

# Introduction to ExperiSense – a How-to Guide

## A General Overview



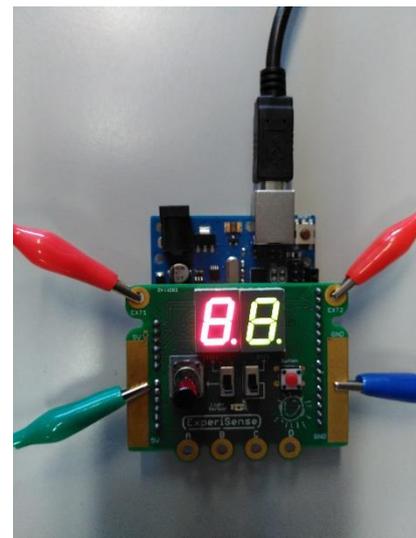
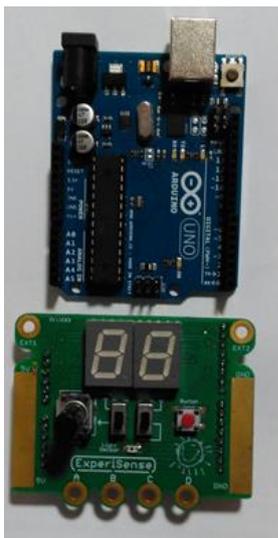
Scratch sparks the interest of young people, encouraging them to develop their own creative projects. Sensor boards, such as the PicoBoard, expand their interest into the world of physical computing, which allows them to engage further with their creations through a variety of real-world sensors.

Unfortunately, PicoBoard's input-only approach and its inability to measure voltage limits the scope of potential resources. Inspired by this, Technology Volunteers developed an inexpensive, open-source add-on board for Arduino using 'off-the-shelf' components, opening up further interactions with the physical world.

ExperiSense was designed with a view to keeping costs from becoming excessive, thus encouraging its application to schools and large class sizes. Arduino is readily and cheaply available (and can be repurposed for other uses/projects) and the ExperiSense hardware can itself be used for standard Arduino projects – although avoiding the requirement for fiddly and often complex circuits to be constructed, which is beneficial from a school perspective.

This worksheet provides an introduction to ExperiSense, detailing how to set up and use the board.

**ExperiSense in Action.** The ExperiSense board has been designed to sit on top of the Arduino, with its prongs fitting perfectly into the holes on the Arduino (see images below). Once the Arduino has been connected to a computer (type A to B USB cable) the visual display should light up as shown.

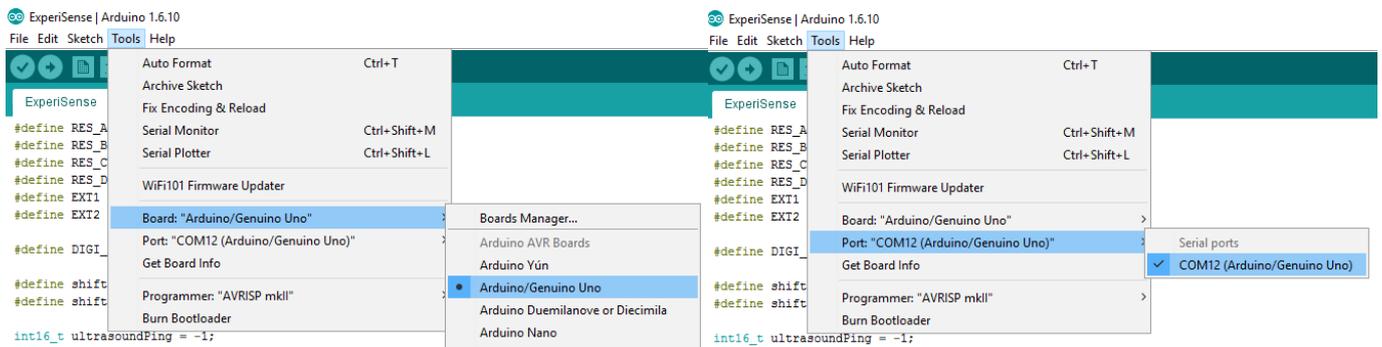


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# How to Setup the ExperiSense Board

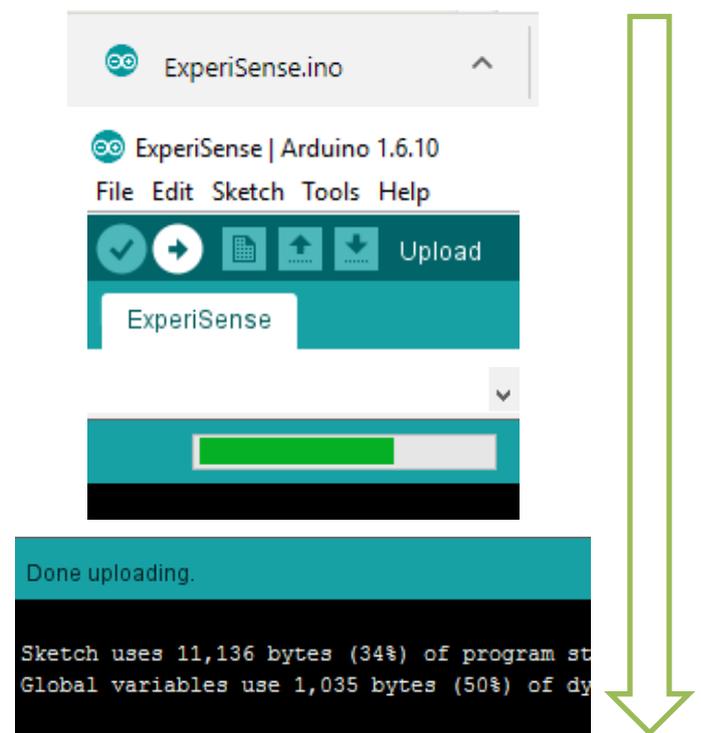
**Step 1:** If you've not already done so, your first step should be to download the Arduino application – see *useful links on page 6*. Be sure to choose the latest version and also the correct download for your computer and operating system. Once downloaded, plug the Arduino into your computer.

**Step 2:** Now you need to tell the Arduino application what board you are using and where it can be found (i.e. Port). Both can be found in the Tools menu (see *pictures below*). If you don't see the correct port even after double-checking the board is plugged in, then follow one of the Arduino installation guides – see *useful links on page 6*.



**Step 3:** It's time to download the custom Arduino ExperiSense sketch – see *useful links on page 6*:

1. Simply click on the link and the file should download to your computer.
2. Once downloaded, open it in the Arduino software and then upload the sketch to the board (see *screenshots on right*).
3. Wait for the code to be uploaded to the board – the progress can be followed by the bar in the bottom right. Once the process has finished the message "Done Uploading" will show in the status window (see *image on right*).



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[N.B. An error will appear if the wrong Arduino board has been selected ("Not in sync"), or the wrong USB port has been selected ("Problem uploading to board"), within Step 2. Another cause for an error message is if you have a program open that has a connection already established to the Arduino – it won't be able to 'let go' of the serial port for Arduino to use until it is closed. If you are still having problems, we recommend going to the online Arduino guide(s) (*see useful links on page 6*).

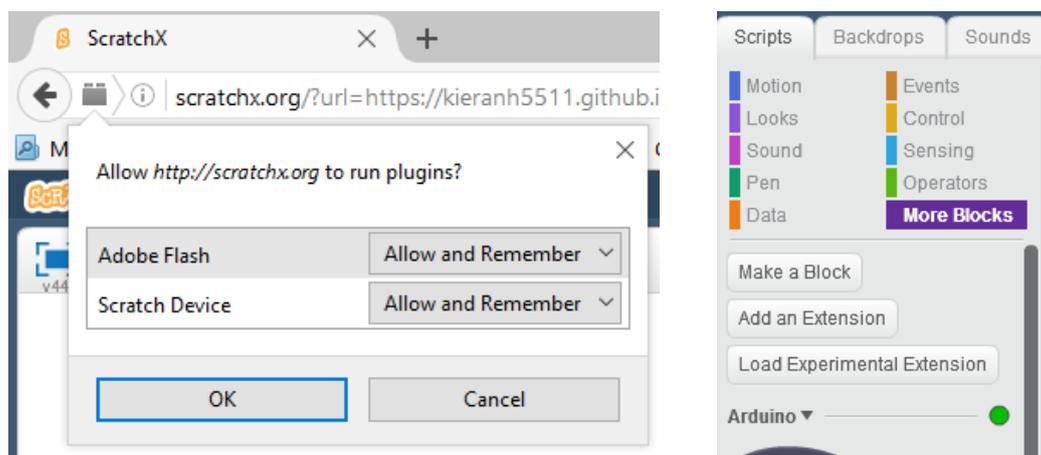
The ExperiSense board communicates with Scratch through an Arduino extension, which uses ScratchX. This extension talks to an Arduino running the custom Arduino ExperiSense sketch. ScratchX is accessed online and grants you the ability to play with experimental extensions to Scratch, allowing the creation of Scratch projects that connect with external hardware (such as electronic devices and robotics) and online resources (including web data and web services).

**Step 4:** Download and install the Scratch Extensions Browser Plugin, which allows Scratch to be used with a hardware device – *see useful links on page 6*.

[N.B. Only Firefox (Extended Support Release – Windows/Mac), Internet Explorer (Windows) and Safari (Mac) are currently compatible with this plugin, therefore you will have to use one of these browsers to operate the ExperiSense board – there is an issue with the Chrome version].

**Step 5:** Now launch ScratchX with the ExperiSense extension included – *see useful links on page 6*. This extension was developed from the original Arduino ScratchX extension, which allows learners to get on with building projects without having to worry about any unnecessary technical details or how the underlying Arduino works. When you see a green light in the "More Blocks" tab then the ExperiSense board is ready to go (*see screenshot below*).

[N.B. On Firefox ESR you will have to set both Adobe Flash and Scratch Device to "Allow and Remember" (*see image below*)].



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# How to Use the ExperiSense Board

**1 Voltage inputs/outputs:**  
Useful for scientific workshops and retains some compatibility with Arduino resources (they function as standard Arduino pins).

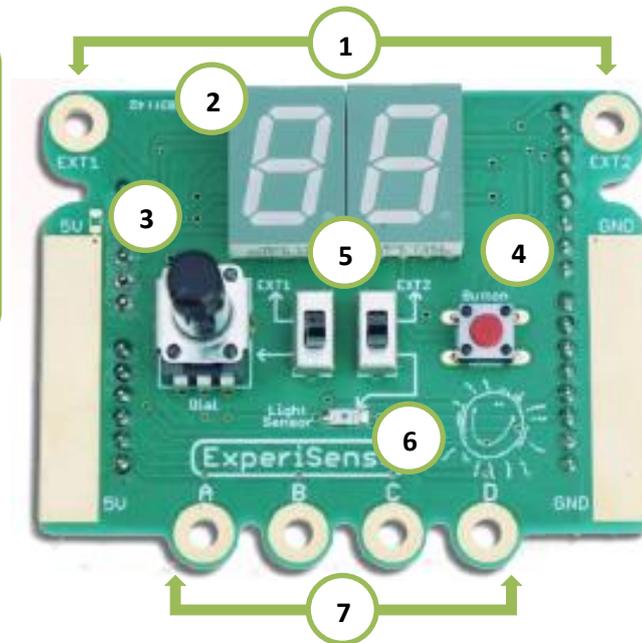
**2 Seven-segment Displays:**  
Simple and immediate output (introduction to output capability); allows scoreboards.

**3 Potentiometer/Dial:**  
Cheaper and easier to source than the PicoBoard's slider and takes up less space on the board.

**4 Button:**  
A simple button that works in the same way as the PicoBoard's.

**5 Slide-Switches:**  
Ability to select between the dial and light sensor, or external sensors.

**6 Light Sensor:**  
A photodiode is used to give a fast response time.



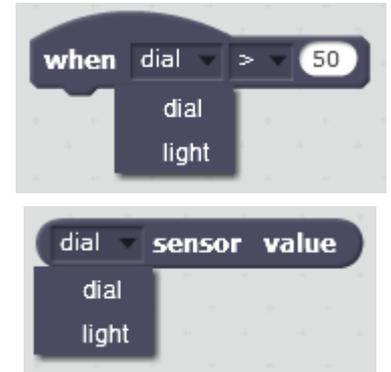
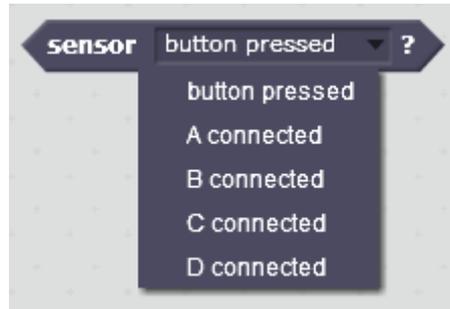
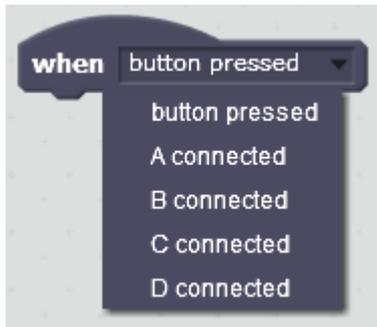
**7 Resistance Inputs:**  
Retain compatibility with PicoBoard whilst also allowing Makey Makey-style sensitivity. The sensitivity can be adjusted in software.

The ExperiSense extension uses some of the original custom blocks from the Arduino extension (*see useful links on page 6*), but tailors them specifically for the ExperiSense board. Many of the existing blocks have also been removed, for simplicity and ease of use.

There are also new blocks that have been designed to incorporate all of ExperiSense's features, such as the ability to easily attach extra devices/hardware to the board, and being able to accurately measure resistance and voltage. Some of the more significant blocks have been explained on the next page.

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The following blocks are an extension to the original “when button is (pressed/released)”, “button pressed?”, and “when (rotation knob) (>) (50) %” blocks. They work in the exact same way, the first two registering when the ExperiSense’s built-in button is pressed, and the third block detects when either the dial or light sensor read a value greater or less than any value of your choosing. The fourth block is new, and allows you to read the value measured by the dial or light sensor. Furthermore, the first two blocks facilitate the attachment of additional buttons to ports A-D of the board, and detect when these buttons have been pressed.



These blocks have been built from the original “read analog ()” block. The left two blocks enable the connection of external sensors between ports A-D and GND (ground) of the ExperiSense board, with the left block checking the current value (0-100) of an analog connection – similar to the PicoBoard – and the middle block giving an exact reading of resistance (in kΩ) of the sensor.

The right block works in the same way, but involves the use of the two external (EXT1 & EXT2) ports on the ExperiSense board. **[N.B. the on-board switches need to be adjusted to select these ports].**

In addition, the sensitivity of the measurement can be adjusted between “normal” and “sensitive”; sensitive should be used in cases where resistances are larger than approximately 20 kΩ.



The blocks below are new and are specific to the seven-segment displays on the ExperiSense board. Numbers can be displayed on the board by simply entering them directly into the blocks. The displays can be used both separately and together, and are able to display a number from 0-99.



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## Useful Links

- Downloading Arduino – <https://www.arduino.cc/en/Main/Software>
- Online guide(s) to Arduino:
  - Windows – <http://www.arduino.cc/en/guide/windows>
  - Mac OS X – <http://www.arduino.cc/en/Guide/MacOSX>
  - Linux – <http://playground.arduino.cc/Learning/Linux>
- Arduino ExperiSense Sketch – <https://kieranh5511.github.io/scratch-experisense-extension/experisense.ino>
- Scratch Extensions Browser Plugin(s) – [https://scratch.mit.edu/info/ext\\_download/](https://scratch.mit.edu/info/ext_download/)
  - Windows (*direct download*) – <http://bit.ly/2ainsCq>
  - Mac (*direct download*) – <http://bit.ly/2aaLZd9>
- ScratchX Webpage and Extensions:
  - ScratchX Website – <http://scratchx.org/#scratch>
  - Original Arduino Extension – [http://scratchx.org/?url=http://khanning.github.io/scratch-arduino-extension/arduino\\_extension.js#scratch](http://scratchx.org/?url=http://khanning.github.io/scratch-arduino-extension/arduino_extension.js#scratch)
  - ExperiSense Extension – <http://scratchx.org/?url=https://kieranh5511.github.io/scratch-experisense-extension/experisense.sbx>
- Brief descriptions of custom blocks with the original Arduino extension – <http://khanning.github.io/scratch-arduino-extension/blocks.html>

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