DPRG
DALLAS PERSONAL ROBOTICS GROUP

March 1994 A Newsletter for Personal Robot Enthusiasts Vol. 2 No. 3

Welcome New Members!

Over the last month we've had quite a few new members join our ranks, many from all over the country. I know it's tough for you guys out of town to make it to our regular monthly meetings. But, I'd encourage you all to still participate and enjoy all the kindred spirits you'll find in our group. We'd love to hear about your robots, projects, dreams or how you think we can solve the "health crisis" with your coin operated Holistically Unmanned Medicinal Bestower & Universal Guru device on wheels. One of the best things about being a part of our lively and autonomous crew is the interaction and exchange of ideas between our members. Years from now, you'll be able to tell your grandchildren about how you hung out with this bunch of pioneers that actually created robots by hand from strange and unusual materials, back in the days before robots had the right to vote! We're glad to have you.

Remote Reporters Requested

With the new blooms of spring come several important and inspiring Robotic Events. If you're able to make it to any of these please take good notes, pictures, and extra freebies and give us all a detailed report. In Austin during March 26th and 27th the Austin Robotics Group will hold their annual ROBOFEST. In West Hartford, Connecticut, during April 16th and 17th, The Science Center of Connecticut is having their Firebot Contest to see who can put out the flaming candle the fastest. No rhinos allowed..

Last Month's Highlights:

- Ed Rivers led us on a mental tour of his automated house, complete with a smart phone switcher which automatically directs a family member's call to the room they're in without disturbing the rest of the house. He also brought details of his latest, a temperature sensor wired into the house's main computer. Weren't we all supposed to be living in "Smart" homes by the end of the 20th century?

- Roger Arrick brought his prototype of the "Dual H-Bridge Motor Driver" (see article later in this issue.) Susan got Roger's design and using her high-tech equipment was going to turn it into a PCB layout, suitable for sending to a PCB maker for mass production.

This Month:

- Planning the next step for the H-Bridge drivers. Are we ready to take orders? Discussion on the kit possibilities...

- Finalize plans for our upcoming contest. Do we want several levels of participation? Or just the fastest, bestest wins! Also, do we have that donated '94 Mustang available for the prize fund yet?

- Discussion on building a "group" robot. It may be just what the "Universal Guru" ordered for getting some people out of the starting blocks and in the robot building race as we enter Star Date: 940401.

- Share in the 1st Saturday Sale riches... steppers for a quarter, laser diodes, and more!!!

The Elusive, Simple, Working H-Bridge.

By Roger Arrick

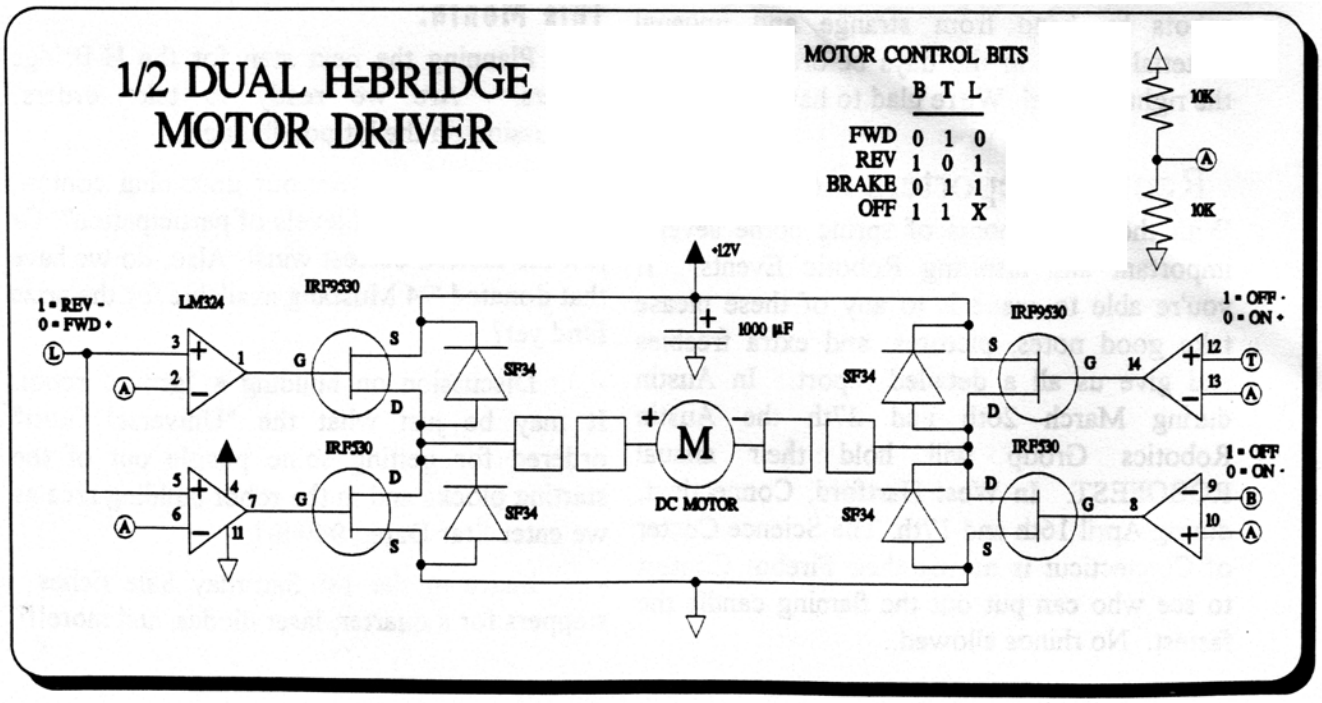
If you've been building or studying personal robots, you've seen an H-bridge motor drive circuit. Since most robots are powered by DC motors, H-bridge circuits are considered one of the fundamental building blocks necessary to construct such a machine.

An H-bridge consists of 4 transistors arranged so that either of the two legs of the DC motor can be connected to positive or minus voltages. This allows forward and reverse directions. Dynamic braking can be accomplished by switching both legs of the motor to minus. Additional circuitry such as logic gates and op-amps are used to control the 4 transistors. Pulsing the transistors off and on, known as pulse-width-modulation (PWM), allows the control of motor speed. All of these features make the H-bridge very appealing to the designer. H-bridges have been around for a long time but have only become simple and cost-effective recently due to the dropping prices of MOSFET transistors.

Many H-bridge circuits are unnecessarily complicated. Some circuits published in well-known books contain errors and have obviously never been built and tested by their writer. This article describes a simple, high-powered H-bridge circuit and an 8051-style microcontroller which takes care of the control functions such as PWM speed control, direction and braking. The micro receives high level commands from the host computer and controls the H-bridge through simple, op-amp gate drivers. Unlike some of the small, single-chip H-bridge circuits available today, this circuit is capable of handling about eight (8) amps with proper heat sinks. Commonly available parts are used and best of all, it's been built and tested!

Roger Arrick is past-president and an active member of the Dallas Personal Robotics Group. He can be reached on the Interocitor BBS at (214) 258-1832 or at P.O. Box 1626, Hurst, TX 76053.

Ed.- Several DPRG members are currently working on designing and putting together commercial grade H-Bridge kits based upon this circuit design, complete with professionally laidout and etched boards. The kit should be available soon at substantially below market prices!



RESEARCH RESULTS!

Typically, being in the Robot-Part-Search-Mode, I'm always wondering, "What about using this weird thing for my Robot's do-bopper?" And the other day while shopping at Sam's Wholesale Club I started salivating (usual sign of RPS Mode) as I came down the aisle where they had mountains of Batteries! Batteries for cars, batteries for boats, batteries for motorcycles, golf carts, garden tractors, weed-eaters, etc... For most of us, batteries mean power for our Bot children, and as I thought about these monster deep-cycle marine batteries, I began to do that caveman grunt thing that Tim Allen does on Home Improvement. Naturally, I wished my wife good luck with the frozen foods section and ran back to the front to get a cart. Then I proceeded to load up my cart with as many of an assortment of batteries as I could and still be able to push the darn thing. And heaved this cart over to the Bathroom Accessories aisle where I found a scale. One by one, I carefully weighed each battery and recorded the $, Ah, and lbs. Now I humbly submit to you my findings.

V	Ah	lbs	$	Type
6	220	62	40	golfcart
12	125	58	58	marine
12	115	53	50	marine
12	80	44	42	marine
12	22	15	23	m-bike
12	10	8	19	bunny
12	4	4.5	12	weeder
12	275*	15	18	tractor

* Cold Cranking Amps... anybody know how that corresponds to Amp Hours?

INTERESTING PART SOURCE:

Thanks go to Mike Neary in Pennsylvania, for this lead on what sounds like a great source. Mike says within their 272 pg. catalog is nearly everything mechanical you can imagine.

From steel tubing thinner than a hypodermic needle to glow in the dark paint and 4-40 hardware. I'm sending for info...

Small Parts, Inc.
13980 NW 58th Ct.
P.O. Box 4650
Miami Lakes, FL
33014-0650

ROBOTIC FORMULAE...

Here are some useful Robotic formulae that I dug out of some of my original design specs, when Sir Swid was still only a gleam in my eye. (now that gleam has turned into tears, sweat, and frustration!) I believe these all to be pretty accurate but, hey, chaos happens... I used these to get some "rough" ideas of how big my motors would have to be to be able to give my Bot a fair shake in life...

1 HP = 746 watts 1 HP = 550 ft-lb/sec
Power = Volts x Amps 60w = 12v x 5A
Acceleration = (final velocity-initial velocity)/time
$A = (V_1 - V_0) / t$ A=V / t
time = distance / average velocity
t = D / (V / 2)

Force = Mass x Acceleration
= (weight / 32.2) x A

Additional Force due to friction & incline:
F_A = weight x sine of incline angle
HP = (force x avg. velocity) / 550

[fasten your seat-belts...]

So, for a 50lb Robot with 8" wheels, that you want to go 0 - 8mph within 10', up an incline of 6°:

W = 50lb, D = 10', d = 8", cir = 25.133", I = 6°
V = 8mph = 11.733fps = 8448ipm = 336 rpm
t = 10 / (11.73 / 2) = 1.70 sec
A = 11.73 / 1.70 = 6.88 fps^2

F = (50 / 32.2) x 6.88 = 10.69 ft-lbs
F_A = 50 x sin(6) = 50 x 0.105 = 5.23 ft-lbs
$F_T = F + F_A$ = 10.69 + 5.23 = 15.92 ft-lbs

For a dual motor drive: 15.92 / 2 = 7.96 ft-lbs
or if you're looking at motors rated in oz-in:
7.96 ft-lbs = 95.52 in-lbs = 1528 oz-in
HP = (15.92 x (11.73 / 2)) / 550 = 0.169 HP
For a dual motor drive: 0.169 / 2 = 0.085 HP
or about two 1/12 HP motors...
0.085 HP = 63.41 watts
63.4w = 12v x Amps; Amps = 63.4 / 12 = 5.3a

So, this Bot is eating about 10.6 amps/hour doing this. See why I was looking at big batteries! Right?!? Heck if I know... ahem... I can see that we're gonna have to cover this a little bit better later! Hey at least the numbers are interesting...

Later - Eric / Editor / President

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NEWSLETTER

Inside:

- ☐ Unusual Growth Patterns
- ☐ Magical Mystery Tour
- ☐ Elusive H-Bridge
- ☐ Research Results
- ☐ Robotic Formulae
- ☐ and much, much, more!

Next Meetings: March 26th, 1994
April 23rd, 1994

DPRG Meeting at the INFOMART
Rm. 1059
2:00 PM