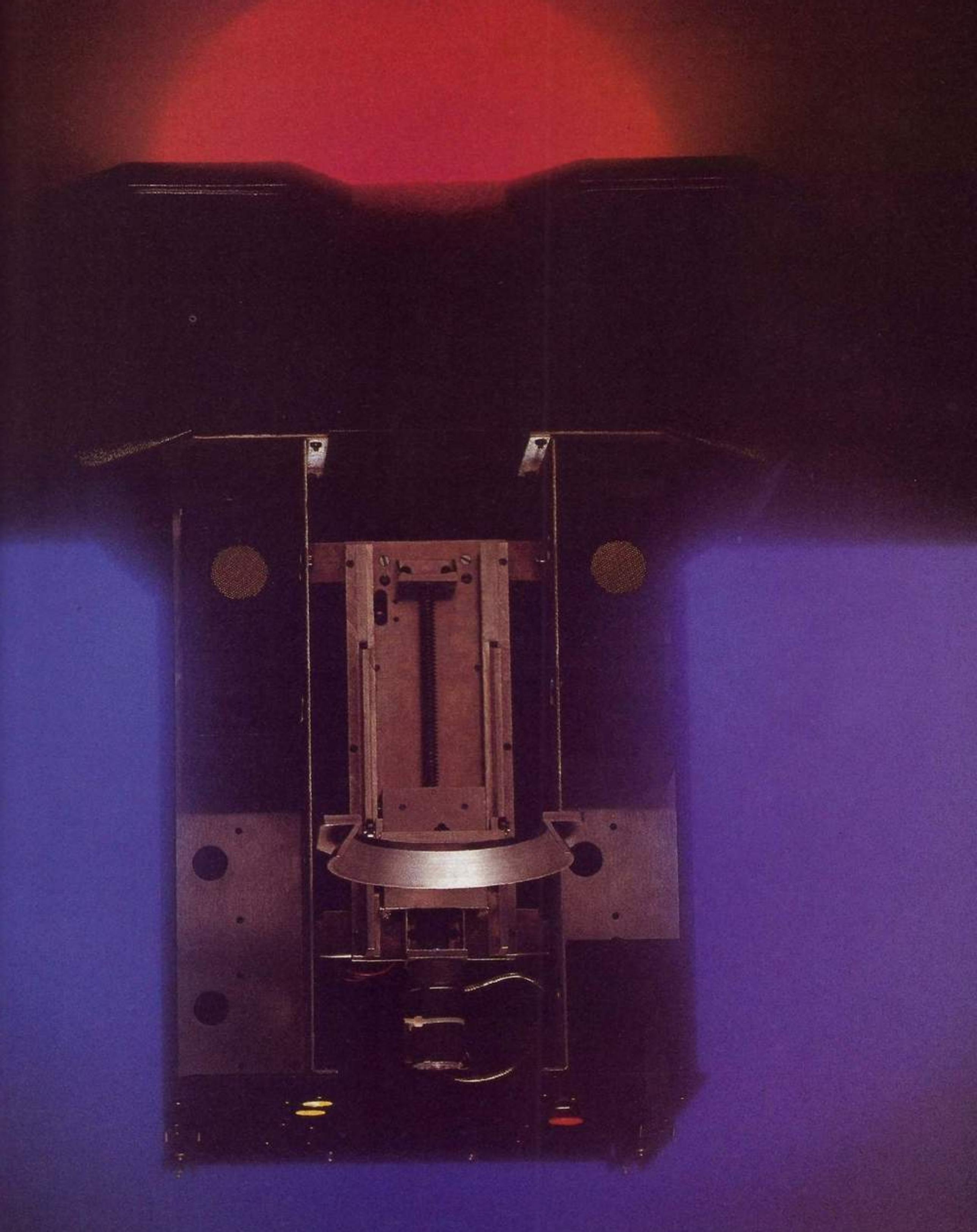
COVER STORY ■ ROBIN WEBSTER

A PERSONAL ROBOT GOES TO MARKET

BOB can walk, talk, and perform simple tasks. Once outside vendors provide this IBM-lookalike-on-wheels with a few more tricks, you may want to have him around your house.



BOB

Waiting in the wings to make an official appearance sometime in September is BOB, touted as the "first personal/home robot." BOB (that's short for Brains On Board) is either the ultimate in portable PCs or at least one reason why you shouldn't buy that shag carpeting for the living room.

BOB is the 3-foot-high offspring of Androbot, the San Jose-based company. Some readers may remember TOPO, the robot produced by the same company for educational purposes. TOPO was quite short and used wheels instead of legs.

TOPO was brainless; he contained none of the computer hardware that would allow him to make decisions about the world around him. Instead, users had to link up their own hardware before TOPO could do his stuff. But even so TOPO fared pretty well. According to Androbot, over 1,000 TOPO units have been sold.

Androbot's $3,995 new baby is a different beast entirely. It's taken the Colby Computer idea (repackaging an IBM PC's innards in a portable box) to the extreme; BOB is a PC lookalike on wheels.

Beneath a cream-colored plastic exterior, which looks like it was dreamed up by someone influenced by Buckminster Fuller's geodesic dome concept, BOB uses an Intel 8088 chip and comes with 64K RAM, which can be bumped up to 640K if required. (BOB's exterior may change before the September launch.)

BOB's full name is BOB/XA, the XA standing for "expandable androbot." And expandability is what this particular robot is all about. Androbot intends to market BOB as a robot prototyping system that comes with just enough hardware and software to make him walk, talk, and perform a few simple tasks. Independent hardware/software vendors will have to provide more advanced abilities.

The main motherboard is set vertically so that it fits into the torso of the robot. There are eight IBM-standard slots for add-on boards. In addition to the regular IBM-lookalike electronics, Androbot has included its own special hardware. A number of sockets can accept plug-in ROM chips, and a selection of specially designed circuits produce speech output, move BOB around, and react to data coming in via external sensors.

Sonar Vision

BOB comes with two head-based ultrasonic transmitter/sensors. These operate in sonar fashion. One sensor sends out an ultrasonic wave and detects any feedback; then the second sensor takes its turn. By computing the time taken for individual signals to go out and return, BOB can determine (using the parallax principle) where objects are located. This ultrasonic setup can be used to great effect during demonstrations of BOB's "follow-me" trick: This robot automatically rolls behind as its demonstrator walks from room to room. Additional ultrasonic sensors can be added for special applications.

BOB also has an optical sensor attached to his waist (designed basically for the same purpose as the bar-code reader in your local supermarket) and moves around by means of two electric motor-powered wheels. Power is supplied to the robot by two 12-volt batteries linked up to generate 24 volts.

A standard pushbutton telephone keypad is used to assign tasks, and somewhere in the final version will be both a 9-pin joystick interface and a 25-pin RS-232 serial port.

Like all good Boy Scouts, BOB has a compass. But this compass is a precise electronic one that allows him to figure out positions and headings. And you'd better stand clear while BOB gets his bearings. I've been told that when booting up under certain conditions, BOB spins like a whirling dervish to calibrate the compass.

The biggest disappointment, perhaps, is that BOB doesn't have an arm in the conventional sense. In fact, he has no gripper device at all. Instead, Androbot has supplied a simple lifting device that operates in the *y* axis (up-down) only.

This lifting device consists of a small servo-motor that turns a long, threaded rod on which the lifting unit—a U-shaped piece of metal that juts out horizontally—has been placed. The device operates much like those simple screw-type car jacks that have to be turned by hand in order to lift or lower a car. Turn the screw one way and the U bracket will lower; turn it the other way and the bracket will rise, lifting anything that fits snugly in the U.

The reason for not including an arm-plus-gripper on a mobile robot is fairly sound. It boils down to how complex you want to make your software and how many breakdowns (nervous or otherwise) you can take before you get anywhere near to making the arm work well under a wide range of operating conditions.

According to Androbot, BOB's lifting bracket can be used to lift specially designed trays or tables that are placed strategically around a room or house. The idea is that you place items of interest on these trays and, after informing BOB of how to identify these items, he will go off and retrieve them whenever you tap in the correct code on the telephone pad.

BOB currently identifies individual trays by means of a bar-coding system developed by Androbot. Like the lines that tell your local supermarket laser scanner

FACT FILE

BOB/XA
Androbot
101 E. Daggett Dr.
San Jose, CA 95134
(408) 262-8676
List Price: $2495, basic configuration; $3995, standard configuration.
Requires: 128K RAM, one disk drive.

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what each item costs. Androbot's bar-coding system uses reflective material to enable BOB, via his optical scanner, to determine whether the correct object is in view. The bar code consists of six digits: one start bit, four data bits, and one stop bit. You can save BOB considerable search time by telling him that an object is located in a different room; the key, though, is to find a way to encode this information in bar-code form and place it on the wall in a prominent place.

BOB can recognize a 2-by-2-inch bar code up to 10 feet away. However, most households have a wide range of items that might produce visual "noise" and interfere with the scanner. I couldn't test how BOB might react to such situations in Androbot's bare-walled San Jose office, but relevant data should be forthcoming when the robot goes on the market.

Sleeping on the Job

I also foresaw some real problems in trying to get BOB to go between rooms that have carpets of differing pile thickness or between split-level floors. In the event that BOB cannot continue because of some physical barrier, he will automatically stop what he's doing after a few attempts and go to sleep. The situation is similar to DOS telling you that, having failed to read a disk track after three attempts, it wants to know if it should "Abort, Retry, Ignore?"—except that BOB seems to be programmed to abort.

Androbot has decided to use the FORTH language to program much of BOB's activity. This is interesting because, technically speaking, FORTH is an ideal language for creating extremely concise code for controlling many types of electromechanical operations.

In fact, this code is so efficient that it is not unusual to find tiny FORTH programs handling data acquisition/hardware control at major radio telescope observatories or unattended radio transmitters. Typically, the FORTH compiler and associated development software only require about 6K in a stripped-down form, while the final FORTH programs could happily live in a handful of kilobytes.

The drawbacks of FORTH center on the ease with which bizarre programs can be created. Because this language is based on a main dictionary in which "defined" words are stored for execution in programs, the programmer creates his own language. Only a few FORTH primitives come ready-defined. One user-defined word may thus include the definitions of many other words already stored in the dictionary. Executing a single word may therefore have a small effect (if that word only represents a one-level definition) or a domino effect (if it represents hundreds of other FORTH words).

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This makes FORTH programs some of the most personalized code ever. The source code is usually unintelligible to anyone not involved in the development process, and documenting the code later may be an impossible task for the careless programmer. However, Androbot is said to be developing a high-level programmer/user interface that will sit above the FORTH routines. Androbot is hoping that people well versed in the PC's architecture will see BOB as a good way to get into some exciting development work.

Many things could be done to enhance BOB's hardware and software. A bolt-on arm could be added complete with a gripper and the software to control it. Perhaps instead of having to tap in commands on the integral telephone keypad, some kind of remote-control command system could be employed (radio signals or, possibly, spoken words), and maybe decision-making software could be introduced that would elevate BOB from a quite good "follower-of-instructions" to an active "learner-of-new-rules."

A New Market?

In the late sixties and early seventies, there was a gripper-equipped robot called Freddy. He used a camera for an eye and was bolted to the ceiling. His sphere of influence consisted of a movable table supporting some wooden toys. Over time, Freddy was taught how to disassemble and assemble these toys and was able to recognize objects and interact with them by moving the table around to bring things into reach.

One-armed industrial robots have, since Freddy's time, come into widespread use. Intelligent robot design, in contrast, hasn't advanced significantly in recent years. BOB may well be in the vanguard of an emerging personal robot market. The concept of the average person owning a personal robot, however, has yet to gain popular acceptance.

If only a personal robot, or any robot, could do something really intelligent like prepare and serve an extra dry Martini without breaking the glass, cook a burger medium-rare and go easy on the mayo, or amuse you and your friends with a juggling act. When that happens, I'm sure no one could imagine being without one. ■