



EduTrend Contents

EDUTECH · INTRODUCTION TO ROBOTICS · HIGH SCHOOL

Line Follower Logic

Compare on-off and proportional control for a line-following robot

Ages 15–18

Level: Advanced

90 minutes

Teams of 3

Activity 05

Inside: activity at a glance · step-by-step session plan · facilitator notes · 3 student worksheets · assessment checklist

ACTIVITY 05 · AT A GLANCE

Line Follower Logic

Teams program a robot with one light sensor to follow a black line edge using on–off (bang-bang) control and time a lap. They then implement proportional control, where the turn is scaled to the error from a target reading, and tune the gain. Teams compare lap times and wobble, and explain the results.

Learning outcomes

By the end of the session students can:

- implement on–off control;
- implement proportional control;
- tune a control gain;
- compare controllers with data.

KEY WORDS

feedback · error · on–off control · proportional control · gain · oscillation

CURRICULUM LINKS

Maths: linear functions. Physics: feedback systems. Engineering: control systems.

1**SENSE**

What can it detect?

2**THINK**

What should it decide?

3**ACT**

What should it do?

4**TEST**

Run it

5**DEBUG**

Find and fix

6**IMPROVE**

Make it better

Materials (per team)

- Robot with a light sensor
- Black tape track on a light surface
- Stopwatch
- Device for programming
- Worksheets 1, 2 and 3

Before the session

- Lay a track with curves.
- Test sensor readings on line and floor.
- Prepare starter code.
- Print worksheets.

SAFETY

Keep the track area clear. Pick up robots only when stopped.

ACTIVITY 05 · SESSION PLAN

Step by step

Too high a gain causes wild oscillation; let teams see this before finding a good value.

Time	What happens	Say or ask
0–10 min Hook	Watch a wobbly line follower.	<i>“Why does it zigzag?”</i>
10–30 min On-off	Program and time laps.	<i>“How smooth is it?”</i>
30–55 min Proportional	Program turn = gain × error.	<i>“What does the gain do?”</i>
55–75 min Tune	Test several gains.	<i>“Which is best?”</i>
75–90 min Compare	Data and explanation.	<i>“Why is proportional smoother?”</i>

CHALLENGE CARD (print or copy onto the board)

Program and compare on-off and proportional line-following controllers, tune the gain and justify the best controller with lap-time data.

ACTIVITY 05 · FACILITATOR NOTES

The robotics know-how in brief

On-off control turns fully left or right depending on whether the sensor sees line or floor, so the robot zigzags. Proportional control turns by an amount proportional to the error from a target reading.

The gain sets how strongly the robot reacts. Too low and it drifts off curves; too high and it oscillates. Tuning finds a balance. This is the basis of the P in PID control.

Common ideas to listen for

- “More reaction is always better.” High gain oscillates.
- “Faster motors mean faster laps.” Control limits speed.
- “Sensors read black or white only.” They give a range.

Adapting the activity

Support

Provide the proportional formula in starter code.

Stretch

Add derivative control and compare.

WORKSHEET 1

Controller tests

Name: _____

Class: _____ Date: _____

Record laps.

Controller tests

Controller	Lap time (s)	Stayed on line?	Wobble (1–5)
On-off			
P gain 1			
P gain 2			
P gain 3			

WORKSHEET 2

Sensor values

Calibrate readings.

Sensor values

Position	Reading
On line	
On floor	
On edge (target)	

WORKSHEET 3

Evaluation

Compare controllers.

Which controller is best and why

FOR THE TEACHER

Assessment checklist

Use during the session. One sheet covers up to eight students; copy as needed.

Student	Implements control	Tunes gain	Explains with data

Suggested codes: W = working towards · E = expected · G = greater depth

ABOUT THIS ACTIVITY

Line Follower Logic is a sample activity from the EduTrend Contents Edutech Introduction to Robotics programme (high school, level: advanced). Every activity in the programme follows the same format: a practical challenge, a clear session plan, facilitator notes and ready-to-print worksheets, so that teachers, club leaders and parents can run it without extra preparation.

Full 15-, 20- and 32-week programmes are available from EduStore at edutrend.org.

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