A Survey of MPEG File Compression

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1. INTRODUCTION

Data compression is the task of representing the same or similar information in less space. For video files, the MPEG format has arisen as a popular method of efficiently storing digital video. The motivation for this topic is to figure out how to both maximize the quality of videos while minimizing the space in which they are stored. The general trade off is that higher quality video takes more space, whereas storing a video in less space requires lowering the quality. The MPEG format seeks a reasonable balance between the two.

Because the format is in widespread use, much research has been conducted regarding how to improve upon it. Since its inception, MPEG has received incremental updates to improve its features and improvements. The literature examined in this survey will focus on the structure of the MPEG file type and how its information is compressed into a file and decompressed into a video.

2. REVIEW

2.1 Paper 1 - The Berkeley Software MPEG-1 Video Decoder

[MPSR05] provides an overview of the structure of basic MPEG files from when they were first invented. It explains how MPEG files use macroblocks, motion compensation, and dithering to minimize the space required to store data, and offers brief evaluations of how each of these processes work. He then describes the implementation of the Berkely decoder, which is used to translate the compressed file into a video, and offers an evaluation of its efficiency.

Some of the information in the article is outdated since new iterations of MPEG have been developed, but the core concepts of the article still hold true for modern MPEG files. The explanation of the decoding techniques and evaluation of its efficiency are extensive. The explanation of the structure of MPEG files is more brief, but also accurate and well written.

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2.2 Paper 2 - MPEG: A Video Compression Standard for Multimedia Applications

[LG91] focuses on both the structure of MPEG files and the applications and the goals of the format. The article explains how MPEG has become a generic standard that can be applied to a variety of multimedia applications. It explains various features of the format, including reverse playback, robustness to errors, and editability. Finally, it explains the structure of MPEG files, and places particular emphasis on motion compensation techniques.

This article's explanation of the structure of MPEG files has less depth than others in this review. Instead, it focuses on the applications and features of MPEG files. It explains the standards for the MPEG format, and emphasizes the features the file format provides.

2.3 Paper 3 - MATHEMATICAL ANALYSIS OF MPEG COMPRESSION CAPABILITY AND ITS APPLICATION TO RATE CONTROL

[KO95] evaluates much of the mathematics behind MPEG compression, to find optimal methods of compressing the information. For instance, the article demonstrates an equation to calculate the optimal number of bits to dedicate to redundant information to maintain a reasonable rate of errors. It also performs calculations to evaluate the effectiveness of using frames involving bidirectional prediction.

This article explains some of the more complex equations and formulas that go in to determining how to optimally compress a file. It does not, however, provide much explanation of how various MPEG compression algorithms work. It assumes the reader has significant prior knowledge in the subject area.

2.4 Paper 4 - Performance of a Software MPEG Video Decoder

[PSR93] proposes a new method of efficiently decoding compressed MPEG files. One of the core features of the decoder is a dithering algorithm to make the decoding process more efficient. The article offers evaluations of the decoder's performance, and compares its price to performance ratio across different platforms. They show that memory bandwidth it the limiting performance of the decoder, which is unique considering that most decoders are limited by computational complexity.

The article offers a somewhat general but still helpful explanation of the structure of MPEG files and the implementation of the decoder. It focuses in more detail on evaluating

the decoder's performance. The article shows many tests to show that dithering accounts for most of the decoder's performance gains, and that it is extremely applicable cross platform.

2.5 Paper 5 - Robust Compression and Transmission of MPEG-4 Video

[GES+99] discusses the transmission of MPEG-4 files over networks. Since networks are prone to errors, MPEG files need to be able to tolerate a certain amount of uncertainty. This article suggests various techniques involving spacial and temporal redundancies to make the video have less errors, and make them lest of an issue when they do occur. At the same time, the data must remain as compressed as possible since network throughput is often limited.

This article provides a general description of the MPEG format, but it is not its focus. It focuses on explaining techniques to make MPEG files more resilient to errors, and evaluating the effectiveness of these techniques on networks.

3. CONCLUSION

The compression of MPEG files remains an important area of study since the files can otherwise be excessively large. As higher resolution screens and greater bit rates become popular, finding ways to efficiently store this information becomes increasingly important. Since its inception, the MPEG format has received incremental updates as better optimizations have been discovered.

Considering how popular video is in mass culture, MPEG file compression is an extremely applicable topic to the real world. Nowadays, videos are increasingly consumed over the internet, so there is a particularly large amount of research evaluating how to efficiently transfer MPEG files over networks while simultaneously handing errors.

4. REFERENCES

[GES+99] Steven Gringeri, Roman Egorov, Khaled Shuaib, Arianne Lewis, and Bert Basch. Robust compression and transmission of mpeg-4 video. In *Proceedings of the Seventh ACM International Conference on Multimedia (Part 1)*, MULTIMEDIA '99, pages 113–120, New York, NY, USA, 1999. ACM.

This article offers another real-world use of MPEG files. It shows how to reliably send MPEG files over the internet while accounting for potential errors. It also provides a detailed explanation of the structure of MPEG files and how they work.

[KO95] J. Katto and M. Ohta. Mathematical analysis of mpeg compression capability and its application to rate control. In *Proceedings of the 1995 International Conference on Image Processing (Vol.2)-Volume 2 - Volume 2*, ICIP '95, pages 2555–, Washington, DC, USA, 1995. IEEE Computer Society.

This article emphasizes the mathematics behind data compression. While it doesn't help to explain the structure of MPEG files, it does help to model data compression mathematically, to find optimal strategies with which to compress data.

[LG91] Didier Le Gall. Mpeg: A video compression standard for multimedia applications. *Commun. ACM*, 34(4):46–58, April 1991.

This article emphasizes the role MPEG files play in multimedia. Since they support are large number of features and are easy to use, they are applicable in a wide variety of scenaries. This article is less helpful for understanding the algorithims themselves, but instead reveals why they are important.

[MPSR05] Ketan Mayer-Patel, Brian C. Smith, and Lawrence A. Rowe. The berkeley software mpeg-1 video decoder. *ACM Trans. Multimedia Comput. Commun. Appl.*, 1(1):110–125, February 2005.

Mayer-Patel explains the origional MPEG file format, and evaluates how effective it is considering the progress technology has made. While the article is outdated, the core concepts behind MPEG file compression have not changed. The information in the article provides a very helpful understanding of the thought process behind MPEG compression algorithims.

[PSR93] Ketan Patel, Brian C. Smith, and Lawrence A. Rowe. Performance of a software mpeg video decoder. In *Proceedings of the First ACM International Conference on Multimedia*, MULTIMEDIA '93, pages 75–82, New York, NY, USA, 1993. ACM.

Patel proposes a decoder for MPEG files. The most useful aspect of this article is that is provides a specific implementation of an algorithim, and it describes it in detail. This article is a useful demonstration of how to take an algorithim and apply it to the real world.