

# **C** - Smoother Line Following

Learn about analogue inputs to make an even more sophisticated line following robot, that will smoothly follow any path.



# INTRODUCTION

Learn about analogue inputs to make an even more sophisticated line following robot, that will smoothly follow any path.

# Step 1

### **Setup Your Robot**

• We just need the **line sensor** for now - make sure your robot is setup like the picture.



# **Analogue and Digital**

Step 2



- To make a **smoother**, better line follower, we need to use the line sensor in **analogue mode**.
- So far, we have been using it as a **digital** sensor it can only be **ON or OFF (HI or LO)**.
- Analogue inputs (and outputs) can have any value think about the difference between a digital and an analogue clock
- A digital clock must display a whole number of minutes
- But on an analogue clock, the minute hand can be **anywhere** even halfway between two minutes!

# **Analogue Line Sensor**

Step 3



- **Build** the simple test program in the picture.
- You can find the analogue block in the Input/Output menu
- Program your robot, and keep it plugged in.
- Try moving the robot slowly from one side of the line to the other, whilst watching the value of t in the variables menu.
- See how it changes gradually as you approach the line?

# 2 Analogue Sensors

- We can use this gradual change to smoothly change the amount the robot turns as it get further from the line!
- Add two new variables to the program called L and R (left and right).
- Let L = the analogue value of the left sensor, and R
   = the analogue value of the right sensor.
- Program the robot and try moving it slowly across the track again whilst still plugged in - make sure L and R behave how you expect them to!

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#### Step 5

Step 4

#### How much to turn?

- The larger the **difference** between L and R, the further the robot is from the line so the **more** we need to turn.
- For example, if both sensors are on the line, we don't need to turn at all and L and R will have the same value.
- Add a new variable called turn.
- After getting the values of L and R, set turn equal to the difference between L and R.

<ul> <li>Crumble Version 0.25.2 - Basic two sensor.crm</li> <li>File Program</li> </ul>	-	×
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# **Using the Turn**

- Program your robot and watch what happens to the value of turn as you move it across the line. It should be 0 when the robot is exactly on the line!
- Let's use the turn variable to set the speeds of the motors.
- Change the motor blocks so they use the turn variable to set the speed like the picture.
- Test it out this should follow the line really smoothly!
- Do you understand how the code works? (hint: turn is positive when we need to turn right, and negative when we need to turn left)
- If you robot can't do the **really tight turns**, try multiplying turn by 2!



#### Step 7

Step 6

#### **Maximum Speed**

- You might have noticed that while the new program is smooth, it isn't as fast as the old two sensor digital program.
- To make it faster, we need to make sure 1 wheel is always going 100% forwards, and then change the speed of the other wheel only based on how large turn is to follow the line.
- So, if turn is **positive**, we should be turning **right**, so motor **1** should be at 100%
- If turn is negative, we should be turning left so motor 2 should be at 100%
- Add an IF/ELSE block to check if turn is positive or not, and set the correct motor to 100%.

Programming successful         Basic (Input/Output) (Sparkles)         Control (Variables) (Dperators)         Ict = 0         Increase by 1         Add New Variable         1 del rename ?         1 del rename ?         w del rename ?         w del rename ?         y del rename ?         y del rename ?         g del rename ?         y del rename ?         y del rename ?         y del rename ?         y del rename ?         g del rename ?         y del rename ?         y del rename ?         y del rename ?         y del rename ?         g del rename ?
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**Proportional line** 

#### follower

Step 8



- Now its over to you!
- Add two more motor blocks into the IF/ELSE block to set the other motor's speed using the turn variable, for turning left and right
- **Test** the program really well **experiment** with multiplying **turn** by different amounts to get a **reliable** line following program.
- *i* Here's a hint if you're confused for the first part where motor 1 is at 100%, motor 2 should be set to forwards at a speed of 100 turn.

#### Step 9

## **Proportional Sparkles**

- If you're feeling really advanced, add the Sparkle module back in and set the colours of the LEDs proportionally based on how far away from the line the robot is!
- Your robot can also get lost and now has no way of finding the line again - try and add the code you wrote previously back in so the robot can't get lost, or at least stops if it loses the line completely.

# Extension Challenge!