SRM INSTITUTE OF SCIENCE & TECHNOLOGY

12marks

① Explain about feature detection.

→ Feature detection is a low-level image processing operation

→ It is usually performed as a first operation to see and examine every pixel, if there is a feature present at that pixel.

→ There are some algorithms associated with it.

    ⊙ Harris corner algorithm

    ⊙ Shi-Tomasi corner "

    ⊙ SIFT (Scale-Invariant Feature Transform)

    ⊙ SURF (Speeded up Robus Features)

Harris corner:

→ It is used to Detect corner in i/p image.

→ It has 3 main steps

    ⊙ Determine the part of the image that has large variation in intensity (mostly corners)

    ⊙ compute Score Value R

           ↳ correctly identified pixels.

    ⊙ Apply threshold to the score & mark the corners

Shi- Tomasi corner algo.

→ Another corner detection algo.

→ Similar to Harris corner.

→ Only difference is computation of R value.

→ Allows us to find best corners in the image.

SIFT

→ Detection of corners, blobs, circles.

→ Here Harris and Shi-Tomasi fails

→ This plays a major role.

→ It can detect features irrespective of size and orientation.

Speeded-up Robust Feature (SURF)

→ Upgraded version of SIFT.

② Approaches used to locate boundary curves in images. Explain intelligent Scissors and level set in detail

→ we have three related approaches to locating such boundary curves in image

→ The first, originally called as <u>snakes</u> – is energy-minimizing 2D Spline curve that move towards strong edges.

→ Second one is intelligent scissors allow to sketch a real time curve

→ <u>level set techniques</u> evolve the zero set of characteristic function.

Intelligent Scissors :

→ Intelligent scissors allow objects to be extracted quickly & accurately using simple gesture motions with a mouse.

→ It uses Dijikstra algorithm and Breadth First search algorithm.

→ Navigate the boundary

↓

Rough curve

↓

Freeze

↓

Cut.

Level Set Technique:

→ This technique acts as a tool for numerical analysis of surfaces and shapes.

→ For a 3D space the constant value c in the range is calculated by

$$c = f(x, y, z)$$

→ It is said to have flexible material domain

→ For local measurements we use local minima, in level set.

→ Fastest method.

Set-B

(6) How can we quantify the performance of a matching algorithm?

→ Matching algorithm deals with how much the image matches with the other one in order to further process the image to its next step.

→ As a first step we use Euclidean feature descriptor to match the potential matches
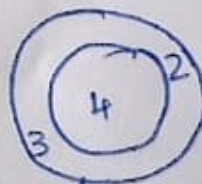
→ If the images are not same they have changed too much.

→ Then as next step it tries to match the known matching objects.

→ The transformation to new scaled basis is called whitening.

→ True match

→ False match

Performance of matching algorithm

TP: True positive
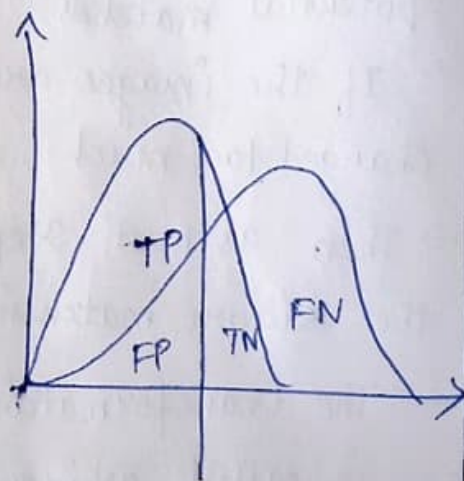
FN: False -ve

FP: False ve

TN: True -ve.

TPR = True positive rate

$$= \frac{TP}{TP+FN} = \frac{TP}{P}$$

FPR = $\frac{FP}{N}$

PPV = $\frac{TP}{P'}$

ACC = $\frac{TP+TN}{P+N}$

⑧ Graph cuts and energy - based methods

→Graph cuts are efficient graph based Segmentation technique that has 2 parts

⊙ Data part → measure data's segmentation area.

⊙ Regularisation part → measure smooth boundaries

Fully connected graph

→ node for every pixel.
→ links every nodes.

min (s-t) cut

→ connect every other nodes
→ create ∞ cost link. to t node.
→ create ∞ cost link to s node.

Segmented Graph

→ Break Graph into segments.
→ similar pixels should be in same segments
→ Dissimilar in different segments

Energy cost functions

→ Used for quantization of data features

→ Eg: Distance metric - Image is sent as a binary image

$$E(b) = \sum_{i,j} E_r(i,j) + E_b(i,j).$$

→ The most natural energy form is

$$E(b) = \sum V_{pq}(b_p, b_q) \sum D_p(b_p).$$

$V \rightarrow$ boundary penalty

$D \rightarrow$ Regional Penalty.

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<u>4 marks</u>

① Explain about Edge detection

→ Edges are significant change in intensity in an image.

→ The main goal of edge detection is to get the line drawing of the image.

→ It is used in high level computer algorithms

<u>Types of intensity changes</u> (SRRR)

→ <u>Step edge :</u> intensity value changes abruptly from one value to another

→ <u>Ramp edge :</u> intensity change over a finite distance

→ <u>Ridge edge :</u> intensity value abruptly changes but it returns back to its original value.

→ <u>Roof edge :</u> same as ramp edge.

④ Explain about intelligent scissors.

→ Intelligent scissors is the technique that allows to extract the required object using mouse gestures.

→ It forms a boundary and snaps out the object image

→ Navigate the boundary

↓
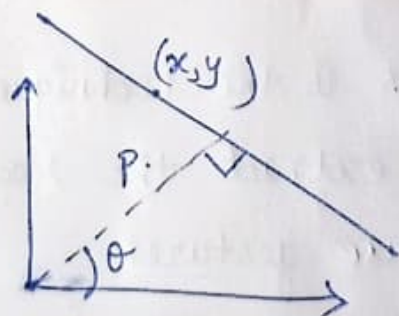
rough boundary

↓

freeze

↓

req. object image alone.

③ **Hough Transform Technique.**

→ Hough Transform is a feature extraction method for detecting simple shapes such as circle, lines etc.

→ The main advantage of using the Hough Transform is that it is insensitive to occlusion

↳ two/more objects come closely seemingly merge.

→

→ $d = x\cos\theta + y\sin\theta$

Advantages

→ works on disconnected edges

→ insensitive to occlusion

→ Effective for simple shapes.

⑤ what is meant by region splitting and region merging?

Region Splitting:

→ Recursively splitting large objects into smaller components based on given attributes

→ Attributes include color, texture, intensity etc.

→ These are recursively split to max regions and further merged in order to form a good segmented image of the original image.

Region merging:

→ In merging technique we consider every pixel as individual region.

→ we select a region as the seed region to check if adjacent region are similar based on predefined rules.

→ If they are similar, we merge them into single region.
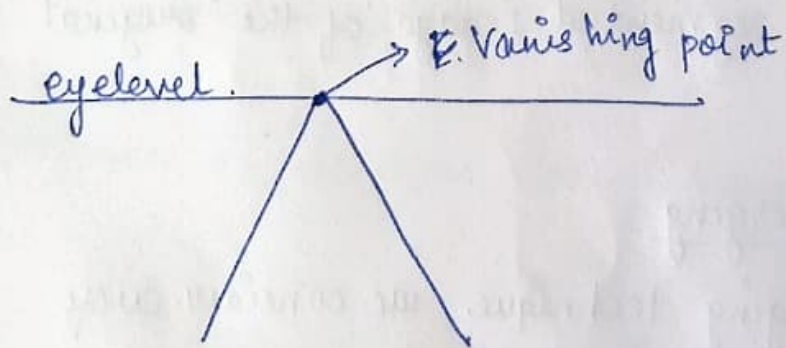

Set B

① Explain about Vanishing point.

→ point on the image plane where 2D drawing in 3D space appears to converge.

→ It's aka direction point

→ It is the spot at where all ll^e line converge

→ Helps to draw perspective drawing.

→ This technique is used in pinhole camera.

<u>eyelevel.</u> → E. Vanishing point

② Explain about snakes?

→ The snake algorithm in computer vision is also called as Active contours.

→ It works like stretched elastic band being released.

→ It is to identify and outline the target objects.

→ Snakes are configured by use of spline.

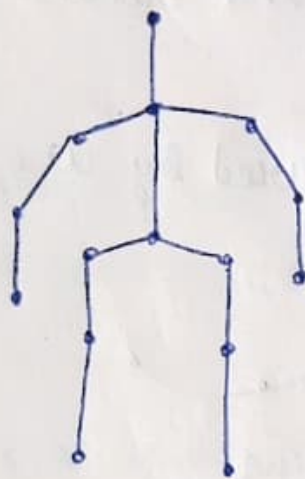→ Used in medical imaging.

Disadv:

→ ℓ. Noise sensitivity

③ note on pose estimation

→ pose estimation is a c·v· technique to track the movements of the person or objects.

→ These are usually found out by key points.

→ The connection between 2 points is called pair

→ These are widely used in Human-computer interaction, motion analysis, sports and fitness and robotics.

Skeleton based.
model.

④ **Edge linking.**

→ Useful technique where the boundaries between objects are automatically identified

→ very useful for segmentation

→ Edge linking

```
                    Edge linking
                         |
        ┌────────────────┴────────────────┐
   (Gradient                         (Guassian based)
     based)
        │                                  │
        ├→ Sobel operator                  ├→ canny edge detector
        │                                  │
        ├→ prewitt operator                └→ Laplacian of
        │                                       Gaussian
        └→ Robert operator
```

first order
   derivatives

Second order
   derivatives.