Digital Film Technology

ARCHIVE SOLUTIONS

Hardware and Software Tools for Archive Scanning, Restoration Processing and Playout

The Archive Solution – SCANITY and FLEXXITY Archive

Film archives are of great historical importance, which require long-term preservation for future generations. Whether you are considering long-term film archival and restoration of the original content and / or digitization of archival material for easier access, DFT Digital Film Technology offers a complete and affordable hardware and software combination for archive facilities to secure the protection of film assets.

Meeting the Goals and Expectations of the Archive Community – SCANITY & FLEXXITY Archive

DFT's goal was to produce an intelligent and powerful solution with dedicated features to scan, save, and restore films for the archive community. The DFT Archive solution addresses the requirements to archive and restore film material for the long-term, as well as archive the material in digital formats for repurposing and sharing. With the DFT Archive toolset, facilities can expect a high quality turnkey solution that can be configured to their specific archive application.

The Archive Process

Even though archived film may often have a number of problems including; shrinkage, bending, warping, buckling, weak or bad splices, damaged or missing perforations, notched or broken edges, faded colors, scratches and dirt, and film grain, it is imperative to protect the original. SCANITY does just that – protect the original film. A newly designed precision roller-gate concept offers unparalleled smooth and safe film handling. In conjunction with a continuous-motion capstan film transport, an optical perforation detection and touch-free pin registration is used rather than mechanical pins. Therefore no stress is placed on precious film.

Once the original film is inspected, cleaned and repaired (when necessary), it is transferred by the high-speed SCANITY film scanner to produce an image for digital capture. SCANITY can help keep the repair down to a minimum due in part to its smooth, pinless and sproketless film transport system. SCANITY light level settings can be easily adjusted to handle different exposures and any unique conditions of the film.

The FLEXXITY Archive software application ingests content either from SCANITY or accesses the content from local or network storage. Image processing functions allow users to perform primary and secondary color correction, 1D and 3D LUTs, cropping and scaling as well as dust busting functions such as dirt and scratch removal and retouching. Users can perform basic editing functions such as dragging and dropping clips, sequence changes, and edit cuts.

There is a large demand for new media – digital cinema, DVD, blu-ray, television broadcast, web and mobile. Archiving and restoring the films preserves them for generations to come and delivers new media that can be accessed by a large variety of users – museums, schools, government, and the public at large. The FLEXXITY Archive software application receives the DPX files and transcodes them into media, file or video formats that are easily accessible for exporting, publishing, sharing as well as for general access of the content.

Customer Reference Sites:

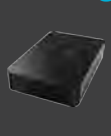
Global facilities and their talented teams are working with DFT Digital Film Technology scanners and software for archive applications:

- BBC Studios and Post Production (London)
- Beeld en Geluid (Amsterdam)
- Cinelicious (Los Angeles)
- FINAS (Kuala Lumpur)
- Gostelradiofond (Moscow)
- Nice Shoes (New York)
- OMNIMAGO (Ingelheim)
- Thought Equity (Amsterdam)

Content Management System

Workflow Management System

Ingest



Audio

SCANITY

With Optional Optical Audio Scanner

FLEXXITY Archive

With Audio Ingest and Preparation

DPX

WAV+MD

WAV+MD

Store

SAN

Storage Area Network

DPX+WAV

DPX+WAV

DPX+WAV+Metadata

Mastering

FLEXXITY Archive

- QC
- Image + Audio Synchronization
- Transformation
- Color Correction
- Dirt, Scratch and Grain Removal
- File Encoding
- Playout to Film/Video

Restoration

Image + Audio Restoration

- Dirt Removal
- Scratch Removal
- Grain Reduction
- Splice Correction
- Image Stabilization

Deliver

Digital Archive (LTO)

Video

Files

Film

SCANITY Archive

SCANITY is a high-speed, optically pin registered film scanner that ensures the smoothest, safest and steadiest film handling. The key features below discuss how SCANITY address the specific and unique requirements of Archive facilities.

Badly Damaged Film

In most cases, archive film can be scanned quite easily, however when film is damaged, special attention to the features in the choice of a film scanner should to be taken. Damaged film includes; warping, buckled, shrunken, weak and / or damaged splices, missing or broken perforations, notched or broken edges, and vinegar syndrome. SCANITY from DFT Digital Film Technology offers a feature-set that is tailored to meet the unique demands of archive scanning including smooth and gentle handling of damaged film. SCANITY's features to address damaged film include:

- Roller Gate: DFT designed SCANITY's roller gate to avoid friction and abrasion on the film. Only the edge of the film touches the roller as it travels gently through the film gate on the two gate rollers.

- Capstan: A rubber-coated capstan for film transport is a proven concept and is tolerant to all kinds of film imperfections. There is no smoother or safer way than to continuously transport the film.

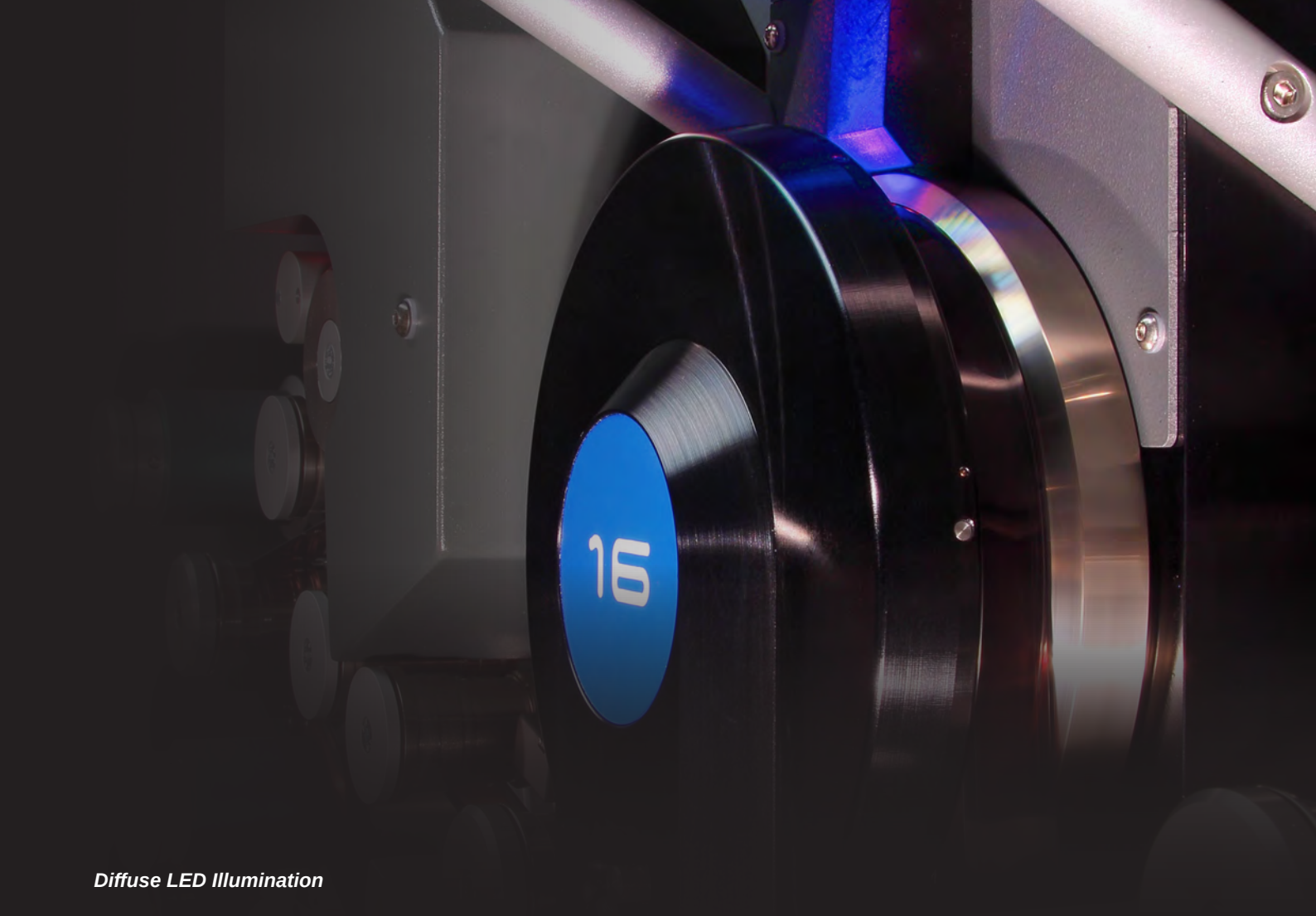
- Pinless, sprocketless film transport: Archive film often has damages due to careless use, aging or wear and tear that may need repair prior to scanning. SCANITY can help keep the repair down to a minimum due in part to its smooth, pinless and sprocketless film transport system. SCANITY's film transport handles the film with great care ensuring that no further damage occurs.

- Film shrinkage measurement and display: SCANITY's film shrinkage measurement feature displays the amount of how much the film has shrunk. SCANITY has the ability to scan shrunken film without adjustments or modifying film gates, supporting shrinkage up to 4%.

- Supporting Film Plate: Supporting film plates that provide precise guidance of the film can be plugged onto the bobbins so that bent film is safely and smoothly wound. This prevents the bent film from becoming slack and fall off the bobbin.

- Vertical Over-Scanning: Splices on films, especially on archive films can have wide tolerances causing the frame bar to jump in and out of the visible area of the image. By scanning more of the nominal picture height and showing small parts of the previous and next frame allows the image area to be selected in a second workflow step without losing any of the content. The advantage of using SCANITY is that the scanned files increase in size as the image area becomes larger (higher and wider). Thus, the resolution per inch / pixel pitch is kept constantly high. In contrast to an optical zoom this allows users to maintain image sharpness throughout the post production process - even after cropping and repositioning. The image height is 25 % larger than the original film frame, equally dispersed on the top and bottom of the frame.

Roller Gate and Optical Perforation Detection



Diffuse LED Illumination

Sensitive & Fragile Film

Often, archive film is extremely sensitive and fragile and should be handled with extreme care. SCANITY has been adapted to meet this challenge with the following features:

- Film Path: Just simple rollers are used in all the film transport. No skid plate or stationary reference edge is in contact with the film ensuring a clean and safe film path as no dust is produced from abrasion.

- Digital Servo Control: SCANITY's digital servo system precisely controls acceleration and film tension individually for different film formats ensuring the smoothest possible film treatment.

- Reduced Shuttle Speed: Some archive material is so delicate or fragile that despite the most gentle film transport, reduced film transport speed is desired. Simply flip a switch to lower the speed of the film transport as well as acceleration and slowing down in visible shuttle or spooling mode.

- Optical Perforation Detection: SCANITY's optical perforation detection is an alternative to mechanical perforation systems using pins that provide a tight and possibly harmful grip on the perfs. SCANITY uses a high resolution optical system for detecting the perfs and a touchless pin registration that ensures safe and gentle film handling, and a smoother transfer. Steadiness of images are electronically corrected in a sophisticated special processor.

- LED illumination: Delicate archive films need to be illuminated with cold and low intensity light in order to avoid thermal stress and additional color fading. The extraordinary low intensity of light required to adequately illuminate the film and produce a high quality image is due to an extremely sensitive TDI Sensor, which comprises of 96 scan lines and scans every film dye 96 times. This new custom sensor features a higher sensitivity of approximately 50 times compared to the sensitivity of a single line sensor. Despite low light levels, scanning still takes place at fast speeds – e.g. 2K at 25 fps on SCANITY.

- Individual Light and Density Range Control: Poor colors can fade both positive and negative film due to age and inappropriate storage or use. As long as there is a little remaining color information left in the color layers it should be recovered. SCANITY offers a wide range and headroom of light as well as the tools to control the intensity of each color of the LED illumination. SCANITY also controls adjustable density range that allows users to get the very best out of the film.

Unparalleled Efficiency and Versatility for Digitization of Archive Films

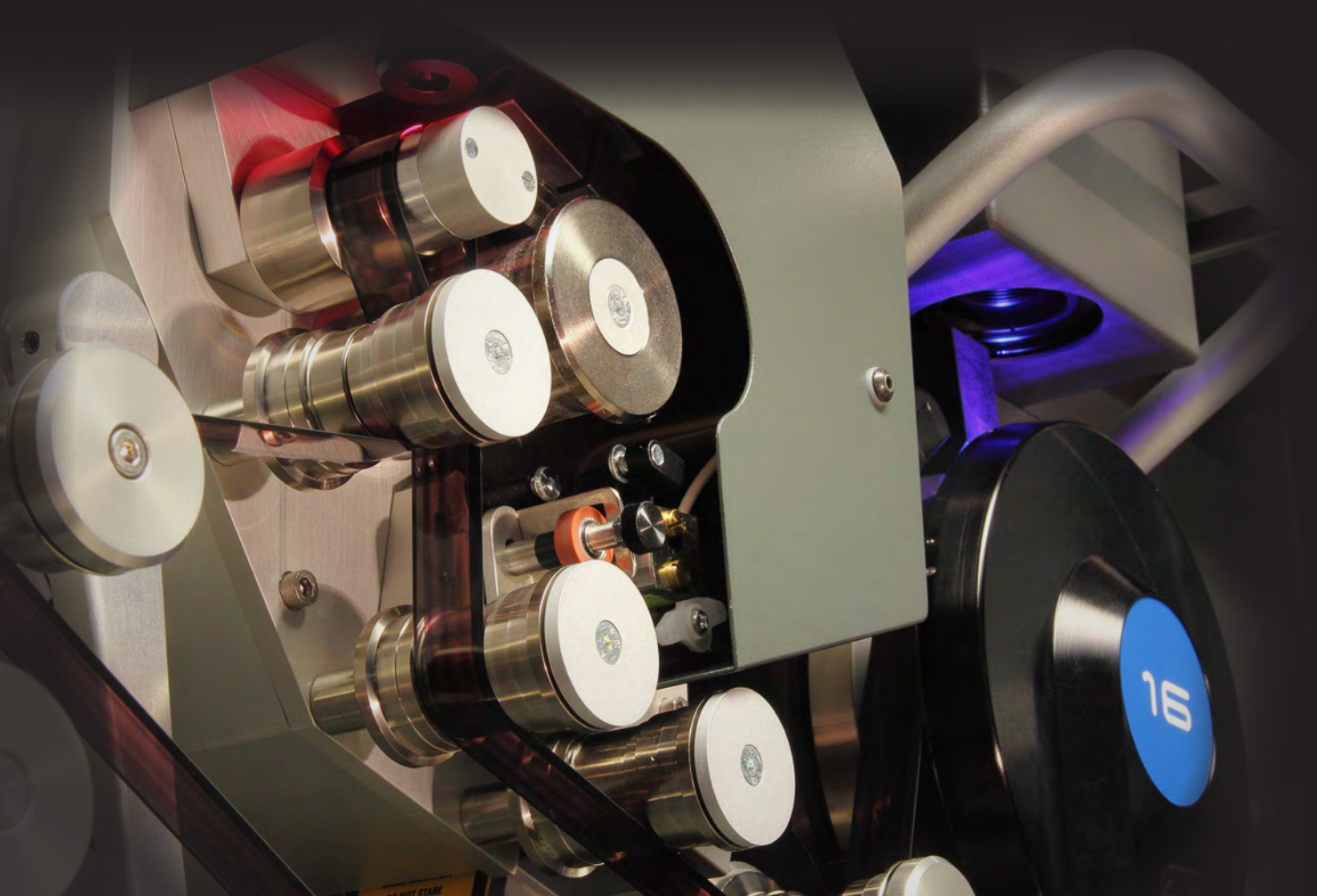
Archives facilities can be faced with many challenges when trying to execute their mission of protecting the valuable and unique heritage and history contained in film vaults. DFT Digital Film Technology has devoted time and resources to develop unique features in SCANITY to assist archive facilities to meet and exceed their goals. These features include:

- Audio Scanning: Optical or magnetic audio on print film: An optional audio scanner mounted into the SCANITY film path reads analog optical mono or stereo audio tracks of 16 and 35 mm film and magnetic audio tracks on 16 mm film. This feature eliminates the need for a separate scanning path for audio scanning and downstream audio/video synchronization.
- Film Grain Reduction: Many features for modifying a scanned file are available in the Batch Processing tool in SCANITY. Grain reduction is just one of them, which allows users to generate a second and cleaned up version of the originally image. The original image is kept in memory unless it is manually discarded.
- Scanning Speeds – 10 x Faster: One of SCANITY's unique features is its extremely fast scanning speeds. For low-resolution files (250x180 pixel), it scans as high as 96 frames per second on 35mm, 4 perf film. For high resolution scans preserving all content detail, SCANITY scans at 15 frames per second on 35 mm and 4 perf film. Whether you need to quickly browse to check content or record high quality files, SCANITY's speed is unparalleled to any other film scanner on the market.

"The SCANITY audio scanning feature provides us with the ability to concurrently scan film and its associated audio, which eliminates the need for separate image and audio scanning passes and synchronization. We can scan and store films without having to edit them."

(Khairunizam Abd Sukor, Post Production Engineer at FINAS)

Audio Scanning Option



Dirt and Scratches and Varying Sharpness on Film

When archived film has been frequently pulled from vaults for use, placed on less gentle film printers or scanners or equipment which may have been poorly maintained, or the film was just carelessly handled, it may have gathered dirt and / or scratches. SCANITY manages dirt and scratches with the following features:

- Diffuse light from adaptive LED light source: Diffuse light optically reduces the visibility of fine dirt and scratches on film and reproduces crisp and natural looking images. The light comes from an integration sphere which is illuminated by four different colored clusters of LEDs – red, green and two different red channels. The red channels with dedicated spectral characteristics take into consideration the differences of positive vs. negative film for ensuring extremely accurate color reproduction.

- IR camera: The optional IR camera scans dirt and scratches separately from the RBG image. It provides a dirt matte either as a separate DPX file or as an RGB image with alpha channel in the same DPX file. The dirt matte supports downstream restoration by making the process faster and easier since the necessary image analysis for dirt and scratch detection is no longer necessary. Only the concealment of the disturbed images parts is still necessary, which is a fairly simple and fast task.

- Dirt and Scratch Concealment: Concealing detected dirt and scratches can be performed on the fly with dedicated firmware algorithms in SCANITY and without compromising speed. The resulting image is cleaned up while it is scanned – free from fine scratches and dirt.

- Variable Aperture Correction: Aperture correction compensates for unavoidable losses that occur in optical scanning systems. If the aperture correction is set to neutral, the images are seen exactly as they are on the film. The aperture correction algorithm has been expanded so that the operator can over or under compensate to make the image sharper or softer. This helps adjust the varying looks of different film stocks, reduce the appearance of the film grain or simply apply a certain look.

“SCANITY is delivering everything it promised. The IR concealment option has significantly reduced the degree of downstream dust busting we have to undertake and the images are as good as we’ve seen in HD and 2K. This coupled with the really impressive speed of scanning means we can expand our restoration capacity significantly with minimal further investment. Finally the potential of moving to 4K scanning is an important future proofing feature as and when our customers require it .”

(Clive Hodge, Head of Digital Media Services BBC Studios and Post Production)

FLEXXITY Archive Software

FLEXXITY Archive is a specialized software tool for file and video conversion and mastering. The application allows users to access archived image / audio files from disk storage as well as ingest material from SCANITY and other film scanners. It performs quality control checks on archive material, executes image / audio synchronization, timeline editing, color correction, and image scaling. Processed files are output in many file or video formats. FLEXXITY Archive has built-in scratch and dirt removal, as well as retouching capabilities.

The FLEXXITY software suite integrates seamlessly with SCANITY to ensure a turnkey archive & restoration solution. FLEXXITY Archive and SCANITY can share production databases allowing access to all metadata information on a particular project.

The key features below discuss how FLEXXITY Archive software when coupled with the SCANITY film scanner addresses the specific and unique requirements of Archive facilities:

Audio Synchronization

Archive media is often stored independently, i.e. separate images and audio. If the audio content is on the film, and the film has shrunk, the audio might no longer match the image sequences.

Audio BWF (broadcast wave format) files can be easily synchronized with image clips using FLEXXITY's slate or sync markers. It is a simple drag and drop operation to establish the sync between an audio and an image clip.
The fit and fill function precisely fits a specific audio take to the corresponding image material, even if the original audio as drifted over time due to shrunken film or other reasons. The audio resampling tool manipulates the audio before being synced to its corresponding image.

FLEXXITY Archive has many different ways to synchronize image and audio files to produce an "on the spot" synchronized version of the content. If both image and audio has been scanned with SCANITY, the sync is already established and the metadata information being shared with FLEXXITY is used to automatically align image and audio clips when they are dragged onto the FLEXXITY timeline. The real-time playback functionality of FLEXXITY can then be used to verify the accuracy of the synchronization.

Background Processing

During the file output format generation process, a system may be blocked or unavailable for other tasks. Rendering tasks often run on a single machine and are often time consuming.

FLEXXITY Archive and SCANITY provide concurrent background rendering of file outputs, batch, scene detection and transcoding tasks while the creative work continues. The background rendering architecture for file outputs and other tasks automatically distributes the rendering to all available nodes in a cluster. This makes optimum use of all available CPU and GPU resources, which helps facilities maximizing the workflow efficiency across their post production applications.

Generating File / Video Ouputs

A large variety of video or file formats are required for archive deliverables so generating different formats should be simple and fast.

Digital archive assets are typically stored as DPX files. However, the DPX files may not be the preferred file type for an online version or a browsing copy. Depending on the archive, a variety of content delivery formats may be required; from SD/ HD video to Windows Media, QuickTime, MXF, AVI, Broadcast WAVE and MPEG file formats. FLEXXITY Archive provides a software toolset to create an array of different file and video output formats. File output templates provide a user-friendly way to repeatedly and automatically produce formats. FLEXXITY Archive also has a powerful built-in rendering engine, which takes advantage of all available hardware resources; CPUs and GPU. This facilitates impressive performance in the parallel generation of a large variety of file formats.

Dust Busting & Retouching

Archive material may have dirt and scratches and for the production of a good looking digital copy those defects need to be removed or reduced.

In addition to the dust and scratch removal tools in SCANITY, FLEXXITY Archive automatically removes dirt and scratches in the images. FLEXXITY Archive also has a manual retouching feature, which provides a fast way to paint out defects on particular images. The dirt and scratch removal tools in FLEXXITY Archive have user adjustable parameters in order to match the repair to its corresponding defect. Larger defects, such as blotches can also be repaired by using image information from the same and surrounding frames that are identified by a very sophisticated motion estimation algorithm. The repair can also be limited to the dirt matte metadata information obtained by the infrared detection in SCANITY.

Image Scaling and Resizing

Archive material that is rapidly scanned with a one-light setting does not necessarily look good enough to produce browsing files for online access and other purposes. Image clips need to be color matched, rescaled and placed in the correct color space.

The FLEXXITY Archive image processing feature generates attractive looking browsing or intermediate versions of the images. Primary color correction allows users to color-match to the scanned images. 1D / 3D LUTS, image transformation and cropping are all standard image processing features. Optional real-time grain reduction and contour enhancement is also available and can be purchased at any time via a software license.

Quality Checks

The archive material needs to be quality checked therefore real-time playback of uncompressed high resolution images is required.

FLEXXITY Archive allows users to perform quality checks in real-time. It plays back DXP sequences and sources in any resolution to a calibrated monitor for verifying that the content has been ingested properly.

Fast Content Ingest & Access

Time consuming media ingest, duplicate storage requirements, incompatible file formats

FLEXXITY Archive directly accesses video and audio archive footage from local, NAS, or SAN disk storage, including scanned material from SCANITY or other film scanners. It also ingests content from video tape decks or audio recorders. FLEXXITY Archive provides a direct, simple and resolution-independent access / ingest tool that is ideal for all kinds of archived source material, including 16/18 fps silent movies. By directly accessing the media, it saves disk storage and ingest time, as no additional copies need to be stored. If the media is not available in online storage or is in a different file format, FLEXXITY Archive can quickly ingest or transcode the content.

Online Editing

Films often contain several independent clips and when a complete film reel is digitized, all the material ends up as one big digital clip. Independent entities have to be generated and a fair amount of online, full resolution and non-linear editing is required to produce the correct files.

The FLEXXITY Archive online editing feature enables users to drag and drop clips onto an editing timeline where they can cut or remove areas of the image, change the sequence of edits, lengthen or shorten clips, add filler or slates, etc.. All of this can be accomplished in sequence with the synchronized audio. Edit timelines can also be sorted according to metadata.

Frequently Asked Questions

"How is IR light used to conceal dirt and scratches?"

When film is illuminated with IR light, the IR sensitive camera picks up unwanted dirt particles and scratches. This is due to the fact that color film is transparent to IR light, dirt particles are non-transparent, and scratches scatter the light. The image from the IR camera is digitally prepared to be used as a dirt matte and placed into the alpha channel of the PDX file together with the RGB image information. The dirt matte can be used in down stream restor.

"What kind of tasks can be performed with batch processing?"

Tasks such as grain reduction, contour enhancement, color correction, 3D LUTS, zooming/sizing/scaling, output format conversion can be delegated to other workstations that are connected to the network.

"What file systems does FLEXXITY Archive support?"

SGI XFS/CXFS, Quantum StorNext FS, BrightSystems BrightClip, IBM GPFS.

"Is the internal SCANITY workstation capable of batch processing?"

When SCANITY is not scanning, the internal workstation automatically performs various batch processing functions. When additional workstations are connected, batch processing tasks can be performed at the same time as film scanning.

"Is FLEXXITY available as software only solution or as a turnkey solution?"

FLEXXITY Archive is available as a turnkey solution only. DFT uses certified and powerful HP workstations powered by a Linux operating system for all FLEXXITY software applications.

"What storage systems does FLEXXITY Archive work with?"

FLEXXITY Archive works with any FC or SAS connected storage system with a minimum performance of at least 2K real-time playback. If there is more than one seat of software then a SAN is required. Examples of SAS storage include: DDN, Bright Systems, DVS SAN or Spycerbox, Autodesk SAN, Rorke Data (Bell Microsystems) Aurora.

NAS (network attached storage) such as CoRAID storage, have limitations in guaranteed real-time performance, yet can be a very cost efficient solution for file based workflows.

"What are the restrictions of IR light for dirt and scratch detection?"

IR detection of dirt and scratches for black and white film is restricted as the emulsion that carries the image information contains silver halides, which are opaque to the IR light. Digital restoration tools analyze the image and discriminate image content from dirt and scratches and conceal them.

"Is it possible to raw-scan the bare output from the TDI sensor?"

A raw scan can be achieved using a linear characteristic, non-inverted negative film, with no LUT applied using a flat aperture correction and a 1:1 scaling straight output into 16bit DPX files or 16bit TIF files. Files can be generated with and without the IR channel (alpha channel) embedded.

"How many video outputs does FLEXXITY Archive offer?"

One seat of FLEXXITY Archive supports up to three parallel video outputs on one output timeline with different settings for standard, resolution, color correction, LUTs, burnins etc. The limitation is in the image processing capabilities of the system. A standard FLEXXITY Archive configuration is one DVS ATOMIX card with two 4:2:2 (single link) video outputs or 4:4:4 (dual link) output.
A second card can be added if users need two additional outputs. Outputs are generated instantaneously from the raw source files (including all metadata; sync or color correction information.) The number of outputs scales linearly with the number of seats. Video I/O is not supported in software-only configurations.

"How fast is the dirt and scratch concealment in FLEXXITY?"

The automatic dirt and scratch concealment in FLEXXITY Archive are not real-time operations. The dirt removal is based on sophisticated motion estimation algorithms which need a lot of processing power and runs with a few fps.

"Is it possible to output two different formats at the same time?"

A high resolution 4K or 2K DPX file can be generated and recorded in parallel to a low resolution 0.5 proxy DPX file. Batch processing generates more files with different resolutions, image formats and file formats including streaming formats such as QuickTime, AVI, BMP, DVD, H264, JPEG 2000, MPEG 4, MXF, PNG, Tiff, Windows Media, and more. Formats are generated in parallel if additional workstations are connected, or sequentially if only using the integrated SCANITY workstation.

"How many types of files outputs can FLEXXITY create? How quickly can FLEXXITY generate file outputs?"

FLEXXITY can generate up to 15 different file outputs from one timeline at the same time. Depending on the image processing, the number of outputs, the output resolution, codec, file format and its specific settings, the output can be generated at up 10x real-time speed. Multiple file formats can be generated in parallel, which effects render speeds. Some codecs scale well in a multi-CPU environment, and others do not. Therefore, it depends on the specific combination of outputs that you are generating.

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