Algorithm for Multimedia Compression

Sara Mohammed Salih Khater¹, Ashraf GasimElsid², Amin Babiker A/Nabi³

¹Department of Data and Communication Network, Al Neelin University/ Faculty of Engineering, Khartoum, Sudan
²Department of Electronics Engineering, Collage of Engineering, Sudan University and Faculty of Telecommunication and Space Technology, Future University, Khartoum, Sudan
³Department of Communication Engineering, Al Neelin University/ Faculty of Engineering, Khartoum, Sudan.

Abstract: In this paper multimedia compression is proposed for multimedia application to fit the available bandwidth. This leads to reduction of the bandwidth problem in multimedia network. This compression algorithm is efficient when the traffic load is high in this study a 45 E and 90E load are used. The algorithm was modeled using MATLAB program. The simulation model was build based on a mathematical model. The simulation result shows a good performance of the algorithm during high traffic load.

Keyword: bandwidth, multimedia, traffic load

1. Introduction

Multimedia refers to content that uses a combination of different content forms. This contrasts with media that use only rudimentary computer displays such as text-only or traditional forms of printed or hand-produced material. Multimedia includes a combination of text, audio, still images, animation, video, or interactive content forms.

Multimedia can be recorded and played, displayed, dynamic, interacted with or accessed by information content processing devices, such as computerized and electronic devices, but can also be part of a live performance; Multimedia devices are electronic media devices used to store and experience multimedia content. Multimedia is distinguished from mixed media in fine art; by including audio, for example, it has a broader scope. The term "rich media" is synonymous for interactive multimedia. Hypermedia scales up the amount of media content in multimedia application.

Since media is the plural of medium, the term "multimedia" is used to describe multiple occurrences of only one form of media such as a collection of audio CDs. This is why it's important that the word "multimedia" is used exclusively to describe multiple forms of media and content. Multimedia involves multiple modalities of text, audio, images, drawings, animation, and video.

2. Multimedia Compression

When talking about compression, we often mean “lossy compression” while “lossless compression” is often termed as coding. However, not all coding algorithm do actually lead to lossless compression, e.g. error correction codes. Like in every other field in computer science or engineering, the dominating language in compression technologies is English of course. There are hardly any comprehensive and up-todate German books available, and there do NOT exist any German journals in the field. Codec denotes a complete system capable of encoding and decoding data which consists of an Encoder and a Decoder, transcoding is a conversion from one encoded digital representation into another one. A fundamental term in the area is compression rate (or compression ratio) which denotes the relation between the size of the original data before compression and the size of the compressed data. Compression ratio therefore rates the effectiveness of a compression system in terms of data reduction capability. This must not be confused with other measures of compressed data size like bit per pixel (bpp) or bit per sample (bps).

During the last years three important trends have contributed to the fact that nowadays compression technology is as important as it has never been before – this development has already changed the way we work with multimedia data like text, speech, audio, images, and video which will lead to new products and applications:

- The availability of highly effective methods for compressing various types of data.
- The availability of fast and cheap hardware components to conduct compression on single-chip systems, microprocessors, DSPs and VLSI systems.
- Convergence of computer, communication, consumer electronics, publishing, and entertainment industries.

Compression is enabled by statistical and other properties of most data types, however, data types exist

a) Classification of Techniques:
   - Lossless: recover the original representation
   - Lossy: recover a representation similar to the original one
     - high compression ratios
     - more practical use
   - Hybrid: JPEG, MPEG, px64 combine several approaches
3. Multimedia Compression Efficiency

The compression efficiency indicate the strength of the compression algorithm and it can be computed using equation (1). In multimedia it can be represented by the cumulative sum of the various media.

<table>
<thead>
<tr>
<th>Short Name</th>
<th>Official Name</th>
<th>Standards Group</th>
<th>Compression Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>JPEG</td>
<td>Digital compression and coding of continuous-tone still images</td>
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<td>15:1 Full color still-frame applications</td>
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4. Multimedia Compression Algorithm

Compression: the process of coding that will effectively reduce the total number of bits needed to represent certain information.

![Figure 1: General Data Compression Scheme](#)

1) Classification

a) Lossless Compression

- lossless compression for legal and medical documents, computer programs
- exploit only data redundancy
- Variable-Length Coding (VLC): the more frequently-appearing symbols are coded with fewer bits per symbol, and vice versa.
- Shannon-Fano Algorithm:
  - Sort symbols according to the frequency of occurrences.
  - Recursively divide symbols into two parts, each with approximately same counts, until all parts contain only one symbol.

b) Huffman Coding

- Initialization: Put all symbols on a list sorted according to frequency.
- Repeat until the list has only one symbol left:
  - From the list pick two symbols with the lowest frequency counts. Form a Human subtree that has these two symbols as child nodes and create a parent node.
  - Assign the sum of the children’s frequency counts to the parent and insert it into the list such that the order is maintained.
  - Delete the children from the list.
- Assign a codeword for each leaf based on the path from the root.
- Statistics are gathered and updated dynamically as data increments the frequency counts for the symbols.

c) Lossless Image Compression

- Approaches of Differential Coding of Images:
- Given an original image I(x, y), using a simple difference operator we can define a difference image d(x, y) as follows:
  \[ d(x, y) = I(x, y) - I(x - 1, y) \]

- Forming a differential prediction: A predictor combines the values of up to three neighboring pixels as the predicted value for the current pixel, indicated by \( \text{'X'} \) in Figure. The predictor can use any one of the seven schemes listed in the below Table.
- Encoding: The encoder compares the prediction with the actual pixel value at the position \( \text{'X'} \) and encodes the difference using one of the lossless compression techniques, e.g., the Human coding scheme

2) Lossy Compression

- digital audio, image, video where some errors or loss can be tolerated
- exploit both data redundancy and human perception properties
- Compressed data is not the same as the original data, but a close approximation of it.
- Yields a much higher compression ratio than that of lossless compression.

3) Distortion Measures:

- mean square error (MSE) \( \sigma^2 = \frac{1}{N} \sum_{n=1}^{N} (x_n - yn)^2 \)

  where \( x_n, yn, N \) are the input data sequence, reconstructed data sequence, and length of the data sequence respectively.

- signal to noise ratio (SNR), \( SNR = 10 \log \frac{\sigma^2_x}{\sigma^2_d} \)

  where \( \sigma^2_x \) is the average square value of the original data sequence and \( \sigma^2_d \) is the MSE.

- peak signal to noise ratio (PSNR) \( PSNR = 10 \log \frac{\sigma^2_{peak}}{\sigma^2_d} \)

  Which measures the size of the error relative to the peak value of the signal \( X_{peak} \)

5. Simulation Scenario

Figure 1 shows the block diagram for the simulation program. This program is written using MATLAB instruction.

Table 1: Multimedia compression

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6. Result and Discussion

Figure 3 shows that simulation windows and it represented the random distribution of user inside the building as defined previously, the X axis represent window length and Y axis represented width equal 4km both of them.

Figure 4 shows the histogram where X axis is the interarrival time [s] and Y axis represented frequency.

Figure 5 shows the The distribution of call arrival time where X axis is User ID and Y axis represented arrival time [s]

Figure 6 shows the The required bandwidth where X axis is User ID and Y axis represented Bandwidth[Kbps]. Table (1) show the compression efficiency.

Figure 3: simulation model window
7. Conclusion

The results indicate reduction in the connection failure due to the increase in the compression efficiency. The amount of the reduction can be observed during the high traffic load. The amount of the connection loss is higher in the heavy traffic load.

References


Author Profile

Sara Mohammed Salih Khater, received the B.Sc. degree in computer engineering from Al ezira University in 2010. She is currently pursuing the M.SC degree with the Department of Data and Communication Network, Al neelain University, Khartoum, Sudan. Her research interests include Mobile system, Data and Communication Networking.

Ashraf Gasim Elsid Abdalla, Associate professor in telecommunication Engineering and researcher in space technology center in future university. Also he is academic members of electronic department in college of engineering, Sudan University of science and technology. He was a former lecturer and researcher in many Malaysia Universities; UKM, UPM, UIA and MMU. He got his Ph.D. and M.Sc. from National university of Malaysia 2001 and 1996 in electrical and electronic system. He got his B.Sc. in electronic engineering from technical university of Budapest 1993. His research focus on Mobile and satellite communication. He published more than 40 technical papers and supervised more than 50 Ph.D. and Master Students.

Amin Babiker A/Nabi Mustafa, obtained his B.Sc. and M.Sc. from the University of Khartoum in 1990 and 2001, respectively. He obtained his Ph. D. from Al neelain University in 2007. He was the Head of the Dept. of Computer Engineering from 2001 to 2004. Then, he became the Vice Dean. He has been the dean since 2009 until 2014 then he is currently the Vice consoler for academic affairs. His research areas include QoS in telecommunications, Traffic Engineering and Service Costing Disciplines. Associate prof. Dr. Amin is a Consultant Engineer. He is a member of the Sudan Engineering Council.