

Activity 7 – Line Bump

Aim:

To run the robot so that it detects and reacts to black tape lines.

Materials:

- Working robots (without switch controller)
- Black tape and Berol Broad felt-tip pens (1 pen per team)
- Square sheets of white paper (cut from rolls provided in the class kit)
- Activity 7 video
- Activity worksheet

Location:

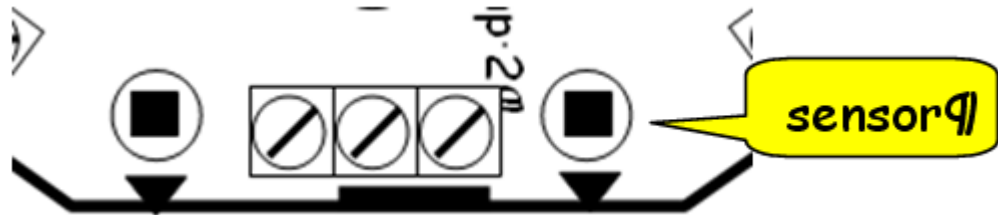
Can be done on desks or a floor area.

Background – General:

- A robot needs sensors to find things out about its environment.
- What sensors (senses) do people have? Eyes (sight), ears (sound), nose (smell), fingers (touch), skin (temperature), tongue (taste).
- What sensors (senses) does Robokid have? Eyes (sight), switches (touch), battery checker (hunger).
- This activity will concentrate on using two of the robot 'eyes'.

Background – Experiment 1:

- The two optical sensors at the front of the robot can detect the difference between black tape and white paper:

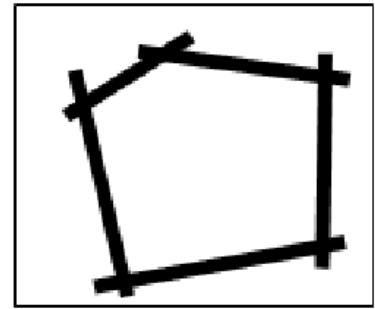


- These two 'eyes' are located at the front of the robot and look down at the floor. They work by sending out some infra-red light and looking at what bounces back. A lot bounces back from white paper, but very little returns from the black tape. The robot computer converts the result to a number and uses it to plan its operation.
- Our eyes cannot detect infra-red light so we will not see the beam. This light is used by TV remote controls to pass signals to your TV.
- The light is called 'infra-red' because it is just above the red light of the visible light spectrum.
- Some animals can see infra-red light. For example, some snakes have little infra-red eyes (called 'pits') as well as normal eyes.
- Experiment 1 shows the robot's basic avoidance strategy. As soon as it detects the line it stops, reverses for a small period of time, then spins for a small period of time before heading off in a new direction. As it always uses the same avoidance mechanism, shapes drawn on the sheet will have regularity to them. However, the final pattern will be heavily dependent on the shape of the black tape perimeter. Try to get each team to use a different shape.

Running Experiment 1:

- Form teams (suggest three pupils per team) and show Activity 7 video (approx. 8.5 mins). The video demonstrates the background and activity step-by-step.
 - <https://www.youtube.com/watch?v=iJPfQqrsib0>
- Get a sheet of white paper – no greater than 60cm in length.
- Create a closed shape with the black tape (example below).

- Set robot into mode 'b0' (power-on then A_2D_2A).
- Place in centre of area and check that it works.
- If all is OK insert a Berol Broad felt tip pen in pen holder (make sure that the tip of the pen is touching the paper).
- Press switch A to start.
- Robot will stop for the following reasons:
 1. If it has been running for 2 mins (this is called a time-out).
 2. If switch A has been pressed and held for a couple of seconds, causing a restart.
 3. If switch C has been pressed and held for a couple of seconds, causing exit of the mode – shown by flashing 'b0' message.



Running Experiment 2:

- Switch B can be pressed to change how the robot reacts. The things that can be changed are set by POT-1, POT-2 and POT-3:
 - POT-1 sets the amount of reverse when robot detects the black tape.
 - POT-2 sets the amount of spin after the robot has reversed.
 - POT-3 sets the speed difference between the two motors. A greater difference means that it moves in a tighter curve.
- Get the team to try changing the parameters and look at the results.
- They can create a multi-colour picture by swapping pens with other teams.

Background – Experiment 3:

- Mode 'b0' is quite a predictable mode: the robot executes a fixed sequence and always turns and spins in a repeatable way. If this was a bug trying to get away from a predator, this type of behaviour would not be a good survival approach.
- Mode 'b1' introduces randomness into the robot's decision making. It is as though the robot has an internal dice that is used to produce random numbers. These random numbers are used to determine the robot's actions, whereas in mode 'b0' the behaviour was determined by the settings of the POTs. Animals have this randomness quality built into their brains.

Running Experiment 3:

- Reverse paper and create new shape.
- Get the teams to run the 'bug bump mode', mode 'b1' (switch sequence A_2D_A_D_A).
- Press switch A to start.
- Robot will stop as in Experiment 1.
- This mode introduces randomness into the robot's decision making by making each decision reliant on a random values. The effect is as if the robot has an internal dice, which is used to get random reverse and spin times.
- Get the teams to compare two drawings, one from the predictable mode and one from the bug mode.

Background – Experiment 4:

- The sensor does not see 'blackness', it measures the amount of infra-red light that is reflected, so black felt-tip pen and black biro ink look like white paper to the sensor.
- Photocopier ink is detected as 'black'.

Running Experiment 4:

- How does the sensor work?
- Try some simple tests with other things that are black: black felt-tip pen, black paint (ensure it is dry before starting the robot), black ink, black photocopier ink, etc.
- Try some other materials.