THE WORD FROM COMPUTALKER

The Computalker Newsletter -- First Issue Issue # 1, Sept 25, 1978

This first issue of THE WORD, the Computalker User's Group Newsletter, will hopefully serve to open up two-way communication between us here at Computalker Consultants and you, a large and growing group of users and interested observers. It will serve as our primary means of introducing new products (yes, several are on the way, both hardware and software). It will inform you of the various different and exciting ways the CT-1 Speech Synthesizer is now being used and it will help you get acquainted with many others who are doing interesting things with the CT-1.

On the other hand, it will serve as a forum for inquiries, complaints and areas that need further explanations. It will help us get to know what problems you have had in getting the most out of your CT-1. It will then help us share the solutions to those problems. We will, from time to time, publish questionaires and surveys designed to help us improve the quality of our products and to serve you better. We would very much appreciate your assistance in this. If the response is there, this forum can become a vital and useful vehicle for our two-way communication.

A Status Report on the Company

Computalker Consultants was formed in June 1976 as a partnership of Lloyd Rice and Jim Cooper in Santa Monica, CA. The first CT-1 Synthesizer, Serial Number 001, was delivered in November 1976. Since then, we have experienced a steady growth in the rate of shipments. Altho our rate of growth has not been quite as explosive as that of some of the micro systems manufacturers, we are certain that the slower, steady growth has been healthier for us. Even so, there has never been time to get everything done. In January 1978, we moved to a suite of offices on 21st Street in Santa Monica and more recently have expanded into an additional room for more manufacturing space. Computalker Consultants now consists of 4 people working full time and a number of others who help out on special tasks. Several hundred Model CT-1 Speech Synthesizers have been shipped to date.

CSR1 Synthesis by Rule Software

Our advertising literature has said for some time that the first issue of this newsletter would announce the availability of the CSR1 software package. That announcement is perhaps a bit out of date, with the CSR1 system being advertised and delivered since June 1977. In any case, this will serve as the official notice as well as to publicize the present status of bug reports on that system.

CSR1 is a fairly large program (about 6K bytes) and has been running on a large variety of different system configurations for over a year now. Considering this, it has held up remarkably well with only a few minor details coming to light as bugs and problems. Some of these problems have been cleared up in the version currently distributed on CPM diskettes. A later section below includes a complete discussion of all these software patches.

How some people are using the CT-1

Work with various languages:

Chris Cutler, University of Mexico	Spanish sounds
Peter Vitzenetz, Datameg, Munich	German sounds
Kazuhiko Nishi, Pax Electronica	Japanese rule system
Bruce Sherwood, Univ of Illinois	rules for various languages

Work with Computer Aided Instruction (CAI):

Steve Storman, New York	writing a large CAI program

There are many other Computalkers around the world being used for such things as language research, psychological research, voices for palsy victims and others with speech disabilities, voices to blind people, industrial warning systems, personalized message announcement systems, phone response systems, electronic sculpture, operating system error readouts, household announcements, educational response programs, musical instrumentation and singing, amateur radio message relays and of course, fun and games. We would very much like to hear of your applications, especially since other people will want to know what you are doing via this newsletter. Write up a short description of your application and we will certainly include it in a future issue.

User's Software and Hardware

Several people have worked out interfaces to a number of the different BASIC systems, which makes the CSR1 Rules system easier to use. The most widely known on the east coast is certainly Roger Amidon's work, using TDL BASIC. This software is available thru several stores in the New Jersey area and a Computalker supported version will be released in a future Software Package (see a later section for more details on Software Package 2, due for release in October 78).

In the San Francisco area, David Grus has done a lot of work adapting Cromemco software to interface with the Model CT-1. David reports that the flexible file access structure of the Cromemco system makes it an easy matter to define a Computalker CSR1 driver as an output device which can then be called by PRINTing the desired phonetic text. He has also written a version of the CDOS Text Editor which implements a TALK command, replacing the TYPE operation.

North Star BASIC uses the "#n" prefix in a PRINT command to reference an output device. A CSR1 driver has been set up to recognize device #4 and send the output to the rules as phonetic text to be spoken. Details on

various BASIC interfaces will be published in a future newsletter as well as in a later Software Package.

Several people have dug deeply into the intriguing world of parameter data editing. At Cornell University, William Hemsath has rewritten much of the CTMON code, adding the insert and delete functions and generating a full screen display with all parameters in view. That version still uses basically the same video refresh technique based on the Processor Technology VDM video board. Shortly after sending us a copy of that code, Bill indicated that they had gone ahead with a modification to the VDM board which gives good vertical resolution, ideal for displaying CT-1 parameters. He said that they had graphics oriented CT-1 parameter editor software in operation at that time. These VDM modifications were described in an article in BYTE magazine, June 1978.

Two CT-1 parameter data editors that we know about have been written in different versions of BASIC. Norman Case, in Oregon, has written an editor in North Star BASIC. Dennis Reinhart, in California, has written a novel editor with both graphic and numerical display capabilities in an extended version of TINY BASIC.

A number of different bus interfaces have been worked out for the CT-1 Synthesizer board. These presently include 6502 systems, 6800 systems, Intel MDS, DEC PDP-8 and PDP-11, Data General, General Automation, and probably several others we haven't heard about. If you have information on any other interfaces or need information on any of these or others, write to Computalker Consultants, and we will try to get you together with someone with a similar system.

Projects underway at Computalker Consultants

You'd think we'd have learned our lesson by now about proclaiming all the good stuff we're planning to get done. If any of it takes as long as this newsletter took to get finished, we will all have pico-computers, and today's hardware will be long obsolete. The fact is that we're finally getting some of the tools together to get more of the work done. One example is the text processor used to generate this newsletter. It's already saving hours of office time. There's still lots of software work to be done of course, but things are happening. Here is a short list of some of the things currently in progress.

Software Package 2:

This is a collection of application and demo programs, most of which we have had running on the demo unit for the last round of shows. Included are 2 new editors, in particular, a parameter editor called CTEDIT. Any of you who have done any work with CTMON will appreciate this editor. It has disk, cassette, Teletype and paper tape I/O, with the ability to append or insert frames directly from the input device, and to write out any block of frames from the buffer. You can also duplicate and delete frames directly in the data. The best part is that the video display code can easily be patched for almost any screen setup, memory mapped or serial. If you haven't been able to use CTMON because you don't have the right kind of memory mapped video, you

can now edit and manipulate the speech data with CTEDIT. We will provide patches for as much I/O as we can get coded and written up.

The other editor is an add-on to the CSR1 rules code that lets you build up a paragraph or so of text and then play the whole thing or selected lines to the CT-1. This includes a neat control scheme that lets you jump around in the text, repeating lines, skipping lines, etc., and has a character-by-character cursor oriented editing capability. It also has a direct mode very much like the present CSRMON text entry monitor.

In addition to the two editors are a diagnostic parameter function generator and several nifty applications programs. Software Package 2 is scheduled to be released in October 78. The next issue of THE WORD will have a complete description of the contents of this package.

TRS-80, Apple and Pet versions of the CT-1:

The plans for these three are firming up. Initially we will have adaptors for the present S-100 board for use with each of these machines. They will be cheaper than the full S-100 bus adaptors which are available from several companies since we don't need many of the signals and no handshaking logic. The Computalker S-100 expandor will have provisions for including an audio amplifier on the PC board. Of course, if you want to run other S-100 boards besides the Computalker, you should use one of the more general adaptors.

The initial version for the Apple II will include a peripheral board with an interface connector for the CT-1 and a timer for controlling the speech playback rate. A possible later version of the peripheral board will include several ROMs containing the CSR1 rules code. CSR1 is currently being re-written for the 6502. This code will also be set up for the PET, altho with the basic 8K system, memory space will be extremely tight.

Most of the software is now up and running on the TRS-80, altho we haven't yet worked out the logistics of mass cassette duplication. We have had a prototype of the interface connected and indeed the TRS-80 can talk, too! The main problem with all three of these machines is their lack of surplus power. The adaptor will include a power supply and a small audio amplifier (3 to 5 watts audio output). The present plan is to offer a choice of cases; none, a small plastic or metal box to house the CT-1 board and the amplifier/power supply, or a nice loudspeaker cabinet with the whole thing built in. We'll be testing the waters to see what looks like the best route to take.

CSR1 code in other programming languages:

We have been digging around in the Synthesis by Rule code recently in connection with getting it running on the 6502. One result of that is that it will soon become availble in one or more high level languages. First will be Microsoft FORTRAN,

because we are using that system here for phonetics research work. It would be nice to get the whole thing into PASCAL, but we have some system reshuffling and ROM burning to do before getting that system going here. And there is still the problem of file incompatibility with CPM.

Phonetic Dictionary:

We've gotten so many requests for this that we had to do something. It could turn into a nightmare, so we'll go easy, but we have typed up some lists of words. We will probably list these in the next issue of the newsletter. The idea is mainly for you to have enough words to look at to start getting the feel of using the phonetic alphabet. The basic problem is really that there is no "ideal and consistent" phonetic spelling. Words sound different in different contexts and in different parts of the country. Even worse is our problem of selecting which 100 or 1000 or million words to list. Any set we come up with will look like a random collection relative to the vocabulary you need for your job.

English-to-phonetic spelling converter:

This is another approach to the above problem. Rather than the look-up table, this program looks at combinations of letters in the English spelled input and substitutes the most likely phonetic equivalent. It is based on the work done at Naval Research Labs, published in '75 and '76. We started coding the system for the 8080 over a year ago and have not had time to finish up the program. We will be working on this program again in the near future.

ROMability of CSR1

A number of people have asked whether the CSR1 code could easily be put in ROM so the operating system itself as well as running user programs could more easily use speech output. The answer is definitely YES. Several CT-1 owners are using it that way now and report greatly increased enjoyment of the extra applications that are easier to program.

The parameter data buffer is easily moveable following the description in the CSR1 software manual. The code itself, however, would be impractical to relocate by patching an assembled object module because of the large number of references to variables in the 2 page RAM area, COMRAM. The best way to shuffle things around is of course by reassembly. The sources of CSR1 have been widely distributed, but a few problems still remain with assembler incompatibilities. The easiest version to work with is that distributed on CPM diskettes, where all six sections have been combined into one .ASM file. If you find you cannot work with the source code for some reason, send us a description where you would like the different parts. We will reassemble the code and send an object module on the media of your choice (from the list: 8" CPM, 5" North Star, Tarbell cassette, SOL-20 cassette, MITS ACR or paper tape). Please include a check for $20.00 for this service.

The space required for each portion is:

ROM code	5368 (=14F8H) bytes
Matrix RAM	512 (=200H) bytes
Parameter buffer	900 bytes per second of speech

The 4 bytes near the beginning of the code which define the parameter buffer location could be put in RAM so you could move the buffer more easily. You would have to provide the code to initialize these values to point to your buffer space before calling CSR1.

Bugs in the CSR1 Subroutine

The interesting thing about problems in this code is that they rarely show up. You could type in different phonetic strings for months before hitting some of the combinations described here.

The hex addresses given below for both CSR1 and CSRMON refer to the original versions assembled at 2000H and 3700H, respectively. If you are using any of the versions reassembled to start at any other address, you will need to compute the appropriate offset. See additional comments below about installing patches into CSRMON.

"PVTAB length"

A loop counter referencing PVTAB was initialized wrong:

> This is an invisible bug in the sense that, as presently coded, no harm can result. However, to fix it up for general cleanliness, the patch is ...
>
> | loc | was | change to |
> |---|---|---|
> | 2218 | 40 | 3C |

"Stress 239"

Entering large stress values (>127) causes weird sounds:

> Some claim this is not a bug but an interesting feature that should be left in. Normally, stress values would not be greater than 5, anyhow. If you wish to fix it, change the JM at location 2780H to a JC.
>
> | loc | was | change to |
> |---|---|---|
> | 2780 | FA | DA |

"Starting with period"

If you start an input with a period, you hear old things you synthesized before:

> When the input line begins with either "." or "?", the parameter buffer pointers are computed wrong. Change the LHLD NEGPSE at location 2BC1 to LHLD NEGBUF.

loc	was	change to
2BC2	ED	EB

"AX Formant 1"

The phoneme AX has the wrong phonetic vowel quality:

The formant 1 target value was coded wrong. This is in the table F1TAR at location 332BH. The correct value should be 124D = 7CH. This has been corrected in most copies released since November 1977.

loc	was	change to
332B	48	7C

"PIHCH DRAAP. doesn't"

Punctuation after a voiceless consonant has no effect:

This is a fairly involved problem having to do with a late change during program development in the details of how voiceless phonemes are handled. A proper fix will require considerable rewriting of the system. In the meantime, a moderately acceptable alternative is to place the punctuation mark ("." or "?") AFTER the vowel and BEFORE the final consonant group. The example above would be written as "PIHCH DRAA.P". Note that the mark would go ahead of an entire voiceless consonant cluster such as in "MAY3 TERN IHZ NEH3.KST".

Bugs in the CSRMON calling monitor

Some of the following patches for CSRMON involve loading addresses into registers, which will require different values if you are using a version located anywhere other than 3700H. In one case, the text input buffer length is loaded immediate into the A reg. These bytes are marked with an * in the tables below. The version of CSRMON distributed on CPM diskettes has been rewritten and does not need any of the following corrections.

Typing a rubout with an empty line causes disaster:

In the code at "GTZ" and following, the contents of C should be checked before decrementing C and HL. The only problem here is where to find the space for a patch. There are still several unused holes in the CSR1 code, so...

loc	was	change to		
3768	0D	3E	MVI	A,INBFLN-2
3769	2B	4A *		
376A	00	B9	CMP	C
376B	00	C3	JMP	P

```
376C    C3      B6
376D    2C      23

23B6    00      CA      P: JZ     CHLOOP
23B7    00      13
23B8    00      37
23B9    00      0D         DCR    C
23BA    00      2B         DCX    H
23BB    00      3E         MVI    A,7FH
23BC    00      7F
23BD    00      C3         JMP    DSP2
23BE    00      2C
23BF    00      37
```

RETURN with an empty line when using matrix display produces garbage:

It seems that an RZ was left out of the matrix dump formatter. Re-writing that chunk of code leaves 2 extra NOPs. Note the assembly address dependency.

```
loc     was   change to
3809    11      3E        MVI    A,-MATRIX-1 mod 256
380A    06      F9 *
380B    35      95        SUB    L
380C    19      C8        RZ
380D    7D      00        NOP
380E    2F      00        NOP
```

RETURN on an empty line should replay the previous phrase:

This is not really a bug fix, but a design improvement. It's the kind of thing you don't have any trouble with once you are familiar with the system, but our demo unit gets around a lot. We find that the natural tendency seems to be to hit RETURN again if a person wants to hear the same thing again. All you need to do is add a test in the CR detection loop to see if the C register still contains INBFLN-2. If it does, JMP to REPLAY. Of course, the real problem is finding room in the present version to do things like that. The input buffer is a little short already. In the CPM version, we took another page for this, kept the stack local and made the buffer longer.

Bugs in the CTMON editor

There are two problems that need comment here. One of these has been noted in the margins of the CT-1 Hardware Manual since serial number 100 or so.

The Tarbell cassette output command does not write a leader:

A symbol error slipped in here when the source code was being typed up. What should have been a call to CASLDR somehow got changed to CALL CASCLR. This has been fixed in the latest releases.

loc	was	change to
0C37	81	96

Program doesn't work properly when reassembled from source:

Somehow a JMP instruction got deleted from some copies of the source code file before it was used for copying the distribution masters. Before reassembling the system, check the code in the routine GETCMC (normally assembled at 066EH). Following the line "GC1 LXI SP,STACK" should be the instruction "JMP CT3A" as shown in the printed listing. The label GC1 is at line number 4050 in the bad copies.

Manual updates

This has been a long, hard road. We have not sent out the promised "revised editions" because there has never really been a definitive revision. A few pages have been added from time to time, mostly listings of the patches for various system configurations. About 8 months ago, we started putting yellow covers on both the hardware and software manuals. They still need page numbers and a table of contents. If you bought your CT-1 before the beginning of 1978 and feel you need a new manual, write and we'll send a new copy as currently being shipped with the new boards. Also, the first few copies of the CSR1 rules program were shipped without a complete list of the phonemes. A page from the new Software Manual is included with this issue of THE WORD. Even if you have the page in your manual, it is handy to keep a copy near the keyboard.

The two major pieces we have been waiting for to get out a new edition of the CT-1 Hardware Manual are the new version of the CTMON editor and a chapter on parameter settings to make different phonemic sounds. The editor has now been done in the form of CTEDIT (see the Software Package 2 description) and will have a full write-up in the manual with that package. Regarding a description of all the neat things that can be done with a parameter editor and how to construct specific sounds, that work has not progressed very rapidly. A write-up was started which included graphs of F1 and F2 settings for most of the English vowel phonemes. These graphs made their way into the CSR1 manual around serial number 150. A good description of the patterns needed to make different consonant sounds has not been finished. Of course, once CSR1 was running, it became easy to generate a parameter pattern example for any particular consonant or vowel sequence. Clearly tho, it is possible to do a better job with the editor than the rules do, and the real function of such a write-up would be to describe that margin of difference. Once again, we repeat the promise to get such a description into a future issue of THE WORD.

Some Hardware notes

Open Sockets:

Frequently we are asked, "What are the open sockets for on the Computalker board? Are there chips missing?" Designed with possible future expansions in mind, the sockets provide convenient signal and power take-offs. The top socket, located just under the voltage regulator at the top left of the board, provides low current power, enough to drive a small amount of external circuitry. The pin assignment is as follows:

PIN	POWER
1,2,15,16	-12V regulated, 15 mA maximum
3,4,13,14	+12V regulated, 15 mA maximum
5,6,7,8	GROUND
10,11,12	+5V regulated, 200 mA maximum

Additionally, pin 9 is the TTL output of the 7485 address decoder. This signal goes true (high) when the address on lines A12, A13, A14 and A15 on the S-100 bus agree with the setting of the port select DIP switch on the Computalker. For example, if the DIP switch is set to its normal value "E" (switches 1, 2 and 3 up, 4 down) then pin 9 will go high whenever any one of the addresses E0 thru EF appear on the S-100 bus.

To understand the function of the other open socket, located near the bottom left corner of the board, we must first understand the role of the DAC chip (IC10) and the control voltages it develops. Each of the nine speech parameters is converted to its analog form via the same process. Here we will examine only one parameter, F0 (fundamental frequency of voicing) as an example.

A byte of data from the speech parameter data file is sent under software control to output port E1 (the F0 port). The numeric magnitude of the byte is converted to a corresponding voltage level by the DAC, ranging from 0 volts to 5.10 volts. Suppose, for example, the byte had the value 120 decimal. The DAC circuitry converts this value to 2.40 volts (the DAC resolution is 0.02 volts per step). This control voltage is sent to the F0 sample and hold capacitor, which holds the voltage level constant. From here, the control voltage is sent thru an LM324 op amp, which supplies current at unity gain to the appropriate analog circuitry inside one of the modules. All nine of the Computalker's analog output channels are controlled by this method. Each channel has its own sample and hold capacitor, charged up by the single DAC. A DAC used in this way is said to be "multiplexed".

Four of the control voltages, F0, F1, F2 and F3, are sent thru jumpers just before going into the modules. You will note these jumpers mounted on a socket just above the lower open socket. The bottom row on this socket, pins 1 thru 8, are the

control voltages (source) and the upper row, pins 9, 12, 14 and 15, are connected to the modules (destination). The pin assignment on this jumper socket is as follows:

PIN (Source)	PIN (Destination)	SIGNAL NAME	PARAMETER	CHANNEL NO. (Decimal)
1		CV11	unused	10
2	15	CV5	F3	4
3	14	CV4	F2	3
4		CV12	unused	11
5	12	CV2	F0	1
6		CV10	unused	9
7		CV13	unused	12
8	9	CV3	F1	2

Pins 10,11,13 and 16 are connected to ground.

Four additional general purpose D to A converted channels are available to the user simply by inserting an LM324 Quad Op Amp chip into the lower empty socket, pin 1 at the lower left. If the port select DIP switch on the Computalker is set to the normal value "E", then outputting a byte of value 04 hex to port E9, for example, will put 0.8 volts on pin 6 of the jumper socket. Similarly, outputting FE hex (254 decimal) to port EA would put 5.08 volts on pin 1 of the jumper socket. The circuit impedance of the control voltages on the jumper socket is 1K ohm, with signal return on pins 10, 11, 13 or 16. When using these additional channels, remember that the sample and hold capacitors were designed to hold control voltages for slightly longer than 20 milliseconds. Therefore, software written to use these additional converted analog signals will have to update the output to the CT-1 at least every 20 milliseconds to hold a steady control voltage.

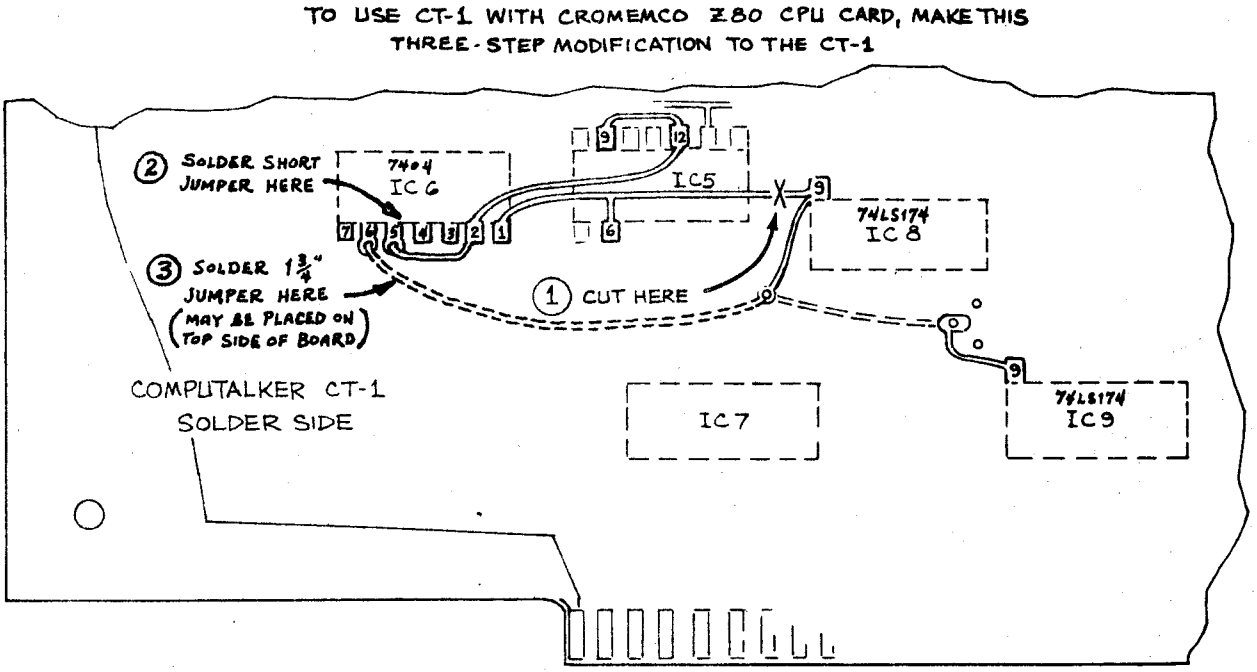
Compatibility with the Z-80:

To use the Computalker with the various manufacturer's Z-80 based CPUs, two areas must be considered, hardware and software.

If you hear a bubbly or halted quality in the speech output, then a timing problem may exist between your CPU and the CT-1 Synthesizer. The CT-1 uses the leading edge of $\overline{\text{PWR}}$ to latch the output data on the bus. Certain manufacturer's Z-80 CPU boards do not allow sufficient time for the data lines to stabilize before the low-going edge of $\overline{\text{PWR}}$. When the CT-1 is used with these CPU boards it is necessary to delay the CT-1 board select signal.

To implement this modification, power down the system, remove the Computalker and place it face down on a soft cloth on your workbench, back (solder) side up. Note that the IC numbers are printed in the foil on the board. Cut the trace connecting pin 6 of IC5 to pin 9 of ICs 8 and 9 (pin 6 of IC5 should still be connected to pin 1 of IC6). Solder a small jumper wire from

IC6 pin 2 to IC6 pin 5. Solder another jumper wire from IC6 pin 6 to IC8 pin 9. Replace the Computalker back in its socket and power up the system.



Note that the above hardware modification has been factory installed on all boards with serial numbers 431 and higher. It is compatible with both 8080 and Z-80 processors.

With or without the above hardware modification, all systems running at other than 2 MHz CPU clock speed will require a small software change. The rate of speaking is determined by a software delay routine. Here we will discuss changes to the three programs supplied by Computalker Consultants and listed in the manuals, CTMON, CSR1 and CTPLAY. The values given below apply for a 4MHz CPU clock speed without memory wait states. For existing user generated software, the same changes can be applied. Referring to the listing of CTMON in the CT-1 Hardware Manual, change address 0661 from 7C to F8 (this is approximate). This doubles the down-counter and slows the rate of speaking in half. Similarly, referring to the source listing of CTPLAY (revision of Sept 22, 1977), change address 018A hex from 21 20 03 to 21 40 06. For those who are running the CSR1 Synthesis by Rule program at 2000 hex, change address 328B from 21 20 03 to 21 40 06. Users who are running the version of CSR1 assembled at 4000 hex will make the same change at address 528B.

Writers, articles wanted

Do you have writing talents to combine with your interests in phonetics or speech synthesis? Computalker Consultants is seeking articles for THE WORD pertaining to perception or synthesis of speech by humans or machines. We would especially like articles on the phonetic or phonemic structure of any language, applications for synthetic speech, timing details in real or synthetic speech, the structure and importance of intonation and stress patterns, etc., etc., etc. We're like Dobbs Journal in that we'll try to make the best of whatever you send. It need not be finished work.

Lists of owners names, address & phone, etc.

In early pre-historic times (2 years ago) we circulated a questionaire requesting miscellaneous information about the goals and desires of our potential customers. One of the things that stood out among the responses was the desire of a large number to establish contact with other CT-1 owners or users. We would like to do our part to initiate this contact, but certainly do not wish to compromise anyone's privacy. We can clearly state initially that the full purchasers mailing list will not be available to any outside interests. As stated above, we will publish any material sent in regarding applications or ideas for synthesis, providing such contributions are clearly marked for newsletter distribution.

Alternatively, we propose to circulate a separate mailing list consisting of the names, addresses and phone numbers of those who specifically ask to be on such a list. Such a list would be strictly limited to CT-1 owners and would likely not be available for other purposes. This list could be published in THE WORD if those included so wish.

In any case, we are definitely interested in forming a User's Group and would like your inputs on just what the format of such a group should be.

Subscription info

Five issues of this newsletter will be included in the price of each Computalker Speech Synthesizer. If you have already purchased a synthesizer and have sent the Warranty Registration form, we will send the first five issues to you at no additional cost. If you have not sent the Warranty Registration form, do so now. In general, if you have bought a CT-1 from us or from a dealer and your name and address is not on this newsletter or is incorrect, be sure to send the subscription form with your CT-1 Serial Number and we will make sure your name gets on the list.

If you do not own a Computalker Speech Synthesizer (or after receiving 5 issues) you may subscribe to THE WORD in order to keep abreast of the exciting developments in speech synthesis. For the present, the price will

be 60 cents per issue, assuming that we hold it down to 2 ounces and that the Postal Service does not up the ante again. Send the subscription form (or write for another one, since this one has probably already been torn out) with your payment for the number of issues you wish to receive. Your mailing label will indicate in some way the number of issues remaining in your subscription.

☐ I now own Computalker Model CT-1 Serial Number _____
I decided to buy it because
- ☐ of a magazine advertisement
- ☐ I saw it at a computer show
- ☐ I heard it talking at a dealer
- ☐ my friends were raving about it
- ☐ I read the Computalker brochures

☐ other _____

☐ I am using my Computalker for _____

_____

☐ Please add my name to the mailing list which will be sent to all CT-1 owners who check this box

☐ I haven't actually done much with the CT-1 yet.

☐ I do not now own a Computalker Speech Synthesizer

Please start my subscription to THE WORD immediately.
I am enclosing $ _____ for ____ issues at .60 each.
(CT-1 owners may extend if desired)

Also send more information on:
- ☐ new speech synthesizer boards
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Other comments:

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SOFTWARE PACKAGE II
to be available October, 78

CTEDIT	A new parameter editor
CSEDIT	Editor for CSR1 input
CTEST	CT-1 Hardware diagnostic
PLAYDATA	To hear the data files
MEMVOICE	A vocal memory dumper
KEYPLAY	Subr. to play letters/digits
PIANO	A simple musical keyboard

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