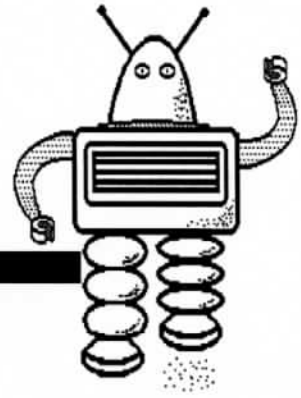

THE ROBOT COMPANION

The Newsletter of the Dallas Personal Robotics Group
May, 1989
Stan Spielbusch, Editor

UPCOMING EVENTS

The May meeting will be held on May 20th, at 2:00PM. Since this coincides with Bill Gates' speech at the Infomart, we encourage people to attend his speech, then regroup at the meeting room afterwards. For anyone not interested in his speech, Brian Vaceluke (Vice President) will hold an informal robotics meeting at 2:00, as scheduled. This would be a good chance to talk to Brian about his homebrew efforts, if you have questions or suggestions.

See the President's Corner for further information on upcoming events.

APRIL MEETING MINUTES

Ed Rivers handed out a DPRG calendar for April & May.

Ed reviewed the book "The World of Robots" by Brian Morris, published by Gallery books. The book gives a layman's explanation of the history, present, and future of robotics, with lots of interesting photos.

Ed asked members to please update their personal information for the club database. Fill out a membership form in the back of this newsletter.

CCAD (Center for Computer Assistance to the Disabled) has joined the Computer Council of Dallas. We hope to have a lot of interaction with this group.

We would like to invite our members to attend the Dallas Personal Robotics Group meetings and user's labs (the last meeting had 5 people, the last lab had 3). Should we reorganize the lab time, day, or frequency so they're more useful?

David Ratcliff has a PASCAL compiler that seems to compile native runnable code on the HERO 2000. This means that anyone with a disk drive can compile and run PASCAL programs directly on the HERO 2000. Software interfaces for the head electronics still needs to be worked out, however.

NOTICE! The deadline for newsletter articles is the 1st of each month! Contact me earlier if you need to make special arrangements to get an article to me, such as via modem or FAX.

MEMBER FEEDBACK

by Stan Spielbusch

Doug Daniels of Ohio owns a HERO 2000, but is discouraged about the results of his point-to-point navigation and arm positioning repeatability results. He would like to find other robot owners to discuss these problems with. He feels he may be missing the point somewhere in regard to the utilization of his HERO 2000.

Well, Doug, you're not alone. I think all HERO owners have had disappointing results in these areas. However, this should be met as a challenge. With respect to ability, the HERO 2000 is much more like a newborn baby than an industrial robot. It needs to be taught to adapt to its imperfections by using feedback. For example, prodigious use of sonar for navigational feedback should improve the reliability. Adding vision or tactile sensors, along with suitable software, should eliminate the need for perfect arm positioning. Since the original intent of the HERO 2000 was as an educational tool, I treat it as such -- perform experiments, learn from the results, and devise ways to improve its performance. Unfortunately, most of the people I know who are capable of real innovation are so busy with their engineering jobs that they don't have much time for robotics work.

I hope this helps your perspective, Doug. I'd be happy to hear more from you about this. Perhaps you have more time to experiment than most of us?

Bob Nansel of Seattle (Seattle Robotics Society) has responded to my request for an information exchange between our groups. His group is very much interested in exchanging newsletters, as well as invitations to contests and events. His invitation to the May 20th Robots-thru-the-maze contest was rather short notice, but he'll be giving advance notice of any future events.

As I've mentioned before, his group is primarily homebrewers designing robots to navigate a maze. In future contests, they plan to add a wrinkle -- an optical/acoustic beacon called a "Cheez". In the simplest "Cheez Maze", the goal would be to find the Cheez and signal that fact. More demanding contests would require the robot to find it and take it out, and perhaps replace it with another one. The idea is to use the sound beacon as a rough locator, and the IR beacon for precise location.

Bob would like to see exchanges of drawings and schematics, and photos of robot projects. He is trying to compile a robotics yearbook. He also passed along the address of another group: San Francisco Robotics Society, 733 27th Ave. San Francisco, CA 94121.

PRESIDENT'S CORNER

By Ed Rivers

Our demo for Girl Scout troop 1380 in Garland has been postponed for the time being. The troop leader cannot guarantee a good turnout during the summer months. We may be asked to give the demo some time this fall.

May 20th will not be your average InfoMart meeting day. Bill Gates and reps from Microsoft are due to be in town that day, and Bill will be doing a talk at our normal meeting time of 2pm. The talk is sponsored by the North Texas PC User's Group, and will be held on the ground floor of the InfoMart near the fountain. Because of this, I'd like to postpone our meeting until the talk is over. If any time is left, we'll meet in our assigned meeting room. The meeting room will be available at 2:00 for those that don't wish to attend the talk.

April 22nd was our last user's lab meeting. Due to the poor attendance for the third month in a row, I will not schedule the next lab until I can guarantee a good turnout. The Highland Park High School is an excellent meeting place, but we cannot plan activities if only two or three people show up.

C-CAD MEETING ANNOUNCEMENT

by Ed Rivers

C-CAD, The Center for Computer Assistance to the Disabled, is now an affiliate of the Computer Council of Dallas and will be holding its first meeting at Infomart this month. All user group members are invited to attend.

Among the purposes of C-CAD are: to disseminate information regarding computer applications for the disabled; to encourage the development of new and creative software and computer modifications for the disabled; and to provide an opportunity for the disabled to learn marketable computer skills and the use of a computer to enhance daily life.

Scheduled for the meeting is a presentation "Rehabilitation Engineering" by Richard L. Roa, D.Sc., Vice President of Baylor Biomedical Services. Dr. Roa will describe the history of rehabilitation from an engineer's perspective and give an overview of this emerging field with a review of current leading-edge technologies being explored in research laboratories with emphasis on the role of computers. Please check the overhead projector in the lobby for time and room assignment.

There will also be a demonstration of computer control of home appliances by voice command running all day in the vendor area.

ARTICLES OF INTEREST

by Stan Spielbusch

ARTICLES:

Robotic Arm Apes Human Movement; April 10, 1989, Electronic Engineering Times. Matsushita has developed a 7-axis dual-arm robot, whose arms mimic human arm movement. The project, which is near the end of its 9-year term and $76 million budget, is developing the robot to automate a sewing factory. With its dual arms, it can delicately pull the fabric through a sewing machine, while maintaning a constant tension with the other arm. A 3-D vision system and tactile sensors, along with about 40 microprocessors from 8 to 32 bits, help it avoid bumping into things. See article for photo.

Nakano's positive Perceptron perception; April 17, 1989, Electronic Engineering Times. Kaoru Nakano of Tokyo has been experimenting with perceptron theory, which is similar to neural networks. His work has recently shown some terrific results, in the form of a ball-throwing robot and a walking robot, both taught by positive/negative reinforcement. Proper behavior is taught by 'rewarding' for correct movements and 'punishing' for wrong movements. Another experiment involved two robots communicating between each other about what they 'see' by writing symbols of their own design. Eventually, they created their own language and were able to understand each other, although humans could not decipher the language.

PUBLICATIONS:

The Encoder (Seattle Robotics Society). This is a small newsletter, similar to ours in the early days. Their group seems to be entirely homebrew-oriented, with a common activity of maze-running. It appears that newsletter subscriptions are $5/year (6 or so issues). Contact the Seattle Robotics Society, c/o United Products, Inc., 1123 Valley St., Seattle, WA 98109.

Computer Visions (Robots, etc., aka Loren Heiny). This is a 2-page 'occasional' newsletter for registered users of Loren Heiny's program EyeSight. I have several copies I can hand out at the meeting. Loren is knowledgable in the field of computer vision, and we should be able to learn a lot from his work. Also see his article in this newsletter. For more information, contact: Robots, Etc., P.O. Box 122, Temple, AZ 85280. Send a self-addressed, stamped business-sized envelope for a free sample issue.

SEEING CIRCLES, SQUARES, AND TRIANGLES

by Loren Heiny

An earlier issue of Robot Companion discussed the possibility of programming a robot to see some simple shapes such as circles, squares, and triangles. This article describes how you might implement such a system and presents some of the problems you might encounter.

The Objects

In particular I'll describe my experiments with black, cardboard cut-out shapes of a circle, square, and triangle--each about 12 inches in width (see Figure 1). I chose flat objects like these because they avoid some of the perspective problems associated with recognizing three-dimensional objects. In addition, the objects are all black so that they are easily visible on a white wall, which is where I placed them.

Object Recognition

The two most common ways to get a computer to recognize objects are region analysis and edge detection. Region analysis attempts to group like pixels (usually of binary images) into regions that are then labeled as objects. The assumption is that pixels that are similar belong to the same object. In contrast, edge detection bases the recognition process on finding neighboring pixels that are not alike. These pixels are assumed to belong to the edges of objects and are used to identify which object they belong to. Neither approach is always successful, but they are good beginnings.

Recognizing Objects by Regions

Recognizing the cardboard cut-outs described earlier by region analysis is fairly straightforward and is the focus of this article. The approach is to take an image, convert it to binary form (all black and white) and then group any adjacent pixels that have the same pixel values. Along the way, measurements on each region's location, width, area, "color," and perimeter are accumulated. Using these dimensions to identify the regions is the next step.

Unfortunately, we can't just say a circle must have an area of 500 pixels, a perimeter of 50 pixels and so on, because these values will vary depending on how far away the camera is from the object. (For now we'll always assume the camera is directly facing the target object.)

To get around this problem we'll exploit a few geometric properties. For example, the formulas for calculating the area of a circle, square, and triangle are:

Pi * r * r b * h 1/2 * b * h

We can plug in the measurements of each region's width and height into these equations and test how well the region's calculated area matches its measured area. The closest match is the object. (Of course, if there is no close match, then the region is left unidentified.) For instance, if a region's width, height, and area are 61, 53, and 1722 pixels, respectively, then the three calculated areas are (for a circle, square, and triangle) 2922, 3233, and 1616. The area equation for a triangle gives the closest match to the region's actual area of 1722 pixels. Therefore, this region is labelled as a triangle.

Problems, Problems, Problems

Unfortunately this approach may not always work. For example, if the lighting is poor, the camera is far away, or the robot is not looking at the object head-on, then the image dimensions of an object may not reliably indicate which type of object it is.

Similarly don't be surprized if your robot mistakes a shadow or two for one of these shapes. One way to partially get around this problem is to make the objects more unique. For example, try adding one or more white spots to each object. One robot project that I worked on (Whacky, see Robot Companion Feb 88), for instance, used black circles with white dots on them as binary encoded representations of room numbers.

Finally, using simple geometric properties to recognize objects may break down as more objects are added. If you encounter this problem, you may want to use additional image features to help in the recognition process.

Ways to Use Simple Shapes

Working with such trivial objects may seem like a waste, but here are some justifications for doing so:

1. It's a great way to start learning about computer vision.

2. The shapes can be used as landmarks. A circle can identify the living room, a square the kitchen, and so on.

3. How about a to do list for your robot? For example, if you place a square in a predesignated spot it instructs your robot to stand guard or a circle commands it to return to its charging station.

4. Play hide-and-seek. Place one of the cut-outs somewhere in your house and see how long it takes your robot to find it. (We tried this with Whacky and its room numbers and it usually took our robot about 20 minutes to correctly find the marker in a 15x20 foot room.)

Conclusions

This article has described a way to get a computer to see some simple objects like circles, squares, and triangles. There are other techniques you could use -- most notably edge detection. If there is interest, I'll describe some of these in a future article.

Finally, I'm passing along to the club program library a copy of EyeSight (a shareware computer vision program for IBM PCs with CGA, EGA, or VGA, and 256K) and sample images of a circle, triangle, and square for those who would like to experiment first-hand with the techniques presented here.

Editor's note: Ask for disk 'EyeSight' from the library.

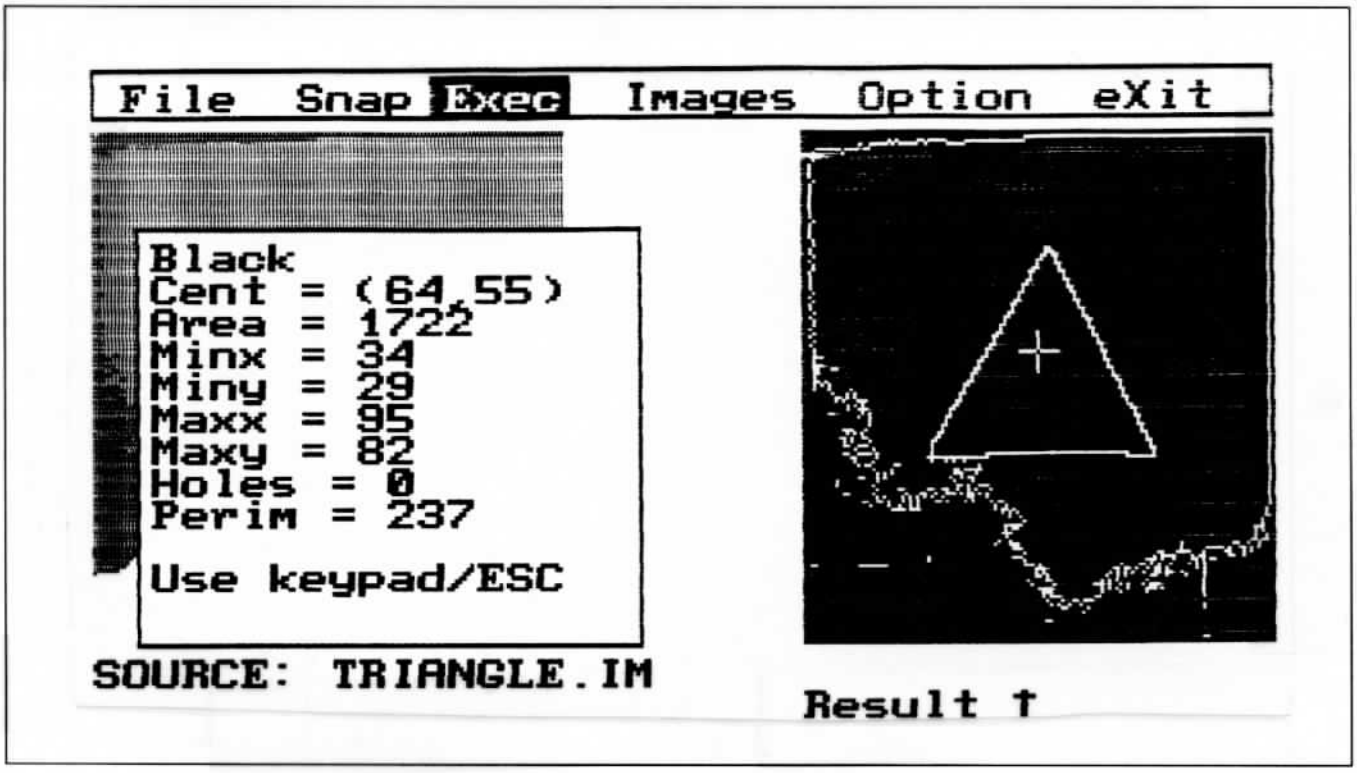

Figure 1. Shown here are the measurements found by EyeSight for the region that corresponds to a triangle.

FROM THE LIBRARY

by Stan Spielbusch

I have added Loren Heiny's EyeSight program, with several sample images, to the library. This is a shareware program, and if you choose to register your copy (for a small fee, to get printed manuals and support), you will also get the newsletter mentioned earlier.

If you have a program to submit, put it on an MS-DOS format disk (double sided, double-density standard format) and bring it to the meeting or send to:
Stan Spielbusch, 2404 Via Barcelona, Carrollton, TX 75006

****** Please ***** include a description of the program, either as comments in the program or as a separate .DOC file. I don't have the time to study each program to figure out what it does!
When you submit a disk, you receive credit for 1 disk in return. Let us know which one(s) you want, or if you just want your original disk back.

We currently have 4 disks in the library -- a HERO-1 BASIC disk, a HERO-2000 BASIC disk, a HERO-1 Assembler disk, and Loren Heiny's EyeSight program.
If you want a copy of a disk, the best way is to bring a blank, formatted PC-DOS/MS-DOS disk to the meeting and trade with me there. If you forget to bring a disk, we will have to collect $2.00 per disk. Mail-order -- $3.00 per disk -- no need to include a disk with order. Send orders to Stan (address above).

SOME FINAL NOTES

by Stan Spielbusch

Well, I have to admit that I'm getting some pretty good input for the newsletter lately. Since I've been getting a few letters, I've started the 'MEMBER FEEDBACK' column. I hope I continue to receive enough letters to contine this column!

What we really need now is some projects to keep everyone interested and educated. We are strongly considering an incentive program for good project. It would work something like this:

Members vote on their favorite project each quarter (once every three months). The winner would receive a prize, such as a gift certificate or some other valuable item that is donated or purchased by the club. We would also like to hear ideas about what would be good prizes, within a reasonable price range of $25 to $50.

To be 'in the running', the project must be current, and of your own doing (not something your company is doing, like a sewing robot). When appripriate, the project must be discussed or demonstrated at a club meeting. Out of town members must send a photo or other appropriate proof that the project was actually done. It doesn't have to be a 100% working model, but remember that the voters may judge on how complete it is!

Also, you must provide an article for the newsletter, so that all members can get a chance to read about what you're doing. Since a large percentage of our members are out of town, the article could be a major factor in the vote. A maximum of two project articles will be published per month (depending on the size of the articles), so in any given quarter no more than 6 projects will be in the running, keeping the odds pretty high. 1st/2nd/3rd place prizes will be considered to make it even more attractive.

An addressed, stamped envelope with a ballot will be sent to all members, to encourage voting. Votes may also be phoned in, or placed at the meeting.

We still have some details to work out, such as how to deal with past projects. Possibly a contest for all projects in 1988, and another for 1989. So please don't 'hold back' your project or article -- we won't forget you!

Let me know if any of you have suggestions regarding this incentive program.