Mid Exam

Digital Image

1. What is a digital image?

A digital image is a discrete representation of data processing both spatial and intensity.

- Discrete => separate
- Spatial => Layout
- Intensity => color

2. Image => 2D plane
   - combination of pixels

3. Pixel => Combination of pel or picture elements
   - Each pixel has some intensity/shade/color

4. Raster Image => Image through camera any other devices. (scanners & digital camera)

5. Vector Image => Through computer & Using matrix.

6. Basic color => RGB => (Red, Green, Blue)
   Other colors => CMYK
   - Binary color

- CMYK ⇒ Cyan magenta yellow and key.
- Digital Image ⇒ Gray scale processing
- Binary color → 0 & 1 (Black & white)

7. Camera through pixel
   ↳ single scaler element or a multiple component, representation.

8. Raster:
   ↳ A finite set of digital value.
   Image ↳ Pixel position
   or
   pixel ↳ Intensity

9. Digital Image processing

- First → Digital signal processing
- Now → Digital image processing

10. Raster file formats:
   ↳ through digital cameras

Lossless:
1. TIFF (Tagged Image File Format)
2. GIF (Graphics Interchage Format)
3. BMP (Windows bitmap)
4. JPEG

∴ Mathematically an image is a matrix.

$$\begin{array}{c} \\ 1 \\ \vdots \\ n \end{array}\begin{bmatrix} 1 & 2 & n \\ a_{11} & a_{12} & a_{1n} \\ a_{m1} & a_{m2} & a_{mn} \end{bmatrix}$$

∴ m = no of rows
∴ n = no of columns

Digital image $I(m,n)$
↓
name of Image

∴ Raw image format ⇒ ① TIFF (Tagged Image File Format) → positive
② JPEG (Joint photographic experts groups) For storage, printing & manipulate.

∴ Raster graphics ⇒

∴ Digital Negative ⇒ is based on TIFF/EP (Electronic photography)
↳ Graph
↳ 2 standard formats
(i) TIFF
(ii) EP
⇒ Both are lossless

Vector:,

A vector consist (Both magnitude, or length and a direction).

Types =) 1) EPS (Encapsulated postScript) of vector

2) PDF (Portable Document Format)

3) AI (Adobe Illustrator Artwork)

Image viewing:, General, webbrowser slideshow

- PNG (Portable Network Graphics) is a raster, lossless data comparsion) graphics
- SVG (Scalable Vector Graphics) is an Extensible Markup language XML based vector image.
- JPEG =) lossy
- GIF =) lossless

are W3S format.

- Scientific image very large.

Milky way =) 194Gb in size.

Digital Image Sensors:-

- MOS technology.

MOS => Metal - oxide - semiconductor Field effect transistor.

- Invention => Mohammad M. Atalla &
  => Dowon Kahng
  Bell Labs in 1959

Digital Image Processing:-

Is the use of a digital computer to process digital images through an Algorithm.

- Data can be represent in two types
  1. Analog
  2. Digital

- Distortion => alteration of the original shape of something

- Noise => General term for unwanted modifications

capture, storage, transmission, processing or conversion.

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Computer Vision

CS-718

computer — 2 Types — something relating with seen

→ The vision of computer.

How a computer see. (Through camera)

sensory system
1) See
2) Touch
3) Smell
4) Taste
5) Hear

(*) What is computer vision?
↳ is the science and technology of machine that see.

Primary thing ⇒ camera
you need to understand → Images
↓
KNOW about image is huge task.

Digital Image processing ⇒ (6) Computer Vision

∴ Video ⇒ 25 images per second
↳ sequence of images

(★) Artifical System ⇒ computer vision

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(★) Make computers understand images and videos.

computer ⇒ understand
↳ not only see

(★) Main component of CV
↳ (1) Camera
↓ just tool
⇒ Develop program to perform some task.

(★) Computer vision Vs Human vision

image
↓
[Matrics
↳ number
Digits

Rage of number
⇒ 0-255

(★) Computer is nothing without Algo, program generated by Human.

Computer Vision → Wiki pdf

Assignment
8-March-2021

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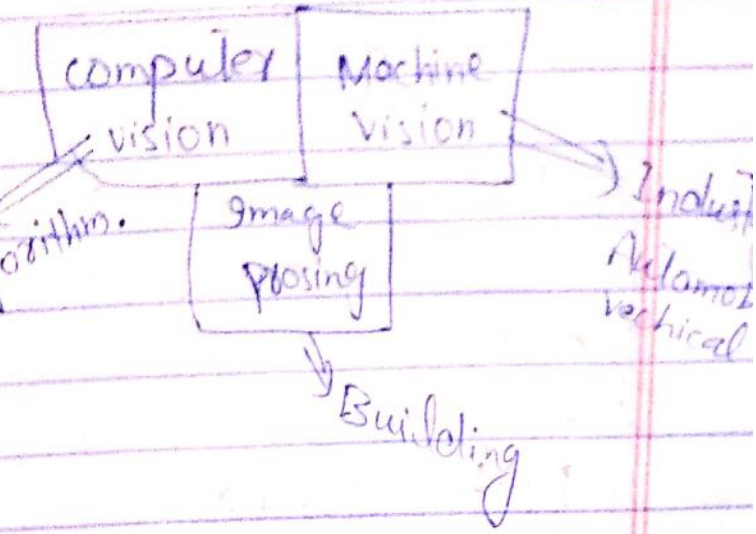
(*) Vision is really hard

(*) Vision is multidisciplinary



1) HCI => Human Computer Interaction
2) Mathematics
3) Control Robetics

These are most imp

(*) Why computer vision matter => very much
(1) Safety (2) Health (3) Security
(4) Comfort (5) Fun (6) Access

Beginning of C.V => 1966

1980 => Artifical Neural Networks

2000 => full body => broader recognition

HCI => interaction
↳ with Different apps => like Mobile
↳ using whatsapp
↳ using
↳ chat with friends

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★ Face detection
↳ oldest example
Family picture

★ Object recognition
↳ gmp for research topics

★ Vision based biometrics

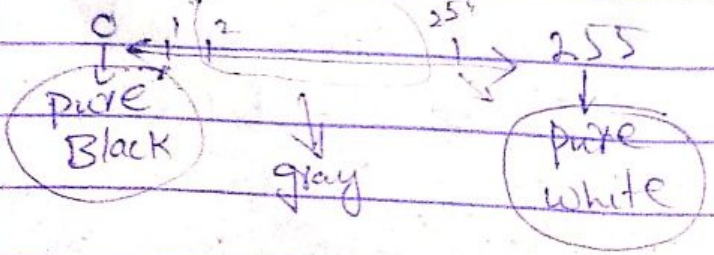
Computer Vision

Mubarak Shah
Shah@eccs.ucf.edu

(0) black
(255) white → in b/w gray

collection of pixel ⇒ image
B+W = Gray

Binary image → 0,1 no
colored image ⇒ 0 - 255



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1 byte → 8-bits
↳ 0 – 255 value

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Depth size
1 byte
↓
Gray image

Bit-depth ⇒ 1 byte
↓ 0 – 255

Depth size ⇒ 2-byte
65536

0 —— 65535
↓ (B) ↓ (W)

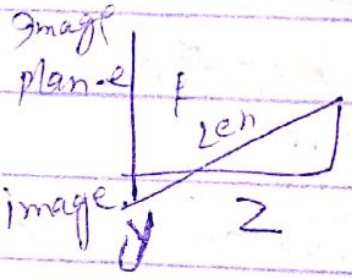
Every image
↳ (1) Frame

(*) camera ⇒ two parameters

picture
↳ 3D scence
↳ 2D-image project

3-D ⇒ World / Wis

2-D ⇒ image captured



$$\frac{-y}{y} = \frac{f}{z}$$

$$y = \frac{-fy}{z}$$

f ⇒ focal length

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12 columns, 16 Rows

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Matrics

Image ⇒ Mathematical (Matrices) on computer Form

- Pixel (layout) ⇐ Rows → columns

$16 \times 12 = 192$
R C

- pixel (Intensity) → color

Image → pixel
1. → Matrices
2. → Shade
   - → Intensity
   - → Color

⇒ Each pixel has some intensity / shade / color.

1-byte ⇒ For each pixel.
(8-bits)
↳ possible range ⇒ 0 – 255 ⇒ If range increase than 1-byte not enough.

1. 0 ⇒ black intensity / shade / gray level
2. 255 ⇒ White " " "

↳ b/w colour / different shades.

Matrics ⇒ Row / columns
↳ location of elements

Note ⇒ location of elements cannot be changed.

16
12 1
32
16 x
192

Matrics ⇒ Rows/columns
↳ in Matlab ⇒ 2 Dimensional arrays

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∴ Image processing
↳ Matrics ⇒ process

∴ 1 → pixel ⇒ 1 byte
in RAM according to our self

∴ 1 → pixel stored
↳ bit / Depth ⇒ How many colors

∴ 1 bit per pixel (1bpp) = 2 colors
∴ 2bpp , 2^2 = 4
∴ 2bpp , 2^3 = 8
∴ 8bpp , 2^8 = 256
∴ 16bpp , 2^{16} = 65536
∴ 24bppp , 2^{24} =

Drawback
↳ Memory more than consume

Mathematically an image is a Matrix

$$\begin{matrix} & 1 & & 2 & & n \\ 1 & \left\{ \begin{matrix} a_{11} & & a_{12} & & a_{1n} \\ \\ a_{m1} & & a_{m2} & & a_{mn} \end{matrix} \right. & & & & \\ m & & & & & \end{matrix}$$

always indicated by an image ⇒ ∴ image $I(m,n)$

I ⇒ name of a image

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∴ Digital image $I(m,n)$ ⇒ standard representation of an image.

I ⇒ name of an image

∴ Input signal ⇒ continues / Analog

m ⇒ Row
n ⇒ Column

★ Sampling & Quantization
analog → digital

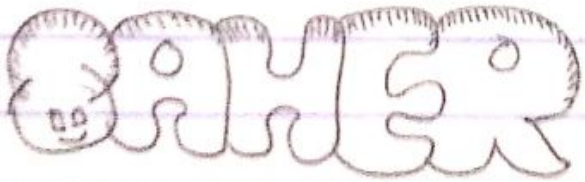
① Sampling ⇒ corresponds to a discretized of the space.

② Quantization ⇒

Assignment

② Digital image

② Digital image proc... wikipedia



Developer → focus on market side (software not suitable for matlab.

MS → Researcher students

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book text with image proc. Computer vision → Computer Vision

Matlab → program run/compile
→ if-else / program
→ Similar to C++
easily way to access

Matrix Laboratory
→ language → like java, C, C++
→ programming easily

benefit
1. → without any data directly assign value, of a variable.
2. → Not include any library. any tools

why need.
1. Matlab → suitable for researcher
2. R language → both used in research work.

Matlab interface
1. current folder
2. workspace → All variables in program appear in workspace.
   - Name
   - value

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③ Command window ⇒ Small program used.
↳ Direct matlab command execute ⇒ Enter

④ Editor
↳ If program lengthly

Matlab ⇒ help very very rich
↓
is a language

Note ⇒ In matlab you can use variable without given any data type & use data type also.

Note:- In matlab any variable use according to matrix.

Matrix ⇒ row & column combination

Both toolbox used in this course

why many tools?
① ?
↓
help click.
② contents
↳ next show all tools

∴ Automatic Driving tool
∴ Computer vision toolbox
∴ Deep learning toolbox
∴ Image processi toolbox

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X = 1;

↓ Matrix: Row & columns,
→ One row & one column

In Matlab

Command window
X = 1;

Workspace
Name: X
Value: 1
Double click
Dimension 1X1 double

* Row vector
↳ only one row & multiple columns

* Column vector
↳ only one column & multiple rows.
↳ Mostly used

Note :-

Vector :- Both Quantity and direction
↓ column vector

Scaler → Quantity not direction

In accordingly to

In matlab

→ In only one value store

→ Single row but multiple values.

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Computer Vision

=> According to Exam important

Image processing Toolbox

(1) Geometric transformation and image registration

Type of processing
↳ Geometrically transform

eg:- Two diminisonal plane x, y-axis

Note:- ORegion of image is called top first row and column.

∴ Image => 2D plane => If geometrically work then
↳ 2D matrix

(i) Common geometric TransFormations
(ii) Generic geometric "

(i) Common geometric transformation

1. ↳ imcrop => Crop image
2. ↳ imresize => Resize image
   ↳ no of pixel changed / Less / grater
   ↳ image locked not distributed

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Matlab program extension → .m

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=) Image pixel increase/ Decrease.

imresize3 =) Not use

3. imrotate =) Degree 30°, 45°, so...

imrotate3 =) Not use

4 imtranslate, =) translate image

Translate ← LtR (-10.1) ↳ RtoL ↳ 255 → color

Only 4 top cover.

1. Imcrop =) way of imcrop is 9.

I = imread('name of image. image of extension');

↳ load image Function

whos =) show workspace data

whos variable name =)

Detail of function

Output Arguments

I_2 = imcrop(I[75 68 130 112]);

size of rectangle

name of image

GPU:- GPU of common computer use.
(parallel processing)

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2. imresize => ways of imresize is 5.

=> imresize(I, 0.5);

I => name of image
0.5 => resize of a image

∴ Scale => How many size of image (Increase / Decrease)

Methods:
=> 'nearest', 'bilinear', 'bicubic' => name + definition

3. imrotate => 3 way
=> Basic J = imrotate.

4. imtranslate

4. Top cover properly.

common CPU & common GPU working changed

Not in exam Question about GPU

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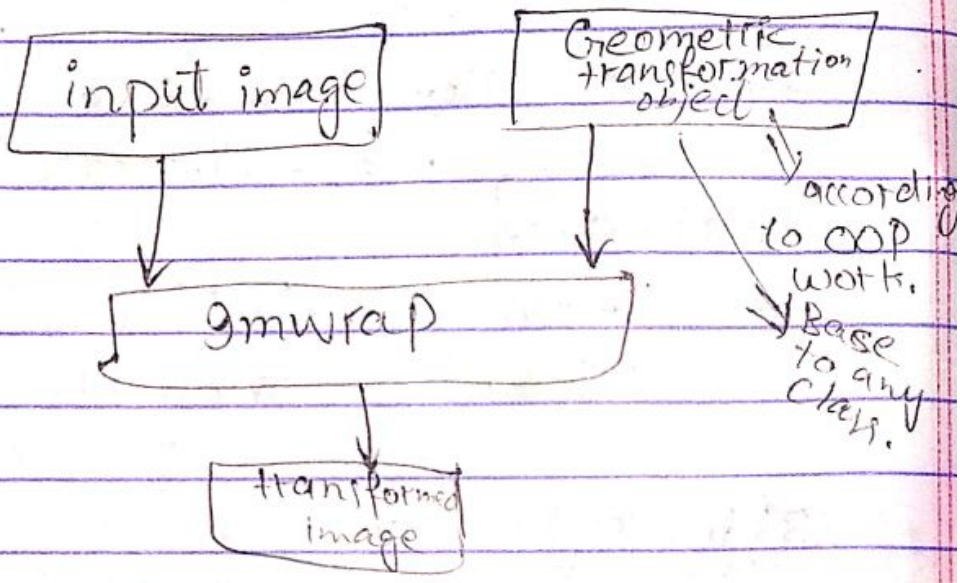
Class:- Template
↳ Create objects
OOP ⇒ C++

Generic
(2) Geometric transformations

(i) 2-D and 3-D geometiric transformation process over-viem.



Types of geometry object 5 ← object create using transformaled → affine2D, affine3d, projective2d

5-ways to create these transformation object

Table information must.

(*) Affine → ? transformation

All Affine operation ← imcrop, imresize, imrotate, imtranslate

12/04/21 [Sir Ahsan CV] Monday

Generic Geometric Transformations
↳ last => Featured example

2D and 3D

Mathed name → Definition

① Define transformation Matrix

⑤

object create mathod.

① Define tranformation Matrix

(2D Affine) => Most common

Four types of Define

① Translation ② Scale ③ Shear

④ Rotation

affine + Definition

Types of Affine

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(1) Translation => Image shift
=> geometric object must

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ t_x & t_y & 1 \end{bmatrix}$$

(2) Scale => Length / width => Image shift
=> Geometric object must

$$\begin{bmatrix} S_x & 0 & 0 \\ 0 & S_y & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

(3) Shear => object must

$$\begin{bmatrix} 1 & shy & 0 \\ shx & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

x → axis
y - axis

(4) Rotation => object must

$$\begin{bmatrix} \cos(\alpha) & \sin(\alpha) & 0 \\ -\sin(\alpha) & \cos(\alpha) & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

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2D projective Transformation

Tilt $\Rightarrow \begin{bmatrix} 1 & 0 & E \\ 0 & 1 & F \\ 0 & 0 & 1 \end{bmatrix}$ (vanishing point ↓ point infinite)

3D Affine $\Rightarrow$ with types example.

imrap $\Rightarrow$ $y = mx + c$

Vanishing point $\Rightarrow$ eye point / converge

∴ checkerboard (n) ↓ size of pixels

	0°	30°	45°	60°	90°
cos°	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
sin°	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
tan	0	$\frac{1/2}{\sqrt{3}/2}$	$\frac{1/\sqrt{2}}{1/\sqrt{2}}$	$\frac{\sqrt{3}/2}{1/2}$	
	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	∞

∴ checkerboard (size 90, P, Q)

Farmbat Express( )