GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION
Audio and Video Compression
SUBJECT CODE: 3714109
M.E. 1st SEMESTER

Type of course: Programme Elective-I

Prerequisite: Fundamental knowledge of Digital Signal Processing , Image Processing & Digital communication

Rationale: In this digital age**,** it is necessary to digitize audio and video signals for storage and transmission purpose. Digitization of audio and video signal demands for huge memory for storage and very high bandwidth for transmission. For optimum utilization of prime resources memory and bandwidth, it is necessary to compress digitized audio and video signal. This subject will cover audio and video compression techniques. It will be helpful to the students who want to contribute in research in the area of compression technology. Research in audio and video compression has led to the emergence of sophisticated compression techniques leading to massive compression. This has made possible transmission of multimedia signals through internet. Apart from lossy and lossless audio and video compression, this course provides an understanding and in-depth of knowledge of multimedia systems, motion estimation algorithm, video coding standards, audio coding standards and multimedia synchronization.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Multimedia Systems and Processing, Lossless Image Compression Systems Image Compression Systems, Huffman Coding, Arithmetic and Lempel-Ziv Coding, Other Coding Technique	**08**	20
2	Lossy Image Compression Systems, Theory of Quantization, Delta Modulation and DPCM, Transform Coding & K-L Transforms, Discrete Cosine Transforms, Multi-Resolution Analysis, Theory of Wavelets, Discrete Wavelet Transforms, Still Image Compression Standards: JBIG and JPEG	**08**	20
3	Video Coding and Motion Estimation: Basic Building Blocks & Temporal Redundancy, Block based motion estimation algorithms, Other fast search motion estimation algorithms	**08**	15
4	Video Coding Standards MPEG-1 standards, MPEG-2 Standard, MPEG-4 Standard, H.261, H.263 Standards, H.264 standard	**08**	15
5	Audio Coding, Basic of Audio Coding, Audio Coding, Transform and Filter banks, Polyphase filter implementation , Audio Coding, Format and encoding, Psychoacoustic Models	**07**	15

6	Multimedia Synchronization, Basic definitions and requirements, References Model and Specification, Time stamping and pack architecture, Packet architectures and audio-video interleaving, Multimedia Synchronization, Playback continuity, Video Indexing And Retrieval: Basics of content based image retrieval, Video Content Representation, Video Sequence Query Processing	**06**	15

References:

- Iain E.G. Richardson, "H.264 and MPEG-4 Video Compression", Wiley, 2003.
- Khalid Sayood, "Introduction to Data Compression", 4th Edition, Morgan Kaufmann, 2012
- Mohammed Ghanbari, "Standard Codecs: Image Compression to Advanced Video Coding", 3rd Edition, The Institution of Engineering and Technology, 2011.
- Julius O. Smith III, "Spectral Audio Signal Processing", W3K Publishing, 2011.
- Nicolas Moreau, "Tools for Signal Compression: Applications to Speech and Audio Coding", Wiley, 2011.
- NPTEL lecture/IEEE Xplore.

Course Outcomes:

At the end of this course, students will be able to

- Familiarity to lossy and lossless compression systems.
- Study of Video coding techniques and standards.
- Understand audio coding and multimedia synchronization techniques

List of experiments:

- Write MATLAB/SCILAB code for ADPCM coding and decoding (Waveform Audio Coding)
- Write MATLAB/SCILAB code for LPC coding and decoding (Parametric speech coding)
- Write code for CCITT G. 723 CELP coder in MATLAB/SCILAB or C language and test it for sample speech/audio
- Read given audio file in .wav format. Plot waveform. Apply adaptive delta modulation on it.
- Write program for lossless compression using entropy coding
- Write program for lossy compression using Discrete Cosine Transform followed by thresholding and LZW coding
- Apply wavelet transform on given audio signal, remove small wavelet coefficients (high frequency part) and apply LZW coding for compression.
- Apply wavelet transform on given Image, remove small wavelet coefficients (details) and apply LZW coding for compression
- Prepare simulink model in MATLAB to implement Video compression on live video and display compression ratio.
- Prepare simulink model for psychoacoustic bass enhancement for band limited signals

List of Open Source Software/learning website:

List of Audio Coding Tools :

1. G.191 : Software tools for speech and audio coding standardization
2. RealView® Development Suite
3. Opus Interactive Audio Codec

List of Video Coding Tools :

1.Datavyu

2.Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11

3.Beamr