ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 2, February 2018

Audio/Video Compression Using Transformation Techniques

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***Abstract* - Audio compression is designed to reduce the transmission bandwidth requirement of digital audio streams and storage size of audio files. Audio compression has become one of the basic technologies of the multimedia age to achieve transparent coding of audio and speech signals at the lowest possible data rates. Similarly, Digital Surveillance Systems are becoming increasingly important to commercial and residential security.**

Index Terms: Compression, Signal processing, transformation techniques, audio, video, graphical representation, security.

I. INTRODUCTION

Audio compression is designed to reduce the transmission bandwidth requirement of digital audio streams and storage size of audio files. Audio compression has become one of the basic technologies of the multimedia age to achieve transparent coding of audio and speech signals at the lowest possible data rates.

Lossy compression consists of a transform to separate important from unimportant data, followed by lossless compression of the important part and discarding the rest. The audio compression software crop off the inaudible frequencies, reduce the bit rate of the less sensitive sound signals etc. Thus in this project our aim is to use Fourier Transform to differentiate a frequency from another.
Similarly Digital Surveillance Systems are becoming increasingly important to commercial and residential security. Having the ability to compress large videos to videos which requires little storage and to use compressed videos to monitor, track and store digital and visual data about your premises and operations can be key to protecting brick-and-mortar security, hardware, and fixed assets as well as cash and liquid assets vital to the operation of your business or home.

II. PROPOSED COMPRESSION SYSTEM

User can provide audio/video input within a single software application and then system will generate performance parameters for audio and functionalities like Mean Grey Levels-Histogram,Frame differencing, Binarized Difference Image, Moving Object Detection on run-time and store the compressed file on the local hard drive.

Audio/video compression aims at designing advanced software for surveillance system using Transformation techniques. An application will provide an User Interface for the operator to compress audio/video files and perform many other operations.

III. SYSTEM DEDIGN

In digital signal processing data compression involves encoding the information using fewer bits than the original representation.

Fig:General encoding and decoding flow

Compression Types

There are mainly two types of compression techniques: Lossless Compression and Lossy Compression techniques. Lossless data compression algorithms allow exact reconstruction of original data from the compressed data. Lossy compression techniques does not allow perfect reconstruction of data but offers good compression ratio values relative to the lossless compression techniques.

Fourier Transform

Many audio compression software make use of psychoacoustic property of the human auditory system. They crop off the inaudible frequencies, reduce the bitrate of the less sensitive sound signals So, how do they differentiate a frequency from another? The answer is a mathematical device called the Fourier Transform. The Fourier Transform is defined as:

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$$X(\omega) = \int_{-\infty}^{+\infty} x(t) e^{-j\omega t} dt \quad \text{Fourier Transform}$$

$$x(t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} X(\omega) e^{j\omega t} dt \quad \text{Inverse Fourier Transform}$$

However, in Senior High School mathematics lesson, we know that only continuous function is integrable. From the section on digital audio, we know that digital audio signal is not continuous, so there's a problem. Luckily, there is another version of the Fourier Transform, which is called the Discrete Fourier Transform. The "discrete" in its name tells us that it doesn't act on continuous function, instead, in acts on discrete sets of values, just like our digital audio signals. The Discrete Fourier Transform is defined as

$$X(k) = \sum_{n=0}^{N-1} x(n) e^{\frac{-i2\pi nk}{N}}, k = 0 \ldots N-1$$

1) General Audio Compression architecture

The most common characteristic of audio signals is the existence of redundant information between adjacent samples. Compression tries to remove this redundancy and makes the data decorrelated.Typical audio compression system contains three basic modules to accomplish audio compression. First, an appropriate transform is applied. Second, the produced transform coefficients are quantized to reduce the redundant information; here, the quantized data hold errors but should be insignificant. Third, the quantized values are coded using packed codes; this encoding stage changes the format of quantized coefficients values using one of the suitable variable length coding technique.

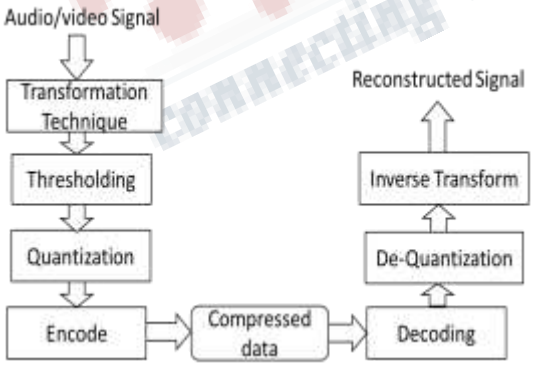

Fig: Flow of audio compression

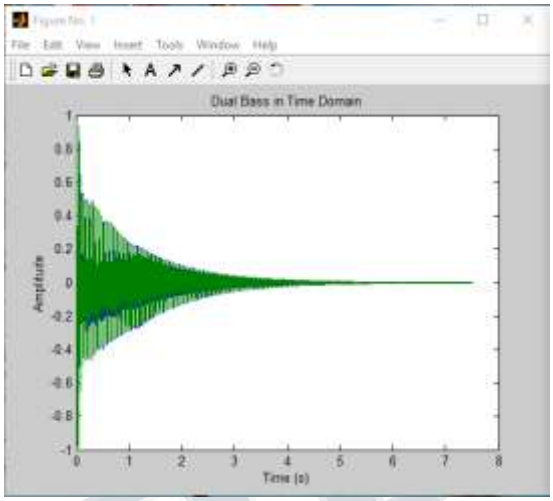

Fig:Plot for frequency response for an input file

2) Video Compression

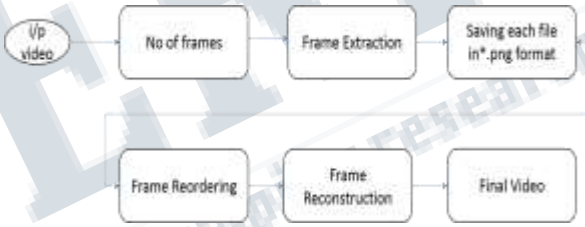

Fig:General architecture for video compression

1) Calculates number of frames and other information about the video file.
2) Option to save individual frame in *.png format.
3) Generates Mean Gray Levels ,Adaptive Background and Binarized Difference Image at run-time.
4) Finally, the compressed file can be played by recalling it from the disk.

Fig: Snapshot of the application

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Mean Gray Levels-Histogram
The histogram of an image normally refers to a histogram of the pixel intensity values. This histogram is a graph showing the number of pixels in an image at each different intensity value found in that image.
For an 8-bit grayscale image there are 256 different possible intensities.Histograms can also be taken of color images --- either individual histograms of red, green and blue channels can be taken. Grayscale images are distinct from one-bit bi-tonal black-and-white images, which in the context of computer imaging are images with only two colors, black and white (also called bilevel or binary images).

Frame Differencing
The simplest techniques that we can use to see what parts of the video are moving. The difference between successive frames gives a lot of information. We just take the difference between successive frames and display the difference.

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IV. OBSERVATIONS

Application of FFT on audio file
I am able to apply FFT in MATLAB successfully on an audio file and extract the frequency component and amplitude of the input file. Graph of Amplitude vs Time and Frequency Response is plotted for the same on run-time.

Video Compression
I am able to calculate number of frames and other information about the video file. Option to save individual frame in *.png format.*.png file are efficient in terms for storage and are faster to access. I am able to generates Mean Gray Levels ,Adaptive Background and Binarized Difference Image at run-time. Finally, the compressed file can be played by recalling it from the disk.

V. FUTURE WORK

1) Audio compression.
2) To calculate Performance measures.
3) Added functionalities for surveillance system such as Moving Object Detection etc.
4) Developing a single software application for both audio/video compression.
5) Development and Testing.

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