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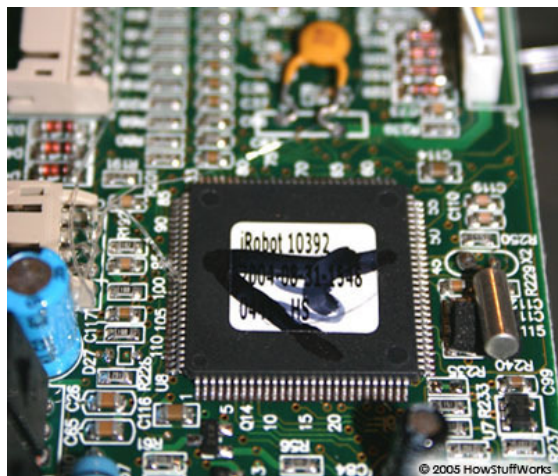
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How Robotic Vacuums Work

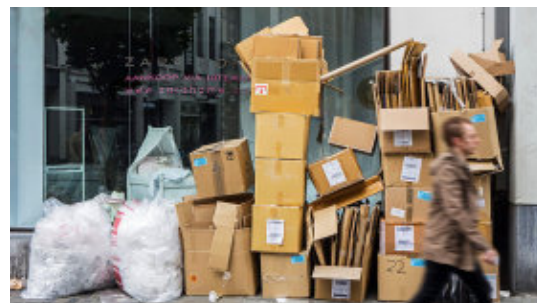
BY JULIA LAYTON

Roomba Navigation

[<< PREV](#) [NEXT >>](#)**Roomba Red's microprocessor**

The self-navigation system is what makes a robotic vacuum robotic, and the biggest difference between a \$50 model and a \$1,500 model is the precision of the navigation sensors. Roomba uses iRobot's AWARE(tm) Robotic Intelligence System to make many decisions for itself, so minimal human input is required. The AWARE system is made up of multiple sensors that pick up environmental data, send it to robot's the microprocessor and alter Roomba's actions accordingly.

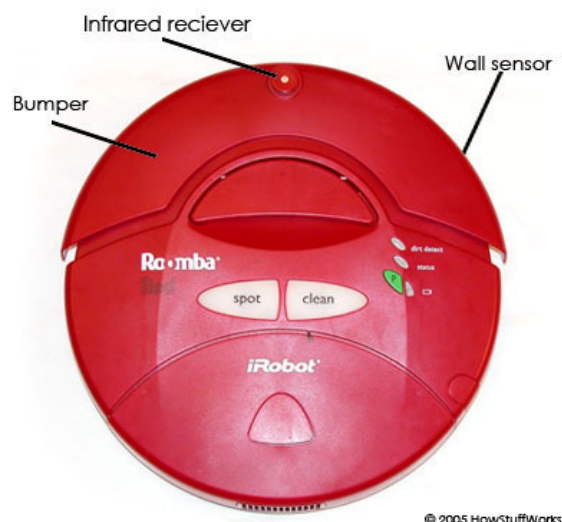
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According to iRobot, the system can adapt to new input up to 67 times per second.

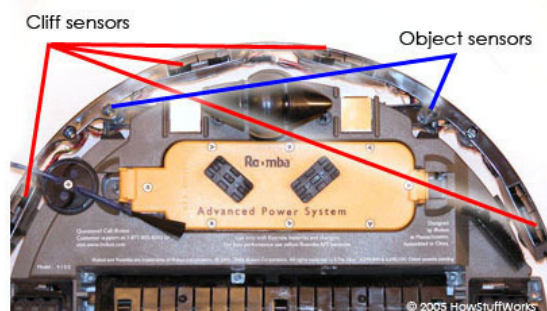
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We'll look at the following parts to learn how Roomba navigates its environment:



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Pressing on the bumper activates the object sensors (below).



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The first thing Roomba does when you press "Clean" is calculate the room size. iRobot is a bit hazy on how it does this, but HowStuffWorks believes that it sends out an infrared signal and checks how long it takes to bounce back to the **infrared receiver** located on its bumper. Once it establishes the size of the room, it knows how long it should spend cleaning it.

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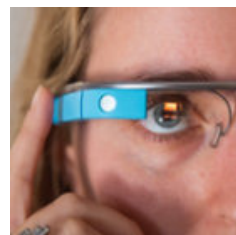
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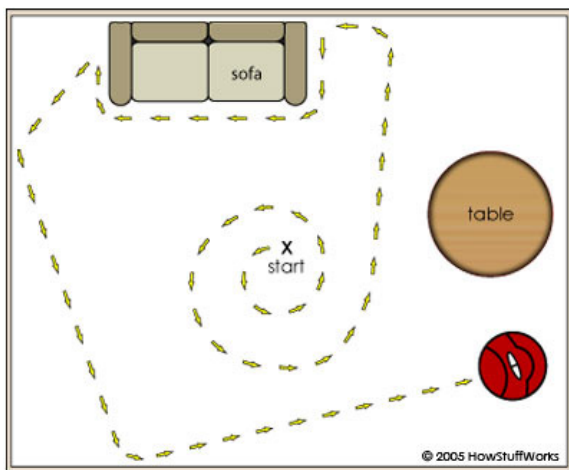


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While Roomba is cleaning, it avoids steps (or any other kind of drop-off) using four infrared sensors on the front underside of the unit. These **cliff sensors** constantly send out infrared signals, and Roomba expects them to immediately bounce back. If it's approaching a cliff, the signals all of a sudden get lost. This is how Roomba knows to head the other way. When Roomba knocks into something, its bumper retracts, activating mechanical **object sensors** that tell Roomba it has encountered an obstacle. It then performs (and repeats) the sequential actions of backing up, rotating and moving forward until it finds a clear path.

Another infrared sensor, which we'll call a **wall sensor**, is located on the right side of the bumper and lets Roomba follow very closely along walls and around objects (like furniture) without touching them. This means it can clean pretty close up to these obstacles without bumping into them. It also determines its own **cleaning path** using what iRobot says is a pre-set algorithm that achieves complete floor coverage.



Roomba Red's "cleaning algorithm"

When HowStuffWorks tried it out, we found that

Roomba starts cleaning in an outward-moving spiral and then heads for the perimeter of the room. Once it hits an obstacle, it believes it has reached the perimeter of the room. It then cleans along the "perimeter" until it hits another obstacle, at which point it cleans around it, finds a clear path and proceeds to traverse the room between objects like walls and furniture until the allotted cleaning time is up. The idea appears to be that if it cleans for a certain amount of time, it'll cover the whole floor, but whether it actually achieves complete floor coverage is pretty much hit or miss.

Roomba can clean for about two hours on a single charge. If you have the **self-charger**, Roomba will return and connect to the charger all by itself when the battery power is low (the self-charger is sold as an add-on to the Roomba base model but comes included on most of the higher Discovery models). It accomplishes this using the infrared receiver on its front bumper. When the battery power gets low, the vacuum starts looking for the infrared signal emitted by the charger. Once it finds it, Roomba follows the signal and docks itself to the charger. Some robotic vacuums with this self-charging feature will head back out to resume cleaning once they're fully recharged.

So the Roomba is smart enough to clean your floors while you're at the movies, but there are still some decisions you need to make for it. First, you need to remove small obstacles from the floor so Roomba doesn't get stuck on them or try to suck them up. You also need to tell Roomba where it should not go. Using included **virtual wall** units, you can keep the robot within certain boundaries. Virtual walls send out infrared signals that Roomba picks up with the receiver on its bumper. When it picks up a signal from a virtual wall, it knows to turn

around and head the other way.

Roomba's sensors allow it navigate your home with relative autonomy. Now let's find out how it accomplishes its real purpose: vacuuming.

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