Image Sensing & Acquisition.

* Images are created when light or other energy (like X-rays or in frared) interacts with objects by reflecting off or passing through them.

If the energy reflects, we see
an image like a mirror reflection.

If it passes through, like

X-rays through body, it helps

create an internal image.

* Some systems, like electron

microscopes or gamma imaging

(SPECT), use special converters

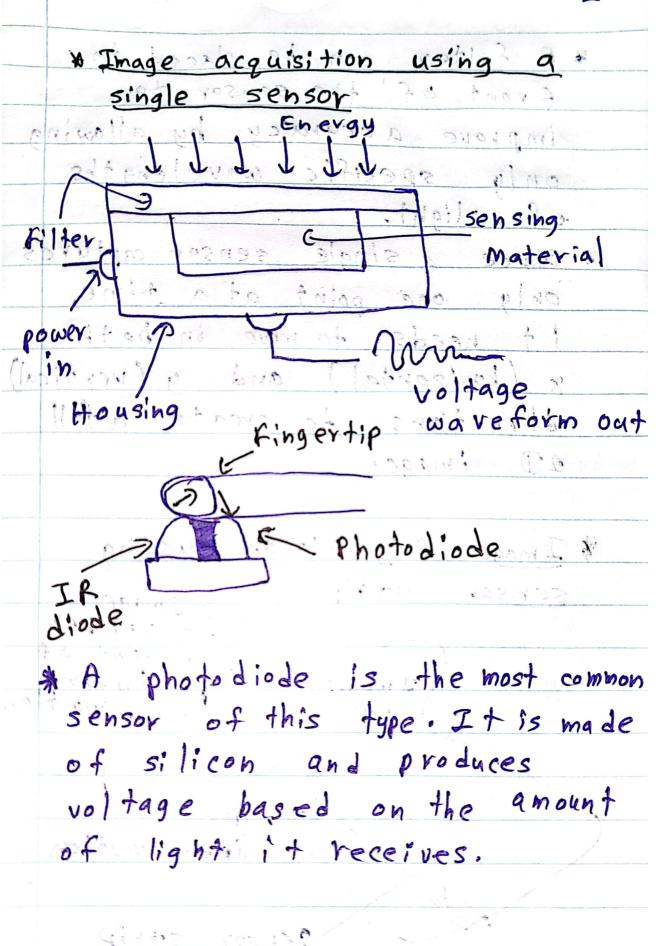
to turn this energy into

visible * images.

of sensors used to convert light or other energy into

electrical power and special

1. single imaging sensor Captures one image a and Xata timeno vale 22 Line Sensor - Captures images line by line, useful for se sis escanning order ad to 3. Array Sensor -- Captures the entire image at once, like a son camera ist sensor, stages Some systems, like ele Sensor Processo 3000 (SPECT), use special converter * The sensor converts incoming energy into voltage using electrical power and special materials that react to the energy type * This voltage signal is then digitized to create a digital limage.



* A filter can be placed in Front of the sensor to improve accuracy, by allowing only specific wavelengths of light. * since a single sensor captures only one point at a time, it needs to move on both x (horizontal) and y (vertical) directions to create a full 2D image. * I mage Acquisition Jusing sensor strips one image ine out per increment of onlinear I maged mo tion d roa libear motion sensor strip

* A sensor strip captures Images in one direction Clike a single row of pixels) * To create a full image, move in the perpendicular direction TOD : 23/gmars & * This method is commonly used in flatbed scanners, where the scanning head moves to capture the entire 2 documents Image, ve constru ale thing cross-sectional of 3D object images X-ray source linear Sensor motion 30 object circular sensor

3 Sensor Strips in a Ring Configuration * Used in medical and industrial imaging to capture crosssectional (slice - by - slice) Images of 3D objects * Examples: CAT (CT seans), MRI, and PET scans use . This methods as beau W. Unlike regular scanning, these images require complex processing to reconstruct meaningful visuals * A 3D digital volume is created by stacking multiple 20 images as the object moves perpendicular to the sensor ring.

* I mage Acquisition using Sensor Arrays.

* Many electromagnetic and ultrasonic sensors are arranged in arrays for imaging. * This method is commonly used in digital cameras * Each sensor in the array captures total light energy falling on it, converting it into a s'digital simagenti * key advantage: A 2D sensor array captures a complete image instantly without heeding movement. (energy) source

> Imaging System

3 cene element

(Internal) image plane

output (dig itized)

Image Formation Model

An image is represented as 20 function: f(x,y), where X and y are coordinates and of (n,y) gives the brightness bar a tolac that sipointion sill & * The brightness value depends on the energy source, such & as lightisor electromagnetic to waves invest time pails? * since light has positive energy, roadhe function musit be nonzero and finite (oxf(x,y) image instantly without the coing Components of Image formation An image is formed two factors: 1. illumination (1(x,y)) The amount of light falling on the object. 3 cene ellinesalla

2. Reflectance (r(x,y)) -The amount of light reflected from the object.

These combine as:

mede you seported.

 $f(x,y) = i(x,y) \times \gamma(x,y)$

positive (0 < i(x,y)) is always

* Reflectance (r(x,y)) is between

O (total absorption, black) and I (total reflection, white)

Gray Levels and Grayscale

*The brightness at any point is called its gray level (1), which lies within a range [L Lmin, Lmax], called the gray scale.

In practice, this range is mapped to [0, L-1], where:

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