A Computer-Aided System for Indexing People in Historical Images

David Lunardi Flam, Camillo Jorge Santos Oliveira, Arnaldo de Albuquerque Araújo
Núcleo de Processamento Digital de Imagens – NPDI
Departamento de Ciência da Computação – DCC/ICEX
Universidade Federal de Minas Gerais - UFMG
{david, arnaldo, camillo}@dcc.ufmg.br

Abstract

Our work describes a computer aided system for indexing people in historical images based on facial recognition. A prototype has already been built and it is currently being applied to selected pictures from the Mineiro Public Archive´s digital photographic database. The architecture of the system is described and explained briefly. The methods used in our work for facial detection and identification are presented, along with some results. Finally, further directions and possible improvements are given.

1. Introduction

The advances of computer resources for acquisition and transmission of digital images is increasing quite fast the amount of data in digital databases. The rate of grow in such databases is larger than the capacity of indexing all the pictures involved.

One common approach for indexing photographic databases is using handwritten notes. An example is the database from the Mineiro Public Archive, which often contains complete collections of a public person. After the digitization of those collections, the pictures pass through an indexation process. In this process many famous people are identified. In order to fully complete this task successfully, historians must analyze picture by picture manually and take relevant notes about them. This is expensive considering time and money for an institution.

This work presents a computer aided system which is able to assist historians to retrieve and identify personalities' faces from the Mineiro Public Archive digital image database, using facial detection and identification methods.

Section 2 shows the system architecture; Section 3 comments about facial recognition challenge; Section 4 makes some initial conclusions and future directions.

2. System Architecture

The considered system is composed by three databases: image database, facial database and text database. The image database contains all digital images that should be available publicly. The facial database holds faces detected as segmented images and rectangles coordinates that represent their boundaries in the original image. The text database is composed by relevant information for the faces and the photos available in the system.

Three modules compose the system: the detection module, the identification module and the indexer module. The former is responsible for the detection of the faces in the pictures, and takes care of the facial extraction and inclusion in the facial database. The second module is responsible for aiding historians in identifying faces using a facial recognition method. The latter is responsible for mapping all the extracted faces, showing where they appear in the original images and associating them with the text database.

The system has three types of users: the common user, responsible for two types of queries using a web interface, by text or by face; the operator user, responsible for including images into the system; the historian, responsible for confirming facial identification and submission to the indexer system using the web interface. Figure 1 illustrates the system.

3. Facial Recognition

Facial Recognition is a complex problem and can be divided into two steps: the facial detection and the facial identification.

Facial Detection can be defined as the task of finding all the faces in a picture and extract them with the correct rectangle bounds. Therefore, bidimensional coordinates of the faces locations are produced. If

those coordinates correspond approximately to the real coordinates seen by humans it is considered a positive detection else it is a negative one.

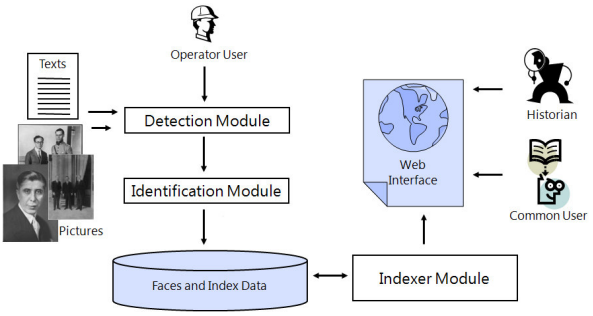

Figure 1. System Architecture

Facial Identification can be defined as the task of identifying people's faces. Given one's face an algorithm should find that person in other images.

There are however obstacles in images that must be surpassed to achieve good results in facial recognition. Those are: rotation, presence or lack of structural facial components, facial expression, occlusion and lighting conditions.

Many methods have already been described to solve those difficulties, as seen in [1] and in [3]. We chose the Ada-Boost and extended Haar-Features based algorithm presented in [2] for face detection. For face identification the PCA algorithm presented in [4] was selected. The choices were made considering accuracy, speed and existing code in the OpenCV library (see [5]), that greatly simplified their implementation.

4. Conclusions and Future Work

Number of Faces	Correct Detections	False Negatives	False Positives
107	91	16	40
100%	85,0%	15,0%	-

Table 1. Detection Module Results

Results of the facial detection step are shown in Table 1. The high level of false positives can be attributed to the quality of the old images used in the prototype and the difficulty of choosing a good training set for the detection algorithm.

Figure 2 shows some results of the identification step. We could not analyze those results in a quantitative manner since there were not so many individuals that would appear in more than one image in the selected database. Better results were obtained when we had more than five pictures of the same person.

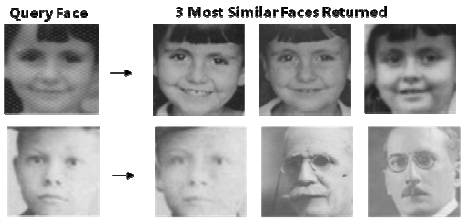

Figure 2. Identification Module Qualitative Results

Future work includes the improvement of image quality using image restoration techniques for better detection and identification. Further, a border detection algorithm can be applied to faces detected and, by comparing the borders with an oval shape, some false positives (Fig. 3) can be discarded. Another goal is to find a more suitable algorithm for facial identification. This will provide a robust computer aided system for indexing people in the Mineiro Public Archive.

Figure 3.Detection False Positive Examples

5. Acknowledgements

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6. References

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