



# IMAGE PROCESSING

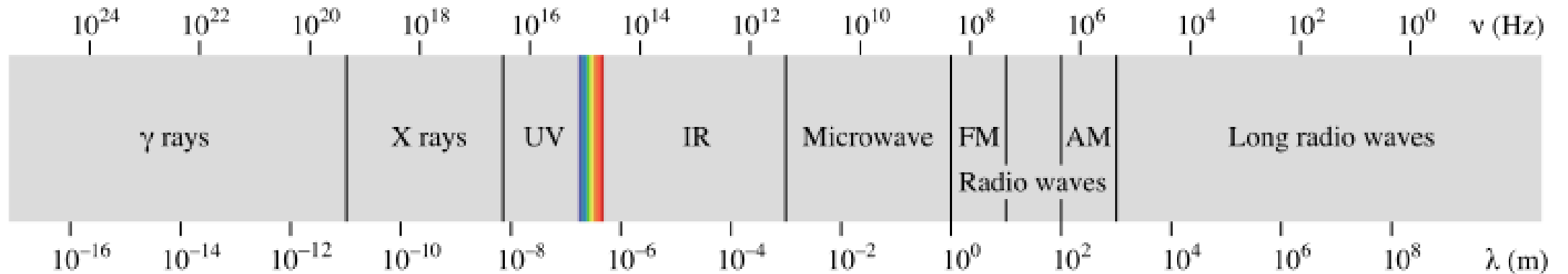
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# Scope of Image processing

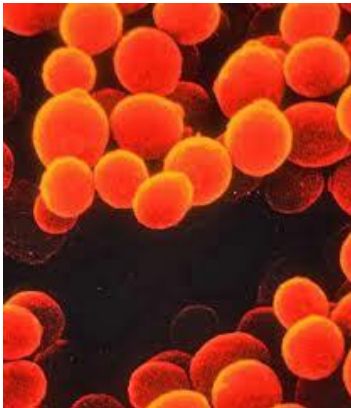
- Applied in whole range of electromagnetic waves



- Applications in many scales: micro scale, human scale, remote sensing, cosmos scale

# In wide range of applications

Biology



Astronomy



Medical



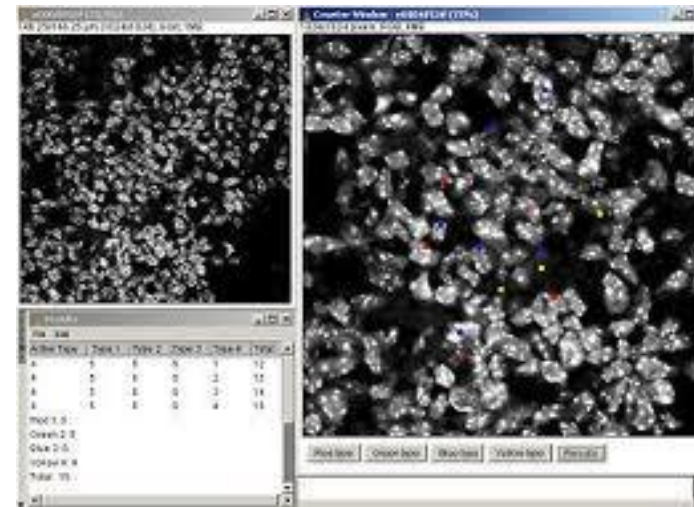
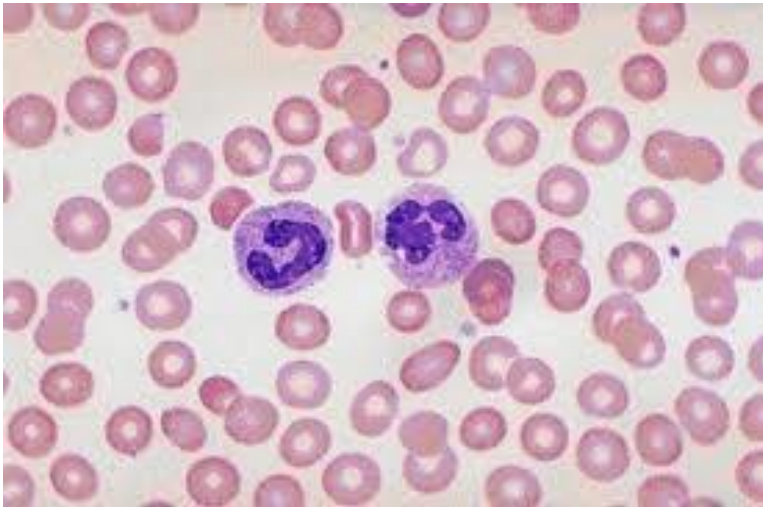
Daily images



Lab of HM  
Le Thanh Ha, Lab of HMI

# Biomedical imaging

- Cell counting

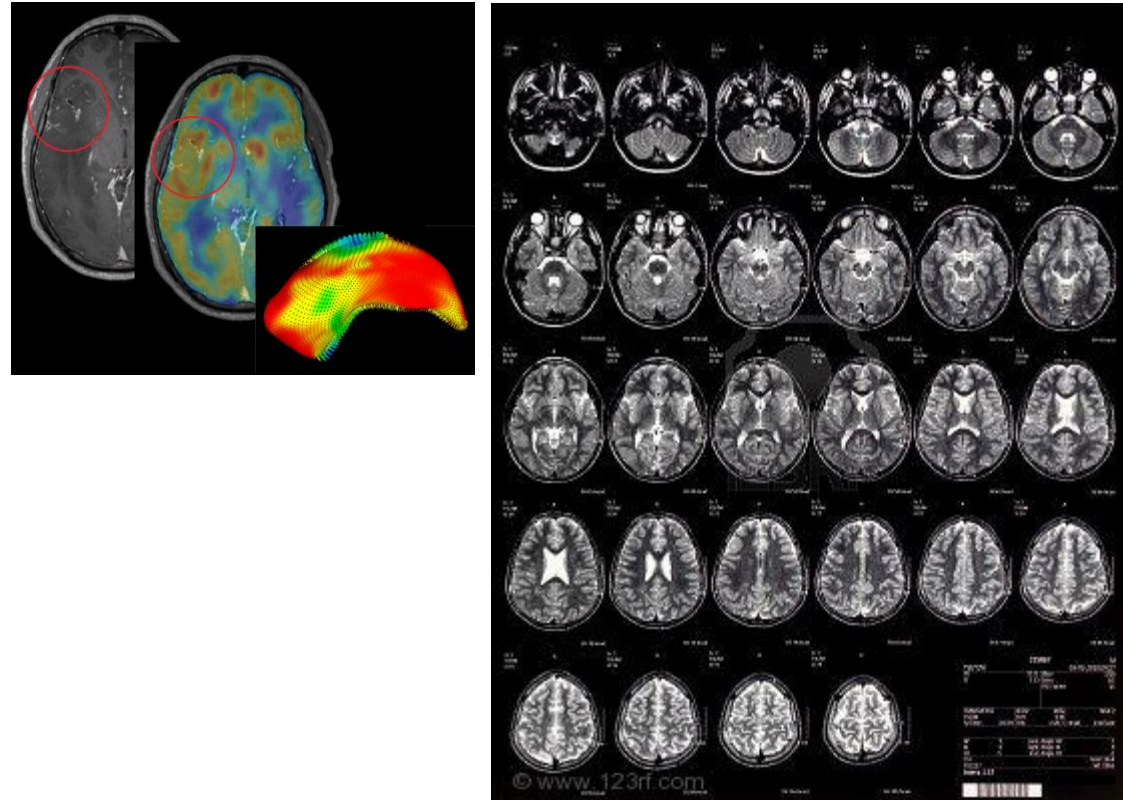


# Medical imaging

X-ray - Broken bone



Magnetic resonance imaging (MRI) images – Brain

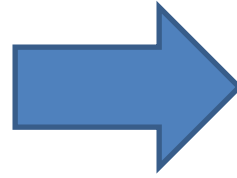


Ultra sound – prenatal baby



# Imaging in Industry

- Control product quality and appearance



# Automatic sorting

- Barcode 1D&2D for identifying products and consumer items





# Imaging in robotics

Sputnik



Sony Aibo robots - RoboCup



Mars rover - Opportunity



Industrial Parallel robot:  
Picking & Placing





# Satellite images

Wiki mapia



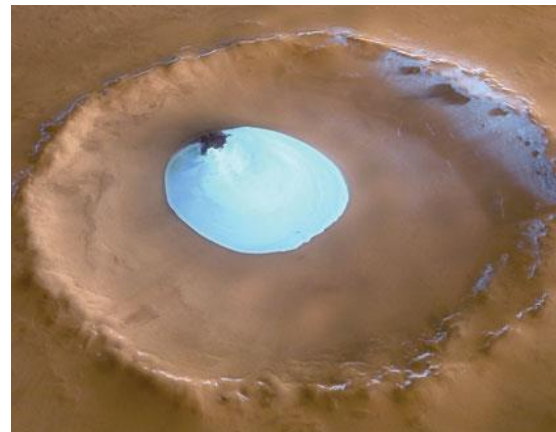
Weather forecast



Fire detection



Where is it???

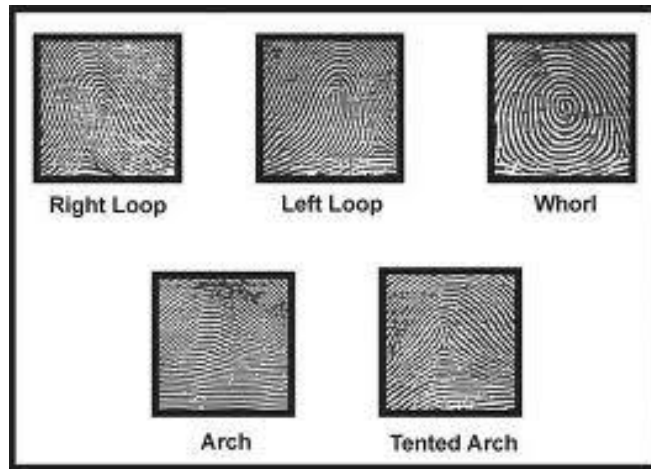


Military: Iran Nuclear Facility

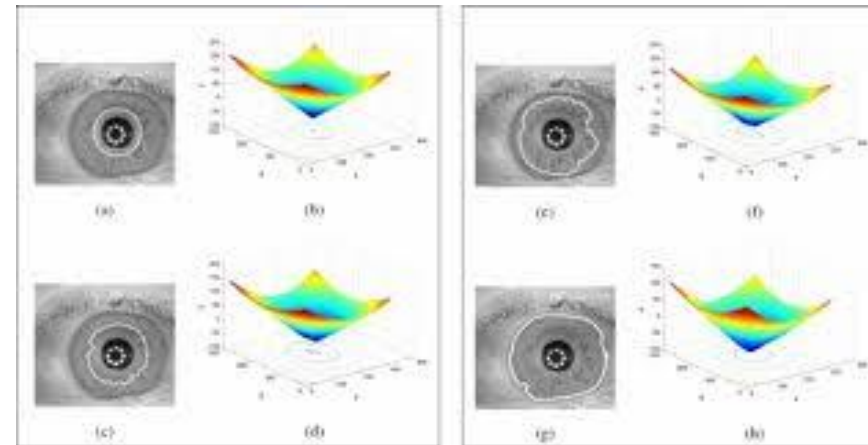


# Images in biometrics

Finger print



Iris recognition



Face Detection & Recognition



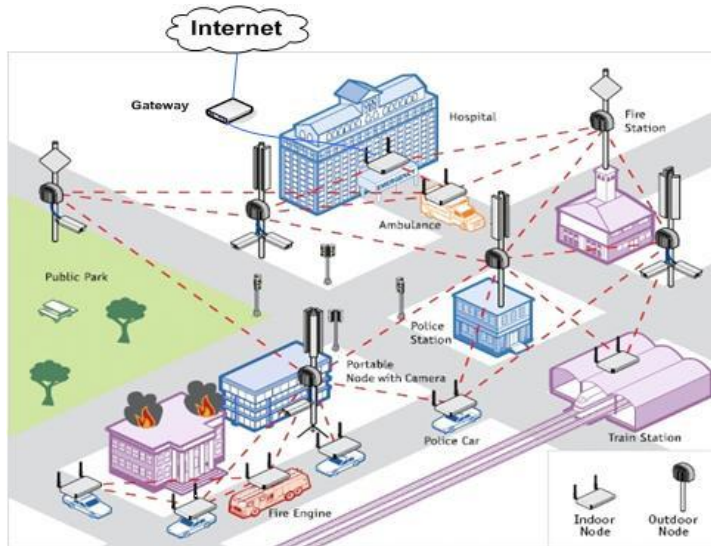
Le Thanh Ha, Lab of HMI



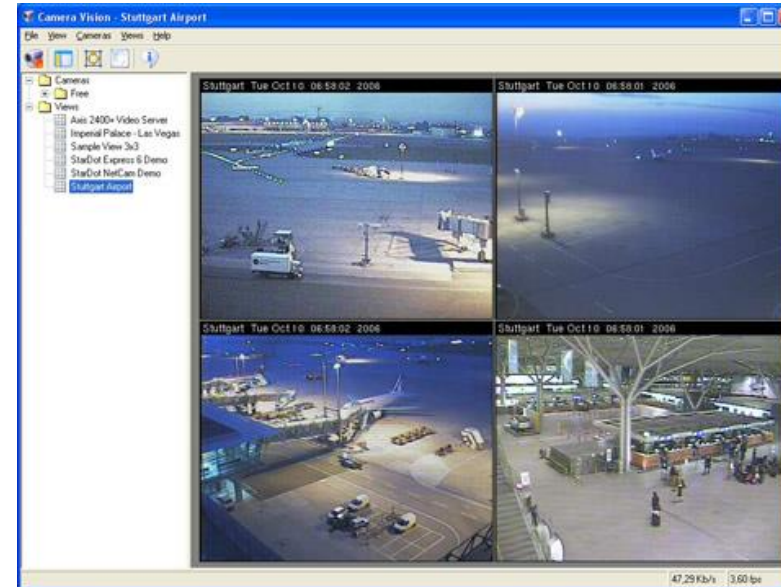


# Surveillance systems

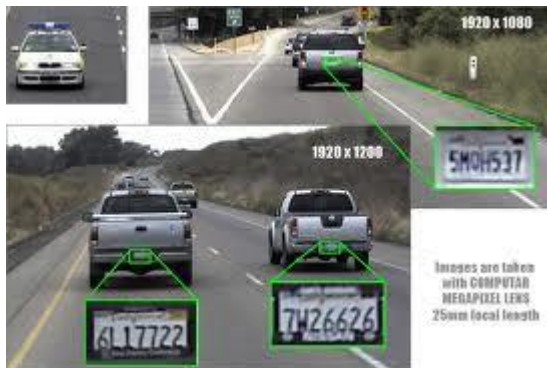
Transportation service



Security service



Vehicle plate recognition



Super market monitoring



# Astronomy images

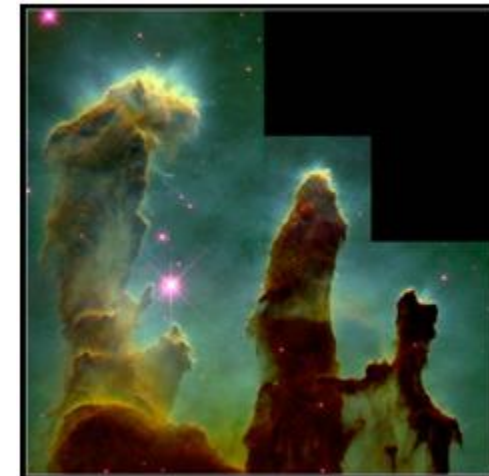
NASA Hubble Telescope



Supernova Bubble (160,000  
light-years from Earth)



Engle Nebula  
(7,000 light-years  
from Earth)



# Office applications

- Character recognition:
  - Vietnamese/English
  - Printed text - Scan/ digital text - PDA

Example of online text  
recognition application





# Camera 360





iphone



oppo

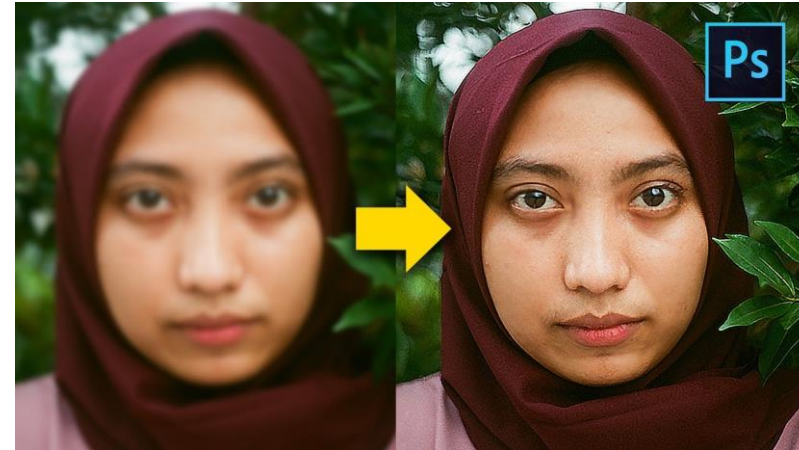


# AI-Based Image processing

Colorization



Supper resolution

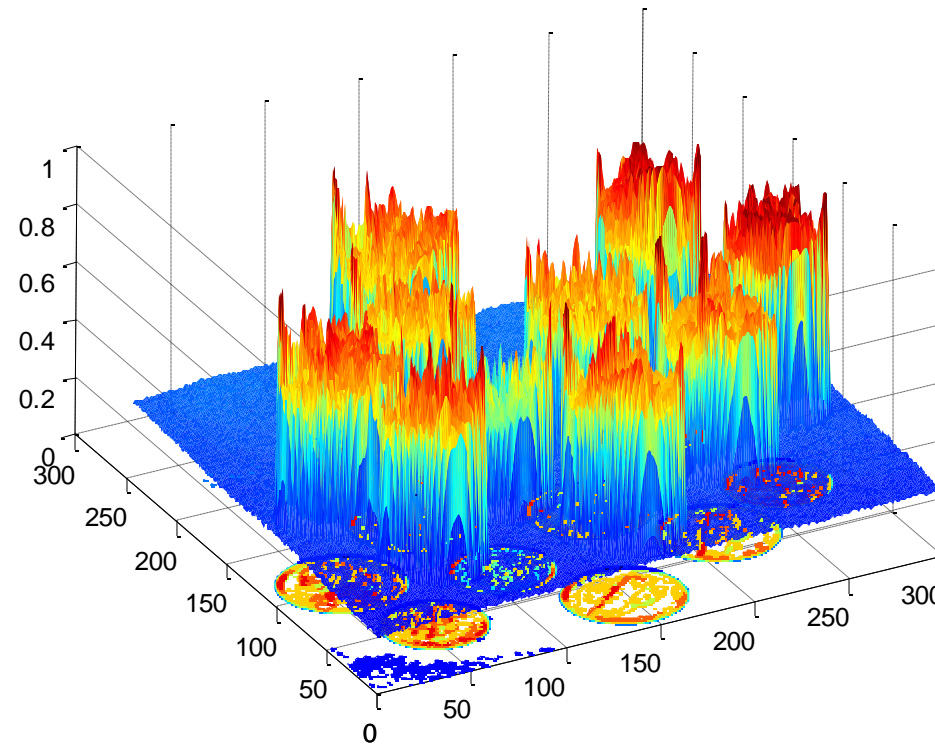


Toonization



# Concepts of Digital Images

- An Image is defined as a 2D function,  $f(x,y)$





# Digital Image Processing

- Low-level process:
  - Inputs and outputs are images.
  - Noise reduction, contrast enhancement, ...
- Mid-level process:
  - Extract attributes from images.
  - Segmentation, single object recog., ...
- High-level process
  - Perform cognitive functions