Acorn Replay

Innovations and Novelties

Philipp Wirtenberger

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1 Introduction

In the early 1990s British Acorn employee Sophie Wilson developed what was to become the most capable video playback engine of its time, the Acorn Replay. The Acorn Replay video architecture used to be included on the later Acorn RISC machines, such as the Archimedes or the RiscPC, notably contributing to the sales figures of these systems. The purpose of this document is to illustrate the innovations that led to Acorn Replay outranking its competitors both performance-wise and with regards to compression size. Additionally, some alternatives for video playback available at that time are briefly discussed.

2 Video Playback Before the Acorn Replay

2.1 Hardware-Based Solutions

Before the Acorn Replay, video playback was mainly limited to the use of special purpose systems. These high end systems were rather expensive, and with a cost in the hundreds of thousands of pounds they were definitely not suitable for the video playback needs of the average consumer. Thus, their main application was non-linear video editing by industry professionals. Popular choices were particularly Quantel's Harry and later HAL, with the former being the first of its kind. [1]

2.2 Software-Based Solutions

Video playback software requiring no special hardware actually predates Sophie Wilson's invention. Still, the only application whose main purpose was the playback of video files was Apple's QuickTime Player. But there were several video editing suites and while primarily targeted at professionals, they inherently provided some form of video playback. Those included - though this list is by no means exhaustive - EIDOS' EditOne, Avid's Media Composer and systems from Lightworks and DVision. [2]

However, all these systems either failed to achieve a uniform frame rate or suffered from poor resolution. Due to data storage limitations, compression was about as important as real time operation. Hence, better compression and decompression methods needed to be developed in order to save space and realize real-time playback.

3 The Acorn Replay Playback Engine

3.1 The Capabilities of Acorn Replay

Acorn Replay introduced techniques to both reduce the processing requirements when producing video images from a compressed data stream and save storage space by providing an innovative compression algorithm specially tailored for the handling of video data.

3.2 The ARMovie Format

The wrapper format for Acorn Replay files was called "ARMovie", the extension "rpl". Using standard compression, for every minute of a Replay movie approximately 9Mb needed to be stored. [3]

A set of predefined suffixes was used to describe special kinds of video data:

> "2" a movie made at half the frame rate of its base movie this movie can be expected to be playable on less powerful machines (generaliseable if required!)

> "S" a movie made with much smaller chunks than its base movie this movie can be expected to be playable on small memory machines (an "S" suffix movie may not work from a CD-ROM drive). For example if the base movie has 2 second chunks, then an "S" suffix might only have 1 second chunks.
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> "L" a movie made with much larger chunks than its base movie this movie will not work on CD-ROM, but can be copied from CD-ROM to a faster filing system (winchester, magneto-optic) and played. Such movies will usually require an ARM3 (or better) to replay them. [1]

When recorded with proper equipment, ARMovie files allowed for publishing high quality video files on CD-ROMs instead of VHS or Sony's Video 8, yielding images with the necessary levels of luminance and chrominance required for professional use. [3]

Eidos, using their own ESCAPE compression, later chose the ARMovie format for cut sequences in several computer games, such as the first installment of the Tomb Raider series.

3.3 An Optimized Approach to Video (De)Compression

The efficiency of Acorn Replay first and foremost originated in the sophisticated use of pixel copy codes. As several limitations did apply to display devices from that time, e.g. in range of colours and intensities, a computational expensive mapping from pixel appearance values to pixel display values was required. Wilson overcomes this issue by writing only the new pixel codes into the appropriate array of pixel display values, otherwise saving computation time utilizing pixel copy codes, cf. [4].

For most video files, only parts of the image change with a new frame. Similar to this temporal also a spatial correlation is present amongst different image parts. Thus, compression size can be reduced when said parts of the image are stored only once and retained for the following frame(s). Following this idea, no mapping from pixel appearance values

[1] newsgroup: comp.sys.acorn; subject: Playing 16 bit music, samples etc; date: 12 Jun 92 10:51:04 GMT; sender: rwilson@acorn.co.uk; available at: `http://www.chiark.greenend.org.uk/~theom/riscos/docs/apps/ReplayFormat.txt`

to pixel display values is needed for pixel copy codes, as they do not contain new appearance information. As a result, computing power needs to be spent on new pixel codes only, leading to a remarkable improvement of performance; Wilson names a 30% reduction in processing time. [4] This allows for processing other data, e.g. in order to produce sound accompanying the images.

Furthermore, image data can also be stored more efficiently in a similar manner. For this reason, storage of the video files on a CD-ROM is possible.

4 Conclusion

The Acorn Replay software featured a novel take on video compression and decompression. It shaped the feature set of the later Acorn RISC machines and was an integral part of the RISC OS environment. Moreover, it is a striking example of the exceptional work Sophie Wilson has done in the area of computer science. Wilson's idea for a feasible playback method that could be run on common hardware systems eventually gave birth to an amazing piece of software. Its astonishing capabilities grant it the reputation of the first reasonably usable programme for digital video playback on a personal computer.

References

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[2] R. Barnes. *Motion JPEG 47 Success Secrets - 47 Most Asked Questions On Motion JPEG - What You Need To Know.* Emereo Publishing, 2014.

[3] S. Palmer et al. *Acorn Replay Compression Process Overview.* Acorn Computers, Sep 1992. Revision C.

[4] A.R. Wilson. Image data compression, March 5 1996. US Patent 5,497,434.