



Cardiff School of Computer Science &
Informatics

CM3203

One Semester Individual Project

40 credits

Project 87

Medical image processing – bruises

Initial Plan

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Project Description

Bite mark analysis is the interpretation and comparison of two pieces of evidence, namely, the photographic record of the bite mark and the dental casts of suspect biter. There are two well recognized physical comparison methods, Feature-based Analysis and Superimposition-based Analysis. Both of the methods require some features including class and individual characteristics which could be found from the bite mark in the skin and the dentition cast.

Class characteristic includes the shapes, sizes and arches of the teeth of the maxillary and mandibular anterior dentitions.

Individual characteristic are related to the distinctive features of the incisors and canines of anterior dentitions such as displacement, rotation and incisal edges.

However, due to the various distortions, potential human errors and subjectivities, collecting those characteristic and analyse process become a main problem in forensic odontology. Therefore, using image processing technique to automatically collect and analyse characteristics from bite marks and dentition casts is desired.

There are three main stages in this project.

1. Feature detection in the bite mark in skin.
Skin detection, thresholding and blob detection techniques will be experimented to extract arch and bruise areas to obtain shapes, size and orientation information of the bite mark from the image.
2. Feature detection in the dentition cast.
Edge and region detection techniques will be experimented to produce the outline of the biting edges of the teeth (Overlay Production). Extract the edges of the casts and teeth and delete unwanted areas. The requirement of overlay production is mentioned in reference [1].
3. Bite mark analysis – Matching
 1. Arches size, orientation and distance feature matching
 2. Automatically landmarks generation on arches such as mid and end point of an arch.
 3. Pairwise matching between the two sets of landmarks which indicates that better the match, smaller the error.
 4. Random sample consensus (RANSAC) to find a good subset of these matches that provides a consistent transformation such as affine transformation.

Reference:

[1] Forensic Odontology: An Essential Guide, Catherine Adams, Sam Evans, Romina Carabott

[2] Mathematical matching of a dentition to bitemarks: Use and evaluation of affine methods,

H. David Sheets a, Mary A. Bush b,*

Project Aims and Objectives

Aim: Search and experiment skin detection technique

Objective:

- Narrow down the searching area of bite mark
- By removing background and the ABFO (measurement tool in the image)

Aim: Search and experiment hair remove technique

Objective:

- Avoid the effect of fluffy hair

Aim: Investigate and experiment thresholding & blob detection & clustering on skin

Objective:

- Identify the bruise arches by the potential strong brightness contrast between skin and bite mark
- Or using DOG to detect blobs created by the bruise

Aim: Geometric Moments/Polygonal Approximation/SIFT to describe detected region/arch

Objective:

- Obtain measurement of perimeter, area, orientation, center point, compactness and convexity of the arches which are the parameters for feature-based analysis

Aim: Edge detection, Hough transform and edge linking to find biting edges from dentition cast

Objective:

- Outline the biting edges of the teeth from dentition cast
- Obtain features from overlay production
- Include displacement, rotation and incisal edges of the incisors and canines

Aim: Geometric Moments/Histogram of Oriented Gradients /SITF to describe biting edges

Objective:

- Obtain measurement of perimeter, area, orientation, center point, compactness and convexity of the biting edges which are the parameters for feature-based analysis

Aim: Arches size, orientation and distance analysis

Objective:

- Match between the arches of bite mark and the biting edge of the dentition cast

Aim: Automatically generated landmarks on arches

Objective:

- For Pairwise matches between the two sets of landmarks and random sample consensus (RANSAC) analysis
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Aim: Pairwise matches between the two sets of landmarks

Aim: Random sample consensus (RANSAC)

Objective:

- Matching between a bit mark and the corresponding dentition

Work Plan

Supervisor Meetings

My supervisor and I have scheduled a weekly meeting every Monday at 12:30 in order to discuss the progress of the project.

Deliverables

- Weekly reports documenting the progress of the project
- Final Report
 - Documentation describing approach taken to project
 - Documentation cumulating the weekly reports to describe its progress
 - List of successful and unsuccessful aims, providing reasons for any failure
 - Discussion of how to improve the project in future
 - Conclusion discussing what I have learned with this project
- Software performing image processing to detect bite mark, produce overlay of cast and basic matching

Week by week plan

Week 1
<ul style="list-style-type: none"> - Complete initial plan - Initial investigation: procedure of bite mark analysis
Week 2
<ul style="list-style-type: none"> - Search and experiment skin detection technique - Search and experiment hair remove technique - Investigate and experiment thresholding on skin to detect bite mark
Week 3
<ul style="list-style-type: none"> - Investigate and experiment blob detection on skin & clustering to detect bite mark

