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CD32

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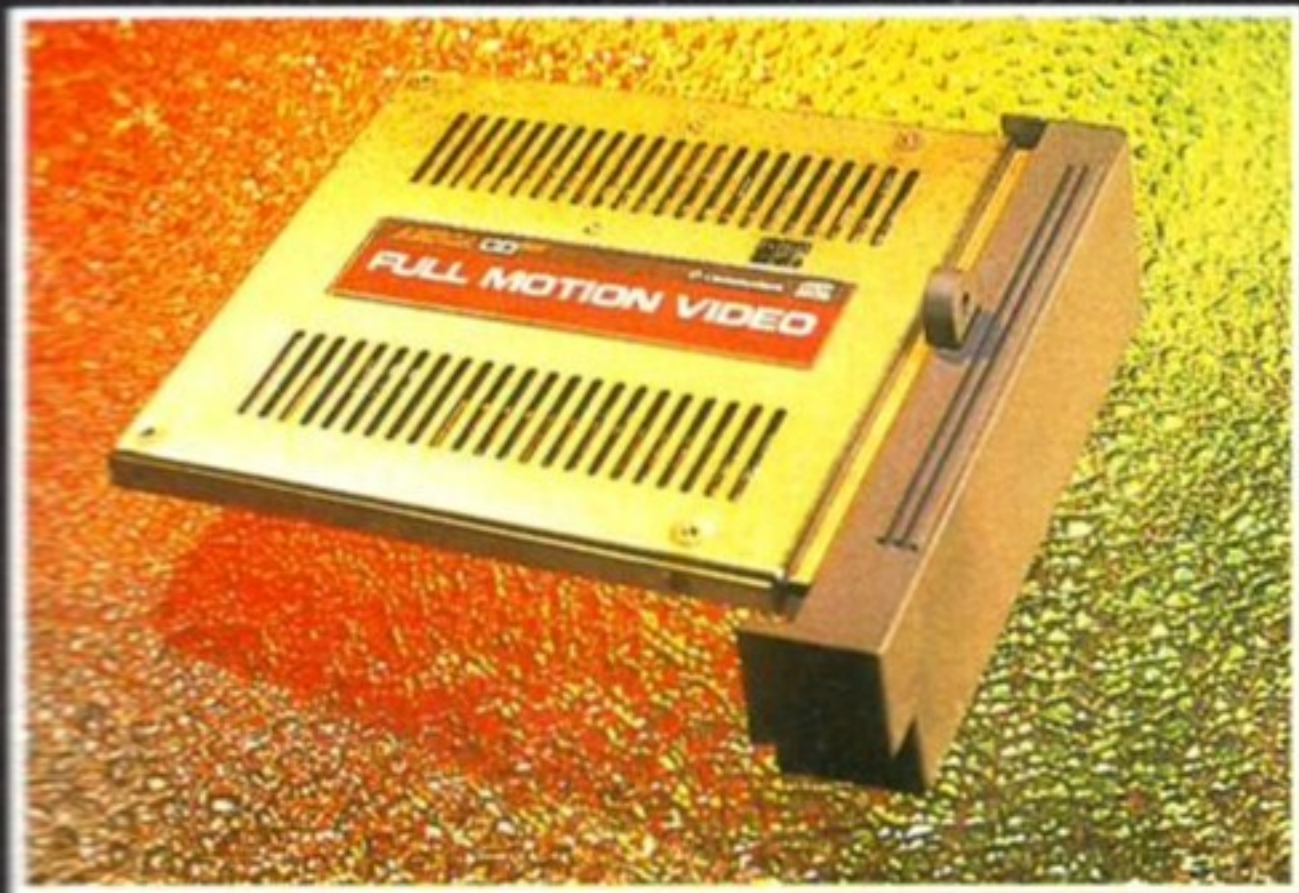


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The CD32 straddles the two genres of games and videos, with the ability to play both from standard CDs. And, currently lying dormant somewhere between the two is the potential for a new breed of entertainment – less of a video game... more a game video. But before we take a look at the future, Steve Jarratt examines the here and now. Readers of *Amiga CD32* should already have a CD32 console and for around £190, you can buy Commodore's Full Motion Video (FMV) cartridge. This unimposing metal box holds the key to the future of video: the MPEG decoding chip.



MOVIES, GAMES AND VIDEOS. ♦ ♦ ♦



MOVIE EXPERT

MPEG is the acronym for the Motion Picture Experts Group – a collection of technicians well-voiced in the fields of video, electronics and communications – who were given the task of storing video on CD.

Of course, you can store video on CD already. But FMV, by its very definition, constitutes full-screen, full-colour, full-motion video, running at least 25 frames per second. You can store video on CD, but using conventional storage methods, the shiny disc is hard pressed to hold anything more than 26 second's worth of movie footage. And with today's laser technology you could only show one frame every three seconds. Hardly FMV...

So the problem that the MPEG guys faced was twofold: how to store enough video to make it a convenient medium; and how to play that footage back to FMV standards. In fact the solution to both problems is high speed compression/decompression routines which are defined by the standard known as MPEG1.

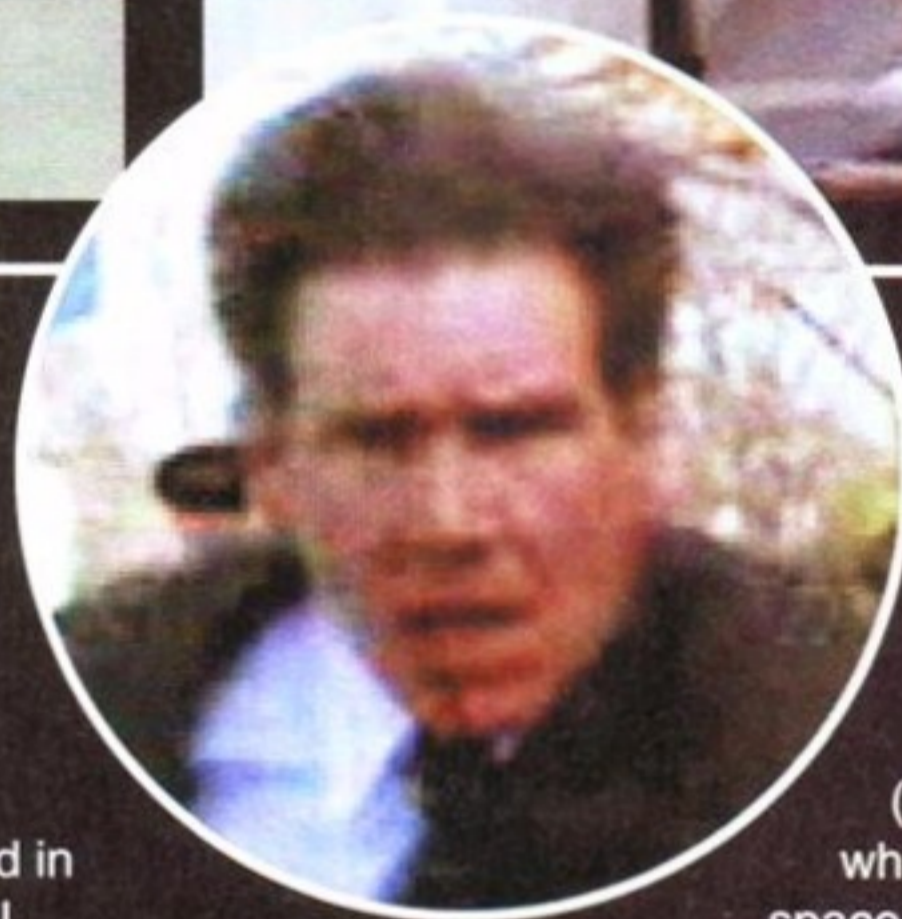
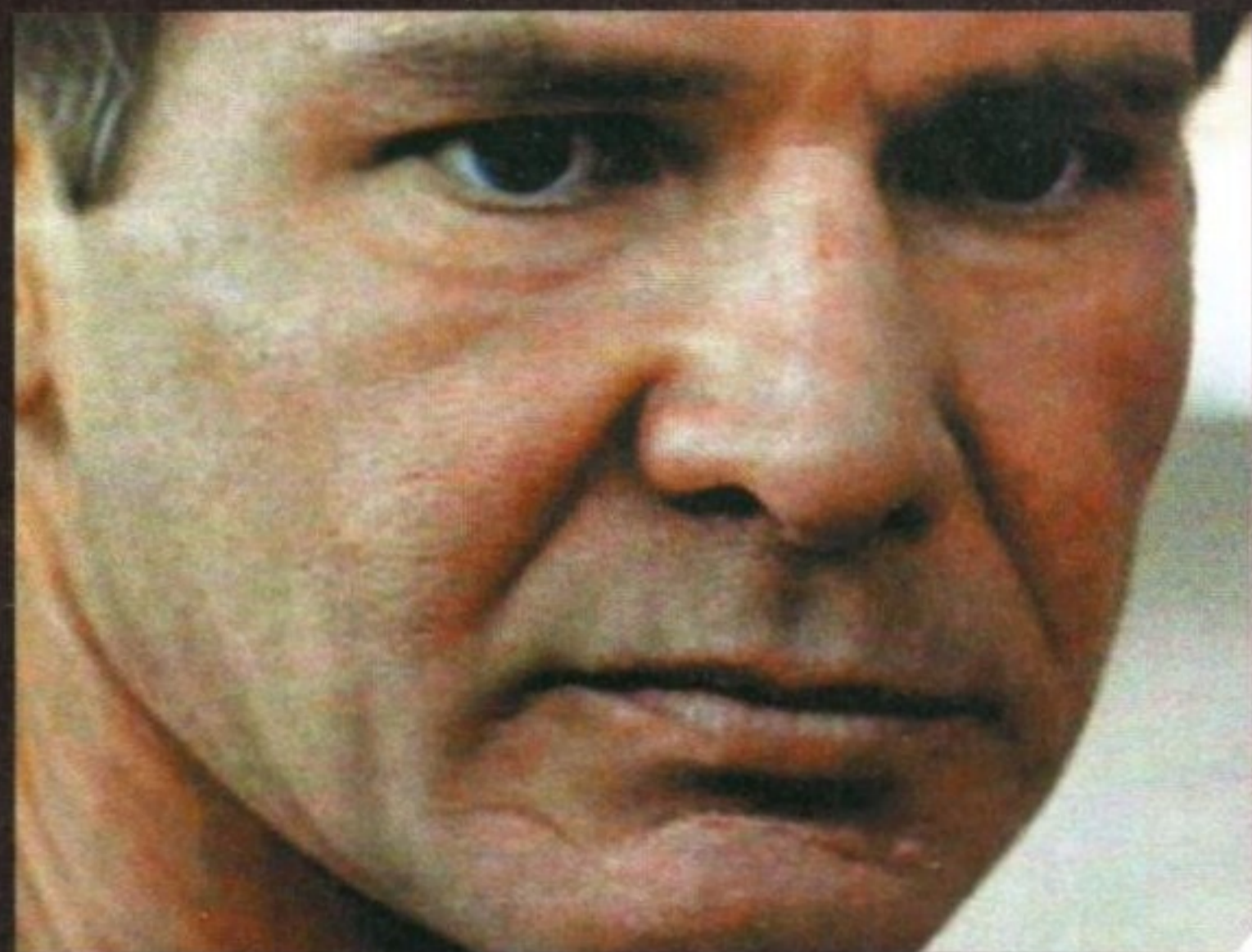
Today's CD-ROMs can hold 630Mb of data, and current CD-ROM

drives can access that data at around 150K/second. You'll probably know that the CD³² boasts a 300K/second drive, but for MPEG1 to be a standard, it had to operate to the lowest common denominator which is a transfer rate of 150K/second.

So how do you squeeze 25 frames of FMV into a 150K data stream? You compress it, that's how – by a factor of 200:1. First, you compress the sound. Human hearing isn't that sensitive, so the sound can be topped and tailed, removing high and low frequency audio and by taking out those sounds masked by louder ones. An MPEG soundtrack takes up less than one-tenth the space of a normal video soundtrack – and yet still contains all the data for full stereo and Dolby Surround effects!

FIELD WORK

Of course, compressing video is a much trickier task and was achieved using three cumulative methods. First, you reduce the resolution of each screen by a quarter, taking out every other interlaced field. Normal TV images are made up of a series of odd lines and even lines, interlaced to



show a complete picture. One field is displayed every 50th of a second (that's what it means when UK TVs are said to operate at 50Hz) and so a single frame of two fields takes up one 25th of a second.

With every other frame out of the picture, literally, you immediately reduce the amount of data by 50 per cent. Now you remove every other pixel, halving the resolution and reducing the data down to a quarter of the original. This entire process is called decimation.

Next the video data is converted to a YC signal – luminance (brightness) and chrominance (colour) – which is a much more compact method of carrying video data than the normal RGB signal.

The final and vastly more complex compression methods are termed Discrete Cosine Transformation Quantisation and Run Length Encoding. The basis for these is that not every frame of video is required: by storing certain frames, the

decoding chip can interpolate between them and generate the in between frames 'on the fly'.

Only certain key Intraframes are encoded in their entirety and these I frames then act as markers for the rest of the video. As such, I frames are usually the first frame in a sequence or in a scene change. The remaining frames are either the P (Predicted) frames or B (Bi-directional Interpolated) frames.

IN THE FRAME

P frames contain only the information about the changes in the movement and colour on screen. So, for instance, if you had a scene of a spaceship moving against a static backdrop, only the information regarding the direction and speed of the ship is stored as a motion vector. That way all the non-vital information can be discarded.

The final stage is to create the Bi-directional Interpolated (B) frames, which fill up the space between the I

and P frames. B frames are generated by comparing the differences between the I and P frames and storing any changes in positional data. This sounds like a complex and difficult process, and indeed it is – but it works!

Once the video compression is complete, one second of film footage takes up around 120K. The sound data takes up another 20K, leaving the remainder of the 150K as control data. The final step is to interleave the sound and video data, so that the CD drive reads a continual stream of video and sound.

The final result can vary depending on the quality of the original footage and, more

Good FMV, bad FMV – part 1: *Patriot Games*: Here you can see that a static close-up of Harrison (steady, girls) is crystal clear. But when the action starts, the fine detail, such as his face (inset), suffers badly.



FMV cartridge owners will see this a lot: so far, the only movies available are from Paramount's back catalogue, thanks to a deal with Philips.



The CD32 menu screen. This automatically pops up when a film is loaded to show the contents of the disc – in this case one of Philips' movies.



At any time during the film, you can access a meter which shows the length of the movie, the elapsed time, the time remaining and so on.



importantly, the quality of the encoding. Film duplicators can simply set up the MPEG encoding hardware and let the machine do the rest; careful encoders will go through the film frame by frame to make sure that major scene changes are encoded as I frames, and that artifacts are kept to a minimum.

Artifacts are the strange blocks and 'heat haze' effects which can occur during particularly busy scenes. It's a fact that MPEG playback loves *Driving Miss Daisy*, but hates *Star Wars*: the busier the scene, the more difficult it is to encode it properly. The screen information is encoded in groups of pixels – reminiscent of character blocks – and occasionally the amount of data simply isn't sufficient to fully describe the finer details of the image, especially when it's interpolating between those frames which contain fast-moving or blurred images.

With regard to vertical resolution (the number of horizontal lines) and

picture clarity, MPEG video is higher quality than VHS videotape, but compared to the more expensive 12-inch analogue LaserDiscs, it still has some way to go in terms of quality.

The MPEG2 standard – which is designed to deliver 10 times the data of MPEG1 – solves any questions of picture quality, but is reliant upon doubling the data rates to 300K/sec. Fine, you might say, my CD32 can do that! But the downside is that you could only store 37 minutes of FMV instead of 74...

DIGITAL VIDEO: THE FUTURE

Obviously, the first use of MPEG-based FMV is in the storage and playback of movies, and much has been made of the potential. Several electronics manufacturers will soon be entering the Digital Video market with carousel players, which can

store and hold several Video CDs at the same time. But given that

VHS video recorders are installed in the majority of homes across the world, Digital Video has quite a task on its hands to usurp the familiar VCR from its position beneath the family TV. The key is real-time MPEG encoding – and the time when that will arrive isn't so very far away.

MPEG encoding currently takes between 20 and 200 times longer than playback: which in reality is between one and ten seconds. But real-time encoding systems are beginning to arrive. The first system, C-Cube's CL4000 costs around the £70,000 mark.

But, as with any technology, MPEG encoding is constantly being refined, updated and being made more efficient – and therefore becoming cheaper. Eventually mass-

Good FMV, bad FMV – part 2: *Star Trek VI*. One of the best MPEG movies so far, the bulk of *Star Trek VI* – especially the slow-moving ships (left) – contains some excellent detail. But once the action starts, so does the picture break-up (right and inset).



Virgin's *The 7th Guest* has been converted to run on Philip's CD-i machine in MPEG FMV – but this overblown puzzle game hardly justifies the effort.



Mad Dog McCree on CD-i benefits greatly from FMV sequences. But like *Dragon's Lair* and *Space Ace*, it's hardly state of the art gameplay.



Sprawling adventure *Return To Zork* has been converted to run on the ReelMagic MPEG PC board. Slick graphics add nothing to the gameplay, though.

market real-time encoders will be available, accompanied either by cheap hard drives or re-writable CDs. And when the real-time encoders do arrive, VHS will quickly become a thing of the past.

For the immediate future, Digital Video has a much more important role to play in the arena of interactive TV: with sound and pictures squeezed into such a small bandwidth, the lanes of the information superhighway are already beckoning!

Fibre optic cables are already able to relay enormous amounts of data, and so all that is required for video-on-demand to become a reality is MPEG-standard players. The theory is simple: instead of watching what the broadcast stations decide you'll watch, you simply download whatever film

you want. The MPEG signal is pumped down the cable network and your player decodes it as you watch.

The other major use for Digital Video is in video games. Already there are games on the PC and CD-i that employ Digital Video sequences, with titles like *Return To Zork* and *Dragon's Lair* on the PC, plus *Mad Dog McCree* and *The 7th Guest* on CD-i paving the way.

EYE CANDY

So far no major developers have nailed their colours to the CD³² FMV mast, but David Pleasance, joint MD of Commodore UK, has stated that there are several FMV games currently in various stages of development for the CD³² and that they are looking fantastic.

WHAT'S IN A NAME?

If nothing else, the advent of moving pictures on CD has brought with it its own confusing nomenclature. MPEG movies, Full Motion Video (FMV), Digital Video (DV) and Video CD are all one and the same thing: film footage compressed to the MPEG1 standard and stored on CD.

So far, though, all FMV or Digital Video, call it what you will, has offered us are 'eye candy' video sequences or rehashes of LaserDisc games such as *Mad Dog McCree* and *Dragon's Lair*. Just how the games developers will choose to use the undeniable potential and power of MPEG video remains to be seen...

MPEG

MPEG – The Motion Picture Experts Group – is the task force set up by the film industry and major electronics manufacturers to crack the almost insurmountable problem of storing FMV on CD.

The MPEG committee held its first meeting in Ottawa, Canada, back in May of 1988. A year later, at RCA's research centre in Princeton, New Jersey, they showed that it was possible to squeeze full-screen, full-colour motion pictures and sound into the 150K/sec bandwidth of a typical CD player. This was achieved, they explained, by comparing the content of certain frames in a sequence with other frames, and coding only the differences between the two. Digital Video was born.

But, thanks to lengthy corporate haggling (due mainly to Philips, the inventor and standard bearer of the Compact Disc), it wasn't until November 1992 that the MPEG1 standard was set. And then it took another two years for the first mass-market systems to become available: first as the DV cartridge for Philips CD-i players and then as the FMV cartridge for the CD³².

Since then, the committee has been working on MPEG2 – an improved compression method which can deliver a vast 15Mbits/sec – MPEG1 currently delivers up to around 3Mbits/sec from a 150K/sec data stream. MPEG2's higher quality pictures and sound are primarily designed for broadcast purposes, since it requires a data rate of 300K/sec, which then means the CD can only hold 37 minutes of FMV.

BLUE LASERS

Work is already underway on CD systems that have four times the density of normal CDs. But then these discs will have to spin four times faster and require special blue lasers which can focus on the smaller pits. Such laser optics are prohibitively expensive – at the moment. The work on MPEG3 was absorbed into the MPEG2 standard, but there is also an MPEG4 system which is based around low data rates for videophones and teleconferencing.

VIDEOS ON CD



So far, the list of movies on CD consists mainly of films from Paramount Studios' back catalogue, since they were the first to sign a deal with Philips early on in the history of Digital Video. Obviously, as more and more studios get in on the act, you can expect to see this list increase dramatically.

By far the best quality Digital Video film on release at the moment is *Star Trek VI*, which was encoded by Philips themselves from the direct master of the movie. Sound and pictures are crystal clear, with artifacts and blocking kept to a minimum.

MUSIC VIDEOS ON CD



Digital Video has captured the imagination of the music industry because of its link with CD. Music videos on CD are friendlier, since you can instantly skip to the track you want to listen to and watch; and since most music video footage isn't of the best quality, any blocking or picture break-up is more easily ignored. The current catalogue of titles isn't exactly awe-inspiring, but as with the line-up of movies, this is just the beginning...

A Fish Called Wanda
Black Rain
Coming To America
Fatal Attraction
Frauds
Ghost
Goldfinger
Indecent Proposal
The Krays
Naked Gun
Naked Gun 2 1/2
Patriot Games
Planes, Trains And Automobiles
Sliver
Star Trek VI
The Crying Game
The Hunt For Red October
Top Gun
Wayne's World

Andrew Lloyd Webber – The Premiere Collection
Antistatic
Bon Jovi – Keep The Faith
Bryan Adams – Waking Up The Neighbours
David Bowie – The Video Collection
Kate Bush – The Whole Story '94
Pink Floyd – Delicate Sound Of Thunder
Queen – Greatest Flix I & II
Sting – Ten Summoner's Tales
The Cream Of Clapton
The Cure – Show
The Three Tenors
Tina Turner – Rio'88
Tina Turner – Simply The Best
The Worlds Of...