InO-Bot

Teacher Guide - Scratch

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InO-Bot

InO-Bot - full of inputs and outputs

Contents

Previous Experiences

Prior to using InO-Bot, children should have some experience of using Scratch and ideally experience of other robots such as Bee-Bot and Blue-Bot.

Progression

The activities outlined below are in a suggested order of progression. There is no specific amount of time to be spent on each as this will vary from one situation to another. It may also be necessary to break some of the activities down further to suit children's needs.

National Curriculum

The National Curriculum for Computing references listed below are indicative of some aspects of the curriculum the activities cover. They are not an exhaustive list nor do they indicate that one activity fully covers that curriculum area. The activities support children in learning computing skills and applying computational thinking.

Attainment Targets

Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output
- Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs

Key Focus 1 – Getting started with InO-Bot

InO-Bot is full of inputs and outputs but it is best to start as simply as possible. Begin with outputs and get children to explore what can be done with the 8 RGB LED lights on top.

Run the TTS Scratch Launcher. Select InO-Bot Basic. Once connected remove the example programs already on screen by dragging them off the scripting area. For full details on connecting to InO-Bot, see the InO-Bot user guide.

Use the 'Set LED' and 'wait' blocks to light one LED different colours. Investigate what happens if the 'wait' time is changed or removed.

The LEDs are numbered 1 to 8 starting at the back right (InO-Bot facing away from you). Children could explore changing the LED number and work out which LED is which.

Introducing the concept of repetition will allow this activity to be developed. Children can explore lighting the LEDs in different orders to create alternative patterns. The example (right) could be seen as an emergency vehicle light pattern.

Having explored different patterns, the next step could be to mimic something real world. Traffic lights are a great option. Ask children to write a program that lights LEDs 1, 2 and 3 as if they were traffic lights.

It helps to have an image of the sequence traffic lights cycle through. This will allow children to plan their program before they start work in Scratch.
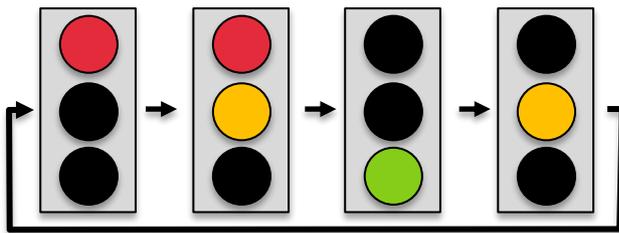
An example program for traffic lights is shown above. Note: there will be a number of ways to achieve the same result.

Extension Activity
To extend this activity, ask children to create a second set of lights in a counter sequence. These could be lights on cross-roads or where a road narrows to one lane with lights at either end. This can be achieved using the two sides of InO-Bot, i.e. LEDs 1, 2 and 3 against 8, 7 and 6.

Key Focus 2 – Getting into shape

InO-Bot has a lift and lower pen carrying mechanism. This feature is really useful to see where InO-Bot has moved. Drawing shapes is a good activity to develop programming skills using repetition and also maths knowledge.

The first challenge is to make InO-Bot move in a square shape.

Notes:
The 'Movement Complete' block is available when Scratch for InO-Bot is first launched. The block ensures the next command is not sent to InO-Bot before the previous command is completed. Bear in mind that InO-Bot is being controlled live by the PC.

InO-Bot has large wheels and these may account for some small errors. Although not mathematically accurate, turns may need to be increased or decreased by a degree or two. The accuracy of movement may also be affected by the type of surface InO-Bot moves over.

The example program (shown above) works but isn't very efficient. Using repetition can help reduce the number of instructions required. "Forwards 10 cm then spin right 90 degrees" is repeated four times. The example (right) shows what this would look like.

Now use InO-Bot's pen holder to see what shape has been drawn. What other regular polygons can the children create?
 Try drawing an equilateral triangle. This is actually quite challenging and can provoke useful discussions about internal and external angles.

You may also wish to talk about the relationship between the number of sides and the angles, e.g.

A square - 4 sides, external angle 90°
A pentagon - 5 sides, external angle 72°
An octagon - 8 sides, external angle 45°
Tip: For each of the above multiply the number of sides by the angle.

Key Focus 3 – Name that tune

InO-Bot has 29 built-in sounds. Full details of these are listed in the user guide.

Begin by creating a simple loop to enable stepping through the sounds on a key press. The example (right) makes use of a variable. In the Data section of Scratch choose 'Make a Variable'. Call it – 'note'. The set of blocks shown right mean that pressing the up arrow on the keyboard adds 1 to the variable note and then plays that sound on InO-Bot. Pressing zero resets the variable called 'note' to 0. For example press 0, 'note' is set to 0. Press the up arrow 'note' = 0 (its current value) + 1 i.e. 'note' now = 1, so sound 1 is played on InO-Bot. Press the up arrow again 'note' = 1 + 1 i.e. 'note' now equals 2 etc.

Having listened to all the different sounds, a program could be written to play a tune. Below is a list of the musical notes InO-Bot can play. To the right is an example of a known tune. (Can you find out what it is?)

Sound Musical Note
17   1c
18   1d
19   1e
20   1f
21   1g
22   2a
23   2b
24   2c
25   2d
26   2e
27   2f
28   2g
29   3a

It is important to have the 'wait' blocks in place as these set the pauses between notes. These pauses could actually be created as a variable. This would mean the pause duration could be altered in one place rather than many times through the program.

This is an example of using a variable to set the pauses throughout the tune. One change at the top of the program will change the pauses throughout.
Note: Where a longer pause is needed the tempo variable is doubled (* 2). It could also be shortened by halving it (/2).
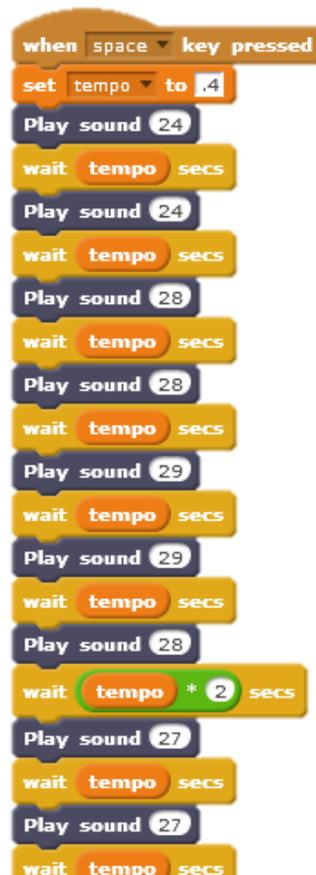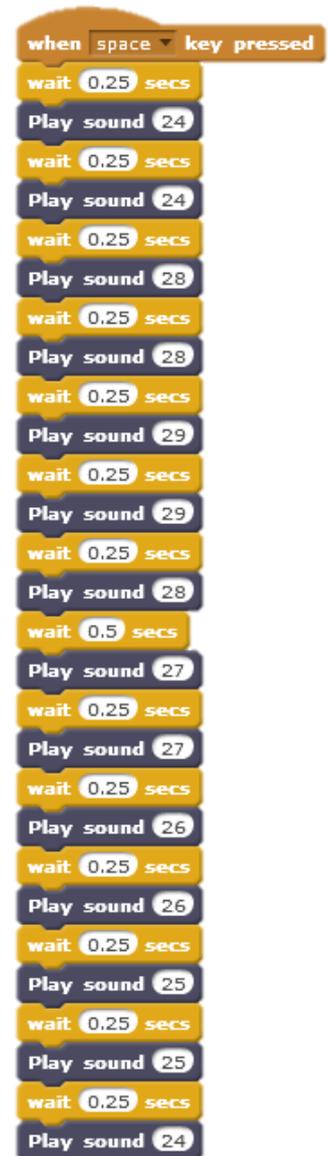
Key Focus 4 – Automatic headlights

InO-Bot has a range of sensors which can be used as input triggers. These triggers can then activate outputs; for example to switch on headlights when dark.

The example on the right shows a conditional statement ('If…then…else' block) in use. 'If' the value from the light sensor is less the 25 'then' turn the front lights on. 'If' it's not less than 25 (25 or more) 'else' turn them off. The check needs to be run continually (not just once) therefore a 'forever' loop has been used. Some experimentation will be required to work out what value the light sensor should report to trigger the lights.
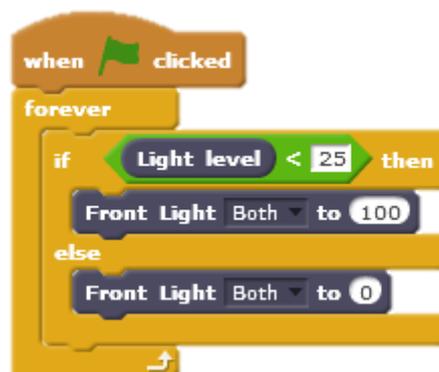
Key Focus 5 – Avoid obstacles

On the front of InO-Bot there is an ultrasonic range finder. This is a sensor that reports values from 0 to 255. The values are reported in centimetres and indicate how far an object is from the front of the sensor. InO-Bot can be programmed to move around and when the range finder reports an obstacle at a given distance in front it can back up and turn.

The 'Movement Complete' block is defined to allow movements to be completed before the next command is issued. This block is there when the TTS Scratch Launcher runs. If the block isn't available, it can be recreated by dragging the same blocks together, as shown.

The 'when q key is pressed' set of blocks is created as an emergency stop. Pressing q will quickly stop InO-Bot moving.

The 'when x key pressed' set of blocks is the main program and InO-Bot is set to start moving forward. The 'wait' command ensures this movement starts before more commands are sent. The 'forever' loop then contains a conditional check. If the distance sensor reports an object less than 20cm in front, the program makes InO-Bot reverse, turn and then start moving forward again.

There is a sound added ('Play sound9') to indicate when an object is detected. The additional wait ensures commands run.

Children should experiment with the commands above and spend time working out the optimum trigger distance. Should it be more or less than 20cm? There may be some discussion around the trigger point. Does InO-Bot react at exactly 20cm? If not, why not? Often it will be a little less and this is due to reaction time, i.e. the sensor sends data back to the PC, Scratch then needs to read that data and send commands to make InO-Bot do something else. Data needs to be sent back and forth. Although this data transmission is speedy there is still some lag. Are children able to modify their program to address this? For example, they may put 25cm when they want InO-Bot to stop at 20cm.
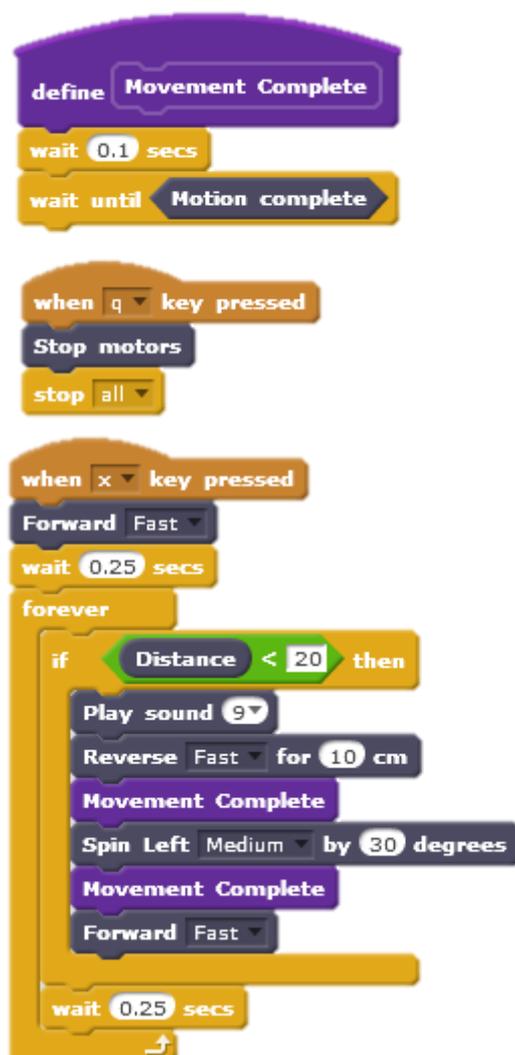
Key Focus 6 – Responding to sound

Just behind the pen tube is a sound sensor (a microphone reporting values 0 - 100). InO-Bot can be programmed to respond to sound. It might move, stop moving or light up different lights.

An example is shown on the right. 'If' the sound level rises above 12 'then' light the front two LEDs 'else' turn them off. 'If' it rises above 20 'then' turn the next row of LEDs on 'else' turn them off. Because both conditional checks are in the same loop both can be true at the same time and therefore the first two rows of lights come on at the same time.

Note the commands used in the 'else' section. These are used to ensure the lights switch off again rather than switching on and staying on.

A further challenge could be to light another row of lights or make something else happen, e.g. at different sound levels change the colour of LEDs 4 and 5 only.
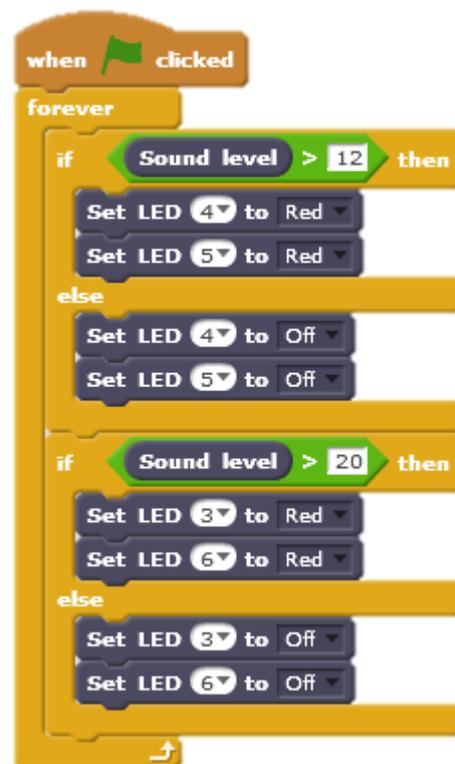
Getting Started with InO-Bot and Scratch on Windows

InO-Bot Bluetooth Connection

For all versions of Windows:

1. Ensure that Scratch 2 Offline is installed. For more details see:
   https://scratch.mit.edu/scratch2download/

2. Download and install the TTS Scratch Launcher from the supporting material section of this page:
   http://www.tts-group.co.uk/ino-bot-scratch-programmable-bluetooth-floor-robot/1009821.html

Windows 7 Bluetooth Connection

1. Switch on InO-Bot

2. Click on the small arrow on the taskbar and then click on the Bluetooth icon.
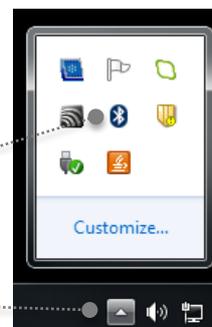
3. From the menu that appears click on 'Add a Device'.
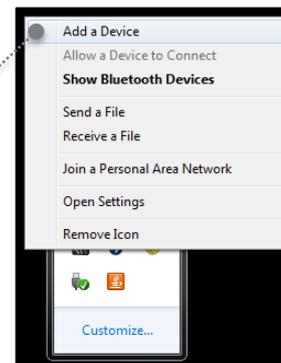
4. A list of available Bluetooth devices will be shown.

5. Click on the icon by InO-Bot and then click on 'Next'.
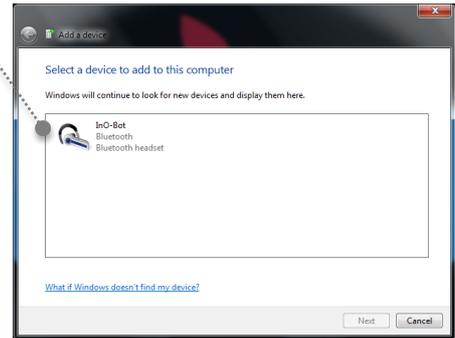
6. Once a connection is made the screen below will be shown. Click on 'Close'.
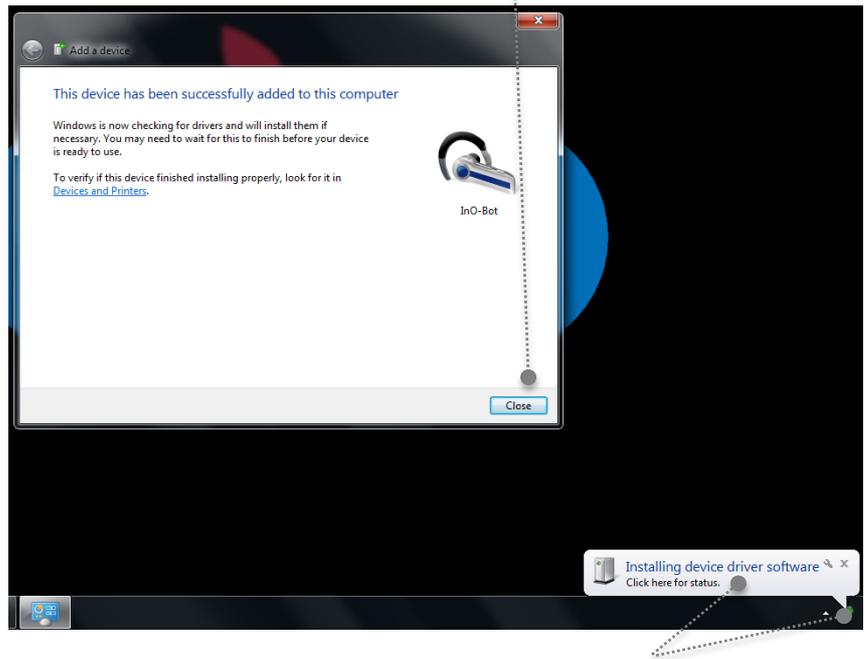
7. Click on this message or icon to view the driver installation progress (shown below).

8. Windows will automatically install the required drivers.
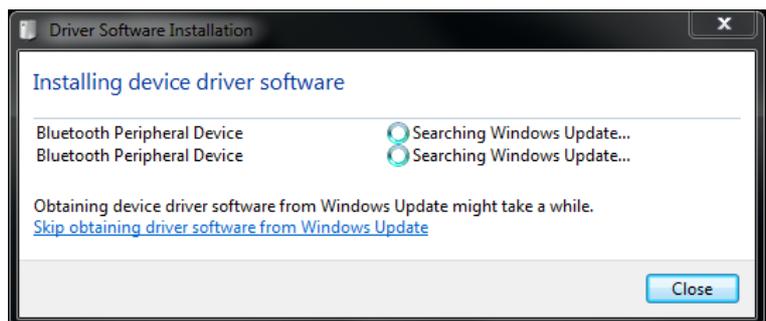
9. Once the drivers are installed the message below will be shown. Click on 'Close'.
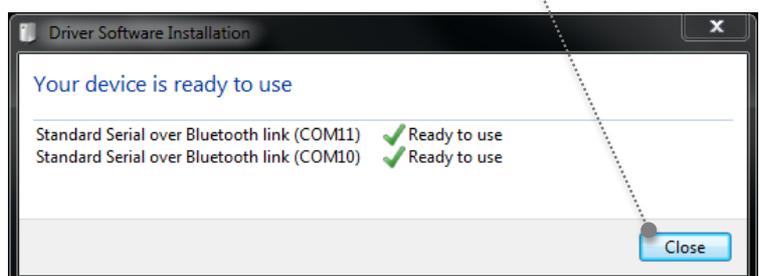
Note: Steps 2 to 9 above only need to be completed once for an InO-Bot to be used. Once complete the computer will remember that particular InO-Bot.

Windows 8.1 Bluetooth Connection

1. Switch on InO-Bot

2. Click on the small arrow on the taskbar and then click on the
    Bluetooth icon.
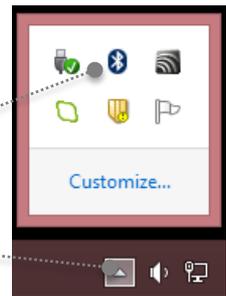
3. From the menu that appears click on 'Add a Bluetooth Device'.
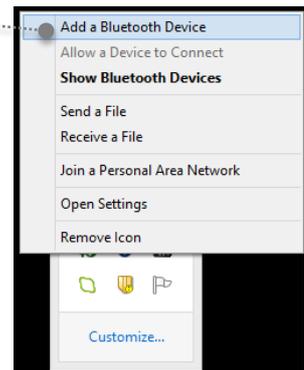
4. The screen will change and a list of available Bluetooth devices will be shown.
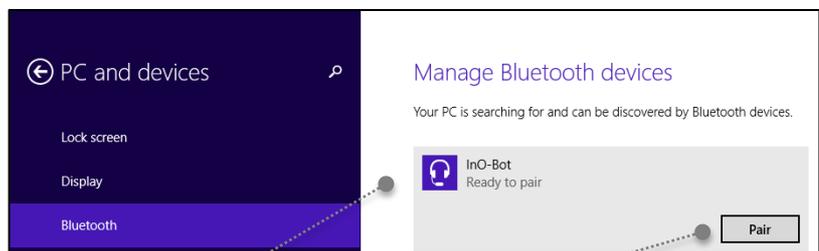
5. Click on the headphone icon by InO-Bot and then click on 'Pair'.
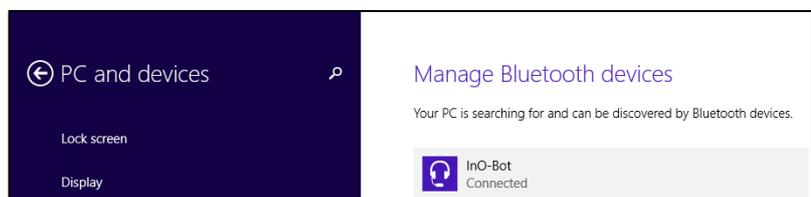
6. Once paired a Connect message will be displayed.

7. The Bluetooth connections panel can be closed.
    Windows will display a message while the Bluetooth
    connection process completes.
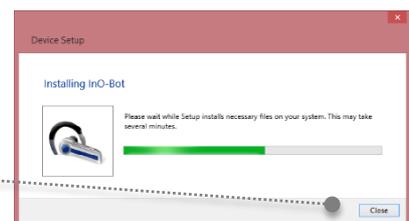
    Note: Steps 2 to 7 above only need to be completed once for an InO-Bot to be used. Once complete the computer
    will remember that particular InO-Bot.

Windows 10 Bluetooth Connection

1. Switch on InO-Bot.

2. Click on the Bluetooth icon from the system tray (bottom right of the screen).

3. Click on 'Add a Bluetooth Device'.

   | Add a Bluetooth Device |
   | Allow a Device to Connect |
   | **Show Bluetooth Devices** |
   | Send a File |
   | Receive a File |
   | Join a Personal Area Network |
   | Open Settings |
   | Remove Icon |
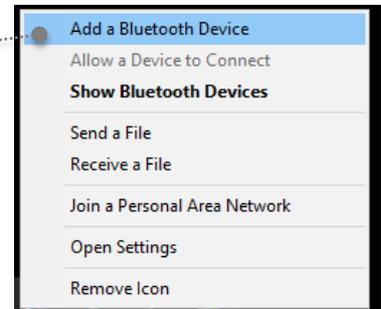
4. Click on the headphone icon by InO-Bot. (Ignore the tablet / phone icon)

   Manage Bluetooth devices

   Bluetooth

   On

   Your PC is searching for and can be discovered by Bluetooth devices.

   · · · · ·

   InO-Bot
   Paired

   InO-Bot
   Ready to pair

   InO-Bot
   Ready to pair
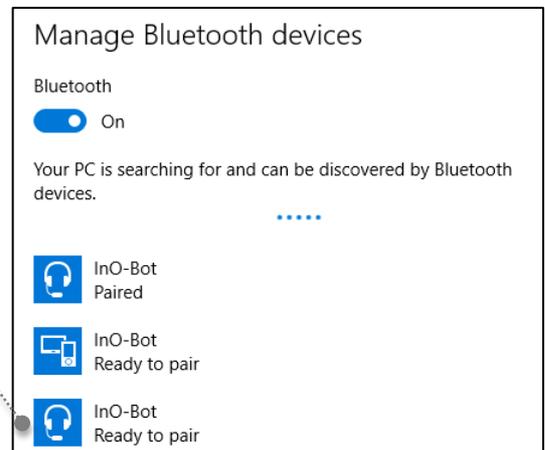
5. An option to pair should appear. Click on the 'Pair' button.

   InO-Bot
   Ready to pair

   Pair

6. Once the pairing completes the Connected message should appear:

   InO-Bot
   Connected

   Note: Steps 2 to 6 above only need to be completed once for an InO-Bot to be used. Once complete the computer will remember that particular InO-Bot.

Using InO-Bot (Windows 7, 8.1 and 10)

1. Double click on the Scratch Launcher icon

2. The TTS Scratch Launcher will open and try to detect if a Scratch Controller or Rainbow Matrix is connected. If either is detected a tick will appear in the box underneath the icon.
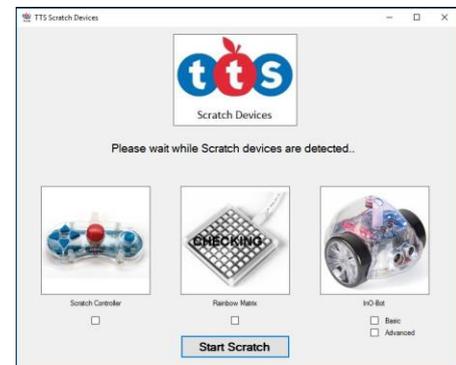
3. Tick the 'Basic' or 'Advanced' box underneath the InO-Bot icon. Basic is a more limited set of Scratch Blocks for InO-Bot and Advanced contains all blocks available for InO-Bot. Click on 'Start Scratch'.
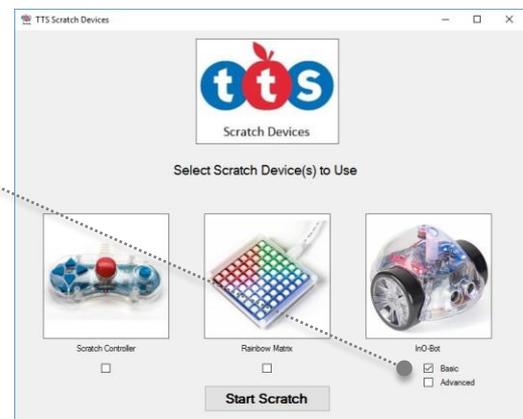
4. Scratch will open and a graphic will appear which indicates the PC is searching for InO-Bots that have been paired with that machine.
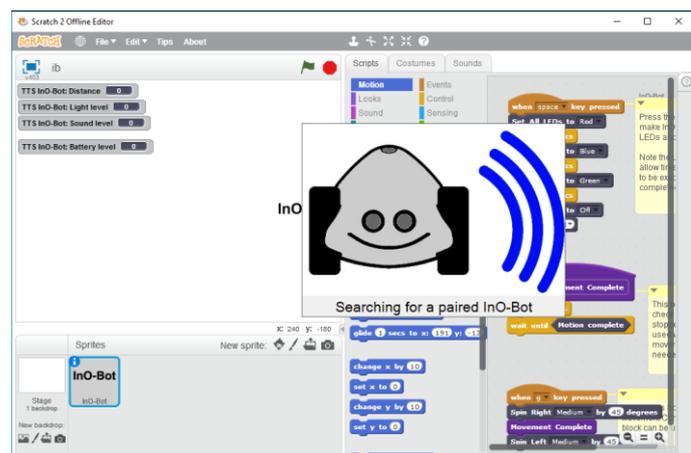
5. If an InO-Bot is detected a dialogue box should appear which indicates the COM port an InO-Bot is connected to (COM ports can vary from machine to machine).
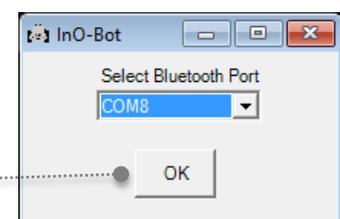
6. Click on 'OK' to close the dialogue box.

7. InO-Bot can then be used with Scratch. Additional blocks to control InO-Bot are available in 'More Blocks'.
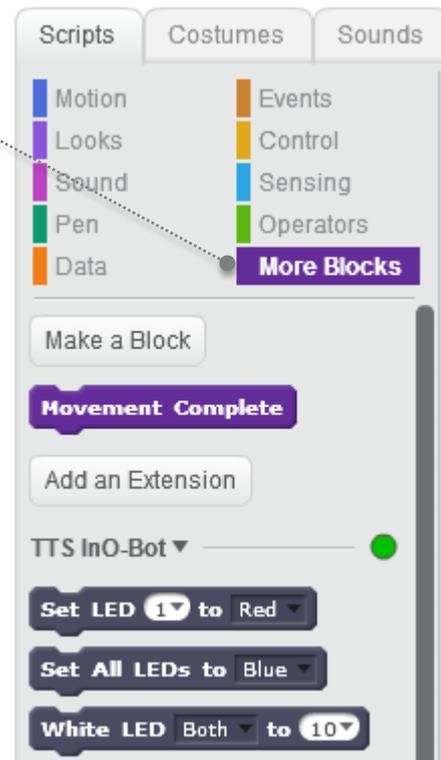
Scratch Blocks

Basic

| Command	Values	Description
Set LED 1 to Red	1 – 8	Lights the top LEDs in different colours. LED 1 is on the back right hand side and numbered in an anti-clockwise direction i.e. LED 8 is on the back left.
Set All LEDs to Blue		Lights all the LEDs on top a given colour.
White LED Both to 10	0 – 10	Lights the headlights – left, right or both. 0 is off, 10 is full brightness.
Forwards Medium for 10 cm	1 – 127	Moves forwards the stated distance and given speed (slow, medium or fast).
Reverse Medium for 10 cm	1 - 127	Moves backwards the stated distance and given speed (slow, medium or fast).
Forward Medium		Switches the motors on forward.
Reverse Medium		Switches the motors on in reverse.
Stop motors		Stops the motors.
Spin Left Medium by 45 degrees	0 – 180	Turns stated angle anti-clockwise at given speed (slow, medium or fast).
Spin Right Medium by 45 degrees	0 – 180	Turns stated angle clockwise at given speed (slow, medium or fast).
Play sound 0	0 – 29	Plays given sound (see below for index).
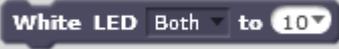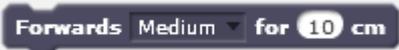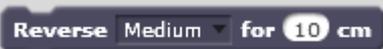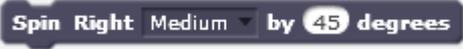
"Scratch is developed by the Lifelong Kindergarten Group at the MIT Media Lab. See http://scratch.mit.edu."

Sensors

IR Sensor FL	Proximity (Corners) FL – Front Left FR – Front Right BL – Back left BR – Back Right Line Follower Left Right	Returns a true or false value (true = triggered) e.g.
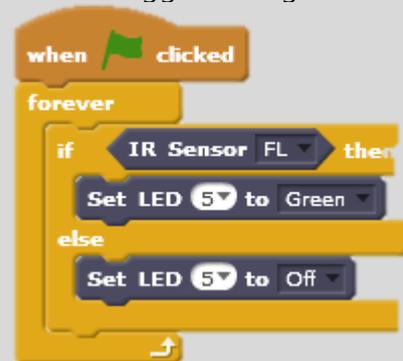
Distance
Light level
Sound level
Battery level

Return values from the on board sensors. Placing a tick by them will allow them to display values on the Scratch stage.

Advanced

The commands and sensors below are available in addition to the Basic blocks listed above.

Command	Values	Description
Set All LEDs to RGB 0 0 0	0 - 255	Sets the top LEDs a given colour using red, green and blue values.
Set LEDs 0 to RGB 0 0 0	1 – 8 and 0 - 255	Sets LEDs on top a given colour using red, green and blue values.
External connector Stop	Forward, Reverse, Stop	For use with the external connector.
IR Beacon On	On / Off	Switches the infrared beacon on or off.

Sensors		
IR Receive	255 - 0	If infrared is detected. Lower value is high level of infrared.
Left Wheel Right Wheel		These show the readings from the wheel counters built in to the robot.

Sounds

Effect		Piano		Xlyo	
Index	Sound	**Index**	Sound	**Index**	Sound
0	1	10	a	17	1c
1	2	11	b	18	1d
2	3	12	c	19	1e
3	4	13	d	20	1f
4	5	14	e	21	1g
5	6	15	f	22	2a
6	7	16	g	23	2b
7	8			24	2c
8	9			25	2d
9	10			26	2e
				27	2f
				28	2g
				29	3a

Technical Support

Please visit www.tts-group.co.uk for the latest product information.

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