

# Days of Future Past

The Future of Video & Film Preservation is New Equipment

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*The home of media professionals, technologists, and engineers*

# Days of Futures Past

- Media preservation at a crossroads:
  - Hundreds of millions of audio and videotapes are known to exist
  - Billions of feet of film is known to exist
  - Tens of millions of data carriers exist
  - Across all six inhabited continents
  - More undigitized content exists than content already digitized
- If even a portion of this culturally and commercially significant content is to survive into the next generation thousands of playback devices are required

# Days of Futures Past

- Today we are going to explore:
  - The VTRs of the future based on the designs of the past
  - Low-cost, high-quality film scanning for under \$30,000

# The Tape Machines of the Future

Using the designs of the past to build machines for the future.

# Days of Futures Past

- Problem: the vast majority of audio and videotape players manufactured no longer exist
- Most have been recycled
- Some still exist with their original owners
- Media digitization efforts (both commercial and non-commercial) are buying up what is left as quickly as they become available
- Hobbyists are also collecting large quantities of playback machines, taking them off the market for those digitizing content
- Costs of remaining machines are rising significantly
- Cost per digitized item increasing

# Days of Futures Past

- Two short-term solutions:
  - Keep existing equipment running with spare parts manufactured during the original manufacturing run
  - Create spare parts from 3<sup>rd</sup> party manufacturers that can be easily reverse engineered
- All major manufacturers (Sony, Panasonic, JVC, Studer, Ampex) have sold off their spare inventories to 3<sup>rd</sup> parties
  - Some 3<sup>rd</sup> parties have created a business out of acquiring parts stocks and reselling them
  - Some are hoarding factory original parts and not selling them to anyone
- Some consumable parts can be manufactured now:
  - Rubber items such as pinch rollers and rollers currently being produced
  - Some parts currently are only available on the after market:

# Days of Futures Past

- Long-term (5-10 years) required solutions:
  - Manufacture new spare parts
  - Manufacture wider variety of spare parts
  - Original manufacturers have indicated they will not make new spare parts
- Manufacture new equipment
  - Make equipment cheaper than the original versions
- Original manufacturers have indicated they will not make new equipment
- New vendors have been identified that can produce key components
- More manufacturers will be needed to create complete machines

# Working Group on Media Resilience

- Several dozen organizations and individuals have been working on how to produce new equipment
- A group of over 20 media migration vendors and preservation organizations started meeting this past spring: the Working Group on Media Resilience
- Initial focus is spare parts:
  - Rubber rollers and pinch rollers already being produced by several vendors
- A number of groups are working on reading signals from tapes, then using SDR (Software Defined Radios) software to recover audio, demux video, recover data.
  - Some success has been achieved: VHSDecode

# Working Group on Media Resilience

- Long-term focus is on new equipment
  - Focus remains on reading signals from tapes, then using SDR (Software Defined Radios) software to recover audio, demux video, recover data
  - Avoid complete VTR designs unless there are no other alternatives since they require investment in more complex circuit boards and software to recover baseband video and audio.
  - Plan for both options

# Days of Futures Past

- Challenge is how to design new equipment
  - Basing designs on existing equipment using original vendor design documents is ideal
    - Discussions are ongoing with several original manufacturers
  - Reverse-engineering is an option
    - More fraught with danger:
      - Reverse engineering rarely creates machines with the same tight tolerances as the originals
- Tight tolerances are especially important with complex videotape formats
  - VHS Hifi used ‘depth modulation’
  - Various formats used heads with different azimuth angles between track
  - How to recover linear audio and maintain timing with HiFi audio and digital audio tracks
- Tends to be significantly more expensive at the design stage

# Days of Futures Past

- A lot of work still to be done
- If you would like to participate or keep updated on the Working Groups efforts: [@mediaresilience](https://twitter.com/mediaresilience) @ [unicoi.net](https://unicoi.net)

# The Tape Machines of the Future

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# Creating an Affordable Film Scanner for Preservation & Production

# Creating an Affordable Film Scanner

- Media preservation at a crossroads:
  - Billions of feet of film is known to exist
  - Across all six inhabited continents
    - Many collections are in the former colonial nations
      - Africa, Asia, South America, Pacific Ocean nations
    - Much of the footage is of both historical and cultural significance
    - Document groups and languages that no longer exist
  - More undigitized content exists than content already digitized
- If even a portion of this culturally and commercially significant content is to survive into the next generation thousands of playback devices are required

# Creating an Affordable Film Scanner

- Production & preservation quality film scanners for 35mm and 70mm start at around \$150,000
- Production & preservation quality film scanners used to start at \$80,000
- New software technologies and design focus on reducing the cost of manufacturing using off the shelf IT, physical printing, precision engineered parts.

# Creating an Affordable Film Scanner

- The first goal was to create a film scanner for film gauges 17.5mm and smaller (16mm, 9.5mm, 8 & Super8mm, 3mm) for under \$30,000
  - Achieved in 2023 with the Filmic Technologies film scanner
  - One other vendor has entered the market around that price point since 2023
- The next goal is to produce a film scanner for 35mm and under (35mm, 28mm, and the smaller formats)
- Learn from the successful designs for larger film gauges, both current and historic
  - Current: 65mm camera negative, 70mm release prints
  - Historic film gauges: 50mm Gaumont; 55mm Fox Grandeur; 68mm Biograph-Mutoscope

# Creating an Affordable Film Scanner

- Technical requirements:
  - Find precision motors that can be tightly controlled with high precision
  - Create a film path that treats film gently
    - Must be able to handle misshapen films damaged by vinegar syndrome
    - Must be able to handle brittle film
    - Must be able to handle damaged film
    - Sprocket hole damage
    - Edge damage
    - Poor quality splices
    - Must not require pins or sprockets to advance or steady the film

# Creating an Affordable Film Scanner

- Technical requirements:
  - Software must be able to:
    - Stabilize pictures captured from film moving in multiple directions
    - Recover audio from optical sound tracks
  - Create metadata from the edge markings, including text, production codes, and key codes
  - Magnetic stripe audio must have low wow and flutter
  - Must capture at or greater than real time
    - 24fps for most formats
    - 30fps for IMAX
    - Capability to write metadata for playback speed less than 24fps
  - Goal of 60fps capture, with correct audio playback of both optical and mag stripe audio
  - Possible wet-gate options, but as an option at additional cost

# Creating an Affordable Film Scanner

- Technical requirements:
  - Software must be able to:
  - Create Files that match current production & preservation standards
    - Images with bit depths up to 16 bits per channel
    - Resolutions up to current camera capabilities
    - Frame rates up to 60fps
  - Moving image files: JPEG2000 in MXF, DPX, OpenEXR
  - Audio tracks/files:
    - minimum 48kHz/24 bit sampling
    - Preferable 96 kHz/24 bit sampling
    - Option for up to 192 kHz/32 bit sampling
  - Standalone audio files up to BWF (Broadcast WAV) RIFF 64

# Creating an Affordable Film Scanner

- Technical accomplishments
- Chassis can be machines with current production technologies to a very high precision
- Precision motors are now common, capable of handling very heavy weights
- 1 hour reel of 70mm film weighs about 50 lbs
- High resolution cameras up to 10k lines are available that capture 24 fps...at higher cost
- Affordable cameras above 4k UHD resolution that capture 48 fps now available under \$5000

# Creating an Affordable Film Scanner

- Technical challenges:
- Magnetic stripe reader heads are difficult to get, expensive to produce, and only a few people still know how to make head of sufficient quality
- The loss of perc (perchloroethylene) as a film cleaner makes wet gate designs more difficult to implement
  - It's a known cancer causing chemical
  - Other cleaners don't work as well
- Creating usable images beyond 12% film shrinkage

# Creating an Affordable Film Scanner

- Next challenges:
  - 35mm and up scanner under \$70,000
  - 17.5mm and smaller film scanner for under \$10,000
    - Under \$10,000 means the scanner can be afforded worldwide and used in the farthest reaches of the most remote areas
    - A true ‘suitcase scanner’ as portable as a laptop computer
    - Possibly operable on battery or with portable generators
    - The design is mostly done.
  - Aimed at film collections left over in former colonial areas or in poorer areas

# Creating an Affordable Film Scanner

- Conclusions:
  - Small, portable film scanners handling film under 17.5mm is not only possible, its now a shipping product
  - Can still produce common preservation quality scan files
  - Allows neglected or abandoned film collections into public awareness that couldn't otherwise achieved in areas of the world where media preservation isn't commonly available
    - Former colonial countries
    - Poorer areas of the world
    - Remote areas of the world
    - Former communist countries

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