(Erbil Technology Collage) Course Catalogue

2024-2025

College	**Erbil Technology Collage**	
Department	**Information and Communication Technology Engineering**	
Module Name	**Image Processing**	
Module Code	**IMP306**	
Semester	**3rd**	
Credit	**6**	
Module type	**Core**	
Weekly hours	**4**	
Weekly hours (Theory)	**(2)hr Class**	**(68)hr Workload**
Weekly hours (Practical)	**(2)hr Class**	**(68)hr Workload**
Lecturer (Theory)	**Lect. Haval Ahmed Abdulrahman**	
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Lecturer (Practical)	**Lect. Lect. Haval Ahmed Abdulrahman**	
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Course Book

Course overview:

This course is an introduction to image processing and image analysis techniques and concepts. Areas examined include: Imaging sensors and their principles; Image representation and storage, coding and compression techniques, lossy versus lossless; Techniques for noise reduction. Image enhancement including contrast manipulation, histogram equalization, edge highlighting; Filtering and transform techniques for image processing including two dimensional Fourier transforms, wavelets and convolution; Spatial transformations and image registration. Segmentation and thresholding techniques; Applications of morphology to image processing including erosion, dilation and hit-or-miss operations for binary and grey scale images; Image feature estimation such as edges, lines, corners, texture and simple shape measures. Object classification, template matching techniques and basic image based tracking will also be examined.

Course objective:

The aim of this course is for students to become familiar with a wide variety of techniques in modern Image Processing. These techniques can be used to subjectively improve image quality for the end-user (image enhancement), remove known image distortions (image restoration) and to reduce image data sizes for storage or transmission (image compression). These techniques are valuable in a range of applications and careers including, but not limited to, medical imaging, astronomy, remote sensing, automation etc. Stress is placed on deep understanding of the principles underlying the techniques rather than memory learning of algorithms.

Student's obligation

Methods of Instruction: Methods will include lectures and demonstrations that discuss key terms, concepts and formulae of the assigned chapter. During the lecture a quiz about the basic concepts of each chapter will be given. The student is expected to read one chapter and solve the assigned problems each week. This will require an average of three hours of study outside of the classroom each week. The previously assigned problems will be collected for grading and the solutions will be derived in class. This process is designed to help the student thoroughly understand the concepts and applications of the material covered.

Attendance Procedure: Attendance will be taken at the beginning of each class. Students are expected to attend every class. Students are responsible for all material covered during any absence and assignments must be completed by the due date for credit. The absence of four or more lectures results in an involuntary withdrawal grade. Missed exams will require proof of extenuating circumstances for any make-up consideration.

This course goal is to familiarize each student with:

1- evaluation techniques

2- functional modules and related technologies

3- Provide the student with knowledge of the theories and applications of image processing and machine vision.

4- Give the student some experience in the development of image processing applications and research using MATLAB, Python, OpenCV and other libraries for numeric processing.

5- Familiarize the student with a broad range of operators and processing techniques for image reconstruction, filtering, enhancement, expansion, motion estimation, optic flow, image classification and video processing

6- Future Developments The details for the course content are found in the weekly syllabus. In the LAB the students will take MATLAB as an example of CVIPlab.

Forms of teaching

Lecture halls with data show equipment for lecture presentations, white board, overhead projector, posters and computer networking laboratory.

Assessment scheme

10% Mid. Term Exam (Theory).
15% Mid. Term Exam (Practical).
8% Quiz.
5% Homework.
10% Lab. Reports & Activities.
12% Class Activity.
20% Final Exam (Theory).
20% Final Exam (Practical).

Learning outcomes

On successful completion of this course students will be able to:

1	Demonstrate a knowledge of a broad range of fundamental image processing and image analysis techniques and concepts (linear and non-linear filtering, demising, deburring, edge detection, line finding, detection, morphological operators, compression, shape metrics and feature based recognition)
2	Identify, Demonstrate and apply their knowledge by analyzing image processing problems and recognizing and employing (or proposing) effective solutions
3	Design and create practical solutions to a range of common image processing problems and to critically assess the results of their solutions, including shortcomings

Course Reading List and References:

1- Gonzalez R., Woods R.: “Digital Image Processing”, Third Edition, Pearson Prentice-Hall, 2002.
2- Robot Vision - B.K.P.Horn
3- Computer Vision - D.H.Ballard & C.M.Brown
4- Syntactic Pattern Recognition: An introduction -R.C.Gonzalez and M.G.Thomason
5- Pattern Recognition - A Statistical Approach - P.A. Devijver and J. Kittler
6- Digital Image Processing - W. K. Pratt
7- Fundamentals of Digital Image Processing - A.K. Jain
8- Digital Picture Processing - A. Rosenfeld and A.C. Kak
9- Pattern Classification and Scene Analysis - R.O. Duda and P.E. Hart
10- Object Recognition by Computer - W.E.L. Grimson
11- Digital Pictures - A.N. Netravali and B.G. Haskell

12- Vision in Man and Machine - M.D. Levine
13- Pattern Recognition Statistical, Structural and Neural Approaches, R.J Schalkoff, John Wiley & Sons NY
14- Digital Image Processing and Computer Vision, R.J. Schalkoff, Wiley
15- Artificial Intelligence: An Engineering Approach, R.J. Schalkoff, McGraw-Hill
16- Algorithms for Graphics and Image Processing, Theo Pavlidis, Computer Science Press, call no.: T385.P381982
17- Handbook of Pattern Recognition and Image Processing, K.S. Fu and T.Y. Young, Academic Press
18- The Image Processing Handbook, John C. Russ, CRC Press SIUE Library call #: TA1632.R881992 (reference)

Course topics (Theory)	Week	Learning Outcome
Introduction to Image, Digital Image Processing, Image processing Concepts.	1	Recognize the different parts of digital image processing.
Types of Digital image processing.	2	Ability to interface the components with Image processing.
Filtering, Edges, Segmentation	3	Implement convolution and understand what kind of filtering operations can be implemented as a convolution.
Linear Filtering: Gauss filter, Linear diffusion	4	To understand the effects of linear filtering on random signals through the analysis of correlation and power spectral density functions.
Nonlinear Filtering, Active contours, variation segmentation models.	5	Select a suitable filter method by analyzing the properties and requirements in an application. Apply the linear and nonlinear Rauch-Tung-Striebel smoothers to general smoothing problems
Sparse coding, K-SVD algorithm, LO-smoothing.	6	Understand a wide variety of learning algorithms. Understand how to apply a variety of learning algorithms to data. Understand how to perform evaluation of learning algorithms and model selection.
Introduction of Deep Learning	7	Understand the main fundamentals that drive Deep Learning. Be able to build, train and apply fully connected deep neural networks. Know how to implement efficient

		CNN or RNN. Understand the key features in a neural network's architecture
The Perceptron, Output Activation of The Neuron, Multi-Output Perceptron, Single Hidden Layer Neural Network, SGD, Deep Convolutional Neural Networks	8	The ability to use the neural networks in some applications like pattern recognitions and classification. The ability to adapt the weight matrix of a given neural network during the training process in a small dataset.
Convolutional Neural Networks	9	be able to analyse a problem for neural network solution in terms of these techniques
Deep Generative Networks, Autoregressive Models, Latent Variable Models, Transformation Models.	10	Go beyond associating inputs to outputs, Understand high-dimensional, complex probability distributions, Discover the “true” structure of the data, Detect surprising events in the world (anomaly detection), Missing Data (semi-supervised learning), Generate models for planning (model-based reinforcement learning)
Image Deblurring, Introduction • Blind deconvolution • Non-blind deconvolution • Deep learning based solutions	11	The ability to recover a sharp image from a blurred input image, where the blur can be caused by various factors.
Semantic Segmentation	12	Ability to recognize a collection of pixels that form distinct categories.
Practical Topics (If there is any)	**Week**	**Learning Outcome**
Introduction to MATLAB in image processing	1	Learning the basics of MATLAB such as installing, layout, interface of the program.
Features that are included in MATLAB for image processing	2	Image Analysis, Image segmentation, Image registration, 3D image workflow, Hyperspectral image processing, Deep Learning in image processing, Image preprocessing, Apps for exploration and discovery, Acceleration and deployment.
Introduction to Array in MATLAB	3	• Uses of Vector Elements, Arrays and Matrix in image processing • Performing arithmetic operations in Array.

Basic Image Import, Processing, and Export in MATLAB	4	Read and Display an Image, Check How the Image Appears in the Workspace, Write the Adjusted Image to a File
Performing Image Filters	5	Convert an image to Black and White, Binary.
Using Plot, and Subplot	6	Using Plot and Subplot in MATLAB to show images.
Image Preprocessing	7	Enhance contrast, remove noise, and correct blurring using contrast adjustment, morphological operators, and custom or predefined filters.
Image Segmentation	8	Determine region boundaries in an image using different approaches including automatic thresholding, edge-based methods, and morphology-based methods.
Deep Learning in Image Processing	9	Perform image processing tasks, such as removing image noise and performing image-to-image translation, using deep neural networks.
Image Analysis	10	Extract meaningful information from images, such as finding shapes, counting objects, identifying colors, or measuring object properties
Image Registration	11	Align images to enable quantitative analysis or qualitative comparison using intensity-based, multimodal, and non-rigid registration techniques.
Acceleration and Deployment	12	Automatically generate C/C++, CUDA®, and HDL code for prototyping and deploying image processing algorithms to CPUs, GPUs, FPGAs, and ASICs.

Examinations (question design):

1. Definition or Compositional: In this type of exam the questions usually starts with Explain how, What are the reasons for…? Why…? How….?
With their typical answers
Examples should be provided

2. True or false type of exams:
In this type of exam a short sentence about a specific subject will be provided, and then students will comment on the trueness or falseness of this particular sentence. Examples should be provided

3. Multiple choices:
In this type of exam there will be a number of phrases next or below a statement, students will

match the correct phrase. Examples should be provided.
4- list or Explain: The student must fill the blanks with the correct answer.
5- Draw: Draw some flowcharts, figures, illustration.
Q1. Define the following terms.
Answer:

· Image Processing is a field that focuses on the manipulation, analysis, and interpretation of digital images using computer algorithms.

Q. 2 True or false type of exams:
1. DAC converter is a circuit that convert analog input signal into optical output

Answer: False, DAC converter is a circuit that convert digital input signal into analog output signal

Q3. Image filtering is the process of modifying an image by changing its shades or color of the pixel.

a) Image Editing
b) Image Filtering

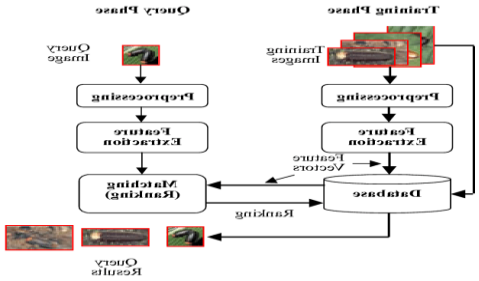
Answer: (b)

Q4. List the Types of Image Filtering.

Answer:

1- Linear filtering
2- Non-Linear Filtering

Q5. Draw an image retrieval system.
Answer:



Extra notes:

Making the topics covered in the semester compatible with reality of the educational. Covering more than 80% of the prescribed subjects to improve the scientific level of students and preserve the standardization of diploma programs.

All lectures should mostly focus on practical session because students will better learn practically, and rather than exam paper should lectures give higher mark for practical exam or practical work such as projects or practical homework.

External Evaluator

I have reviewed this course book, and it's perfect and fit for this subject at the level of the college student, so I have no suggestion.