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# Methodology of the Determination of the Uncertainties by Using the Biometric Device the Broadway 3D

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**Abstract.** The biometric identification by face is among one of the most widely used methods of biometric identification. Due to it provides a faster and more accurate identification; it was implemented into area of security 3D face reader by Broadway manufacturer was used to measure. 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 measurements were used 3D face reader the Broadway 3D. First, the person was scanned and stored in the database. Thereafter person has already been compared with the stored template in the database for each method. Finally, a measure of reliability was evaluated for the Broadway 3D face reader.

**Keywords:** Biometric identification, face, Broadway 3D reader, reliability.

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## INTRODUCTION

Facial recognition by using the 3D readers is important 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 biometric systems for identifying people by 3D images are safer and more effective method for identifying. 3D face image is created by using the polygonal network of triangular shape.

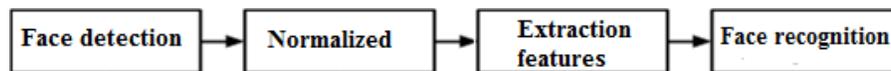


FIGURE 1. The process of facial recognition

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.

## 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. [1, 2, 3]

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. Sight on the device during walking or even running is sufficient to enable. 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. [3]

3D face reader is used in the registration method "Eigen face" [5]. This means that the modelled standardized (average) face is saved in the database, which was formed statistically from a huge set of images with faces. It is for reason that the program is was able to detect the human face as it looks, even from the distance. Standardized head is stored as a set of vectors (numbers) in the program, whose projection is then a 3D model. Subsequently, when a person wants to verify, program for the face defection captures her face even while walking. 3D scanner it loads him, the program detects the geometry of the facial features and the database is searched. In the case that there is a match, the person passes through the security checkpoints. The entire recognition time takes about 2 seconds. Facial recognition in the Broadway 3D system is based on about 40,000 facial features, which are saved in the program as the mathematical formula to unique to each face. [4]

## TURNSTILE ENROLLMENT APPLICATION

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 [4].

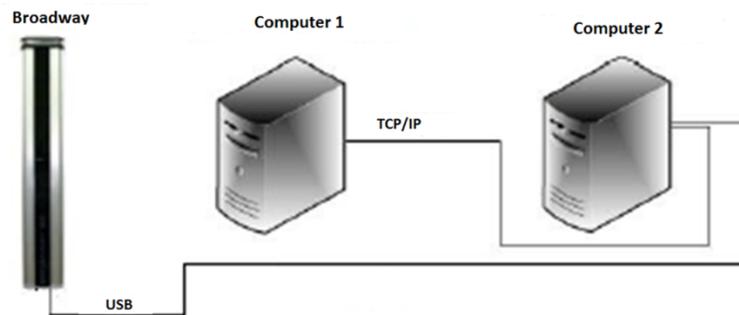


FIGURE 2. Complete Measurement Interface – Schematic [4]

## METHODOLOGY OF MEASUREMENT

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 they were performed various methods of measurement for determine the reliability of the device.

## THE RESULT OF MEASUREMENT

Rotation or percentage masking was performed with 10 the measurement for a given angle. The result was the percent agreement with a recognition template. These values were subsequently averaged and shown in tables. They were marked as the average value of the measurement. For each of the measurement methods were followed by 10 ° in the rotation by a person in a horizontal direction and over 10% was always gradual shading of face. As soon as the recognition ability of a device to significantly deteriorate, the measurement continued for 5 ° and 5%.

## A Person who is Rotated in a Horizontal Direction

The first method is focused on a gradual rotation of the person's face from the reader. During this the measurement it was examined if he must look directly at the reader or how much a person can be rotated from readers and she was recognized yet.

**TABLE 1.** The detection range of the horizontal field

Angle	Average Value	Success Rate
0°	70.75	100%
10°	66.2	100%
20°	66.39	100%
25°	54.23	60%
30°	65.4	10%

Table 1 shows the measurement results when rotated by a person from the reader in a horizontal direction. The results show that person should not turn away from the reader more than 20 °. The success of recognition person rapidly decreased at higher rotational angle. The person was recognized by only one of the ten experiments at 30 °.

## Gradual shading of the face in a horizontal direction

The second method was focused on identifying the person with gradually covering up his face. When the first measurement progressed from chin to forehead and the second measurement was aimed at covering up from head towards the chin. The face was covered up by using opaque paper. At the beginning the face was measured and divided into 10 sections, which determined a percentage covering of the face.

Table 2 shows that the detection value significantly decreased at higher percentage face is obscured. The reader was not able to recognize the person at covering more than 55% of the face. In the case covering up from the forehead to the chin toward the reader was able to recognize a person minimal. It is because a larger part of the recognition points is in the upper part of the face.

**TABLE 2.** The detection range of the horizontal direction

The Percentage of Cover	Average Value	
	From Chin to Forehead	From Forehead to Chin
10%	68	75.8
20%	65	75.4
30%	58	51.3
40%	57.3	45.3
50%	55.5	37.9
55%	49	0
60%	0	0

## Gradual Shading of the Face in a Vertical Direction

The last method was covering up the face with an opaque paper. However, the face was masked by gradually from the side, from one side to the other side. At the beginning the face was divided into 10 parts for determine the percentage of the gradual covering face.

In Table 3, we can see that in covering up the face from one side to the other side was the reader is able to recognize a person with only 40% coverage. For larger percentage coverage has not been able to recognize the person.

**TABLE 3.** The detection range of the vertical direction

<b>The Percentage of the Masking</b>	<b>Average Value</b>
10%	54.3
20%	55
30%	42.1
40%	22.2
50%	0

Tables show that the Broadway 3D the reader is capable of recognizing a person at a slight rotation in the face in horizontal direction or face is partially covert. The first table shows the ability of the reader to recognize a person by rotating the head maximal than 30 ° when the average value of detection was only 58.9. Another measurement was focused on the possibility of covering a percentage the face that the person is still recognized. In the case the face covered up in the horizontal direction, the face could be covert by a maximum of 50% to 55%, here the average value was between 37.9 and 49. For the covering the face in the vertical direction of the percentage dropped to 40% with an average value the recognition 22.2. The reader has not been able to recognize a person at 50% covering.

## CONCLUSION

Biometric systems occupied an important position in the security field. The reason is their speed, reliability in the identification / verification of persons. People recognizing by face among the oldest and the most widespread methods biometric identification. It is for this reason, user friendliness, speed and accuracy of detection.

The main objective of this study was to test biometric readers Broadway 3D. When was tested for its ability to recognize a person's face when it was rotated from the reader and the gradual covering up of the face. During the gradual covering up of the face, the person could be covered in a horizontal direction of 50% and in the vertical direction of 40%, the reader to be able to recognize a person. In the case of rotation of the face from the reader, to the person's head to be rotated through 25 ° in order to a person is recognized in most experiments. The results show the ability to recognize a person who passes around card reader, and he need not look directly at the reader.

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