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**Features: How-To: Build BEAM Vibrobots**
Posted by: gareth


In the current issue of MAKE (Vol. 8), I have a piece on Pummers, a type of solar-powered robotic plant life. I've known about Pummers for years, but my inspiration for doing the MAKE piece was finding Zach Debord's gorgeous Pummer set on Flickr. Being an artist and designer, Zach understands the value of making miniature robots that are as beautiful as they are functional. Mark Tilden, the "Big God" of BEAM robotics, has a wonderful adage that a human is a way that a robot makes another robot. One "evolutionary strategy" here is centered on aesthetics. Aesthetics drive interest. The Pummer piece is a prime example. I saw Zach's bots, I was wowed by their beautiful designs, and wanted others to see them. The piece got published, and now, if you search on Pummer in the MAKE Flickr pool, you see other people are making them. The robots are replicating themselves.

In the realm of behavior-based robotics, BEAM, bio-mimics, and other bottom-up, bug-brained approaches to robotic design, nearly every conceivable form of motility has been tried. There are bots on wheels, two-, four-, six-, eight-legged bots, bots with whegs (wheel/leg crossbreeds), snakebots, spinnerbots, swimmers, fliers, climbers. You name it. One of the less documented types of robotic motility is found in the Vibrobot, a type of robot that gets around by shimmying, shaking, and scooting. It's not the most graceful or accurate way to explore the world, but it's very easy to build a Vibrobot and they're really fun (and funny) to watch.

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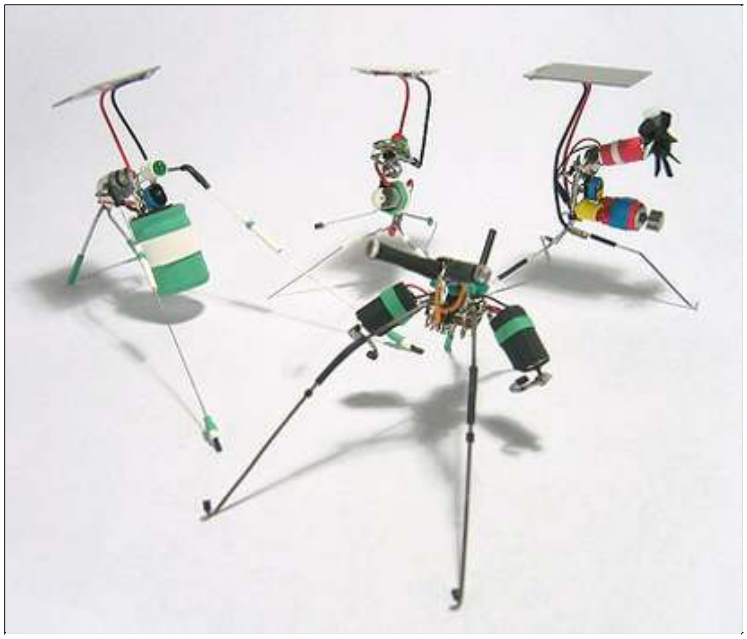
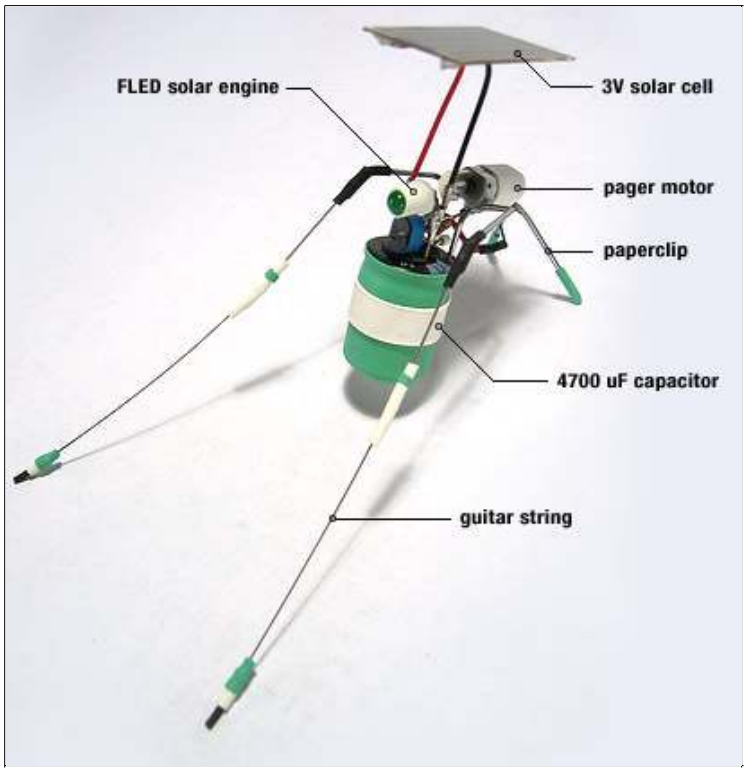


The key to Vibrobot movement is a motor (or motors) that employs an unbalanced weight. Pager and other motors used to create vibration alerts in consumer electronics use this technique. As the motor shaft spins, the weight on the shaft, being off-kilter, makes the motor, and therefore the entire pager, vibrate. Hook such a motor up to a little robo-critter with four fixed legs, and when the motor fires and the weight starts spinning, the bot will skitter across the floor. That's all there is to it. Since the legs don't need to be articulated or driven, there are few mechanical challenges in building a Vibrobot. The power circuit is very simple too. The simplicity of the mechanics and electronics frees you up to put more effort into making the bots look incredibly cool. It's no wonder then that, as with Pummers, Zach has built an amazing menagerie of Vibrobots. We asked him to tells us how he goes about building these wacky little robo-critters.

Here's a call-out image that details the parts used in a basic Vibrobot (the Solar Engine circuit is detailed in the diagram below).




As you can see, it's all fairly simple. This Vibrobot uses the FLED (as in



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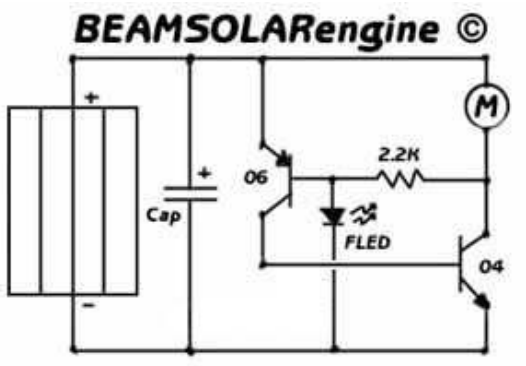
**SOLDERING THUMBNAIL...**

"Flashing LED") version of a Type 1 Voltage-Triggered Solar Engine. This type of common BEAM power circuit was discussed in my "Beginner's Guide to BEAM" and the "Two BEAMBots" projects in MAKE Vol. 6. This is the same FLED Type 1 SE used in Zach's Twin-Engine Solarroller we wrote about on Street Tech a few months back. In that piece, tl quote from a reasonably clear explanation of how a FLED-driven voltage trigger works from well-known BEAM builder Wilf Rigter.

Here is a schematic for the basic FLED SE circuit, taken from Beam-Online.




## Parts List

Here's the list of parts that Zach uses to build a basic single-motor Vibrobot. Solarbotics parts numbers are given, but you can also get many of these parts from your own techno-junk collection, from Radio Shack, or other electronics sources (see "Resources List" below).

| Quant | Part | Solarbotics Parts # | Notes |
|---|---|---|---|
| 1 | Pager Motor | #RPM2 | With weight still attached |
| 1 | 3v Solar Cell | #SC2433 | Any 3v cells, such as the 24mm x 33mm ones SB sells |
| 1 | 4700uF cap | #CP4700uF | N/A |
| 1 | 2N3904 NPN transistors | #TR3904 | N/A |
| 1 | 2N3906 PNP transistors | #TR3906 | N/A |
| 1 | Flashing LEDs | #FLED | N/A |
| 1 | 2.2K-ohm resistors | #R2.2k | N/A |
| N/A | Heat Shrink Tubing | N/A | Radio Shack has an assortment in various sizes. You'll want tubing all the way up to 2" dia. |
| 1 | Medium-Size Paper Clip | N/A | N/A |
| N/A | Guitar String | N/A | N/A |
| N/A | Red and Black Hook-Up Wire | N/A | Used to attach solar cell to SE circuit |

Reviewed by: Gareth Branwyn

Special Features

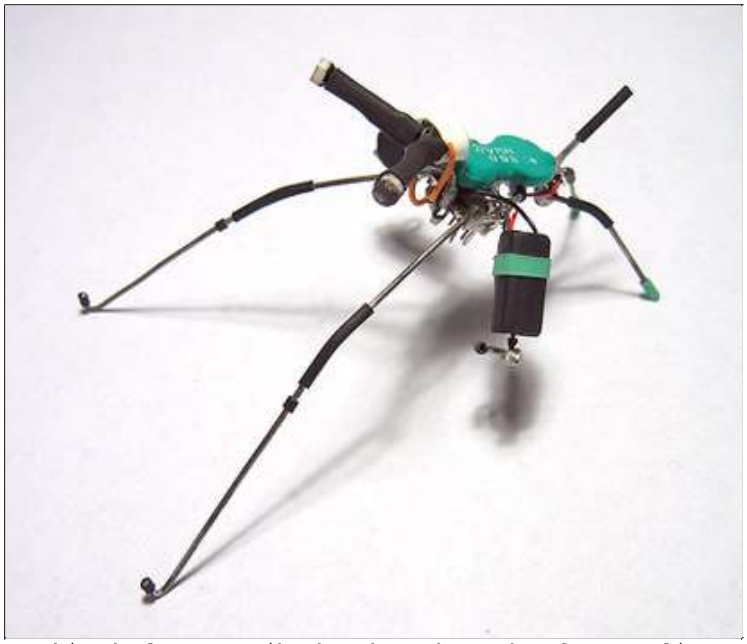
- The Rules for Roboticists (Feb 28, 2008)
- Mouse Dissection 101 (May 02, 2007)
- Mousey the Junkbot FAQ (Apr 30, 2007)
- How-To: Build BEAM Vibrobots (Jan 14, 2007)
- [Dead Inventors] (Jan 14, 2007)
- How-To: Build a Robot from a Coat Hanger (Sep 20, 2006)
- Twin-Engine Solarroller (Aug 30, 2006)
- Blow Your Socks Off! (The Bell Rocket Belt) (May 05, 2006)
- The SCO Monkey Trial (A Street Tech Intro) (Dec 08, 2003)
- Gar's Tips on Sucks-Less Writing (Oct 26, 2002)

This bot has two pager motors. The first one (on top) has a fan attached to it. This doesn't have much purpose besides offering some kinetic visual interest.

### Zach's Building Tips

Zach offers the following bits of additional bot-builder wisdom for success in creating your own Vibrobots:

- The key to a good Vibrobot is to keep it as lightweight as possible so the motor can really jiggle it around when it fires.
- Play around with leg placement. Having only a couple of the legs touching the ground at the same time can create some interesting movement patterns.
- Buy a pack of jumbo- and regular-sized paperclips. For the US$2 you spend, you'll be able to build a whole fleet of robots. I almost exclusively use paperclips and guitar strings for my creations.
- An assortment pack of heat shrink tubing goes a long way. Not only are your bots more interesting-looking, but you can use the tubing in key places to reinforce weak joints. I rarely have two strips of heat shrink on top of each other *just* for visual appeal.



This dual-motor vibrobot has the ends of paperclips soldered to two pager motors. Each motor is connected to a CdS cell so the more light each "eye" gets, the more the motor on that side fires. It's great to watch it react to a flashlight.

### Resource List

Here are a few of the parts suppliers and websites that Zach (and I) recommend when planning out a BEAM project.

Solarbotics These guys are the go-to source for everything BEAM. I've been buying from them (and working with them) for many years and have always been impressed with their intense devotion to the BEAM hobby (and their customers).

Hobby Engineering Good source for motors, robot kits, parts, and other geekly goodies.

Goldmine Electronics I've never met a hardware geek who didn't heart the Goldmine. If you're not on their free catalog mailing list, get on it! It's a treasure-trove of weird and wonderful parts and deep discounted gadgets.

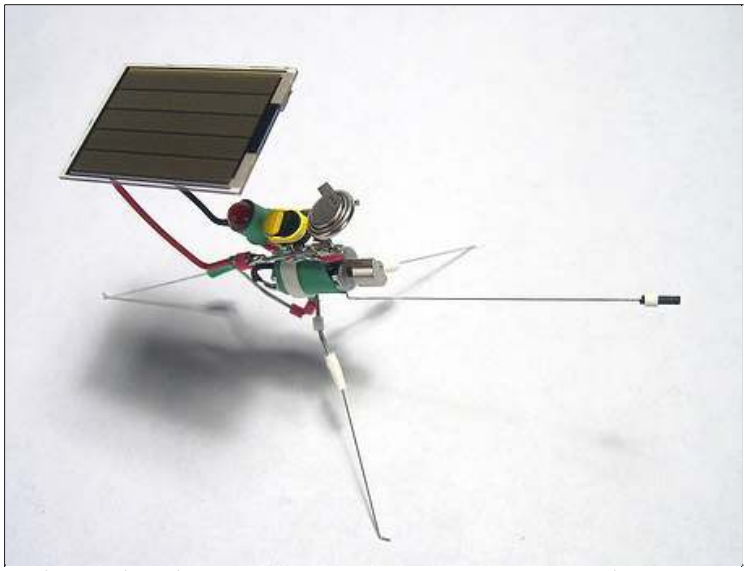
Mouser Zach sez (and I concur): "Great for any extra parts you might need. You may be able to find parts a little cheaper elsewhere but I've found that their fast shipping and great packaging (every item comes in a clearly marked bag) makes it worth any savings you might find elsewhere."

eBay Several good places in Hong Kong offer cheap LEDs via eBay.

Solarbotics.net The BEAM community portal. The Library section drops all sorts of mad science on BEAM theory and practice.

Beam-Online Another venerable and useful site for all things related to BEAM.

Zach's BEAM Bots on Flickr To see additional (and hi-res) versions of these images, and Zach's other bots, check out his Flickr page. To learn more about his design and fine arts work, visit his website.



This basic vibrobot uses a polyacene battery instead of a cap (to deliver about .6F of power). The bot gets a decent power burst when it fires. It also has a guitar string "nose" to help keep it away from larger bots.

### Other Robot Projects from Street Tech

- Zach Debord's Twin-Engine Solarroller
- Gareth's Coat Hanger Walker
- Gareth's Mousey the Junkbot Page
- Mousey the Junkbot MAKE Project PDF
- Gareth's MAKE Vol. 8 Pummer piece PDF (with Zach's Pummers)
- Solarbotics Herbie the Mousebot Review
- Solarbotics Turbot Kit Review

And you might also want to check out the companion site to my book, The Absolute Beginner's Guide to Building Robots.

*[Robot illustration by Mark Frauenfelder]*

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