

DIGITAL IMAGE PROCESSING

Introduction: Digital Image processing

- **Image processing** is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it.
- It is a type of signal dispensation in which input is an image, like video frame or photograph and output may be image or characteristics associated with that image.

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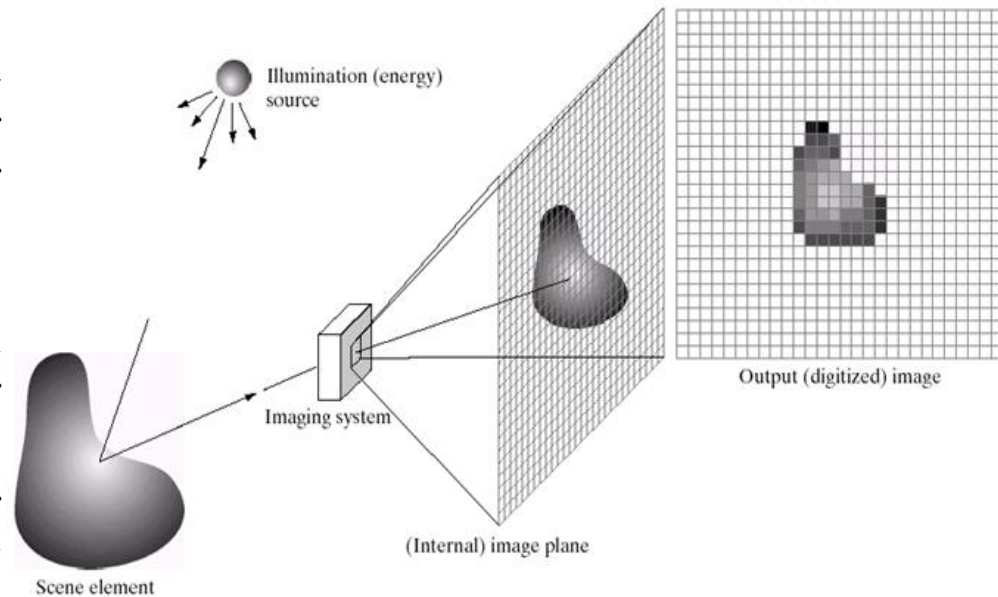
Purpose of Image processing

The purpose of image processing is divided into 5 groups.

- 1. Visualization** - Observe the objects that are not visible.
- 2. Image sharpening and restoration** - To create a better image.
- 3. Image retrieval** - Seek for the image of interest.
- 4. Measurement of pattern** – Measures various objects in an image.
- 5. Image Recognition** – Distinguish the objects in an image.

Introduction: Digital Image processing

- Digital Image Processing techniques are motivated by the following major applications:
- The processing of image for improving the pictorial information for better interpretation/image will have a better look at the image.
- Images captured by satellite in various environmental conditions are useful in prediction of agricultural crops, weather conditions etc.
- Applications in medical field are for screening, monitoring patient, processing of chest X rays, tomography images, and for patient diagnosis.



Digital Image

- An image may be defined as a two-dimensional function, $f(x, y)$, where x and y are spatial (plane) coordinates. The amplitude of f at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point.
- When x , y , and f are all finite, discrete quantities, we call the image a digital image.

Pixel

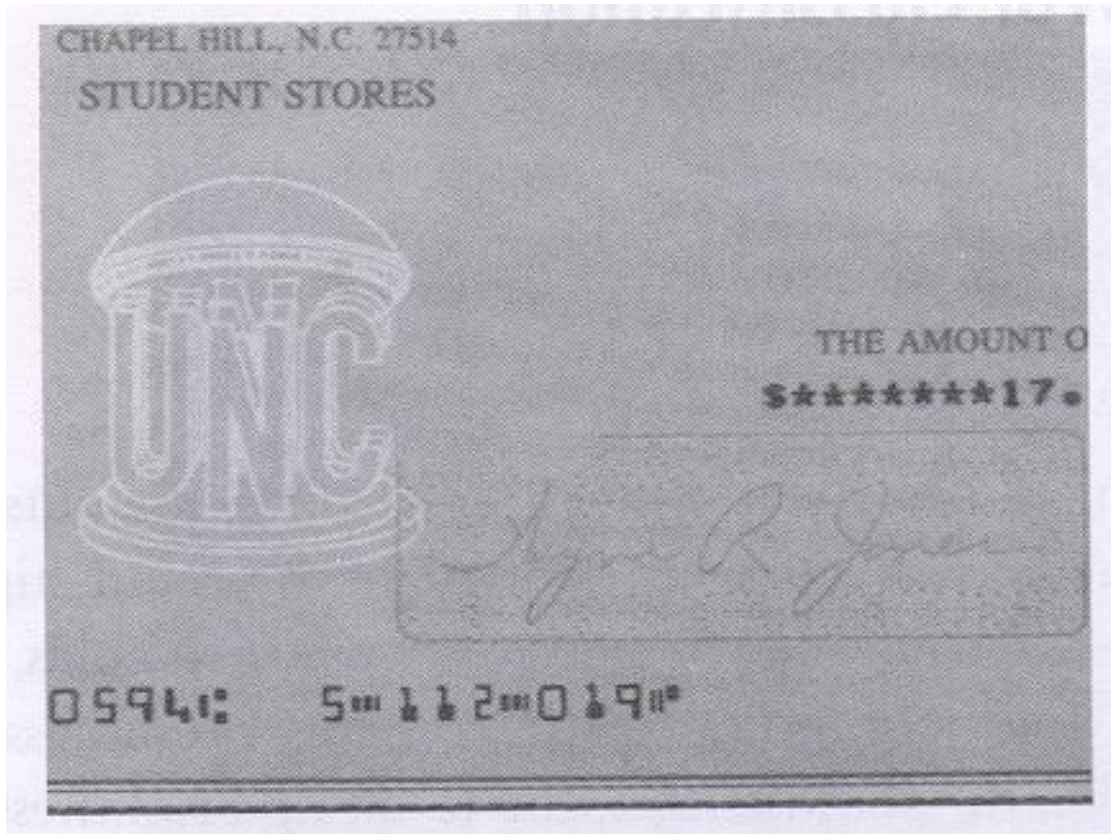
- A digital image is composed of a finite number of elements, each of which has a location and value.
- These elements are called pixels.
- In 8-bit representation pixel intensity values change between 0 (Black) and 255 (White).

Three types of processes in Digital Image Processing

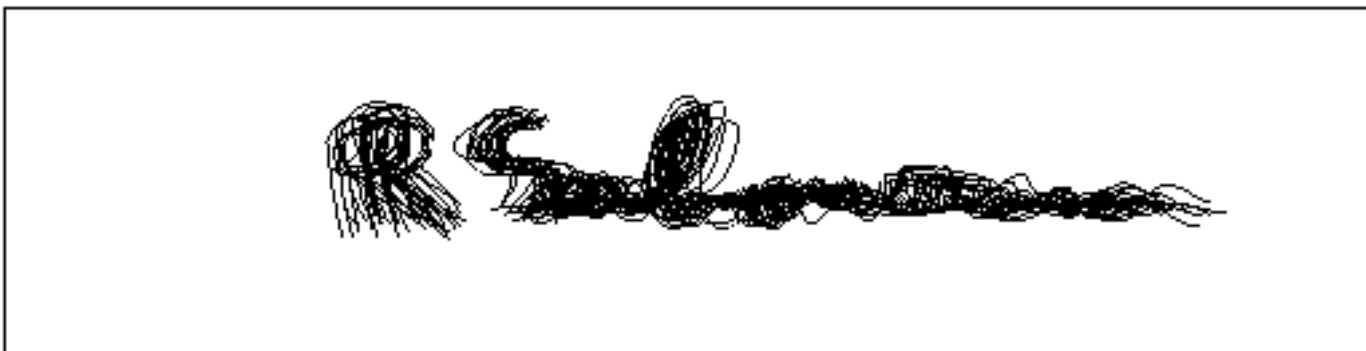
Process digital images by means of computer, it covers low-level, mid-level, and high-level processes

- Low-level: inputs and outputs are images
Examples: Noise removal, image sharpening
- Mid-level: outputs are attributes extracted from input images
Examples: Object recognition, segmentation
- High-level: an ensemble of recognition of individual objects
Examples: Scene understanding, autonomous navigation

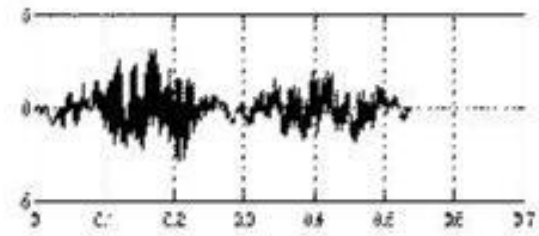
Document Handling



Signature Verification

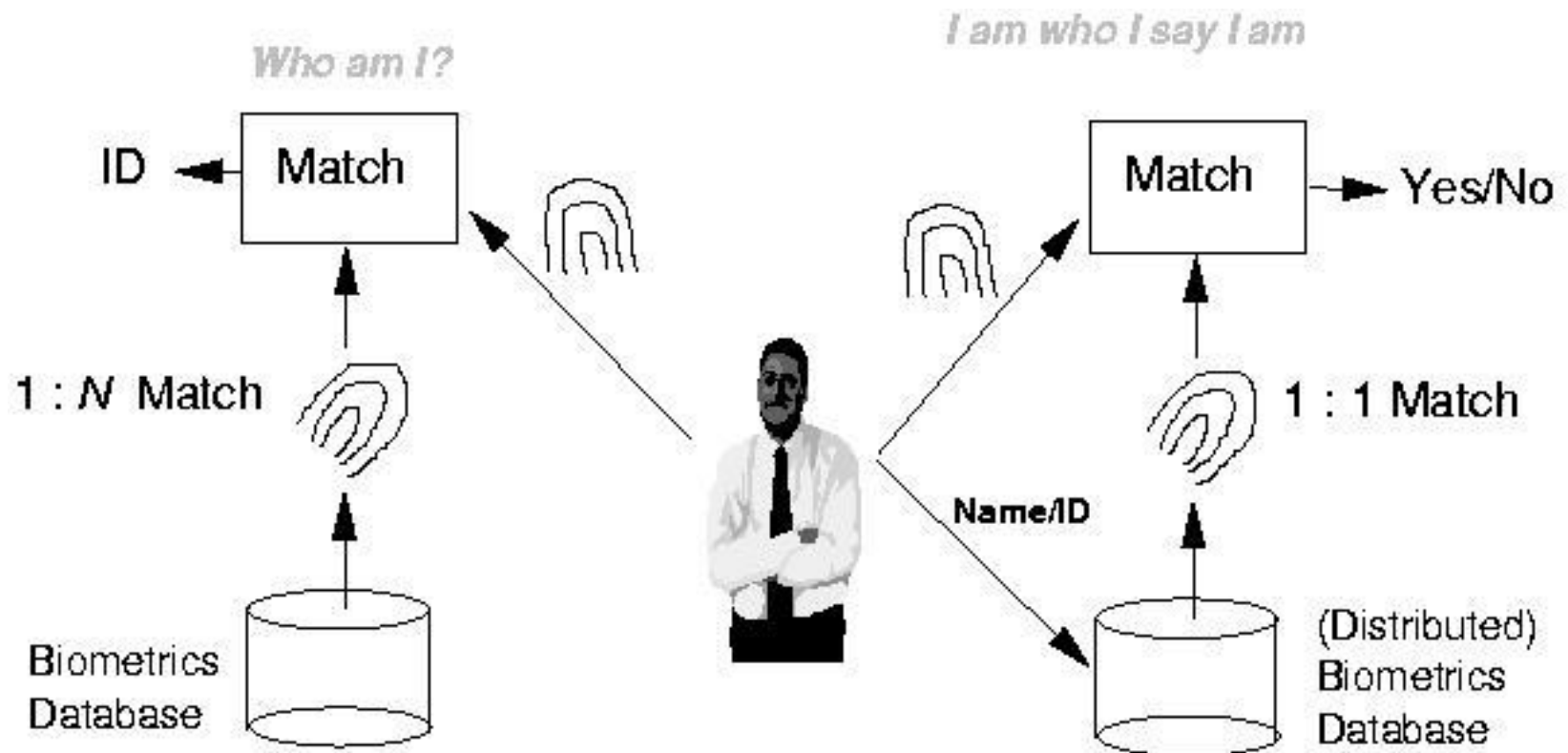


Biometrics



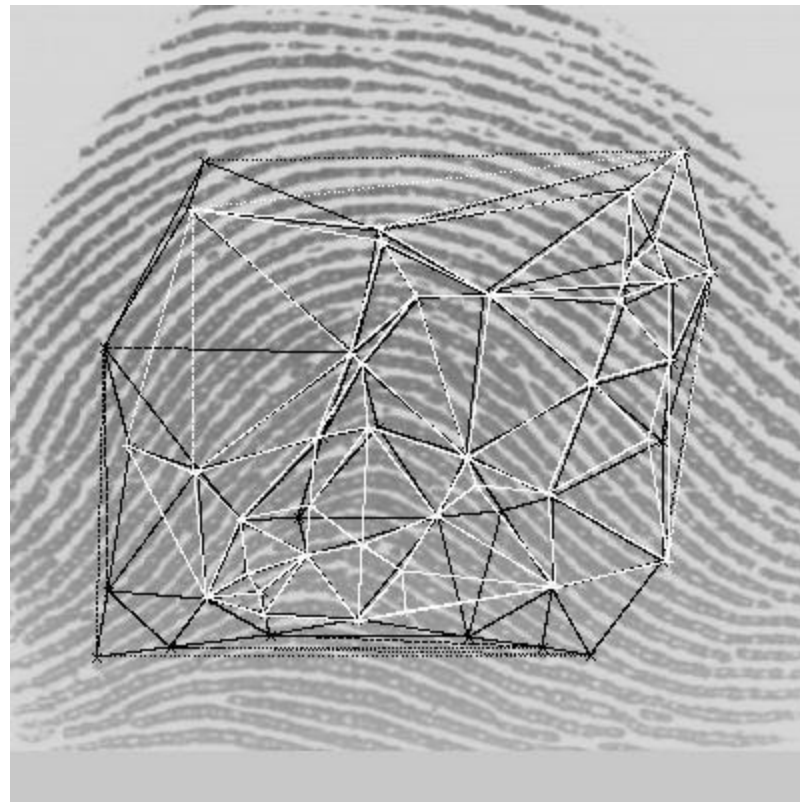
John Smith

Fingerprint Verification / Identification

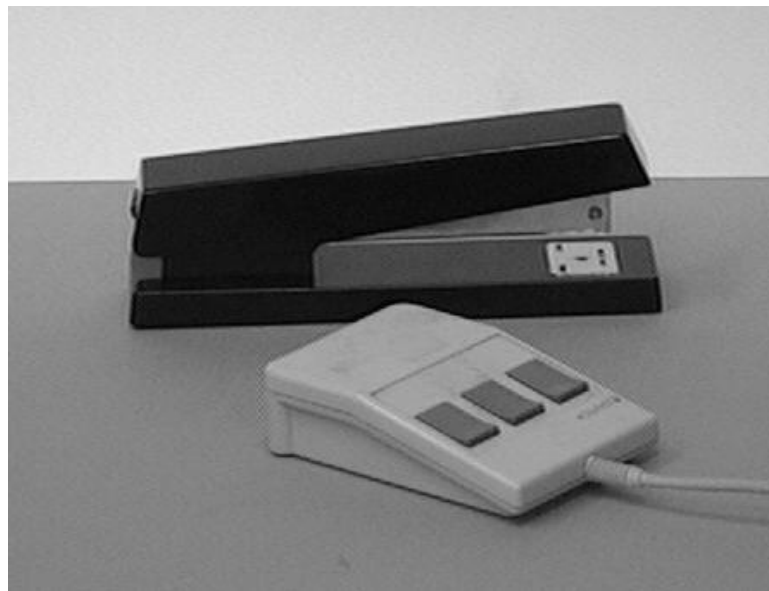
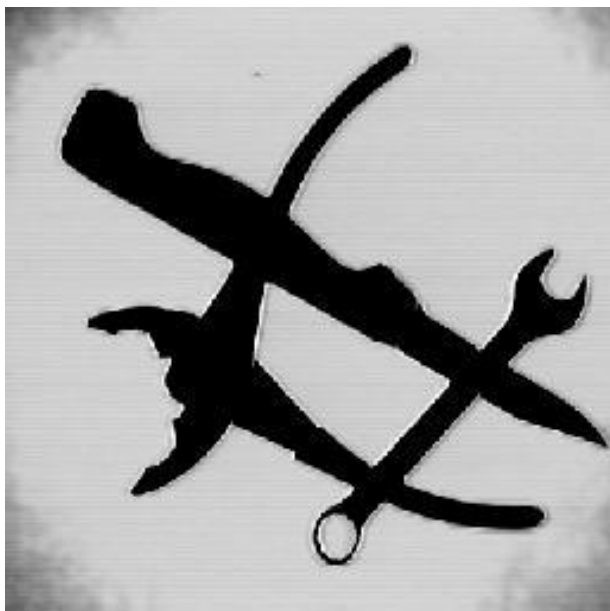


Fingerprint Identification Research at UNR

Matching

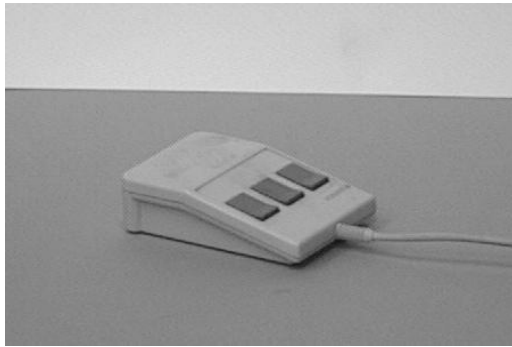


Object Recognition

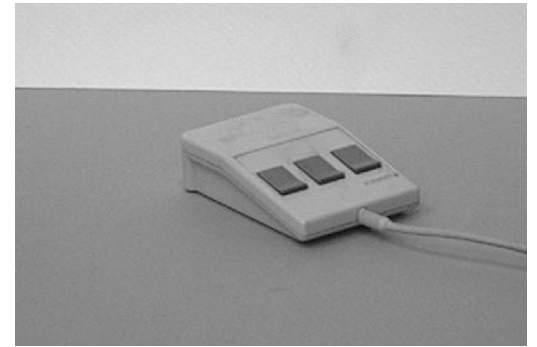


Object Recognition Research

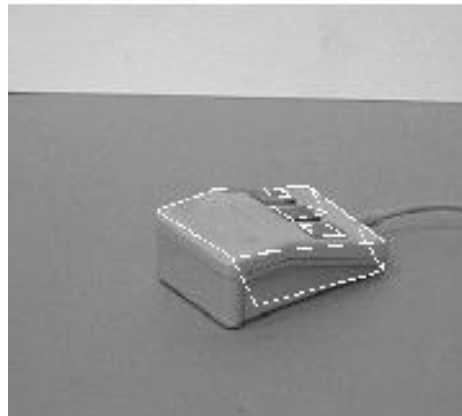
reference view 1



reference view 2

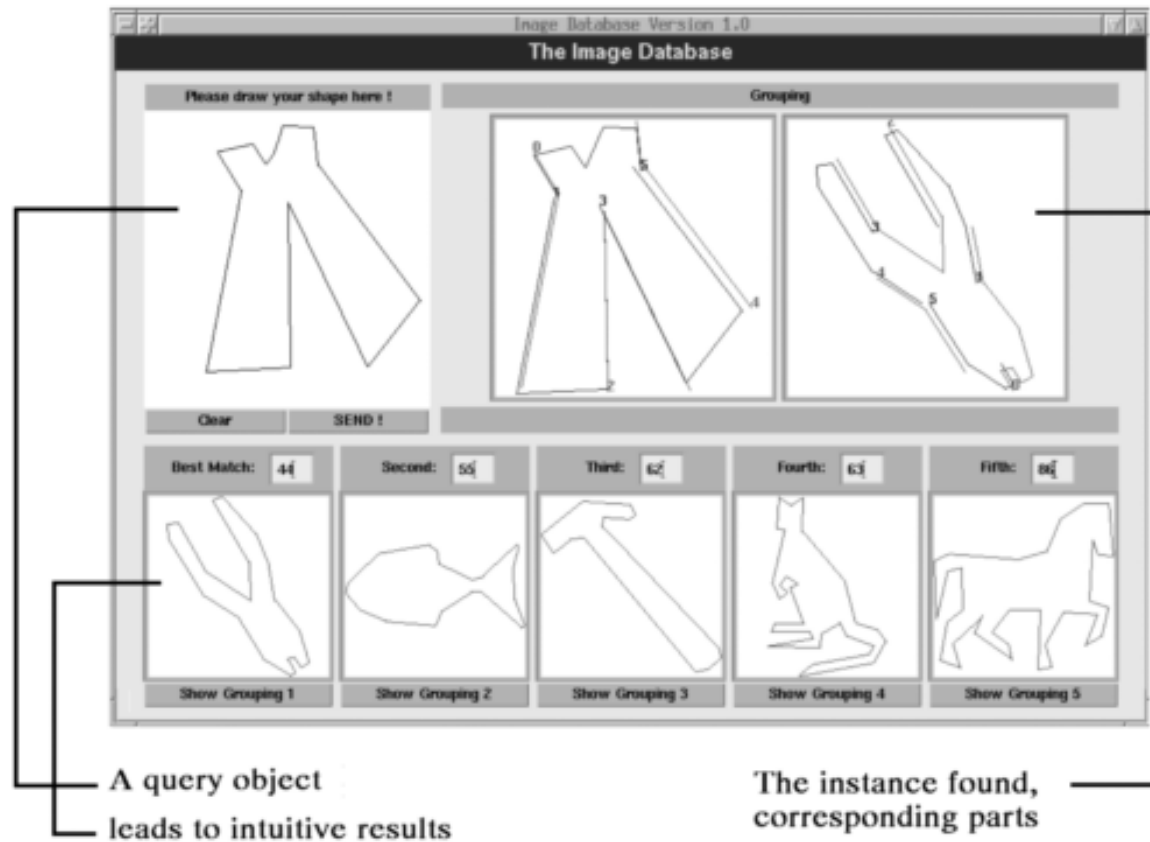


novel view recognized



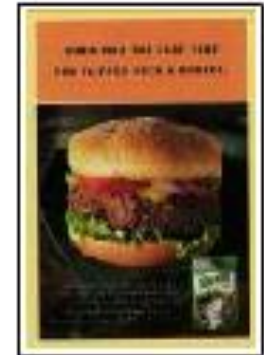
Indexing into Databases

- Shape content



Indexing into Databases (cont'd)

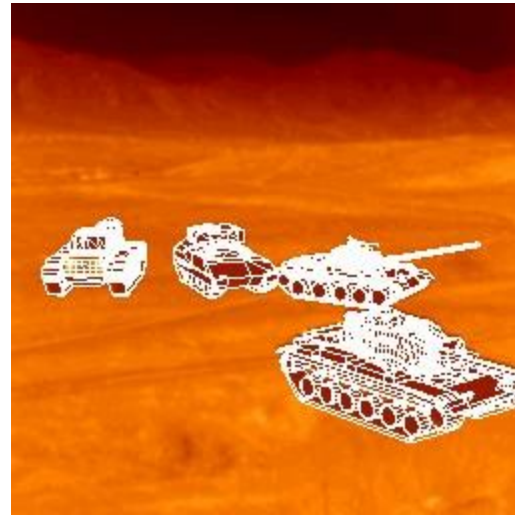
- Color, texture



$T = 33.6s$, found 2 of 2

Target Recognition

- Department of Defense (Army, Airforce, Navy)



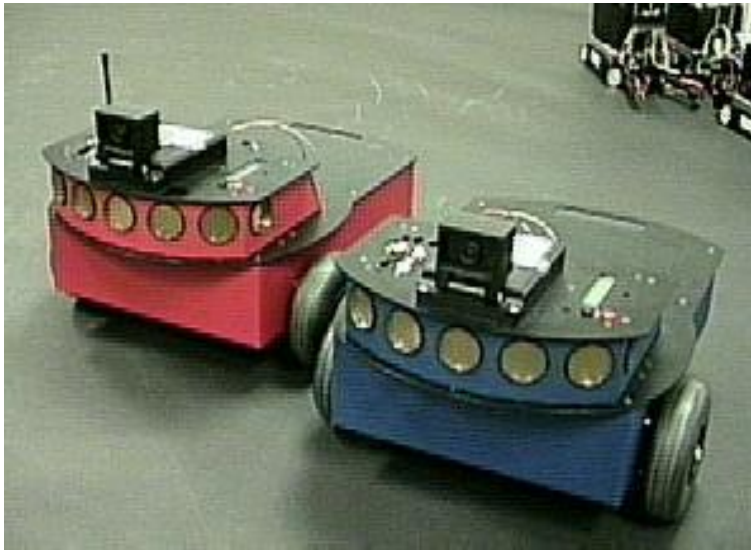
Interpretation of Aerial Photography

Interpretation of aerial photography is a problem domain in both computer vision and registration.

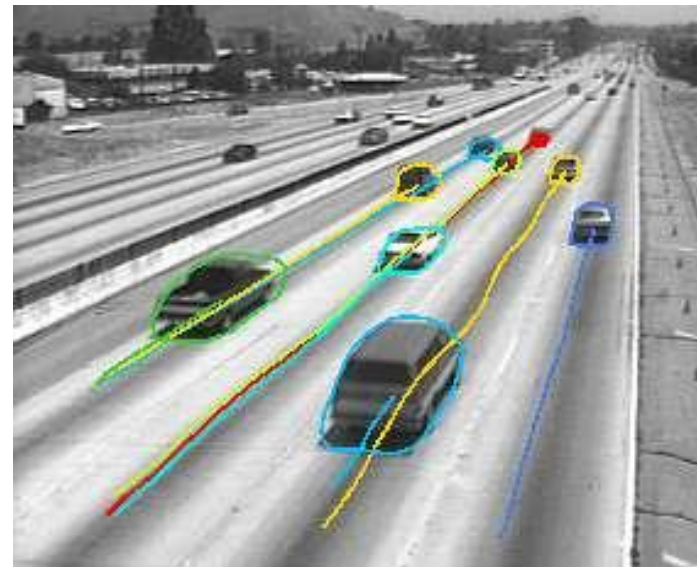
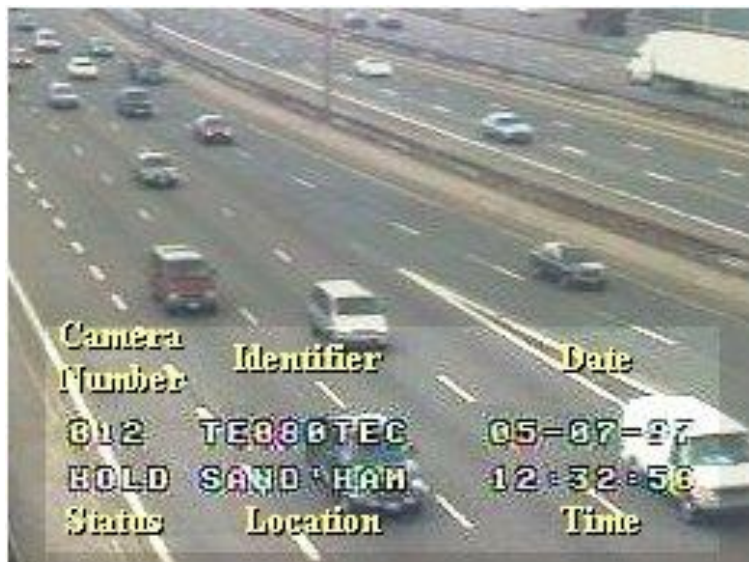


Autonomous Vehicles

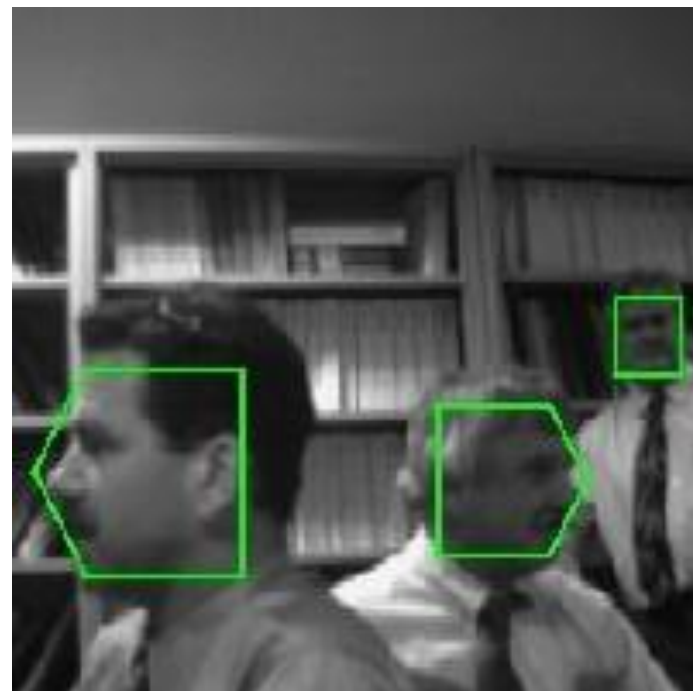
- Land, Underwater, Space



Traffic Monitoring



Face Detection



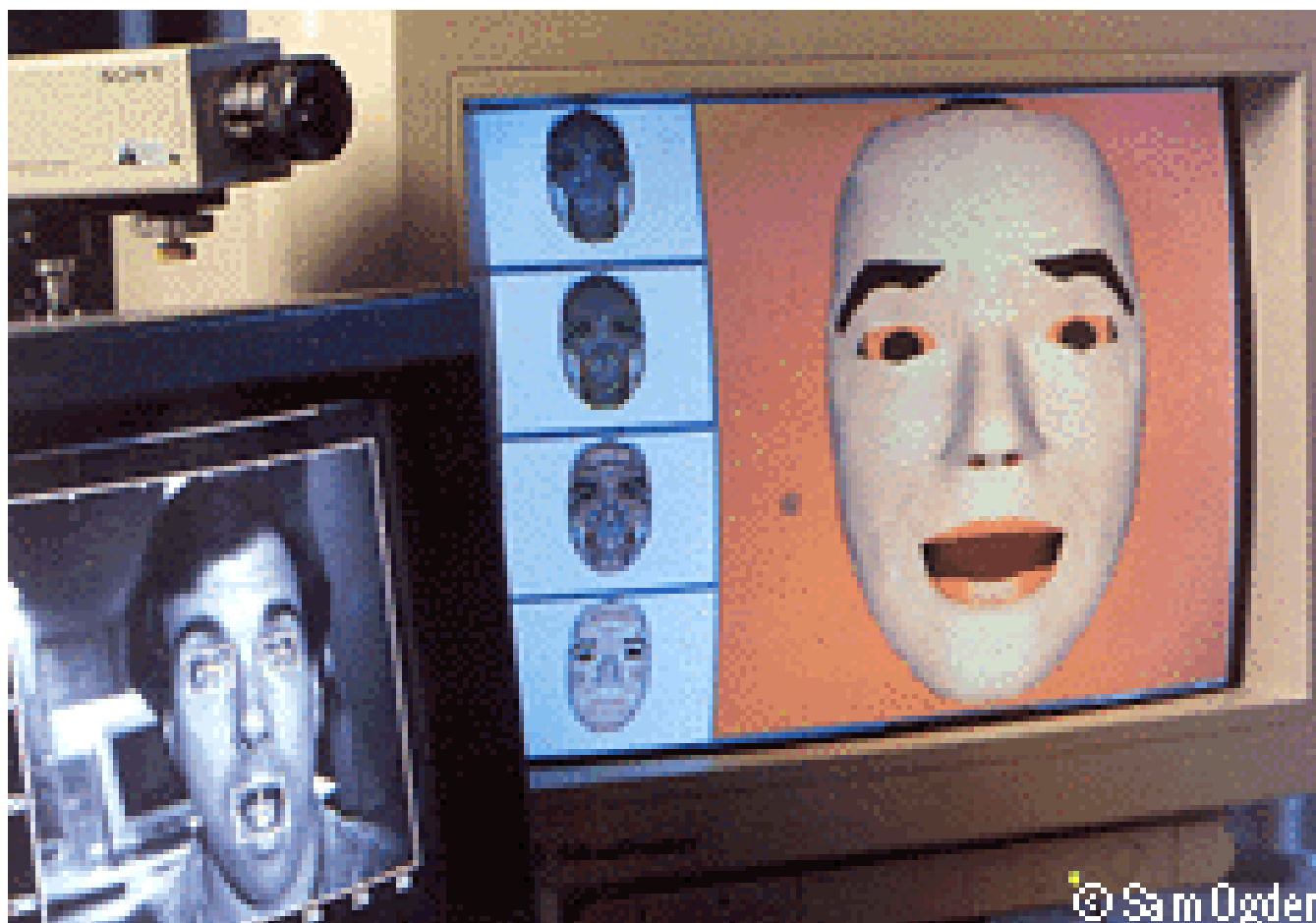
Face Recognition



Face Detection/Recognition Research at UNR



Facial Expression Recognition



Face Tracking



Face Tracking (cont'd)

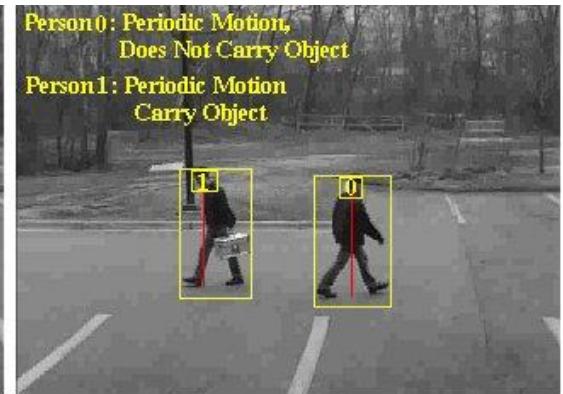
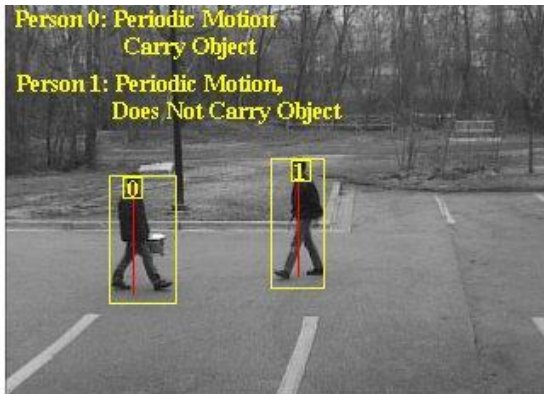


Hand Gesture Recognition

- Smart Human-Computer User Interfaces
- Sign Language Recognition

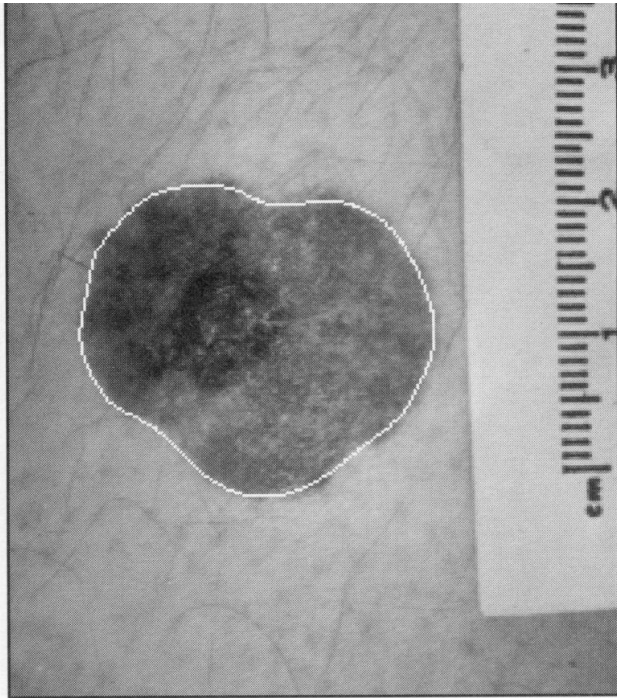


Human Activity Recognition

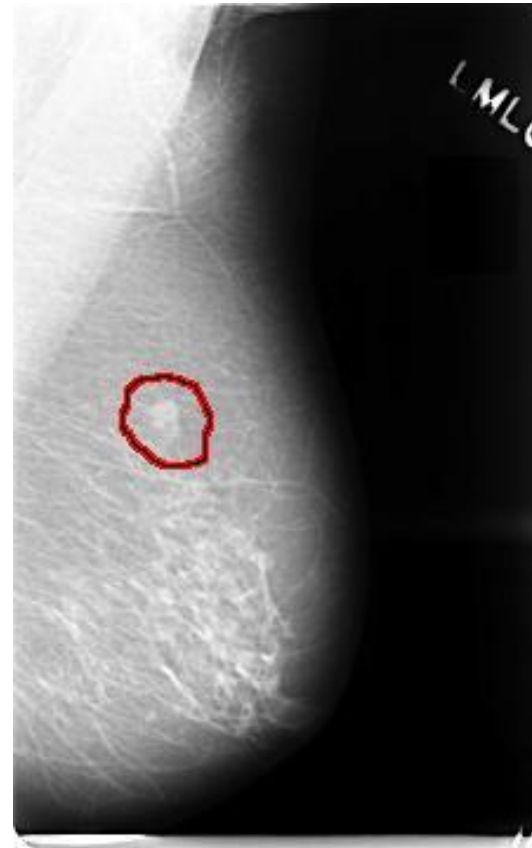


Medical Applications

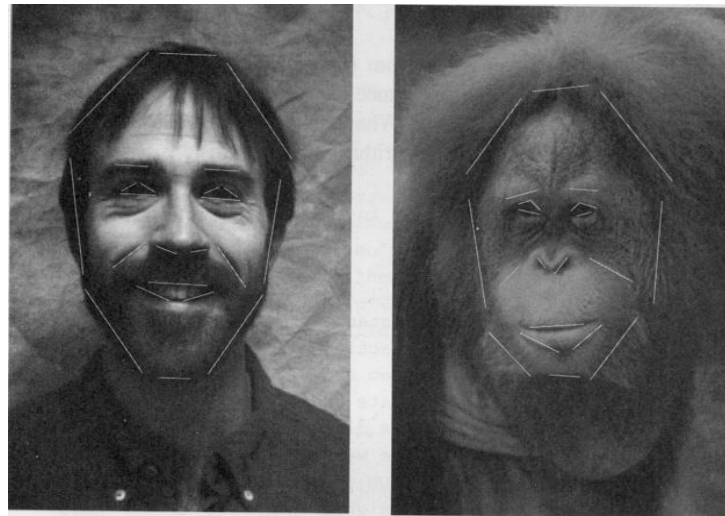
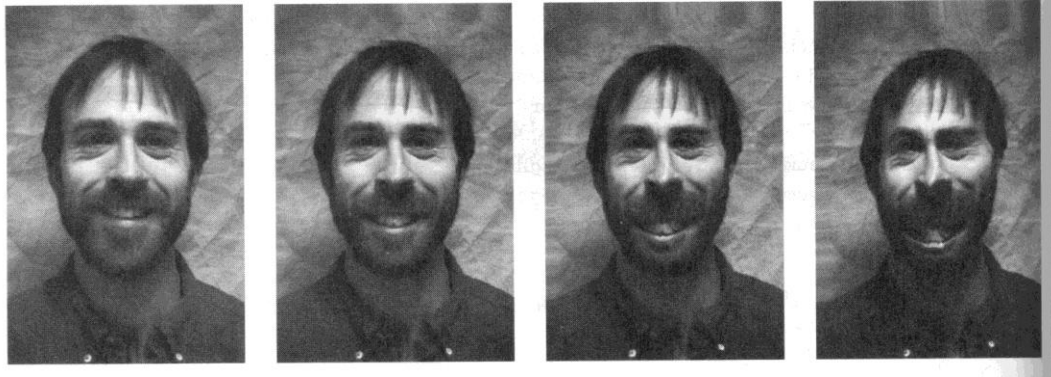
- skin cancer



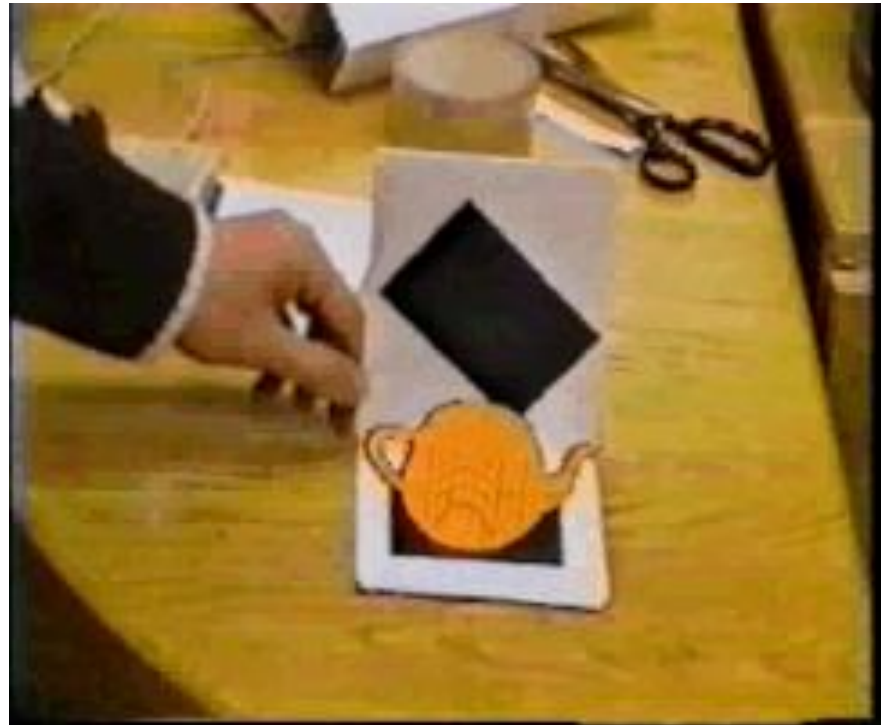
- breast cancer



Morphing



Inserting Artificial Objects into a Scene



Companies In this Field In India

- Sarnoff Corporation
- Kritikal Solutions
- National Instruments
- GE Laboratories
- Ittiam, Bangalore
- Interra Systems, Noida
- Yahoo India (Multimedia Searching)
- nVidia Graphics, Pune (have high requirements)
- Microsoft research
- DRDO labs
- ISRO labs

Text & Reference Books

- Rafael C. Gonzalez & Richard E. Woods, “Digital Image Processing”, Pearson Education.
- A.K. Jain, “Fundamental of Digital Image Processing”, PHI.