# THE ROBOT COMPANION

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MEETING ON JUNE 15.1985 AT THE HEATH COMPUTER CENTER IN DALLAS TEXAS

- OUR ROBOTS ARE GOING!!! - TO DEMONSTRATE THEIR TALLENTS, BEAUTY, AND ATHLETIC ABELITIES AT THE UP-COMING "ROBOT OLYMPICS" IN A MAJOR DALLAS MALL.
- TEACH YOUR ROBOT TO TELL TIME!! - EASY BASIC PROGRAM WHICH READS YOUR ROBOT'S BUILT IN CLOCK, CALENDAR, ETC. - ED RIVERS
- "HOME MADE LIGHT SEEKING ROBOT DEMO" - REPORT ON THE BOOK "EVERYONE CAN BUILD A ROBOT BOOK" - TOD ANDERSON
- THE CLUB'S "CPU", (COMMON PROGRAM UNITS) HOW ALL OUR CLUB MEMBERS CAN SHARE IN THE CLUB'S LIBRARY PROGRAMS
- COMPASS DEMO - WILL DEMO THE ADDITION OF AN IMPORTANT NEW SENSE WHICH WILL ENHANCE YOUR ROBOT'S ABILITY TO FREELY MOVE ABOUT - WALTER BRYANT
- ASSEMBLY LANGUAGE LAB - TO BE HELD AT 3:00 P.M., MEETING AT 4:00 P.M.

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INFORMAL - "HAND'S ON", USER'S LAB TO BE HELD JUNE 30.1985 (SUNDAY) AT JOHN AND DIANE SPRAGUE'S HOME IN LEWISVILLE AT 2:00 P.M. (PHONE 214 436-6351). DIRECTIONS AND A MAP WILL BE HANDED OUT AT THE NEXT CLUB MEETING ON JUNE 15.1985.

# HERO I ASSEMBLY LANGUAGE PROGRAMMING
## Part I
by Joe Rowe

This is the first in a series of articles based on the Hero I Assembly Language Labs presented each month at 3:00 pm preceeding the regular Dallas Personal Robotics Group meetings.

The Hero I robot uses the Motorola 6808 microporcessor to control every function of the robot. Before learning the assembly language (or machine language) of the robot, it is essential to understand some key elements of the 6808. The 6808 uses several registers to contain the data being manipulated and to control the processing sequence of the program being executed. It is important to understand that whenever the robot is turned on (except for portions of sleep mode) a program is always being executed by the microprocessor. Whenever it is not executing a "user" program (one that you have entered) it is executing a program called the "executive" which is contained in a ROM (read only memory). User programs are normally contained in the robot's RAM (random access memory).

The basic unit of a program is an instruction. An instruction tells the microprocessor to perform some specific small task. It may take a sequence of many of these instructions to perform what would normally be considered a trivial task. For the 6808, instructions may be from one to three bytes in length. The first byte of an instruction is called the opcode (operation code). It tells the microprocessor what function (instruction) is to be performed. The second and third bytes, if included, provide additional information required to execute the instruction. Instructions are executed sequentially as they exist in the robot's memory unless a special instruction is executed to tell the microprocessor (CPU) that the next instruction is at some other point (address) in memory. Since each instruction always has the same length (based on the opcode), the CPU can always calculate the starting address of the next instruction. The CPU keeps the address of the next instruction to be executed in a special register called the Program Counter (PC for short). The program counter is two bytes long since the maximum address for the 6808 is hexadecimal FFFF (X'FFFF). It always contains the address of the next instruction to be executed, even during the execution of the current instruction.

Since a byte can represent 256 possible values, there could be that many different machine language instructions for the 6808. There are in fact many unused opcodes in the 6808 instruction set. Heath has taken advantage of that fact to provide a set of robot language instructions based on unused opcodes. It is very important to realize that the robot language instructions are not directly executed by the microprocessor. They are interpreted by programs within the robot's ROM whenever the robot is in "robot language" mode. A great number of actual 6808 instructions may be actually executed in order to execute one "robot language" instruction through this interpreter. It is thus very important to keep track of which mode is current in your programs. The 6808 CPU contains several other registers which we must understand in order to do assembly language programming. These are the accumulators, the index register, the stack pointer and the condition code register.

The 6808 contains two single byte registers called accumulators. They are designated accumulator A (ACCA) and accumulator B (ACCB). These registers are used in almost every 6808 instruction. They are the only registers in which data can actually be manipulated (i.e., added, subtracted, etc.). As a consequence, most 6808 programs are heavilly laced with instructions to load data into them (i.e., LDAA and LDAB) and to store the results of the manipulation (i.e., STAA and STAB).

The index register (IX) is two bytes long and is normally used to contain an address. The use of the index register to point to data areas makes it possible to manipulate large quantities of data much more easilly. It also permits the use of common program routines which can manipulate data in different areas of memory.

The stack pointer (SP) is another two byte register. Since the 6808 has so few registers to contain data, it is very frequently necessary to temporarilly save their contents while they are used for something and then to restore their former values. The "stack" provides an efficient way to save and restore registers in RAM memory. The details of the operation of the stack and stack pointer will be explained when the stack oriented instructions are discussed.

The condition code register (CC) is a unique single byte register. It is often necessary in programs to compare to values in order to determine what should be done next. The condition code register is used to contain the results of such comparisons so that subsequent instructions can test the results of the comparison and act accordingly. Some instructions other than comparisons also set values in the condition code register. Each bit of the CC represents a specific condition or "flag". They are designated the H, I, N, Z, V and C flags. The "Z" flag, for example, is used to indicate a zero or equal result.

THE WALL STREET JOURNAL.





# R2D2 May Be a Wiz, but Robots For Home Use Still Can't Do Much

By Robert L. Simison
*Staff Reporter of* The Wall Street Journal

When the personal robot trundled onto the scene three years ago, optimists predicted a growth sensation. Consumers inspired by R2D2 and C3PO, the charismatic robot aides of the "Star Wars" movies, seemed eager to welcome a helpful batch of real-life androids into their homes.

But early models turned out just bright enough for serving drinks or amusing children. Sales fell short of projections, and most of the fledgling home-robot industry's pioneers hit financial trouble.

Robotics consultants still predict a boom, eventually. For now, however, most manufacturers are pulling back. Rather than market their primitive devices as all-purpose home robots, they are peddling them to schools and amateur inventors—who seem to relish the challenge of finding something useful, or at least creative, for the machines to do.

**'Laughable' Stuff**

And it can be quite a challenge. "All this stuff that's being proffered now is laughable," says Thomas Frisina, a former president of Androbot Inc., an early personal-robot maker that experienced financial losses and recently agreed to be purchased by RB Robot Corp. in Golden, Colo. "Most of these robots have no utility. They are just an excuse to get somebody to buy a personal computer that walks around."

About a half-dozen small companies have each sold anywhere from a few dozen to several thousand machines costing $500 to $8,000. Sales last year totaled $25 million to $50 million.

"The mistake we made was to assume that if you just set up with computer dealers, people would come in and buy robots," says Constant Brown, vice president for sales and operations of RB Robot. The company, which has been operating under bankruptcy-court protection since April 1984, introduced one of the first personal robots. Its $4,000 RB5X, which resembles a two-foot, plastic-domed trash can with a mechanical arm, was initially offered through computer stores. But RB gave up when few sold, and is now concentrating on selling to schools. "What we learned was that you have to define and cultivate specific markets that the robot is ready for," Mr. Brown says.

Consumers' biggest problem has been finding work for the machines. "People want a robot, but they really don't know what they want it to do," says David Wilson, a research manager at Future Computing Inc., a consulting firm. "When you ask them, they hem and haw and say they want it to clean house, do the dishes, take out the trash."

Personal robots can't do any of that, however, so tinkerers have cast around for other tasks. Keith Collins, an Irving, Texas, computer salesman, says he stationed his $1,200 Hero 1 near the Christmas tree last December. Whenever it detected any of Mr. Collins's three cats nearby, the robot said, "I'll get you, ha, ha." The cats kept their distance.

Jack Boyd, owner of an Atlanta engraving company, says he uses his $3,500 Hubot to entertain guests by singing in a Southern drawl. The nearly four-foot-tall robot has a video-display face, microprocessor, voice synthesizer, radio, television and polyethylene body. "What do I use him for? Nothing, just amusement," Mr. Boyd says.

If personal robots are to win wider acceptance, a number of technological advances are needed. Most of those currently available rely on navigation systems that involve either trial-and-error, using sonar or infrared sensors, or following a painstakingly programmed route. In a sales demonstration, the top-selling Hero 1, made by the Heath Co. unit of Zenith Electronics Corp., blunders into a corner. "I think I'm lost," it says, adding "oops" when it bumps a wall.

*One couple has a robot with its own room, toy box and personal computer. 'Since we don't have kids, we call Robbie our little entity,' the husband says.*

Personal robots also need artificial intelligence, or programming that would permit them to learn from experience. Today's models have to be programmed to do everything. And to become really useful, personal robots must have vision sophisticated enough to control a mechanical arm and the ability to follow voice commands.

"Everybody thought they could solve those problems more easily than it turned out," says John Peers, a Cupertino, Calif., semiconductor expert and another former Androbot president.

**Basement Tinkerers**

That's where the amateur inventors come in. If enough basement tinkerers get their hands on personal robots, somebody is bound to come up with a breakthrough, or so the theory goes. Personal robot proponents draw parallels to the development over several years in just that way of personal computers.

John Normark, a San Jose, Calif., software engineer, spends his evenings working on a voice-command system for a $2,500 RoPet, made by Personal Robotics Corp., San Jose. After about three years, and outlays of $2,000 to $3,000 a year on equipment, Mr. Normark says he can get the robot to respond to single-word commands, but not in a noisy room or with several people talking. "It still has some limitations," he says.

Walter and Beverly Bryant, of Lewisville, Texas, say that in the past year and a half they have made their Hero 1, named Robbie, write its name, answer their phone and patrol the house as a sentry. The Bryants devote much of their spare time to developing new software, and Mr. Bryant, an industrial engineer, writes programs on his lunch hour. Robbie has its own room, toy box and personal computer. "Since we don't have kids, we call Robbie our little, our little entity, our product," Mr. Bryant says proudly.

Heath estimates that amateur inventors bought two-thirds of the 8,000 Hero 1s it has sold. It says schools bought the remaining third.

**Teachers' Helpers**

Indeed, Heath and other manufacturers have been pitching their products to schools from the elementary level through college. Niki Delgado, a Las Cruces, N.M., former school teacher, has used an RB5X to teach children reading, language and mathematics. Keith Bridges, coordinator of the electronics technology program at a junior college in Tyler, Texas, uses a Hero 1 to teach robotics to future technicians.

Many people think personal robots could soon be used as memory aids for the elderly or to fetch things for the handicapped. "There is a very clear-cut need for this," says K.G. Engelhardt, a research health scientist who has been studying the idea at a Veterans Administration unit in Palo Alto, Calif. But she says present models can't carry a heavy enough load and need better voice control. Others say similar improvements are needed before personal robots can be used in factories as sentries or to carry materials.

Others foresee a simpler role for personal robots. Nelson Winkless, an Albuquerque, N.M., writer and consultant on technology, suggests they might become a sort of cross between the family pet and a home computer. "They could keep an eye on the house, monitor the children or an elderly parent, do some calculation, collect information and have it ready for us."

"WAKE UP PROGRAM"

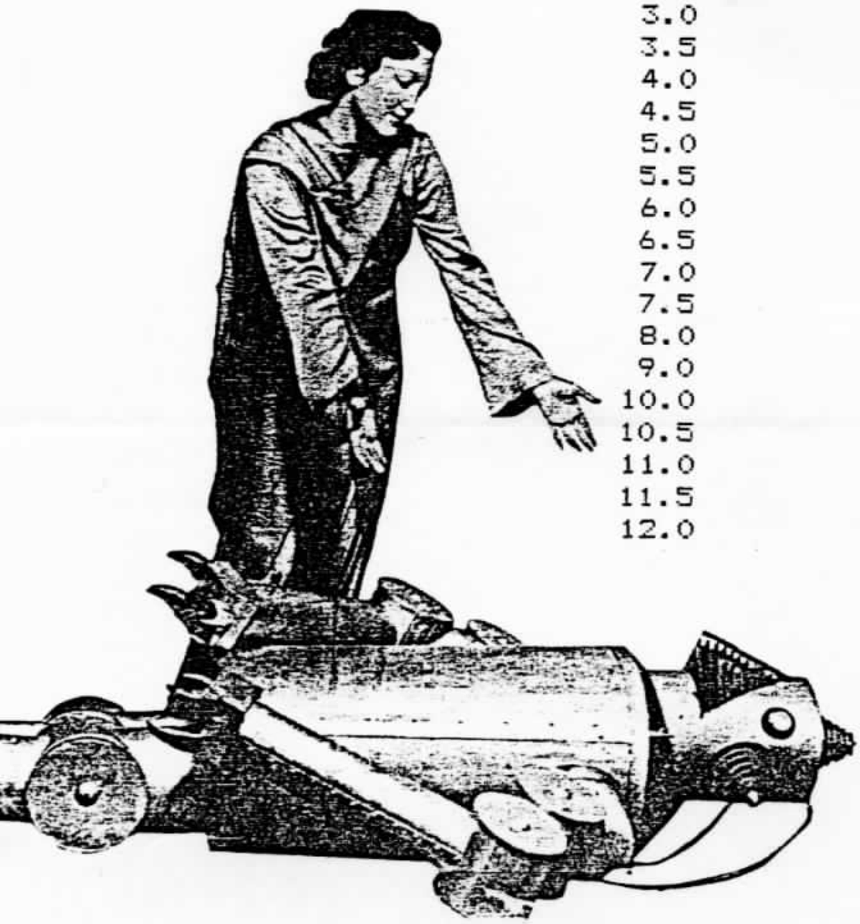
THE FOLLOWING IS A "BASIC" PROGRAM WHICH USES "PEAK AND POKE" TO ENTER A CHOSEN SLEEP INTERVIAL (YOU GET FROM THE LIST) TO WAKE YOU UP. THE EXAMPLE PROGRAM IS FOR 8.5 HOURS.

HEX CONVERSION CHART
FOR WAKE-UP PROGRAM

EXAMPLE :

8.5 HOURS X 60 (MINUTES IN AN HOUR) X 6 (10 SECOND INCREMENTS IN A MINUTE) X 0.8916086 (RUNTIME FACTOR) = 2728 (BASE 10) = AA8 (BASE 16)

| MINUTES | HOUR | BASE 16 |
|---|---|---|
| 1 | 0.166667 | 5 |
| 5 | 0.833333 | 1A |
| 30 | 0.5 | A0 |
| | 1.0 | 140 |
| | 1.5 | 1E1 |
| | 2.0 | 281 |
| | 2.5 | 322 |
| | 3.0 | 3C2 |
| | 3.5 | 463 |
| | 4.0 | 503 |
| | 4.5 | 5A4 |
| | 5.0 | 644 |
| | 5.5 | 6E5 |
| | 6.0 | 785 |
| | 6.5 | 827 |
| | 7.0 | 8C6 |
| | 7.5 | 967 |
| | 8.0 | A0E |
| | 9.0 | B48 |
| | 10.0 | C89 |
| | 10.5 | D2A |
| | 11.0 | DCA |
| | 11.5 | E6B |
| | 12.0 | F0B |



AFTER A LITTLE "WD40". I AM SURE THAT WON'T HAPPEN AT THE ROBOT OLYMPICS.

```
3 REM          "WAKE UP PROGRAM"
4 POK $E41,$3F:POK $E45,$83:POK$E46,$39:POK $3F,$E:POK $40,$41
10 SPE "BEEP PA1"
11 REM
12 REM  YOU WILL HEAR THIS "BEEP" AS HE "GOES TO SLEEP"
15 REM  INTER TIME IN HEX AFTER "$E43" AND "$E44",(LINE 20)
17 REM   EXAMPLE: "$A" AND "$A8" = $AA8. WHICH IS 2.728 (BASE 10)
18 REM
20 POK $E43,$A:POK $E44,$A8:POK $40, $41:POK $E42,$87:USE
30 A = 0
31 REM
32 REM
35  REM  FROM LINE (36) ON, YOU CAN PUT IN YOUR OWN "SPEAK STATEMENTS"
36  REM  MOTOR, OR SENSOR COMMANDS, ETC.,ETC....
37 REM
38 REM
39 REM    "IT IS TIME TO GET UP"
40 SPE "2I1I3T I3Z 3T AH1 EH3YM 2TU1 GEH1EH3T 3UH1UH2P PA0"
50 SPE "PA1 PA1 PA1 PA1"
55 REM
56 REM
58 REM ANY HUMAN WHO CANNOT COPE WITH MATHEMATICS IS NOT FULLY HUMAN.
59 REM
60 SPE "3EH2EH22NY 1WUH1UH2N 1HIUU1U1 2KAE1EH31NAH1UH3T 3KO1U1P PA0"
70 SPE "2WI1I3TH 3MAE1EH31THUH12MAE1EH31TI1KS 1I1 I3 Z 2NAH1UH3T PA0"
80 SPE "2FOO11LY 3HHY1IUU1U12MUH3UH3N PA1 PA1 PA1"
85 REM
86 REM
89 REM AT BEST, HE IS A TOLERABLE SUBHUMAN WHO HAS LEARNED TO
90 SPE "2AE1EH3T 3BEH1EH3ST PA1 2HE1Y 1I1I3Z 1A1AYY PA0"
100 SPE "3TAH1UH12LERUH11BUH1L 3SUH1UH3B2HY1IUU1U12MUH3N PA0"
105 REM
109 REM WEAR SHOES, BATHE, & NOT MAKE A MESS IN THE HOUSE.
110 SPE "2HIUU1U1 1HAE1EH3Z 2LERRND 1TU1U1 3WEH13R 2SHU1U1Z PA1"
120 SPE "3BA1AYYTH PA1 1AE1EH3ND 3NAH1UH3T 2MA1AYYK PA0"
130 SPE "1A1AYY 3MEH1EH3S 2I1I3N 1THVUH1UH3 2HUH3AH2U1S PA0"
135 REM
136 REM
140 A = A + 1
150 IF A < 20 THEN 40
160 END
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## THE DALLAS PERSONAL ROBOTICS GROUP

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