

# WORK MEMORIES IN SUPER 8: THE DAWN OF PAPER RECYCLING IN BRESCIA

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**Abstract – This paper describes the digital acquisition and restoration of a documentary in Super 8 of the origins of citizen’s awareness on paper recycling in Brescia, a city of Lombardy, northern Italy.**

**This short movie has been shot in 1980 by ASM the public company which used to provide all the city supply (gas, water, electricity, district heating) and city transport. Now this film is part of the Fondazione ASM archive and its acquisition is part of a larger project of preservation of industrial memories in Italy.**

**Here we describe the tools used for the acquisition and the technical choices done, together with the restoration test made. As well, we discuss the problems that one must face in trying to preserve a visual document of this kind from the unavoidable damage of time.**

**Key Words – Digital Movie Restoration, Digitization, Valorization**

## I. INTRODUCTION

The Super 8 film format was presented in 1965 by Eastman Kodak as an advance over the Regular 8 mm home movie format. It was very popular for shoots in the private sectors and for filming home movies. Unfortunately, as all films, it also is subject to a fast decay and aging, especially when the conditions of conservation are not appropriate. The decay process is irreversible and the digitization is the usual way to preserve the content of the film and eventually restore it.

Before digitizing the film, one wants to recover the history and check the authenticity of the film. When working on a Super 8 recording it is very rare to have authenticity problems, since making copies of super 8 films was quite rare. Nevertheless, each film must be considered as a unique historical record. For this reason, the historical research is important. There is the need to understand the

nature of the video by answering to the questions “*Who recorded it? What was the importance that the author gave to the film?*”, and the nature of the materials with the questions “*Where the film was stored? What is the conservation state?*”. In this way, it is possible to make a preliminary study on the historical importance of the film and the conservation state of the employed materials. Then, the following phase is the digitization and in case of need, a digital restoration [1,2].

In this work, we present the digitization and restoration of a 1980’s Super 8 film, proposing the use of an innovative software for the unsupervised automatic restoration of color and contrast.

The innovative idea introduced by this software is the goal of restoring the appearance of colors rather than the original color information. [3,4]

At first, we describe the instrument used, followed by a brief description and some historical information about the analysed film and an explanation of the employed algorithm for frame adjustment, with some examples.

## II. MATERIALS AND METHODS

### **Reflecta Super8 Scanner**

For the digitization, we have used the Reflecta Super8 Scanner, introduced to the market in spring 2014. This was one of the first equipment for private users with a very wide diffusion also in the semi-pro market. This handy instrument is suitable for positive Super 8 film in color or black and white. The system employs a LED light calibrated to obtain an ivory-ish color, like if the film was exposed to a halogen light (3200 K) but eliminating the problems of heating up the support.

The time required for the digitization is 2.5 seconds per frame. In this case the film rate is 18 fps (frames per second) and the obtained resolution is 200 dpi.

The final movie is obtained through single JPEG images for each frame processed at the end of the digitization resulting in a MPEG (motion – JPEG codec) video contained in an AVI file. The movie is computed through the CyberView S8 software [5].

The use of JPG format, a forced choice in the system, is a potential point of discussion, but for the actual dimensions of the film to scan, we have not experienced a very noticeable loss of quality.

### Super 8 film

The film that we have digitized is “Raccolta della carta nelle scuole” (“Paper collection at schools”), it is a Super 8mm and does not present a soundtrack. It is recorded on Kodak film and was shot around December 1980 by different citizens. The different films were acquired by ASM for a project of people’s awareness in environmental protection.

The aim of this film was to provide documentary proof of an important moment of environmental education made in schools on the theme of paper recycling. In the video, it is possible to see the collaboration between schools, teachers and children with ASM to collect wasted paper for recycling. This awareness campaign worked on improving the civic consciousness of the citizens of Brescia on the theme of sustainability and separate waste collection, issues that are still very relevant also nowadays.

The film is in pretty good condition. It was stored in the proper Super 8 film container, appropriately labeled. More specifically, the film did not present any serious damage on the surface and the only deterioration that occurred was due to the aging and to the presence of dust on the surface.

### Algorithms for restoration

In this work, we follow the suggestion of E. Gombrich for the digital color restoration: “*We are not asking them [Restoration experts] to restore the original dye color, but something much more subtle and delicate: preserve ratios*” ([6] translated from Italian version). Following this goal, we have chosen a method based on the characteristics of the human vision, restoring each frame using an estimate of the scene color appearance, instead of the original colors [7]. The chosen algorithms simulate some of the mechanisms of the Human Visual System (HVS), with particular attention for lightness and color constancy. These algorithms are

called Spatial Color Algorithms (SCAs) [8]. One of the useful characteristics of SCAs is their small set of parameters and the fact that they do not need any a-priori information on the image to filter.

The concept-base of the SCAs is that the color sensation depends on the spatial arrangement of the stimuli in the scene [8]. Thus, the considered algorithms compute the final pixel value performing a spatial comparison among the pixels of the input image [9,10].

### ACE (Automatic Color Equalization)

Among the possible SCAs, ACE algorithm has been used for this restoration project since it does not add noise to the frames, a characteristic that in case of Super 8 films is very important. It works by comparing every pixel  $p_t$  in the image  $I$  to every other pixel independently in the RGB channels and summing all the difference to compute the final value:

$$p_{new} = \frac{1}{k_t} \sum_{p_j \in I, p_j \neq p_t} r(p_t - p_j) d(t, j)$$

$$k_t = \sum_{p_j \in I, p_j \neq p_t} d(t, j)$$

Before the sum, each difference is modified by a non-linear function  $r(\cdot)$  and weighted by  $d(\cdot)$ , the inverse of the Euclidean distance among the pixels ( $p_t$  and  $p_j$ ). The normalizing factor  $k_t$  is used to make the weighting meaningful. The factor  $r(\cdot)$  is the truncated gain function:

$$r(p_t - p_j) = \begin{cases} -1 & \text{if } (p_t - p_j) \leq -thr \\ \frac{(p_t - p_j)}{thr} & \text{if } -thr < (p_t - p_j) < thr \\ 1 & \text{if } (p_t - p_j) \geq thr \end{cases}$$

This last function is a non-linear amplification of the normalized difference between pixel values, responsible of the final spatial rearrangements [3]. The filtering effect of ACE depends also on the slope value of  $r(\cdot)$ , in fact the growth of the slope is proportional with the increase of contrast. In this study, we selected a starting value for the contrast slope around 20.

Original Frames



Adjusted Frames



**Figure 1** Restoration example of two frames of "Raccolta della carta nelle scuole". On the first column, an original frame (left) and on the second column the same frame restored using ACE (right).

### III. RESULTS AND DISCUSSION

The video "La raccolta della carta nelle scuole" is a piece of the history of the city of Brescia, linked with the *Azienda dei Servizi Municipalizzati*, born in 1908, and today part of the ASM foundation that involves also part of the area of Bergamo. The ASM foundation supports cultural events and works, and is also involved in different project for citizen's growth and awareness with a particular attention for social issues, promotion of artistic expressions and support on education and environmental protection. This Super 8 movie documents the origin of the ecological attitude of the city in the 80's, through the activity of paper recycling. The *Azienda dei Servizi Municipalizzati* of Brescia was responsible of the urban waste collection since the 1968, and in 1974 the separate waste collection was activated,

starting from the paper. The appeal and projects involving local schools fostered the growth of citizen awareness on themes of sustainability and recycling. The film is an important visual document of this sensibilization project. Its digitization and restoration is an opportunity to make this document available for the community and is part of a larger project of preservation of the industrial memory in Italy.

After the digital acquisition, the movie has been subdivided into shots, then we extracted the relevant frames that summarize the content of each shot. These frames are used to set the ACE parameters. After this step, the SCA filtering is performed on the whole shot sequence and then rejoined in the same editing sequence.

In Figure 1 it is possible to see a couple of frame restoration examples. The side by side comparison of the frames shows the dynamic restoration and the adjustment of contrast obtained by the ACE filtering. The resulting frames appear clearer, with

more details, and with a strong reduction of the color fading caused by the aging.

Usually, for a big amount of dye fading the restoration process is complex and requires specialized techniques [11]. In this case, ACE filtering achieve an acceptable result without need of dye fading models and in case of very degraded images can be a practical kick-off technique, able to shorten the restoration effort needed.

In conclusion, thanks to this innovative approach based on the application of the ACE filtering on the Brescia's ASM film it was possible to quickly restore an important record of the Italian industrial memory at a very low cost.

#### IV. CONCLUSION

The digital restoration of a film is, in many cases, a long and expensive process. In fact, many software require high competence and a constant supervision by qualified personnel. With this work, we demonstrate the possibility of a quasi-automatic and almost unsupervised method for film restoration. Thanks to this approach we obtained an acceptable frame adjustment in a fast way.

This process has been tested on a Super 8 film, part of the industrial memory of the 80's that documents a significant step in the process of public awareness on the theme of paper recycling and sustainability starting from children and schools.

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