

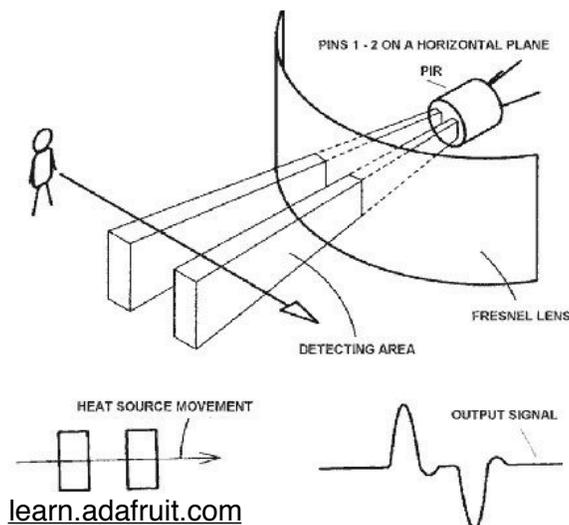
Sensor: Motion Detector

Included in your kit is a PIR motion sensor (HC-SR501 clone). This ubiquitous sensor is actually quite complex. PIR is commonly said to be a TLA for 'Passive InfraRed', but it is probably more accurately called a Pyroelectric InfraRed sensor.

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The core of the sensor is just an element which presents a change in resistance when it 'sees' infrared energy (aka heat radiation), similar to the IR receiver used in a TV remote control system. This element has two small openings for the IR to pass through. These slits mean that the value of the element may change depending on if the IR source (e.g. a 'warm' human body) is able to pass through one slit or both. This implies that an IR source moving across the device will cause the value to move up a bit, then a lot, then back down a bit, and finally back to the original base value. The value coming from this element must be filtered



and amplified, then sampled by a microcontroller fairly rapidly. The microcontroller must keep track of the recent history of readings and use those values over time to determine if something warm is moving in the field of view of the element.

The field of view of the element is generally not adequate for monitoring a very large area, so a special lens is required. This is the white plastic half dome on your sensor. You can carefully push its tiny white legs from below and remove it to see the actual PIR sensing element — as well as the labels for the expected three pins to connect to your micro (GND, VCC, and OUT).

On the bottom of the unit you will see various surface mount components, four electrolytic capacitors, one on each corner. The largish chip is a BISS0001 microcontroller that handles the signal processing direct from the element. There are also two trim pots. The one closest to the short edge of the board adjusts how long the OUT pin stays HIGH after motion is detected. This has a range from about five seconds to several minutes. The other adjusts the overall sensitivity to motion, which, with the lens on, effectively adjusts the distance from about 8' to 20' or so — even with the lens off, the range only adjusts from about 2' - 6', so consider that during your testing.

There is also a jumper on the board. The jumper determines how the OUT timing works. When it is on the two pins closest to the long edge of the board, then upon motion detection it will bring OUT to HIGH and start counting down from whatever the delay trim pot is set to, then bring OUT back to LOW when the countdown completes. If the jumper is in the other position, OUT will go HIGH when motion is detected, and the countdown will start, BUT, if further motion is detected while counting down, the countdown will reset.

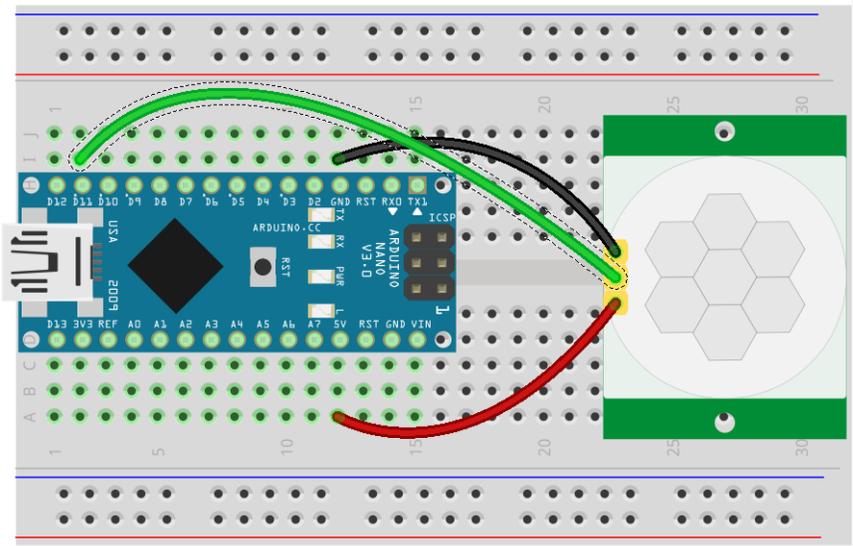
Use is simple - provide power and connect the OUT to a pin on the nano, then start reading the pin. When motion is detected the value will be HIGH.

There are lots of things motion detectors are used for, lighting, security, water faucet control, soap dispensers, etc. Ever had trouble getting the automatic paper towel dispenser to give you a towel? Try washing with hot, and be sure to move your hand across the entire field of the sensor's view, depending on its design you may see better results.

This experiment provides a framework for sensing motion. But Serial output has limited use. Combine your previous knowledge of speakers and tones, to try making a motion alarm that will cry out when motion is detected. When an active motion sensor detects motion, it is called being 'tripped', generally a secure sensor/area, called a 'zone' stays tripped for several seconds.

Note that movement of the sensor itself can have the same effect as movement taking place in its field of view. You may want to secure your sensor to the breadboard with some extra jumpers, tape, etc.

Experiment: Who goes there?

Components	Wiring Diagram
<ul style="list-style-type: none"> ✓ Battery Pack ✓ Breadboard ✓ HC-SR501 motion ✓ Speaker & LEDs 	
Connection Instructions	
<p>Using some of the supplied jumpers, power the motion detector with 5V and GND, then connect the OUT (center) pin to D11. Be careful not to reverse the 5V and GND when connecting the sensor, it will damage it. Remove the white plastic dome lens to double check which pin is which if unsure — GND is on the same side as the yellow jumper and the BIS0001 IC.</p>	
Sketch(es)	motion.ino
Analysis Questions	
<p>How does operation change without the lens?</p>	
Programming Tasks	
<p>Add some sound. Connect a speaker and make some noise when sound is detected. You may have to play around with the trimpots and your code so you get a reasonable alert that resets w/o constantly activating — i.e. a 5 sec sound is probably not appropriate.</p> <p>Try adding a light show too if you want.</p> <p>See this article for more info on tuning your PIR detector.</p>	