



## Digital Image Processing

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**Why do we need Image Processing?**

It is Motivated by two major applications-

- Improvement of pictorial information for human perception

- Image processing for autonomous machine application

- Efficient storage and transmission





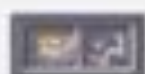
# Human Perception

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Employ methods capable of enhancing pictorial information for human interpretation and analysis

Typical applications:

- 🖥️ Noise filtering
- 🖥️ Content enhancement
  - Contrast enhancement
  - Deblurring
- 🖥️ Remote sensing





# Image Enhancement

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Low contrast Image

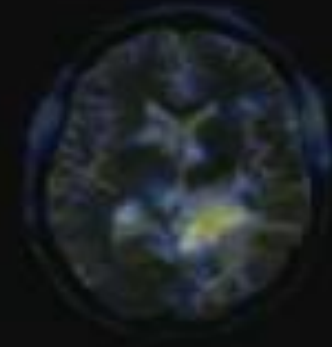
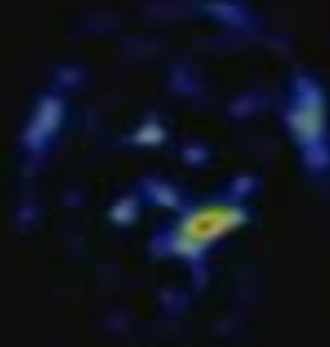
Enhanced Image





# Medical Imaging

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Brain Tumor

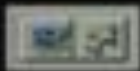


# Medical Imaging

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**Cancer Detection**



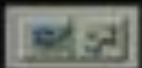


# Remote Sensing

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Satellite  
Image,  
Kolkata







## Machine Vision Applications

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Here the interest is on procedures for extraction of image information suitable for computer processing

### Typical Applications:

- Industrial Machine vision for product assembly and inspection
- Automated Target detection and tracking
- Finger print recognition
- Machine processing of aerial and satellite imagery for weather prediction and crop assessment etc



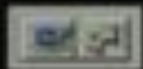


# Automated Inspection

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**Bottling Plant Automation**







## Boundary Information

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Importance of  
**Boundary**  
Information





# Automated Inspection

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# Automated Inspection

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# Automated Inspection





## Automated Inspection

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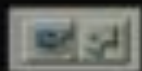


# Automated Inspection

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Inspection of IC Manufacturing





## Video Sequence Processing

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The major emphasis of image sequence processing is detection of moving parts

This has various applications

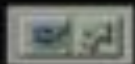
- Detection and tracking of moving targets for security surveillance purpose
- To find out the trajectory of a moving target
- Monitoring the movements of organ boundaries in medical applications etc.





# Movement Detection

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# Movement Detection

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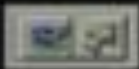


# Image Representation



$x$   $f(x,y) = r(x,y) \cdot i(x,y)$

- An image is a 2-D light intensity function  $f(x,y)$
- A digital image  $f(x,y)$  is discretized both in spatial coordinates and brightness
- It can be considered as a matrix whose row, column indices specify a point in the image and the element value identifies gray level value at that point
- These elements are referred to as pixels or pels

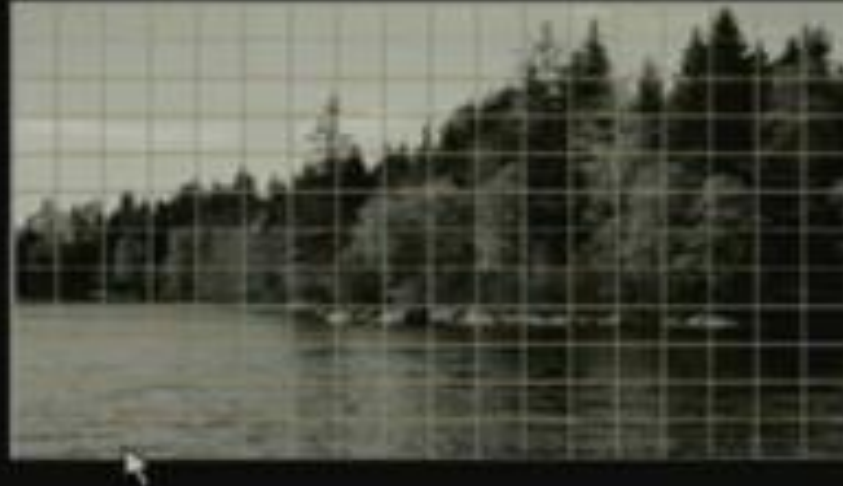




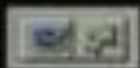


# Image Representation

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- Spatial discretization by grids
- Intensity discretization by quantization





## Image Representation

$$I = \begin{bmatrix} f(0,0) & f(0,1) & f(0,2) & \dots & f(0,N-1) \\ f(1,0) & f(1,1) & f(1,2) & \dots & f(1,N-1) \\ f(2,0) & f(2,1) & f(2,2) & \dots & f(2,N-1) \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ f(M-1,0) & f(M-1,1) & f(M-1,2) & \dots & f(M-1,N-1) \end{bmatrix}$$

Image Size : 256x256, 512x512, 640x480, 1024x1024 etc

Quantization: 8 bits



# Image Representation



189	184	181	190
183	185	186	183
182	179	185	193
188	192	202	195
194	196	197	198

