GUJARAT TECHNOLOGICAL UNIVERSITY

BIO MEDICAL ENGINEERING (31)

BIOMEDICAL IMAGE PROCESSING

SUBJECT CODE: 2723103

SEMESTER: II

Type of course: Core Subject

Prerequisite: Physics of Medical Imaging, Fundamentals of signal and Image processing

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction - Driving problems in biomedical imaging - Sources of imaging data: acquisition and noise - Elementary image processing.	**8**	**15**
2	Edge detection and active snakes - Intensity-driven methods: expectation-minimization, Markov random fields - Graph cut algorithms for image segmentation - Shape-driven methods: active shape/appearance models, problems of correspondence - Level set methods - Skeletonization and medial methods	**10**	**22**
3	Hands-on introduction to Image registration - Geometric mappings - Numerical methods and optimization in registration - Parametric deformable registration - Non-parametric deformable registration - Image match metrics in registration – Applications.	**10**	**20**
4	Introduction to functional Neuroimaging - Hypothesis testing and statistical mapping; permutation tests - Cortical surface segmentation and flattening - Diffusion tensor imaging	**10**	**20**
5	Biomedical image analysis using MATLAB – Image registration – unaided and Interactive – Segmentation – Edge detection – Real time imaging applications	**10**	**23**

Reference Books:

1. John.L.Semmlow, Biomedical signal and Biomedical Image Processing – MATLAB based applications, Marcel Dekker Inc., 2004.
2. Rangaraj M. Rangayyan, Biomedical Image Analysis, CRC press
3. R.C.Gonzalez, R.E.Woods, “Digital Image Processing”, 3/e Pearson Education.
4. S. Jayaraman , S.Esakkirajan, “Digital Image Processing”, McGraw Hill.

5. Horst Bunke, Abraham Kandel, “Applied Pattern Recognition”, Springer International Edition, Springer.
6. Frank Y.Shih, “Image Processing and Mathematical Morphology”, CRC Press

Course Outcome:

After learning the course the students should be able to explain about digital images, spatial and gray level resolutions, image enhancement operations, image restoration operations and image segmentation operations. The student should be able to develop a new algorithm for various automatic applications like counting the no. of objects in an image, extracting the feature of the objects form an input image, recognizing the objects from the input image based on the extracted features from the image database. They should be able to design a new image processing algorithm. The student should be able to compare the developed the algorithms with the existing ones. At the end they should be able to develop a real time system based on the input images.

List of Experiments:

Major Equipments and Software:

1. Computing and Simulation Stations
2. High performance simulation software

Design based Problems (DP)/ Open Ended Problem:

1. Design an algorithm for performing the various point operators on an input image.
2. Design an algorithm for transforming the input image into frequency domain and than apply low pass filter for performing the smoothing operation on the input image.
3. Design an algorithm for performing the boundary detection of an input image using morphological operator.
4. Design an algorithm for extracting the features of different objects present in an input image.
5. Design an algorithm for point, line and edge detection operations on an input image.
6. Design an algorithm for segmentation of region using region growing technique.
7. Design an algorithm for detecting the human face from an input image. (Input image may contain one or more human faces)

List of Open Source Software/learning website:

1. http://www.scilab.org/
2. http://www.imageprocessingplace.com/
3. http://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/video-lectures/
4. http://imagingbook.com/

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website