Forensic Microscopy: Innovations in Forensic Digital Microscopic Analysis of Human Bone

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a digital image whether microscopic or not is a function of two elements

a digital sensor
optics

digital imaging

1. terms

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terminology

pixel

digital sensor unit

photons converted to electrical charge by a photodiode

ccd

charge coupled device

cmos

complementary metal oxide semiconductor

interpolation

software algorithm that interprets spaces between pixels

terminology

focal length

distance from lens center to sensor

optical zoom

increase in image size due to lens magnification

digital zoom

digital cropping of image creating magnification when projected to sensor size

AD Converter

analog to digital converter

terminology

noise

unwanted signal produced by a photodiode

color filter array

red, green, and blue filters above sensor

storage medium

magnetic storage device

varying sizes

compression

file size reduction

lossy vs. lossless

terminology

jpeg

joint photographic experts group
compressible

tiff

tagged image file format
uncompressed universal digital file format

raw image

unprocessed digital image format
proprietary software needed

2. the process

the process

1. **light from an object enters the lens**
2. **light (photons) strike the sensor (CCD or CMOS)**

the process

3. pixels (photodiodes) convert photons into an electrical charge

photon → pixel → elec. charge

the process

4. the electrical charge is amplified and converted into a digital value

elec. charge → amplify → digital value

the process

5. digital value is converted to digital image via an AD Converter

the process

6. digital image saved

image → jpeg, tiff, raw

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optics

the lens is the primary variable in image sharpness and overall quality

the lens

- **sensor resolution is secondary**
- **quality ranges from poor to extremely high**
- **magnification up to 1000x**
  - point and shoot cameras rely on digital magnification to supplement optical
- **depth of field is reduced as magnification increases**

examples

cell phone camera

- simple to use
- inexpensive
- portable
- low resolution
- no magnification control
- limited exposure control
- image download

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point and shoot camera

- simple to use
- variable cost
- portable
- modest to high resolution
- limited magnification control
- limited exposure control
- image download

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eyepiece camera

- simple to use
- inexpensive
- modest resolution
- no magnification control
- requires pc
- entirely software driven
- relies on microscope optics

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portable camera microscope

- simple to use
- variable cost
- portable
- requires PC
- modest resolution
- limited magnification control
- no exposure control

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SLR digital camera

- learning curve
- high cost
- portable
- high resolution (lens and sensor)
- magnification control
- exposure control
- image download

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microscope mounted camera

- simple but awkward to use
- low to moderate cost
- moderate resolution (lens and sensor)
- magnification control
- exposure control
- relies on microscope optics
- image download

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dedicated digital microscope

- simple to use
- low to moderate cost
- moderate resolution
- requires PC
- entirely software driven
- relies on microscope optics

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dedicated digital microscope

- learning curve
- high cost
- very high resolution
- extensive magnification control
- limited exposure control
- extensive image adjustment
- image download

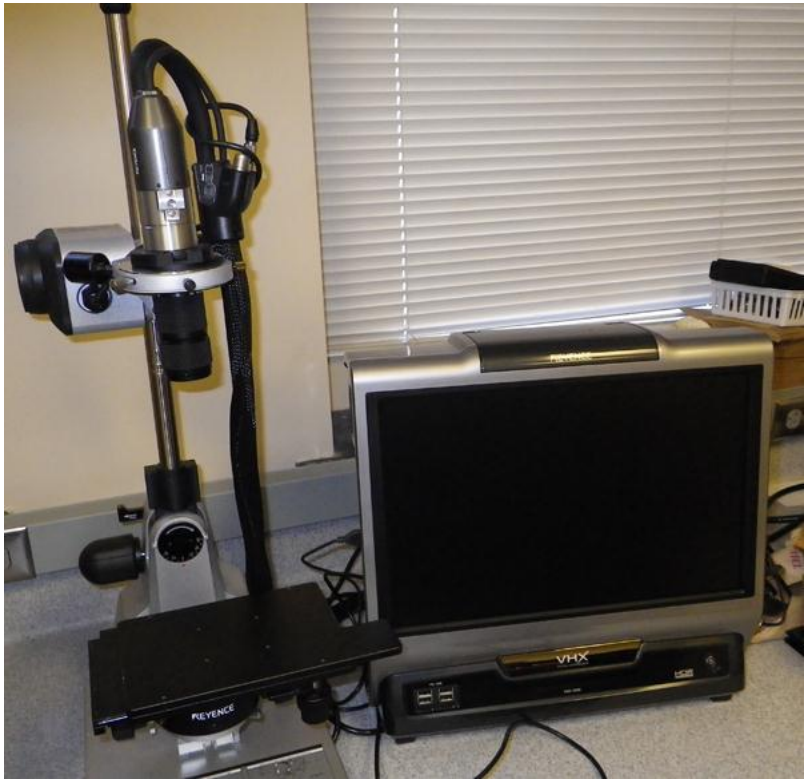

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image examples

what to do?

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considerations

1. **cost**

   as cost increases so does quality and functionality
2. **use**

   what need does the equipment fill
3. **practicality**

   learning curve, ease of use, and functionality

considerations

4. **portability**

   does the equipment stay in the lab or travel

   is the equipment stand-alone or tethered

5. **repair and replacement**

   cost usually equates with the cost of maintenance

when all is said and done digital microscopy boils down to use and cost


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