ROBOTS: Extra sensors

QUICK FIXES

The sensors that come with the MindStorm are limited. So John Southern decided to make some of his own

Having finally read the whole of Luis Villa's Mini-HOWTO on Lego MindStorm with Linux, and received lots of emails back from those who asked for the PDF files of the previous article that should have been printed in December, the biggest request was for DIY sensors and actuators, as the range with the MindStorm is considered small.

Sensors consist of two parts: the first connects to the RX brick and the latter is the actual sensor. Like most people I want to do things quick, so I'm prepared to cut corners if the time saved outweighs the flimsiness of the product.

How to hook us easily to the Lego connectors

When making extra sensors I should have produced wonderful connectors by using a lathe, turning down machine screws and mounting these inside a Lego brick to make good connectors. If I had that much spare time I would do something more constructive such as watch TV. A quick look through the spares box finds mini crocodile clips, which clip onto the Lego RCX and hold quite well. Hurrah! The easy part of the sensor, done in a minute.

The heat is on

Now for the actual sensor. The first we build is a temperature sensor in the hope of making the buggy move towards heat. Adding a thermistor to the other ends of the crocodile clips is the quickest way we can make a temperature sensor.

Temperature probe

The only problem that arises from this, is that it needs a temperature offset constant to make it accurate. After two days of playing with this, we found that the crocodile clips give variable contact resistance – so what works one day fails to be accurate the next time we build.

Rather than be forever adjusting the program data each time we build, we can fudge the sensor by putting a variable potentiometer in line with the thermistor. We can now easily adjust the resistance in the connecting cable so the thermistor gives an accurate reading. At this point the buggy sort of works, except that changes in temperature are actually very small and the thermistor requires time to settle on a temperature. This meant it worked very slowly to choose the correct path and we had to drive the buggy, wait, test the temperature and compare this with the previous result to see any change. Another quick fix to make it a waterproof sensor was to cover it in hotmelt glue.

The motion of the ocean

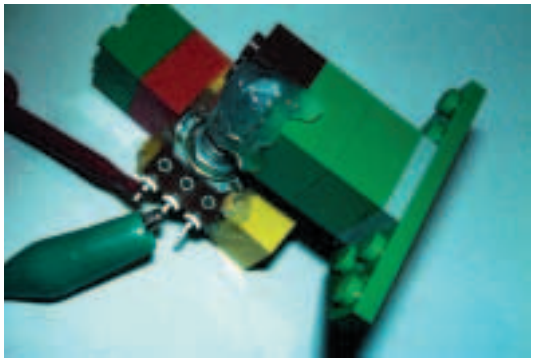
The next quick fix sensor is a mercury tilt switch. This works as a simple contact when turned in a set orientation. These are great fun, as by putting them in series with resistors in parallel we are able to make a motion detector. Changing the orientation proved to be tricky, but hotmelt glue came to the rescue. With one mercury switch we could sense if the buggy was travelling on a level surface or on a slope.

With two mercury switches we have enough data to determine whether it's travelling uphill or downhill. This is done by positioning one sensor so it only contacts when the bugging is climbing and one that makes contact when running level. If sensor one is connected then the buggy is going up hill; if the second sensor is connected the buggy is running level; and if neither sensor is connected the buggy is travelling downhill.

Orienteering

Next up is an angle sensor. Here we simply link a ski on the bottom of the buggy to a variable potentiometer. As the ski changes angle with the terrain so too does the resistance through the potentiometer. This is much easier that our other sensors, and means we can also now work out the gradient.

At this point we were still plagued with cats thinking the buggy was their personal plaything so we will investigate imaging next time.



Hot glue – the quick fix solution. Angle sensor using a potentiometer