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15 March 2010

Facial Recognition Identification Testing Utilizing Still and Live Twin Children Face Images

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***Topic Area I: Test Methods**:*

Product and component tests; Identification systems

Abstract

This abstract will give a brief overview of the testing, methodologies and observations.

This project was undertaken in order to develop methods and ways to test Facial Recognition Identification and Verification products. A unique face database of twin children has been created as well as live testing of Facial Recognition products is conducted on a yearly basis since 2004.

The approach was undertaken to obtain photographs of different sets of twin children located in South Africa over a minimum period of five years, with an extension to ten years, as well as conducting live operational testing of facial Recognition products once a year.

This face database has the following properties:

- Twin siblings
- Ageing
- Varying ethnicity

These aspects are critical when analyzing the quality of face recognition products as they deal with three of the most concerning issues surrounding face recognition.

Before face recognition was ready for industrial application, the issue of varying ethnicities was the major concern for researchers and developers. This problem has since been solved, and skin tone no longer plays a role in the success rate of recognition algorithms, including those which make use of visible light only. A face database of ethnic twin children was however not available.

Since the maturity of face recognition technology, two new concerns were raised. For the general public, ageing in face recognition systems is an issue and a critical measuring stick for the evaluation of face recognition systems. Despite the prevalence of face databases available, none include sufficient ageing and none include the ageing of young children.

Another aspect of ageing in children is being able to find children who have gone missing. Recognizing such children would only be possible if the system had recently added a reference image of the child and a probe image from years before. It is expected that a human would struggle to identify people in such scenarios and the ability of face recognition systems to do so is to be tested in this project.

The issue of twins originated due to security issues, for example at a bank where there might be twin siblings making use of the same branch. Would the system be able to tell them apart? Furthermore, would the system be able to differentiate between non-twin siblings that look alike or even members of the general population that might look alike? The questions of non-twin siblings and general populous look-alikes are obviously obsolete when set aside the issue of twins and leads to the desire for a twin sibling face database.

Testing

A static, image-to-image facial recognition system was tested as a goal for this project. It should thus be considered that all results in this document are directly linked to the accuracy of the algorithm and implementation thereof in the chosen application.

Methodology

The subjects

The database is comprised of twenty (20) members, each a member of a set of twins, eight (8) of identical twins and two (2) pairs of non-identical (fraternal) twins, in this case boy-girl pairs. At the commencement of the project during 2004, the youngest of the 10 pairs were five (5) years old, turning six (6), and the eldest were twelve (12) turning thirteen (13).

During the various image collection attempts, the resolution of images was not held consistently, causing discrepancies in the yearly image resolutions. This also has consequences in the training times and general results.

Testing

Various tests were conducted using the Twins database as a reference, simulating real life scenarios.

- General ageing: images from 2005 used to probe a database trained with images from 2004, etc.
- New reference images with old probe images:

  Images from 2005 used to probe a database trained with images from 2006 etc
- Duplicate analysis: Determining whether or not the systems can differentiate between the twin siblings.

Research and Analysis

General Observations

The images were received in different resolutions; the images from 2004 were 640x480, while the images from 2005 and 2006 were in much more detail (3072x2304). The images from 2005 and 2006 were thus resized to 640x480, to ensure an accurate test.

During the testing the program responded almost immediately when doing enrolments and recognitions. There is thus no timing information in the results.

Table 1: General observations

	Number of Images	Dimensions (in pixels)	Average size if file
2004	20	640x480	140 kB
2005	20	640x480	170 kB
2006	18	640x480	167 kB

- Number of images: The number of images from each year. '20' indicates a full complement of images.
- Dimensions: The resolution of that year's images, in pixels.
- Average size of file: Average memory occupation of each image file in the corresponding year.

When testing facial recognition the issue of background noise is critical. Consistency of image colour and quality should be relatively similar throughout databases (this cannot always be the case, but when photographs are taken in controlled conditions, it should be possible). Table 2 shows a breakdown of the quality of images used in the twin database.

Table 2: Image Quality & Background Noise

Year	Colour Consistency	Background	
		Colour	Texture
2004	Inconsistent: Brown lighting & blue lighting	Grey (9/20) Brown (11/20)	Plain, wrinkled
2005	Consistent	Grey	Plain
2006	Consistent	Grey	Plain, wrinkled

From Table 2 it is clear that the images captured in 2005 are most suitable for recognition purposes, while the images from 2006 are of sufficient quality to be used in such tests. The images from 2004 are however, problematic, with inconsistent lighting throughout and a wrinkled background. The fact that these images are less suitable for this type of test is confirmed in the results throughout.

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