Exploring TPBot

Introduction to TPBot (no micro:bit required)

The micro:bit TPBot is a smart car robot that helps students explore key concepts in the Digital Technologies curriculum.

After a short discussion about robots and where they can be found in the real world, this short activity introduces using a TPBot using the line following function and obstacle avoidance without a micro:bit. By observing a robot in action, students will discover how it uses sensors to follow a line and how those sensors gather real world data to guide its movements. A brief follow-up discussion explores how branching (IF/THEN/ELSE) statements instruct or program robots to react to outside data.

Curriculum links

We encourage teachers to adjust the content to suit the needs of their students. The activity can be adapted for students between Year 3 and Year 4. More details are provided in the supporting documents.

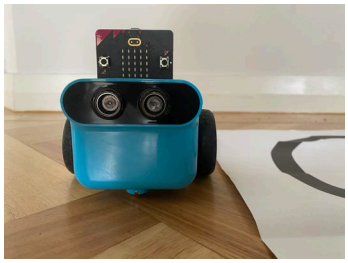
Digital Technologies		
Technologies Core concepts	Systems – inputs, processes and outputs	Interactions and impacts
	Systems thinking	Computational thinking

For more information about the Australian Curriculum Technologies core concepts Understand this learning area - Technologies

Required resources

You will need the following materials which are available in our CSER lending library kit:

- TPBot smart car robot
- 4 x AAA batteries (providing a runtime of approximately 1.5hrs)
- Line tracking map



No prior knowledge is required.

Introduction to robots

Begin this session with a discussion about robots. The video What is a robot (for kids) by *janellevideo* describes robots as machines that humans build to do something. They have sensors, processors and tools (actuators). The first 7 minutes provides a good introduction. Possible questions:

- What parts does a robot have that help it do its job?
- Name one thing a robot can do to help people.
- Can robots think or feel like humans? Why or why not?
- If you could make your own robot, what job would you want it to do?

Automatic line following

Engage – Watch the robot detect and react

Show the TPBot running in 'automatic line-following mode' around a simple track (line tracking map). Place the TPBot on the line-following mat and press the power button on the back. Ask students:

- What do you notice about how it moves?
- Does it stay on the line?
- How does it follow the line?

Discuss the TPBot ultrasonic sensors (front) and line following sensors (underneath) that can detect the contrast between dark and light surfaces and send data to the micro:bit to control the motors.

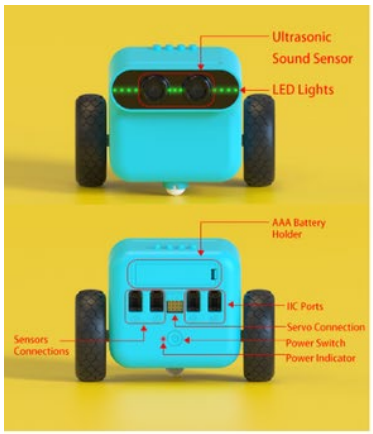
Explore – Investigating sensors

What is a sensor? Student friendly definition	A sensor is a small device that can detect things like light, sound, movement, or temperature and turn that into information. In digital technologies, sensors help computers and machines detect what is happening so they can make smart choices, like turning on lights when someone walks into a room. A sensor (an input device) on a TPBot detects lines (changes in colour) on the ground and identifies obstacles in its way, so it decides where to go. The robot's sensors send this information to its computer, which is then programmed to follow the line, turn, or stop so it does not crash.

In small groups, let students explore what happens when they place the TPBot on and off the line - to see how the behaviour changes. Gently cover the line following sensors (we used a sticky note) to observe what happens when the sensors are covered.

Guiding questions:

- What might happen if we cover one floor sensor? (the bot follows the line for short time but then circles).
- What might happen if we cover both floor sensors? (the bot proceeds straight until it senses a wall and stops).
- What happens as the bot moves towards an obstacle in front of it? (the bot stops a few centimetres away from the obstacle).
- What might happen if we cover front ultrasonics sensors? (the bot proceeds and hits obstacles it encounters).



To operate without the micro:bit

Press the power button to enter into its standby mode, lights on the power indicator [LEDs = green]
While in standby mode, press the power button to enter into the line-tracking & obstacles-avoidance mode [LEDs = rainbow mode].

Double click the power button to power off the TPBot

Explain – Connecting robot movement behaviour to algorithms and programming

Discuss the following:

- to complete a task, a robot needs both hardware and software.
- hardware includes the TPBot body, motors and sensors that collect data from a user, digital system or the environment.
- software is the program stored on the robot that tells it what actions to take.
- an algorithm is the step-by-step set of instructions that connects the sensor data (what the robot detects) to the output (what the robot does). When this algorithm is written using a programming language, it becomes a **program**.

Refer to how the TPBot behaved when following the line or sensing an object in front of it, and have students create an algorithm (pseudocode) using simple branching (if/then/else). For example:

- If the line following sensor detects a dark line what does the robot do?
  [IF line is detected THEN follow line ELSE continue forward]
- If the ultrasonic sensor detects an obstacle in front
  [IF obstacle is detected THEN stop ELSE continue forward]
- If ultrasonic sensor does not detect an obstacle in front
  [IF no obstacle is detected THEN proceed forward ELSE stop]

Evaluate – Reflecting on systems and thinking

Prompt students to reflect:

- What features make up this robotic system (sensors, processor/micro:bit, motors, power)?
- Where might line-following robots be useful (e.g. warehouses, factories, hospitals)?
- What's one thing you now understand about how robots move?

Why is this relevant? (Real world connections)

This lesson connects to the real world by showing students how robots and automated systems can be programmed to follow instructions, just like machines used in warehouses, hospitals, and farms. It helps them understand that digital systems, sensors, and coding are part of many everyday technologies, preparing them for future jobs and problem-solving in a digital world.

Assessment

Observation can be used to check students' ability to carry out tasks aligned to the Australian Curriculum. We have included some suggested questions for teachers to reflect on and to guide these observations.

Checking for understanding

- Can students identify real-life opportunities for robotics?
- Can students describe the role of a sensor in a digital system?
- Were students able to describe the TPBots behaviour using an algorithm?

For more assessment resources we recommend the Assessment resources on the Digital Technologies Hub.

More details about the TPBot are available on Elecfreaks - Learn page

Australian Curriculum

Students in Years 3 and 4 learn to:

- follow and describe algorithms involving sequencing, comparison operators (branching) and iteration (AC9TDI4P02)

By the end of Year 4 students follow and describe simple algorithms involving branching and iteration.

Teacher professional learning opportunities

We would like to thank the Australian Government Department of Education for funding our Lending Library and associated resource development.

We run a range of STEM programs for Australian teachers, including our online CSER MOOC courses, free professional learning events, and our National Lending Library.

Our free, self-paced online courses available from CSER and Maths in Schools in the following areas:

- Decoding Digital Technologies
- Digital Technologies + X
- Cyber Security and Awareness
- Teaching AI in the classroom
- Maths in Schools: Foundation - Year 2, Year 3 - 6 and Year 7 – 10

See the CSER National Lending library for more lesson ideas

www.csermoocs.adelaide.edu.au