

A Web Based Tool for an Automated Dental Identification System (ADIS)

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Abstract

We present a web-based environment for the Automated Dental Identification System (ADIS). This system is designed for identification missing, unidentified and wanted persons based on dental characteristics. The web-based environment of ADIS allows users to browse through different databases from remote locations, to digitally process query dental images in order to extract the distinctive features used for record matching, and to finally present to the forensic expert a short match list to be inspected.

Introduction

Law enforcement agencies have been exploiting biometric identifiers for decades as key tools in forensic identification. With the evolution in information technology and the huge volume of cases that need to be investigated by forensic specialists, automation of forensic identification became inevitable. Forensic identification may take place prior to death and is referred to as *Antemortem* (AM) identification. Identification may as well be carried out after death and is called *Postmortem* (PM) identification. While *behavioral* characteristics (e.g. speech) are not suitable for PM identification, most of the *physiological* characteristics are not appropriate for PM identification as well, especially under severe circumstances encountered in mass disasters (e.g. airplane crashes) or when identification is being attempted more than a few weeks after death.. Therefore, a postmortem biometric identifier has to survive such severe conditions and resist early decay that affects body tissues.

Dental features are considered the best candidates for PM identification. This is due to their survivability and diversity. *Forensic odontology* is the branch of forensics concerned with identifying human individuals based on their dental features. Traditionally, *forensic odontologists* relied on the morphology of dental restorations (fillings, crowns, .. etc.) to identify victims. However, modern materials used in restorations and fillings have poor radiographic characteristics. Hence, it is becoming important to make identification decisions based on inherent dental features like root and crown morphologies, teeth size, rotations, spacing between teeth and sinus patterns.

Based on the information provided by experts from the Criminal Justice Information Services Division (CJIS) of the FBI, there are over 100,000 unsolved Missing Person cases in the National Crime Information Center at any given point in time, 60 percent of which have remained in the computer system for 90 days or longer. It is worth mentioning that the computing systems developed and maintained by CJIS are used by more than 94,000 agencies [1].

CJIS includes in its strategic plan the creation of an Automated Dental Identification System (ADIS), with similar goals and objectives to its Automated Fingerprint Identification System (AFIS) but using dental/teeth characteristics instead of fingerprints.

ADIS will provide automated search and matching capabilities for digitized x-ray and photographic images. In this demo, a web based tool will be introduced for the ADIS project. The proposed tool will enable users to be able to browse through dental record databases from remote locations through the U.S.. Unidentified dental records can be entered into the system from remote locations, enhanced, segmented and matched against different dental missing personnel databases. Missing personnel dental records can also be compared with unidentified databases with the proposed system.

In the next section we show an overall architecture for ADIS, followed by a description of the proposed demo.

Proposed Demo

The structure of ADIS is depicted in

Figure 1. The main task of ADIS are to achieve reference dental records and later on when presented with a subject dental record, ADIS should retrieve a short list of reference records that possess high similarity to that subject record. Retrieval of the short match list is carried out in two stages:

- Potential search matching, where coarse-level dental features (e.g. number and position of teeth/dental objects, .. etc.) are used to generate an “initial” candidate list, then

- Image comparison matching, where dental images from the subject record and the candidate list are examined at a fine-scale in order to produce a ranked short match list.

Finally, the short match list is presented to a forensic expert who examines the radiographs of the subject against those of each record in the short match list.

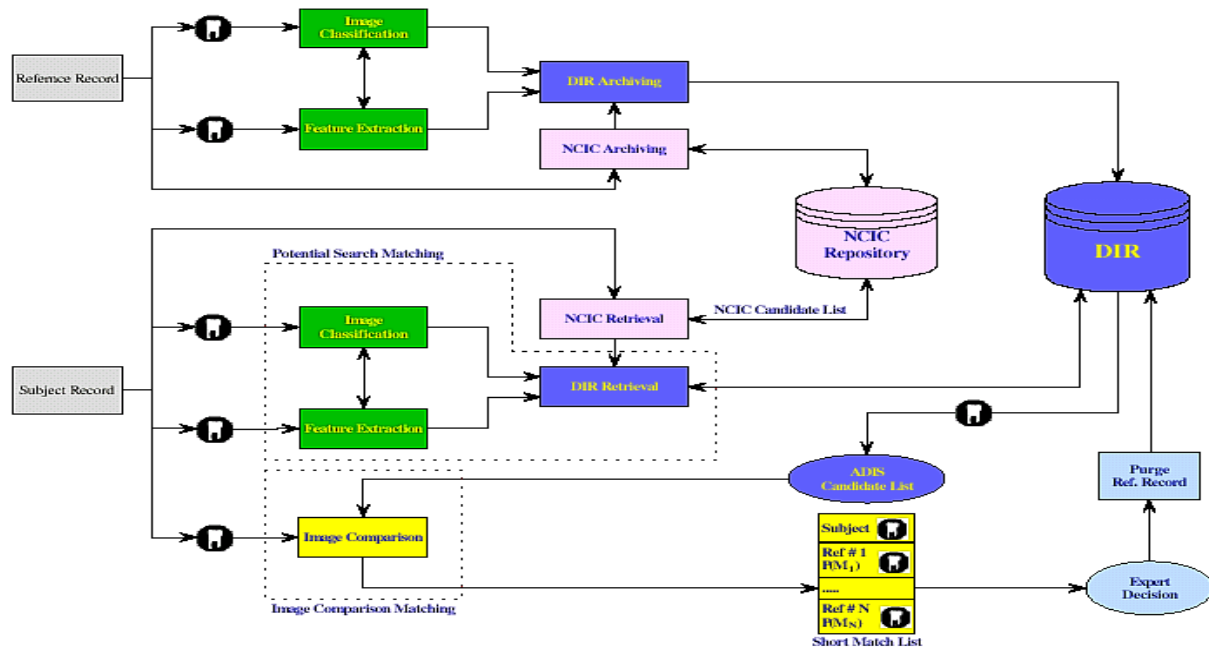


Figure 1: A block diagram of ADIS

In developing ADIS we employ Internet/Intranet technologies in order to build a web-based environment that facilitates remote access of ADIS servers. The web-based environment also provides a tool for assessment of the performance of ADIS and its components, thus allowing collaborating researchers to examine integrity between their components.

The demo we are proposing illustrates the role of the web-environment of ADIS in accessing and assessing the performance of ADIS components and functionalities we developed so far through. In the demo, we will particularly be showing examples of record archiving and retrieval, dental film mounting, and segmentation of films to extract teeth. Teeth segmentation is the first step needed for extraction of dental features (e.g. shape).

References

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