

# Capabilities of automatic and manual face morphing

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## Abstract—

**Keywords**—*Face morphing, face detection, automatic border controls.*

## I. INTRODUCTION

Face recognition systems have become one of the most popular biometric authentication methods in the last years. It is based on the fairly unique biometric characteristic of a human face. One of their advantages are the property of a contactless capturing the face images with help of an arbitrary high resolution camera system which highly accepted by the data subjects. In addition to this, the capability of a visual inspection instead of an automatic process is one of the reasons why face recognition is selected as authentication method for biometric passports. The basic idea is simply to observe certain properties of the human face, such as the shape of the head or wrinkles and furrows, and place landmarks on characterizing points.

Hier knnte noch kurz aging und posing rein.

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cite

Since 2002 face recognition is used as identity confirmation in the electronic Machine Readable Travel Document (eMRTD) by the International Civil Aviation Organisation (ICAO). This means every eMRTD issued by an governmental organisation contains an facial image which has to follow certain properties in order to support the machine based automatic verification.

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In several countries, such as , it is possible to provide own printed pictures to the issuing organisation. This practise leads to the possibility of processing on the photo and therefore altering the biometric data set stored in the eMRTD. Of course these alterations form a potential attack vector on the Automatic Border Control systems (ABC) . A feasible attack would be an alteration in the way that another individual than the one which the passport is issued to is recognized by the ABC or both individuals are recognized as the same person.

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To achieve this the face of the issuing individual and an attacker has to be morphed together. The goal onthis process is to provide a morphed photo to the issuing instance which visually nearly identical with the issuer but automatically accepts both, the issuer and the attacker. Having reached this both, the issuer and the attacker are able to show up at the ABC system and both will be accepted.

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What are we doing on the topic?

## Outline

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The rest of this paper is organized as follows: In ... we provide some details on the topic of face detection followed by describing the procedure of morphing faces. ... deal with the selected detection algorithm and gives some details on our test setup. Finally in ... the result of test subjects are discussed followed by a conclusion in ... .

## II. FACE DETECTION

## III. DATABASE AND SELECTION OF TEST SUBJECTS

DB given samples given

## IV. MORPHING OF FACES

Creating morphes can

### A. Automatic morphing

#### 1) Results:

### Manual morphing

In contrast to the automatic face morphing approach, manual morphing is discussed in this section.

To achieve morphes, the open source software GNU Image Manipulation Software (GIMP) (Version 2.8.16) with the GIMP Animation Package (GAP) (Version 2.6) was selected for this paper. Morphing with GAP follows the simple approach of manually placing connected landmarks at characterizing points in both faces. The algorithm shifts the landmarks from face one to face two. In addition to this the color of the skin is transmitted.

*Morphing setup:* For the test samples 100 - 125 landmarks were placed, depending on the face characteristics. The output contains a sequence of 30 photos which show different stages of the morphing procedure. A manual post production of the morphed was not necessary.

*Results:* .

Detailed description of the morphs

## V. DETECTION ALGORITHM

As face detection algorithm the open source software OpenFace was selected. OpenFace is based on a neural network which is fully trained and has high confidence rates in the shipped version. Because OpenFace's main goal is to detect faces on arbitrary photos, the expected accuracy level is expected to be higher if it works on ICAO compliant data sets.

### A. Process of work

30 photos of one sequence  
compare every morph with picture one and picture two

## VI. RESULTS

## VII. CONCLUSION

## VIII. FURTHER TOPICS

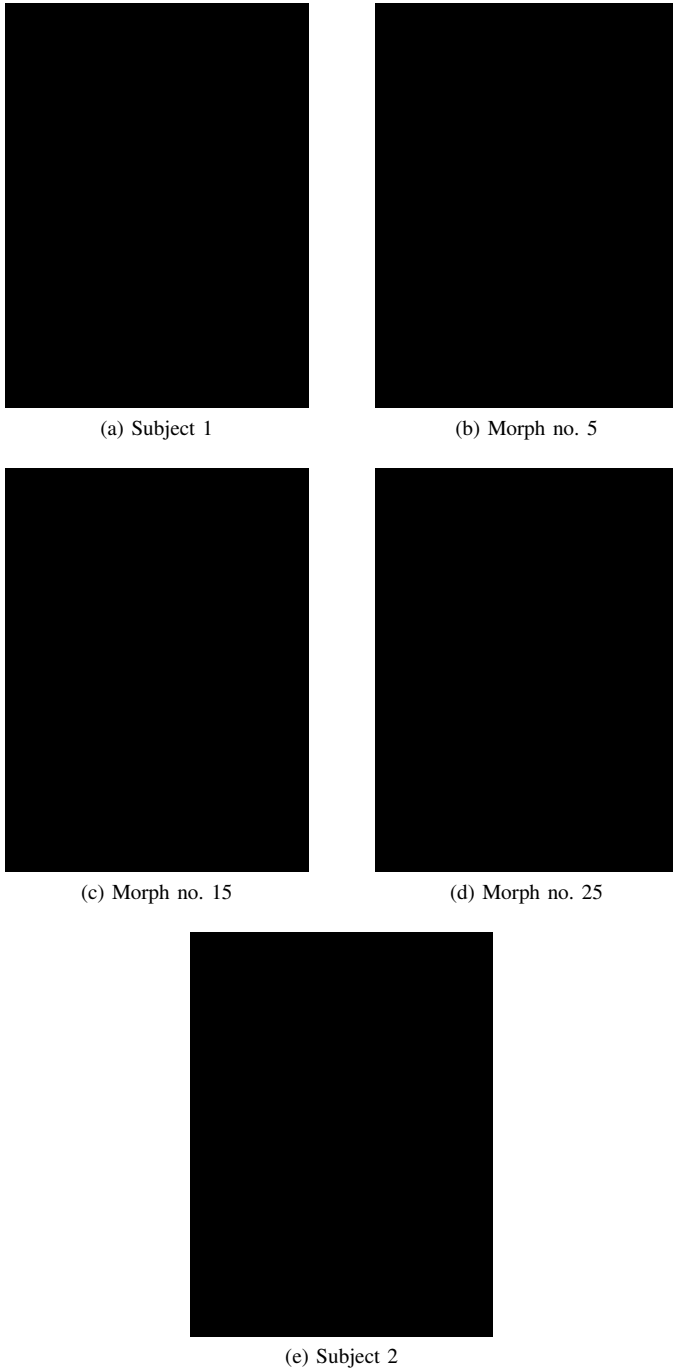


Fig. 1. Example of two ICAO compliant photos (1a and 1e) and morphs at stage 5 (1b), 15 (1c) and 25 (1d)