G24 Automated Identification From Dental Data (AutoIDD): A New Development in Digital Forensics

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Learning Overview: After attending this presentation, attendees will understand new developments in the automation of forensic identification using 3D dental images and will appreciate the functionality of this automatic program in identifying significant changes in an individual's dentition.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by exploring a novel identification system in dentistry and its application in the field of forensic dental identification and how this supports further research in the field.

Background: Various techniques have been proposed for automating the identification process using dental records. The use of 3D dental images has widely expanded in recent years. An efficient automatic identification program would enhance the identification process. This study proposes a novel technique to assist the forensic expert in identifying deceased individuals using an automated system, provided Antemortem (AM) records are available. This has been implemented in a newly developed AutoIDD.

Goal: To design a new method in Digital Forensics for accurate identification by comparing 3D dental models.

Materials and Methods: A new automated software was designed that uses a combination of techniques, including Iterative Closest Point (ICP) and Principal Component Analysis (PCA) for accurate identification using 3D images.

The total study sample consisted of 240 3D maxillary and mandibular dental data. The data was divided into two groups: Group A (n=120) and Group B (n=120).

Group A was composed of 3D-scanned orthodontic patient models from the Dundee Dental School (30 maxillary and 30 mandibular). This data was considered as AM digital data. To generate an identical sample, the dental casts of the same patients were retrieved and laser scanned to create indirect 3D dental models and considered as Postmortem (PM) digital data. This was to test the software for correct identification of all identical 3D models which validates the function of AutoIDD.

Group B consisted of 120 Intra-Oral Scans (IOS). To reconstruct a dental identification scenario, 30 maxillary and 30 mandibular IOS were obtained from 30 volunteers in the dental school and were considered as IOS-AM. After a year's interval, another 30 maxillary and 30 mandibular IOS were acquired from the same volunteers and considered as IOS-PM. This was to determine the sensitivity of AutoIDD toward any variations in an individual's dentition.

This study hypothesizes an accurate dental identification can be facilitated through the use of AutoIDD. The identification process is based on shape and alignment of the 3D dental arches, which can comprise a unique set.

A user-interface was designed to import digital dental data into Reference section (AM) and Unknown section (PM), which allows the operator to align the entire datasets to produce results—match percentage and mean distances.

Results: Group A Data: 30 AM and 30 PM maxillary 3D models were aligned followed by 30 AM and 30 PM mandibular 3D models. The results indicate that the system is able to correctly distinguish the matching models from the non-matches. In both the experimental studies, 100% matching results were produced.

Group B data: 30 AM and 30 PM maxillary IOS were aligned, followed by 30 AM and 30 PM mandibular IOS. The results indicate that the AutoIDD was able to accurately identify the matching AM-PM IOS from the non-matches. The match percentage ranged from 64% to 100% with a mean of 95.5% for maxillary scans and 87% to 100% with a mean of 96.5% for mandibular scans.

In summary, AutoIDD was able to demonstrate the identification of correct matches with a match percentage that clearly differentiates the matches from non-matches. This system also enables recognition of the changes in the human dentition, such as restorations and missing teeth. The match percentage is a combination of the best fit alignment and the changes identified by the system. A low match percentage may also infer that there has been significant changes to that individual's dentition, usually due to dental or orthodontic intervention.

This study presents a novel method for automatic human dental identification using 3D images and the performance of this software using digital dental data.

Automatic Dental Identification, 3D Models, Intra-Oral Scans

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