Determination of the Uncertainties and the Physiological Similarities of Family Members by using the Biometric Device the Broadway 3D

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Abstract
The biometric identification by the face is one of the oldest biometric identification. With increasing progress has been using of identification by the face was implemented into area of security, where it provides a faster and more accurate identification. The 3D face reader uses for the identification of the person: eyes, mouth, nose, and in contrast to 2D readers also chin and cheeks. 3D face reader by Broadway manufacturer was used to measure the physiological similarities of family members. It is equipped with the 3D camera system, which uses the method of structured light scanning and saves the template into the 3D model of face. The obtained data were evaluated by software Turnstile Enrolment Application (TEA). The participants of the measurement were members of three different families. Each person was compared with the previously saved templates of other family members. On basis of this fact was evaluated the similarity of family members.

Keywords: Biometric identification, face, Broadway 3D reader, similarity

Introduction
The identification of people by face is one of the oldest methods of biometric identification. People recognizing another person by face, because it is the easiest and the most natural way. The face is suitable for identification or verification. This method was gradually introduced into the security area. At the entrance to the object, the user submits identification document to the doorman who subsequently recognized by the attached photo of face, whether it is the authorized person. This type of verification is still used. . With the progress of technology, doormen have been replaced by this biometric system. The security staff can make a mistake when they check a large number of people. The biometric reader of face provides a faster and more accurate identification then standard visual method.

The face is composed from three basic characteristics the external structures, which help to shape the overall picture of the face. These are the eyes, the nose and the mouth. These parts are variables for each ethnic group, it is reduces the likelihood of two people with all identical characteristics. Other characters determining the face image are chin and cheeks, which are important especial for 3D face readers. The shape of the chin is located in the lower part of the face and it is determines the overall shape of the lower part of the face. The cheek is another part which is important especially for side view. It is formed by the shape of the obverse, the temporal bone and their interconnection cheeks arches. Furthermore, its shape is affected by soft parts of the face, thus facial muscles and subcutaneous tissue.

Facial Recognition by Using the 3D Readers
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Figure 1: The process of facial recognition

Face Detection consists of four steps (Figure 1). The first step is to identify the face in the image. The eyes and mouth are searched in images that together they form a triangle and they are darker than their surroundings. The process continues by normalization face, so that the image of face was predefined standardized dimensions and it was comparable with a pattern. Where the facial image is cropped and standardized in terms of size, pose, lighting to the stored template face. Then they are found individual characteristics that are observed (regions eyes, nose, mouth, chin, eyebrows and other important points on the face). At the end of the fourth step is the recognition of faces. [1,2]

The Biometric Device Broadway 3d
The biometric device Broadway 3D represents the possibility of protection objects which require a high security level. The device acquires biometric samples (template) of the user at registration, which are used for identification or verification. The Broadway in complete autonomy evaluates whether the user is authorized or not. The resulting information is displayed on the connected display unit or indicated by LEDs in the upper part of the device[7].

Broadway 3D face reader is first device around the world which is capable to visually identify person as easily as people are identifying with each other. While the identification only takes a split second. Sight on the device during walking or even running is sufficient to enable The Broadway to recognize the identity of one user of the tens of thousands of previously registered individuals. The 3D face reader The Broadway is equipped by 3D camera system which records and saves the unique three-dimensional shape of face. In contrast to the human eye the device has the ability to distinguish slight the differences of geometry with accuracy of fraction of a millimetre, allowing it to detect even identical twins. Technology of 3D scanning enables fast and precise scanning the faces of person by using the method of structured light. The light is projected through the grid on the surface of the object where the camera scans the surface of the object from another location than the light and thus leads to measuring the angle and the distance. The advantage of 3D face detection consists in the ability to measure the angle and the distance, unlike the 2D reorganization which only measure the distance in the structure of face. The grid formed on the surface of the scanned object the network coordinates, which are used for accurate calculation for each point. The texture of camera is synchronized with the 3D sensor, which has a wide field of view. The sensor captures the shape and surface structure of the object. Frame frequency of the camera is 15 frames per second and captures images at wide angles up to 41 degree. So it is able to capture people's faces reaching down half the height of an adult such as children and people in wheelchairs [7].

Methodology of Measurement

For working with the biometric device was used freeware software Turnstile Enrolment Application (TEA). The application TEA was developed for managing of biometric database. The TEA is user-friendly and offers many possibilities. It represents easier alternative for SDK, which also allows the biometric data from the reader.

The Broadway was connected to the two computers. The computer 1, which includes a database of biometric samples, is connected with the computer 2 by using Ethernet cable. The Broadway 3D is connected directly to the computer unit 2 by using USB. The computer 1 keeps the database of biometric samples and communicates with a TEA, which is installed on the computer 2 [6].
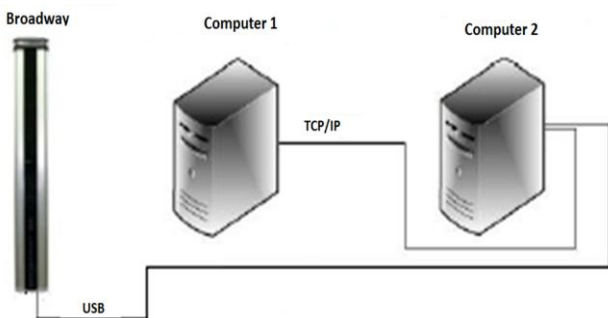
Figure 2: Complete Measurement Interface-Schematic[4]

The threshold was specified 60%, thus the lowest possible value, which causes a reaction of the biometric system. When applies that the smaller threshold, the greater probability of the false identification or verification of the person. And with high threshold the particular user may not be identified. In this case, depends on the quality of the model, generated during scanning faces which is affected by environment.

During registration the user is asked to appear before the Broadway 3D and maintain a specified distance from the biometric device from 90 to 120 centimetres. The quality of the model created during the registration process can be evaluated based on the value of quality the registration. This parameter can take values between 0 and 1000. The model was evaluated as suitable for use as a reference template, when the value ranged from 850 to 1000. Otherwise, the registration had to be done again. Subsequently, the identification was performed of each person and comparing with the each family member.

Result of measurement the physiological similarities of family members

The Result of Measurement

The measurement was participated by three families. The first family is three generations and has 8 members. While the second and third family is only two generations which have only 3 and 4 family members. First, the biometric template was created for all measured persons. Thereafter, each person was measured and compared with their template (yellow values) and subsequently with other family members.

Table 1: Family 1

	GMS	GMI	Father	Mother	Aunt	Son1	Son2	Cousin
GMS	60.4		22.2		32.6		18.7	19
GrMI		60.3	15.8	14.7			14	16
Father		18.4	61.2			20.3	25.3	21.2
Mother	12.2	15.1	14.1	69.3		13.4		
Aunt			24.1		60.4	21.6	18.6	24.9
Son1	16.5		21.3		19.9	63.2	23.1	
Son2	16.2		20.1		16.6	22.3	69.3	
Cousin	18.5	16.5	14.7		22.3			60.2

Table 1 shows the family 1. The family lineage in this investigated sample is Grandmother S (GMS) has a son and a daughter (father and aunt) Grandmother I (GMI) has a daughter (mother), father and mother have 1 son, but his father still has a son 2.

Comparing of saved templates between father-son brings similarity in the range from 20.1% to 25.3%. Comparing of saved templates between mother-daughter brings similarity in the range from 14.7% to 32.6%. The degree of similarity between siblings is around 23%, whereas comparing with the other family members, the degree of the similarity is around 15%.

Table 2: Family 2

	Son	Father	Mother
Son	70		
Father	23	83.7	
Mother			70.8

In Table 2, we can see a family 2 where value during repeted identification of the same person was obtained in the range from 70% to 83.7% .According to obtained values; the highest similarity is between father and son. When, their relative similarity is in the range from 23% to 25.4%.

Table 3: Family 3

	Mother	Father	Son1	Son2
Mother	62.1			
Father		61.1		27.8
Son1		28.8	60.9	29.7
Son2		27.3	23.9	78.3

Table 3 presents values of a two-generation family 3, which consists of four members. Here we can see again the relative similarity between sons and father. When, the value of similarity is in the range from 23.9% to 29.7%. The degree of similarity between siblings is in the range from 23.9% to 29.7%.

Tables show the comparison of the physiological similarities of family members in the biometric identification by the face. As we can see, repeated identification of the same person is in the range from 60% to 83% compliance with the saved template. This low compliance may be caused by adverse light conditions, when measurement was made in illumination with fluorescent lamps. Comparing of saved templates between father-son brings similarity in the range from 20% to 30%. Comparing of saved templates between mother-daughter brings similarity in the range from 14% to 32%. The degree of similarity between siblings is also around 25%, whereas comparing with the other family members, the degree of the similarity is around 15%. In Tables, there are some empty cells because similarity was lower than 10% and this value is irrelevant. Registration was significantly more difficult for women who have long hair. In many cases, the hair fall down into his face and reduce the visible area faces. This is reflected in the quality of the resulting template. Therefore, it was often necessary to repeat the registration process.

Conclusion

The measured results show that the degree of similarity in the family is maximal 32%. When, the similarity in the family there is always the mother-daughter and father-son. Further, the measured values show that if family members over two generations are compared, then the degree of similarity is low. However, when two family members of the same generation or following generation are compared, then the results of similarity are higher.

The biometric accesses are increasingly also used in the public areas and therefore precision and accuracy of scanning is very important. Therefore, it is necessary to set up correctly the threshold in the access systems in order to avoid granting access of an unauthorized person.

Acknowledgment

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