lesson. For best results, mount your line sensor in the position shown.
- Connect the left sensor to **P1**, and the right sensor to **P0**.

Step 3

Test the line sensor

```
11 def digital_read_line(s): return 1 if (  
12 def analog_read_line(s): v=p0()if s==0  
13 # Invent! Code End  
14 # Start your code below here!  
15  
16 calibrate_line_sensors()  
17  
18 while True:  
19     if digital_read_line(0):  
20         drive_motor(0,100)  
21     else:  
22         drive_motor(0,0)  
23  
24  
25  
26
```

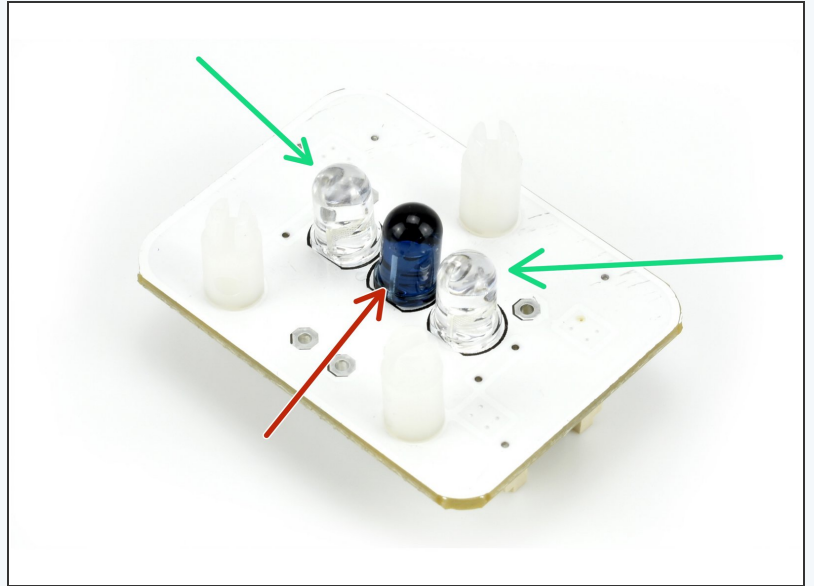
- How does the line sensor work? Let's write a **test program** to find out.
 - **Build** the test program in the picture. Can you **guess** what it will do?
 - Program your robot and place it on the activity mat, **with the sensor right on the edge of the planet**. This is very important - the **calibrate line sensors block** spins the robot before starting the program, to calibrate the sensor on the surface.
- ⚠ Whenever you use the line sensor module, you must **always** have a calibrate block at the start of your program.
- Once the calibration has finished, try moving the robot by hand **on and off the planet** - the motors should spin when it is on the planet!



Step 4

How does it work?

- Turn the robot over and look at the **bottom** of the line sensor. You should see **3 LEDs**.
- The centre LED is an **infrared emitter** - just like on your TV remote control! It shines infrared light downwards **all the time**.
- The two outer LEDs are **infrared receivers** - they can **sense infrared light**.
- When the robot is on a **black surface**, infrared light is **not reflected** and so the receivers give a **0** signal.
- On a **white surface**, the light is **reflected** and so the receivers give a **1** signal.
- Using the signal from the sensors (1 or 0), we can **detect what colour surface to robot is on!**



Step 5

Don't drive off the planet!

- Let's use the line sensor to stop the robot from **driving off** the planet.
- Don't forget - the sensor is **1** on **white** backgrounds, and **0** on **black** backgrounds.
- Using the structure in the picture, make the robot:
 - Drive **forward**
 - **Stop** IF it drives off the planet (when the background is **black**)

```
def analog_read_line(s): v=p0()if s==0 else
# Invent! Code End
# Start your code below here!

calibrate_line_sensors()

drive_motor(0,100)

while True:
    if # Check if robot is off the planet:
        # Stop
```


Step 6

Patrolling the Planet

- Now we have everything we need to drive around the edge of the planet **automatically!**
- To do this, your program needs to:
 - Drive **forwards**
 - **Check** the sensor
 - If the sensor is **0**, we are about to drive off the planet! **Turn slightly** towards the **middle of the planet** and then go **forwards** again.
- Your robot should drive around the edge of the planet, without getting lost.
- Try and make your robot drive around the planet as **smoothly** as you can, by adjusting the turning time.



Step 7

Orbiting the Planet

- Currently, the robot tries to **stay** on the white and **avoid** the black.
- Can you change the code so the robot **orbits** the planet by staying on the black, and turning **away** from the white?
- Hint: instead of normally going forwards, you will need to **normally be turning towards the centre of the planet**.

