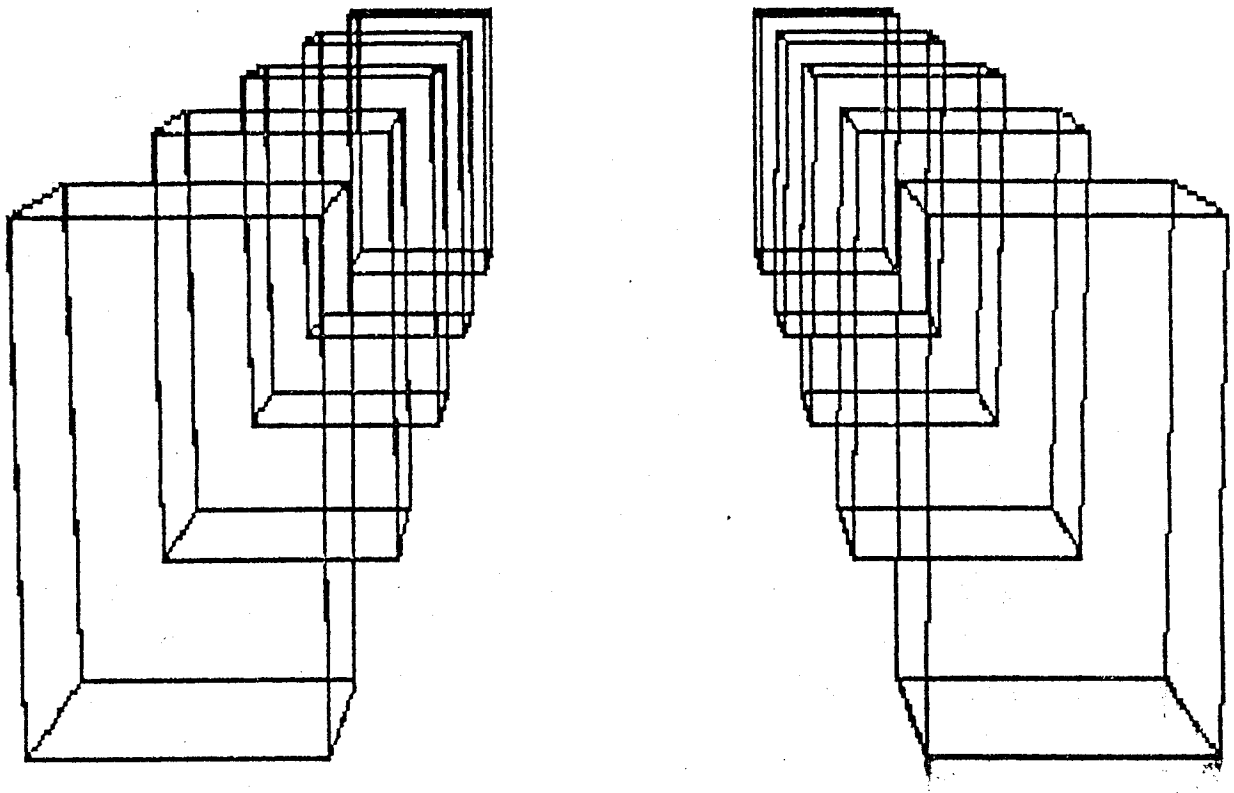
$39.95

3D-PLOT

USER'S REFERENCE MANUAL V1.1

Minimum System: 48K, Single Disk Drive



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High Resolution Three-dimensional
Object Plotting Routine

Introduction and Applications

I'm sure you have been thrilled and amazed at the extraordinary improvement in the graphics capability of your TRS-80 with your new hi-resolution graphics board. Replacing the low resolution block graphics with the high resolution graphics has given you the tools for creating new and more interesting pictures. However, you have probably discovered (like the rest of us) that it is difficult to manipulate those 100,000 video bits to do your bidding. Well, HAP:Software has developed the solution in the form of a new software package called VIEW3D.

Now, you simply supply the coordinates of the object and VIEW3D will create the display for you. In addition, you can change the viewing position until the most pleasing picture is found. Another feature allows you to remove hidden lines in an object; the hidden line removal changes the appearance of the object from that of a stick figure to that of a solid shape. Finally, if your desired object can be built by combining several simple shapes, you will find them already prepared and stored on the VIEW3D diskette.

As you learn to use VIEW3D, we are sure you will discover many new and interesting applications, as we have. Here are a few we have tried; scale models of buildings and streets (saved as Figure 1), computer artwork composed of various geometrical shapes (Figures 2, 3, and 4), and architectural plans (Figure 5).

BRIEF DESCRIPTION AND FEATURES

The VIEW3D package is a menu-driven program which allows the user to create a wide variety of three-dimensional objects. These objects can be created in two ways. First, we have prepared a library of basic objects (cube, prism, and pyramid) which are stored on the VIEW3D diskette and can be read, modified, and then combined in a variety of ways to create unique shapes. Second, with the aid of this manual and a series of prompts from VIEW3D, you are able to develop objects of your own creation which can then be saved for later use or combined with other objects. Up to 10 objects can be combined to create many interesting and unusual shapes. These objects can be moved about the screen and viewed from different positions until the desired effect is obtained.

Another feature which enhances the versatility of this program is the ability to change the magnification of any object independently in three orthogonal directions. Thus, the simple cube can become a skyscraper (with the Z-axis magnified), a long low building (with the X- or Y-axis magnified), or a single story shopping mall (with both the X- and Y-axis magnified). A hidden line removal routine allows you to remove hidden lines from individual objects in order to create the illusion of solid objects.

If you have purchased the high-resolution drawing program DRAW from Micro-Labs, you can call upon it to perform some additional enhancements on your pictures. These include shading various faces of the objects and removing hidden lines from overlapping objects created by VIEW3D. In addition, captions can be added to your pictures using DRAW.

I'm sure you are beginning to develop many ideas of your own for applying this program in business, science, art, or simply for your entertainment, so let's proceed to the instructions on how to load and use VIEW3D.

HARDWARE AND SOFTWARE REQUIRED FOR VIEW3D PROGRAMS

To use VIEW3D high resolution three-dimensional object plotting routines your computer system needs the following items:

1. TRS-80 computer with 48K of memory.
2. Add-on high resolution board.
3. The Micro-Labs GBASIC software.
4. Disk drives if you are going to save and load objects.
5. High resolution printer if you want to print pictures.

PROGRAM LOADING INSTRUCTIONS

DISK OWNERS WITH A MODEL 3 WITH MICRO-LABS GRAFYX SOLUTION: Place the 3D-PLOT diskette in Drive 1 and a TRSDOS 1.3 diskette in Drive 0. Then, in response to the prompt 'TRSDOS Ready', type 'VIEW3D' and <Enter> to load the program. If you have only one disk drive, you should place the 3D-PLOT disk in drive zero and press the orange reset key. You will then be prompted to transfer the files to a system disk.

DISK OWNERS WITH A MODEL 4 IN THE MODEL 4 MODE: Place you TRSDOS 6.1 disk containing GBASIC in drive 0 and the 3D-PLOT disk in drive 1. Type 'CONV :1 :0' to copy the files onto your system disk. Reply with a 'Y' to the following files: CUBE, PYRAMID, PRISM, CUBEB, DODECH, LVIEW3D/BAS. The /HR sample picture files can also be converted but only a few will fit on the system disk. The conversion need only be done one time. From that point on, type 'GBASIC LVIEW3D/BAS' to execute 3D-PLOT.

ALL OTHER DISK OWNERS: Place the 3D-PLOT disk in drive 1 and a TRSDOS 1.3 disk in drive 0. In response to the 'TRSDOS Ready' prompt type 'GBASIC VIEW3D/BAS' to execute 3D-PLOT.

In addition to the VIEW3D plotting program, a number of hi-resolution pictures are also contained on the disk. These pictures may be loaded with the VIEW3D program. The remaining files are data files containing the three-dimensional object definitions and are also loaded using VIEW3D.

EXECUTION AND USAGE

Easy access to the programs in the VIEW3D package is provided by a main menu. The first four prompts ask you for information about the objects you will be using. If you can provide this information, the program running time will be shorter and less memory will be used. If not, the program will provide default values when you press <ENTER>. The default value for the first prompt is 5, and the values for the remaining three prompts are the maximum permissible values. The first four prompts are:

```
Maximum number of objects desired N<=10 ?
Maximum number of faces per object N<=14 ?
Maximum number of vertices per object N<=20 ?
Maximum number of vertices per face N<=10 ?
```

Next, the main menu appears on the screen. The menu options are:

```
 1--Start over
 2--Define object
 3--Read object
 4--Enter eyepoint
 5--Enter distance to projection plane
 6--Draw transparent picture
 7--Draw hidden line removal picture
 8--Save picture on diskette
 9--Recall diskette picture
10--Send the picture to the printer
11--Edit the picture using DRAW  (n.a. under TRSDOS 6.x)
12--Quit and exit VIEW3D
```

You will be prompted with "Command to execute:?", after which you can type in a command (1-12) followed by <ENTER>. We will now explain what each command will do. Since Command 2 is the most complicated, we will explain Commands 1 and 3-12 first and then return to Command 2.

COMMAND 1--"Start over". It is essential that this command be entered each time you begin to produce a new picture. It loads default values for the constants in the plotting routines. If this command is not executed, your new picture will also contain the old figures and/or you may recieve an error message due to exceeding the array sizes which were dimensioned previously. The error message will be "Subscript out of range". After "1" is entered, the message "Initializing" will appear and remain on the screen intil this step is complete. After this, the menu will again be displayed. The VIEW3D program automatically performs this initialization for you when you first execute the program.

COMMAND 3--"Read Object". This command is used to recall one of the figures we have included in the 3D-PLOT package or one that you have prepared using the "Define Object" command. After entering "3", the reply "Object filename" appears on the screen and you should enter the appropriate name; for our example the name is "CUBEB". Next, you are asked to locate the figure with "Position for the object CUBEB X,Y,Z?" We are employing a Cartesian cordinate system with the positive X-axis out of the screen, the positive Y-axis to the right-hand side of the screen, and the positive Z-axis toward the top of the screen. The default values 0,0,0 will be used if you press <ENTER>. A reply of 0,0,0 locates the object at the center of the screen, 0,8,0 positions the object on the right-hand side of the screen,etc. The precise value that will move an object to the edge of the screen depends of the values of the eye point and the projection plane; these features are discussed below.

Now, you are asked "Size scaling factors for the object <Sx,Sy,Sz>?" This feature provides for much flexibility in creating objects. For example, if the object is the standard cube, a reply of "1,1,3" will produce an elongated box with the long side running from the center toward the top of the screen. Note that the scaling factor can be different for each x,y,z direction and for each object added to the picture. One note of caution. If you enter "0" for any of the scaling factors, your beautiful three-dimensional object will collapse into a one-dimensional heap, a single line or a point. If only <ENTER> is pressed, the values 1,1,1 are entered for sx,sy,sz.

COMMAND 4--"Enter eyepoint" When "4" is entered, you are requested "Input the eyepoint location <Radius, Theta, Phi>?" This feature is illustrated in Appendix B. The radius is the distance between the eyepoint and the object and can be any value greater than zero; the angle Theta (in degrees) is the eyepoint position as the viewer moves around the object and can be any value between 0 and 360 degrees. The angle Phi controls the elevation of the eyepoint, with a top viewing position corresponding to 0 degrees and a bottom view corresponding to 180 degrees. The default values (set each time you enter "1"--Start over) are "30,0,60". To get a feel for this command, read in the truncated cube CUBEB and change one value (Theta or Phi) at a time in order to see the effect. Then use Command 6 to draw each new orientation.

COMMAND 5--"Enter distance to the projection plane" Once again, refer to Appendix B for a sketch which illustrates this feature. You will note that a combination of the distance from the eyepoint to the object and the distance from the object to the projection plane determines the

size of the object. The best way to appreciate this command is to try a few examples. You will find that when the distance to the eyepoint is too small, the object will appear to be distorted (parallel lines do not appear parallel, for example). On the other hand, if the distance to the eyepoint is very large relative to the distance to the projection plane, the object will appear very small. The default value for the distance to the projection plane is 500. Any value greater than zero is accepable here.

COMMAND 6--"Draw transparent picture" Now you are ready to view the fruits of your labor! Once you have initialized, defined the object, or read in an object, you can enter "6" and View3D will begin constructing the object (or objects). This procedure and the next ("Draw hidden line removal picture") are the time-consuming steps for the program. After the operation is complete, the word "Done..." will appear in the upper left-hand corner of the screen, together with the picture. If the picture does not appear, the position may have been off the screen and you should check the object position coordinates (see Command 3--"Read object").

If the resulting picture meets your expectations, you can print it and/or store it on diskette (see below). If not, you can change the eyepoint, magnification, or distance to the projection plane until you are satisfied. Depressing any key will return you to the menu.

COMMAND 7--"Draw hidden line removal picture" This command operates much like Command 6, except that the hidden lines are removed for each individual object in the picture. Certain figures, especially those with many sides, appear confusing when hidden lines are included. Also, the visualization of the object by the viewer is changed, from that of a stick figure (hidden lines remaining) to that of a solid object (hidden lines removed). Note that this command only removes hidden lines for each individual object. Hidden lines which result from overlap of different objects will remain. Those users who also have the "Draw" program have the option of removing these additional hidden lines (see Command 8 below).

COMMAND 8--"Save picture on diskette" After all the time and effort you have spent entering values for vertices, eyepoints, projection planes,etc., you will certainly want to save some of your most impressive figures. To do this, enter "8" and then choose a filename. An extension /HR is automatically added to any name you enter. In this way, the pictures you save can be distinguished from the objects you have saved with Command 2. While this operation is being performed, the word "Saving..."

appears in the upper left-hand corner of the screen. After the figure is saved, you are returned to the menu.

COMMAND 9--"Recall diskette picture" In response to entering "9", you are asked for "Plot filename:". After you respond with the name (no need to add /HR, it is added automatically), the figure will be plotted on the screen. We have prepared several pictures for your entertainment and saved them as FIGURE1, FIGURE2, FIGURE3, FIGURE4, and FIGURE5. We have also prepared some common geometrical shapes and saved them as CUBE, PRISM, PYRAMID, and CUBEB (a truncated cube).

COMMAND 10--"Send the figure to the printer" When you enter "10", a list of the printers and associated numbers will appear. Simply press the number between 0 and 9 corresponding to the printer you have. The compatible printers and their corresponding numbers are listed under the graphics Basic LPRINT command in your GBASIC 3.0 or Grafyx Solution manual.

After printing the figure, VIEW3D will again return you to the menu.

COMMAND 11-"Edit the picture using program DRAW". If you have purchased the program DRAW from Micro-Labs, and have copied it onto the diskette containing VIEW3D, this command will transfer you to the DRAW menu. You should refer to your DRAW instruction manual for details on the options available. When you exit the DRAW program you will be returned to the operating system. Type "VIEW3D" to re-enter the program..

COMMAND 12--"Quit and exit VIEW3D". This command will exit VIEW3D and return to BASIC. To return to VIEW3D, just type RUN.

COMMAND 2--"Define Object". Now, you can begin to construct pictures of your own creation. Up to 10 objects can be entered in order to construct a picture. Many of the pictures you may wish to create can be broken down into simple shapes such as cubes, prisms, etc. With this in mind, we have included these simple shapes as building blocks under Command 3 (explained above). Before proceeding with an example of contructing an object, we must define some terms. The sides of an object are referred to as "polygons", and the corners of the object are referred to as "vertices". We will be using the Cartesian coordinate system to determine the values of the vertices (X positive out of the screen, Y positive toward the right-hand side of the screen, and Z positive toward the top of the screen).

Some time spent in organizing your ideas and drawing your objects out on graph paper will save you time and prevent some frustration later. We will now illustrate this procedure using a truncated cube as an example object (we chose a truncated cube since it will be used later to illustrate changes in viewing direction). The first step is to draw each side of the object to scale and to sketch a perspective view of the object (this is illustrated for the truncated cube in Appendix A). Then the vertices of the figure can be determined. You have some flexibility in picking the orientation of the object relative to the coordinate system. However, a judicious choice here will enable you to maximize the number of simple integer coordinates. In our example, we choose the orientation so that the cube sides are parallel to the x,y,and z axes with the cordinate origin (0,0,0) located at the center of the cube. Now, we can determine the values of the vertices and proceed with the construction.

After you type "2" and <ENTER>, you will be asked to enter an object filename. This name can be any legitimate Basic filename, but be sure that it is not one we have already used (these are CUBE, CUBEB, PRISM, PYRAMID, and DODECH). Now, you will be asked to provide VIEW3D with detailed information about the object.

A. "Number of vertices for the object?" Your response to this request can be any number up to and including 20. For our example of the truncated cube, the answer is "10".

B. "Number of surfaces for the object?" Again, you are allowed to enter any number up to and including 14. The correct answer for our example is "7".

C1. "Coordinates for vertex #1 X,Y,Z?" In response to this request, you should enter the Cartesian coordinates for the point which you have labeled "#1" on your figure. For our example in Appendix A, we have labeled the vertices A,B,C,etc., rather than 1,2,3,etc., so the response for our example is 1,-1,-1 for vertex A.

C2--Cn. You will be asked to continue providing coordinate values until you reach the number you entered in A (above).
In our example, we enter coordinates for A-J.

D. "Number of vertices for polygon 1:?" In response to this prompt, you should choose a polygon face on your sketch of the desired object, count the number of vertices, and enter this number. For our example, we choose the face A,B,C,D,E and the corect entry is "5".

E1. The program responds with "Enter point #'s for vertices in clockwise direction", and then "Point for vertex #1:?" Your job here will be made easier if you prepare a table for each object you have sketched and labled. We illustrate this procedure for our truncated cube in Appendix A. For polygon 1, the correct response is "1", which corresponds to the point labeled "A".

E2--En. This step is repeated until you have responded with the number of points specified in D (above). In our example, the responses are "2" for point B, "3" for point C, "4" for point D, and "5" for point E. Then you are asked to enter the number of vertices for polygon #2 and steps E1--En are repeated.

It is relatively easy to determine the clockwise direction for point entry if the polygon is in view in your sketch. However, the correct direction is more difficult to ascertain if the polygon is hidden. A rule to remember is that if the polygon is hidden (or if you are viewing the polygon from the inside of the object) then you should list the points as they appear in a counterclockwise direction. In our example, polygon 6 is hidden and the correct order of points is 7,8,9,10, corresponding to points labeled G,H,I,J.

NOTE: After defining your object, the data is stored in the disk filename you specified and is no longer in memory. Therefore, if you want to draw the object that you just entered, you will need to first choose menu option 3 -- Read object and enter the object filename.

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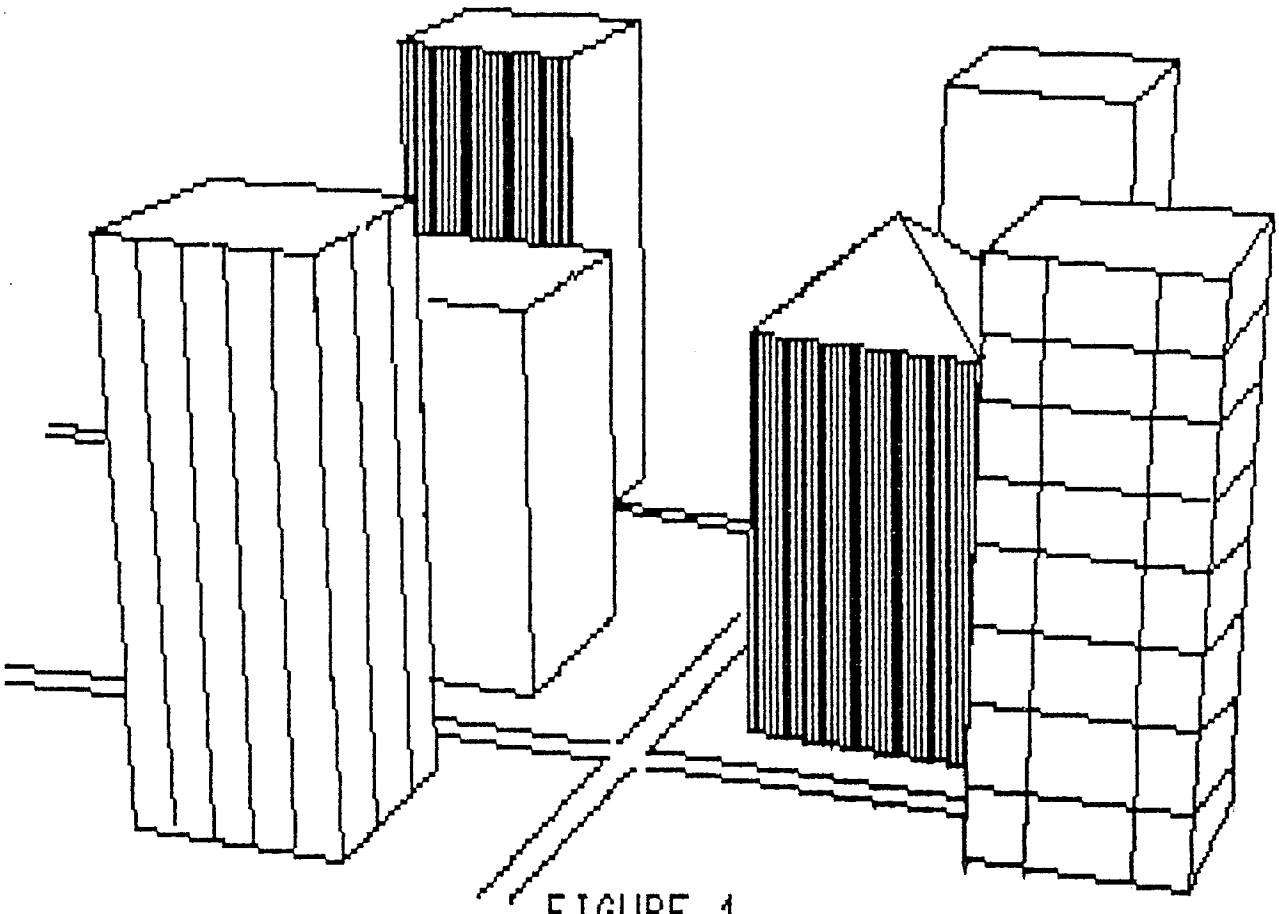


FIGURE 1

HIDDEN LINE REMOVAL DEMONSTRATION

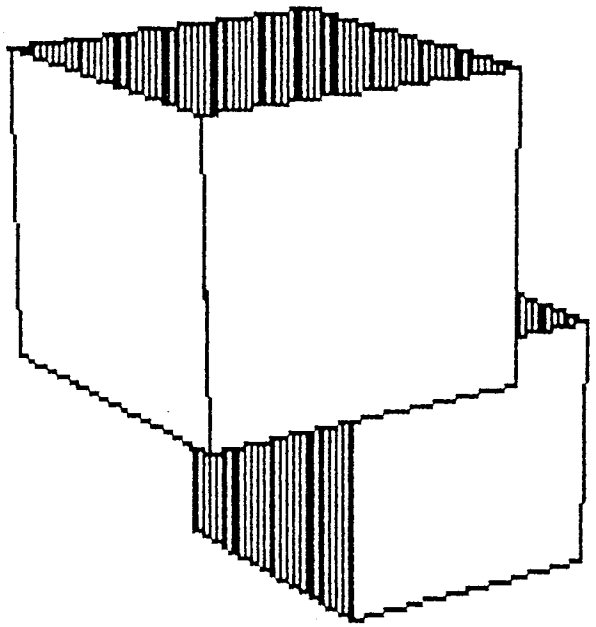


FIGURE 2

GEOMETRICAL SHAPES

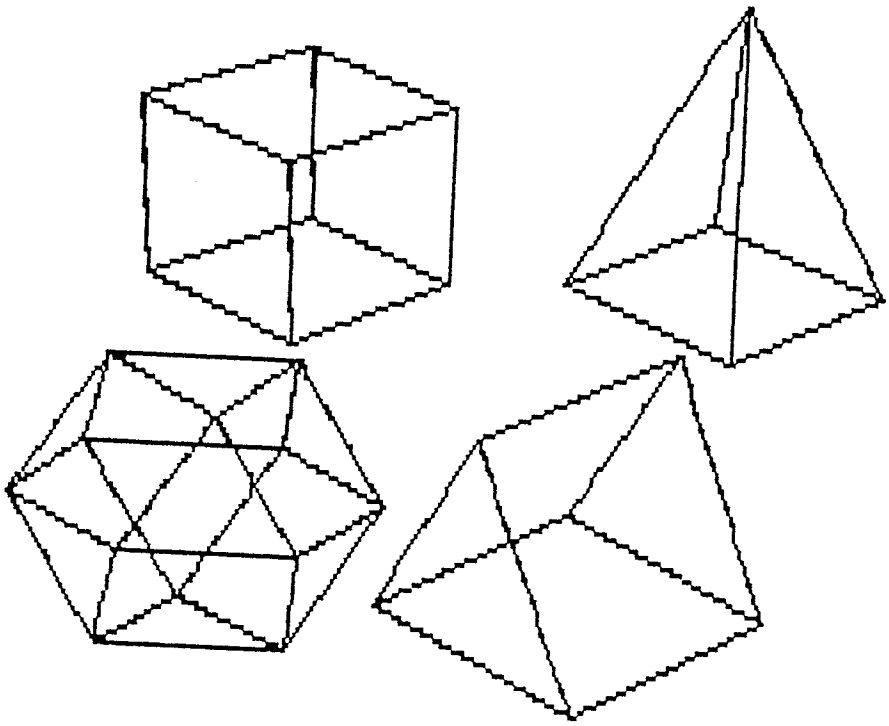


FIGURE 3

PERSPECTIVE DEMONSTRATION

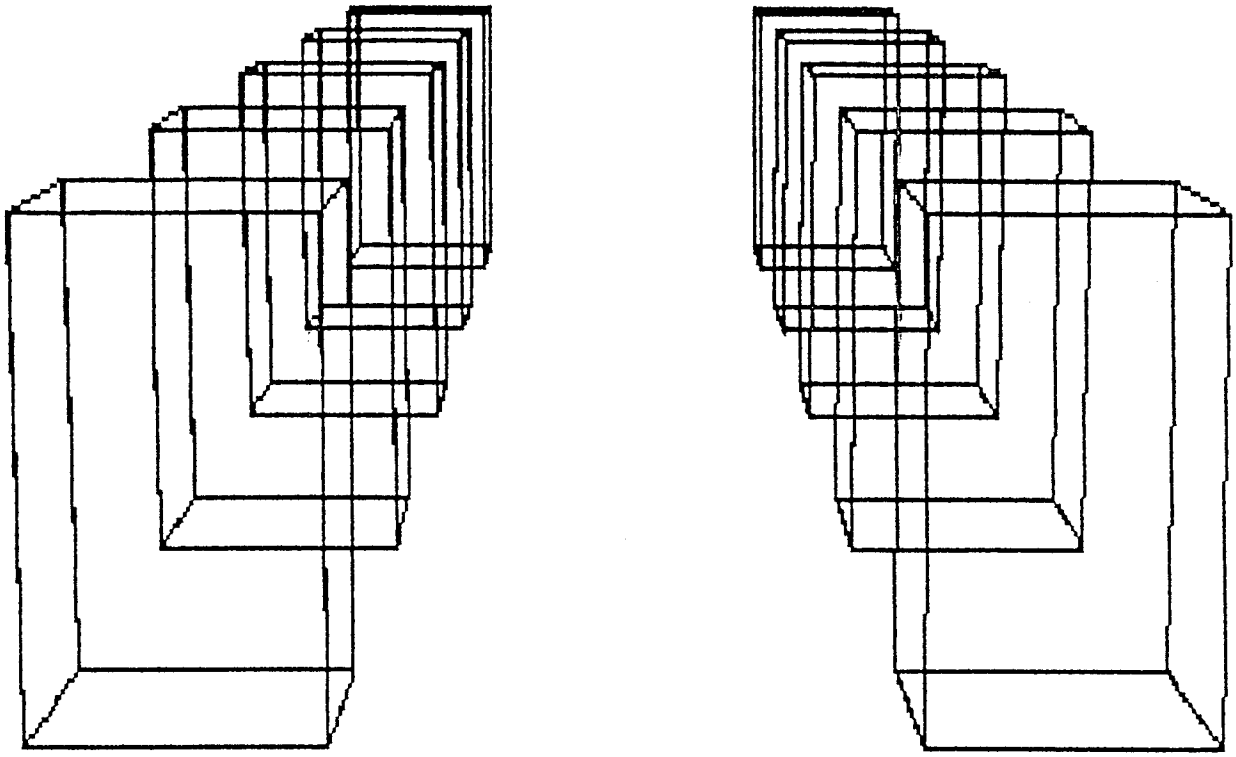


FIGURE 4

HOUSE PLANS

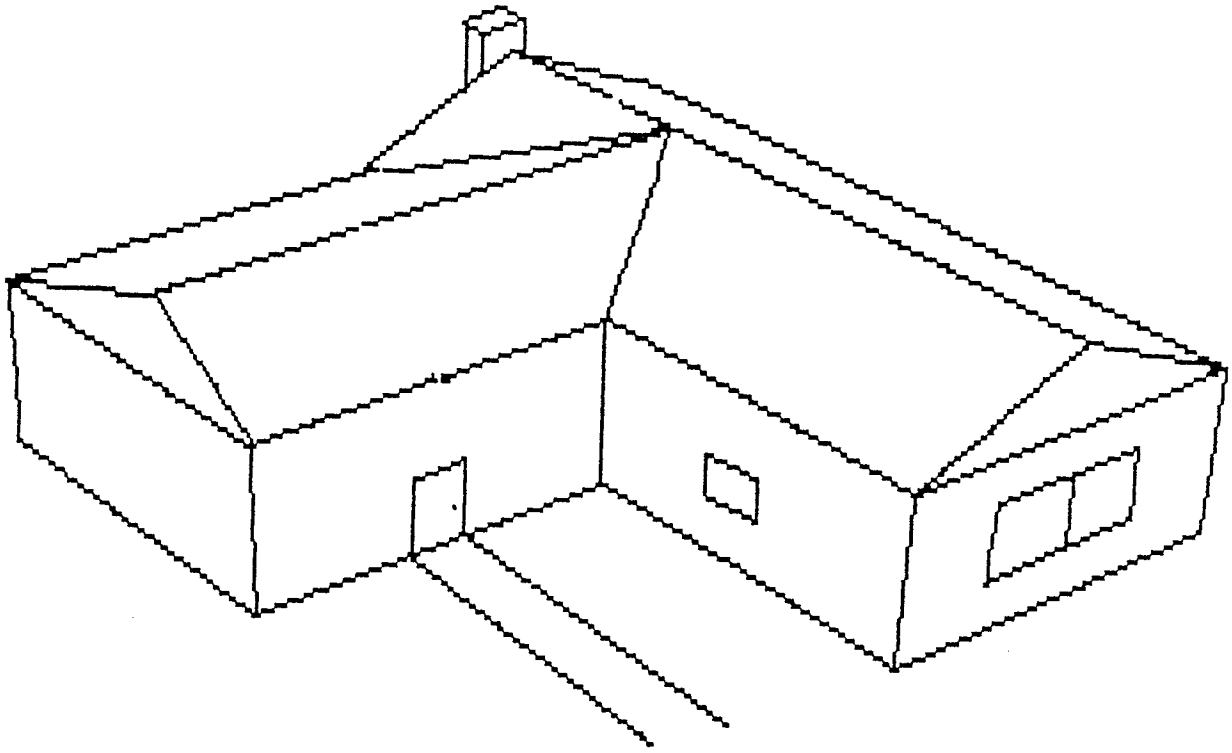
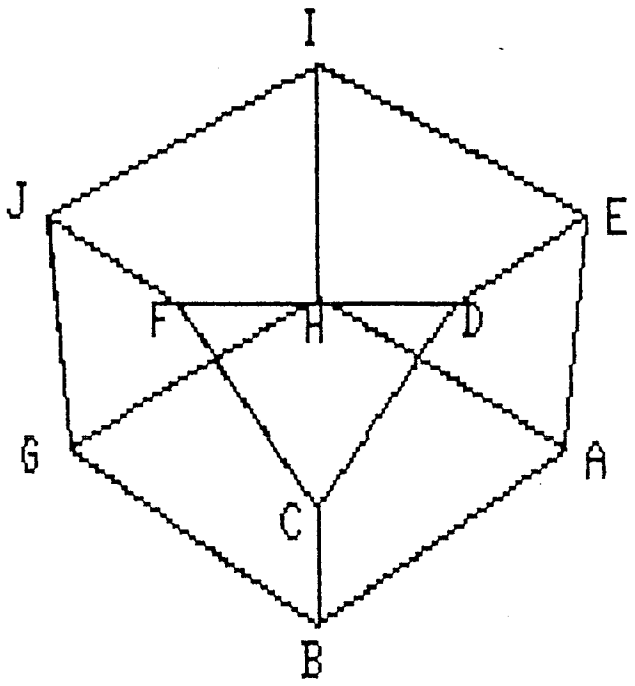


FIGURE 5

APPENDIX A. OBJECT CUBEB AT POSITION (0,0,0)

	X, Y, Z
A	1,-1,-1
B	-1,-1,-1
C	-1,-1, 0
D	0,-1, 0
E	1,-1, 1
F	-1, 0, 1
G	-1, 1,-1
H	1, 1,-1
I	1, 1, 1
J	-1, 1, 1



POLYGON	VERTICES
1	A,B,C,D,E
2	C,F,D
3	B,G,J,F,C
4	F,J,I,E,D
5	A,E,I,H
6	G,H,I,J
7	B,A,H,G

APPENDIX B