The PowerMaze Electrical Distribution System

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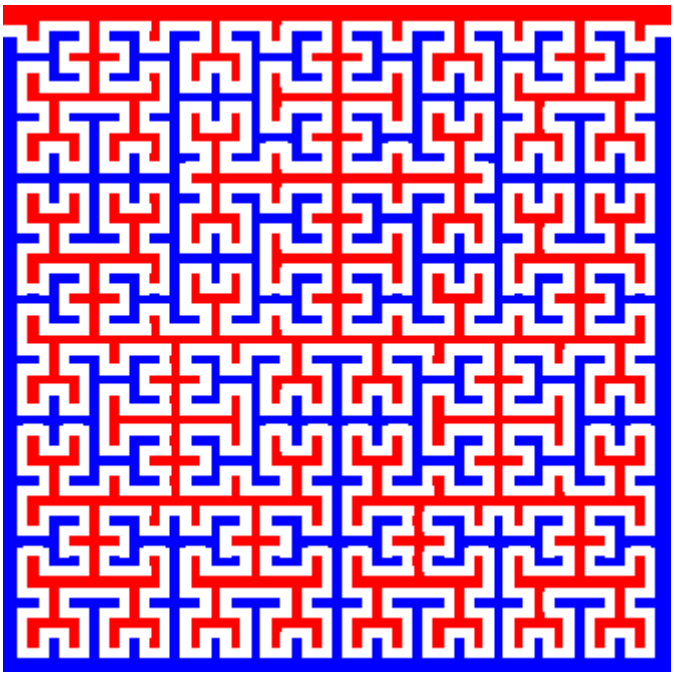
PowerMaze is a device that allows two-pole electrical contact to be established between two touching objects. The two-pole contact is established regardless of their relative position and orientation, as long as they touch with a contact area greater than a pre-defined minimum.

The light fitting shown above has no wires going to it. It is picking up its electrical power from the pattern on the ceiling, to which it is magnetically attached. It can be placed anywhere on the ceiling in any orientation. Multiple lights can be handled too.

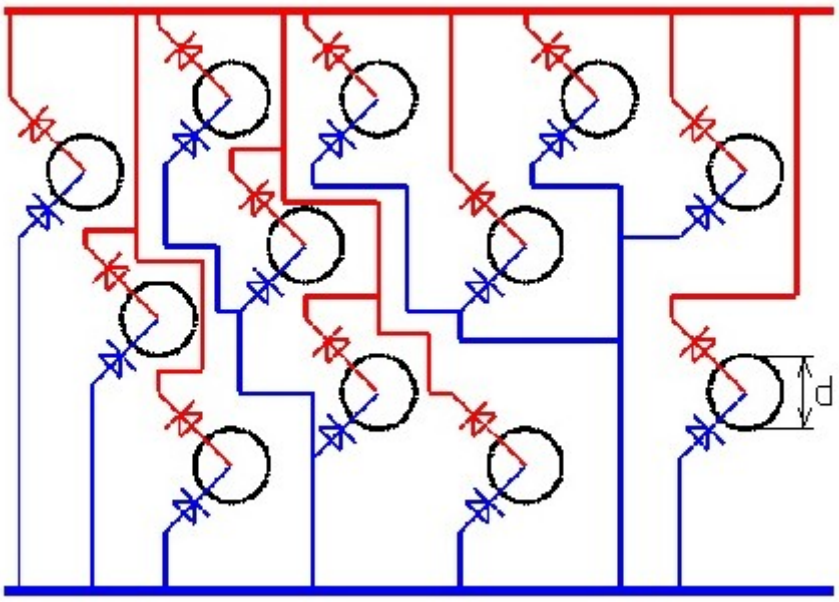
How PowerMaze works

The first object (the ceiling in the instance above) has a pattern (either random or regular) of contacts over its surface:

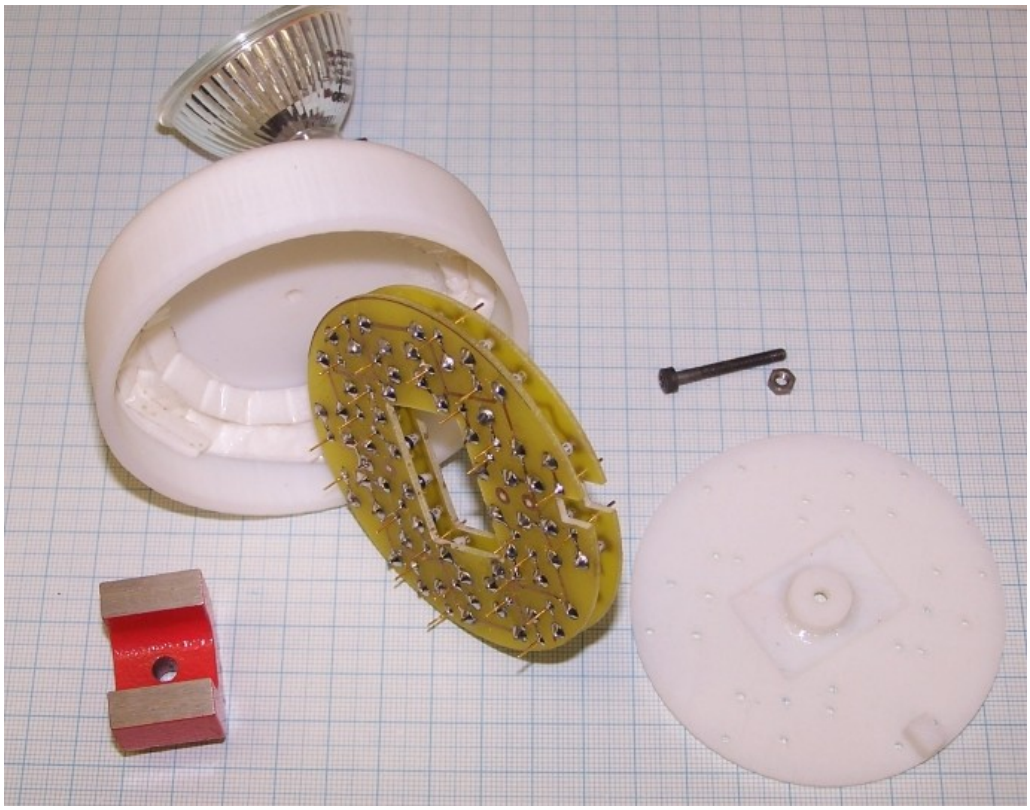


Half the pattern is connected to one pole of the supply (either AC or DC) and the other half is connected to the other pole. The pattern here is based on a Hilbert curve (the white area). This curve fills the whole plane and, because it is a single continuous line, must have two sides. These two sides can form the two poles of the supply.

Other fractal and non-fractal patterns can be used as well. The only requirement is to distribute the two poles of the supply over the surface roughly evenly with a guaranteed minimum gap (the width of the white line in the example) between them.



The second object (the light in the instance above) has a set of sprung contact pins arranged randomly in its base. These are represented by the black circles. The diameter of the pins (d) must be less than the minimum gap between the poles of the supply (the width of the white line). Other than that the pins can be any size and in any position, as long as there are enough of them. The pins are connected by diodes to two power rails as shown. These are the power output. They always have the same polarity regardless of how the two halves of the system are made to touch because of the diodes.



This picture shows the internals of the light fitting. The diodes are sandwiched between the two PCBs, and the sprung pins project from one side of the bottom PCB. The magnet that holds the device to the ceiling is also shown. The large squares on the graph paper are 10mm across.

Applications

The genesis of this idea was a requirement to make an electric road - a road from which an electric car could pick up power whilst still being able to steer at liberty. For this and similar applications the diode contact set would make rolling contact (as wheels) with the polarized set, which would be the road. Clearly it would not be an economic proposition to make a significant proportion of a real road from, say, copper. But existing roads are made from tar. Conducting polymers are now available, and these use petrochemicals as the feedstock for their synthesis, so it may prove economic to construct such a road using them rather than metals as the conductors. There are also now *semi*-conducting polymers from which the diode set could be made, in the form of a tyre. There are clear safety implications with this electric road, especially if it is run at any significant voltage; consider people stepping onto it, or rain... A more structured environment might prove suitable,

though. Examples are automatically-guided vehicles in factories, or the small mobile robots that are widely used in research into co-operative behaviour..

However, the first applications of the idea are likely to be at a smaller scale. Indeed, one of the simplest ways to mass produce both the diode and the polarized contact patterns would be to use standard PCB etching or, at an even smaller scale, chip-manufacturing photo-lithography.

It would be possible to transfer both data and power simultaneously from the polarized set to the diode set by modulating the supply in addition to a fixed D.C. offset voltage. The device connected to the diode set would then separate the modulated component as the data and use the D.C. voltage as its power source. In fact it would be possible to move full-duplex data in both directions simultaneously by having the diode set modulate its power consumption from the polarized set too.

There are all sorts of circumstances in which it is advantageous to be able to make bipolar electric contact (sometimes only for a short time) between two objects that may not be well-aligned. Examples are swipe and smart cards, bar-code readers, simple credit and debit transactions, the recharging of electrical and electronic devices such as mobile phones, cordless drills, and so on. All of these could be achieved, and in many cases made simpler, using PowerMaze. Alternatively, imagine a glove with a set of the contacts embedded in the index fingertip, or a stylus with a set of the contacts at the end. Just tapping this on an active area (the other contacts) of some object would be enough to transfer data between the two. Applications of this include stock control, library book issues and returns, and user authentication for things like terminal access and door locks.

As seen, the polarized contacts can be embedded in a ceiling (or maybe a wall), and surrounded or backed by a polymer insulator impregnated with ferrite powder to make it magnetic. The diode set can be assembled together with magnets to clamp it to the wall or ceiling, and used to power spotlights (or anything else). These can be attached anywhere on the ceiling (or wall) at any orientation to allow light distribution to be changed in a very versatile way for things like art galleries and exhibitions. Power cords (probably helically wound) could also be run from the magnetic diode set and used to power more or less any device that would at present use a combined mains plug and transformer/rectifier (such as a mobile phone charger).

It would be possible to make the surface of a desk the polarized contacts, and to have a diode contact set on the back of a laptop computer or PDA. Placing the computer or PDA on the desk would both recharge its batteries and connect it to a network, all via the same contacts, without any need for wireless communication such as Bluetooth.

This might form the basis of a useful public service in areas such as airport lounges, or on aircraft or trains. Many such environments need to facilitate network access whilst minimizing RF interference and the use of radio links (especially aircraft in flight, of course).

Licence

PowerMaze is OpenSource technology; you are free to use it as long as you acknowledge its creator, Adrian Bowyer.