TIMETABLE FOR CYCLOPS AND TV DAZZLER DEVELOPMENT

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CYCLOPS FIRST CONCEPTION AND BREADBOARD TEST	4/5/1974
CYCLOPS FIRST PROTO BUILT IN CASE	5/2/1974
CYCLOPS ARTICLE SENT TO POPULAR ELECTRONICS	7/22/1974
CYCLOPS ARTICLE PUBLISHED IN POPULAR ELECTRONICS	FEB 1975
COMPUTER CONTROLLED CYCLOPS DESIGN INVESTIGATION	3/10/1975
TV DAZZLER DESIGN START	3/15/1975
ALTAIR CYCLOPS DESIGN START	3/23/1975
ALTAIR CYCLOPS ANNOUNCED BY CROMEMCO	JUL 1975
ALTAIR CYCLOPS ADVERTISEMENT IN POPULAR ELECTRONICS	JAN 1976
TV DAZZLER ARTICLE PUBLISHED IN POPULAR ELECTRONICS	FEB 1976

HISTORY AND THEORY OF OPERATION:

The Cyclops design was initiated as a result of seeing an advertisement for the AMI M4008-9 pseudo-static random access memory chip (RAM) in the magazine Electronics. The advertisement included a nice die photo about 1 1/2 inches square, in which it was obvious that the RAM cells were fabricated in a uniform square array with 32 rows and 32 columns. The uniform array arrangement was good for making an imager without breaks in the image. Most modern RAM chips made after that time have the memory cell array broken up into sections with row and column drive electronics between the sections. The RAM chip was made with PMOS technology, using +5V and -12V supplies, with 5V logic compatible inputs and outputs.

The pseudo-static design was done to give faster address response times compared to full static RAM chips of the same time, but had the compromise that the cell contents could fade with time unless a special refresh cycle was performed. Each cell contained independent read and write circuitry, with the cell state stored on a diffused diode. This meant that the cells could be used as an imager since the act of reading out the state of any particular cell would not erase or restore the state of the cell to a full voltage level. If a cell was repetitively read out, after a certain amount of time the cell state would change from a high level to a low level, and stay that way until an explicit cycle to write a full voltage level in the cell was performed.

The Cyclops exploited this technique by first writing a logic '1' high level (+5V) to the chip input, which put a large negative voltage on the internal diode storage node. Since this was PMOS, the chip substrate was connected to the +5V supply, and any leakage discharge of the diode storage node would cause it to move in a positive direction. When it went high enough, the sensing circuits would read the cell content as a logic '0', and output a logic '0' low level (ground or 0V) on the chip data pin. Light shining on the individual memory cells caused the stored charge to discharge at a rate depending on the brightness of the light.

Now imaging with limited gray scale operation could be obtained by repetitively reading out the entire memory cell array in a regular manner multiple times. The Cyclops actually reads out the complete memory 15 times, sending the logic value of each RAM cell to the display each time. After a few readout scan cycles, depending on the brightness of the light shining on the RAM chip, a memory cell would discharge due to photo currents, resulting in a low data level representing white being sent to the display on that scan cycle. Every 16 scan cycles, one cycle would be used to rewrite the entire memory array to a logic high level representing black in the image.

The Cyclops camera was made with digital to analog converters so that X axis and Y axis staircase signals could be generated for an oscilloscope display, and and amplifier for 12 volt output pulses to drive the cathode of the oscilloscope display tube to cause it to turn on for image regions with light. The number of times a particular location would receive a pulse to light up depended on the approximate incoming image intensity at that location.

With the publication of the Altair 8080 computer kit article in the January 1975 issue of Popular Electronics and the Cyclops article in the February 1975 issue, it became an interesting question to make a computer interfaced version of the Cyclops camera. Two sets of electronics for the S-100 bus were needed: 1) the camera data input interface, and 2) an inexpensive image display. This was the impetus for development of the Altair Cyclops camera and interface for input, and the TV Dazzler interface for output. Although the Altair Cyclops output would be a black and white image, it was quickly realized that an important addition to the TV Dazzler would be NTSC color video output. This would make the TV Dazzler much more interesting as a general purpose graphics output for the Altair computer, and indeed the TV Dazzler was the first color graphics device sold for home computers.

The Cyclops image sensor was repackaged with CMOS control electronics and a bidirectional serial cable interface in a small package for use as the Altair Cyclops. A two board S-100 set of drive electronics was designed and made for generating the scan counters, control, and direct memory access (DMA) interface for putting the Altair Cyclops data into the memory of the Altair computer. The Altair Cyclops camera could be located up to 100 feet from the computer on a small multiwire cable.

The TV Dazzler was designed as a two board S-100 set, with one board performing DMA fetches of the digital image data from the Altair computer memory, and the second board having the scan counters, TV sync generators, digital to analog video converter, and color encoders. The TV Dazzler output on a single standard coaxial cable could be displayed as 64 by 64 pixels on most TV sets in black and white gray scale for the Altair Cyclops camera or in color for graphics plotting and image generation. It had a special mode for generation of graphics up to 128 by 128 pixels in a square on the TV screen for games usage.

Later versions of the TV Dazzler were made with increased image resolution as memory chips became larger in capacity, more compact, and less expensive per stored bit. The Altair Cyclops, which spawned the TV Dazzler, had only a small number of sales, whereas the TV Dazzler had much larger sales due to its more universal capabilities.