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M. Pistoni and L. Trasatti:
CANDI AS A TEKTRONIX 4006 EMULATOR.

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One of the more relevant problems in the development of a new graphics interactive system is to allow the user to take advantage of the new possibilities offered by the new generation of graphic systems (raster scan technology, multiple memory pages, colors) without destroying the work that has already been done on traditional storage screen devices.

With this in mind, while developing a set of graphics subroutines for the CANDI system (see Ref. 1-11), we used as a guide the well known Tektronix PLOT-10 package, implementing a subset of equivalent routines as primitives of our system.

Furthermore, since a lot of time and effort has been spent in the last few years implementing graphics programs on big machines using quite a few high level graphics packages, we decided to build a program to emulate a popular Tektronix graphics terminal when CANDI acts as a transparent terminal tied to a host computer (typically a PDP-11 or VAX).

The program allows, through a control character which can be sent both by the host and by the keyboard, to enter the "Tektronix emulation mode", where all the commands recognized by a Tektronix 4006 are interpreted and translated to CANDI graphics language (See Ref. 8 for further details).

On top of this, we implemented a series of new commands which allow to take advantage of the additional capabilities of our system. This commands are shown in Tables 1 to 4.

Table 5 shows the color code of the CANDI system.

TABLE 1 SINGLE-CONTROL CHARACTER COMMANDS (FROM KEYBOARD)

Abbr.	ASCII Code		Keyb. Key	CANDI FUNCTION
	Dec.	Hex.		
STX	2	2	CTRL B	ENTER TEK4006 EMULATION MODE
EOT	4	4	CTRL D	EXIT TEK4006 EMULATION MODE
ENG	5	5	CTRL E	CLEAR PAGE INITIALIZE
ACK	6	6	CTRL F	BACKGROUND
DC4	20	14	CTRL T	CLEAR PAGE
ETB	23	17	CTRL W	HARDCOPY

TABLE 2 MULTIPLE-CONTROL CHARACTER COMMANDS (FROM KEYBOARD)

Abbr.	ASCII Code		Keyb. Key	CANDI FUNCTION
	Dec.	Hex.		
SYN	22	16	CTRL V	SET CHARACTER SIZE 1 (min)
	34	22		
SYN	22	16	CTRL V	SET CHARACTER SIZE 2 (med)
	35	23		
SYN (large)	22	16	CTRL V	SET CHARACTER SIZE 3
	36	24		
SYN	22	16	CTRL V	SET CHARACTER SIZE 4 (max)
	37	25		
CAN	24	18	CTRL X	SET COLOR
	n1			
	n2			

TABLE 3 SINGLE-CONTROL CHARACTER COMMANDS (FROM HOST)

Abbr.	ASCII Code		Keyb. Key	CANDI FUNCTION
	Dec.	Hex.		
ACK	6	6	CTRL F	BACKGROUND

TABLE 4: MULTIPLE-CONTROL CHARACTER COMMANDS (FROM HOST)

Abbr.	ASCII Code		Keyb. Key	CANDI FUNCTION	
	Dec.	Hex.			
ESC	27	1B	ESCAPE or CTRL [SET CHARACTER SIZE 1	
	34	22			"
ESC	27	1B	ESCAPE or CTRL [SET CHARACTER SIZE 2	
	35	23			
ESC	27	1B	ESCAPE or CTRL [SET CHARACTER SIZE 3	
	36	24			\$
ESC	27	1B	ESCAPE or CTRL [SET CHARACTER SIZE 4	
	37	25			%
CAN	24	18	CTRL X	SET COLOR SEE NEXT TABLE FOR VALUES OF n1, n2	
	n1				
	n2				

TABLE 5: CANDI COLOR CODES (n2)

ASCII Code	Keyb. Key	CANDI COLOR	
		Dec	Hex
48	0	30	BLACK
49	1	31	BLUE
50	2	32	RED
51	3	33	MAGENTA
52	4	34	GREEN
53	5	35	CYAN
54	6	36	YELLOW
55	7	37	WHITE

TABLE 6: CANDI COLOR ENABLE CODES (n1)

ASCII Code		Keyb. Key	CANDI COLORS	
Dec.	Hex.		DISABLED	ENABLED
48	30	0		ALL
49	31	1	BLUE	RED GREEN
50	32	2	RED	BLUE GREEN
51	33	3	BLUE RED	GREEN
52	34	4	GREEN	BLUE, RED
53	35	5	GREEN BLUE	RED
54	36	6	GREEN RED	BLUE
55	37	7	ALL	

We give now a short description of the new commands.

CTRL B : This command, sent by the keyboard, directs all the following input stream from the host to the Tektronix emulation program. From this moment and until a CTRL D command is recognized, the system acts as a Tektronix 4006 terminal.

CTRL D: Exit Tek 4006 emulation mode. See CTRL B.

CTRL E: Clear page setting white background and black writing color. Set terminal to alpha mode (Tektronix).

CTRL F (from keyboard or from host): Erase and set background using the present writing color (see CTRL X).

CTRL T: Erase without changing neither background color nor writing color.

CTRL W: Make color hardcopy of present display using Integral Data System printer type "PRISM".

CTRL V (followed by " , \$, %): Set hardware character size 1, 2, 3, 4. Size 1 corresponds to the hardware character size of the Tektronix 4006.

CTRL X (from keyboard or from host, followed by two numbers, n1, n2): Set writing color.
n2 = 0 to 7; three bit number to enable (bit = 0) or disable (bit = 1) writing on the three color planes. Least significant bit = blue plane, second bit = red plane, third bit = green plane.
n1 = 0 to 7; three bit number to write (bit = 1) or erase (bit = 0) the enabled color planes. Same bit assignement as n2.

Four new ESCape sequences have been implemented:

ESC followed by " , \$, %. Set character size: same as CTRL V from keyboard.

NEW VERSION OF GD3.

To take advantage of the new capabilities offered by CANDI, a new version of the GD3 library has been implemented on a VAX 11/780. A list of the new features introduced follows:

1. In the standard call CALL TVBGN (<logic unit>, <terminal>) a new terminal type has been added: <terminal> = 9900. If the program is initialized with this value, the host sends a CTRL B at the beginning of the execution and a CTRL D at the end. If, on the contrary, the program is initialized with <terminal> = 4006, the CANDI system must be set to Tektronix emulation mode (CTRL B) from the keyboard. Moreover, for <terminal> = 9900 the addressable range is 1024 x 1024, instead of 1024 x 780, since the CANDI graphics window is a square instead of a rectangle like the Tektronix 4006. Since the CANDI resolution is 512 x 512 pixel, these addressable ranges are converted to a physical range of, respectively, 512 x 512 pixel and 512 x 390 pixel.
2. CALL TVSET (OPT), which was a dummy for Tek 4006, is now implemented for 4 possible hardware character sizes in CANDI. OPT = large, medium, small or minimum. Note that minimum corresponds to the Tektronix size.
3. CALL TVCOLO, which was a dummy for <terminal> = 4006, is now operative and performs the same function as CTRL X with a single parameter (n2).
4. CALL TVBACK is a new subroutine, which performs the same function as CTRL F.
5. CALL TVCOL99 (i1, i2, ..., i6) is a new subroutine which performs the same function as CTRL X; i1 - i3 are the enable bits (i1 is the most significant = green: 0 = enable); i4 - i6 are the write/erase bits (i4 = green: 1 = write).

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