# PIXELS,PIXELS AND MORE PIXELS.

Presentation to the Lexington Computer Club

May 19, 2010

By

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# OVERVIEW

- What is a Pixel?
- What is a Pixel Count?
- Is more better than less. When?
- Relationship between Mega Pixels and Megabytes
- When does your Camera cheat a bit, or quite a bit?
- What does Suppression really mean?
- What are the Requirements for a matched Display?
- Digital Projector Issues
- Digital Printer Issues
- Limitations for Displays – Selection of Size
- Illumination / Sharpness Issues for Zoom and normal Operation

# WHAT IS A PIXEL?

- The Word Pixel was coined in the Sixties
  as a Combination of
  PICTURE and ELIMENT
  somehow the “C” became an “X”.

- In the Forties very detailed studies of the relation between image content and resolution (Pixel size).

  And the Answer is: It Depends

- Different concepts for Cameras,
  Projectors, TV Displays and Printers

In digital imaging, a pixel is a single point in a raster image. The pixel is the smallest addressable screen element, it is the smallest unit of a picture which can be controlled.

# Let’s Start With A Quick Detour

Much of our communications in our daily life are based on visual clues. Pictures, Print, Drawings, Letters, Photographs, TV Displays , Books were designed to be “Looked at”.

# The Vision Process

- it stands to reason to explore the Vision Process and the Eye’s Signal Processing capabilities.
- The understanding of these Processes allows for maximizing vision devices
- Such as Cameras, Projectors, Printers, TVs and Monitors.

# The Most Sophisticated DigitalCamera

The big surprise:

The human eye works exactly like a modern Digital camera,

or

A modern Digital Camera works exactly like the human eye !

The digital camera was invented in the sixties, but Mother Nature beat us engineers by

Several 100 million Years!

# Components of The Human Eye

Three major components of the eye

- The lens
- The Retina
- The Nerve Center behind the eye, connecting to the brain.

# How does the Human Eye Digitize

Close look at the Retina:

- Two types of special nerve endings:

  About 75 t0 100 Million Rods

  About 150 Million Cones.
- Rods are not color sensitive. but detect shape and outlines.
- Cones are detecting colors

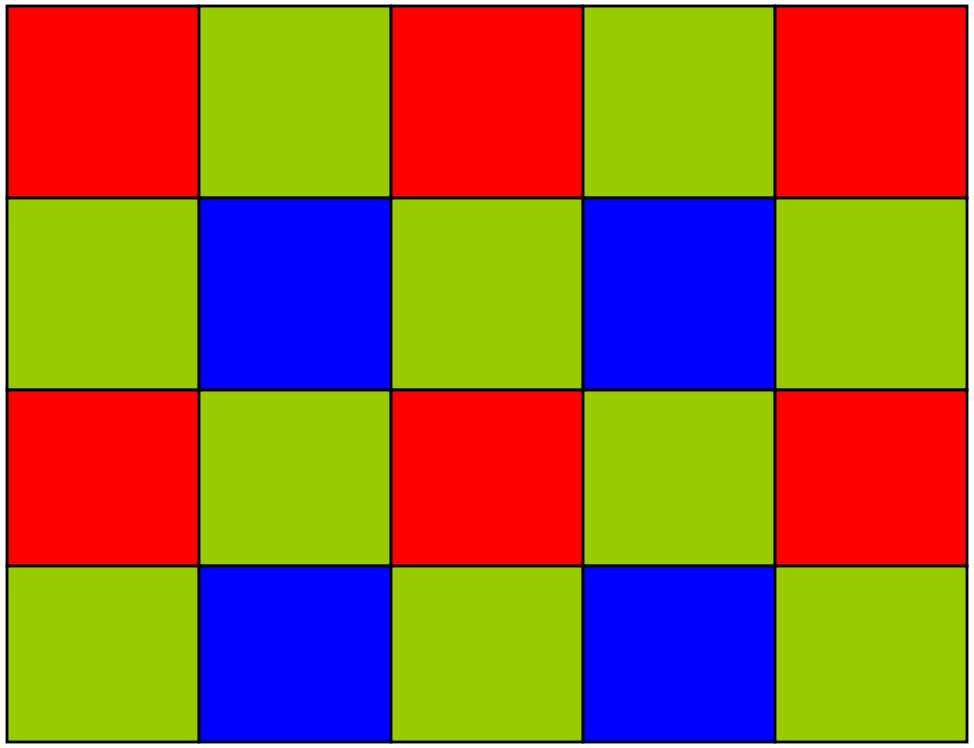
# The Retina as a Detector array

- One Rod and Three Cones are grouped together.
- One of the cones records BLUE
- One of the cones records Green
- One of the cones records RED
- Combinations of one, two or all three create all visible colors
- Together they form the smallest Detection unit
- The human Eye is equivalent to about a

  200 -400 Megapixel Camera

# Digital Camera Sensor

The BAYER Configuration



# Camera’s Color Vision

- 50% of Sensors detect Green
- 25% detect Red
- 25% detect Blue
- To increase Resolution:
  Calculation of “Missing Colors”
  on Sensor Chip

# What is a Pixel Count

- Usually Count of all individual Sensors
- But Pixel Count does not clearly define Resolution
- Interpolation of Signals can blur small Details
- Modern Standard is the MEGAPIXEL
- Latest up to14 Megapixel Cameras
- Effect of Camera Lens

# Effects of the Lens Quality

- Even the best camera lenses can image small details only to a limit.
- Every object will be imaged with a small, but important blur
- Blur size depends on lens quality
- Importance of match between size of lens blur and sensor pixel size
- Reflected in cost of camera

# Need new Units for Measurements

- Dimensions of pixels are very small
  (in the vicinity of 1/10,000 inch)
- For comparism:
  Human Hair app. 4/1,000 inch
- Convenient Metric: Use of the “Micron” (mu)
  25 Microns (mu) = 1/1,000 inch
- Modern pixel sizes: 2 to 7 mu
- Blur size of best lenses: 2.5 to 5 mu
- Substantial larger for Zoom Lenses

# Revised Pixel Count

- Blurred images obtained by inexpensive lenses cover several pixels – bad match!
- Can cause substantial reduction in real pixel count!
- Usually only 95% of all pixels are “Active”, remaining pixels used for controls

- Manufacturers use different methods for counting pixels – reason to “Watch Out”

# Is more better than less?

Important Parameters:

What will the camera being used for?

- Taking casual, personal pictures
- Taking close-up pictures with great detail
- Taking architectural pictures
- Taking landscape scenes
- Pictures to be blown-up to large formats
- Photographing printed documents

# Pixel Count Considerations

- Most modern cameras offer selection of different pixel count settings.
- Read-out time:

  generally fixed time to read one pixel
- Picture storage; how much memory is required
- How many pictures total can be stored

# Pixel Count Summary

- Again, it depends on what you want to pay

  and
- How you want to present your pictures.

  Print, project or never look at them again
- Most cameras have different pixel count settings

# Megapixels and Megabytes

- A few numbers:
- Example: 14 Megapixel camera

  14 million pixel addresses – 3 bytes each

  3 colors, 256 intensities each color,

  3 bytes each
- Additional picture notes - 4 bytes each
- Total bytes count 10 x 14 = 140 Megabytes

  or about 7 pictures/Gigabyte in memory

# Does your Camera cheat a bit?

- The answer is yes!
- The number of 140 Megabytes/picture applies only to a very special setting, a so called

  “Bitmap”.
- For normal use the bitmap is much to cumbersome, it is only needed for professional editing – changing faces, inserting people etc.
- With normal settings the camera COMPRESSES the information automatically!

# What is Image Compression?

- The camera does exactly what the human eye does – it only records the important information!
- In principle the computer in the camera considers the green information the most important one (outlines/shapes) and uses red and blue to color-in with less resolution
- Some very small details may be lost, but are usually not noticeable.

# The JPEG Standard

- This is the most used compression standard; in expensive cameras others may be selected
- It uses very complex algorithms
- It comes in several modes expressed in % (from 90% down to 30%) which in some cameras can be selected

# Matched Displays

- For optimum results the screen resolution of a display should be the same as that of the recorded picture
- Example: Pictures taken with high resolution and displayed on regular TV usually look disappointing blurry
- This is very important when text is projected ( Choice of fond size)

# Resolution of projected Fonds

- Number54
- Number 48
- Number 40
- Number 36
- Number 28
- Number 24
- Number 20
- Number 18

# Results of unmatched Displays

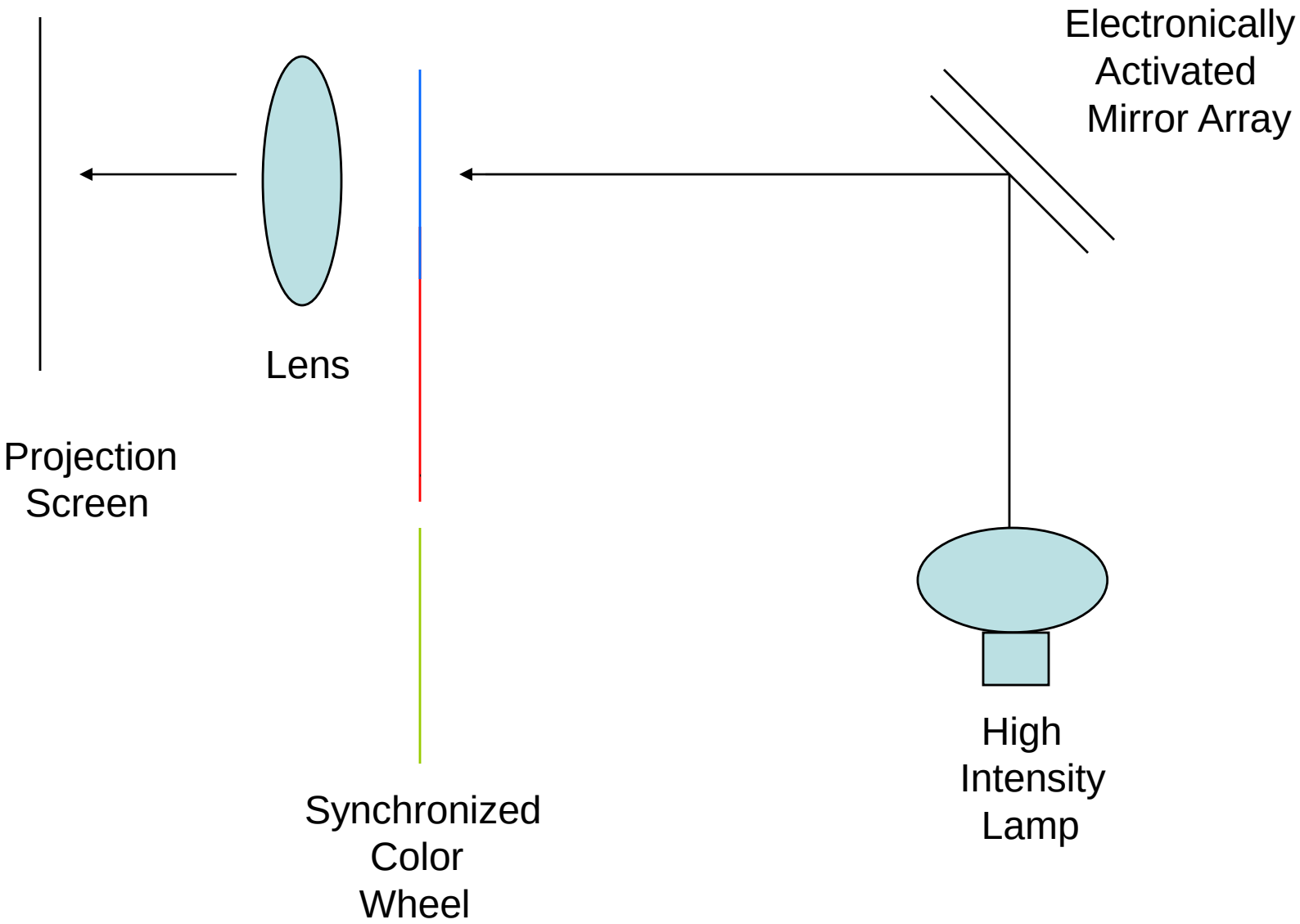
- The display processor has to find a compromise.
- on a pixel - to - pixel basis If the pixel counts are multiples of each other, 600 vers 1200 or 600 vers 2400,

  the processor just ties several pixels together.
- If there are no multiples, interpolations have to take place, creating two new pixels out of three etc.
- This leads to blurring and loss of resolution

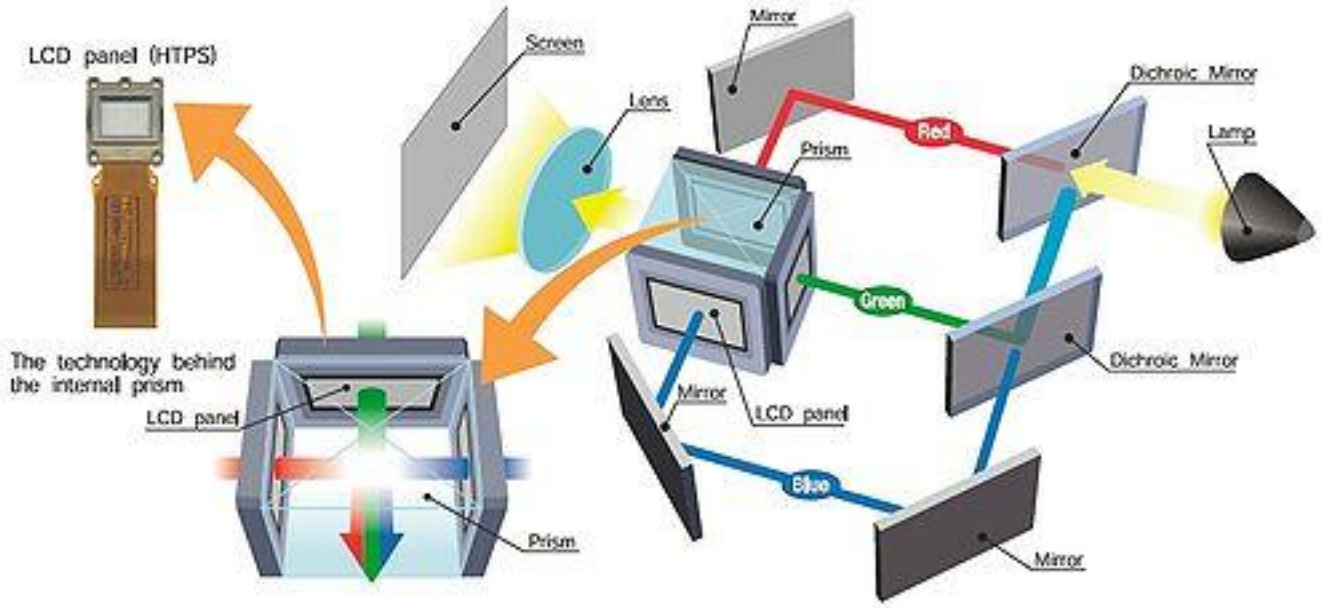
# How does a Digital Projector work?

- There are basically two types devices sold by various vendors
- Digital Light Processing (DLP) units
- 3 LCD devices (based on Liquid Crystal Technology

# DLP (Digital Light Processing)

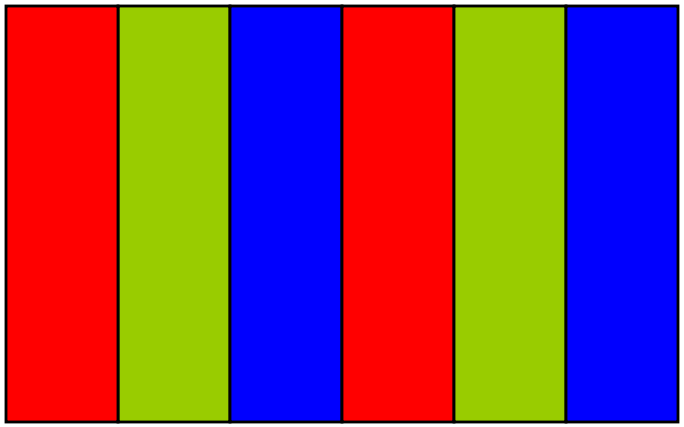


# 3LCD Principle




(Copy from Wikipedia)

# LCD Cell for TV Displays



# The liquid Crystal Display Cell

- Uses complex Polarization Effects
- Several liquid crystals change polarization when voltage is applied
- Very short response times
- Usually referred to as

  “Controllable Light Valves”
- These cells can withstand very high light intensties

# Summary

- This presentation contained a lot of technical information.
- If you forgot all the stuff presented today, you still can enjoy your camera, your pictures and your computer as always by the time you get home!

Thank you!