

**COMPUTER ANAGLYPH PROGRAM
FOR THE APPLE II GS**

BY

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A computer vision therapy program was developed as a convenient, and simple way to treat patients with suppression or binocular vision problems. This program was designed for the Apple II GS personal computer, with the intention that it be graphically reproduced on videotape for home use.

Many people suffer from vision abnormalities, which can be corrected by simple vision therapy exercises. This computer program is designed to treat patients with suppression and/or binocular vision anomalies. It was created with the intention that it would be used for in office treatment of these conditions, and in conjunction with other therapy regimens. These computer programs will eventually be transferred to broadcast quality videotape for the purpose of home therapy. By using innovative new computer therapy regimens to eliminate suppression, strabismus, and poor visual skills, the therapist may increase his effectiveness in treating these disorders.

The use of color filters is quite frequently employed by vision therapists. By placing red and green targets on a white background, and wearing red/green spectacle filters, individual targets may be viewed monocularly under binocular conditions. On a white background, a color target is invisible to an eye wearing a filter of the same color, but visible to an eye wearing a filter of its complimentary color (i.e., red targets are seen by the eye behind the green filter, but invisible to the eye behind the red filter). On the other hand, if the background is black, the reverse is true (i.e., the eye behind the red filter sees the red target, but the green target is invisible to it). This

technique can be utilized to create a disparity between two objects in order to produce a stereoscopic effect. Devices which employ this technique are called *anaglyphs*.

Certain computer programs try to use color filters for visual training exercises, but have problems filtering out the corresponding colors on video. Most employ red/blue filters for video. The result is adequate for many exercises, but not very practical for stereoscopic viewing. This is because the colors are not completely filtered by the red/blue spectacles. This problem can be eliminated by proper color mixing of the video targets and background. The video color aquamarine corresponds well with the spectacle filter green, whereas the video color orange corresponds well with the spectacle filter red. When these colors are placed upon a video background shade of light yellow, the anaglyphic process works optimally. This "video-anaglyph" technique may be used to develop stereoscopic scenes on a video monitor simply by creating a disparity between two identical, but complimentary colored targets.

Many techniques have been used to eliminate suppression. These methods vary according to the depth of the suppression. Griffin recommends that twelve factors always be considered when treating a patient with suppression. They are as follows: occlusion, naturalness, attention, brightness, target size, intermittent stimuli, target movement, contrast, color, tactile/kinesthetic senses, auditory senses, and combinations of these factors.

The size of the target is very important, because it relates to the size of the suppression zone. Targets larger than the suppression zone should always be employed first. As the anti-suppression training progresses, consecutively smaller targets should be utilized as the suppression zone decreases.

Target movement is also very valuable in anti-suppression training. One reason is the fact that noncorresponding retinal points are stimulated by target oscillation. Also, the possibility of retinal receptor fatigue is decreased by the varied stimulation of different corresponding retinal points.

Furthermore, target motion serves to increase the patient's attentiveness, thereby reducing the likelihood of suppression.

The more natural the setting, the easier it is for the patient to suppress. As the naturalness of the training conditions is reduced, patients with deeper suppression will be less likely to "turn off" the nondominant eye.

One frequently employed training technique is the placing of red and green anaglyphic filter sheets on both halves of a television screen (or window), and viewing targets through spectacle filters. Another method utilizing the filters is the bar reader, which alternately filters out columns of letters and words on a page of reading material. Root rings, and the Box-X-O add yet another dimension to the arsenal of vision therapy devices currently used today.

By utilizing the high resolution graphics, and multi-colored display afforded a computer monitor, the same type of therapy regimines can be produced and enhanced for vision training. This is extremely practical for both in office, and home therapies, because exercises can be developed that meet most of the twelve aforementioned criteria. By transferring computer exercises to videotape, the patient may be able to perform them at home. Verbal instructions could reduce the chance for mistakes made by the unsupervised trainee, and sound effects would help increase patient attentiveness. Another benefit of the home therapy tape is that specified intervals of time may comprise each daily session, therefore insuring that the patient spends a certain number of hours training per week. The therapy programs can be varied in order to heighten patient interest and enthusiasm. Obviously, this concept is extremely practical due to the relative inexpense of spectacle filters, and prevalence of home videocassette recorders.

METHOD

This computer video anaglyph program was designed for the Apple II 65 personal computer. The therapy series was created utilizing Activision's Paintworks Plus software. The colors, aquamarine and orange, were used to create on-screen video anaglyphs in place of taping red/green filters on the computer monitor. By designing a loop of consecutive images, assigning them a value, and having the computer flash them on the monitor for a specified interval, a stereoscopic animation was created.

In order to create the stereoscopic effect, there must be a disparity between two identical images of the colors aquamarine and orange. When viewing the monitor at a distance of 40 centimeters, each two pixel disparity is equivalent to stereoscopic value of 524 seconds of arc. This value is calculated for a person with an interpupillary distance of 60 millimeters. The following chart indicates the approximate angles of stereopsis for pixel disparities (1 to 10), and the equation used for determining those values:

number of pixels (1 pixel = 0.5 mm)	angle of stereopsis (in seconds)
1	263
2	524
3	796
4	1,066
5	1,344
6	1,630
7	1,916
8	2,209
9	2,511
10	2,812

$$\text{Eta} = \frac{\text{I.P.D.} (X)}{d} (206,000)$$

Eta = stereoacuity
 X = lateral displacement
 d = testing distance

By merely switching the zoom feature of the program on, all the various stereoscopic targets may be quantified. Because the video anaglyph program contains numerous targets of varying disparities in each frame, it

is not feasible to list each stereoacuity. By knowing the limit of stereopsis attainable at the test distance, and/or the specific object perceived in the third dimension, you can readily quantify stereoacuity with the magnification feature. To increase the sensitivity of the test, merely increase the viewing distance and calculate using the previous formula (1).

The program series contains the following video anaglyphic exercises:

(1) Box-X-O, (2) tracings, (3) mazes, (4) word searches, (5) poems, (6) anti-suppression scenes, and (7) stereoscopic visual tracking exercises. For the mazes, tracings, and word searches, it is recommended that clear plastic wrap (i.e., Saran Wrap) be placed over the monitor, and the exercises be completed using a felt-tip pen.

The Box-X-O in Figure 1 may be used to decrease the patient's suppression zone, and thereby decrease the angle of strabismus. The Bone Show tracing in Figure 2 provides tactile/kinesthetic support for an anti-suppression exercise. It also serves to improve eye-hand coordination. Figures 3 and 4 illustrate the alternating colors of the word searches, as in Color Word Search, and the poems, as in Poem 1. Figures 5 and 6 demonstrate both the stationary and moving stereoscopic targets of the animations, as in Beach Show. Figure 7, Maze 1, combines both anti-suppression, and eye-hand coordination activities.

The following table lists one possible sequencing of exercises:

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Session #1

Box-X-O
Word Search
Poem.1
Bee
Maze.1
Sammy Seal

Session #2

Box-X-O
Color Word Search
Mountain
Maze.2
Bike Show

Session #3

Box-X-O
Zoo Word Search
Bone Show
Poem.2
Maze.3
S Show (Space)

Session #4

Box-X-O
Anatomy Word Search
Maze.4
Archery Show

Session #5

Box-X-O
Poem.3
Maze.5
Beach Show

The in office procedure may be varied according to patient progress. For the home therapy tape, however, a specific sequence must be chosen. This does not present a problem regarding patient proficiency, because exercises may be completed according to ability, and repeated when the appropriate level of competency is attained. For example, if the word searches were not completed initially, the patient can merely rewind the tape to Color Word

Search, even though he is on Session #5.

CONCLUSION

The use of a computer monitor or television screen in vision therapy is quite significant, because it provides patients with a simple vision therapy technique using something with which they are quite familiar. Computers are readily becoming the rule, not the exception, in private practice today. Because of the simplicity of the procedures, more time can be spent on patient education and progress evaluation, instead of instruction. The belief that it is better to have them do a few exercises well, than many incorrectly, is a wise one. These computer programs include a wide variety of uncomplicated exercises, therefore allowing the clinician to add other home therapy procedures without making the training regimen too complicated or burdensome. Another benefit of this technique is that it requires less clinical, or parental supervision. Perhaps, a series of computer anaglyph programs lies ahead in vision therapy's near future.

REFERENCES

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BOX-X-O

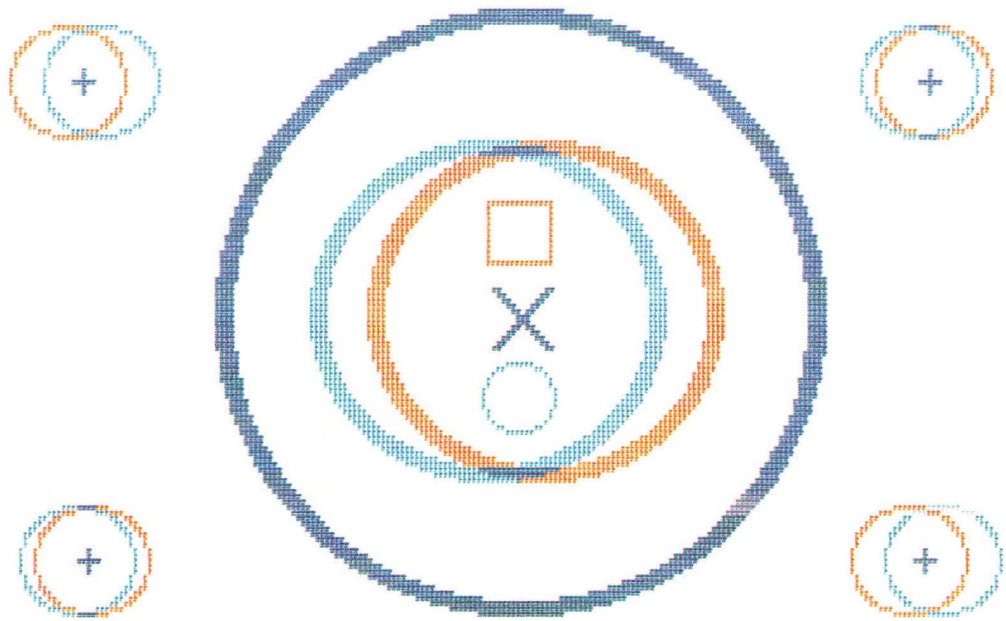


Fig.1

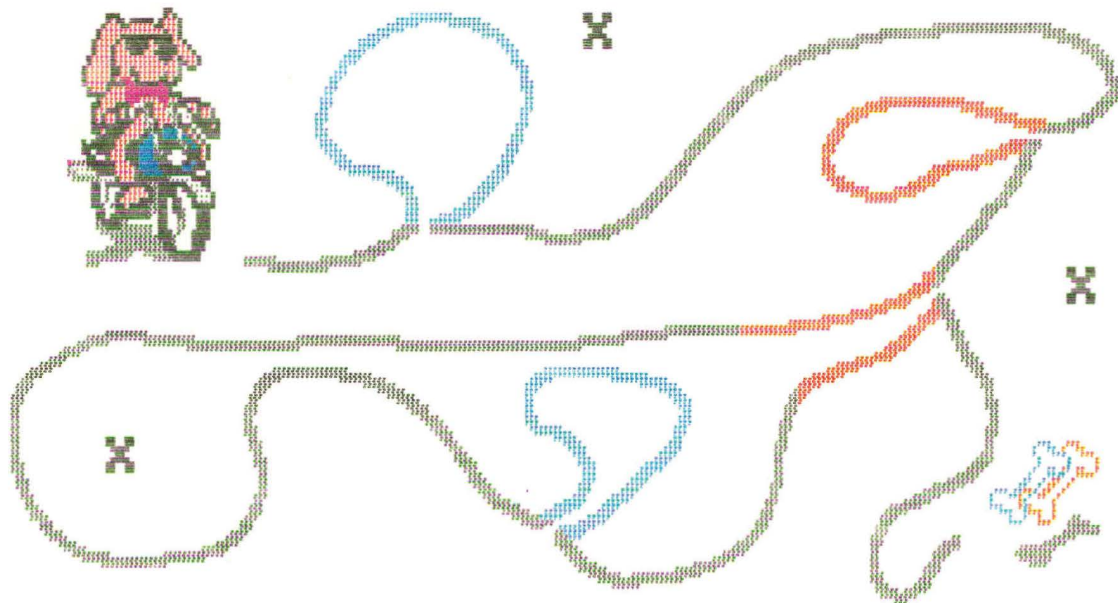


Fig.2

THERE ARE SEVEN COLORS
HIDDEN IN THIS WORD SEARCH
CAN YOU FIND THEM?



ALWAYS FINISH

IF A TASK IS ONCE BEGUN
NEVER LEAVE IT TILL IT'S DONE.
BE THE LABOR GREAT OR SMALL,
DO IT WELL OR NOT AT ALL.

UNKNOWN

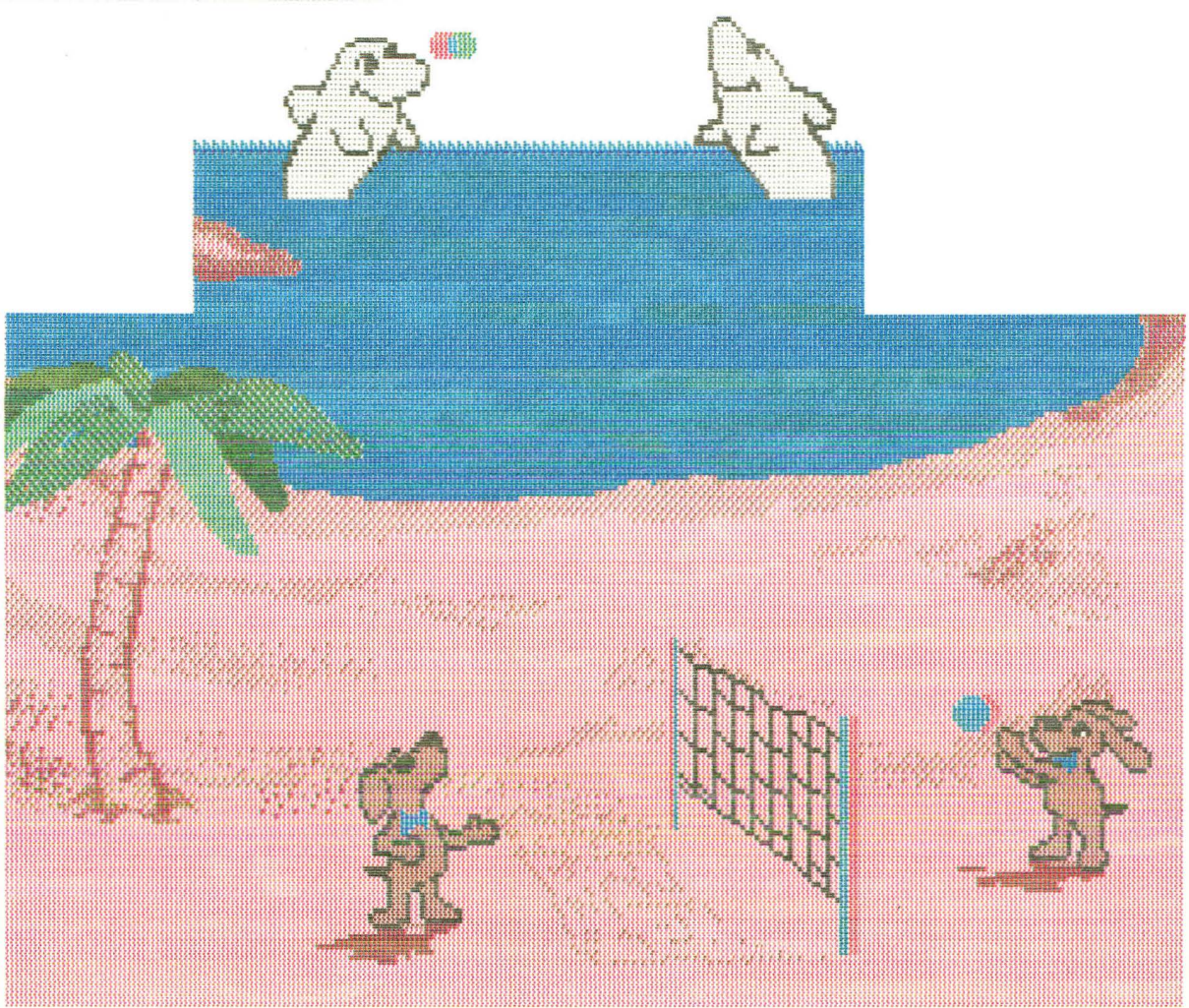


Fig.5

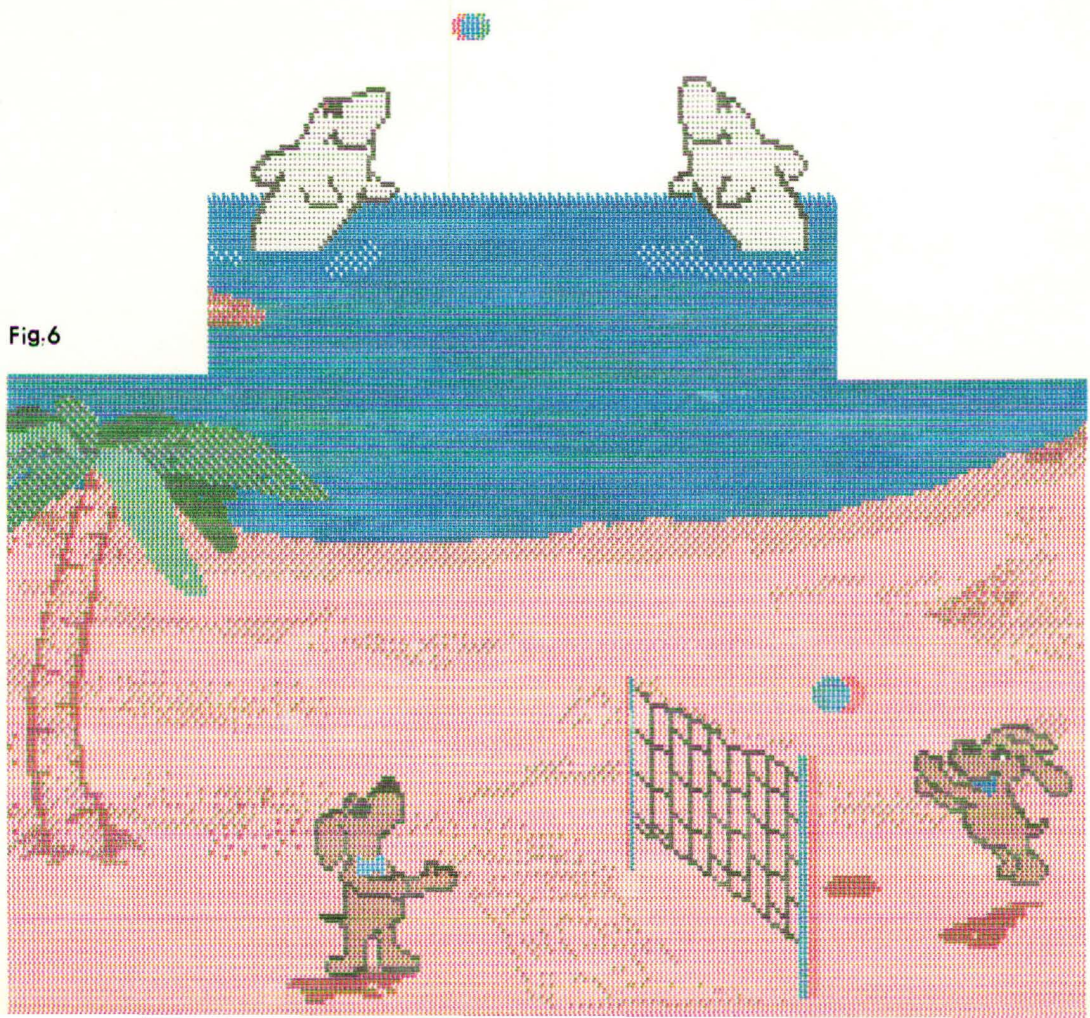


Fig.6

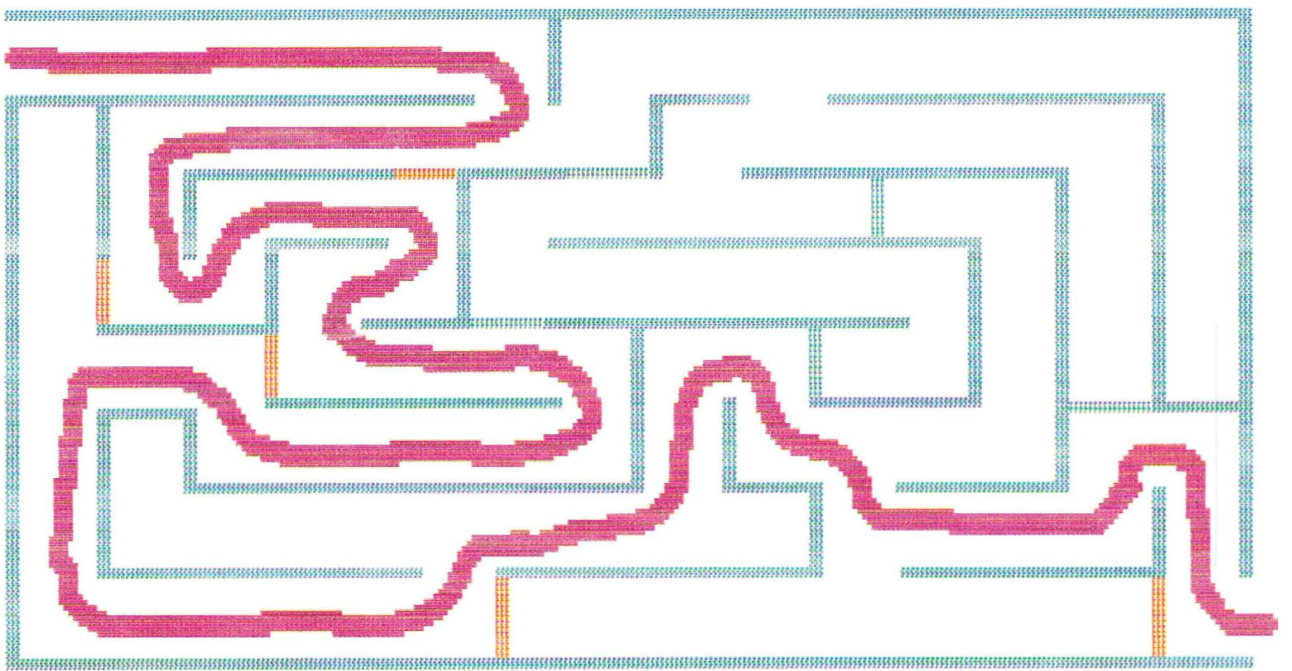
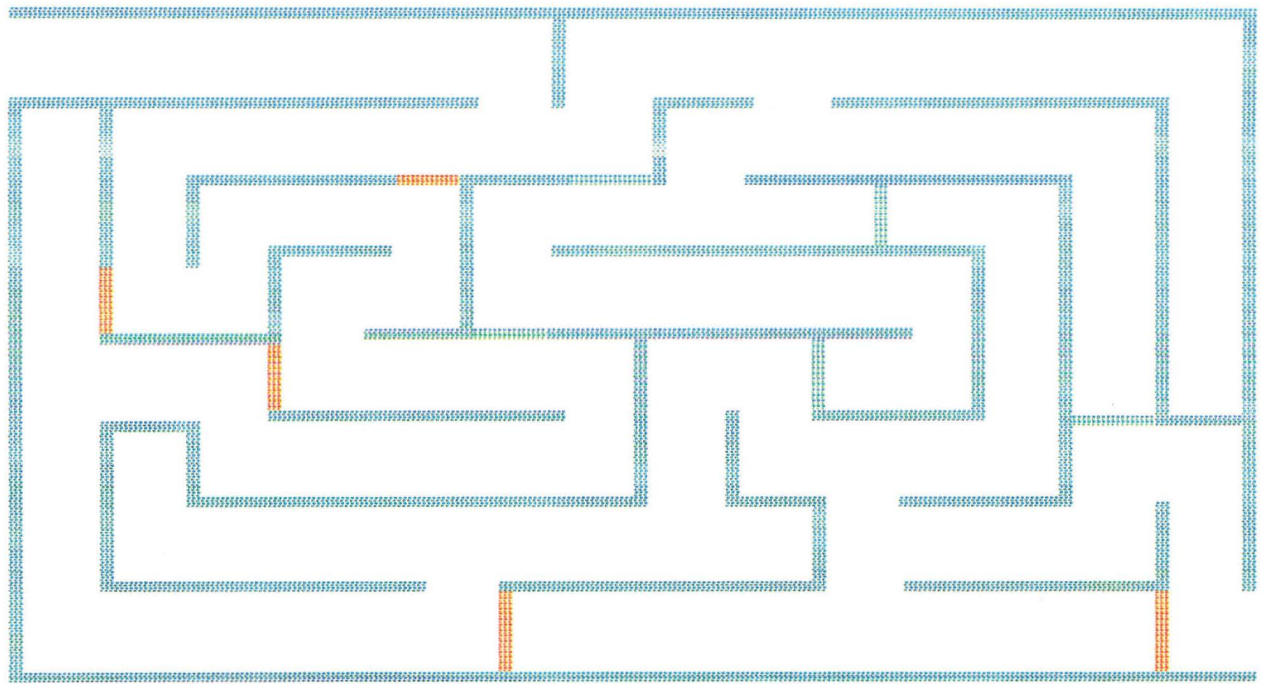


Fig-7