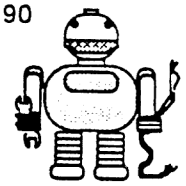
June 1990

ROBOT BUILDER



The official publication of the Robotics Society of Southern California
P.O. Box 3227, Seal Beach CA 90740, Meetings the 1st Tuesday @ 7:00 PM at MTI College

UPCOMING EVENT CALENDAR:

June 5:	RSSC June Meeting, MTI College: Topic - Motors
June 9:	RSSC Robot Project Workshop, *The Robot Company*
July 3:	RSSC July Meeting, MTI College: Topic - TBD
July 7:	RSSC Robot Project Workshop, *The Robot Company*
July 11-22	Orange County Fair
July 29:	Computer Swap Meet at Advanced Computer Products
August 7:	RSSC August Meeting, MTI College: Topic - TBD
August 11:	RSSC Robot Project Workshop, *The Robot Company*

MAY 1st RSSC MEETING

We had a good turnout at our May 1st meeting with about 25 people in attendance. Our featured speaker for the evening, Allen Neal from *Interstate Batteries*, was very informative (see photo). He passed out spec sheets on his line of gelled-electrolyte batteries along with price sheets. He also distributed calendars and donated a digital multimeter to the Society for us to raffle off as a fund/interest raiser. After his presentation, he answered questions about batteries from the group. Many were amazed at the differences between standard "car- type" batteries and the sealed gelled electrolyte batteries. All agreed that the sealed type battery is the better choice for robots, despite its higher cost.

Scott Forest, a senior engineer from McDonnell Douglas in Long Beach, gave us a presentation (see photo) on Robot Assembly Automation being performed by the aerospace company. He brought in a MD80 wing assemblies for us to look at and presented a videotape of how variable assembly tooling and a robot system can reduce many hours of tedious manual setup, assembly, drilling, riveting, and inspection of the aluminum wing components. We all appreciated Scott's talk and encourage any and all people in the industry to present information on their particular robot-related jobs.

Tom Carroll brought in a videotape that showed the space repair mission of the *Solar Max* spacecraft back in the mid-80's. Another portion of the tape showed how a small teleoperator robot company in Minnesota, *Central Research Labs*, responded to a NASA request for robots to perform the same space repair tasks. The CRL demonstration proved that complex panels could be removed, cables cut, and electronics boxes changed out by teleoperation. CNN taped part of the demo at NASA's Goddard Space Flight Center in late 1988.

MAY 1st RSSC BOARD MEETING

After the regular membership meeting, the RSSC Board members met very briefly to discuss some issues related to the Society. The $50 multimeter donated by Allen Neal of *Interstate Batteries* will be raffled off at our June 5th meeting with tickets going for $.50 each or three for $1.00. New members will receive a free raffle ticket.

MAY 5th RSSC ROBOT PROJECT WORKSHOP

On March 31st, the RSSC had our third robot project workshop at *The Robot Company* shop in Costa Mesa. The three

Allen Neal of *Interstate Batteries*

Scott Forest with a *McDonnell Douglas* robotically assembled MD80 wing assembly

committees (mechanical, electronics, software) were all represented with over 12 members present.

Mark Frank presented to the group the latest work done on the robot base and frame. He has done a great job of providing the raw materials and machining for the Society's robot design.

Most of the 2-hour meeting was spent discussing the head design and the number and location of the sonar sensors.

Our next workshop will be held on June 9th, at 10:00 a.m., again at ***The Robot Company***, 881 West 18th Street, Costa Mesa.

ROBOT PART SOURCES ALL AROUND US

(Editor's note: As promised in last month's newsletter, the following article on alternative part sources is provided by Tom Carroll.)

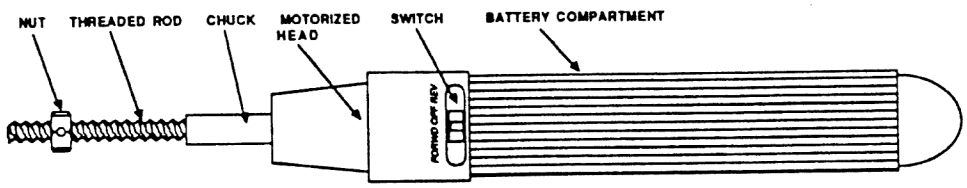
The RSSC is almost one year old, and many of you joined with the hope that you would learn more about building a robot. We've got a group project going, but many of you would like to experiment with a robot on your own. Many may have wondered where does one go to find a robot parts store. Well, there's ***Robot World*** back in Rochester, New York, but they handle only the small ***Movit*** robot kits in the $30-100 range, all the way up to completed robots ranging upwards to $15,000. No parts as such.

There are many robot parts stores in our midst of which you may not be aware of. I don't mean the neighborhood ***Radio Shack*** or the many "normal" sources listed in the RSSC Resource Directory. I'm speaking of hardware stores, bike shops, appliance repair places, junk parts stores, and similar places familiar to all of us. Most of us have no real problem with the electrical wiring and related parts that we can find at the local electronics store. The main problem that people ask me about is how to make their robot move, pick things up or make their robot's wheels move slowly using the high-speed motor they already have. It's the movement requirement that makes a robot project different from a computer system, and it is that feature that gives most of us the greatest problems.

Let's examine the local hardware/ builders supply store. A flat lazy-susan bearing of 3 to 4 inches in diameter makes a nice arm and head joint. Drapery hardware displays have all types of swivel joints, bearings, and pulleys that work nicely on robots. Continue looking all over the hardware store at replacement wheels for lawn tools and lawn mowers, plumbing supplies, cheap bike parts, hinges, brackets, and even motorized toy riding vehicles. You can also grab a few cheap sonic "tape measures" for potential robot obstacle detectors and interface them to the robot's computer. Don't forget the infrared detectors priced as low as $16.95, which are used to turn on outside lights in the presence of people - a great robot "people detector." Only a year or two ago, these things were priced close to a $100 at burglar alarm dealers.

Inexpensive ***Ohio Forge***, ***Black & Decker***, or ***Skill*** brands of battery-powered hand tools such as a cordless screw driver, drillmotor, and socket wrench have virtually unlimited application in a robot. These tools are unique in that they contain a very high torque dc gear motor in a compact size along with a rechargeable battery. Granted, the voltage is usually 2.4 volts or some multiple of 1.2 volts up to 9.6 volts (not your normal robot battery voltage), but these motors are somewhat forgiving of over-voltage for short periods of time. You may be able to make use of the built-in battery and charger.

You may still think that the end speed of, say, the cordless screwdriver is too high. Consider the use of a leadscrew arrangement (see Figure 1) to change the higher rotational speed to a slower and high force linear motion. The use of a standard threaded rod or long screw and a nut will suffice for an experimental robot. You may later want to upgrade to an industrial surplus lead screw that has a properly designed threaded rod and



TYPICAL CORDLESS SCREWDRIVER

Figure 1.

recirculating ball-bearing nut, but many have used regular screws and a standard nut to create an "electric robot bicep muscle" with a good amount of lifting power. The 120-rpm powered socket wrench makes a great robot shoulder motor geared down.

Now let's go across the street to the hobby shop that handles model airplane/car parts. Besides the obvious uses for radio control systems and the many styles of servos, look at radio control cars for use as a ready-made robot base with the motor drive and battery system already designed. These cars from a quality hobby store are far better than the toy type. The many tiny airplane servo linkages are perfect for small robots, and airplane engine starting motors are powerful but inexpensive dc robot motors. The servos make excellent arm and hand or "claw" joint motors, and the large servos can be configured to make compact, continuously rotating wheel RC system driven motors.

Our shopping bag is bulging as we head over to the bike repair shop. The owner has many used 10-speed derailleur cluster gear assemblies, tensioners, chains, and bearings that will do nicely to drop the speed on a large robot drive motor. Even small bike wheels make great "robot feet." Next door at the appliance store we find washing machine gear assemblies, mechanical timers, and miscellaneous old things in the back room that the owner was going to throw out anyway.

We now head over to a used auto parts store and plow through used electric window motors, power seat motors, leadscrew actuators, and windshield wiper motors, all useful for large robots. Next door is a wheelchair repair place that has old electric wheelchair motors, the same ones you've heard us talk about at the meetings for $600 each being thrown out because they were dirty inside and needed new brushes. The owner is glad to give them away; he sells new ones to the unfortunate disabled owners who need the VA to pay for them.

You stumble out of the shop, your eyes glassy and gleaming from visions of the ultimate robot serving you a nice cool one as you relax in your pool. You haven't even visited the surplus store such as *C & H Sales* in Pasadena to view the thousands of dc gearmotors, bearings, wheels, pulleys, leadscrews, and other weird things you just know will make a great robot part until you get it home and try to figure out why you bought it.

Hopefully you have learned from experienced RSSC members not to buy used surplus gelled-electrolyte or NiCad batteries, but "junk" is the word for almost anything else. Look at toy trucks and cars, your wife's old electric can opener (it's ac, but you can use the gears), a junked computer printer, an old Xerox machine, heck, even your kid's skateboard (when he's not looking). Parts are all hidden in previously used everyday items!

Tom Carroll

RSSC BOOTH AT THE MAY 20th ACP SWAP MEET

On May 20th, RSSC had our first booth at the ACP bi-monthly computer swap meet. The goal of our participation was to attract interest in the Society and solicit new members. As usual, there was an enormous crowd, and a lot of people stopped to watch Joe McCord's *Probot* and the demonstration of *Newton*. The Society passed out about 300 information/membership flyers. The Sunday morning was definitely worth the effort to bring in more interested members!

The Society is very fortunate to have Tom Freeman of ACP donate the booth for our use. Our thanks go out to him and to the very helpful employees of ACP!

UPCOMING RSSC EVENTS

For our June 5th meeting, we are making arrangements to have representatives from some manufacturers come and present a short technical overview on motors. I'm sure you won't want to miss this meeting!

On July 11th through 22nd, the RSSC is planning to have a booth at the Orange County Fair. The Society will be needing individuals to help man the booth.

It is tentatively planned to go back to the ACP swap meet on July 29th to continue to attract new members and individuals in robotics. We hope to have the Society's robot ready to show and in addition have more of our member's robot projects.

JUNE 5TH MEETING AGENDA

1) Business agenda
   a. Plans for staffing OC Fair booth
   b. Multimeter Raffle (during break)
2) Presentation of RSSC robot design and construction
3) We are still making arrangement to have a representative from industry to present information on motors
4) RAM (Random Access Meeting) - bring something of interest to share with the membership!

Again, I hope to see the entire membership there, along with any interested individuals or business representatives! Pass the word around about the RSSC!!

Scott MacGillivray, Editor

The following was found in *NASA Tech Briefs*, and may be of interest to the membership.

Electronically Scanned Laser Rangefinder

A system would measure distances to objects in front of a vehicle.

NASA's Jet Propulsion Laboratory, Pasadena, California

A proposed electronic laser scanner would sweep across its field of view without any moving parts, measuring the distances to objects between 0.5 and 20 meters away. The scanner would guide a robotic vehicle around obstacles.

In a conventional laser scanner, the laser is moved by panning and tilting mechanisms to steer the beam. The equipment is bulky and complex and consumes substantial power. The proposed scanner would scan electronically rather than mechanically. It would be immune to the wear, stress, and breakage to which mechanical scanners are subject.

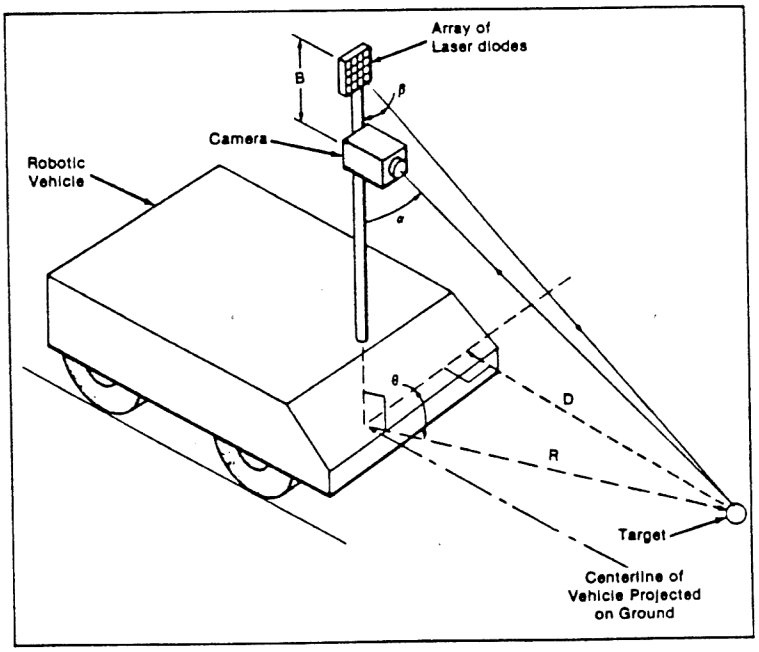
An array of laser diodes, each oriented in a precise angular increment from its neighbor, would be turned on and off in sequence (see figure). This mode of operation would, in effect, move a beam across the field of view, column by column and row by row.

A charge-coupled-device (CCD) camera, mounted on the vehicle at a fixed distance from the array of laser diodes, would intercept beams reflected from targets. A microprocessor on the vehicle would calculate the distance of a target by triangulation from the measured angle of the reflected beam, the known angle of the transmitted beam, and the known distance between the camera and the array.

A practical design would probably call for two CCD cameras to obtain accurate measurements over a large range of distances. A wide-angle camera would be used for distances from 0.5 to 5 m and a narrow-angle camera would be used for targets from 5 to 20 m. The accuracy of measurements with the dual cameras is estimated at 1 to 3 percent of the distance to the target.

A triangulation calculation would be done for each scanned row in the array. The composite scans for each row would show all targets in the field of view. Currently available CCD cameras can produce full composite scans many times per second, so that the relationship of the vehicle to objects in its path can be updated frequently.

This work was done by Katsutnori Shimada of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, Circle 17 on the TSP Request Card. NPO-17571*

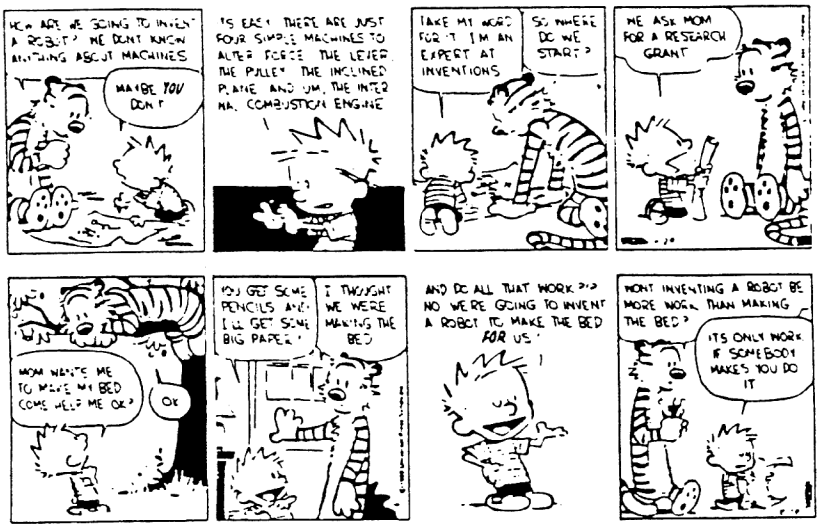


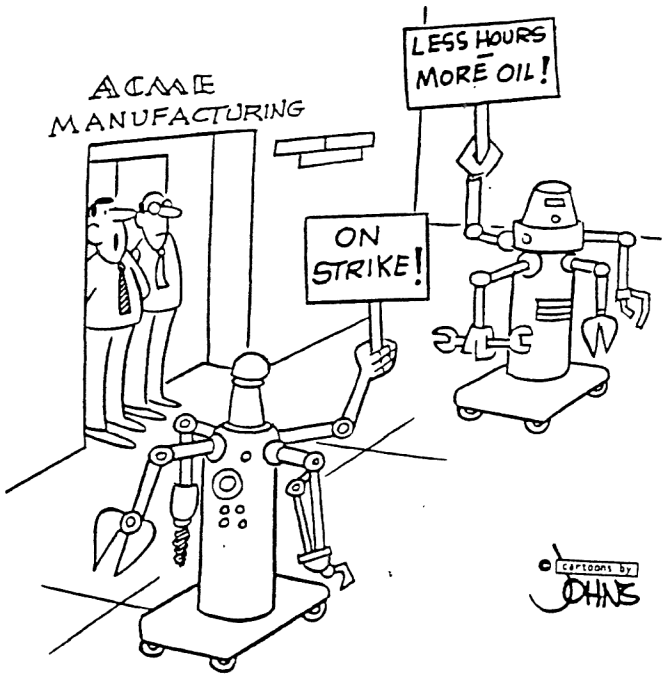
The Robotic Vehicle Would Scan vertically and horizontally to detect objects in its path. The scanning would be done electronically, with no mechanical movement. A microprocessor on board would calculate the distances to objects by triangulation. Specifically, R and D are calculated from B and β (which are known in advance) and α and θ (which are measured by the camera).

ıe following were provided by Jerry Burton for our enjoyment-

Calvin and Hobbes

by Bill Watterson





" I SUPPOSE IT WAS BOUND TO COME TO THIS EVENTUALLY "