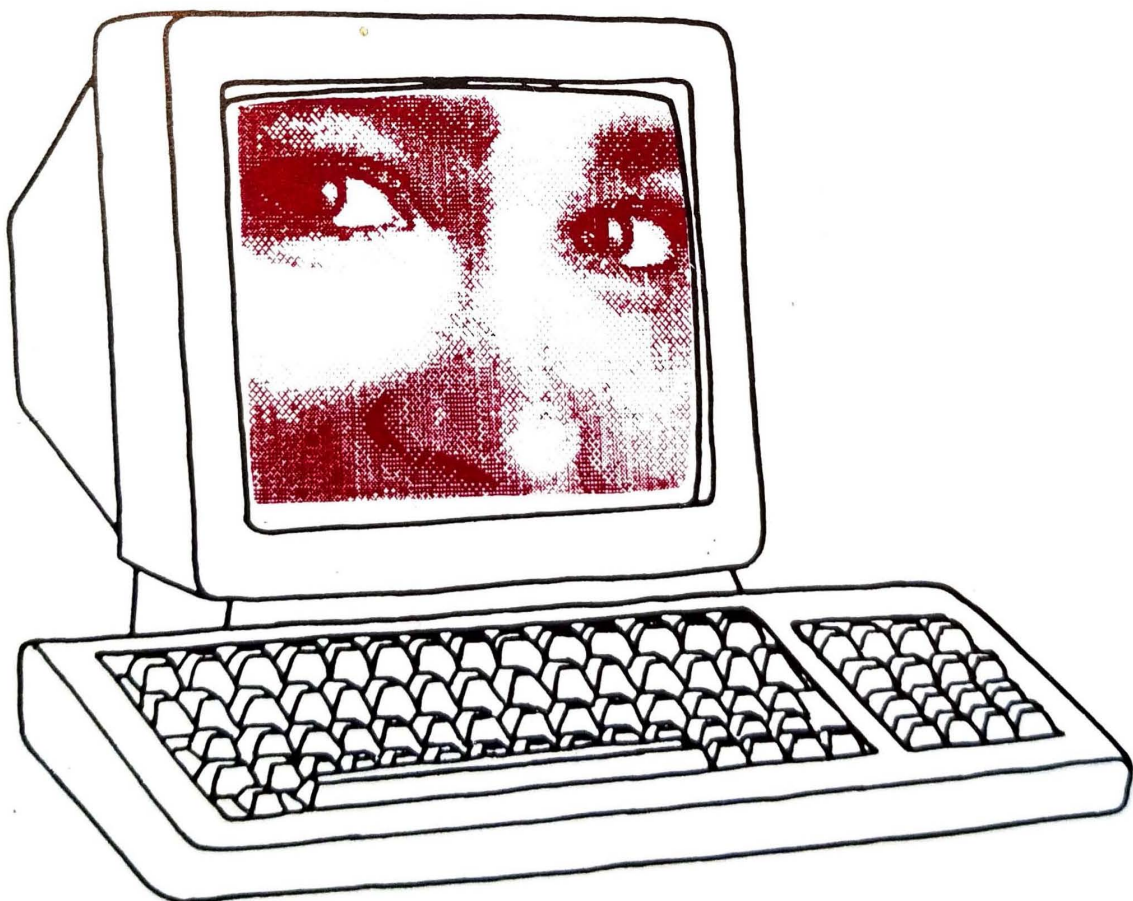


# COMPUTEREYES™

By

|||||DIGITAL VISION|||||

VIDEO ACQUISITION SYSTEM  
FOR  
COMMODORE® COMPUTERS



OWNERS' MANUAL

# COMPUTEREYES OWNERS' MANUAL

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## SECTION 1

# INTRODUCTION

Congratulations on your purchase of the COMPUTEREYES video acquisition system. We are confident that you will find it to be one of the most valuable and useful peripherals ever developed for the Commodore series of personal computers. The ability to inexpensively acquire real-world images from any standard video source opens the door for many new applications for your computer.

This manual contains all the information you should need in order to make full use of the COMPUTEREYES system. The manual covers the installation and operation of the COMPUTEREYES hardware and software, including the COMPUTEREYES Camera System. We suggest that you read the INSTALLATION and GETTING STARTED sections thoroughly before you go too far in order to avoid any possible confusion.

COMPUTEREYES is warranted to be free of manufacturing defects for a period of one year from the date of purchase (ninety days for the camera itself in Camera Systems). Please fill out and return the Owner Registration Form in the rear of this manual. This way, we can keep you informed of updates and enhancements as they become available.

Digital Vision considers you, our customers, to be a valuable resource. We encourage your suggestions and comments concerning any current products or ideas for future ones. Feedback of any type from our customers helps us maintain our high standards of quality and value. Please refer any correspondence to the address on the back cover of this manual.

Thank you for selecting this Digital Vision product. We trust that it will provide you with many years of outstanding service.

## SECTION 2

# INSTALLATION

The installation of COMPUTEREYES is a simple, straightforward procedure that takes only a few moments to perform. Installation consists of two parts: Connecting COMPUTEREYES to the Commodore, and connecting your video source to COMPUTEREYES. The two parts are described separately below.

### CONNECTION TO THE COMMODORE

The COMPUTEREYES module is provided with a 24-pin female edge connector located on the right side of the box (with the knobs facing you). This connector plugs into the Commodore's User I/O port on the rear of your computer. To perform the connection to the Commodore, just follow these easy steps:

1. TURN OFF THE POWER to the Commodore.
2. Locate the Commodore's User I/O connector. Refer to your Commodore's Owners' Manual if you are uncertain as to its location.
3. If anything is currently plugged into the User I/O Connector, unplug it. Unplug by gripping the module at the sides and applying a slight side-to-side rocking motion while pulling gently.
4. Plug the COMPUTEREYES module into the User I/O Port by placing the module connector's slot over the User I/O Port's edge connector and applying a slight side-to-side rocking motion while pushing gently. The COMPUTEREYES label should be facing up, with the knobs facing left (viewed from the keyboard). Make sure that the connector is seated firmly.

## CONNECTION TO THE VIDEO SOURCE

After COMPUTEREYES has been connected to your Commodore's User I/O Port, all that remains is to connect it to your video source. This is done via the standard RCA-type Phono Jack mounted on the rear of the COMPUTEREYES module (now facing to the right). Since COMPUTEREYES is capable of acquiring images from a wide variety of sources, the following paragraphs are guidelines for making this connection.

### COMPUTEREYES Camera System

If you have purchased the COMPUTEREYES Camera System, then you have been supplied with a coaxial cable assembly. On one end of this cable is a BNC-type connector (the larger connector). This end connects to the camera by aligning the two tabs on the camera's connector at its rear with the two slots on the cable's connector, inserting the connector, and twisting clockwise to engage the locking mechanism. The other end of the cable is fitted with a Phono Plug. Connect this to the COMPUTEREYES Module by inserting with a slight twisting motion. Connect the power cord of the camera to any standard AC outlet.

### Video Tape Recorders / Video Disk Players

These types of equipment are universally fitted with Video Output connectors of some type. By far, the most common connector is a Phono Jack labelled "Video Out". What you need is a coaxial cable between your recorder/player's Video Output connector and the COMPUTEREYES input connector. In most cases, this is just a Phono-Plug-to-Phono-Plug cable, the same type used to make most stereo system connections. If your equipment was not provided with such a cable, or you don't have one in your collection, they are readily available at any stereo or radio supply store. Insert at both ends with a slight twisting motion.

### Video Cameras for Video Tape Recorders

Video cameras that were purchased to operate with Video Tape Recorders usually have special cables that connect them to the recorder, since they often have power, audio, and remote control signals along with the video signal. The easiest way to interface to this type of camera is to connect it to the recorder as usual, and connect the recorder to COMPUTEREYES as discussed in the paragraph above. Alternatively, an adaptor for your particular camera can be purchased where you bought the camera if the recorder must not be present. This adaptor supplies power to the camera and makes the audio and video signals available on connectors. These are usually Phono Jacks, so that you can cable from the adaptor to COMPUTEREYES with a Phono-Plug-to-Phono-Plug cable, as in the paragraph above.

## Other Video Cameras

Other types of video cameras, such as surveillance cameras, can be used as long as they put out standard composite video (that is, the same as Video Tape Players, Videodisks, etc.), or standard industrial (non-interlaced) video. Many cameras have BNC-type output connectors, the type used in the COMPUTEREYES Camera System. For these cameras, a 10-foot cable can be ordered from Digital Vision directly for \$30.00 plus \$2.00 shipping and handling. Other lengths (up to 100 feet) can be special-ordered for an additional \$.50 per foot. For other cameras, special cables may have to be assembled or purchased if the output connector is not standard. Ask about it where you bought your camera.

## SECTION 3

# GETTING STARTED

The purpose of this section is to acquaint you with the operation of COMPUTEREYES and to verify that the system is performing properly. If you have not already installed your COMPUTEREYES system by this point, refer to the INSTALLATION section and do it now.

The System Software disk included with COMPUTEREYES is a standard DOS disk with no form of copy protection. This is to allow you to easily make back-up copies of the software for your own use, and to more readily build your own software around that provided, if you are so inclined. **BACK UP THE SYSTEM SOFTWARE DISK NOW!** Any one of the many available disk back-up utilities will work. We highly recommend copying the System Software disk and then storing it in a safe place, while using the copy (call it the "working copy") when working with COMPUTEREYES.

Before proceeding, make sure that the COMPUTEREYES module is connected to the Commodore's User I/O Port correctly, that you have cabled your video source to COMPUTEREYES, and that your System Software disk is backed up. Now turn on the Commodore in the usual sequence (normally turn on monitor and disk drive, turn on Commodore, and insert working copy of System Software). (Commodore 128 owners: your computer must be in "64" mode.) Then enter the following commands:

```
LOAD "XEC",8  
RUN
```

The disk will spin for a few seconds and then the Commodore will present you with a menu of actions from which you can select. This is the Main Menu of the COMPUTEREYES Executive program (called "XEC").

XEC is a friendly user-oriented program written in BASIC that lets you access all of the capabilities of COMPUTEREYES. It is able to acquire high-contrast and grey-scale images, view the last-acquired image, save images to and retrieve them from disk in both packed and unpacked formats, catalog the disk, etc. It has on-line Help available so that you don't have to keep referencing this manual. XEC is discussed in greater detail in its own section. Right now, you want to see that first image, so this discussion will proceed with that goal in mind.

There are two knobs on the COMPUTEREYES module, labelled "Sync" and "Brightness". Rotate both knobs to approximately the center of their travel. First, you must synchronize the system to your video source (there is indeed a difference among "standard" video signal sources). To do this, select ADJUST SYNC from the XEC Main Menu by typing "A" (a carriage return is not required here). The menu is augmented by a short set of instructions plus a line at the bottom of the screen that indicates which way to turn the "Sync" knob. Adjust the knob in the indicated direction (left means counter-clockwise) until the words "IN SYNC" appear at the bottom. Experiment with this to get the feel. It is a very simple process and is the same as adjusting the horizontal and vertical sync controls on a TV set (it has undoubtedly taken you longer to read this than to perform the adjustment). Once the Sync control has been set for a given video source, it shouldn't have to be adjusted again, although it pays to check it periodically. If you are having trouble getting the system to synchronize, the problem is probably quite simple, but you should turn now to the IN CASE OF DIFFICULTY section before proceeding.

Once the system is in sync, you can press any key to return to the Main Menu. The next step is to adjust the brightness setting by first selecting the BRIGHTNESS command (type "B") and then adjusting the Brightness knob. The XEC begins performing continuous image scans, about one every six seconds, to allow you to set an appropriate brightness level. To adjust the brightness, turn the knob clockwise to make the image brighter or counter-clockwise to make it darker. Don't be alarmed if the image appears a bit distorted during these continuous scans; this is caused by a Commodore quirk and will not show up in the final image. Once you are satisfied with the brightness level, press any key to return to the Main Menu.

At this point, you are ready to acquire your first image. Do it now by typing "N" to select NORMAL CAPTURE from the menu. Then, for the next six seconds or so, the Commodore's screen will go blank while the image is being captured, and the image will suddenly appear when the scan is completed. Once the image has formed, you can view it for as long as you like. Then, to return to the Main Menu, press any key. Try performing more NORMAL CAPTUREs, fine-tuning the brightness to get the most pleasing result.

If you are having difficulty obtaining an image, you can refer to the IN CASE OF DIFFICULTY section to determine the cause. The problem is again probably quite simple, so a few likely causes are listed here:

1. Image quite out of focus (if using a camera).
2. Image not stationary—don't forget, the subject must be relatively stationary during the six-second scan.

Helpful Hint: The video source you are using provides a video signal that is the same type as that put out by the Commodore itself on its five-pin audio/video DIN connector to your monitor (assuming you are using a monitor and not a television receiver through the Commodore's RF output). This means that you can plug your video source directly into the monitor and view the image there! Try it. This often reveals the cause of faulty images.

## SECTION 4

**THE COMPUTEREYES EXECUTIVE**

The COMPUTEREYES Executive (XEC) is a friendly menu-driven program that allows you to acquire images, view them, and save them to disk. It is all you really need in order to take full advantage of the system. Thus, even if you have no programming experience whatsoever, COMPUTEREYES is ready to be used as soon as it's unpacked and installed.

It is assumed here that you have already performed the COMPUTEREYES installation; if not, you must do so before you can use XEC to any advantage. (Commodore 128 owners—make sure that your computer is in "64" mode.) To use XEC, insert a *working copy* of the System Software disk in your disk drive and type the following commands:

**LOAD "XEC",8  
RUN**

After a few seconds, you will be presented with the XEC Main Menu, which looks like this:

**COMPUTEREYES (TM) EXECUTIVE**

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**SELECT FROM MAIN MENU:**

<b>HELP</b>	<b>VIEW CURRENT IMAGE</b>
<b>ADJUST SYNC</b>	<b>SAVE TO DISK</b>
<b>BRIGHTNESS</b>	<b>LOAD FROM DISK</b>
<b>NORMAL CAPTURE</b>	<b>CATALOG</b>
<b>4-LEVEL CAPTURE</b>	<b>EXIT</b>
<b>8-LEVEL CAPTURE</b>	

**SELECTION: \_\_\_**

To make a selection from the XEC Main Menu, just type the first letter of the function you wish to select (it is displayed in inverse on the screen). A carriage return (RETURN key) is not required here. The following sections explain the operation of each of the functions available from the Main Menu.

## HELP

The HELP function provides you with on-line assistance for each of the functions available from the Main Menu. When you select HELP, you are presented with another menu, from which you select the function with which you need assistance. The Help Menu looks like this:

### COMPUTEREYES ON-LINE ASSISTANCE

#### SELECT FROM HELP MENU:

<b>HELP</b>	<b>VIEW CURRENT IMAGE</b>
<b>ADJUST SYNC</b>	<b>SAVE TO DISK</b>
<b>BRIGHTNESS</b>	<b>LOAD FROM DISK</b>
<b>NORMAL CAPTURE</b>	<b>CATALOG</b>
<b>4-LEVEL CAPTURE</b>	<b>EXIT</b>
<b>8-LEVEL CAPTURE</b>	

(RETURN FOR MAIN MENU)

SELECTION: \_\_\_

To select a HELP item, just type the letter of the function of your choice (again, no RETURN required). You will be presented with a screen of information concerning the function. Once you have finished examining the information, press any key to return to the Help Menu. To get back to the Main Menu, type RETURN (or any other key that's not a valid HELP item). In general, the assistance available on-line is a compact outline form of the information in this manual; refer to the following sections for more detail.

## ADJUST SYNC

Before an image can be acquired, COMPUTEREYES must be synchronized with the signal from the video source you are using. This is the same as adjusting, for example, the Vertical Sync control on a TV set if the picture begins to roll, and is necessary because of differences between "standard" video signals. After you select ADJUST SYNC, the menu is augmented by a short set of instructions plus a line at the bottom of the screen that indicates which way

to turn the "Sync" knob. Adjust the knob in the indicated direction (left means counter-clockwise) until the words "IN SYNC" appear at the bottom. Experiment with this to get the feel. Once the Sync control has been set for a given video source, it shouldn't have to be adjusted again, although it pays to check it periodically. In actuality, a Machine Language program is running, continuously monitoring the signals from COMPUTEREYES and displaying the line of text. The program also monitors the Commodore keyboard, and when you press a key you are returned to the XEC Main Menu.

## BRIGHTNESS

The BRIGHTNESS command allows you to adjust the brightness setting on the COMPUTEREYES module prior to performing an actual image acquisition. XEC enters a mode wherein continuous scans are performed, allowing you to perform adjustments to the COMPUTEREYES Brightness control to attain an optimal overall brightness setting. To adjust the Brightness control, rotate the knob clockwise to get a brighter image or counter-clockwise for a darker image. You can also use this mode to help you set camera aim and focus. The image that you see may have a certain amount of distortion while using the BRIGHTNESS command. This is caused by the Commodore's screen display circuitry disrupting the microprocessor timing; when you capture an actual image (see below), this circuitry is disabled and the distortion disappears.

If the image you are about to acquire is the normal (high-contrast) type, adjust the brightness so that the image appears with the amount of brightness that you desire. IMPORTANT: If the image is to be one of the grey-scale types, adjust the brightness so that only the very brightest portion of the image appears white. Experimenting with brightness levels will give you the feel for determining where the control should be set.

## NORMAL CAPTURE

Selecting NORMAL CAPTURE immediately causes a normal (high-contrast) image to be acquired into the Commodore's High-Resolution Graphics memory. During the scan, which takes about six seconds, the Commodore's graphics are disabled so that its screen display hardware doesn't interfere with the microprocessor timing, causing image distortion. When the scan is complete, the image will be displayed for you to view. Press any key to return to the Main Menu. In many cases, you will want to take a few scans before you get an image to your satisfaction. Pressing a key any time while the scan is being executed aborts the scan and returns you to the Main Menu. The scan itself is performed by a Machine Language program that rapidly converts the signals coming from COMPUTEREYES into the image data that you see.

## 4-LEVEL CAPTURE

The 4-LEVEL CAPTURE function operates in a manner similar to the NORMAL CAPTURE function, except that an image containing synthesized grey levels is formed. This image is actually generated from four high-contrast images taken at different thresholds (like different exposures or f-stops with a camera). The images are merged together as they are acquired with different "masks" (or number of pixels, or dots, lit) corresponding to different grey levels. When the four scans are complete, you then see the final result, which you can view until you press a key, returning you to the Main Menu. Since the 4-LEVEL CAPTURE function takes about 25 seconds, it often makes sense to do a high-contrast scan first to make sure that you're getting a good image, although you can press a key at any time to abort the acquisition. Usually, the best results are obtained by setting the Brightness control such that the scan shows just the brightest part of the image (only a very small amount of white showing).

## 8-LEVEL CAPTURE

The 8-LEVEL CAPTURE function operates in a manner similar to the 4-LEVEL CAPTURE function, except that an image containing eight synthesized grey levels is formed. This mode takes about 50 seconds to execute. The effect is to yield an image with smoother grey levels, at the sacrifice of acquisition time.

## VIEW CURRENT IMAGE

This function is fairly self-explanatory. It allows you to quickly view the last image that you acquired (or loaded from disk—see below). When you select it, you are immediately presented with a display of the current image. Press any key to return to the Main Menu. If no image has been acquired or loaded, you are likely to see an incomprehensible pattern displayed. Just press a key to get to the Main Menu.

## SAVE TO DISK

The SAVE TO DISK function allows you to store images that you have acquired using COMPUTEREYES as binary files on floppy disk. These files may then be recalled for viewing at a later date (see LOAD FROM DISK below) or used by other programs for further processing, printing, etc. You have the option of saving the images in either of two formats:

**UNPACKED**—This is the standard Commodore bit-mapped image format. The entire 8 kilobyte bit-mapped graphics area is stored as a binary file, occupying exactly 32 disk blocks. This is the format that most other image handling programs will accept.

**PACKED**—Before the image is saved to disk, a special packing routine is used to encode the image such that it occupies less space on the disk. This means that many more images can be stored on each disk, and they will also be saved and loaded much more rapidly. The amount of space saved depends on the image itself: normal (high-contrast) images typically have large areas of all white and all black, and these images often take as few as 4 to 6 blocks each. Grey-scale images have more complex patterns and require more space; a typical image fills around 18 blocks. Images stored using the packed format may, of course, be retrieved under XEC using the LOAD FROM DISK function.

When you select the SAVE TO DISK function, you are first asked which packing format you want to use, like this:

**UNPACKED -OR- PACKED :** \_\_\_

You respond by typing "U" or "P" (any other key returns you to the Main Menu). Then you are asked for the name of the file to be saved:

**FILE NAME:** \_\_\_

If you just type RETURN (null file name), you will be returned to the Main Menu. If you want to use the name of a file already on the disk and you're not sure of its name, type "?" to get a catalog of the disk (see CATALOG below). Unpacked images are stored using the name exactly as you enter it. Packed images are stored with the prefix "PAC.". For example, if OLDPIC were stored as a packed image, it would appear in the Catalog as "PAC.OLDPIC". You are reminded of this when you enter the file name:

**FILE NAME: PAC.**\_\_\_

XEC then proceeds to write the image on the disk. If something goes wrong, e.g. the disk is full or you attempt to save onto a write-protected disk, an appropriate error message is displayed and you are returned to the Main Menu.

## LOAD FROM DISK

The LOAD FROM DISK function is the opposite of SAVE TO DISK. It allows you to retrieve images saved previously for you to view. It also allows you to load images generated by other programs. A good use for this would be to pack some of the images in your collection, which you can do by first loading them unpacked, and then saving them using the packed format. Using the LOAD FROM DISK function takes exactly the same short steps as using the SAVE TO DISK function, namely that you are asked to specify the packing mode and file name for the image you want loaded. Refer to the SAVE TO DISK description



above. Using the "?" feature to obtain a catalog can be very useful here. Once the image has been loaded, it is displayed for you to view. Typing any key returns you to the Main Menu.

## CATALOG

The CATALOG function allows you to obtain a catalog (directory) listing for the disk drive. The catalog is displayed for you to view, and then you can type any key to return to the Main Menu.

## EXIT

The EXIT function is simply the means by which you leave XEC and return to BASIC. You are given a message to the effect that if you want to re-enter XEC, you may merely type "RUN".

## SECTION 5

# OPERATING COMPUTEREYES FROM USER PROGRAMS

In addition to acquiring images using the COMPUTEREYES Executive detailed in the previous section, the system can be used quite easily from within your own application programs. To do this, you need only to load a single binary file (called CEDRIVER) before running the body of your program. This file contains the Machine Language software required to interface to the COMPUTEREYES module (it's a "driver"). This software can then be called by your application program to acquire high-contrast and grey-scale images, to perform sync and brightness adjustments, and to pack and unpack bit-mapped graphics images for disk storage.

The COMPUTEREYES Machine Language routines can be called from nearly any other language available for the Commodore. The following paragraphs describe how to call these routines from both BASIC and from Assembly Language. Although the scope of this manual does not provide for detailing the calling procedures used in other languages, you should be able to accomplish this using the information supplied here.

In the following paragraphs, hexadecimal numbers and addresses are represented with a "\$" prefix, conforming with Commodore's convention. Decimal numbers are represented without a prefix. In many instances, both the decimal and hexadecimal equivalents are given for the sake of convenience.

## LOADING THE COMPUTEREYES DRIVER

Before using the COMPUTEREYES system, the Machine Language driver file "CEDRIVER" must be loaded into Commodore memory. From BASIC, this can be done using the following statements:

```
100 IF PEEK (49152) = 76 THEN 120
110 LOAD "CEDRIVER",8,1
120 ...
```

CEDRIVER is loaded into about 1.5 kilobytes of memory starting at location 49152 (\$C000). At this location, CEDRIVER is hidden from BASIC, and no steps

to protect the code are required. Line 100 is required since BASIC restarts itself after a LOAD; the "76" is the value of the first byte of CEDRIVER.

Naturally, CEDRIVER must be on the disk that you're using for your software. It can be transferred from the COMPUTEREYES System Software disk using a program supplied on the System Software disk called "BIN XFER". To transfer the file, insert the System Software disk and type:

```
LOAD "BIN XFER",8
RUN
```

The program will ask you for the name of the file to be transferred, and you respond with "CEDRIVER<RETURN>". It will read the file, and you will then be prompted to insert your application disk (which must have been previously formatted) and to press <RETURN>. The transfer will take place and the program will end. Note that BIN XFER can be used to transfer other binary ("Program") files as well, except for actual BASIC programs, which can be transferred much more readily using the standard LOAD and SAVE commands.

## CALLING THE DRIVER ROUTINES

CEDRIVER contains ten Machine Language routines that control the operation of the COMPUTEREYES module. They are Normal Scan, Four-Level Scan, Eight-Level Scan, Pre-set Threshold Scan, Sync, Brightness, Pack and Unpack, Color Initialization, and Save to Disk. Each of the routines can be called from BASIC using the standard BASIC SYS statement, or from Assembler using the Jump to SubRoutine (JSR) instruction. In either case, when the CEDRIVER routine finishes, it returns to execute the next instruction in the application program. The routines are described individually below.

### Normal Scan

The Normal Scan routine is called as follows:

```
BASIC:      200 SYS 49152
Assembler:  JSR $C000
```

This routine performs a single COMPUTEREYES scan using the maximum video threshold value. The image ends up in the standard bit-mapped graphics page—locations 8192 (\$2000) through 16191 (\$3F3F). The Commodore's keyboard is monitored so that, if a keypress is detected, the scan is aborted. Note that the routine turns off the Commodore's bit-mapped graphics to prevent the VIC chip from disrupting the processor timing, resulting in distorted

images. At the end of the scan, the graphics are re-enabled, allowing the image to be viewed. To disable the bit-mapped graphics and re-enable normal text display, you must clear bits in two memory locations:

```
BASIC:      300 POKE 53272, PEEK(53272) AND 247
              :POKE 53265, PEEK(53265) AND 223

Assembler:  LDA $D018
              AND #$F7
              STA $D018
              LDA $D011
              AND #$DF
              STA $D011
```

Incidentally, any time you want to turn on the bit-mapped graphics from within a program, you just set the corresponding bits:

```
BASIC:      400 POKE 53272, PEEK(53272) OR 8
              :POKE 53265, PEEK(53265) OR 32

Assembler:  LDA $D018
              ORA #$08
              STA $D018
              LDA $D011
              ORA #$20
              STA $D011
```

### Four-level Scan

The four-level grey-scale scan routine is called as follows:

```
BASIC:      200 SYS 49155
Assembler:  JSR $C003
```

This routine performs four COMPUTEREYES scans using four different video threshold values. The image ends up in locations 8192 (\$2000) through 16191 (\$3F3F), although locations 16384 (\$4000) through 24383 (\$5F3F) are used to store the intermediate scans. The routine merges each new image with the composite image between each scan. All other considerations are the same as for the Normal Scan described above.

### Eight-level Scan

The eight-level grey-scale scan routine is called as follows:

BASIC: **200 SYS 49167**

Assembler: **JSR \$C00F**

This routine performs eight COMPUTEREYES scans using eight different video threshold values. The image ends up in locations 8192 (\$2000) through 16191 (\$3F3F), although locations 16384 (\$4000) through 24383 (\$5F3F) are used to store the intermediate scans. The routine merges each new image with the composite image between each scan. All other considerations are the same as for the Normal Scan described above.

### Pre-set Threshold Scan

The pre-set threshold scan routine can be used to cause a single scan to occur at any one of the eight possible threshold level settings. Before calling the routine, a memory location must be set to the threshold value (allowable values are 0 through 7). The routine is called as follows:

BASIC: **200 POKE 53232,3 : SYS 49170**

Assembler: **LDA #\$03  
STA \$CFF0  
JSR \$C00F**

All other considerations are the same as for the Normal Scan described above.

### Sync

The Sync routine is provided to assist the user in adjusting the COMPUTEREYES modules's Sync Control. It can be called as follows:

BASIC: **150 SYS 49158**

Assembler: **JSR \$C006**

This routine continuously displays a message on the bottom line of the Commodore's Text Screen indicating to the user which direction to adjust the Sync Control, displaying an "IN SYNC" message when that condition exists. It returns to the calling program when a keypress is detected on the Commodore's keyboard.

### Brightness

The brightness routine allows the user to interactively adjust the brightness level control on the COMPUTEREYES module and make other adjustments that affect the image before doing an actual acquisition, during which the Commodore's screen is blanked. This is accomplished by performing continuous image scans with the video threshold set at 7, the maximum value. The routine monitors the Commodore's keyboard and returns to the calling program when a keypress is detected. It can be called as follows:

BASIC: **270 SYS 49182**

Assembler: **JSR \$C01E**

### Pack

The Packing routine creates an encoded version of the image in the graphics memory in preparation for storage on disk. Calling PACK results in the smaller encoded image stored starting at location 16384 (\$4000) and extending a length whose value is stored in coded form in Zero Page locations 253 and 254.

To use PACK, first call it and then calculate the length of the packed version of the image. This length can then be used in storing the image on disk. The following example illustrates the technique:

BASIC: **300 SYS 49173  
310 L = PEEK (253) + 1 +  
256 \* (PEEK (254) - 64)  
320 . . . : REM SAVE - SEE BELOW**

Assembler: **N/A**

### Unpack

The UNPACK routine can be used to restore an image saved on disk in the packed format using the PACK routine above. No calculations need be done. To use UNPACK, first load the packed image from the disk, starting at location 16384 (\$4000). Then simply call UNPACK. Note that UNPACK does not itself turn on the Commodore's bit-mapped graphics. The following example illustrates the technique:

BASIC: **400 LOAD "PAC.PICTURE",8,1  
410 SYS 49176**

Assembler: **N/A**

**Color Initialization**

The color initialization routine is a utility which presets the Commodore's bit-mapped graphics memory so that it displays white dots on a black background. It is called automatically by the image acquisition routines, but is included here as a separate routine for applications where you might want to display the current image in graphics memory (see Section 5.2.1 above). The routine is called as follows:

BASIC:       **600 SYS 49164**

Assembler:   **JSR \$C00C**

**Save Utility**

The save utility is a routine which allows any portion of the Commodore's memory to be saved to disk as a standard binary ("Program") file. First, a Program-type file must be opened for writing in the usual way. Then, two pairs of memory locations must be loaded with the starting address and length of the area of memory to be saved. These pairs are set up in the standard Commodore low-byte, high-byte 16-bit address format. Then the save utility is called, which causes the write to disk to occur. Finally, the channel should be closed. The following is an example of how the save utility is used:

BASIC:       **700 FS = "PICTURE"**  
               **710 OPEN 15,8,15,"@0:" + FS + ",P,W"**  
               **720 POKE 251,0 : POKE 252,32**  
               **:REM START ADDRESS = 8192**  
               **730 POKE 253,64 : POKE 254,31**  
               **:REM LENGTH = 8000 BYTES**  
               **740 SYS 49179 : REM SAVE TO DISK**  
               **750 CLOSE 15**

Assembler:   **N/A**

**MEMORY CONSIDERATIONS**

Some care should be taken when planning your application so that memory conflicts do not arise. The following areas should be considered:

**Graphics Memory**

The Commodore's Page 1 bit-mapped graphics memory—locations 8192 (\$2000) through 16191 (\$3F3F)—must be reserved, since images are always loaded there.

Page 2 graphics memory—locations 16384 (\$4000) through 24383 (\$5F3F)—must also be reserved if you plan to either acquire grey-scale images or use the packing routines.

**VARTAB**

If your BASIC program is small, you can leave VARTAB in its normal place (just above the program itself) and let variables build from there to below Page 1 graphics memory. If it is large (up to six kilobytes), VARTAB should be set to above the graphics memory that you're using. For example:

**120 POKE 45,0 : POKE 46,64**  
**: REM VARTAB = 16384 IF PAGE 2 IS**  
**UNUSED**

**120 POKE 45,0 : POKE 46,128**  
**: REM VARTAB = 32768 IF PAGE 2 IS USED**

**FRETOP**

FRETOP can be left at its normal default value, since the COMPUTEREYES driver is located in memory above location 49152 (\$C000) where it is unaffected by BASIC string variables.

**CUSTOMIZATION**

The software provided with the COMPUTEREYES system, combined with the documentation in this section, is intended to be sufficient to support the vast majority of application development efforts. The Machine Language routines that make up the CEDRIVER file are fairly complex and involve critical timing loops. However, if your application requires special features not included with the system and you are an accomplished Assembly Language programmer, commented source files and assembly listings may be ordered from Digital Vision at a cost of \$40.00. Please send your order to the address on the back cover of this manual.

## SECTION 6

## THEORY OF OPERATION

The purpose of this section is to acquaint the user with the principles behind the operation of COMPUTEREYES. Although gate-level and line-of-code-level analyses are beyond the scope of this document, the material included here is necessarily somewhat technical. Readers not familiar with the nature of video signals will have difficulty understanding the information presented. It is important to note that it is not necessary to understand any of the information provided here in order to fully utilize the system. Also note that some of the numerical information supplied here pertains to the NTSC video standard; the PAL version of COMPUTEREYES operates similarly but with somewhat different timing.

## GENERAL OPERATION

COMPUTEREYES is a system consisting of a carefully planned combination of hardware and software; neither has any worth without the other. The system performs a slow scan on the video signal present at the COMPUTEREYES module's input connector. During every vertical scan period, the system takes in 200 samples, or one for each of the Commodore's bit-mapped graphics rows. Thus, one column of pixels are stored every vertical scan, or 16.6 milliseconds. The point in time during each horizontal scan period that the samples are taken is delayed from the horizontal sync by an amount that is very slowly increased as the COMPUTEREYES scan progresses. The result is that successive columns of pixels are acquired, beginning with a short delay from the horizontal sync (left side of image) to a long delay (right side). Since 320 columns must be acquired, a complete COMPUTEREYES scan requires 320 x 16.6 milliseconds, or a little under six seconds.

The video information is thresholded against a level determined by the Brightness control and by signals from the Commodore. For a normal (high-contrast) acquisition, just one threshold level is used. For a grey-scale scan, the system automatically steps through four or eight levels and does four or eight complete scans. The data from each scan is combined with data from previous ones after each scan by software that decides whether a pixel should be lit based on what grey level (brightness) is being processed.

## COMPUTEREYES HARDWARE

The COMPUTEREYES module is a plug-in unit that connects to the Commodore via the Commodore's User I/O connector. Software running in the Commodore (see below) controls the acquisition of an image in the following manner. A signal is sent to initiate a COMPUTEREYES scan. The hardware then produces a delay from each horizontal sync pulse that increases slowly during the six-second scan. At the end of the delay, the level of the video signal is sampled. The sampled video and the composite sync signals are sent back to the Commodore. It is the software's task to detect the sync and place the sampled video in the appropriate pixel position in the Commodore's bit-mapped graphics memory.

The Commodore also sends three signals to the COMPUTEREYES module to determine the video threshold level. These signals are digital-to-analog converted, combined with the level from the Brightness control, and applied to one input of a high-speed analog comparator. The other input is the video signal. The comparator's output is sampled by the delayed horizontal sync pulse.

An analog comparator is also used to threshold the video at a lower level to provide the composite sync signal. This level is determined by the setting of the Sync control. Anti-drift circuitry is included to assure that the sync level doesn't change with varying images.

## COMPUTEREYES SOFTWARE

The heart of the COMPUTEREYES software is a Machine Language program that sets the video threshold level, starts a COMPUTEREYES scan, and then gathers the data transmitted by the COMPUTEREYES module. After a scan is initiated, the program waits a predetermined number of vertical syncs so that the image is centered left-to-right and then acquires data. After each vertical sync, a predetermined number of horizontal syncs are awaited so that the image is centered top-to-bottom. Then, a very tight loop is entered wherein horizontal sync is detected and one video sample is taken in. The appropriate bit in bit-mapped graphics memory is calculated and is set or cleared depending on the value of the sample. This continues for the 200 pixels in each column. The process is repeated for each of the 320 columns.

For grey-scale scans, an outer loop is provided that sequentially sets the video threshold to the four or eight possible values and calls the routine discussed in the paragraph above. After each call, a merge routine is invoked that combines the most recent image with the composite image. This routine applies a mask to the image such that only N pixels out of eight will be lit based on the current threshold setting, where N is the threshold setting. For example, 1 out of 8 pixels will be lit for dark areas, 4 out of 8 for medium-intensity areas, etc.

Images are always acquired directly into Page 1 graphics memory (locations \$2000-\$3F3F). For grey-scale images, the composite image is maintained in Page 2 memory (locations \$4000-\$5F3F). After a grey-scale scan is complete, the composite image is moved back down to Page 1. Thus, the viewable image always ends up in Page 1.

A separate program is also provided to assist in adjusting the Sync control. This is done to avoid the inconvenience of performing multiple scans with an unknown image during initial set-up. The Sync routine is also a Machine Language program that, like the acquisition routine described above, can be called from any user program (see OPERATING COMPUTEREYES FROM USER PROGRAMS). This routine monitors the composite sync signal from the COMPUTEREYES module and continuously checks the vertical and horizontal sync widths for correctness within certain tolerances. It displays, at the bottom of the Commodore's text screen, a message relating which direction the Sync control should be adjusted, or a message indicating that the system is in sync. It also monitors the Commodore's keyboard and returns to its caller if a keypress is detected.

The Packing and Unpacking routines are implementations of data compression and expansion algorithms that operate on bit-mapped graphics memory. The packing routine works by detecting common patterns in an image (such as large areas of white or black) and encoding this information. The unpacking routine performs the inverse algorithm. No data is ever lost in the compression/expansion process.

## SECTION 7

## IN CASE OF DIFFICULTY

If, at any point, you experience difficulty with the operation of any aspect of the COMPUTEREYES system, please refer to this section for help. In most instances, the problem can be identified to have a very simple cause, and can be easily remedied. In fact, the least frequently occurring problem is a defect in the COMPUTEREYES system itself. The trouble-shooting information is presented in an easy-to-follow outline format. To use it, first locate the type of problem you are having by major heading (Roman numerals). Then follow the steps in the subtopics to either resolve or isolate the cause of the problem. In the items below, the term "boot" refers to the process of inserting the System Software disk, typing LOAD "XEC",8 and RUN, and observing that the Executive Main Menu appears on the Commodore's screen.

## I. DISK WON'T BOOT

- A. If other disks boot properly:
  1. If this disk is a copy of the original System Software disk, make another copy and try booting that.
  2. If this disk is a fresh copy, try booting the System Software disk.
  3. If this disk is the System Software disk, the disk has been destroyed. For a replacement, send the original System Software disk plus \$15.00 replacement/handling fee to the address on the back cover of this manual.
  4. If even the replacement System Software disk doesn't boot, it is possible that your disk drive has gone out of alignment. See your Commodore dealer.
- B. If other disks also do not boot, a problem with your Commodore system must be resolved. Look in the following areas:
  1. Disk interface cable connectors not seated properly
  2. Disk drive out of alignment
  3. Disk speed out of adjustment
  4. Defective disk drive

If you have two drives, swap their device assignments (with power off) to isolate the problem.

**II. SYSTEM WON'T SYNC**

- A. COMPUTEREYES module not installed in Commodore User I/O port properly. Check that:
  - 1. Connector is centered
  - 2. Connector is seated firmly and module case is against the back of the computer.
- B. No video source at Video Input connector Check that:
  - 1. Video cable is inserted firmly at both ends.
  - 2. Video source is powered (camera, VCR, etc. plugged in and turned on).
- C. Incompatible video signal—video source does not conform with NTSC, PAL, or industrial standard. Consult manual and/or manufacturer of source.
- D. Possible COMPUTEREYES module failure—see Part VI.

**III. SYSTEM SYNCs BUT NO IMAGE (ALL BLACK)**

- A. Turn Brightness control full clockwise and do a high-contrast scan. If screen is not all white, then possible COMPUTEREYES module failure—see Part VI.
- B. If screen is white, adjust Brightness control counter-clockwise and repeat scans until image appears.
- C. If no image, see Part V.

**IV. SYSTEM SYNCs BUT NO IMAGE (ALL WHITE)**

- A. Turn Brightness control full counter-clockwise and do a high-contrast scan. If screen is not all black, then possible COMPUTEREYES module failure—see Part VI.
- B. If screen is black, adjust Brightness control clockwise and repeat scans until image appears.
- C. If no image, see Part V.

**V. SYSTEM SYNCs, ALL WHITE & ALL BLACK ATTAINABLE, BUT POOR OR NO IMAGE**

- A. Image far too light or too dark.
- B. Image quite out of focus (camera only).
- C. Image is changing too rapidly—the image must be relatively stationary for six seconds (high-contrast) or 25 or 50 seconds (grey-scale).
- D. If at all possible, view the image directly on a monitor, such as the one into which your Commodore is plugged. Many monitors, including the Commodore Color Monitor, have phono jacks for input connectors, the same as on COMPUTEREYES. Plugging the video source into a monitor usually reveals the cause of the problem.
- E. If image looks good on monitor, then possible COMPUTEREYES module failure—see Part VI.

**VI. POSSIBLE COMPUTEREYES MODULE FAILURE**

- A. If none of the remedies described above provides a solution to your problem, it is possible that the COMPUTEREYES module has failed.
- B. Visually examine the COMPUTEREYES module for signs of damage (broken connector pins, etc.)
- C. Write Digital Vision Customer Service at the address on the back cover of this manual or call (617) 444-9040 between the hours of 9:00 and 5:00 PM Eastern Time. A representative will be available to either give you assistance with your problem, or to give you a Return Authorization (RA) number. No goods will be accepted for warranty repair without an RA number assigned. Explain the nature of your problem and any evidence of damage you may have found.
- D. If you are returning your unit for repair, pack it carefully (the original shipping container is excellent for this). Send the package prepaid and insured via UPS or US Mail to Digital Vision Customer Service at the address on the back cover of this manual. Digital Vision will repair or replace the unit and return it prepaid within five working days. For units not under warranty, or where the warranty has been voided, a flat fee of \$30.00 must be paid before the unit can be returned.

## SECTION 8

**WARRANTY INFORMATION**

**Product:** COMPUTEREYES Video Acquisition System

**Type:** Limited Warranty

**Warrantee:** This Digital Vision product warranty extends to the original purchaser.

Warranty coverage & performance: Digital Vision, Inc. warrants this product against defects in material or workmanship as follows:

Parts—New or comparable rebuilt parts in exchange for defective parts one year after original purchase (ninety days for video camera as part of Camera System).

Labor & Service—Carry-in service or delivery of the product prepaid & insured to an authorized Digital Vision service facility or to the factory one year after original purchase (ninety days for video camera as part of Camera System).

We suggest that you retain the dealer's dated bill of sale or Digital Vision invoice as evidence of the date of purchase.

**THIS WARRANTY IS VOID IF THE PRODUCT HAS BEEN DAMAGED BY ACCIDENT OR UNREASONABLE USE, ALTERATION, NEGLIGENCE, IMPROPER SERVICE OR OTHER CAUSES NOT ARISING OUT OF DEFECTS IN MATERIAL OR WORKMANSHIP, OR IF THE SERIAL NUMBER HAS BEEN ALTERED OR DEFACED.**

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