Robot Builder

The Official Publication of the ROBOTICS SOCIETY OF SOUTHERN CALIFORNIA
Post Office Box 26044, Santa Ana, CA 92799–6044

PRESIDENTS MESSAGE

by Jess Jackson

Wow! Fires here in the southland, then rain, then wind and power outages and then cold weather. Just another month in paradise.

Just want to remind everyone that the RSSC will move our permanent meeting location to Cal State Fullerton for the January meeting. The CSF undergraduates have already started a student chapter of RSSC at the college. We will be meeting on Saturday the same times and days as the Orange Coast College. If you've forgotten, we meet on the second(2nd) Saturday of every month. I checked the parking requirements at the college and found that they are tightly controlled till 10 PM on weekdays. No permits required for the use of parking on Saturday. See you there in January.

We want to wish a little six wheeled robot bon voyage as it departs for a 310 million mile trip to MARS. This little bot named the SOJOURNER, will land on MARS July 4th if all goes well. The six wheeled rover is about the size of a laser printer. It will explore the landing site, beaming back pictures of the surface and sniffing out the composition of rocks. The rover will be driven by remote control by a team from JPL. The robot weighs 23 pounds and has no shovel or life detecting instruments. The mission of this robot is to inspect Martial soil and rocks, then beam back information about their content along with color images. There are nine more missions to MARS planned over the next decade. Good luck little bot.

The tentative schedule for the December meeting will be as follows:

12:00 RSSC business meeting (short one)

12:30 Break for Lunch

1:00 General meeting (needs to start immediately)

Election of Officers for 1997

Speakers:

Tom Carrol –

(1) Goals 2000 discussion

Tim Lewis –

(1) Midi interface to control multiple servo motors

Henry Arnold –

(1) PC based robot control

(2) PC interface to sensors Jess Jackson –

(1) review of Harvey Mud robot project

Jerry Burton (60 minutes)

(1) 68HC11 programming class

3:30 adjourn

Last month, Joan and I visited the TECHNOLOGY 2006 sponsored by NASA. This was an interesting show.

The Savannah River Technology Center (Dept of Energy) had a couple of handouts covering Robotics & Remote System Applications developed at this facility. There were about 20 different types of robots in five areas, including mobile robots, pipe and wall crawlers, robotic delivery systems, robotic manipulation of tools, and remote viewing systems.

Joan and I were unable to attend COMDEX\96 because there was no room at the inn. Jim Benson provided the Exhibit Passes for us but we found it was too late to reserve a room anywhere in Las Vegas. We decided that a one day round trip would be too much so thanks Jim, we tried.

In This Issue

MORE THINGS OF INTEREST from the shows.

All persons interested in robotics usually generate a lot of unique ideas as we try to find solutions to the many requirements needed as we build our machines. Some of these ideas become formal inventions. For those of you that may have invented something, I found an interesting ad in a NASA publication. It is "How to Offer Your Invention For Sale." It was placed by KESSLER SALES CORP, call 1–800–537–1133 for their help.

New speaker–dependent VOICE–RECOGNITION chip claims 99% accuracy. SENSORY, INC., SAN JOSE, CA have introduced a Voice Direct speech–recognition chip ready for use without programing, except for training done by the end user. The IC can be run either by a host microcontroller or in a pin–configurable standalone mode. Voice Direct mode responds to sets of one to 60 words with a host, or one set of up to 15 words as a standalone. The user trains the device to recognize commands by repeating each word twice. The VOICE DIRECT chip should be less than $20.00 each. For further information call Jeff Rogers 408–452–1000.

UNITRODE CORP introduces the UC3638, a PWM controller for servo amplifier applications requiring bi–directional control. The device generates an analog error signal and modulates two bidi– rectional pulse–train outputs in proportion to error–signal magnitude and polarity. The UC3638 is offered in a 20 pin DIP and will probably be less than $6.00. For more information, call Rick DeMars 603–429–8963.

CAL STATE FULLERTON robot project design is continuing to progress. I spoke to their student IEEE group on Dec 4 about the TECHNOLOGY of ROBOTICS. Another member of our club, Dan Danknick spoke to the group about the development of his warbot entry, AGAMEMNON. This group had mechanical, electrical and computer science students there.

The club has instituted a monthly writing contest for the best article. All submissions are welcome. Even if you speak and discuss your project at the meeting, there are many out–of–state readers that are depending on the ROBOT BUILDER to be their eyes and ears into our robot world. Please document your projects so they can be of help to others. . . . . .JJ

Robotic Cockroaches the next Army special forces?

Bruce V. Bigelow (in San Diego Union Tribune, November 20, 1996)

Despite the best efforts of America's military machine, stealth fighters and smart bombs were not enough to eliminate Iraqi strongman Saddam Hussein during the Gulf War.

So maybe next time the Pentagon will send in the cockroaches to do the job.

We're not talking here about an elite military unit trained to operate behind enemy lines like the Dirty Dozen. Not by a long shot.

We're talking about things that scuttle across the floor.

In a handful of separate efforts, the U.S military has begun developing tiny robots that could be disguised as large insects. These creepy crawlers would swarm like locusts across the battlefield of the the future, equipped with sensors and specialized silicon chips that would enable them to transmit data and to perform simple tasks – perhaps even to kill.

Sound far–fetched?

One of these efforts is under way a Sandia National Laboratory in Albuquerque where scientists have built a robot slightly bigger than a sugar cube. They used about $150 worth of parts off the shelf – just to see what might be possible if they could spend some serious Pentagon money.

The team salvaged the robot's motor from a pager and used the same kind of gears found in a model train. They installed a microchip like those in cellular telephones and installed a sensor designed to home in on a signal.

After two months work, the robot could identify a wire by its particular electromagnetic frequency and follow the wire across a tabletop. It was a crude demonstration of what the military calls signals intelligence surveillance.

"We call it MARV, an acronym for Miniature Autonomous Robotic Vehicle", said Tom Weber of Sandia's Intelligence Systems and Robotics Center. With more work, Weber said it should be possible to deploy hundreds or thousands of more advanced microbot spies.

The center's director, Patrick Eicker, has suggested that such robots, disguised as cockroaches, could be used to investigate the infamous Baghdad baby formula factory to determine whether it actually was manufacturing chemical, biological or nuclear weapons.

The Sandia team envisions that hundreds of mechanical arthropods could be delivered surreptitiously to an enemy plant in a container dubbed "the mothership", which would resemble a brick or rock so as to not arouse suspicion.

Seriously.

The mothership would release a swarm of the Lilliputian spies, preprogrammed to crawl into buildings through air vents and other openings. The microbots would transmit data collected by sniffers and optical sensors to the mothership, which would relay the information by satelllite.

”Having something the size of a large bug that would have these sensors on them would be really valuable,” Weber says. ”We’ve even talked aobut using them to clear minefields”.

Weber said the work at Sandia was made possible be a widespread explosion in micro–machining technology that now allows engineers to craft gears and wheels from silicon materials that are smaller than the thickness of a hair. Continuing advances in micro–machining and micro–electronics could eventually bring down costs to a few dollars per bug.

Weber acknowledges that the burgeoning field of microrobotics must overcome a number of technical problems, arising chiefly from the robot’s requirements for power and mobility.

Nonetheless, legions of microbots could someday search earthquake rubble for survivors or inspect nuclear power plants for contaminants. Someday, microbots might even reside under the refrigerator during the day and sweep the floor for crumbs at night.

OFFICER NOMINATIONS

Tom Thornton

The Robotics Society of Southern California 1997 officer nominations are in. The current nominees are listed below. Remember that nominations are open until the hour of the election.
And . . . the nomineew are:

President	Jess Jackson
Vice President	Henry Arnold
Secretary	Joan Jackson
Treasurer	Tom Thornton
Member at Large	Tom Carroll
Member at Large	Pete Cresswell
Member at Large	Jerry Burton

U.S. FIRST

Pete Cresswell

The 1996 U.S. FIRST competition was phenomenal success. Ninety three teams from 25 state were in attendance for the cometition.

Catch highlights of the action on ESPN in December. Check it out . . .

10–11 am EST	December 15th ESPN2
3–4 pm EST	December 19th ESPN

US FIRST has a new address:

FIRST
200 Bedford Street
Manchester, NH 03101–1103

Tel: 603–666–3906

Fax: 603–666–3907

W3: http://www.usfirst.org

Answer to November Quizette #1 = A

Answer to November Quizette # 2 = C

Sharp IR Sensor Hack for Analog Distance Measurement

University of Florida
Department of Electrical Engineering
EEL 5934: Intelligent Machines Design Laboratory

The Sharp hack was demonstrated to me by lab member Scott Jantz in February of 1995. I subsequently engaged in several experiments to improve the transient response of the device. All mentions of the Sharp device are in reference to the SHARP GPIU5 8X. Information presented is taken from lectures from EEL 5934, Intelligent Machine Design Laboratory or my research.

The Analog Hack

The unmodified Sharp has only a single digital output pin. This signal is taken from a Schmitt trigger in series with a 40KHz bandpass filter and signal amplifier. An integration element (capacitor) is applied before the Schmitt trigger.

If the printer side of the Sharp board is examined, two test points will be found to the left of the output pin. One of these points is the analog signal as it is integrated over a surface mount capacitor. The lead to the capacitor and into the integrated section (black mound) is readily visible. A wire soldered directly to this trace will give the analog response. For practicality, it is much easier to solder to the capacitor terminal than the trace itself. With a multimeter, it can be verified that the other capacitor terminal is grounded and that the capacitor has a value of 0.1uf.

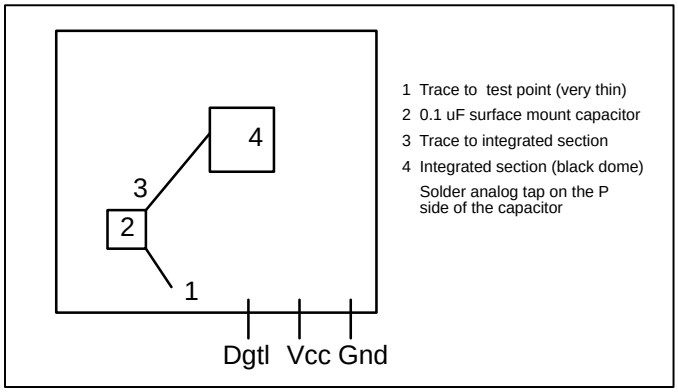


Figure 1 View of opened Sharp case from underside

Using this method, both analog and digital responses can be taken from the same sensor. In other words, the sensor that previously was only used for digital IO can now also measure distance.

Signal Characteristics:

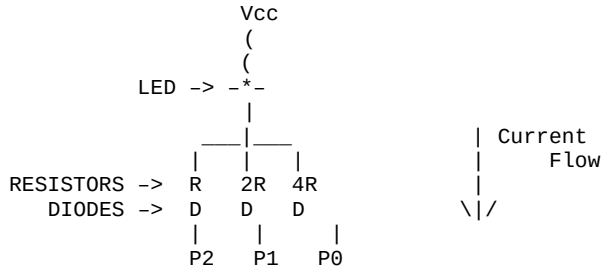
Zero reading : 1.5V, Full saturation: 2.5V, Rise/Fall time : 100ms

The analog tap is very sensitive to loading. Any analog input into which the signal is applies should be of <20pf capacitance. Practically, this means that an HC11 analog input is OK, but a 4000 series analog MUX is not. Also, because of the rise/fall time, a sampling rate of only 10Hz is supported. It is critical that the case of the Sharp be grounded for proper operation. This can be done by simply applying a large blob of solder to the outer pin (ground) and heating the Sharp case with the same soldering iron until a join is formed.

The rise/fall time can be reduced to 1–2ms by replacing the surface–mount integrating capacitor. A value of 5000–10000pf will give rise/fall times of 1–2ms respectively. Using the 5000pf option, the author achieved rise, saturation, and fall within 1ms allowing for a 1KHz sampling rate. Signal stability and range is preserved at these values. Lower values result on significant ripple. Using the improved time–constant hack will destroy the digital response of the sensor. It is no longer possible to use the same Sharp for analog and digital measurements. Detection Range

Range of the hacked Sharp depends on the level of IR used by the emission system and the degree of collimation. A favorite method of collimation used at MIL is to cut the tube of a black Paper–Mate pen and hot–glue the Infrared LED into the tube. Using the standard size LED, the fit is perfect. A length of 1 to 1.5 inches of tube from the back of the LED is used. This tube can then be glued to the side of the Sharp device to form a formidable ranging device.

Range is greatly enhanced by allowing digital control of the IR level. The method currently used at MIL, developed by Scott Jantz and Tae Choi, uses a 74HC374 output latch as follows:

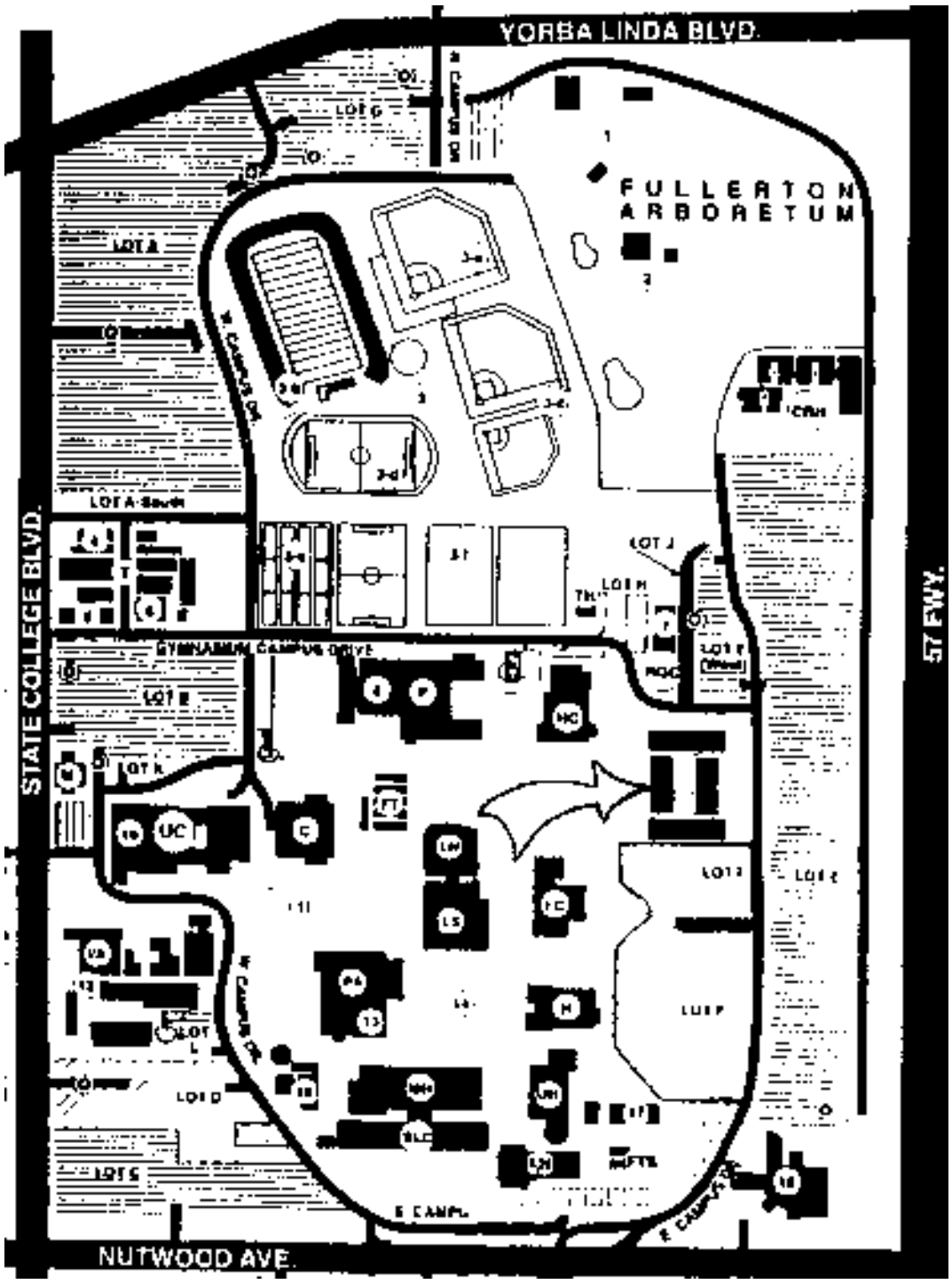


The P2–P0 pins are outputs of the 374 latch. Any digital port can be used, but the provision of sinking substantial current must be taken into consideration. By selecting the appropriate bitmap, P2–P1–P0, the desired resistance level is available to the LED. Using a 5V Vcc, the appropriate value for R is between 300 and 400 ohms. The 374 can sink over 20mA per pin. By using software control of the LED level, a range of .5 to 44 inches can be realized. This required that the software start at the highest level P2=P1=P0=low and decrease the level if the response is saturated at 2.5V. The level which causes the analog signal to come as close to 2.0V as possible is desirable. Alternatively, plot the response of each level vs. distance and define the most linear sections. Then create a composite of eight linear sections with enough offset to prevent overlapping. This gives near 8–bit resolution across the .5 to 44 inch range using an 8–bit A/D with reference voltages greater than (2.5–1.5V) 1V. This is particularly useful for the HC11 which requires a minimal difference of 2.5V between reference voltages.

For up to date research on the variety of projects pursued at MIL, check out our WEB site http://catwoman.mil.ufl.edu .The site is currently under construction but has the email addresses of all persons in the lab and their current research.

University of Florida 12/9/96 Keith L. Doty
EEL 5934 Intelligent Machines Design Laboratory
Erik de la Iglesia

JANUARY MEETING PLACE MAP



Next year (and next month) we begin amassing in a new meeting place. Note the arrow on the map above. More details in next Robot Builder

Building the Lynxmotion Robotic Arm Kit

Tom Thornton KE6NJC

I have been looking for an affordable robotic arm for some time. I have Marvin Green's simple arm – eligantly simple, but more toylike than suits me. I have also taken a long look at the Radio Shack Armatron only to decide that 1 motor is not going to make the grade, regardless of degrees of freedom. Then I ran across Jim Frye's Lynxmotion robotic arm. Sixty dollars for a robot arm with five degrees of freedom? Wow, I thought, this is for me! So into the mail goes my check. About eight days later comes a modest package with my name on. The box contains a plastic box, a plastic sheet, neoprene square tubing, a diskette, and a construction manual.

Lynxmotion sells this beasty in several forms from raw kit with no servos, through assembled and tested. Now, one of the things I have is lots of servos. So, an article I read said the arm is driven by Futaba S148 equivalent servos (the construction manual says the arm is designed to use Hitec HS–300 servos). Great! The servos I have are also S148 plug–and–play replacements. So I ordered the minimum kit – no servos.

Turns out that the TK–S03 servos that I have are just a hair larger than the HS–300 servos that the arm is designed around. This caused me no end of grief from the very first construction step. I cannot stress too heavily that if you buy the Lynxmotion arm that you also get Hitec HS–300 servos. Get them from Lynxmotion (in the level two and level three kits) or from Tower Hobbies.

The manual is about 30 pages long and heavily illustrated. The first eight pages are frontise piece, background information, and software description (yes, the kit comes with s/w to control Scott Edwards' Mini SSC servo controller). The manual is laid out with a two dimensional life–size drawing with description and a three dimensional isometric drawing on the facing page.

The arm itself consists of a 2x4x6 (approximately) inch plastic equipment box and some very nicely CNC machined PVC "plastruct" panels. Construction begins with the forearm. The scheme is to build a box around two servos which are anchored in place with double sided tape. CA (cyano–acrylate, super glue), or jet melt are suggested as possible alternatives to the tape. An idler mechanism is built on the opposite side of the servo from the output control horn.

Then on to the gripper assembly. This is where I first realized that the dimensions I was working with were not the same as those that the arm was designed for. The wrist end of the gripper is a C shape that is supposed to span across a servo/idler on the end of the forearm assembly. Because my servos are larger the C shape in my arm is more nearly an A frame.

The screws that attach the gripper to the wrist are #4 sheet metal variety. I managed to split a control horn during this operation so substituted #2 hardware when I rebuilt this part.

The gripper/forearm complete we move on the the shoulder assembly. The hardware supplied in the kit for this is also #4. So I subbed #2 and didn't blow up any more control horns. Actually, I probably should have drilled pilot holes in the horns before installing the sheet metal screws. The shoulder bears the heaviest loads when the arm is in use so it is designed to be driven with two servos. The two servos are arranged such that they drive in the same direction when the arm link moves.

And, finally, the base rotator assembly. This was the most difficult part for me to fabricate. The procedure calls for three roller bearings under the rotator base. I probably glued these down tight half a dozen times before finally getting the right spacing and little enough glue.

Then the final steps. Connect the servos to the controller: first the base rotator servo; the shoulder servos; the gripper; then the ... what do mean the elbow and wrist servo leads aren't long enough? Well they aren't ! Seems like the HS–300 servos must have leads in excess of 12 inches long. My second cousin substitutes leads are about 8 inches long. Ah well such is life. Cut in extensions on the servo leads, connect up, power up.

Run the "setup" program to pick the physical limits for your particular arm. Individual servos and construction techniques are varied enough so that the factory settings won't do – but this is all explained in the documentation.

Overall this is a good kit – good quality materials and a well written manual. The problems I encountered were for the most part self induced.

I recommend it for anyone who enjoys kitting and is looking for a light duty arm and gripper to expand their robotic horizons.

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If possible, and if you want it to look nice in the newsletter, please submit copy in ASCII or RTF via diskette, email or upload.

rssc@netcom.com (Jim Benson)

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The Robotics Society of Southern California was originally formed in 1989 as a non–profit experimental robotics association. The goal was to establish a co–operative association among associated industries, educational institutions, professionals and particularly robot enthusiasts. membership in the society is open to all with an interest in this exciting field.

The primary goal of the society is to promote public awareness of the field of experimental robotics and encourage the development of personal and home based robots. We meet on the 2nd Saturday of each month at Orange Coast College in Costa Mesa.

The RSSC publishes this monthly newsletter, Robot Builder, that discusses various society activities, robot construction projects, and other information of interest to members.

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Take Fairview Blvd south from the 405 then turn right on Merrimac Way. Free Parking.
** Look for the building with the green glass roof **