VIDION - An On-Line Archive for Video

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Abstract

One of the problems people face nowadays in most of the jobs is the big amount of information that is produced and should be stored, accessed and re-used later. This problem is even more important when talking about a Television Broadcaster, as this kind of information has strong demands on storage capacity, communication bandwidth, classification data, etc.

This paper presents an experience developed in order to preserve a broadcaster audio-visual archive, the architecture of the system being tested and the goals already achieved.

Introduction

VIDION (Digital Video On-Line) is a Portuguese R&D project involving RTP (the Portuguese public TV broadcaster), INESC (a research institute with some experience in the area of digital television) and Europarque (responsible for a science centre park).

RTP owns one of the largest audio-visual archives in Portugal with more than 400 000 documents in different formats (analogue, digital and analogue with special characteristics from the historical archive) amounting more than 300 000 hours.

VIDION main goal consists in proposing a strategy for the evolution towards the digital domain of the complete RTP audio-visual archive. The project will develop a small-scale prototype archive to be used by the News Service, consisting basically in two different kinds of servers - a broadcaster and a browser quality servers - workstations for searching, selecting and previewing video sequences, digitising stations and the required communication infrastructure.

Additionally some extra funcionalities will be developed: a restoration module to automatically correct video impairments and a text-based intelligent search engine to assist the indexing and search processes.

One of the main concerns of the project was on choosing standard video formats, long last storage devices and on finding solutions for easy and efficient access to the information. These three aspects will allow the real preservation of this valuable archive.

System Architecture

The system developed within VIDION is composed by a number of elements as shown in Figure 1.

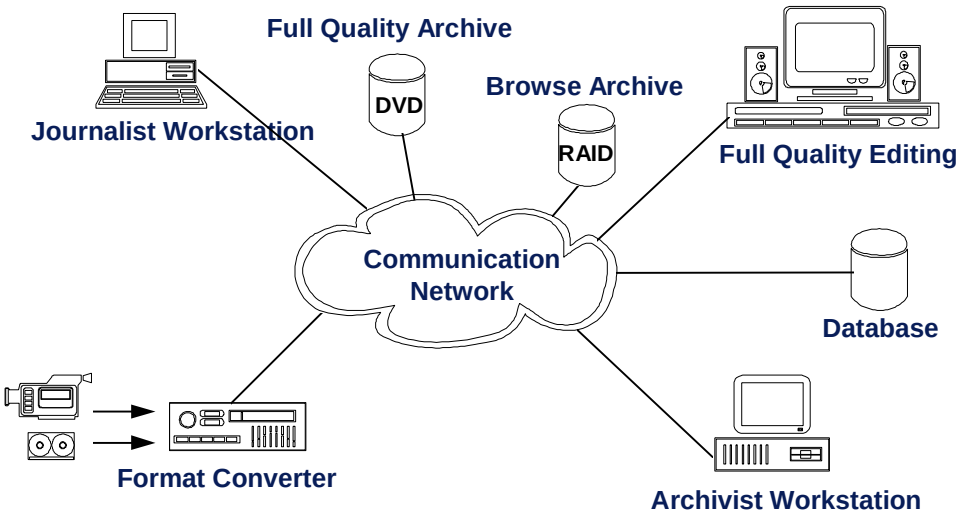

Figure 1 - VIDION Architecture for Digital Studio Archive

The first step on building a digital archive is the digitalisation block and format converter which will enable the creation of two versions, with different dimensions and quality, of the same source. The browse version will be stored in a RAID based archive and after being conveniently documented by the archivist, through a set of indexing GUI and auxiliary tools, will be available for searching, previewing, selecting and pre-editing in the journalist workstation. This will enable the journalist to produce a draft version of a video sequence which will later be produced, based on automatically generated information, in studio/broadcast quality format. The full quality archive, due to the big amount of storage space it represents and to the longevity required, will most probably be based on a DVD based server.

One of the points that should be considered in a system like the one described is the format of the information to preserve. Standard solutions are needed in order to be able to use different kind of equipments from different vendors and to interchange information between similar systems. Based on these ideas, MPEG1 at around 1.5Mbps was chosen for the browse server while MPEG2, the format which is expected to be used in the broadcast world, will be available in the full quality server. Due to the special characteristics and cultural importance of the historical RTP material and also due to the increasing demand for video material from this archive special interest was put in an automatic digital restoration processes.

Digital Video Restoration Module

The major advantage of the digital restoration methods over the traditional ones is that thousands of techniques can be tested without damaging the original copy, therefore allowing the restoration operator to choose the technique that gives the best perceptual and/or objective results.

The main problem with digital video restoration is that it is impossible to find a technique that removes all kind of artefacts from the video. Based on RTP experience, blotches and line scratches (vertical lines) were considered the two most frequent and annoying artefacts in the archive and so the algorithms developed must try to remove them from the original video.

The restoration process can be viewed as a black box which includes the artefact detector, restoration

algorithms (interpolator) and a quality measurement process (Figure 2). The input and output of the restoration chain is a CCIR 601 digital video signal, in order to avoid the extra noise resulting from further coding schemes as MPEG2.

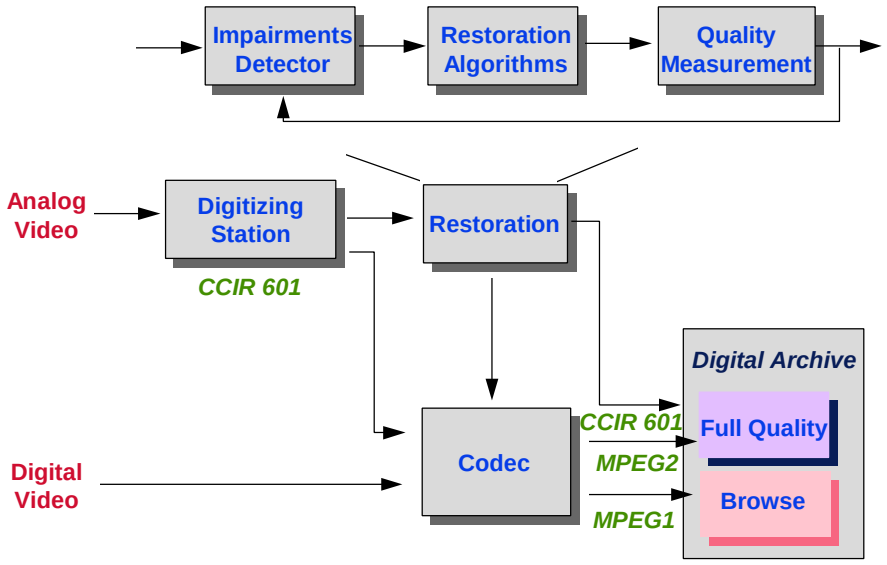

Figure 2 - Digitising and Restoration Modules

The impairments detector, which can be manual, automatic or semi-automatic, analyses the original sequence and marks the pixels in the image that are degraded or corrupted. Blotches are, by definition, features that didn't exist in the original image and that affect just one frame of the sequence, meaning that there is no matching feature in the previous or next frame. According to this definition, an heuristic that tries to find regions that, after motion compensation, show no correlation with the previous and next frames was implemented. A modification of this heuristic is used for detecting line scratches because, in some cases, this artefact stays in the same position from frame to frame so we could have degraded pixels in the same position in two consecutive frames. To eliminate this problem instead of marking the degraded pixels in the entire sequence and then using the restoration algorithms, the restoration is made immediately after the detection.

The restoration block looks at the marked pixels and, after processing them, generates a restored sequence. A multilevel spatio-temporal median filtering, which can restore large degraded areas of the image with little processing time, is used for blotches correction while for line scratches a very simple spatial weighted filter to correct the entire degraded column is in use. Figure 3 shows the results obtained in the correction of a video sequence containing blotches.

The quality measurement block judges the final quality of the output sequence using mainly perceptual distortion metrics as a distortion free sequence to compare with the restored one is not available. A simple automatic perceptual quality measurement algorithm was implemented although allowing the human operating the system to have the ultimate decision regarding the good or bad restoration results of a specific video sequence.

The implementation of further algorithms doesn't interfere with the existing ones providing a continuous upgrade of the restoration chain. While the original copies are always preserved in its original support, multiple copies of the restored material can be made without any risk of damaging the original ones.

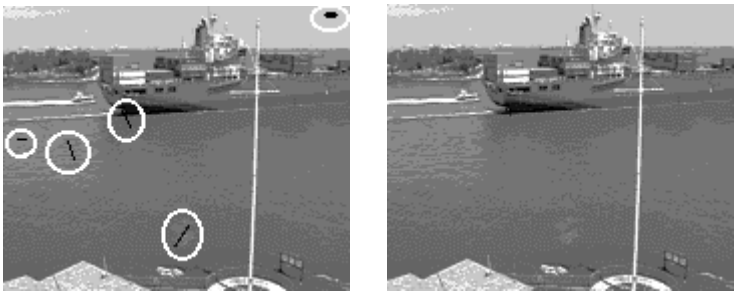

Figure 3 - a) Degraded image containing blotches b) Restored image

Conclusions

The evolution of video archives towards the digital domain are still in the childhood. However the recent developments and the interest put by the scientific community in this area will make greater advances possible allowing the construction of functional systems. The tests and achievements already obtained in VIDION enabled the definition of an architecture which will help on the preservation of an important assets of a TV broadcaster and that can be extended to similar systems in different application areas.