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JUNE 2008

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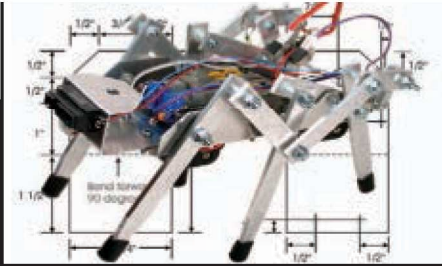
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PERSONAL ROBOTICS

UNDERSTANDING, DESIGNING & CONSTRUCTING ROBOTS & ROBOTIC SYSTEMS

■ BY VERN GRANER

HABITAT FOR HOBBIES — PART 1

JUST AS MOST BIOLOGICAL ENTITIES REQUIRE A SPECIFIC HABITAT TO flourish, hobbies such as robotics and electronics need a place to live and grow. Specifically, the hobbyist workbench.

I closed my last few articles by asking readers to send in pictures of their workbenches as a way to get a look at how we — as a group — approach our hobby. What items do we have in common? What unique solutions have some hobbyists conjured? What items did we never think to have or use? I hoped to address questions like these and also get some tips and comments from a few folks who might bother to send in a photo or two. I asked for pictures of workbenches, for descriptions of the essential components, and any tips or personal experiences you cared to share. Well, the response was over the top! You folks responded in droves, and WOW are there some great workspaces out there!

I was also comforted to find that many of you also conform to my trademark “randomly organized visual database o’ stuff” approach to your sty ... uh ... work space. When I finally started to write up the article, it was apparent all the ideas and submissions wouldn’t fit into a single issue, so after some discussion with the good folks

over at *Nuts & Volts*, it was decided that in order to cover this topic completely, we would have to break it into two parts. In this first part, we’ll cover what was sent in and in the second part, we’ll summarize the ideas and suggestions and see if we can create the perfect workspace. Also, to spice things up a bit we’re going to throw in a little contest with a not-so-little prize!

I’d like to take a moment to thank those of you whose pictures are not shown for sending in your stories and photos. I apologize for not being able to fit everyone in, but there really were just too many responses to print them all. And for those of you featured here, I want to thank you for your emails, letters, and for sharing your workspace with the rest of us. I’m hoping that your hard-won words of wisdom (combined with the photos of these diverse workspaces) will help all of us to improve our own workbenches and make our “Habitats” more hospitable to our hobby.

And now, for our Feature (workbench) Presentation!

Walt Weaver

We begin with Walt Weaver. Walt was one of the first to send in pictures of his workspace. Among other things, he designs and builds his own experimental mini-robots. He provides a glimpse into the basic components he deems necessary for an effective workbench:

It’s great to see someone writing articles on robotics for the “rest of us.” I have been a self-confessed tinkerer all my life. While I do enjoy tinkering with computers, microprocessors, etc., my real passion is with the mechanics and interfaces of robotics. I have a rather cluttered little bench (next to the furnace). As you can see, a lot of the equipment is homebrewed. I think the most used tools are the multimeter, the power supply, the frequency/pulse generator, the frequency meter, and, of course, the computer with a good serial port. The other two things that are necessary are a good assortment of tools (collected over a number of years) and as big a supply of parts as possible. Again, the parts were accumulated over a number of years from various sources ranging from surplus stores to yard sales. Oh yes, one other thing I almost forgot, lots of jumper cables. I have an old website at <http://wwwweaver.tripod.com/robots/robotic.htm> that shows some of my early projects. I am looking forward to some great articles. I hope this helps.



Joe Lutz

Joe's workspace is a model of efficiency. This just goes to show you don't need a ton of space to get things done. A small workspace can also be a good tool to force those of us who are less organized to pick carefully what we are working on and to finish what we start! It's pretty hard to begin a new project when you run out of AFS (Available Flat Surface). Joe's got some good comments and advice for making an efficient workspace:

I live in a small apartment in Seattle, WA, so space is an issue. Check the photo of my workstation. Yes, that is a vacuum tube! It's part of a Nixie clock I'm making with only glue logic; no processors. My father-in-law is an old-school engineer who absolutely loves tubes. We have built oscillators, latches, flip-flops, counters ... all sorts of things out of tubes. I'm not sure if there is anything I'd do differently, I've learned from all my successes and failures.

**TIPS**

- A beginner should invest in a decent soldering iron (Welland). My first two were RadioShack fire torches; I realized after acquiring a decent iron that most of my problems were due to poor equipment.
- Work with plenty of light. I have an "under-the-cabinet" xenon light bar purchased from Home Depot that I screwed in under my shelves. It plugs into the wall and offers great light.
- You can sample parts from most manufacturers. The hobbyist does not need large quantities or very high range components. You can get A LOT of useful components for free.
- Start with easy circuits to gain success and confidence.
- Keep a logbook or journal to document your successes and failures. That way, when you have a similar problem you can return and see what was done before to make it work.

Join electronic forums for advice and ideas. There are a bunch of good ones, Nuts & Volts (<http://forum.servomagazine.com>), Sparkfun (<http://forum.sparkfun.com/index.php>), and ladyada (<http://forums.ladyada.net>). She also has a great discussion on equipment for beginners (www.ladyada.net/library/equipt/kits.html). Or, forums specific to your interests like robotics, RF,

high altitude balloons, etc.

ADVICE

Start with basic circuits, and jump in and do it! I started wanting to do fairly complex projects and got quickly discouraged. I then kept looking for complete projects with a purpose. I finally learned my lesson, but felt like I wasted great tinkering time! I suggest looking at the circuits in Nuts & Volts, especially in the Q&A section. Now, actually go to your workstation and build them. You will find, at first, that it isn't as easy as it looks. There is external power to consider and, of course, debugging your mistakes. Think about why it works, not just replicating a circuit. NOW, start looking at the unanswered and see if you can figure out the answer. I almost never get the exact answer as someone else. Sometimes I use a different method or parts. Sometimes I couldn't answer it, but at least I have thought about the problem and learned from it.

Build and design your own circuits! Start with something easy like oscillating an LED with a 555. Then go to two alternating blinky lights. Figure out how and why it's working, then expand on the design. Can you add an 8 ohm speaker or a switch? What modifications are required? Can you do the exact same blinky light with capacitors and transistors? What is the difference? What are the advantages and disadvantages?

Finally, I've been following the articles and websites for the Ponginator. Kudos to the Austin Robot Group for making electronics fun and exciting! I have also enjoyed Vern's previous articles on the Theringing, model railroad controllers, and Parallax controllers.

Rich Syphrit

Rich sent in a picture and it was high-resolution enough that I could zoom in and make out just about every item he had there. I felt compelled to respond to him with a list of what I thought I could identify from the picture and see how close my guesses were. This is what I sent:

Thanks Rich! I really appreciate you sending in a photo. Love the custom instrumentation panels across the front! VERY cool! Okay, zooming in a bit, let's see how I do at recognizing all this stuff. I think I recognize:

- Stack o' Altoids tins! The electronics enclosure of champions!
- Nice HP scope.
- Nakamichi signal generator?
- An Audio Controls spectrum analyzer/EQ back there peeking out?
- A Game cube NTSC video monitor showing the weather channel (presumably fed from the VHS VCR to the left/below it?).
- A Mini helicopter in a box on top of the VCR
- Video monitor for Windows XP (keyboard and mouse stored on the far left of the bench.
- A video capture interface for the PC attached to the leg of the bench.
- Temperature controlled pencil iron.
- A pair of 6x4 oval speakers with RadioShack tweeters flush mounted?

Now on to the uber-cool custom panels and stuff

suspended from the shelf ... from left to right:

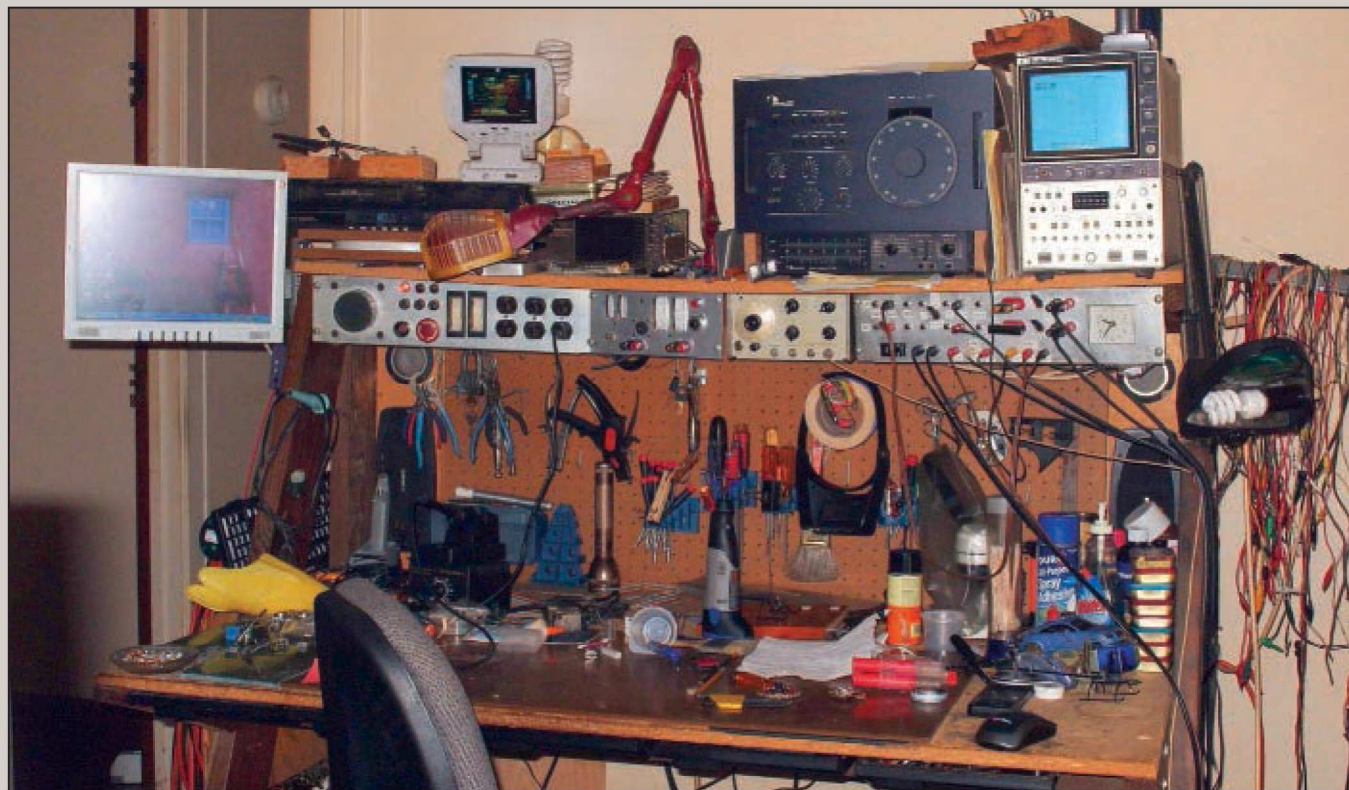
- Large black knob ... a variable transformer?
- Three red pilot lights for status of fuse to AC power plugs?
- Dual vertical meters would be in/out voltages of a transformer?
- Meters and banana jacks would be for testing speakers and audio?
- Next, looks like a function generator or signal generator.
- Last panel looks like an audio/video patch bay for testing AV gear ... maybe an embedded power supply in there?

So, how'd I do?? In addition to the picture, I'd love to know if you have any comments on things you would do differently. Also, are there things a beginner should always have? Any "if I knew then what I know now I would ..." type bits of advice to offer? This was his response:

Very good identification of stuff! Most of my friends just think it is a pile of blinky lights.

- *The Nakamichi is a tuner/pre amp with a tape deck analyzer under it.*
- *The AC supply meters are voltage and current for the first AC outlet.*
- *The meters and banana jacks are my current project: a dual DC power supply. An H-bridge \pm supply to run DC motors forward and reverse, and a large regulated supply.*

For advice – identify your needs, but plan on your needs and equipment opportunities changing over time.



**Russ Kincaid, NV Q&A columnist
Milford, NH**

Russ is a man after my own heart. His workbench looks VERY familiar! I think the general consensus is "if you want a job done, ask the man with the dirty hands." Russ's bench looks like one that's used hard and used often. I have a feeling things get done there. Here's his description:

I didn't clean it up at all! My grandson uses the second bench when he is available, otherwise I use it for drilling and inspection. The scope is a Hitachi that I bought on eBay to replace a Tektronix



541 monster that I purchased in the 1970s.

The circuit boards are homemade using a laser printer and PNP Blue; I wish there were a better way. I have a Wavetek audio generator and a Data Precision frequency counter, both 30 years old. My late friend, Charlie Puckette, gave me all his "stuff" so I have more obsolete parts than I can catalog. Of course, the beginner needs common hand tools like a soldering iron, needle nose pliers, side cutter, and tweezers. A multimeter would be my first choice, then an oscilloscope. Other than that, it depends on what facet of electronics you are into. I bought the frequency counter when I was repairing CB radios. The Wavetek was given to me in lieu of payment; I was designing a burglar alarm at the time.



Dave Lutz KA6GTC

Surprisingly, Dave is the only guy who sent in a picture of himself seated at his workbench! When I saw it, I immediately thought "Old Skool!" This is a veteran of the electronics wars. I mean, c'mon, look at some of that test gear to his left and tell me you're not impressed! Based on the email he sent along with his photo, I was right on the money.

I have been an electronic hobbyist for over 50 years and I still love it. The necessary tools are:

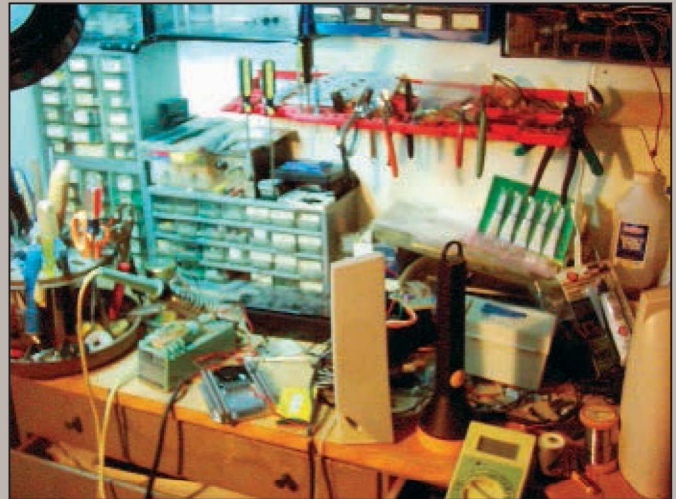
- Soldering irons, one large, and one small tip
- Solder sucker of some kind
- Analog VOM, VTVM, and digital VOM
- Scope, dual trace is handy, but not necessary
- Lots of screw drivers, pliers, and tweezers

If you have to do as I do and can't afford the parts, there are lots of dead pieces of stuff to strip parts from. If you want to have several projects running at the same time, you really need a workbench for each project. I don't, and you can see what happens when you are working on many projects at once.

I have a large projection TV and the

best sound system in town. All for nothing — pieces were given to me to get rid of them and I repaired them for my own use. I am running a local computer net with four systems on it, with a DSL line. Very little of my equipment was bought outright, and I make some side money fixing things for other people. That bench has to cover general appliances along with R&D for my company, computers, ham radio, and home repair (plumbing, etc.); 90% of my parts are from scrounged equipment.





Gary L. Camp

Though Gary's pictures came out a bit on the blurry side, his advice is quite focused! He has some great tips for saving money when putting together a workshop on a budget.

I am writing in response to your request for suggestions on a beginner's lab. I have for years thought of doing some articles on this as there is a lot of economical homemade "lab" equipment that could be made and I see so many overpriced suggestions and tools. I am in the middle of trying to sell my home and move, so my lab is down for the count. Here are two pictures of the old lab with one of the two filled walls in the room. The other walls have a window and an equally filled closet.

My main thrust for a small home lab is the homemade tool. This is both a learning experience and an acquisition of a fine tool that one knows very well since he built it. For instance, a cheap 3-1/2 digit meter can be turned into a number of tools with simple add-on circuits. Temperature, capacitance, inductance, and power can all be done, as well as many more. I also like the idea of using an old PC as part of the lab bench. There are many cheap "scope" hook-ups that go to 100 kHz which is fine for audio. In fact, there are ways to use the sound card inputs, with a little isolation circuitry, for a really cheap "scope" for fun and learning. Note that it is not always smart or cheap to build it. Harbor Freight tool store sells three digit meters for \$3 and there is no way I would ever use a \$10-\$15 panel meter or worse, make a PIC controlled LCD meter when these are so common. Indoor/outdoor temp meters for \$5 can be found, so forget complicated, expensive products when these can be used. Harbor Freight also had an IR temp meter for \$9.95! Note that a trip to the thrift store/swap meet/yard sale can get many great deals. And remember that an old audio receiver can be a preamp, power amp, RF amp, and many other useful bench devices, as well. Be creative.

I see a few minimum tools required. In order of general importance: DMM \$3 for cheapy; \$40 for

multi-functioned with PC connection, a big plus. Over time, get several cheap DMMs for dedicated use like for a power meter (voltage times current is power), bench PC for programing, "scope," spreadsheet, controller/monitor, etc. Note that older PCs with serial and parallel ports can be easily used as controllers/monitors and more using DOS Basic, etc., for a power supply (use old PC supply for great, cheap, highly regulated one). Little white plug-in circuit breadboard is so useful, I have to suggest it. A stereo preamp circuit with settable gain (op-amp) with mic add-on 1-5 watt power amp circuit card for little servos, speaker drivers, etc. Frequency counter/timer/event counter.

There are several circuits to do this using DMMs and PC extras for adding to the set. Lab standards for voltage, current, ohms, etc., using a variety of circuits and devices like precision resistors, voltage standards, etc. PIC (or favorite controller) programmer for PC battery checker /charger /restorer, lots of hand tools, magnifiers, soldering station, glues, etc., and a tool box.

Well, that's the idea for the equipment. As for the layout, I would think that the more space the better and that is usually what we lack. Discipline is the answer but I lack that, too. So, organization is probably the most important thing we can do up front/as we go. I suspect part of your motivation for the request is to get the best inputs on organization for many people.

Here is my take. A table top/bench/desktop/whatever with the test equipment stacked along the wall behind it. Above that would be the shelves with parts, supplies, and misc. A nearby closet with many shelves would be very helpful. A secretary chair with wheels might help in some cases. Needs to be comfy for those long hours at the bench. Good lighting with both overhead and spot. Put the PC under the bench and the KB vertically when not in use. Put the monitor at the end of the bench facing diagonally unless you have a thin screen (big bucks). Laptop is okay in some cases, but bigger \$ and less ports/expandability. A network connection would help find info faster.

Okay, that is a start. When I get my new house done and I'm moved in, I will start on my "cheap lab website."

**Chris Savage
Parallax, Inc.**

I couldn't resist asking Chris to chime in as I thought it might be very interesting to see how the "pros" do it. Chris was kind enough to send in pictures not only of his workbench at home AND at work, but he snuck around with a camera and took pictures of some of his co-workers desks, as well! Thanks Chris, for a glimpse into what the folks at Parallax face on a daily basis!



The first picture below is my workstation at Parallax. Not at its messiest, but this is the daily appearance when not working on a project. I generally try to put things away that I am not using to avoid clutter. Typically, I am a neat freak, although with so much dropped onto my desk at work through the day, it's hard to maintain that. The second picture is my main home workbench. I have

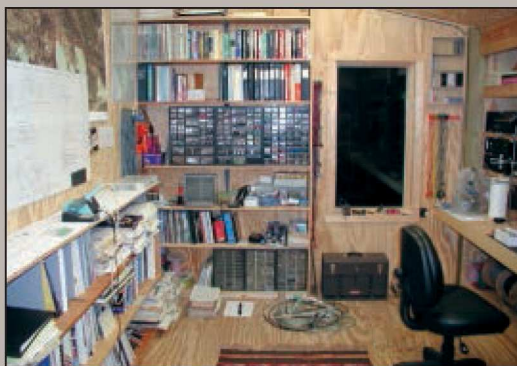
pretty much everything I need. I do 90% of my projects from this bench. It is wired (serial and USB) into the PC just to the left of it. With dual wide-screen monitors, I can fit a lot of code and information on the screen. What you cannot see in this picture are the stacks of 60-drawer parts cabinets which now (due to space) live in my garage aside my secondary workbench. That bench is where I do all my milling and cutting. Almost every tool

at my primary bench also exists at my secondary bench. What doesn't is portable via the laptop. If I need a scope, I use the Parallax USB scope on the laptop. Also, I included pictures of Dave Andreae and David Carrier's cubes at work (at top).



**Joe Flamini
White Hall, VA**

When I saw the pictures of Joe's self-described "sanctum sanctorum," I have to admit I was both inspired and well ... okay, I'll admit it ... down right envious! His shop would be my idea of a "Man Cave!" Not only does he have a large area that's well organized and sprinkled will tools and test gear, but it appears he has a panoramic window looking out into the forest. Wow!

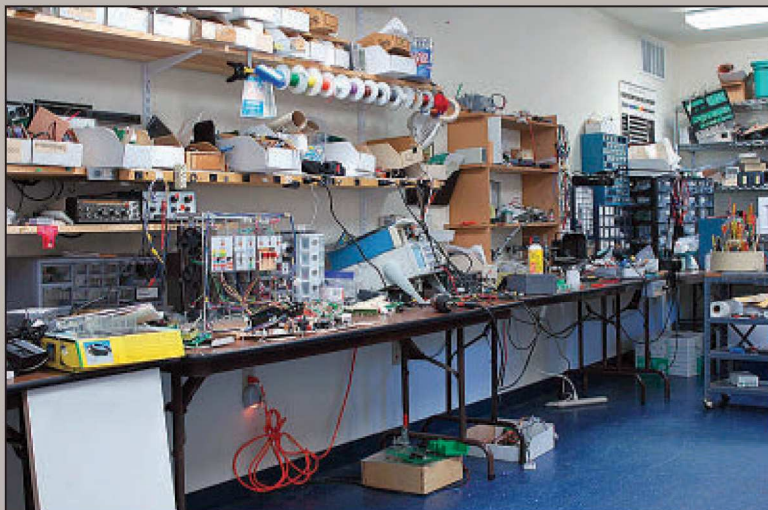


Here's a few shots of my sanctum sanctorum. I keep ongoing (unfinished) projects in project trays on the upper shelf above the bench, and pull them down to work on 'em when I want to. I need to create a more machine-tool-friendly area separate from the electronics (for the drill press, etc.). The metalworking, plastic working, and woodworking stuff is presently in another building. I try to keep 80% of the equipment and tools that I use most within arm's reach of my main work area.

**Jeff Duntemann K7JPD
Colorado Springs, CO**

NOTE: Jeff has an entire website devoted to the creation and evolution of his electronics shop and workbench area. It's a VERY good read if you're getting ready to build or want to improve your workspace (or just want to dream). I've placed one of the pictures of his shop here, but you should really visit the website if you want to see a very cool shop!

Just got the new N&V today and saw your request for workshop photos and tips. I have an entire page devoted to the topic. I'm 55 and have had a workshop of my own since I was 13, but it's taken me all this time to get it just right. I do less robotics than I used to, but I still build things, and the general principles are the same no matter what you're building. Thanks again and good luck! www.duntemann.com/12v_tubes/shoptips.htm



**Chad Shumway
Lincoln City, OR**

Chad "Chadman" Shumway sent a couple of photos of his workspace. Looks well stocked and commercial at first glance. Sure enough it was. Even though there's a large difference between the necessity of a commercial operation and a home work space, it's amazing to see the similarities. Here's what Chad had to say about his workbench:

Is there a prize for the worst/best clutter? I have to say I am the luckiest hobbyist ever paid to hobby! This is my clutter and it's just the tip of the iceberg really. I wanted to point out a development system you might or might not have covered. I have been studying a bit of assembly, PICBasic, and have just begun my uphill curve to learning C/C++. C development seems the way to go for most MCU development and useful beyond that, as well. I recently went to a Cypress seminar and was introduced to Cypress PSoC Express. I was given the "World Tour" dev board and PSoC Express on a disk. I love this development system! I had a fan controller breadboarded with low/med/high fan output based on thermistor temperature input, in under three hours working on my desk. Given two more hours, I could have had my proto board submitted to my proto board house using Eagle. Five hours to prototype with little experience with MCUs, using a program I barely knew. Awesome! Have a look if you haven't already.



Dave Carpenter San Jose, CA

Dave sent in some cool photos and some very good advice. Yet another example of an efficient design and good execution resulting in an efficient workspace.

Per your request for bench photos, here is one of my work place in my home.

The work surfaces are purpose-built lab tables purchased at a company surplus sale; two-inch square steel tube with poly-something laminated particle board tops. Square holes in rear corners of the bench allow access to the inside of the rear legs for adding risers.

I built a shelf on risers consisting of 1-5/8 inch 12 ga SuperStrut (local hardware store) inserted into rear bench legs and 13/16 strut used to form the shelf. Quarter-inch ply covers the frame (note another plank, behind, waiting for a second shelf!).

Good ergonomics are essential to avoid body fatigue and pain. I find that the scope and meter displays need to be straight ahead of my eyes without having to look up. Raising the chair to meet a too-high shelf is a poor solution, IMHO.

On shelf, L to R:

- Two old three-output (0-30V, 0-30V, 0-5V) supplies, one for backup.
- A 12V, 20A regulated supply for those car audio repairs.
- RadioShack FET meter sits atop the 12V supply.
- Assortment of Fluke DMM, Bob Parker ESR, and AADE cap/coil meters.
- Tek 2465DVS four-channel scope with integral DMM.
- Two HP 33120A arbitrary signal synthesizers for dual-channel audio work.
- Audio power amp for confirming preamp sounds (the ear is better than any test equipment!).

On bench top:

- Pace 45 temperature-controlled soldering station.
- Small, high-intensity incandescent lamp for good lighting
- Fluorescent lamp w/integral magnifier for those old eyes.
- Several loupes and magnifiers.

Not visible, just under the shelf:

- 20-outlet power bar w/on-off switch.
- Height-adjustable, wheeled lab chair.

Missing from the photo:

- Panavice rubber-protected jaw vice

with articulated base

As for workbench design, I think you have to put yourself in the head of the guy/gal who wants to get a bench to replace the kitchen table or whatever as their workspace. I would suggest these areas of discussion:

1) Readily-available sources of benches (Home Depot, Ace Hardware, Sears, etc.) and actually go look at some of those as research.

2) Surplus sources (announcements in newspaper of foreclosure of businesses).

3) DIY means (lumber, SuperStrut, etc.).

4) Design considerations: safety (soldering fume ventilation just came to mind), ergonomics, efficient use of space, storage, etc.). I'd talk about ideas like putting only soldering station on the bench, if possible, and building a shelf (see my photo!) to get all the equipment up so you can have maximum space (that ubiquitous STUFF on the bench notwithstanding) for your actual work.

5) Lighting!

6) Basic equipment (temperature-controlled soldering station, multimeter, power supply, scope).

Those are the ideas off the top of my head. The Yahoo! groups TekScopes, TekScopes2, Test-Equipment, and hp_agilent_equipment have been answering questions I've asked and put forth suggestions, i.e., my bench. You might want to search the archives for those groups at Yahoo! to see if you can glean some more ideas.



Joe Kissell Gardner, KS

Joe sent in a neatly labeled picture with each of the items spelled out, so I didn't get to play the guessing game like I did with Rich Syphrit. Here's his info with each of the items and a few tips thrown in for the home electronic hobbyist:

I want to submit my workbench as you requested in the February '08 issue of Nuts & Volts. I love being organized and am fairly happy with my current setup. I do, however, wish I had left myself some additional room for growth. Also, I have some terrific tools in my arsenal that I think would be great for anyone just diving into the world of electronics. Specifically, I'm referring to items 5, 12, and 13.

- 1) Parts box.
- 2) Storage bins.
- 3) Tool bag.
- 4) Oscilloscope – BK Precision 20 MHz, two-channel Model 2125.
- 5) Box of various resistor values.
- 6) DMM.
- 7) Dual isolation transformer with 120 VAC output.
- 8) Power strip with on/off switch – shut down entire bench with one switch!
- 9) Breadboard.
- 10) Desk protector (should upgrade to anti-static mat).
- 11) Soldering iron – switchable between 15 and 30W. I typically use the 30W setting with a small 15W tip which works great for getting into tight spots. Soldering station is complete with extra set of hands and sponge.
- 12) EasyPIC3 Development Board – extremely versatile and easy to use board for development of PICs.
- 13) Two-channel USB oscilloscope/two-channel spectrum analyzer/16-channel logic analyzer/eight-channel logic generator. Great for capturing data on the PC (and



much more). Just don't exceed the maximum ratings or you'll be replacing this unit along with your PC mother board!

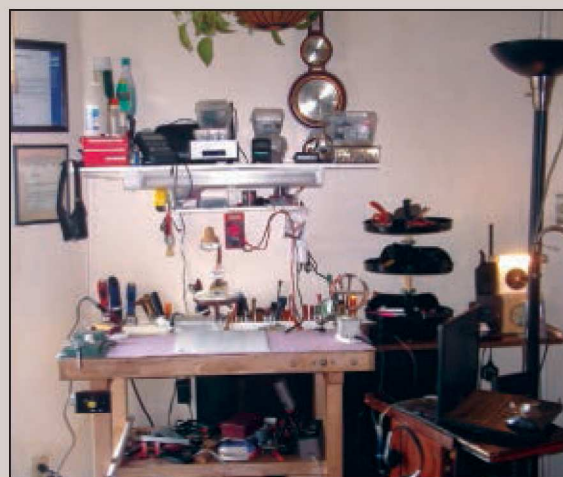
- 14) Notebook – you should always use a permanently bound (not spiral like I have here) notebook with numbered pages in order for the patent office to take you seriously.
- 15) Baby monitor – keep tabs on activity upstairs.
- 16) Ambient data display: temperature, barometric pressure, and relative humidity.
- 17) Pegboard.
- 18) Light and magnification lens.
- 19) Alligator clip assortment.
- 20) Test-lead rack.
- 21) Salvage pile for old projects.
- 22) Etching chemicals for making your own PCB.
- 23.) Infrared laser thermometer – Sentry 650.
- 24) Pint-sized replica of my dream car – 1995 Toyota Supra with twin turbochargers.

I look forward to reading your "Habitat For Hobbies" article.

Earl Schlenk

Another example of a small, efficient design. Earl's bench is also located where he gets some nice daylight. Here's Earl's take on working on electronics at home:

Here is my workbench. My experience in 50 years of electronic and ham radio building projects is space and more space. It seems no matter how much room you have on a bench, it still gets cluttered when in use! I live in an apartment so I am very limited in space. I use a metal 'lazy Susan' to hold my hand tools for easy access. Good lighting is essential, also a head band magnifier. A small rotary tool drill press stand is invaluable for drilling small holes accurately and to prevent breaking of the tiny bits. A vise mounted solidly on the bench is also very important. No amount of tools are too many. I find easy access to hand tools a priority as nothing is more frustrating than having to look for a tool you just have used and it vanished in a pile on the bench! A place to put screws and other small parts during disassembly keeps you from constantly hunting for them. I could go on and on, but I'll stop here. I enjoy your articles in N&V.



I want to thank everyone who sent in photos and apologize again if we didn't have the space to include your workbench in this month's column. I'll try to include a few more in next month's, if space allows. In the meantime, I'd like to encourage everyone to visit the *Nuts & Volts* forum where there is a discussion topic on the Habitat for Hobbies theme. Take a moment to stop by and share your views, ideas, and comments on the workbenches shown here and to add your own thoughts and pictures to the thread there. See the resources section for a link to the *Nuts & Volts* discussion forums.

That's all the room we have for this month. I'll be finishing up next month with some comparisons, suggested workbench layouts, and (fair being fair) pictures of my own workbench (a.k.a., Disaster Central). See you next month! **NV**

HELPFUL RESOURCES

- Parallax: www.parallax.com
- The *Nuts & Volts* Forum Discussion: <http://forum.servomagazine.com>
- The Robot Group: www.TheRobotGroup.org

WORKBENCH DESIGN CHALLENGE

Can it be done?

The Challenge: Design and equip a fully-operation, entry-level electronics workbench.

The Catch: Your budget is no more than \$100 USD.

The Fine Print: Your sole source for items is *Nuts & Volts* vendors

1st place prize: A Parallax USB Oscilloscope

2nd place prize: A Parallax Propeller Starter Kit

3rd place prize: A Parallax BASIC Stamp 1 Starter Kit


During the creation of this article, I was discussing workbenches with my fellow roboteers and we started to debate what was "essential" to an electronics workbench. It came down to the old "if you were on a desert island" hypothetical situation where you have to pare your choices down to the bare necessities. It was fun and interesting to listen to seasoned engineers and "young whipper-snappers" spout off about what was essential and what was a waste of bench space and money. I decided

it might be fun to extend the challenge to you, the readers.

So, here's the challenge details. You design a complete, fully-operation, entry-level electronics workbench for under \$100, keeping in mind that you must do so using only items from advertisers and vendors listed in the pages of *Nuts & Volts*. Your entry should be submitted in the form of a list with a line for each item, its associated part number, the vendor name, and the item cost. Make sure the total is \$100 or less.

So, do you think it's possible to stock a workbench on such a stingy budget, including tools, test equipment and the like? If you think you have the magic formula, submit your list of items and prices to vern@txis.com. The best entries (as judged by vote of the totally impartial, tribunal of Me, Myself, and I) will have their listing published in the September Personal Robotics column and will win one of the prizes listed above from Parallax! In the case of a tie, the first response wins. I would like to extend a special thank you to Parallax for their generous offer to provide very cool prizes for this (okay, I'll admit it, somewhat silly but fun) contest!

Official rules are posted on the Nuts & Volts forum.




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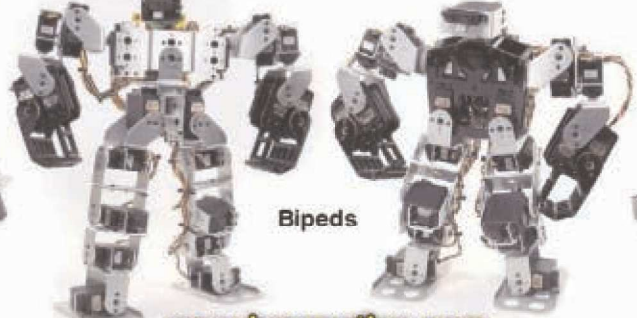
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