DRONES: FRIEND OR FOE?

Thinking like a drone

ROYAL ACADEMY OF **ENGINEERING**

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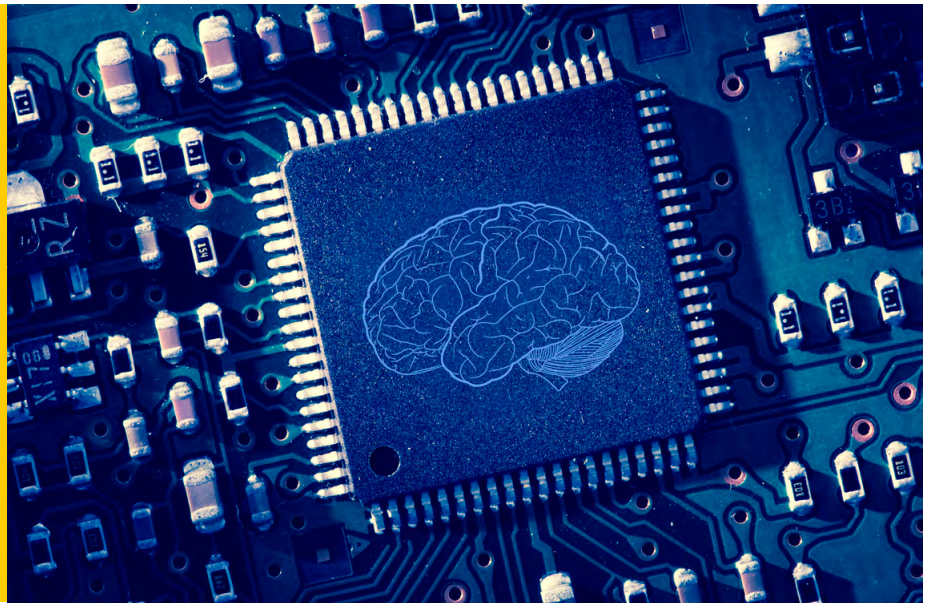
This resource is designed to get students investigating how sensors work.

Thinking like a drone

How do drones think?



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Introduction

Drones and robots with sensors follow the *Sense Plan Act* model. The drone will have sensors to see the environment it is in. Before moving, the drone then plans the best way to act by running through pre-programmed actions. Once it has selected the most appropriate, the drone then acts by running the programme.

Activity 1 – Testing

In this activity you will be investigating how a line tracker robot uses sensors to move. In teams, use the tracks from your teacher to test the following:

- Which tracks can the robot navigate?
- Which tracks cause the robot to stop, or lose the track?

From what you have seen discuss how the robot works.

Things to think about:

- How many sensors are there?
- What does the sensor detect?
- What causes the wheels to move or stop?

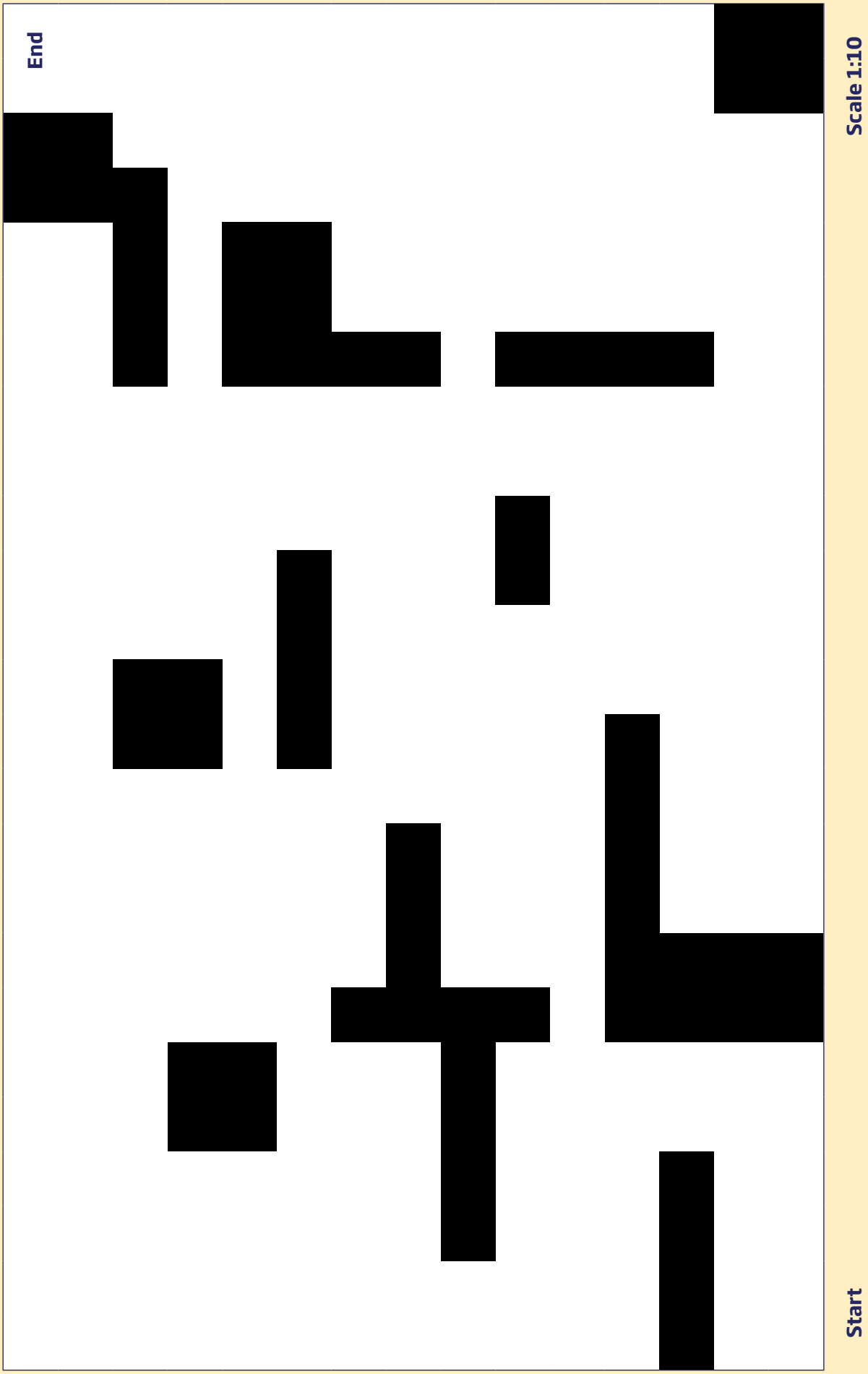
Stretch and challenge 1 – Modifications

How can you improve the design of the robot so that the robot can turn sharp corners?

Are there any other improvements you could make?

Activity 2 – Maze challenge

Your teacher will create a maze through the classroom. In teams your challenge is to create the shortest route for the robot to complete the maze. Plan you route on the map provided. Then use black tape to test your route through the maze.

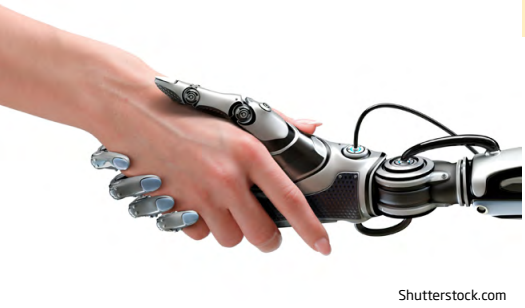


Stretch and challenge 2 – Modifications

The sensors and movements you have investigated so far are only useful for areas humans have seen and can navigate themselves.

How could the robot be changed so that it can sense an environment humans haven't seen?

What other technologies could you use?



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Can humans and robots exist in harmony?

Artificial Intelligence (AI)

Artificial intelligence (AI) is defined as machines or computer software that are capable of intelligent behaviour. There are many ideas about what intelligence actually is; however, intelligent traits are widely agreed to include learning, reasoning, problem-solving, perception and language understanding.

Artificial intelligence can be split into two categories: strong AI and applied AI. Strong AI machines would have an overall intelligence indistinguishable from human intelligence. Applied AI, also known as weak AI, is currently being used in *smart* systems like mobile phone personal assistant software or face recognition software.

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Great golden digger wasp

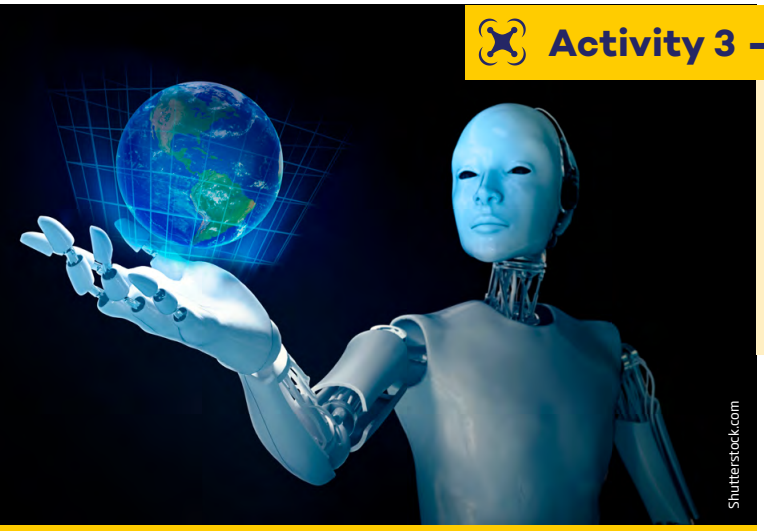
Intelligence in nature

Some consider intelligence as the ability to adapt behaviour to new circumstances. The digger wasp (Sphex Ichneumoneus) is not considered to be intelligent despite relatively complex behaviours.

When a female wasp brings food back to her burrow she will leave it on the threshold before going inside to check for intruders. If there are no intruders, she will then carry the food inside.

This seems to be an intelligent action; however, when entomologists moved the food while the wasp was inside her burrow the true unintelligent nature of the behaviour pattern is revealed.

When the wasp emerges from the burrow and finds that the food has moved, she repeats the whole procedure again. She carries the food to the threshold and leaves it outside, goes in to look around, and emerges for the food. This has been seen to continue for more than 40 cycles.



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Android holding a holographic Earth

Activity 3 – Discussion

Scientists like Stephen Hawking and Elon Musk have warned of the dangers of artificial intelligence taking over the world, and even keeping humans as pets.

Do you think that artificial intelligence could be the greatest achievement for mankind, or that it will be responsible for our ultimate downfall?

Notes for teachers

Before starting this session, the line tracking robot should be made and tested following the instructions included.

Alternatively, a team of students could build the robot while the rest of the group completes activity 2. Or more line tracker robots could be purchased for all students to build from Rapid Electronics (**www.rapidonline.com**), Order code 06-9348.

The maze for activity 2 should also be set up before the session to help the students plan their route.

For more information about Sense Plan Act, you may like to show your students this video **tinyurl.com/senseactplan**

Activity 1

Students should work in teams to investigate how the robot works.

The line tracker robot has two infrared lights and sensors next to the wheels. The infrared light is reflected on white shiny surfaces and detected by the sensor, which causes the wheel to rotate. The infrared light is not reflected by black dull surfaces so no infrared light will be detected by the sensor and the wheel stops. The sensors are 1.8 cm apart so any black line used should be at least 1.8 cm wide.

Stretch and challenge 1

One suggestion for improving the design could be adding another infrared sensor.

By having three sensors, you can program your drone to turn a right angle when only one sensor detects light. To move forward, the left and right sensors (sensors 1 and 3 respectively) would detect light but the middle sensor (sensor 2) would not, as seen in Diagram 1. Diagram 2 shows how the sensors would detect light on a right or left turn. The drone could be programmed to complete a sharp left turn when only sensor 3 senses light; or turn a sharp right when only sensor 1 detects light.

If the electronic equipment, time and expertise are available, you could ask the students to build and test their improved line tracker robot.

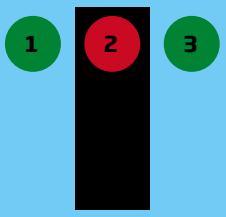
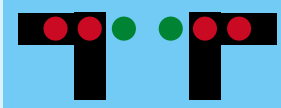


Diagram 1



Sharp left turn

Sharp right turn

Diagram 2

Activity 2

For this activity you will need a 1.45m x 2.4m area of white, or light, coloured even flooring. It is advised that desks are not joined together for this activity as the robot can become stuck in the small gaps or bumps between desks. Set up the maze as shown on page 2. You can use blocks or books as the obstacles (black areas on the map). Students should use black electrical tape to create their track for the robot to follow.

Stretch and challenge 2

There are many ways for drones to sense their environment. Cameras could be used for a pilot to control the drone; however, encourage your students to think of ways to make the movement autonomous. Pressure sensors could be used to sense when the drone hits a wall, or proximity sensors that use electromagnetic or ultrasonic waves reflecting off obstacles to avoid collision like in self-parking cars.

Activity 3

Richard Dawkins explains the digger wasp experiment: **tinyurl.com/digwaspvid**

For this activity it might be interesting to have the students place themselves on a continuum before and after the discussion. One side of the classroom could be for AI being mankind's greatest achievement and the other side for AI being responsible for the ultimate downfall of the human race. Students could position themselves on the continuum as to how strongly they agree with the statement.

Strongly agree that AI will be mankind's greatest achievement

Agree that AI will be mankind's greatest achievement

Unsure

Agree that AI will be responsible for the ultimate downfall of the human race

Strongly agree that AI will be responsible for the ultimate downfall of the human race

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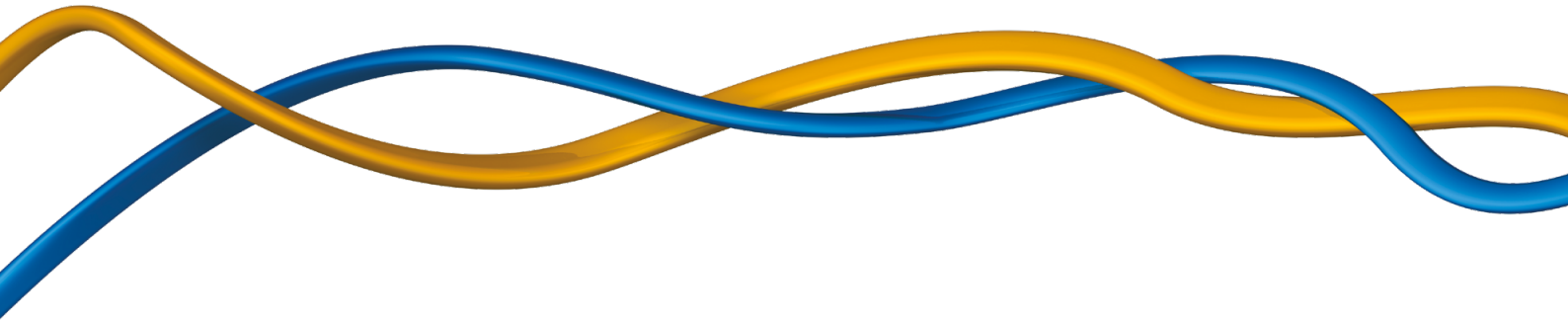

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