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UMTRI - 86 - 50

Wizard of Oz User's Manual Version 4.0

Herbert Wesselman
Paul Green

DECEMBER 1986

UMTRI The University of Michigan Transportation Research Institute

Technical Report Documentation Page

1. Report No. UMTRI-86-50	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle WIZARD OF OZ USER'S MANUAL VERSION 4.0		5. Report Date December, 1986
		6. Performing Organization Code 362905
7. Author(s) Herbert Wesselman and Paul Green		8. Performing Organization Report No. UMTRI-86-50
9. Performing Organization Name and Address University of Michigan Transportation Research Institute 2901 Baxter Road Ann Arbor, MI 48109-2150 U.S.A.		10. Work Unit No.
		11. Contract or Grant No. NCR Gift
12. Sponsoring Agency Name and Address NCR Corporation R & D Division, Human Factors 1700 S. Patterson Dayton, Ohio 45479 U.S.A.		13. Type of Report and Period Covered Interim 1/1/86 - 12/31/86
		14. Sponsoring Agency Code Cost Center 9122 (Human Factors)
15. Supplementary Notes Revised June 2, 1987		

16. Abstract

This manual contains a description of the Wizard of Oz computer program, step-by-step instructions on its use, and other miscellaneous information. The Oz prototyper is best suited for the development of command language, menu-oriented and natural language user interfaces, primarily for "glass teletypes" or computers simulating them. This version was designed for the IBM PC and compatible computers such as the NCR PC-8.

To begin an Oz test, messages a computer might send to a user are loaded using a keyboard enhancer, such as ProKey. The experimenter's PC is then connected to another PC or a terminal used by the subject, who is led to believe they will be interacting with a computer. To begin a dialogue, the experimenter (the wizard) hits a function key. The associated text (e.g., "This is the Galactic Computer. Enter your name.") appears on both screens. Subsequently, the subject types in a response (which also appears on both screens), then the wizard responds, and so forth. The dialogue, along with timing data, are stored on a disk for later analysis.

17. Key Words Human factors, ergonomics, user interfaces, Wizard of Oz, prototyping		18. Distribution Statement	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 57	22. Price

CONTENTS

PREFACE

This manual was written for students at the University of Michigan taking Industrial and Operations Engineering (IOE) 436, Human Factors in Computer Systems. It is also intended for user interface developers, human factors engineers, and programmers developing real user interfaces.

It is assumed readers know:

- how to turn on and restart an IBM PC and XT
- the following DOS commands: DIR, COPY, and PATH
- the rules for naming files and directories
- how to get to subdirectories (DOS CD command)
- the basic commands for EDLIN, the DOS line editor.

Readers without this knowledge should read the first few chapters in the DOS manual, or any one of the many books on the IBM PC Disk Operating System or on MS-DOS available from local computer stores. Readers unfamiliar with a keyboard enhancer (e.g. ProKey, Newkey) should skim a user's manual before reading this.

Recent work on the development of the Wizard of Oz User Interface Rapid Prototyper was supported by the Research and Development Division of NCR, whose generosity is greatly appreciated.

We also would like to thank John Boreczky for his contributions to the editing of this manual, as well as Cam Beattie, Rachel Krupp, Sue Adams, Melinda Rock, and Josh Kerst for their comments. Finally, we would like to thank the over 100 Michigan students who have used previous versions of the Wizard of Oz for their patience and feedback.

WHAT IS THE WIZARD OF OZ?

[This chapter is intended to familiarize readers with the Wizard of Oz method and to describe the version used at the University of Michigan.]

WHAT IS OZ?

The Wizard of Oz Rapid Prototyper is a computer program to help people develop user interfaces to computer systems. It has proven to be an effective tool for teaching human factors concepts at the University of Michigan and convincing people of the value of human factors efforts. In its current form it is particularly well-suited for prototyping command language, menu-oriented, and natural language interfaces intended for "glass teletypes" (dumb terminals) or personal computers simulating them.

WHAT IS NEEDED TO USE OZ?

The Michigan version of the Wizard of Oz was designed for the IBM Personal Computer (PC) family and compatible computers. The current software has been successfully tested on the IBM PC, IBM XT, and the NCR PC-8 (an IBM AT clone.)

In order to use the Wizard of Oz software, one will need:

- an IBM PC compatible with at least 256K of memory, a serial port, and at least one 5-1/4 inch floppy drive. (An AT class computer with a hard drive is preferred.)
- a color or monochrome display (and a display adapter for it.)
- a null modem or modems, connecting cabling, and a second PC or terminal.

- a keyboard enhancer/macro utility. (See STEP 2: GET A KEYBOARD ENHANCER for further details.)

HOW IS OZ USED TO DEVELOP AN INTERFACE?

The development of the user interface begins with deciding what users should be told and how they might respond. Those ideas eventually take the form of a set of messages and program logic. For Oz simulations, the exact wording must be specified and not just the general nature of the message.

After loading the Wizard of Oz and other software, a typical Oz test session might begin with the experimenter (the wizard) sending an introductory message to the subject such as:

"*Welcome to The University of Meshugenah Computer System. Enter your ID.*"

The subject would then type a response such as:

"*TURKEY.*"

Characters typed by the subject are echoed to the wizard's screen as they are typed so the wizard can anticipate what to do next. On the other hand, messages from the wizard are sent to the subject line by line to make it appear that messages are coming from a computer. Thus Wizard of Oz simulations are very much like the situation in the children's tale of that name. In the simulation, the appearance of the user interface is magically controlled by a person behind the scenes.

To make the illusion seem realistic, system responses to user input should be immediate. That is accomplished by having a planned set of responses and assigning the text of messages and menus to function (or soft) keys, though some text may have to be typed in real time. For example, typing function key one (<F1>) might send the welcoming message given previously. Several keyboard enhancers such as Newkey

(Bell, 1986), ProKey (RoseSoft, 1983) and SuperKey (Borland International, 1985) have been used for that purpose.

WHY USE OZ?

The Wizard of Oz method has many advantages over writing application-specific code for a user interface. First, Wizard of Oz prototypes can be operational in much less time than working application code, since the developer does not actually have to code the interface and the program logic. All the error messages and menus are merely assigned to function keys, and the interface is ready to test. Thus, Wizard of Oz user testing can be conducted at an early stage in the development cycle, when there is flexibility in the schedule and little commitment to the code.

Second, Wizard of Oz prototypes are easy to modify. Modifying a message is as simple as using an editor or keyboard enhancer to alter the text of a message. The system is then ready for another user test. Ease-of-modification is important because ease-of-use of the interface being developed increases with the number of iterations through the design-test cycle.

A third advantage of Wizard of Oz is that it contains routines for collecting user performance data (response times, typing times). Those data can be used to make quantitative predictions of benefits of design alterations and ultimate user performance. Thus, the Oz prototyping methodology has many advantages over writing application-specific code.

There is other prototyping software in addition to Oz (Palmiter, 1986), most of which has been designed for engineering workstations and not PCs. Second, alternatives that do exist for PCs (e.g. Dan Bricklin's Demo Program, (Software Garden, 1986)) are strictly prototypers. They do not have the interaction logging and analysis capabilities that Oz has, nor the ability to modify the interface while it is being used (on the fly). On the other hand, they provide many features for simulating full-screen interfaces, something the Wizard of Oz Prototyper cannot do now. There are no good alternatives for the particular class of interfaces and hardware for which Oz was designed.

HOW WAS OZ DEVELOPED?

[This section is intended to give students a sense of how teaching and research are connected and to properly give credit to those that helped develop the software.]

Original BASIC Version

The Wizard of Oz method was first developed by Chapanis and his students at Johns Hopkins, who used it on a mainframe. One of his students, Jeff Kelley, came up with the name. After Chapanis popularized the method, it was used by many others. (See Green and Wei-Haas, 1985a for details.)

The work on Oz at Michigan began just over three years ago. Paul Green heard Professor Marilyn Mantei talk about the method at a seminar. He was then planning a new course on Human Factors in Computer Systems (originally Industrial and Operations Engineering (IOE) 491, now IOE 436). He realized the Oz method was ideal for a user interface design project to be included in the course. He knew that if working code was required, the assignment would be impossible to complete.

Since no one had ever written a version of Wizard of Oz for microcomputers, Paul Green wrote the initial version in his "spare" time. The early versions were written in interpretive BASIC and supported communications up to 300 baud. Paul Ziots, working for Paul Green as a student assistant, helped debug and test the initial version.

Students reacted enthusiastically to the Oz method, so Paul Green continued to work on it on the side. A description of that version of Wizard of Oz was presented at the Human Factors Society Annual Meeting (Green and Wei-Haas, 1985b). Later in that year the code was modified to support communications up to 1200 baud and to provide modem support.

Since then, the Wizard of Oz Prototyper has progressed rapidly. Mark Glaza, formerly a student in Paul's class, modified the original BASIC version in early 1986 so that it could be compiled. The compiled version had fewer bugs and executed much faster than the interpretive BASIC version.

Revised Version in Pascal

In the spring of 1986, Mark left for a "real" job. Cam Beattie, another former student from Paul's class, replaced Mark. Cam redesigned the program and coded it in Turbo Pascal (Borland International, 1985). This version of the Wizard of Oz supported communications up to 9600 baud and added many new features such as a help screen, traps for problems with file and path names, and a one line input window for the experimenter. Much of Cam's work focused on developing code so that cosmetic alterations such as color choices could be made with only minor code changes. At the end of the summer, Cam left for active duty in the U.S. Air Force.

Herb Wesselman, another graduate of Paul's class, replaced Cam as the project programmer. Herb rewrote the main menu, added modem support, enhanced the error checking code, and added a feature to allow for structured walk-throughs. Herb also took the lead in writing this user's manual. He is now also on active duty in the Air Force. Herb was replaced by his friend John Boreczky. John identified numerous small bugs in the code, redesigned some areas of the user interface such as the modem handler, and added new features such as an editor for the wizard, saving of all characters typed by the subject, and improved error detection and recovery. John also revised and added to this user's manual to reflect program changes.

The current version of Oz is written in Turbo Pascal, version 3.01A, and uses I/O routines from several commercial packages. The source code for the wizard's program is roughly 7800 lines long (with comments) and the subject's terminal emulator is 4500 lines. Work on Oz and Oz utilities will continue for the next few years. Readers interested in a more detailed history should read the report describing the design rationale (Green and Wesselman, 1986).

WHAT'S ON THE OZ DISK?

The contents of the Oz disk are described in the README.DOC file. A self explanatory listing of it is in Figure 1. This disk has the main Wizard of Oz program, the subject's terminal emulator, a keyboard enhancer, and analysis software.

To list the latest version (on disk) enter:
type readme.doc<RETURN> [See note below].

```
FILE=README.DOC  ---Wizard of Oz disk--- Version of 6-1-87

File          Description
------------  -------------------------------------------
README.DOC    (list of files on this disk)
COMMAND.COM   system file which allows you to boot your
                system from this disk
WIZARD.EXE    main program file for the Wizard's
                version of the program
SUBJECT.COM   subject's version of the program
NEWKEY.EXE    user-supported keyboard enhancer (version 3.0)
NEWKEYSP.EXE  the support program for Newkey 3.0
WIS4.MAC      a sample key definition file
WIZBATCH.BAT  the batch file used to run Wizard of Oz
WIZCOPY.BAT   the batch file used to make working copy of
                this disk
OZSUMRY.EXE   Oz session summary program
BRUN20.EXE    Microsoft QuickBASIC run-time module (needed
                for OZSUMRY.EXE)
```

Figure 1. Listing of README.DOC file

Note: In this manual

ab..zA..Z0..89,etc.	represents	keyboard characters to type
<F1>...<F10>	represents	the function keys
<RETURN>	represents	the return key (often labeled <-')
<ESC>	represents	the escape key
<CTRL>	represents	the control key
<ALT>	represents	the alternate key
<BREAK>	represents	the break key (often labeled Scroll Lock)
Some text (italics)	represents	messages printed by the computer

USING WIZARD OF OZ

OVERVIEW

These steps are described in greater detail in the section that follows. Readers that are familiar with Newkey and the Oz method may wish to just skim over this chapter.

The steps required for using the Oz program are:

Step 1: Make a working copy of the master disk. Use the working copy at all times.

Step 2: Get a keyboard enhancer. Newkey is the favored choice for IOE 436.

Step 3: Develop and key in the interface dialogue using the keyboard enhancer.

Step 4: Test the dialogue using the Oz walk-through mode.

Step 5: Set up the modems or a null modem cable for a test. A null modem cable is used to hard wire the computers together. Modems are used to link them by a phone line.

Step 6: Prepare the subject's terminal or PC. If the subject is using a PC, use the SUBJECT.COM program.

Step 7: Prepare the wizard's PC. Load in the WIZARD.EXE program.

Step 8: Test a subject.

Step 9: Analyze the results and redesign the dialogue.

STEP 1: MAKE A COPY OF THE OZ MASTER DISK

To avoid accidentally erasing the Oz program, begin by making a working copy of the Oz software. To make a copy of the software, use the standard DOS COPY command. If the computer has a hard disk drive, copy the files to a directory on a hard disk and then to a formatted floppy disk. If the computer has two floppy drives, copy the files directly. (For those unfamiliar with the DOS FORMAT and COPY commands, Appendix A of this manual gives step by step instructions.) Although the Oz software does not take up much disk space, the output files generated from test sessions, which can be quite large, fill disks rapidly. It is therefore suggested that the software be transferred to a newly formatted disk or one that has been erased. If it is anticipated that test sessions will be conducted with the wizard and the subject in different rooms, copy the subject's program (SUBJECT.COM) onto a separate disk.

STEP 2: GET A KEYBOARD ENHANCER

The keyboard enhancer program is used to generate most of the messages sent to the subjects. There are a number of them available including Newkey (3.0), ProKey (4.0), SmartKey (4.1) and SuperKey (1.0).

Newkey has been used by IOE 436 students far more often than any other enhancer. The latest version of Wizard of Oz has been most extensively tested with Newkey. Newkey (3.0) employs the standard Prokey format for data files (Bell, 1986). A copy of this program, as well as its abbreviated manual, are on the Oz disk. As with all user-supported software, Newkey is not copy-protected and can be copied an unlimited number of times for the purpose of evaluation. (The author of Newkey has "stretched" the term evaluation to include use for Paul Green's class.) If used for other purposes, FAB Software, the developer of Newkey, should be compensated. An order form is included in their documentation.

ProKey (4.0) is the most popular commercial keyboard enhancer on the market (RoseSoft, 1985). It is not copy-protected. Most people agree that ProKey is easier to use and better documented than most other enhancers. ProKey (4.0) sells for about $70.

Another popular keyboard enhancer is SmartKey (4.1) (Software Research Technologies, 1984). This program is similar to the others, but has a "SuperShift" key which allows for additional redefinable keys. It is not copy-protected and sells for about $50.

Finally, there is SuperKey (1.0) (Borland International, 1985). Borland has an excellent reputation for high quality software. (They developed Turbo Pascal.) SuperKey is not copy-protected. It provides more features than ProKey and sells for about $40.

All of these packages support saving, loading, and merging of key definitions. The saved definitions can be revised with commonly used editors. They are all memory-resident programs, and thus have an effect on the execution speed of Wizard of Oz. Table 1 shows the display times and computed baud rate for each keyboard enhancer using the Wizard of Oz software. The times are for printing 23 lines of 66 characters. The last two entries of the table are the display speeds of the standard Writeln (print) function for Turbo Pascal and the Fastwrite procedures from Turbo-Plus (Nostradamus, Inc., 1985). The Writeln data approximates how fast Wizard of Oz could run if keyboard enhancers were infinitely fast, the communication rate was infinitely fast, and the standard Turbo Pascal display routine was used. The Fastwrite data is for the same conditions, but with the display routine actually used in Wizard of Oz.

Table 1. Comparison of Enhancer Speed

	Computer			
	IBM PC		NCR PC-8	
Program	Time (Sec)	Computed Baud Rate	Time (Sec)	Computed Baud Rate
Newkey	7.65	1980	2.59	5860
ProKey	8.81	1720	2.87	5290
SmartKey	8.96	1690	2.96	5130
SuperKey	9.51	1590	2.96	5130
Writeln	2.20	6900	0.49	30970
Fastwrite	0.55	27600	0.27	56220

The data suggests that if a high speed (2400-9600 baud) system is being simulated, Newkey on an IBM AT or compatible should be used. For a slow speed system (300-1200 baud) the choice of keyboard enhancer and computer has no limiting effect of practical importance.

Those interested in more details about the keyboard enhancer speed test should see the report describing design rationale (Green and Wesselman, 1986). For reviews of enhancer software in computer journals, readers should look at Obregon (1985) or White (1985).

STEP 3: DEVELOP AND KEY IN THE INTERFACE DIALOGUE

After the choice of keyboard enhancers is made, the interface messages must be developed and assigned to function keys. The development of the interface messages is a time-consuming process. After they are composed, they can be assigned to function keys as follows.

3.1 Load the enhancer - type: **newkey** /X<**RETURN**>

The loading process depends on the enhancer selected. For Newkey, the number of characters (X) needed to store the function key definitions (the messages being keyed in) must be determined. This number is used by Newkey to reserve space for these memory resident definitions. (Other enhancers have similar requirements.) For those with no idea of what that total might be, start with X=15000.

If the definitions have been saved previously, use the directory (DIR) command to determine the size (in bytes) of the file holding the function key definitions. That number is about 2X since each character is stored as a two byte value. To be on the safe side, always allow for room to add in new definitions. The maximum allowable value of X is 32000 characters.

After entering "Newkey," etc, if the computer responds with "*Bad command or file name,*" then the keyboard enhancer is not on the current drive:\path. Change the current drive, path, or both to the one where Newkey resides. Once Newkey has been loaded it will reside in memory until the system is restarted.

3.2 Begin a key definition - type: **<ALT>=**
The procedure for starting a key definition depends on the program being used. In Newkey, holding down the **<ALT>** key and then typing the "**=**" key will put the enhancer in the definition mode. In response, a message will appear at the top of the screen asking for the key to be defined.

3.3 Identify the key to be defined - type: **<F1>**
When a key is requested, depress it (in this example, function key one on the upper left corner of the keyboard, not capital F and then the digit one). Other enhancers, such as SuperKey, require selecting the definition mode before the key is identified.

3.4 Enter the key definition - type the definition
The enhancer is now in record mode. Type the text of the message such as, **Welcome to the University of Meshugenah Computer System. Enter your ID.<RETURN>.** Every key pressed is recorded as part of the key definition. (If a mistake is made while typing a definition, refer to the General Advice section on page 13.

3.5 End the key definition - type: **<ALT>-**
The procedure to end a key definition also varies from enhancer to enhancer. For Newkey, hold down the **<ALT>** key and press the "-" key on the top row. The message at the top of the screen will then disappear, and the

program will allow more keys to be defined using steps 3.2 through 3.5.

3.6 Save the key definitions - type: **newkeysp<RETURN>**
When the key definitions are finished they will need to be saved to a file. With Newkey this is done by using Newkeysp (a support program) and choosing option 3 in the menu displayed on the screen. The program will then ask for a file name for storing the current definitions. After typing the file name and pressing **<RETURN>** the program will then save the current definitions, overwriting the previous contents of the file. When it has finished press **<RETURN>** twice to return to DOS.

General advice

When defining keys, watch out for the backspace key. Some of the programs assume a backspace should be included in the current definition if it is pressed, while others use it as the correction key. For example, in Newkey, typing "**Help I'm trapped inside the computer.**" and then 37 backspaces will cause the message to appear and disappear on the screen. Typing a series of spaces and backspaces results in a dancing cursor. To find out how the backspace key functions, read the user's manual for the enhancer selected. The correction key combination for Newkey is **<CTRL>h.**

To add a beep in a message type **<CTRL>g** where the beep is to occur. For several beeps, type **<CTRL>g**, several spaces and backspaces (for a delay between beeps) then **<CTRL>g** again.

When using multiple line messages or menus, assign the entire text to one function key. If many messages share a common phrase (e.g. "**Enter choice and press return.**"), the phrase should be assigned to a function key to save typing. Nesting a definition in another often leads to errors.

Be sure to end each line in a key definition with a **<RETURN>** so that pressing a function key prints the message on the wizard's display and sends it to the subject. Users often forget to append **<RETURN>** to the last line of a multi-line message. Including **<RETURN>** reduces the response time and makes the wizard's job easier.

In order to define keys, most enhancement programs suggest that an editor, such as EDLIN, be used. Once in EDLIN (by typing: **edlin** filename**<RETURN>**) enter the insert mode by typing "**i**" and then **<RETURN>**. The keys can now be defined without system messages being displayed after **<RETURN>** is pressed. When all the keys have been defined press **<CTRL>**c followed by **<RETURN>** to get out of insert mode. If the unformatted text for the messages is to be saved, type "**e**" then **<RETURN>** to exit EDLIN, otherwise type "**q**" then **<RETURN>** to return to DOS. (Saving the text provides a history of what has been defined.)

For further details on using Newkey, see Appendix B.

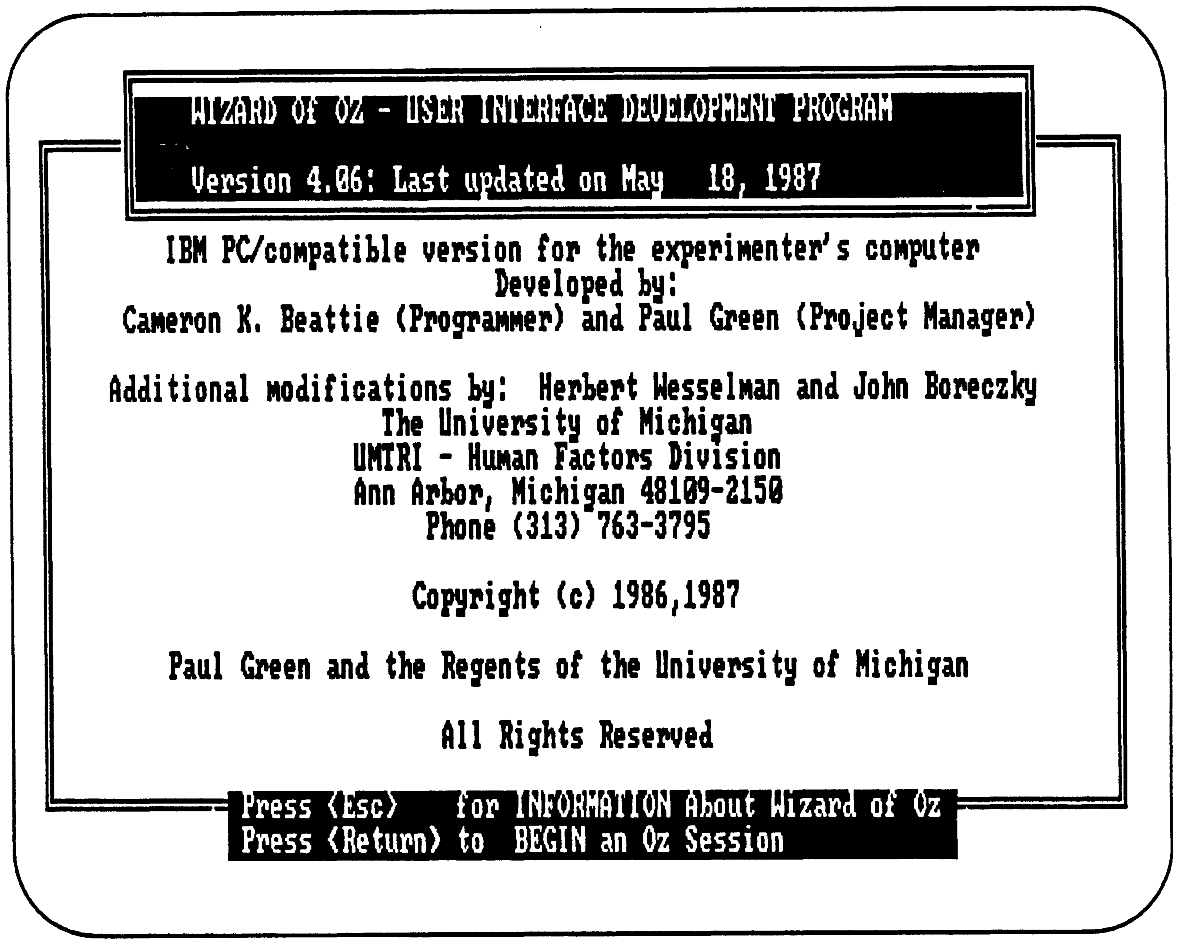
STEP 4: TEST THE DIALOGUE WITH A WALK-THROUGH

After the messages have been assigned to function keys, there is one more step before testing begins: carrying out a one-machine walk-through of the interface. Walk-throughs serve to test the interface without a subject. In this case the wizard will display messages in the desired order and type the expected subject response from the keyboard. All keystrokes are recorded to an output file. The purpose of the walk-through is to make sure the messages and their sequence make sense. It also allows the wizard to become familiar with the sequence of keys, decreasing "system" response time.

4.1 Load the key definitions - type: **newkeysp<RETURN>**, etc. If the system has been rebooted, Newkey will have to be reloaded (type: **newkey<RETURN>**) before Newkeysp will load the files. (It is assumed that Newkey is the keyboard enhancer used.) Load the key definition file by choosing option 4 in the menu displayed by Newkeysp. The program will then ask for the file which contains the key definitions. Type the name of the file which holds the key definitions followed by **<RETURN>**. Any previous key definitions in memory will be erased. Once Newkeysp has loaded the file, press **<RETURN>** twice to return to DOS.

4.2 Load wizard's version - type: **wizard<RETURN>**
If WIZARD.EXE is not in the current directory, change the drive:\path to the one where WIZARD.EXE resides.

4.3 Exit title screen and go on - type: **<RETURN>**
Once the program has been loaded, the title screen in Figure 2 (page 16) will be displayed on the screen. To obtain further information about the Wizard of Oz methodology press the **<ESC>** key. To start a session press the **<RETURN>** key.



```
WIZARD OF OZ - USER INTERFACE DEVELOPMENT PROGRAM
Version 4.06: Last updated on May  18, 1987

IBM PC/compatible version for the experimenter's computer
Developed by:
Cameron K. Beattie (Programmer) and Paul Green (Project Manager)

Additional modifications by: Herbert Wesselman and John Boreczky
The University of Michigan
UMTRI - Human Factors Division
Ann Arbor, Michigan 48109-2150
Phone (313) 763-3795

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Paul Green and the Regents of the University of Michigan

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Press <Esc>    for INFORMATION About Wizard of Oz
Press <Return> to  BEGIN an Oz Session
```
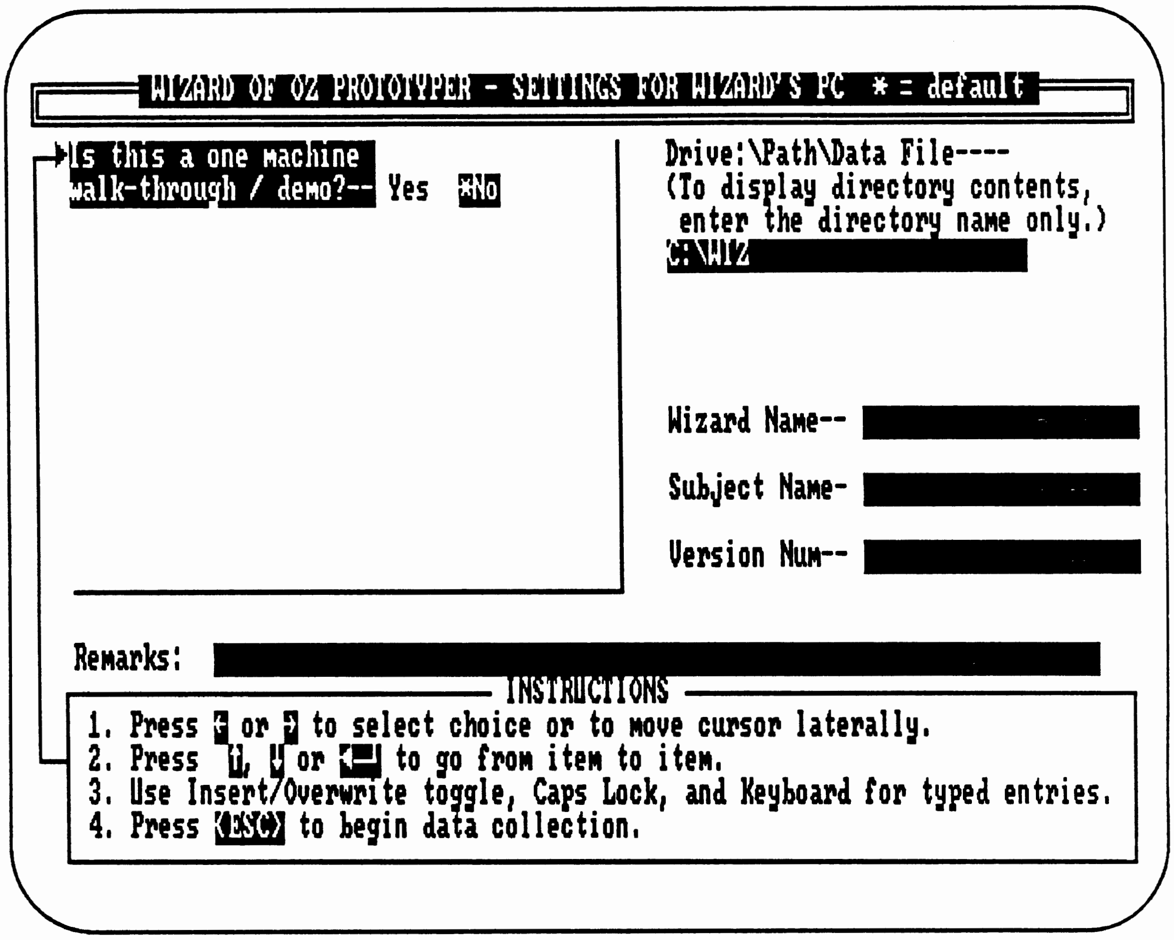

Figure 2. Wizard of Oz title screen.

4.4 Specify walk-through mode - answer: yes

Pressing **<RETURN>** will cause the parameter menu to appear with the walk-through question displayed on the left half of the screen (Figure 3 on page 17). Answer "Yes" to this question so the program will enter the walk-through mode.



```
WIZARD OF OZ PROTOTYPER - SETTINGS FOR WIZARD'S PC  * = default

Is this a one machine                    Drive:\Path\Data File----
walk-through / demo?-- Yes *No           (To display directory contents,
                                          enter the directory name only.)
                                         C:\WIZ

                                         Wizard Name--
                                         Subject Name-
                                         Version Num--

Remarks:
                          INSTRUCTIONS
1. Press ← or → to select choice or to move cursor laterally.
2. Press ↑, ↓ or ↵ to go from item to item.
3. Use Insert/Overwrite toggle, Caps Lock, and Keyboard for typed entries.
4. Press <ESC> to begin data collection.
```

Figure 3. Walk-through menu screen.

4.5 <u>Enter data fields</u> - type in responses

Now specify the items on the right half of the screen by typing the response and using the arrow keys to traverse the fields. The only data which must be entered is the data file path and name. Entering only a directory name will list the files in that directory on the screen. For the remarks, enter any information which might help describe the test session (e.g. overall interface test, test of revised transfer funds menus, etc.).

4.6 Start data collection - type: **<ESC>**
Once the data fields are specified, press the **<ESC>** key to begin the walk-through. The program now enters the data collection phase of the simulated user test. For example, the wizard might press **<F1>** to display the message "*Welcome to the University of Meshugenah Computer System. Enter your ID.*" and would also type "*TURKEY,*" the subject's expected response. Continue pressing function keys and entering responses until the interface has been completely tested. The wizard can type in notes about how the function key messages should be changed during the walk-through.

4.7 End data collection - type: **<CTRL><BREAK>**
After you are done, press the **<CTRL><BREAK>** combination to end the walk-through. The program will then ask if another session is desired.

Most likely, typographical errors in some of the definitions or confusing messages will be discovered during the walk-through. These errors are readily detected by an observer who was not involved in entering the function key definitions. To revise them, answer "no" to the repeat question so the Oz program will return control to DOS. Use the enhancer or an editor to alter the messages before testing subjects. If, on the other hand, the interface is ready to be tested, answer "yes" and Oz will return to the settings screen.

STEP 5: SET UP NULL MODEM OR MODEMS FOR A TEST

To use Wizard of Oz with the wizard and subject in close proximity to each other, a null modem cable will be needed. This cable has two 25 pin "D" connectors (the end looks like a trapezoid or a "D" squashed sideways). Both ends of the cable have identical female connectors. (Female connectors have holes in them to plug things into. Male connectors have pins that stick out.) Connect either end to the mating male connector on the back of the PC or terminal. Each end will mate in only one way because of the connector's "D" shape. Most computers have two of these connectors. If the computer is connected to a network (or other computers, e.g. MTS - Michigan Terminal System), only one of these will be exposed, usually port #2. (The port used is selected later in the settings menu.) Generally the ports are not labeled or numbered, so guessing is required. If both ports are available, use either one.

If the subject and experimenter will be separated by some distance, two modems and telephone connectors will be needed to communicate. The Wizard of Oz program expects the modem used to be a Hayes Smartmodem or a 300, 1200, or 2400 baud Hayes-compatible modem. To set up the modems:

5.1 <u>Connect the modems to the computers</u>

Connect one modem to the wizard's PC and the other to the subjects's PC or terminal using RS-232 communications cables. The cables should be connected to the computers in the same manner as null modem cables (described above). Then, connect the modem to phone lines using the phone cord with the modular connectors which comes with the modem.

5.2 <u>Turn on the modem</u>

Once the connections have been made, plug in the modem to a wall outlet and turn it on.

5.3 <u>Prepare modem for session</u>

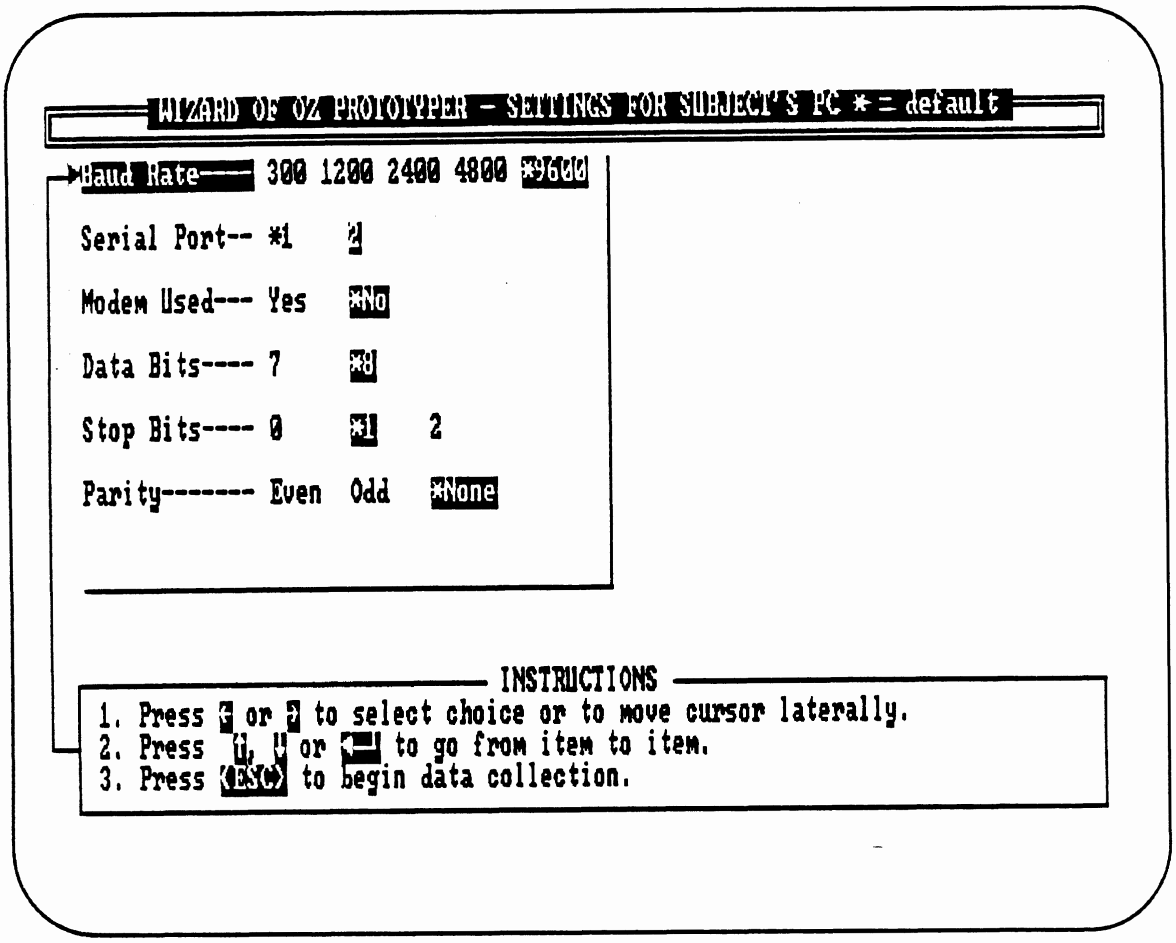
Modem set-up is done automatically by the program when modem usage is specified in the opening menu. The program will take care of dialing the phone or answering it. If the subject is using a terminal, the experimenter will have to set up the modem. (See Appendix D for instructions.)

STEP 6: PREPARE THE SUBJECT'S TERMINAL OR PC

If the subject is using a PC, run the subject's version of Wizard of Oz. The actions listed in this step (6.1 through 6.5) should be completed by the experimenter before the subject arrives. (An abridged version of this section is in Appendix E.)

6.1 Start subject's version - type: **subject<RETURN>**
With the Oz disk in the active drive of the subject's PC type: **subject<RETURN>** at the DOS prompt (*C:>*). The program will load and initially display a screen resembling the one in Figure 2 (page 16). To obtain additional information about Wizard of Oz, press the **<ESC>** key.

6.2 Go to settings menu - type: **<RETURN>**
Typing **<RETURN>** will cause the screen to blank momentarily, and then the main menu (Figure 4 on page 21) will appear. The experimenter uses this menu to set the communication parameters.



WIZARD OF OZ PROTOTYPER - SETTINGS FOR SUBJECT'S PC * = default

```
Baud Rate---- 300 1200 2400 4800 [✓ *9600]
Serial Port-- *1   [✓ 2]
Modem Used--- Yes  [✓ *No]
Data Bits---- 7    [✓ *8]
Stop Bits---- 0    [✓ *1]  2
Parity------- Even Odd [✓ *None]
```

INSTRUCTIONS
1. Press → or ← to select choice or to move cursor laterally.
2. Press ↑, ↓ or ↵ to go from item to item.
3. Press <ESC> to begin data collection.

Figure 4. Subject's settings menu.

6.3 Set parameters - use ARROW KEYS

The menu in Figure 4 will have the default values (8 data bits, no parity, 1 stop bit, etc.) already selected. Alter these settings by using the "<-" (left) and "->" (right) arrow keys to change the value of a field. Go from field to field by using the up and down arrow keys, or with the <RETURN> key. The values selected must match the ones selected on the wizard's PC. Furthermore, make sure that the port specified in the menu matches the one to which the communication cable is connected.

6.4 Exit settings menu - type: <ESC>

When satisfied with the communication settings, press the <ESC> key.

6.5 Optional modem preparation - type: phone number<**RETURN**>
This step will only take place if modem usage is specified in the communication settings menu. The program will display status messages while the modem is being set up. When the set up is complete, the program will prompt the experimenter for the phone number of the wizard. Type in the phone number and press <**RETURN**>. (Dashes, other punctuation, and spaces may be typed as desired. Commas may be used to place a 2 second pause in the dialing. Letters may be substituted for numbers.) The modem will then dial the phone and establish the connection with the wizard's PC. Once the connection has been made, the program functions as if the PCs were connected by a null modem cable.

6.6 Begin terminal emulation
The screen will clear, and the message "*Beginning Terminal Emulation. Use <CTRL><BREAK> when ready to quit. Press <RETURN> to clear the screen and begin testing.*" will appear at the top of the screen. When <**RETURN**> is pressed, the screen will clear and the cursor will be placed in the upper left corner of the screen. The computer is now ready for the subject to take control and test the interface.

Table 2 summarizes the actions needed to start the subject's program.

Table 2. Summary of actions needed to start subject's version of Wizard of Oz.

Situation	Key pressed or Action taken	Result
DOS prompt (*C:\>*)	Type **SUBJECT** **<RETURN>**	Starts subject's version
Title screen displayed	**<RETURN>**	Brings up settings menu
Parameter menu displayed	Select desired settings	Sets communication parameters
Parameter menu displayed	**<ESC>**	Exits menu and displays message
Opening message displayed	**<RETURN>**	Clears screen and ready to test

If the subject is using a dumb terminal, it will have to be configured by the experimenter. On some terminals this can be done by using the keyboard or special function keys to alter the communication parameters. On others, one may have to remove the cover on the terminal and adjust the dip switches on the circuit board. The terminal should be set for full duplex mode or FDX (sometimes called no local echo). If each character typed appears twice, the terminal is in half duplex mode or HDX (local echo) and needs to be changed. Also, the terminal should be set to 8 data bits, no parity, and 1 stop bit (the defaults for Wizard of Oz). Other values will work too, but whatever values are selected, the communication settings of the terminal must match the ones on the wizard's PC exactly. Otherwise, the text sent by the wizard will appear as garbage on the terminal's screen.

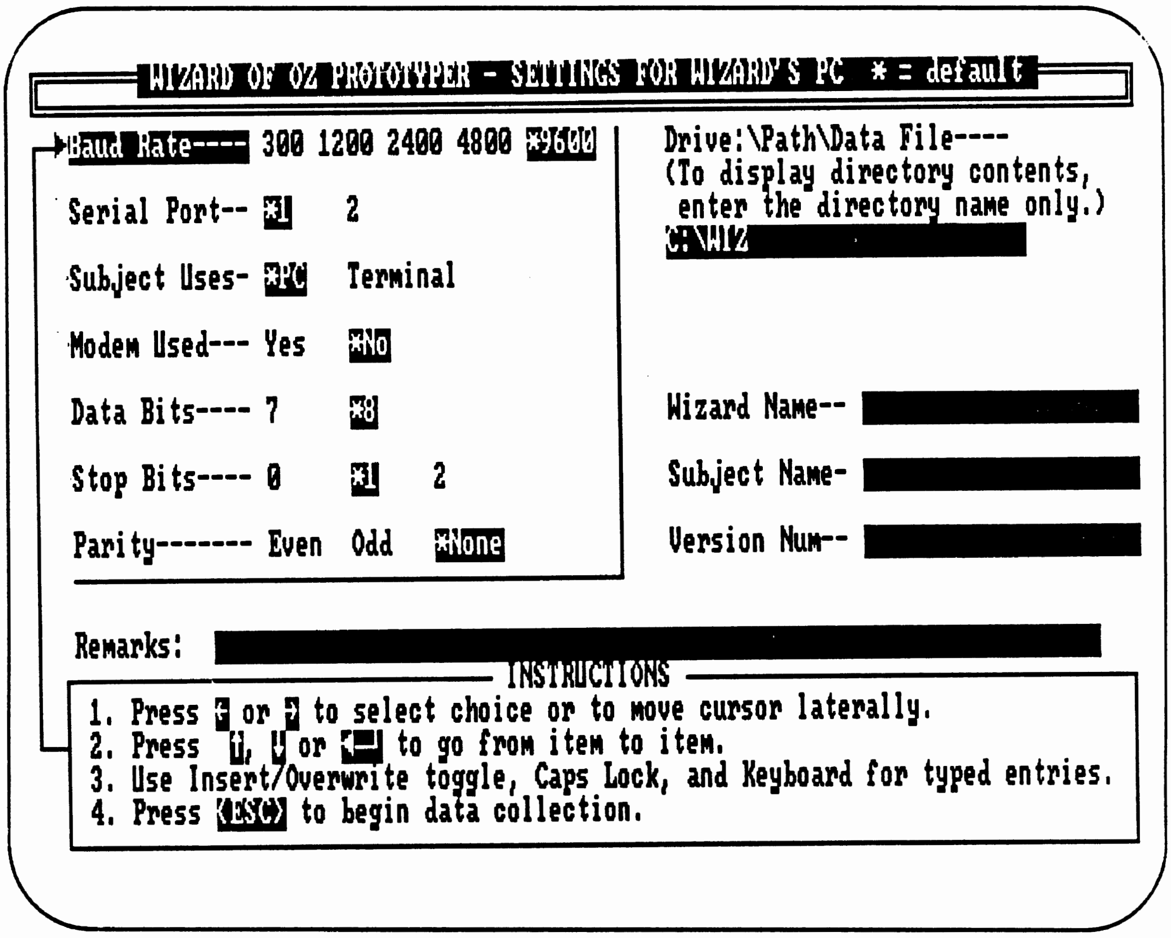
To initialize the modem and dial the wizard, see Appendix D.

STEP 7: PREPARE THE WIZARD'S PC

Before loading the wizard's software, the pre-defined key definitions must be loaded, using Newkey and Newkeysp as done in STEP 4. (If Newkey was loaded after the computer was last turned on, there is no reason to load it again as it remains in memory.) After the definitions are loaded, several actions follow. (An abbreviated version of this section is in Appendix E. Appendix F contains an automated version.)

7.1 Start wizard's version - type: **wizard<RETURN>**
After the key definitions have been loaded and control is returned to DOS (as indicated by its prompt, *C:\>*), type **wizard<RETURN>**. There will be a momentary pause, the screen will clear, and the opening screen (Figure 2 on page 16) will appear. (If the WIZARD.EXE file is on a floppy disk, this disk can be removed and replaced with a data disk at this point.) To get further information about the Wizard of Oz method, press the **<ESC>** key.

7.2 Go to settings menu - type: **<RETURN>**
By pressing **<RETURN>** the settings menu with the walk-through question (Figure 3 on page 17) will be displayed. At this time answer "No," and the list of communication options, as shown in Figure 5, will be displayed on the left side of the screen. The right side of the screen has several fill-in-the-blank fields (e.g. Drive:\Path) which may contain initial values.



```
WIZARD OF OZ PROTOTYPER - SETTINGS FOR WIZARD'S PC   * = default

Baud Rate---- 300 1200 2400 4800 *9600    Drive:\Path\Data File----
                                          (To display directory contents,
Serial Port-- *1   2                       enter the directory name only.)
                                          C:\WIZ
Subject Uses- *PC  Terminal

Modem Used--- Yes  *No

Data Bits---- 7    *8                     Wizard Name--

Stop Bits---- 0    *1    2                Subject Name-

Parity------- Even Odd   *None            Version Num--

Remarks:
                         INSTRUCTIONS
 1. Press ← or → to select choice or to move cursor laterally.
 2. Press ↑, ↓ or ↵ to go from item to item.
 3. Use Insert/Overwrite toggle, Caps Lock, and Keyboard for typed entries.
 4. Press <ESC> to begin data collection.
```

Figure 5. Wizard's settings menu.

7.3 Set parameters - use **ARROW KEYS**/keyboard

The default settings (marked with asterisks) on the left side of the screen can be altered to any of the desired values by using the "<-" (left) and "->" (right) arrow keys to change the value, and the up and down arrow keys to go from setting to setting. These entries must match those selected in the subject's version. Furthermore, the port to which the communication cable is connected must match the port given in the menu. To alter the fields on the right side of the screen, select the appropriate field with the up and down arrow keys and then type the response. The insert/overwrite, caps-lock, and num-lock keys all can be used to perform their normal functions. See

Appendix C for an explanation of errors which may occur in the settings menu.

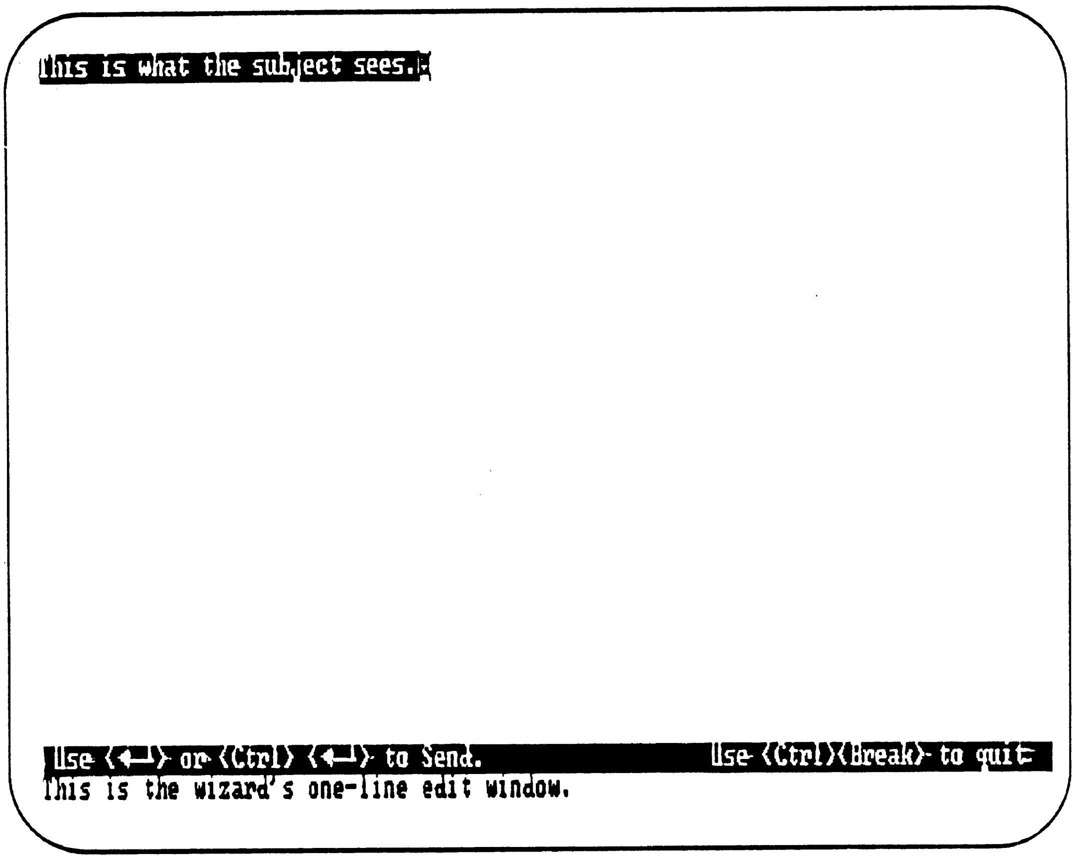
Be sure to enter a new data file name for each session. It may be helpful to include the subject's initials or interface version number in the file name. To display a list of the files in a directory on the screen, enter only the name of the directory (no filename). The directory listing is removed when a filename is specified. (If Oz does not give a directory listing, check the spelling of the directory name. If the specified directory does not exist, Oz follows the DOS convention in assuming that the user is specifying a data file on the main directory.)

7.4 Exit settings menu - type: **<ESC>**
When satisfied with the settings press the **<ESC>** key to start the actual testing.

7.5 Optional modem preparation
If "*Yes*" is selected for the "*Modem Used*" entry, the modem will be automatically set up to answer the phone. The program will display messages describing the current state of communications.

7.6 Begin data collection
There will be a momentary delay while the output file is prepared. The screen will then clear and look like Figure 6 (page 27). The system is now ready to begin a test session. The screen is divided into three parts. The top 23 lines duplicate the text on the subject's screen. (The subject actually can see 24 lines.) The second line from the bottom of the screen is the status bar. This line displays the two sending options, and tells how to end a test session. At the bottom of the screen is a one line window for the wizard to edit messages. This is a simple line editor that allows normal typing and backspacing, cursor movement using

the "<-" (left) and "->" (right) arrow keys, tab and backtab, deletion of the character under the cursor using the **<DEL>** key, and insertion of characters at the cursor position using the **<INS>** key. (The cursor is enlarged while in insert mode.)



This is what the subject sees.

Use <↵> or <Ctrl> <↵> to Send. Use <Ctrl><Break> to quit

This is the wizard's one-line edit window.

Figure 6. Data collection screen.

The actions needed to begin a test are summarized in Table 3 (page 28). A complete list of commands used during a test session is given in APPENDIX E.

Table 3. Summary of actions needed to start the wizard's version of Wizard of Oz.

Situation	Key pressed or Action taken	Result
DOS prompt (C:\>)	Type: **WIZARD** **<RETURN>**	Starts subject's version
Title screen displayed	**<ESC>**	Displays further information on Wizard of Oz
Title screen displayed	**<RETURN>**	Brings up parameter menu
Parameter menu displayed	Select desired settings	Sets communication parameters
Parameter menu displayed	**<ESC>**	Exits menu and enters data collection phase

STEP 8: TEST A SUBJECT

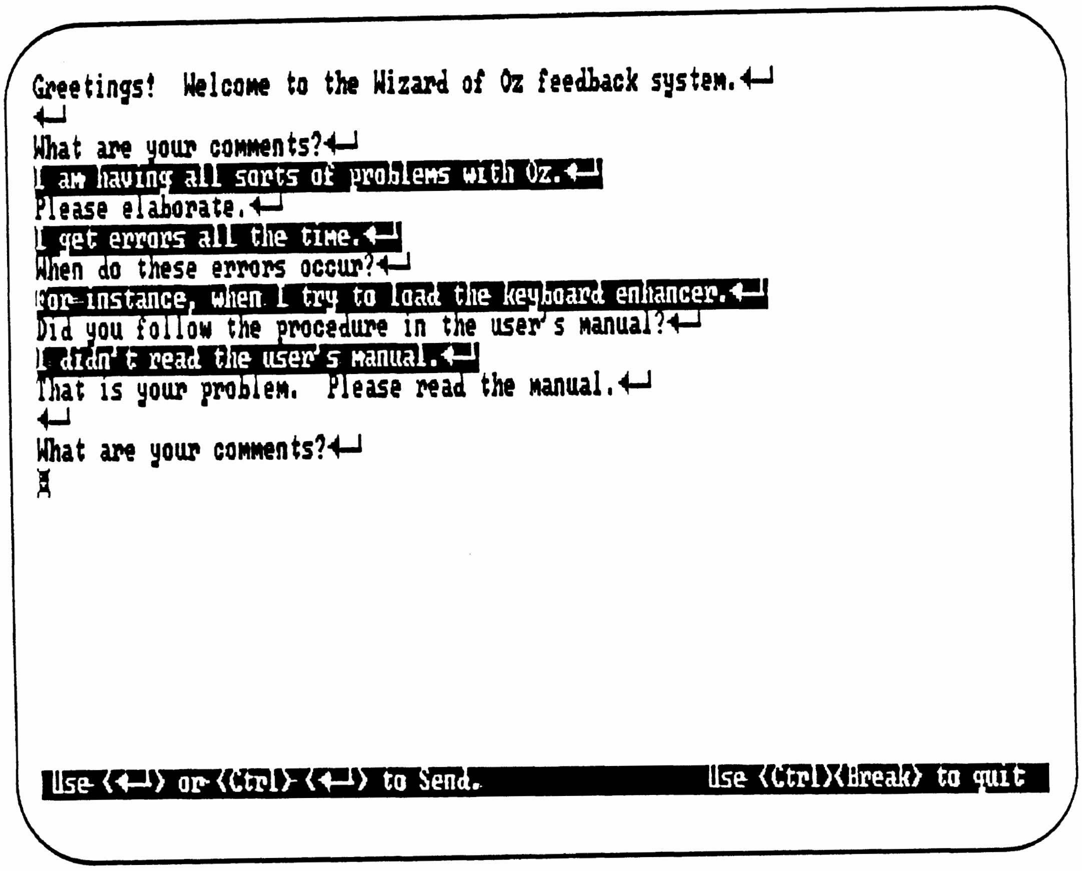
Wizard of Oz interactions follow the WhaYKIWhTSS (wacky wits) principle, What You Key Is What The Subject Sees. In its simplest sense, Wizard of Oz simulations are conversations between two parties who type in what they say to each other. As was noted earlier, a line of text from the wizard does not appear on the subject's screen until it is complete. This makes the source look like a computer to the subject. On the other hand, the subject's responses appear on the wizard's screen as the subject types them, so that the wizard can plan a response.

Messages from the wizard are sent by pressing the **<RETURN>** key, which also moves the cursor to the next line as expected. To send a message and not advance the cursor, the wizard types **<CTRL><RETURN>** (a special type of return). The **<CTRL><RETURN>** is used primarily for fill-in-the-blank responses and sending a system prompt (e.g. "=>") to the subject.

Most Wizard of Oz tests begin with the wizard sending an introductory message, to which the subject replies. When the subject has finished the response, the wizard will send the next message. This type of exchange will continue throughout the interface test. The predefined function keys are used for most messages sent to the subject, although short or unplanned messages may be typed in.

A sample dialogue between a subject and wizard is given in Figure 7 (page 30). On the video screen, the text typed by the wizard will be displayed in normal video (bright characters on a dark background), while the subject's responses will be shown in reverse video (dark characters on a light background.) At the end of each line there will be a return symbol if the **<RETURN>** key was used to send the line. If the **<CTRL><RETURN>** key combination was used, then no return symbol will be placed at the end of the line. When the screen fills up, the text will be scrolled upward to make room for new lines as they appear. If the current line in the wizard's one line window extends beyond the eightieth column, the line will be scrolled sideways across the screen as more text is typed. Lines longer than 80 characters will wrap around on the subject's display.

Notice that there are two different cursors on the screen. A blinking underscore in the wizard's one-line edit window shows where text entered by the wizard will appear. This cursor will be larger when the line editor is in insert mode. The blinking happy face shows where responses from the subject and messages sent to the subject will appear.



```
Greetings!  Welcome to the Wizard of Oz feedback system.↵
↵
What are your comments?↵
I am having all sorts of problems with Oz.↵
Please elaborate.↵
I get errors all the time.↵
When do these errors occur?↵
For instance, when I try to load the keyboard enhancer.↵
Did you follow the procedure in the user's manual?↵
I didn't read the user's manual.↵
That is your problem.  Please read the manual.↵
↵
What are your comments?↵


Use <↵> or <Ctrl>-<↵> to Send.                    Use <Ctrl><Break> to quit
```

Figure 7. Sample dialogue screen.

When the test is complete, hold down the **<CTRL>** key, and while it is depressed, hit the **<BREAK>** key to end the data collection. Do this on the wizard's PC first, and then on the subject's PC if one was used. The screen will clear, and a message will pop up asking about conducting another session. Answering "no" will cause the program to end and control will be returned to DOS. Answering "yes" will cause execution to continue with the settings menu. (Notice that the settings will default to those of the previous session. If the settings are to remain the same in the next session, only the data file name needs to be changed.)

STEP 9: ANALYZE THE RESULTS AND REDESIGN THE DIALOGUE

After testing one to three people, look at the test data. Analysis of these data should reveal weak or confusing parts of the interface. Revisions to the interface should then be made based on this analysis.

Shown in Figure 8 is the listing for the data file from the test session in Figure 7 (page 30). Notice that there is a heading which contains information about the participants in the test, the current test session, and the starting date and time.

```
#MMMMMMMMMMMMMMMMM University of Michigan, UMTRI - Human Factors  MMMMMMMMMMMMM
#*
#*Wizard of Oz session listing. file = TEST1
#*
#*   Session started at 14:15:44 Wed, 1 Apr 1987
#*
#*   Wizard ---------> John Boreczky
#*   Subject --------> Joe Shadowfax
#*
#*   Subject used an IBM PC or compatible hard wired at 9600 baud.
#*   Version Number -> 4.0
#*   Comments: This is a sample Oz session listing.
#*
#*=============================================================================
#* Thinking/System Response Time ( in Seconds )
#* |      Typing Time ( in Seconds )
#* |      |  Author ( W=Wizard, S=Subject )
#* |      |  |Line Type ( :=Normal text, <=editing (e.g. bksp), ?=Other chars,
#* |      |  || Message Text ->   ("<-" = RETURN)         *=other and editing)
#*-+-- --+- || +-----------------------------------------------------------------
05.2  18.3  W? Greetings!  Welcome to the Wizard of Oz feedback system.<-
02.9  00.0  W: <-
00.8  06.9  W: What are your comments?<-
04.6  13.5  S: I am having all sorts of problems with Oz.<-
19.8  04.8  W: Please elaborate.<-
04.5  07.8  S: I get errors all the time.<-
13.2  10.3  W: When do these errors occur?<-
04.3  18.5  S: For instance, when I try to load the keyboard enhancer.<-
24.2  15.6  W? Did you follow the procedure in the user's manual?<-
05.9  09.8  S: I didn't read the user's manual.<-
14.6  16.6  W? That is your problem.  Please read the manual.<-
02.4  00.0  W: <-
02.5  06.9  W: What are your comments?<-
#*=============================================================================
#* Wizard of Oz Session terminated by Wizard
#*   Session ended at 14:19:42 Wed, 1 Apr 1987
#*=============================================================================
```

Figure 8. Data file listing.

Below the heading is a short segment which describes what each column in the data segment represents. The first column represents the thinking time for that line. For the wizard, thinking time (actually "system" response time), is the interval from when the subject typed the last character (**<RETURN>**) to when the wizard types the first character. For multiple line menus, the wizard's thinking time is the duration from when the **<RETURN>** on a line was typed until the first character on the next line is typed. The subject's thinking time is the interval from when the wizard sent the last line to the time the subject types a character. The second column represents the typing time. It is the elapsed time from when the first character was typed until when the **<RETURN>** was typed.

The third column is used to indicate who was responsible for the line of text that follows. A "W" denotes that the wizard typed the line, and an "S" denotes that the subject typed it. A ":" after the letter indicates that the text is exactly as it appeared on the screen during the test. A "<" indicates that editing characters (backspace, insert, etc.) were used. A "?" indicates that one or more of the characters on the line are unprintable, and may not have appeared on the screen. (These characters include control keys.) A "*" indicates that both editing and unprintable characters appear. When analyzing the data, look at the "<", "?", and "*" lines carefully since they contain errors subjects made. One sign that an interface is easy to use is that subjects make few errors.

Finally, the last field contains the entire text of the message. Lines typed by the subject include <u>all</u> the characters typed. Control and editing characters are shown as "^(some character)", meaning **<CTRL>**(some character). The most common of these are shown in Table 5 in Appendix B. The lines typed by the wizard do not include these characters.

At the end of the file is a closing segment which tells when the session ended. If the ending segment does not appear, either the session listing continues on another disk or it was lost.

To obtain a condensed version of the data file, run the program OzSumry on the session data file. To do this on an IBM PC, type: **ozsumry<RETURN>**. The program will ask for the session data file name, and for an output file name where the condensed version of the data will be stored.

After OzSumry has finished executing, print a listing of its output file (the condensed data) and review it carefully. The condensed data should suggest areas where the subject had trouble with the interface. Look for long subject response times, long typing times, and response errors. Also, look out for places where messages were created on the fly. Based on this evidence, revise the interface (and the associated predefined keys) before testing the next subject. Messages from the wizard more than a few characters long should be assigned to function keys.

This may require reloading the keyboard enhancer and typing in new messages, or using an editor on the key definition file. Don't forget to save the revisions to a file. Once these modifications have been completed, the interface is ready to be retested.

SUGGESTIONS FOR TEST PROCEDURES

This section contains hints on conducting Wizard of Oz sessions based on experience with the software. It is similar to the material in Green & Wei-Haas, 1985a and 1985b. While some of these suggestions may not seem worthwhile, following them makes Oz sessions go much more smoothly.

As was mentioned previously, conduct practice runs to familiarize the wizard with the interface before testing subjects. This will help speed up the "system" by reducing the wizard's response time. Practice runs may be conducted using either the walk-through mode, or the test mode with a member of the design team posing as the subject.

The optimal number of experimenters is three. One will act as the wizard, the others as observers. One observer would deal directly with the subject giving any pretest briefings and taking notes during the test. (This observer should, however, play dumb if the subject asks questions about the interface during the test: "I'm just taking notes. I don't know what is supposed to happen.") The second observer should be stationed next to the wizard. That person should take notes and help the wizard decide what to do. The observers can also aid in detecting any problems with the connecting communication link during the session, since they can have a greater range of view than the wizard alone. (Remember, two or three heads can be better than one.)

If the system being prototyped has a telephone hot line, give the subject a phone to call the wizard's assistant for help. The assistant should note or tape record any questions and responses.

When conducting tests with subjects, have a copy of the function keys and their associated messages next to the wizard's display. It hasn't been fully resolved whether messages should be listed alphabetically, grouped by function, or correspond spatially to the associated keys. By some time early in 1987 there should be utilities written to generate these lists.

Another listing which has proven helpful is a decision tree (or flowchart) showing the function keys and the alternatives available at any particular time.

When developing a test scenario, use a task list or script. This will decrease the system response time by allowing wizards to plan in advance the sequence of actions to be taken during a test. By using a script, the interface can be more thoroughly tested. When subjects are just asked to "try it," they don't know what to do. This causes parts of the interface to be missed during a test.

Even when scripts are used, subjects often respond in unexpected ways. When the wizard tries to respond immediately, the result is often a frantic search for the appropriate function key or the hasty composition of a message on the fly. Those response times are rarely short. Such delays take some of the magic out of the Oz paradigm. Further, when response times exceed a second or two, subjects often realize something is not right and compound the wizard's problem by entering a second message. When unexpected responses are received, experimenters should stall for time by sending the subject a planned (function-key based) message to read while they wait.

Experimenters need to be clever in creating such stall-for-time messages. For example: "The system load is very high. Please be prepared for some processing delays." Translation: "We're confused and not sure what to do next. Please wait." Such a message should minimize idle time, but it should not be so long that it delays reading of the next message sent by the wizard. Further, stall-for-time messages should not distract subjects from the ongoing dialogue. One or two such messages should be sufficient.

Messages are also needed for when the wizard hits the wrong function key and thus sends the wrong message to the subject. For example: "The system is recovering from primary processor failure. Please ignore the previous message." Since these errors are not common, one or two ignore-the-blooper messages should be adequate.

Giving the subject tangible materials that would normally be associated with the type of system being developed improves the task fidelity. Consider giving the subject real phone bills or checks to use in a banking simulation, for example. If available, give the subject a preliminary user's manual describing the operation of the interface being developed.

When testing the interface, try to simulate as closely as possible the speed at which the final system will run. If the system is to be a high-speed system (2400-9600 baud) try to test it using an IBM PC AT or an AT compatible. If the system is to run at a much slower rate (300-1200 baud) then an IBM PC, PC XT, or compatible will do. The reader may recall the performance data for computers and enhancers was provided in STEP 2: GET A KEYBOARD ENHANCER.

When using modems to communicate, a second telephone line for voice communication will be extremely helpful. This will allow the wizard and the subject's observer to communicate and discuss any problems which may arise during the test session.

Finally, keep the test atmosphere relaxed. Most people report that using Wizard of Oz is fun!

CONVERTING THE PROTOTYPE INTO WORKING CODE

[This section applies only to programmers in industry, not students in IOE 436.]

While students taking Paul's class do not develop working applications based on Oz prototypes, programmers in industry will. How the results of the prototyping study are communicated to programmers, and what information they need, will depend upon the composition of the interface design team.

In some organizations, interface development is carried out entirely by the programming team without advice from human factors engineers. Since coding the interface is done by the same people that designed it, transfer of the prototyping study results is not required.

In other organizations, the design of the interface is turned over to human factors engineers who have total control over the interface. They work independently of those who will write the code. In that instance, the programming team will need extensive documentation on how the interface should function.

Currently, the most popular model is for one human factors engineer to collaborate with a team of programmers to develop the dialogue. The human factors engineer takes the lead in designing and managing user tests. The programmers help collect the data. This model works well because it takes advantage of the expertise of the limited number of human factors engineers and the availability of programmers. It also increases the commitment of programmers to human factors considerations because they have had a hand in the tests. By witnessing those tests, programmers become more attuned to what users can and cannot do. Programmers usually assume that ordinary users are more knowledgeable than they actually are.

Of the items programmers need, a flow chart of the message sequence is the most important. They will also need a listing of all the messages sent to the user, both those assigned to function keys and those entered on the fly. Programmers should be given a copy of the floppy disk with the function key definitions from the final version of the prototype. That way, the programmers can load a keyboard enhancer and use the function keys to enter the messages in the source code. This will reduce the amount of typing they do, saving time and minimizing errors. An added advantage is that the desired wording is preserved. Some have suggested that a listing of a typical session might also prove to be useful.

The programmers should also be given a list of the anticipated responses to each system message and how often each response will occur (including errors), along with predictions of user response times. This information can be used to trap errors and predict performance of the completed software.

Providing programmers with videotapes of users working with preliminary and final versions of the prototype can be most informative. The preliminary version shows how the interface should not be designed and how users reacted to it. The final version documents what is preferred. Usually programmers are given only static information about an interface and find it difficult to appreciate the interaction dynamics. As an alternative, programmers might be given a "re-play" file to show the interaction.

Finally, some have suggested a lessons learned/changes made list to be provided for each version of the prototype. ("When the same prompt was used for both modes the subjects were confused about whether they should ... or .... To eliminate that problem...") This information is useful in supporting previous design decisions, and when differences between the prototype and application interfaces are considered, it may help identify which changes will improve user performance.

Since Oz has yet to be used in an industrial setting, it is unknown what format the information for programmers should take -- a formal report, a memo, a specifications document, etc. This issue will be resolved in the future.

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APPENDIX A - DETAILED FORMAT AND COPY INSTRUCTIONS

FORMATTING A FLOPPY DISK

Before a new disk can be used, it needs to be formatted. Formatting puts reference marks on the disk and erases all existing information on it. To format a disk, put a disk in the floppy drive, close the drive door, and type: **format a: /s/v<RETURN>**. This will also put part of the operating system on it and allow the disk to be named. NEVER TYPE **format<RETURN>** as you may erase the hard drive, a major disaster. While being formatted, the floppy disk will spin for about 30 seconds and then ask for a volume (disk) name. Choose one that is meaningful (e.g. Wizard-1).

COPYING A FLOPPY DISK

The Oz distribution disk should not be used for tests. To copy it on a system with one floppy and a hard drive complete the following steps:

1. Create a temporary directory on the hard drive by typing **mkdir** <path><**RETURN**>, where <path> is replaced by some meaningful name.

2. Make the directory just created the current directory, by typing **cd** <path><**RETURN**>.

3. Copy the contents of the Oz disk to this directory, using **copy a:*.* c:<RETURN>**.

4. Insert the disk (newly formatted or erased) for the Wizard of Oz software in the floppy drive, and type copy *.* a:<RETURN> to transfer the files to the disk.

Table 4. Summary of copy command sequence.

Type	Result
mkdir <path>	creates a new directory
cd <path>	makes <path> the current directory
copy a:*.*	copies all files on drive A to the directory
Replace disk	
copy *.* a:	Copies files to a new disk

If the system being used has two floppy drives, place the Oz disk in drive A and a formatted disk in drive B, and type: **copy a:*.* b:<RETURN>** instead of the two copy commands given above. This will produce an exact copy of the Oz disk on the other disk.

APPENDIX B - HOW TO USE NEWKEY 3.0 WITH WIZARD OF OZ

1. When loading Newkey, use a very large value for the number of bytes reserved for definitions such as: NEWKEY /15000. If an out of memory message appears, save the existing definitions to a file, then reboot the system (press **<CTRL>**, **<ALT>** and **<DEL>** at the same time) and start Newkey with more memory. Once Newkey is up again, load the previously defined definitions and begin defining the rest.

2. If the machine is left idle for more than two minutes the screen will automatically turn off until any key (even **<SHIFT>**) is hit. To disable the screen-saving option use the Newkeysp program. When the menu appears enter 9 (Display/update parameters) to get another menu where this option can be turned off or the time increased. When exiting this menu answer "no" to the question about making the changes permanent, unless they should be.

3. While defining keys use Edlin to keep track of what has been defined. While Newkey is loaded, type: **edlin** filename**<RETURN>** to start the editor and "**i**" to enter the insert mode. Then use Newkey to define the function keys. When finished, type **<CTRL>**c to exit the insert mode and "**e**" to save the file and end the editing. (More complete information on the Edlin line editor is in the DOS manual.) Be sure to save the key definitions to a file by using Newkeysp. (The file saved by edlin is just the text of the messages.) For this phase Vedit, Microsoft Word, Wordstar, and other editors should not be used. They all use function and control key combinations which are likely to conflict with those being defined.

4. Once the keys are defined and saved to a file, an editor such as Vedit can be used to edit them. If this editing takes place immediately after Edlin is used, reboot the system so Newkey and the conflicting definitions are removed from memory.

   Using this editing procedure, changes in wording can be made easily. When making changes, be careful not to delete any text inclosed in greater than and less than signs (e.g., <enddef>) since this might render the file unreadable by the keyboard enhancer. Once the corrections have been made, reload the definitions and begin testing.

5. To get a listing of how keys are defined, print the file where the key definitions are saved. For a more readable copy of the key definitions, make a copy of the definition file and edit the copy as desired. Make sure that the original definition file is not changed, since this will prohibit it from loading. In the near future a utility program will be available for listing key definition files.

6. If a definition uses many spaces, use the <**TAB**> key for every eight spaces instead of the space bar. A special character is used to indicate a tab which reduces the amount of memory used by the definitions, as well as the time needed to display the messages.

7. When assigning messages, use the ten function keys for the most common messages. Messages can be assigned to combinations of the <**ALT**>, <**SHIFT**>, and <**CTRL**> keys with the function keys (30 combinations) and the <**ALT**> key with the numbers and letters (36 combinations). Users should not redefine the numbers and letters, or the <**SHIFT**> key in combination with them. Redefining the <**CTRL**> in combination with the numbers and letters

should be avoided. As shown in Table 5, many combinations have other meanings. Redefining keys to the right of the **<RETURN>** key (**<INS>**, **<DEL>**, the number pad, etc.) should be avoided as those keys are used elsewhere. For a further discussion, see the Newkey manual.

Table 5. Synonymous keys

Control key	Meaning
CTRL G	BELL
CTRL H	BACKSPACE
CTRL I	TAB
CTRL J	CTRL RETURN (LINE FEED)
CTRL K	HOME
CTRL L	FORM FEED
CTRL M	RETURN
CTRL [	ESC
CTRL \	CURSOR RIGHT
CTRL]	CURSOR LEFT
CTRL ^	CURSOR UP
CTRL -	CURSOR DOWN

In general, use of the control key with letters and numbers should be avoided. The codes that these combinations generate can have unpredictable effects. With the recommended combinations, as many as 76 messages can be defined.

8. If the interface requires more than about 40 function key combinations (but less than 76), consider dividing the definitions among two or more files, being sure to keep related functions together. Multiple files facilitate editing by making it easier to find definitions to be changed. Just before testing, these files should be merged into one. (If the definitions are in files A and B then type: **copy a+b c<RETURN>** or use the merge function in Newkeysp.)

9. If more than 76 definitions are needed, the interface must be tested in pieces. In such circumstances, it is

best to put all of the common definitions (e.g., main menu, frequent prompts and error messages, etc.) in one file, and have a different file for each piece of the interface to be tested. This allows using a function key for more than one message in separate pieces of the interface.

For interfaces significantly in excess of 76 definitions, developers may wish to consider other prototyping methods. Not only does one reach the limit of available key combinations (for Newkey), but the limit of what the wizard can handle as well.

APPENDIX C - ERROR MESSAGES AND THEIR MEANING

With the number of things that the Wizard of Oz program does, it is not surprising that there are many error conditions which can occur. Most of the errors are non-fatal and can be handled from within the program after some intervention from the user. When an error occurs, a message describing the error and how to correct it will be displayed. In all cases when an error occurs, the program stops until the error has been resolved. The errors are listed alphabetically on the following pages with a short explanation as to the cause and cure for each.

Descriptions can be found for the following error messages:

```
ACCESS TO THE FILE YOU HAVE SPECIFIED IS NOT PERMITTED
BUSY SIGNAL FROM WIZARD
CALL TO WIZARD ABORTED
CALL WAIT ABORTED
CAN'T FIND DATA FILE
COMMUNICATION CARRIER SIGNAL HAS BEEN LOST
COMMUNICATION PORT NOT READY
DATA DISK HAS FILLED UP
FILE ALREADY EXISTS
FILE NAME ENTERED IS MISSING A ROOT
FILE NAME EXTENSION HAS MORE THAN THREE CHARACTERS
FILE NAME NOT GIVEN
FILE NAME ROOT IS LONGER THAN EIGHT CHARACTERS
IMPROPER CHARACTER IN FILE NAME
IMPROPER FILE NAME EXTENSION
MODEM MALFUNCTIONING
MODEM NOT RESPONDING
MODEM PREPARATION ABORTED
MODEM STILL NOT RESPONDING
MORE THAN ONE PERIOD IN FILE NAME
NO CARRIER SIGNAL FROM THE CALLER
NO CARRIER SIGNAL FROM WIZARD'S MODEM
NOT READY ERROR WRITING A:
PATH NAME IS NOT CORRECT
SUBJECT PRESSED <CTRL><BREAK>
THERE IS NOT ENOUGH DISK SPACE TO SAVE THE DATA
WRITE PROTECT ERROR WRITING A:
```

ACCESS TO THE FILE YOU HAVE SPECIFIED IS NOT PERMITTED

This error occurs if the file name specified in the settings menu already exists and is a read-only file. Type a new file name when the settings menu returns.

BUSY SIGNAL FROM WIZARD

This error occurs when the phone number that the subject program calls is busy. Either someone else called the wizard's phone number first or the wrong number was dialed.

CALL TO WIZARD ABORTED

This error occurs in the subject's program if <CTRL> **<BREAK>** is pressed after the wizard's phone number is dialed but before the wizard's modem responds. This is not really an error and is in fact what should be done if the wrong number was dialed.

CALL WAIT ABORTED

This error occurs in the wizard's program if <CTRL> **<BREAK>** is pressed after the program starts its wait for the subject's call. This is not really an error and is in fact what should be done to stop the session if there seems to some problem.

CAN'T FIND DATA FILE

This error occurs at the end of data collection. It originates from changing floppy disks used for output in the middle of a test session without being prompted to do so. Oz can detect a disk swap only when trying to close the output file. An unprompted swap will lead to ALL the data being lost. More importantly, data on the second disk may be overwritten. (The drive continues writing to the disk from where the heads were last positioned.)

COMMUNICATION CARRIER SIGNAL HAS BEEN LOST

A carrier signal exists when using modems, or when the subject uses a dumb terminal or PC. This is used to determine if a connection exists. If this error occurs when the subject is using a terminal or PC hardwired to the wizard's PC, the error is non-fatal. To correct it, find the break in the line and fix it. There are several possible causes of this error when modems are used for communication. All of the causes stem from either the modem or from the telephone system. For modems the error is fatal. The only way to handle this is to end the session, and try again. (Note: If the phone used has a call waiting feature, garbage may be displayed on the screen. This results from the computer trying to interpret the signal which is used to indicate an awaiting call. Phones with call waiting should not be used.)

<u>COMMUNICATION PORT NOT READY</u>

If the communication cable is not connected to the serial port specified in the settings menu, this error will occur. To correct this situation, connect the communication cable to the proper port.

<u>DATA DISK HAS FILLED UP</u>

This is the only disk error which can occur during data collection. If this happens the program will request that a new disk be inserted into the drive. Once the new disk is placed in the drive the program will continue as before.

<u>FILE ALREADY EXISTS</u>

If the output file name entered on the settings menu is a duplicate, this message will appear. Wizard of Oz will not permit the overwriting of existing files since these may contain important data. If this error occurs, just type another file name (one not used previously) when the program returns to the settings menu.

<u>FILE NAME ENTERED IS MISSING A ROOT</u>

A file name was entered that consisted of only an extension. A file name cannot have a period as its first character. Type in a new file name with at least one character before the period.

FILE NAME EXTENSION HAS MORE THAN THREE CHARACTERS

The file name entered had more than three characters to the right of the period. Type in a new file name with three or less characters to the right of the period.

FILE NAME NOT GIVEN

This error occurs if the path and file name combination ends with a "\". In order to get a directory listing, enter a path name without a "\" at the end. In order to specify the output data file, type a file name after the "\".

FILE NAME ROOT IS LONGER THAN EIGHT CHARACTERS

This error occurs if the file name entered has more than eight characters before the period, or is more than eight characters long without a period. Type in a new file name with the root no longer than eight characters.

IMPROPER CHARACTERS IN FILE NAME

The file name that was entered contained an improper character. The only characters DOS allows are the letters of the alphabet, the numbers 0 through 9, the following special characters:

$ # & @ ! % ( ) - { } ` _ '

and a period to start the file name extension. Type in a file name that contains only these valid characters.

IMPROPER FILE NAME EXTENSION

The file name was entered contained an improper extension. Oz does not allow output data files to have the following extensions:

.PAS .COM .EXE .SYS .BAT .BAS .DOC .BAK

because these extensions are used to indicate system files or programming language files. Type a filename that has a different extension.

MODEM MALFUNCTIONING

This error occurs when there is something wrong with the modem, or if it is not Hayes-compatible. To correct this, use a working Hayes or Hayes-compatible modem and restart the test session.

MODEM NOT RESPONDING

If the modem has not been turned on, or is not connected, this error will result when the program tries to set up the modem. To correct this, turn on the modem or connect it to the PC.

MODEM PREPARATION ABORTED

This error occurs if **<CTRL><BREAK>** is pressed while the program is preparing the modem for communication. This is not really an error and is in fact what should be done to stop the session if there appears to be a problem.

MODEM STILL NOT RESPONDING

This error will rarely occur. It arises from three attempts to reset the modem which have failed due to the modem not responding. If it occurs, check the modem and cables, and restart the test.

MORE THAN ONE PERIOD IN FILE NAME

The file name that was entered contained more than one period. A file name is allowed to have only one period to indicate the start of the file name extension. Type in a file name that contains only one period.

NO CARRIER SIGNAL FROM THE CALLER

This error occurs in the wizard's program if the incoming phone caller did not send a carrier signal (like the subject's program does). Either the subject's modem is not set up properly, the subject's program settings are incorrect, or the call was a wrong number.

NO CARRIER SIGNAL FROM WIZARD'S MODEM

This error occurs in the subject's program if the phone number that was called did not respond with a carrier signal (like the wizard's program does). Either the wizard's modem is not set up properly, the wizard's program settings are incorrect, or a wrong number was dialed.

NOT READY ERROR WRITING A:

This error is intercepted by DOS. It occurs whenever the program tries to access the disk drive, and the door on the drive is open or there is no disk in it. Solve the problem and type "r" (for Retry), and the program will resume where it left off. The screen may appear garbled when control is returned to the Oz program.

PATH NAME IS NOT CORRECT

If the path specified in the drive:\path field does not exist, this error will occur. To correct this error enter a legal drive:\path after the program starts again. Notice that the drive:\path is automatically reset to the last legal path when the program resumes.

SUBJECT PRESSED <CTRL><BREAK>

This error occurs in the wizard's program if the subject is using a PC and pressed **<CTRL><BREAK>** to exit the program. If the PCs are connected by modems, the Oz session must be restarted on both PCs. Otherwise, simply restart the subject's program to continue the session.

THERE IS NOT ENOUGH DISK SPACE TO SAVE THE DATA

This error arises when there is a shortage of disk space on the proposed data disk. If the disk has between 10K and 40K bytes of available space, the program will ask for confirmation before using the disk. If there is less than 10K bytes available the program will ask for the disk to be replaced, since this will not be enough space to save even a small test session.

<u>WRITE PROTECT ERROR WRITING A:</u>

This error is intercepted by DOS. DOS will stop execution of the program until it is resolved. If this error arises, remove the write protect tab from the disk in the drive or use another formatted disk. Since DOS takes control in this situation, the screen may appear garbled when the program regains control. The last message may not be properly saved to disk, but everything else should be fine. Ignore the garbled characters and continue.

APPENDIX D - MODEM SETUP

To set up a modem when using a terminal for the subject's machine, give the commands in Table 6 after the terminal communication parameters have be set. All commands must be in capital letters, and must be followed by **<RETURN>**.

Table 6. Modem setup commands

Command or action taken	Results
ATZ	this resets the modem
AT F1 E0 S7=255 S12=150	this establishes full duplex, echo off, and wait times for the session
ATDT phone number	replace phone number with the wizard's phone number
...conduct the test...	
ATH0	hangs up the phone

APPENDIX E - QUICK REFERENCE LIST OF COMMANDS

Tables 7 and 8 below give a quick summary of the commands used during a Wizard of Oz session. Table 7 has the commands needed to run the subject's version, while Table 8 has the commands for the wizard's version.

Table 7. Summary of actions needed to run subject's version of Wizard of Oz.

Situation	Key pressed or Action taken	Result
DOS prompt (*C:\>*)	Type: **SUBJECT <RETURN>**	Starts subject's version
Title screen displayed	**<ESC>**	Displays further information on Wizard of Oz
Title screen displayed	**<RETURN>**	Brings up parameter menu
Parameter menu displayed	Select desired settings	Sets communication parameters
Parameter menu displayed	**<ESC>**	Exits menu and displays message
Opening message displayed	**<RETURN>**	Clears screen and ready to test
End of test	**<CTRL><BREAK>**	Clears screen and displays repeat question
Repeat question	**Y**	Returns to parameter menu for new test
Repeat question	**N**	Returns control to DOS

Table 8. Summary of actions needed to run the wizard's version of Wizard of Oz.

Situation	Key pressed or Action taken	Result
DOS prompt (*C:\>*)	Type: **WIZARD** **<RETURN>**	Starts wizard's version
Title screen displayed	**<ESC>**	Displays further information on Wizard of Oz
Title screen displayed	**<RETURN>**	Brings up parameter menu
Parameter menu displayed	Select desired settings	Sets communication parameters
Parameter menu displayed	**<ESC>**	Exits menu and enters data collection phase
End of test	**<CTRL><BREAK>**	Clears screen and displays repeat question
Repeat question	**Y**	Returns to parameter menu for new test
Repeat question	**N**	Returns control to DOS

APPENDIX F - BATCH FILE

Figure 9 is a listing of the file WIZBATCH.BAT. This file can be used to start Wizard of Oz up from DOS. To use this file simply type: **wizbatch.bat** <keys><**RETURN**>, where <keys> is the name of the file which contains all of your key definitions. This batch file assumes Newkey has not been loaded and that all the key definitions are in one file. It also assumes that Newkey (3.0) is the keyboard enhancer, and that all the files are on the same disk as the batch file.

Figure 9. Listing of WIZBATCH.BAT

```
ECHO OFF
PROMPT $P $G
REM *** SET DATE AND TIME SO THAT TIME STAMPS ARE ACCURATE
DATE
TIME
REM *** LOAD NEWKEY AND SET DEFINED AREA = 20000
NEWKEY /20000
REM *** LOAD YOUR KEY DEFINITIONS
NEWKEYSP %1/1
REM *** LOAD WIZARD OF OZ
WIZARD
```