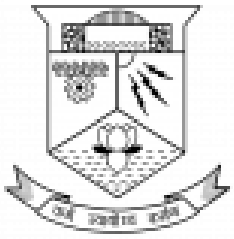
LABORATORY MANUAL

Subject code: 222LEC001

Subject Name: SIGNAL PROCESSING LAB 2

2022-2023



DEPARTMENT OF ELECTRONICS AND COMMUNICATION
COLLEGE OF ENGINEERING TRIVANDRUM
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Course PO mapping

	222LEC001 Signal Processing Lab 2		PO1	PO2	PO3	PO4	PO5	PO6
CO1	Apply knowledge of Advanced Signal Processing, Image Processing and Speech Processing in various signal processing applications.		0	0	3	0	0	3
CO2	Develop the student's ability on analysing observations of experiments/simulations, interpreting them and preparing reports.		0	0	3	0	0	3
CO3	Implement the algorithms learned in machine Learning/Deep learning for Image and Speech Processing		0	3	0	0	0	3
		Course PO mapping	0	3	3	0	0	3

Syllabus

No	Topics
Set I	**Speech, Image and Deep Learning Lab**
1	Image processing fundamentals-Simulation and Display of an Image, Negativeof an Image- Implementation of Relationships between Pixels Geometric transformations- Image rotation, scaling, and translation
2	Apply 2 D DFT, DCT and DWT transform for an image and compare the results
4	Image enhancement-Point/spatial/transform operations Enhance an image using image arithmetic and logical operations--- Gray levelslicing/Sharpening/histogram equalization/Filtering/homomorphic filtering
5	Colour image processing --Wavelet-based Image Processing.
6	Image Segmentation
7	Edge detection-basic edge detection methods- parametric and non-parametric approaches Morphological operations -dilation, erosion.
8	Object recognition in an imageTemplate matching/ clustering
9	Feature extraction from speech Implement the steps for the extraction of MFCC/rhythmic features from a given audio file Visualization of spectrogram/Mel-spectrogram---narrow-band and wide-band spectrogram
10	Implement the steps to extract LPC coefficient from the given speech file
11	Implement the steps to extract formants using homographic filtering
12	Pattern classification using machine learning/Deep learning, Implementation of KNN, K-Means Clustering, Implementation of Logistic Regression, SVM (speech or image data) Deep learning architectures using TensorFlow/Keras(speech or image data)

EXPERIMENT NO-1

IMAGE PROCESSING FUNDAMENTALS

AIM : To simulate and display an image, Negative of image, and to implement the relation between the pixels, Geometric transformations.

1. Display an image Program

- Load an image from file (replace 'path/to/your/image.jpg' with the actual file path)
- Check if the image is loaded successfully
- Display the image using OpenCV
- Alternatively, you can use Matplotlib for displaying the image

2. Display negative of an image Program

- Read the image
- Calculate the negative of the image by subtracting it from 255
- Display the original and negative images side by side

3. Relation Between Pixels

i) Brightness Adjustment Program

- Read the image
- Adjust brightness (increase by 50)
- Display original and brightened images

ii) Contrast Adjustment

- Read the image
- Adjust contrast (increase by a factor of 1.5)
- Display original and high-contrast images

iii) Thresholding

- Read the image
- Define a threshold (e.g., 128) threshold = 128;
- Create a binary image
- Display original and binary images

iv) Histogram Equalization Program

- Read the image (convert to grayscale for histogram equalization)
- Perform histogram equalization
- Display original and equalized images

v) Geometric Transformations(Image Rotation, Scaling and Translation)

- Read the image
- Define rotation angle, scaling factors, and translation offsets
- Perform rotation
- Perform scaling
- Perform translation
- Display original and transformed images side by side

RESULT : Simulated and displayed an image, Negative of image, and implemented the relation between the pixels, Geometric transformations.

EXPERIMENT NO-2

DFT, DCT, DWT TRANSFORMS

AIM : Apply 2D DFT,DCT and DWT transform for an image and compare the results.

STEPS

- Read the image
- Perform 2D DFT
- Perform 2D DCT
- Perform 2D DWT (Discrete Wavelet Transform)
- Display the original and transformed images
- Adjust subplot spacing

RESULT : Applied 2D DFT,DCT and DWT transform for an image and compared their results.

EXPERIMENT NO-3.1

IMAGE ENHANCEMENT

AIM : To enhance the given image using point, spatial, transform operations.

STEPS

- Read the input image
- Convert the image to grayscale
- Point operations
- Apply negative transformation
- Apply logarithmic transformation
- Apply Spatial operations
- Apply Gaussian blur
- Apply edge detection
- Transform operations
- Apply histogram equalization
- Display the enhanced images

RESULT : Enhanced the given image using various point, spatial, transform operations.

EXPERIMENT NO-3.2

IMAGE ENHANCEMENT

AIM: To enhance the given image using gray level slicing, sharpening, histogram equilization, homomorphic filtering.

PROGRAM

- Read the input image
- Convert the image to grayscale
- Gray level slicing
- Create a mask for the pixels above the threshold
- Apply the mask to the image
- Sharpening
- Histogram equalization
- Homomorphic filtering
- Convert the image to frequency domain
- Apply low-pass filter
- Convert the image back to spatial domain
- Display the enhanced images

RESULT : Enhanced the given image using gray level slicing, sharpening, histogram equilization, homomorphic filtering.

EXPERIMENT NO-4

WAVELET BASED IMAGE PROCESSING

AIM: To apply wavelet based image processing on the given image.

STEPS:

- Read the noisy image
- Display the noisy image
- Perform wavelet transform (2D wavelet transform)
- Approximation, Horizontal detail, Vertical detail, Diagonal detail
- Set a threshold for denoising
- Apply soft thresholding to the detail coefficients
- Reconstruct the denoised image
- Display the denoised image
- Display the detail coefficients

RESULT : Applied biorthogonal wavelet based image processing on the given image.

EXPERIMENT NO-5

IMAGE SEGMENTATION

AIM: To implement image segmentation on the given image**.**

STEPS

- Read the input image
- Convert the image to grayscale
- Define a threshold value
- Perform binary image segmentation using the threshold
- Display the original and segmented images

RESULT : Performed binary image segmentation based on a grayscale image and a threshold value.

EXPERIMENT NO-6.1

EDGE DETECTION

AIM: To detect the edges of the given image .

STEPS

- Read the input image
- Convert the image to grayscale
- Perform Canny edge detection
- Display the original and edge-detected images

RESULT : Edge detection using the Canny edge detector is done for the given image.

EXPERIMENT NO-6.2

MORPHOLOGICAL OPERATIONS

AIM: To perform the morphological operations such as erosion and dilation on the given image.

PROGRAM

- Read the binary image (0 for background, 1 for foreground)
- Define a structuring element
- Creates a disk-shaped structuring element with a radius of 3
- Perform dilation
- Perform erosion
- Display the original, dilated, and eroded images

RESULT : Performed the morphological operations such as erosion and dilation on the given image.

EXPERIMENT NO-7

OBJECT RECOGNITION

AIM : To detect the object in a given image using template matching.

STEPS

- Import the necessary packages
- Load the main image and the template image
- Make a copy of the image
- Convert the images to grayscale
- Get the width and height of the template image
- Perform template matching using the normalized cross-correlation method
- Find the location of the best match in the result map
- Draw a rectangle around the best match
- Show the images

RESULT : Deteced the object in a given image using template matching.

EXPERIMENT NO:8.1

FEATURE EXTRACTION FROM SPEECH

AIM : To extract the MFCC features from the given audio file

STEPS

- Load and process the audio file
- Calculate the MFCC features
- Calculate the mean of MFCC coefficients
- Save the mean MFCC values to a CSV file

RESULT : Extracted the MFCC features from the given audio file.

EXPERIMENT NO-8.2

SPECTROGRAM

AIM : To visualize the narrow band and wide band spectrogram from the given audio file.

STEPS

- Load the audio file
- Calculate the mel spectrogram (narrow-band)
- Calculate the mel spectrogram (wide-band)
- Convert to dB scale (decibels)
- Plot the narrow-band mel spectrogram
- Plot the wide-band mel spectrogram

RESULT : Visualized the narrow band and wide band spectrogram from the given audio file.

EXPERIMENT NO 9

LPC COEFFICIENTS

AIM : To extract the LPC coefficients from the given speech file

STEPS

- Load the audio file using librosa
- Extract LPC coefficients using librosa
- Plot LPC spectrum
- Order of LPC coefficients
- Extract LPC coefficients
- Display LPC spectrum

RESULT : Extracted the LPC coefficients from the given speech file.

EXPERIMENT NO-10

FORMANTS

AIM : To implement and to extract formants using homographic filtering.

STEPS :

- Load the image
- Define a Gaussian filter kernel
- Calculate Hessian matrix and eigenvalues for curvature
- Extract relevant features based on eigenvalues
- Visualization

RESULT : Implemented and extracted formants using homographic filtering.

EXPERIMENT NO-11

PATTERN CLASSIFICATION

AIM : To implement KNN, K-Means clustering ,SVM for pattern classification.

1. KNN

- Import necessary modules
- Create feature and target arrays
- Split into training and test set
- Loop over K values
- Compute training and test data accuracy
- Generate plot

2. K-Means Clustering

- Simulate and Display Data
- Initialize Cluster Centers
- Display Data and Initial Cluster Centers
- Define Distance Function
- Implementing E step
- Implementing the M-Step
- Implementing Prediction Step
- Execute K-Means Steps
- Display Final Clusters

3. SVM

- Creating datasets X containing n_samples
- Y containing two classes
- Plotting scatters
- Creating linespace between -1 to 3.5
- Plotting scatter
- Plot a line between the different sets of data

RESULT : Implemented KNN,K-Means clustering, SVM for pattern classification.