Massachusetts Institute of Technology
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Project MAC

Artificial Intelligence Project
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Television Camera-to-Computer Adapter; PDP-6 Device 770

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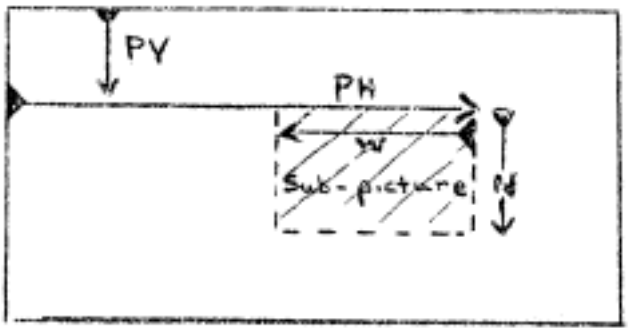
The TVA (Television Adaptor) is a data-input device just completed. Any standard Closed-Circuit Television Camera can be connected to the PDP-6, without modification, by a single BNC connector. Then a simple program can make a digitized image of selected size and position appear in core memory. Operation is automatically controlled by the PDP-6 priority-interrupt system so that, to the programmer, the core-image is automatically read-in and maintained.

This is an open invitation to come in and discuss applications. We are particularly interested in (i) projects leading to a working page-reader system, first for teletype character sets and later to include recognition of larger alphabets and hand-written corrections, and (ii) projects leading to recognition functions that will be useful in coordination with the mechanical hand system.

1. Sub-picutre Selection Control.



All pictures are composed of 36-bit groups of single-level digitized video. The basic function of the device is to read-in to the computer the contents of a 36-bit shift register that is loaded at a certain (programmable) rate from the video signal for each horizontal line.

The dimensions of a core-image picture are controlled by 5 program parameters:

PV = Vertical location of top of sub-picture

PH = Horizontal location of right-hand side of picture

W = Picture width. (4 spacings of 36 bits, in powers of 2)

N = Number of horizontal lines in picture. (i.e., vertical height of sub-picture)

Z = digitizing threshold--absolute brightness level.

Remarks.

1. The device ignores horizontal interlace. Therefore one has in effect a 256 line picture. The maximum sampling rate is about 4 mc/sec so that the effective horizontal resolution is about the same order.

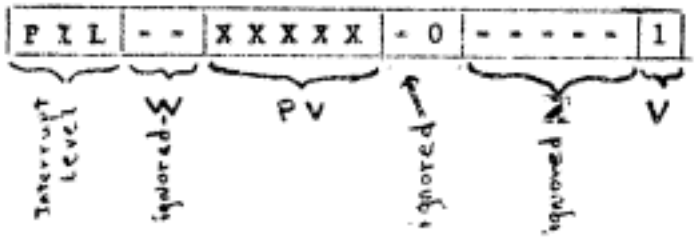
2. The present MAC TV camera, a Packard-Bell instrument, has a great deal of internal AGC for the video signal, hence the exact role of the Z parameter depends to an extent on picture context. If this becomes a nuisance, we will try to eliminate this effect.

Picture selection is done in two phases.

A. Vertical select.

A CONO 770 instruction sets the device to wait until the camera scan passes through vertical location PV and then causes a priority interrupt. This is done by executing the instruction CONO 770

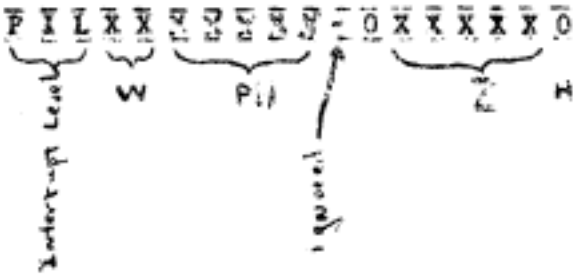
with control bits



This will cause an interrupt on channel PIL when vertical position PV is reached. The parameters W, PH, and bit 10 have no effect. Bit 11 becomes set at interrupt time. Bit 17 determines whether the device is in vertical or horizontal select mode.

B. Horizontal select or picture-transfer.

A CONO 770 instruction loads the device with parameters PH, W and Z. Bit 17 is cleared to indicate this horizontal mode. The device will now interrupt on each horizontal line, when PH is reached. Then a BLKI instruction in the interrupt location controls the parameter N and the location of the core-memory block that is to receive the picture. The instruction is



Remarks.

The bit assignments of the CONO register are;

0-2. Priority interrupt level

3-4. W = picture width = sampling rate.
00=small width=4 mc/sec samples
01= =2 mc.
10= =1 mc.
11=large width=0.5 mc.

5-9. 32 levels of vertical position selection

10. Not used. Is part of clock divider chain.

11. Interrupt flag. Can be reset by another CONO. Is automatically reset by a DATAI instruction. Loading this bit with a "1" will cause an immediate interrupt.

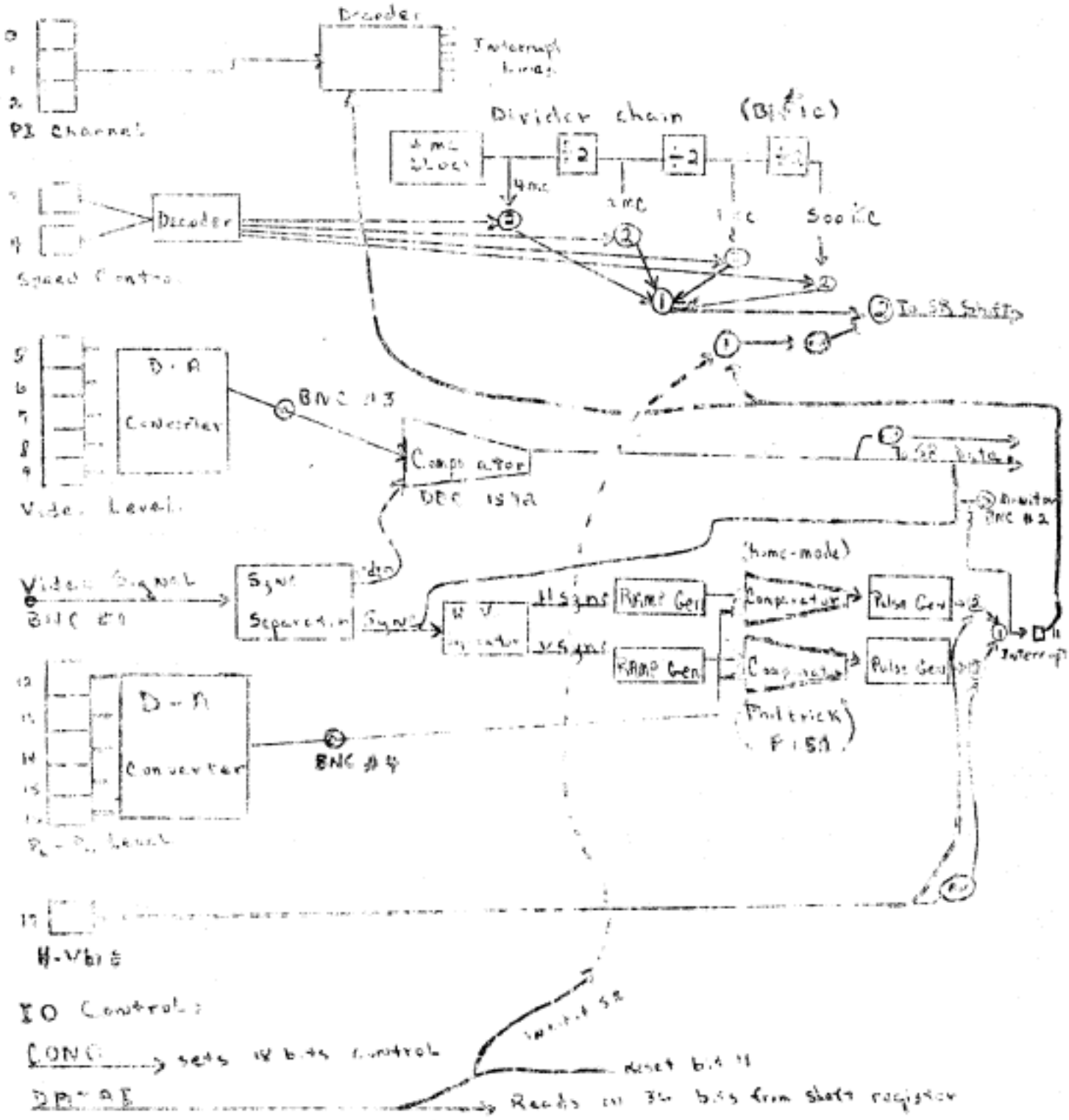
12-16. 32 levels of horizontal position selection

17. Vertical-horizontal mode-selection bit. "1" is vertical.

Hardware organization.

IVA is on two chassis. One contains a 36-bit shift register and the associated gates for read-in to the I-O bus. The other contains the control unit that manages video quantizing, clock control of the shift register, sub-picture selection, and syntheses of a digitized image for a TV monitor. The following diagram should be self-explanatory.

Hardware Logical Diagram



Remarks

The resolution of a conventional TV system is too low for large scenes or page-reading. It is more than adequate for character reading and small scenes. I plan to extend the field of view by adding a synchronous rotating mirror system. This will be synchronized with a stroboscopic flash to eliminate shutters and reduce motion blurring, picture persistence, and for better illumination control.

1. The shift register is stopped when the position interrupt sets bit 11. It is started again by the end of the subsequent DATAI level, or by another CONO instruction.

2. The monitor channel will show the digitized picture with a bright bar at the right-hand edge of the sub-picture.

3. The two digital-analog channels are available for general-purpose uses at BNC connectors 3 and 4. Be sure to set the PIL level to 0 or random interrupts will occur.

4. Theoretically, interrupts will not occur when the camera is disconnected.

5. The SYNC signals come from the camera, and not the line.

6. Please report hardware bugs to me immediately. If there is any reason to move the control bits around, this should be done soon, before programs accumulate. In principle one more control bit, bit 10, could be available.

WARNING

THE TV CAMERA IS PERMANENTLY DAMAGED BY BRIGHT LIGHT OR LONG-STATIONARY SCENES. A BRIGHT AFTERNOON WINDOW WILL BE FATAL AT F 2.8. ALWAYS KEEP CAMERA STOPPED-DOWN AS FAR AS POSSIBLE. Do not point it at lights or polished reflecting surfaces and keep lens cap on when not in use. DO NOT ADJUST THE BEAM CURRENT. At present only D. Edwards and S. Nelson are authorized to make adjustments, other than optical focus, on the TV camera.