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**Department of Software and Informatics Engineering**

**College of …Engineering….**

**University of ....Salahaddin….**

**Subject: Introduction to computer animation**

**Course Book 4th year**

**Lecturer's name: Dr. Gullanar M Hadi**

**Academic Year: 2023/2024**

**Course Book**

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| **1. Course name** | **Introduction to computer animation** |
| **2. Lecturer in charge** | **Dr Gullanar M Hadi** |
| **3. Department/ College** | **Software and Informatics Engineering/ Engineering** |
| **4. Contact** | e-mail: gullanar.hadi@su.edu.krd Mob: 07503108228 |
| **5. Time (in hours) per week**  | **2 Theory + 2 Practical** |
| **6. Office hours** | **Mon 8:30 – 12:30, Wend 10:30 – 2:30** |
| **7. Course code** |  |
| **8. Teacher's academic profile**  | **Gullanar, M. Hadi, was** born in 1964. I received my B.Sc. and M.Sc. degrees from Al-Mustansyriah University / Collage of Applied Science in 1985 and 1989 respectively. My PhD degree in optoelectronics Engineering/ Image Processing from Shanghai Jiao Tong University-China in 2004. My research interests include digital image processing and analysis. Also I am interesting in computer programming languages (i.e.,Java, Matlab programming, and Visual Basic 6.0). From 1985-2006, I am worked at Al-Mustansyriah University / Collage of Science, Baghdad –IRAQ / as a lecturer., also I was a lecturer (2006) in the Dept. of Computer Science-AL-Esraa Private University-Jordan. In 2007 to 2009 I taught in German-Jordanian University- Jordan. I supervised master degree students in Software Engineering Dept –College of Engineering at Salahaddin Univ. Erbil. Now I am a senior lecturer in Software and Informatics Engineering/ college of Engineering/ Sallahaddin University since 2009. |
| **9. Keywords** | Animation**,** image enhancement**,** image filtering, image spatial domain, image in frequency domain, image segmentation, linear filtering |
| **10. Course overview:** Visual information plays an important role in almost all areas of our life. Today, much of this information is represented and processed digitally. Digital image processing is ubiquitous, with applications ranging from television to tomography, from photography to printing, from robotics to remote sensing. Main topics to be covered in this course are:**1**. An introduction to digital image processing: What is Digital Image Processing? image and pixels, fields that use Digital Image Processing, The Elements of Digital Image Processing. Image Sensing and Acquisition, Image Sampling and Quantization, image formation, Representing Digital Images, Image types **2**. Digital Image Fundamentals: digital image operations (point operation, neighborhood operations, and geometric operations **3**. Image convolution with a linear mask, Image Enhancement in spatial and frequency Domains **4**. Image Format Operation: compression, segmentation, transformation. **5**. Color Image Processing. In the lab we will use MATLAB programming to implements many image processing applications tasks mention above. |
| 11. Course objective: Student will be able toDefine the scope of the field that we call image processing* Discuss briefly the principal approaches used in digital image processing
* Know digital image fundamentals, image sensing and acquisition ,sensors how it work, sampling and quantization
* Know image processing in frequency domain and spatial domain and color image processing

Use MATLAB environment to process digital images in the LAB |
| **12. Student's obligation: The student must be done the following**First semester Exam: 12 % , Assignments,Quizzes , and report: 6%2nd semester Exam: 12 %Lab First semester Exam: 10 %Lab 2nd semester Exam: 10 %Final Examination: 50%   |
| **13. Forms of teaching:** 2 weekly theoretical hours + 2 weekly practical (lab) hours in the lab writing programs + doing assignments.  |
| **14. Assessment scheme:**First semester Exam: 12 % , Assignments,Quizzes , and report: 6%2nd semester Exam: 12 %Lab First semester Exam: 10 %Lab 2nd semester Exam: 10 %Final Examination: 50%  |
| **15. Student learning outcome:**By the end of the course, students should be able to:* Theoretical foundations and modern applications in Digital Image Processing
* Image processing fundamentals and image processing Programming using Matlab functions
* Image enhancement, image classes and how to handle image file
* Design Matlab program tools(functions) that can be used to process images.
* Build Matlab optional toolboxes including image processing
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| **16. Course Reading List and References‌:****List of Recommended Text Books****Textbook**: Computer Graphics using Open gl by F.S.Hill**supported refs:**1. Digital Image processing; 2nd Edition 2002: Rafael C. Gonzalez,Richard E. Woods.
2. Digital Image processing: Kenneth R. Castelman ; 2003
3. Digital Image processing algorithms and applications. I. Pitas; john wiley and sons ,inc.2000
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| **17. The Topics:** | **Lecturer's name** |
| **1. Introduction to Image Processing** * Basic definitions
* The electro-magnetic spectrum and related imaging systems
* Components of digital image processing system
* Image processing applications and tasks

**2. Digital Image Fundamentals*** A simple image formation model
* Image sampling and quantization
* Digital image representation
* Types of digital images: binary images, gray-scale images, color images, multispectral images
* Digital image file formats
* Spatial and gray-level resolution
* Image algebra
* Zooming and resizing
* Some basic relationships between pixels
* Simple processing- Transpose
* Simple processing- Flip vertical
* Simple processing- Cropping

**3. Image Enhancement In The Spatial Domain** * Histograms and statistical properties
* Simple image statistics- sample mean and sample variance
* Simple image statistics- histogram
* Some basic gray-level transformations
* Histogram manipulation techniques
* Spatial filtering
* Combining spatial enhancement methods

**4. Image Enhancement In The Frequency Domain*** Fourier transforms
* Frequency domain vs. spatial domain
* Fourier spectrum and phase spectrum
* Filtering in the frequency domain

**5. Image Restoration** * Noise models
* Restoration in the presence of noise only –spatial filtering

**6. Image Segmentation** * Point detection
* Line detection
* Edge detection

**7. Image Compression** * Lossless compression
* Lossy compression
* Huffman coding
* Arithmetic coding

**8. Morphological Image Processing*** Thresholding
* Dilation and erosion
* Opening and closing
* Basic morphological algorithms
* Gray-scale images morphology
 | Week 1Week 2-------------Week 3Week 4Week 5Week 6Week 7---------------Week 8Week 9Week10Week 11--------------Week 12Week 13Week 14Week 15--------------Week 16Week 17Week 18Week 19Week 20Week 21Week 22----------------Week 23Week 24Week 25Week 26-------------Week 27Week 28Week 29Week 30 |
| **18. Practical Topics** * Introduction to image processing in MATLAB
* Image Import and Export ( read ,display, write image ..etc)
* Image type in toolbox (binary, grayscale, true color images)
* Threshold the image
* Separate true colored image to its RGB channels
* Simple processing (transpose, flipping)
* Simple processing (crop image)
* Image histogram
* How to find simple image statistics-mean, variation, and standard deviation
* Reducing the number of intensity levels in an image
* Zooming Images by bilinear interpolation
* Shrinking Images by bilinear interpolation
* Arithmetic operations(addition, subtraction, multiplication, and division)
* Logic AND, Logic OR operations
* Image negative
* Histogram equalization( how to convert dark, washed-out, low contrast images to high contrast images)
* Histogram specification
* Spatial filtering
* Enhancement using Laplacian
* Edge detection combined with smoothing and thresholding
* Unsharp masking
* Fourier spectrum and average value
* Low pass filtering and high pass filtering in frequency domain
* Image segmentation
* Image entropy
* Transform coding (Huffman coding)
* Dilating an image
* Eroding an image
 |
| 19. ExaminationSample of the Exam paper:**Q.1** Given a $16×16$, 2-bits image with the histogram shown in the figure below**.** Find an **arithmetic code** for this **row:** $[0 0 3 1]$   **Q.2: A) (15 Marks)** Given the following tables of an **image histogram** and a **specified histogram,** find **the mapping tables** and the **resulting histogram after histogram specification process** is performed.

|  |
| --- |
| **Image Histogram** |
| **Gray Value** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **Number of Pixels** | **10** | **5** | **5** | **11** | **5** | **0** | **3** | **6** |
|  **Specified Histogram** |
| **Gray Value** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **Number of Pixels** | **5** | **5** | **5** | **10** | **10** | **5** | **5** | **0** |

**Q.2: B) (15 Marks)** Given an image **with3-bits per pixel, with the following histogram:**

|  |  |
| --- | --- |
| **Gray Value** | **Number of Pixels** |
| **0** | **30** |
| **1** | **50** |
| **2** | **100** |
| **3** | **1500** |
| **4** | **2300** |
| **5** | **4000** |
| **6** | **200** |
| **7** | **20** |

**Find the histogram mapping table** and the resulting **histogram after histogram equalization.****Q.3: (15 Marks)** Given $I\left(c\right)=\left[3,2,2,1\right]$**,** corresponding to the brightness values of one row of a digital image. **Find the one-dimensional discrete Fourier transform** $F(v)$ in both rectangular form, and its exponential form. Where:$$F\left(v\right)=\frac{1}{N }\sum\_{c=0}^{N-1}I(c)e^{{-j2πvc}/{N}}$$ |
| **20. Extra notes:** The students must be known how to write some programs for reading image doing some process such as linear filtering, cropped image ,transpose image, image segmentation , edge detection using matlab and C++, Java. Also the student must present project related with the topics in the lectures above |
| **21. Peer review :** This course book has reviewed and signed by Dr Nassir H Salman: I approved the contents of this course book. It is good topics and international new reference (text book 2008). It covers the whole image processing field with applications mentioned in the table above, where I have enough knowledge about the topics above.Dr Nassir H Salman |