GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (COMMUNICATION SYSTEMS ENGG) (05)
VIDEO PROCESSING
SUBJECT CODE: 2740501
M.E. 4TH SEMESTER

Type of course: Major Elective-V

Prerequisite: Higher Engineering Mathematics, Fundamental knowledge of signals and systems, Strong knowledge about Digital Image Processing.

Rationale:
The prospect of using computers to emulate some of the attributes of human visual system has attracted the interest of scientists, engineers and mathematicians, making the field of image and video processing one of the fastest growing field in Electronics & Communication Engineering research. The growth is driven by several factors: widely available and relatively inexpensive hardware, variety of software tools for image and video processing, popularization of Web and its strong emphasis on visual information, a true revolution in photography, advances in movie industry and TV programs. Thus video is becoming face of television, Internet and mobile devices.

Starting with basics of video sampling and motion estimation, the subject covers essential topics including video segmentation, enhancement, video compression standards and video quality assessment.

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	
4	0	2#	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction to Digital Video Processing** • Sampled Video • Video Transmission • Video Sampling & Interpolation	**2**	**5**
2	Motion Detection and Estimation Notation and Preliminaries • Binary Hypothesis Testing • Markov Random Fields • MAP Estimation • Variational Formulation Motion Detection • Hypothesis Testing with Fixed and Adaptive Threshold • MAP MRF Formulation • MAP Variation Formulation • Experimental Comparison of Motion Detection Methods	**6**	**15**

	Motion Estimation • Motion Models • Estimation Criteria • Search Strategies Practical Motion Estimation Algorithms • Global Motion Estimation • Block Matching • Phase Correlation • Optical Flow via Regularization • MAP Estimation of Dense Motion		
3	Video Enhancement and Restoration • Spatiotemporal Noise Filtering • Coding Artifact Reduction • Blotch Detection and Removal • Vinegar Syndrome Removal • Intensity Flicker Correction • Kinescope Moire Removal • Scratch Removal	**6**	**15**
4	Video Segmentation • Scene Change Detection • Spatiotemporal Change Detection • Motion Segmentation • Simultaneous Motion Estimation and Segmentation • Semantic Video Object Segmentation • Examples	**7**	**17**
5	Motion Tracking in Video • Rigid Object Tracking(2D and 3D) • Articulated Object Tracking (2D and 3D)	**4**	**10**
6	Basic Video Coding Digital Video Signals and Formats Video Compression Techniques • Entropy and Predictive coding • Block Transform Coding • Quantization • MC and Estimation Transform Coding	**5**	**13**
7	Video Compression Standards MPEG-1 and MPEG-2 • Video structure and bit-stream • Video Input Resolution formats • Scalable coding • Data partitioning • Comparison of MPEG-1 and MPEG-2 MPEG-4 Visual and H.264/AVC: Standard for Modern Digital Video • Object based Representation • Video Object coding • Mesh Object Coding • Model-based coding • Still Texture coding • Error Resilience	**6**	**15**
8	Video Quality Assessment	**4**	**10**

	• HVS Modelling based methods • Feature based methods (VQM) • Motion Modelling Based methods		

Reference Books:

1. 1. The essential guide to Video processing by Alan C. Bovik, Elsevier Science
2. Handbook of Image and Video Processing, Alan Bovik, Academic Press
3. Video Processing and Communications, Yao Wang, Jorn Ostermann, Ya-Qin Zhang, Prentice Hall, 2002
4. Digital Video Processing, A. Murat Tekalp, Prentice Hall, edition 1, 1996
5. Practical Image & Video Processing using MATLAB by Oge Marques
6. Digital Video Processing for Engineers: A Foundation for Embedded Systems Design By Michael Parker, Suhel Dhanani
7. Video Coding for Mobile Communications, David Bull et al, Academic Press
8. Introduction to Data Compression, Khalid Sayood,
9. Data Compression: The Complete Reference, David Salomon

Course Outcome:

By the end of this course, the student should be able to write codes and analyze results for the following algorithms learned during the course :

1. Video enhancement and restoration
2. Motion detection
3. Segment the video for scene change and motion detection
4. Tracking the object position and/or orientation in video
5. Video compression.
6. Video quality assessment methods

Student can also implement the above algorithms on hardware.

List of Experiments:

Sr. No.	Program title
1.	Read, process, write (or save few frames) and play a video file.
2.	Reading and playing video files in different formats.
3.	Read, process and display YUV video data.
4.	Convert aspect ratio of video.
5.	Object Detection
6.	Video enhancement and noise removal
7.	Noise removal from video.
8.	Video compression.

Design based Problems (DP)/Open Ended Problem:

Develop simulation of Motion based multiple object tracking.

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.