Personal computing—An overview for computer professionals

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ABSTRACT

The brief history, current status, and foreseeable developments in the areas of home and hobby computing are outlined. Major points in the two and half year history are presented. Characteristics of current hardware, software, and systems configurations are discussed. Mention is made of a variety of activities for which these systems are currently being used. Emphasis is placed on those features and uses that are unique to personal and hobby computing. Differences are noted between personal computing and professional computing. Developments known to be in progress are outlined. Several interesting and feasible projects that the author believes no one is yet pursuing are mentioned.

INTRODUCTION

Within the past several years, general purpose digital computers have become a consumer product. A number of developments have occurred that are unique to this new area of personal and hobby computing. More are imminent. Some of these developments are beginning to impact the professional computing community. This paper surveys the brief history of home computers, the current situation, and the foreseeable developments. The reader should be aware that, since this paper was written over six months prior to NCC 77, portions of it are either obsolete history or six-month prognostications. And, six months is a fifth of the lifetime of the home computing movement.

There are two distinct subjects within the realm of home computing: hobby computing, in which the users view the hardware and software systems as the primary items of interest, and personal computing, in which the participants are primarily interested in the applications of personal computers. Up through 1976, users of home computers were invariably hobbyists. The hardware that was available in a consumer's price range was too complex for the casual user who was primarily interested in serious personal applications. Additionally, the available systems software was, for the most part, insufficient to support serious applications work. This situation was about to change at the end of 1976. By the middle of 1977, there should be a number of units on the market in the $1000 range that are fully assembled, include a useful amount of memory and interfacing for low-cost mass storage, and include systems software that make them marginally usable by the applications-oriented non-professional.

Typical configurations

The vast majority of personal computers are 8-bit machines. Memory tends to range from one kilobyte to 64K, with most users having 4K-20K. A majority of home systems appear to use a standard television as their primary alphanumeric output device. Not uncommonly, they have no hard-copy capability. Phillips-type audio tape recorders are the dominant mass storage medium, usually having a transfer rate in the range of 100-800 bytes/second. Assemblers are in widespread use. Various versions of BASIC form the dominant "high level" language used for most applications.

Differences from industry

A number of noteworthy differences exist between personal computing and professional computing. Within home computers: Price is crucial; speed, capability, and reliability are secondary. Time and effort is essentially free. The primary motivation is entertainment in the broad sense of the word. Essentially, all not-for-profit home computers are purchased out of the family's entertainment budget.

Neighborly, noncompetitive sharing is quite widespread among home computing enthusiasts. Software, assistance, and solutions to problems are readily exchanged among hobbyists.

Attractiveness of the hardware is of minor consideration to computer hobbyists. Although they might wish to have a beautiful enclosure for their computer, they will be more likely to invest limited funds in additional capability than in a walnut cabinet. This characteristic will almost certainly change, however, as there come to be more personal computers than hobbyist computers.

Second-hand equipment is in quite widespread use among
hobbyists. This is particularly true of peripherals. To a minor extent, used minicomputers are also appearing in home computing environments.

This is a consumer marketplace. Thus, it requires a much higher level of customer service and responsiveness than has been traditionally available in the small computer industry. Users of personal computers tend to have less expertise and less patience than industrial computer consumers, and tend to expect a level of vendor responsiveness equivalent to that found in other retail consumer markets.

There is no national organization of the personal computing community. There are several regional organizations, however, and 160-200 or more local amateur computer clubs.3

The extreme price sensitivity of the marketplace has enabled the widespread development of very small businesses: computer craftspeople. A surprising number of highly reputed products—hardware and software—are being manufactured or assembled in basement workshops or garages. As a small company becomes successful, grows, incurs more overhead costs, and finds it necessary to raise its prices, it thereby makes room for a new, lower-cost garage shop competitor.

HISTORY

The first microprocessor, the Intel 4004, was produced in 1974. It has been estimated that, prior to 1975, there were only 50-200 computers in personal use. Although an Amateur Computer Society has existed for some years, it has remained in the background of the current personal computing movement, and has had little if anything to do with its growth or popularity.

The beginning of hobby computing can easily be dated from January, 1975. In that month, Popular Electronics carried a cover story on the Altair 8800 microcomputer kit newly available from MITS, a small electronics kit manufacturer in Albuquerque. Within three months, two computer hobbyist clubs had formed on opposite sides of the country, unknown to one another. In July, 1975, the first retail computer store opened in Los Angeles. By September, the new hobby had its first national magazine. May, 1976, saw the first regional amateur computing convention. Three months later, the first “national” convention was held and drew an estimated 4,500 enthusiasts.

As of December, 1976, the following situation existed: There were 16,000-20,000 computers installed in homes. There were 160-200 local computer clubs, and at least three local associations of clubs. The largest club had 4,000-5,000 local members. There were 150-400 computer stores. (The number is difficult to ascertain since some “computer stores” are mail order distributors with only a P. O. box. Others are general electronics retailers who happen to carry hobby computers. Still others may be deeply involved in computer retailing but keep a carry-over name implying that they are a hi-fi store or a repair shop.) At least two companies are actively pursuing franchise licensing in multiple states and plan to set up chains of computer stores.

As of December, there were three national magazines explicitly directed to this audience. Two were more about to publish their first issue. Another had published its first and only “monthly” issue in August. Two more periodicals existed that were targeted to the broader topic of popular computing. The largest of all of these had a circulation in excess of 60,000. Two others were reporting circulations exceeding 20,000.

Two or three major conventions explicitly concerned with personal and hobby computing were planned for 1977, as of last December. Additionally, a number of smaller trade shows and conferences were being promoted. The First West Coast Computer Faire planned for 7,000-10,000 attendance at a weekend event in San Francisco in April. NCC’77 expected their Personal Computing Section to expand attendance by at least several thousand.

HARDWARE

There are three identifiable levels of computers in personal use. The first level is the tutorial unit costing $100-$400, having a keypad “front panel,” a minimal monitor in read-only memory (ROM) or programmable ROM (PROM), and 256-1K bytes of semiconductor random-access memory (RAM). The second level is the hobby computer costing $600-$1200, with a full front panel or a turnkey control panel backed by a good monitor in PROM, and including 4K-29K of RAM. The final level is the small industrial computer priced at $1,000-$1,500 or more with a full front panel and 4K-8K bytes or words of RAM. Used minicomputers also fall in this third category.

Two types of home computers can be identified: kits, and preassembled units. The kits are usually—but not always—less expensive for a given level of capability. They generally require some reasonable degree of hardware and electronics expertise in order to properly construct and debug the hardware. A considerable increase in the number of preassembled units on the market is expected in 1977, and these units are expected to be reasonably cost-competitive with the kits. Several manufacturers have reported that it is as economical to produce assembled units as it is to produce kits and have to staff the large customer service activity necessary to back the kits.

Peripherals

Several traditional computer peripherals are popular among hobbyists, most notably used Teletypes, I/O Selectric typewriters, and paper tape equipment. Some home computers also have joy sticks for two-dimensional input, or digital-to-analog converters, usually used for output of music or voltages to drive CRT’s. Fewer systems have real time clocks, or sensors or analog-to-digital converters for real-world input.

A variety of peripherals have appeared that are unique to
home computing. TVT's—television typewriters—are in widespread use by hobbyists. These scan a portion of the system's RAM, treating the bytes of data as ASCII character codes and generating a video signal for use with a television or video monitor. Video graphic capability has been available for over a year in the form of a 64x64 color array or 128x128 black-and-white display. 256x256 black-and-white arrays should be economically available by the middle of 1977. That provides half the resolution of a standard U.S. television and is quite adequate for interesting real-time graphics.

Several dot-matrix impact printers are appearing in the hobbyist market. These are priced in the range of $200-$400 and print 40-80 columns on regular paper. Three speech synthesis units were on the market by the end of 1976 and a fourth one was expected in January. They are $400-$750. One is based on a much more expensive unit that has been in industry use for several years. Another, with proper editing, allows not only voice synthesis, but also singing and music synthesis. A speech input experiments unit was also planned for introduction in January.

Other subsystems that are expected on the hobbyist (and industrial) market before the middle of 1977 include several mini-floppy disc systems for $600-$700, microprogrammable microprocessor kits, a 16-bit processor that will fit in many of the hobbyist computers, and 64K byte memory banks on a single circuit board.

Undone products

Several products would be of interest to the personal computing community that this author believes are not yet being planned by any manufacturer. An electronic telephone dialing peripheral would be simple to produce from current components, and could provide hobbyists with the hardware necessary for an electronic telephone book. Acoustic couplers and modems can be easily interfaced to home computers. Then, once the communication protocols are developed, personal computers can communicate with one another, and with central data and program repositories. Somewhat further into the future: interfacing to video tapes and video discs would provide the home computing enthusiast with on-site encyclopedic storage capacity.

SOFTWARE

Hobbyists with tutorial systems often program in machine code and load the programs via the front panel. On hobby and industrial level systems, editors, assemblers, debuggers, and monitors are in widespread use, often based on cassette tape. A variety of BASIC interpreters are available. Interpreters for several string processing languages, PASCAL, P-Code, APL, and LISP subsets are expected to become available in 1977. Compilers for BASIC and FORTRAN are also expected to appear in 1977. Several disc operating systems for floppy discs, and cassette operating systems for Philips-type cassette tape are available, but are little more than simple file systems and program development systems. They have little comparison to the DOS found on midi and maxi computers in business or industry.

1977 should see the introduction of a number of special purpose editors, e.g., for manuscript preparation, word processing applications, and document generation. Spelling checkers should appear around the end of 1977.

A considerable variety of compilers for machine code or pseudo-code to be interpreted are expected in 1977. There has been and will undoubtedly continue to be considerable experimentation and "homebrewing" of programming languages for home computers. Many of these will be highly interactive. Block structured languages are beginning to appear.

There is very wide demand for business applications software. As of the end of 1976, very little had appeared. A considerable number of people were known to be working on various business packages, however, and these should appear in 1977.

Software problems

Several problems exist for home computing software. One major problem is that of machine independence. Even with machines having identical processors, a variety of design decisions have been made by the hardware manufacturers that impact software. Some assume a given I/O port has a specific function. Many furnish software or firmware—particularly monitors—that make hardware or address assumptions. TVT's commonly make some hardware and software-particularly monitors—that make hardware or address assumptions controlling the location of the display memory. Few of the programmers developing software for a given CPU give adequate care to isolation of the hardware-and-address-dependent aspects of their programs.

In the purely software realm, there are a number of variations of BASIC. Rarely will source code for one version be acceptable without change to another BASIC interpreter.

Control of proprietary software that the hobbyists consider overpriced has been a problem. In these cases, many hobbyists will freely exchange software with little consideration for its proprietary character. Most of the producers of software for this market have chosen to sell it for a large price to the hardware manufacturers who need it to enhance their products. Or, they have chosen to sell it for a very nominal fee—often including source-code listings—and depend on sales volume to obtain an adequate return on their time and effort. It is evident that different marketing practices must be adopted when marketing software to not-for-profit home users than have been used in selling software to a more controllable, for-profit user community.

A possible solution to this problem well may appear in the form of software being stored in masked ROM that plug into an external socket on the computer. Manufactured in sufficient quantity, such firmware units could be priced low enough to be economically competitive with the cost of a tape cassette, plus being far more convenient to use.
USES FOR HOME COMPUTERS

Undoubtedly the question most widely asked concerning personal computers is, "What will they be used for?" In answering this question, the traditional business and industrial uses will be ignored, even though a number of hobby computers are being put to traditional uses in traditional environments.

The most widespread use, currently, is unquestionably for the purpose of playing games. The games are usually single-player games, though an increasing number of multi-player games are beginning to appear. Some of the games are simple games of chance. Many of them, however, involve simulations of varying degrees of complexity. Many such games have a significant subliminal education value. Most of the games seen through 1976 used only alphabetic input and output. An increasing number of games are beginning to appear that use graphic output, and this trend is certain to continue.

Self education concerning computer hardware and programming well may be the next most widespread use of these home computers, to date. Probably a majority of the owners of personal computers spent most of their time, through 1976, learning how to build and debug the hardware, and then learning how to use basic systems software and program. Much of the software work undoubtedly was concerned with learning how to modify some existent software so that it would work with a system that was "almost like" the system for which it was designed. A surprising number of disassemblers have appeared in the hobbyist community, included several that were written in BASIC.

A number of systems include simple analog output equipment, often used for experimentation with computer generation of music. A number of people appear to be experimenting with biorhythm or biofeedback applications. Amateur radio enthusiasts are showing widespread interest in home computers, both for radio applications—e.g., code conversion, antenna control, message processing—and for their own value as a technical hobby. There is considerable interest in word processing applications, however the cost of good-quality hard-copy devices has restrained development in that area. There is also great interest among the physically handicapped, though little work appears to have been completed in this area, so far.

Contrary to what many outsiders appear to expect, virtually no work has been done in the area of automating the house, or kitchen, or sprinkler system, or security system. This is not surprising when one realizes that the interfacing problems are significant and expensive, the need is minimal, and the computers were purchased from entertainment budgets rather than home improvement funds.

Foreseeable personal applications

Black-and-white, and color graphics is an area of considerable and rapidly increasing interest. Economical video interfaces of good resolution should be on the market before the end of 1977. Somewhat further in the future, higher speed processors and interfaces to video tape units will give the personal computer user access to exciting computer graphics and animation facilities.

Considerable interest will be shown in 1977 in experimenting with the several available speech synthesis units. As experimentation in this and the graphics area matures, it is reasonable to expect self-teaching systems for prereader children to begin to appear. Speech units will also prove useful for the handicapped.

Mundane applications such as intelligent music tape systems and electronic phone books may be expected before the end of the year, at least as homebrewed designs. Some experimentation with holographic art and light shows has already begun and will slowly develop in sophistication. Experimentation will considerably increase in applying computers to amateur radio problems. Work will also begin in networking "ham" computers via radio transmission. The hams will need considerable assistance from the computer hobbyists who are familiar with network designs and protocols.

Word processing, manuscript preparation, and letter writing applications will slowly increase as used I/O Selectrics can be found and interfaced to home computers. This application area will explode as soon as someone manufactures an inexpensive, reliable, removable, non-destructive interface that will fit most electric typewriters.

Experimentation will continue and grow in the area of computer music. This year or next year will see the availability of more complex analog output devices which, when coupled with faster processors, will allow very exciting experimentation in the realm of sophisticated electronic music. Input devices appropriate for such music systems will develop more slowly.

As is currently true, there will be unending experimentation with the design and implementation of systems software and homebrewed hardware. This can be viewed as entertaining and intellectually stimulating self-teaching (with all of the problems thereof). There will be significant developments in the areas of floppy disc operating systems, and resident compilers for reasonably interesting high level languages.

The first steps will be taken towards computer networking via unconditioned telephone lines using couplers or modems. Probably, some of the first results of this will be interactive games between users at different sites. Significant usage of computer-to-computer communications is unlikely to occur before 1978 or 1979.

Personal computers will see an exponentially increasing use in hardware, software, and mathematics education, both in home and in public schools.

Applications software will continue to be dominated by games and simulation programs of increasing complexity. Simple data processing software will appear in 1977 to perform such chores as maintain the family budget (balancing a checkbook is too trivial), process club and organization mailing lists, keep indices of music albums, stamp collections, etc., and possibly perform dietary intake moni-
toring. Spelling corrector software may appear by early
1978. Very simple database management systems will ap-
pear by late 1977 or early 1978.

The more distant future: three to five years

Electronic libraries, in which one may browse by subject,
keyword, or whatever, will appear. These will include the
capability of making marginal notes that are stored locally
and mapped to a single original of the full-text publications.
Prototyping of this system is already under way 43 and
should be available in a rudimentary form in 1977.

Various versions of computerized bulletin boards, mes-
sage centers, want ads, and "switchboards" will become
available. A mobile, LSI-II version of this is currently
being implemented. 44 The prototype may be operational
by the end of 1977.

An electronic news system into which all of the news is
fed—at least all of the news concerning, say, the computer
or electronics industry—may be operational within five
years. There appears to be a considerable problem in
extending such a system into the general news media, in
that newspaper publishers have a significant vested interest
in keeping it from happening. And, the wire services—from
whom much of the news flows—are financially tied to the
publishers. Once implemented, however, it would mean
that everyone would have access to all of the news, rather
than having an Editor inserted between them and the news
source.

IMPACTS ON COMPUTER PROFESSIONALS

The immediate impact is already appearing. There are
more jobs in that there are more applications to be pro-
grammed, more systems to be developed, more units to be
maintained, and more consumers to be served. A rash of
computer stores are opening. More and more often, they
are being financed by an entrepreneur who is not a com-
puter professional. Yet, they require a person who is
knowledgeable of computer hardware and software to ade-
quately serve their customers. It is becoming increasingly
simple for a competent computer professional to spin off
from a company, develop his own product, and be his own
boss through selling that product. Since his overhead is
often minimal, he can afford to price his product low
enough to make it highly competitive.

The impact, further into the future, is less predictable,
and may best be illustrated by some questions: What hap-
penes to computer science education when an entering
college freshman, interested in science or engineering, has
already designed and implemented three compilers, two
interpreters, and a parser in a LISP tree? What happens to
programming jobs when the average manager can program
in three or four high-level languages and does so, regularly,
on his home computer. What impact will there be on
undergraduate electrical and computer engineering pro-
grams when the average freshman engineering major not
only has been programming since he was in elementary
school, but has been repairing the family computers for four
or five years, and worked for four summers in the repair
shop of the local computer store?

The potential for computer professionals—and anyone
owning his own computer—to interact with the society at
large is even more interesting: What happens to food
marketing when you can link your home computer to the
club's grocery price database and run a quick optimal
shopping program? What effect will there be when you
have access to all the news; not just all the news that an
Editor feels is fit to print? What effect will there be on the
political process when any consumer group or individual
voter can trivially ascertain a candidates' actual voting
record?

As far as this author is concerned, the next several
decades hold promise for a great deal of excitement.

REFERENCES

1. Jef Raskin provided a broad-ranging evaluation of computer hobbyist
products in "Personal Computers: A Bit of Wheat Amongst the Chaff," DDI, 20
September 1976, pp. 15-17.
2. Fully assembled, good capability machines should be announced by a
number of companies before June 1977. Including units from ECD Corp.,
196 Broadway, Cambridge, MA (news to be released 76-12-1); Apple
Computers, 770 Welch Rd., Palo Alto, CA 94304 (prototype was demonstrated, July 1976), and MIT'S (expected to include a high
resolution CRT).
3. Software to support random-access mass storage will still be very
limited.
4. Two exceptions are the LSI-11 from Digital Equipment Corp., Maynard,
MA, and the 16/8 microprocessor board already prototyped around a
custom LSI chip from Western Digital, to be available from the
Computer Mart of Orange County, 625 W. Katella #10, Orange, CA
92667.
5. Extensive lists of computer clubs have been published in PCC, 13 and
IA. 33 An up-to-date, computerized list is being maintained by the
Computer Faire, Box 1579, Palo Alto, CA 94302.
7. Popular Electronics, 1 Park Ave., New York, NY 10016.
8. MIT'S, 2450 Alamo SE, Albuquerque, NM 87106.
9. Homebrew Computer Club, Box 626, Mountain View, CA 94042.
10. The Computer Store, now located at 820 Broadway, Santa Monica, CA
90401.
11. Byte, 75 Min St., Berkeley, CA 94704.
12. The Trenton Computer Festival, Trenton, NJ, May 2, 1976. It was
estimated that there were 1,500 people in attendance, and 45 exhibitors. Sponsors were the Amateur Computer Group of New Jersey, UCTI,
1776 Raritan Rd., Scotch Plains, NJ 07076.
13. The Personal Computing '76 Trade Fair was held in Atlantic City, NJ on
Aug 28-29, 1976. It included 103 exhibitors. It was sponsored by the
Southern Counties Amateur Radio Association of New Jersey.
14. No "hard data" was available at the time this article was written.
15. The Chesapeake Microcomputer Club, Inc., 236 Saint David Ct X4,
Cockeysville, MD 21030, has six chapters. The Midwestern Affiliation of
Computer Clubs, 14058 Superior Av #8, Cleveland, OH 44116, has
eleven affiliates. The SC5C has seven chapters.
16. Southern California Computer Society, 1702 Ashland, Santa Monica, CA
90405.
17. The Computer Faire maintains an up-to-date computerized list of stores and retail distributors.

18. Byte, DMM, and IA.


21. Interface Age, Box 1234, Cerritos, CA 90701.

22. People's Computer Company, a bimonthly tabloid, Box E, Menlo Park, CA 94025.

23. Microtek, 333 Dows Bldg., Cedar Rapids, IA 52401. Only the August issue had been published by the end of November, 1976.


25. The First West Coast Computer Faire was sponsored by a number of local and regional educational, professional, and amateur groups interested in personal computing. These included local chapters of the ACM and IEEE, Stanford's EE Department, UC-Berkeley's Lawrence Hall of Science, the Homebrew Computer Club, and the SCCS. As of December, 1976, it expected 200 exhibitors, 100 conference sessions.

26. For example, the Apple is priced below many of the kits of equivalent capability.

27. Cromemco, 2432 Charleston, Mountain View, CA 94043, manufactures excellent, inexpensive joy sticks, as well as the "TV Dazzler" which provides both black-and-white and color TV graphics (of limited resolution).

28. Matrox, Box 56, Ahuntsic Stn., Montreal, H3L 3N5 manufactures a number of alphabetic video units and several video graphics arrays.

29. For example, Southwest Technical Products, 219 W. Rapsody, San Antonio, TX 78216, offers a 40-column printer in kit form for $250.

30. The Votrax kit from Federal Screw Works, 4340 Campus Dr. #212, Newport Beach, CA 92660.

31. The CT-I from CompuTalker Consultants, Box 1951, Santa Monica, CA 90405.

32. A new unit from Logistics Speech, c/o John Ross, 900 Dickson St., Marina Del Rey, CA 90291.

33. A unit from North Star Computers, 2465-4th St., Berkeley, CA 94704, will include a Shugart mini-floppy drive and complete controller and interfacing to many hobbyist computers, and will be priced at $599.

34. Ratheon Semiconcductor Division, 150 Ellis, Mountain View, CA 94042.


36. The essential element is a solid state binary-to-dial pulse converter available from Collins Radio Group, 4311 Jamboree Rd., Newport Beach, CA 92663.

37. For example, Digital Research, Box 579, Pacific Grove, CA 93950, has an excellent floppy disc operating system called CP/M available for $70, including a "loaded" floppy disc, documentation, a TECO-like editor, transparent debugger, assembler, and a PDP-10-like command language.

38. Cromemco has "Space War" running on their TV Dazzler.

39. See the Computer Music Journal, PCC, Box E, Menlo Park, CA 94025.

40. Chod Harris, an organizer for the American Radio Relay League stated that there were approximately 290,000 "hams" in the U.S. in November, 1976, and estimated that approximately one fourth of them had a serious and active interest in hobby computing. Kilobaud16 is being published by the publisher of 73 Magazine, the third largest amateur radio periodical in the U.S.

41. Multiplex (holograph images), 448 Shotwell, San Francisco, CA.

42. The Xanadu system, Ted Nelson, Itty Bitty Machine Co., 1316 Chicago Av., Evanston, IL 60201 (being implemented on a PDP-11 in TRAC, Calvin Mooers' trade-marked, copyrighted, and patented string processing language).

43. The Community Memory system, Lee Felsenstein, LGC Engineering, 1807 Delaware, Berkeley, CA 94703.