ISSN 2224-087X. Електроніка та інформаційні технології. 2019. Випуск 12. С. 30–38
Electronics and information technologies. 2019. Issue 12. P. 30–38

УДК 004.93'1 DOI: https://doi.org/10.30970/eli.12.3

FACIAL RECOGNITION WITH USING OF THE MICROSOFT FACE API SERVICE

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Results of creation and testing of software for recognition and comparison of human faces are presented. The program was created to run on Windows and implemented using the features of the face recognition service Microsoft Face API. Some peculiarities of work and practical use of this service for creation of user programs are analyzed. The work of the created program was tested on real examples of face recognition both on images belonging to one person and to different persons. The influence of the presence of emotions on the face and different shooting conditions of the submitted photo on the recognition result is investigated. Some aspects of the practical use of this service are also noted. In particular, the positive aspect is the ability to allow the use of Face API services for free for 30 days, which allows users to develop and test a recognition program and evaluate the quality of its functionality before acquiring commercial rights to the Microsoft API.

Keywords – facial recognition, Microsoft Face API, face detection, facial landmarks

Introduction.

The problem of identifying visual images, in particular – face recognition, whose solution is based on the use of their 2D and 3D images, is today very topical. A number of approaches are used to solve the recognition problem and a large number of methods are developed [1, 2]. When implementing such methods, fundamental statistical approaches and (especially in recent times) artificial neural networks [3, 4] are used.

The bases of most of the current methods of recognition are the methods of biometric measurements [5], in particular – the definition of distances between so-called key points of the face. Initial recognition technologies used direct measurements and therefore were difficult to automate. Automatic 2D-recognition of faces became possible in the 60's of the twentieth century. Thanks to the wide introduction of 2D images (photos) and increased access to computing power. The latter allow archive the image for its further use, directly measure the error of the expert and proceed to automate the process of recognition. [6].

In order to the 2D face recognition system to be effective, it must deal with possible complications that may occur when the 2D image pattern for recognition is detected and which arise from the features of the recording device itself. For a facial recognition system to be effective, it must deal with the possible complications that may arise when a 2D picture is detected for recognition and which arise from the features of the recording device itself. In par-

ticular, the quality of face recognition is affected by the colour gamut, resolution, distortion caused by the properties of the recording device, as well as the some features of the objects being recorded - the pose occupied by the subject when shooting, the presence or absence of facial hair (whiskers, beard), facial expression, his facial expressions, etc. An important role in recognition is played by the conditions under which the shooting takes place, including lighting, scaling, shooting angle, background. In particular, the posture and illumination variations during image capture are still problems that are difficult to solve during 2D recognition.

This paper presents the results of the development of a software product created using the features of the Microsoft Face API technology, designed to facilitate users of the procedure for creating recognition systems, and study some of its features.

This paper presents the results of the development of a software product created using the features of the Microsoft Face API technology, designed to facilitate users of the procedure for creating recognition systems, and study some of its features.

When choosing the Microsoft Face API technology for image recognition, a comparison of this technology with other recognition tools that was provided to Amazon, Google, IBM, OpenCV, Affectiva, etc. [7,8] was taken into account. The reason for choosing the Microsoft Face API is that this technology represents a rich set of features for recognition. In addition, in the analysis, it uses the largest number of key points on the face compared to other technologies. This is because the number of users of the Face API is one of the largest in comparison with other similar technologies [8].

The data that characterize each recognition technology (including the time delay for each of them, the set of functions they perform, the level of recognition success, the conditions of free use, etc.) are given in 7, 8 where we direct the reader which is interested in them. They are not cited in this article due to lack of space.

The use of the Microsoft Face API in the development of this application is because this technology integrates well with the .NET platform, which is based on the tool that uses the Face API, and the ability to interact with the Windows Presentation Foundation (WPF) technology, through which created user interface of the program. In addition, the advantage of using this service is a fairly simple implementation of the possibility of using the Face API in projects and a large range of features that it provides to the user.

Some features of Microsoft Face API Application.

Microsoft Face API [9] is a service that provides facial recognition algorithms, such as face verifying, identifying faces, grouping faces, identifying individuals. The basis of this service is the Infer.NET framework [10], which is used to create machine learning models. As generative models, Infer.NET uses Bayesian networks to create probabilistic models that can be trained as new data enters.

The Microsoft Face API is generally a commercial product. Its use requires the user to have a subscription key on Microsoft Azure. It is also possible to use a free trial subscription key. However, such a key has a short period of possible use – only 30 days. Therefore, when using it in 30 days, you must generate a new subscription key. There are also 30,000 API calls within 30 days; In addition, the use of such a key allows you to make a maximum of 20 API calls per minute. This feature of the API is designed to enable a potential user to test and test the effectiveness of its possible use before deciding on the final use of the service when developing and using a recognition system and, accordingly, purchasing a subscription to the Azure portal and payment for additional calls of API.

One of the main functions of the Face API is face detection. For this purpose, the person's face orientation (its so-called “key points”) is used – a series of informative points on the person whose position is information about his confidentiality and individuality. By default, the Face API uses 27 tokens that determine the position of the points specific to each face (facial landmarks [11]), such as the position of the pupils and corners of the eyes, nose, mouth, etc. [12]. It is not necessary to specify these landmarks – they will be analyzed by the API when they are detected in the image. The data on the detected points is returned in a rectangular frame around the person's face pixels. In addition to identifying facial features in the image, these guidelines can also be used to determine the direction of the look of the face [13].

For recognition, an image is provided, either directly in the form of a digital file, or taken from the Internet through a link to its URL. To ensure good recognition accuracy, it is advisable to use clear frontal images of a face larger than 200×200 pixels. When each person is detected, a rectangle appears in the image of her face, indicating the location of the person in the image.

When recognizing two persons, the Face API performs a verification of the identity of the two discovered faces or verifies the verbality of the detected face with respect to the specified person. The results of the recognition are two parameters:

- "is Identical" – returns the value "True" if both faces of the compared images belong to the same person; otherwise the value "False" is returned.
- "Confidence" is a numerical value indicating the probability that both faces belong to the same person or to different persons (that is, the value of trust in similarity).

By default, the value of the "is Identical" parameter is "True" if the confidence is similar to ≥0.5. It is also possible to redefine the confidence level threshold and fine-tune the result to its own data.

Another function of the service is the search for similar faces in an image, in which the Face API supports two modes – “Match Person” and “Match Face”. “Match Person” mode defines similar faces, taking into account the value of confidence in the similarity specified during the verifiability check. “Match Face” mode ignores this threshold and defines candidates with the most similar faces. The person recognition API can be used to identify people both based on the identified person and a separate database of individuals. This database must be created in advance and may change over time.

The easiest way is to identify individuals by passing the right image directly. To do this, send a POST request with the type of application/octet-stream content and read the data from the image in JPEG format. Maximum image size is 4 MB. If the image is already online and has a URL, you can use it to identify individuals.

Interface of interaction with the Microsoft Face API.

The application was created using the Visual Studio 2017 programming environment and using the NuGet package of the Microsoft Azure Cognitive Services Vision Face 2.0 client library.

Each call to the face recognition API requires a subscription key. This key must be passed through the query string parameter or specified in the request header. When using a client library, the subscription key is passed through the FaceServiceClient class constructor.

The interface of interaction with Microsoft Face API is implemented using the technology of constructing WPF user interfaces and System.Windows.Media classes. Using this interface allows user to use a set of features that this service provides for facial recognition and

comparison, including facial expressions, facial recognition in photographs featuring more than one person, and presentation of facial features.

The interface appearance of the interaction with the Microsoft Face API is shown in Fig.

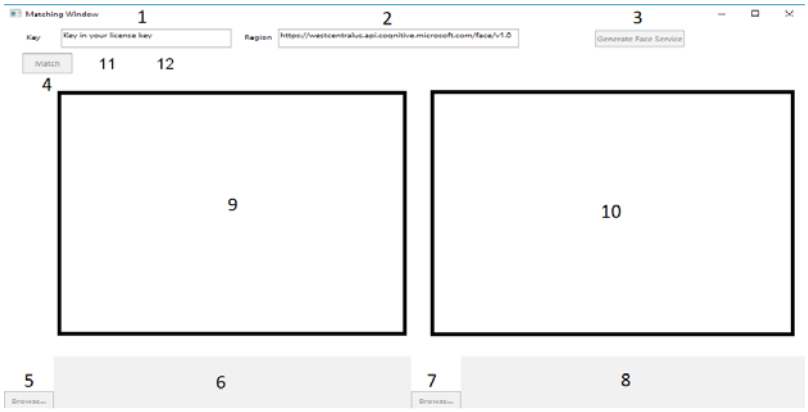

Figure 1: Interface of interaction with Microsoft Face API:
1 – "Key" – field for entering the key API; 2 – "Region" – field to enter the region where the API will be used; 3 – "Generate Face Service" button; 4 – "Match" button; 5, 7 – "Browse" button to enter the first and second images, respectively; 6, 8 – field for displaying the characteristics of the first and second images, respectively; 9, 10 – display area of the first and second images, respectively; 11, 12 – the places of display of facial fragments allocated by the Face API.

It contains:

- the "Key" field for entering the API subscription key (1, Fig. 1);
- field "Region" to enter the name of the region where the API will be used (2, Fig. 1);
- the button "Generate Face Service" (3, Fig. 1), through which the validation of the subscription key is made and access to work with the Face API is provided;
- button "Match" (4, Fig. 1), the click on which starts the comparison of two images and their comparison;
- two "Browse" buttons (5 and 7, Fig. 1) that allow you to select two images for recognition; Such attributes are a certain age and the sex of the identified person, as well as the presence of a smile on her face, the presence of sunglasses, emotions, hair, makeup, occlusion, accessories, blurring, exposure and noisiness of the recognizable image;
- fields 6 and 8 display the attribute data that recognizes the selected images;
- fields 9 and 10, in which the selected images of comprised persons will be shown, respectively;
- fields 11 and 12, in which the fragments of face images selected by service API for the recognition will be shown.

Testing the recognizsing abilities of the created program.

To get started with Microsoft Face API you need to enter the key in the "Key" field (1, Fig. 1). The required key is available from the official Microsoft Azure website at https://azure.microsoft.com/en-us/try/cognitive-services/?api=face-api).

After entering the received key, it is necessary to validate it by pressing the button "Generate Face Service" (3, Fig. 1). After successful validation, you will have access to the Face API. If the validation did not pass successfully, the message is displayed (Fig. 2).

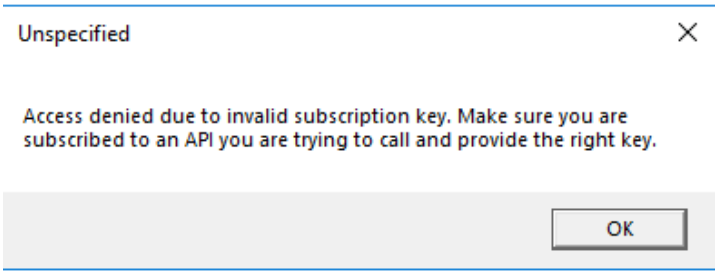

Figure 2: Notification about failure of the API-key validation.

After successfully validating the API-key, access to the functional API is provided. To continue the work, you need to select the desired image from the available photos in the computer or from the Internet with the "Browse" buttons using. You can choose both one and two images if you want to compare them.

After loading the image file, the API service processes it and returns the received characteristics, which are displayed in the field under the corresponding photograph (fields 6 and 8, Fig. 1). Also, a rectangle on the face of the image is highlighted, which points to the area of the image to be recognized. The highlighted areas appear above the main image (in field 11 or 12, Fig. 1). By clicking the "Match" button we are compared the selected faces. The comparison results are displayed in the field below the "Match" button in the value of two parameters – "Is Identical" and "Confidence". The value of the "Is Identical" parameter, which characterizes the similarity of both faces, is Boolean – "Truth" means that the faces are similar and most likely belong to the same person, and "False" – that they are no similar and belong to different people. The parameter "Confidence" – the parameter of correspondence of the compared images – acquires value on the interval [0; 1]. It is believed that if the value of the "Confidence" coefficient is more than 0.8, then it can be argued with high certainty that the faces are similar and they belong to the same person. If the value of this coefficient is considerably smaller than 0.5, it can be assumed with high certainty that the faces belong to different people.

The results of the comparison of images in the case of use for the recognition of two identical facial images of the same person are shown in Fig. 3. As you can see, as a result of the comparison, the value of the "Confidence" parameter defined by the Face API is equal to 1, and the values for the all corresponding attributes (see fields 6, 8, Fig. 1) are identical. That testifies to the absolute identity of two faces. Accordingly, the value "Is Identical" in this case is "True".

Now, we will compare the face images of the same person with different emotional expressions of the face (in the absence and presence of a smile) and different conditions in which the registered photo (in the presence of different backgrounds and colours gamut of the image). The results of the corresponding recognition are shown in Fig. 4.

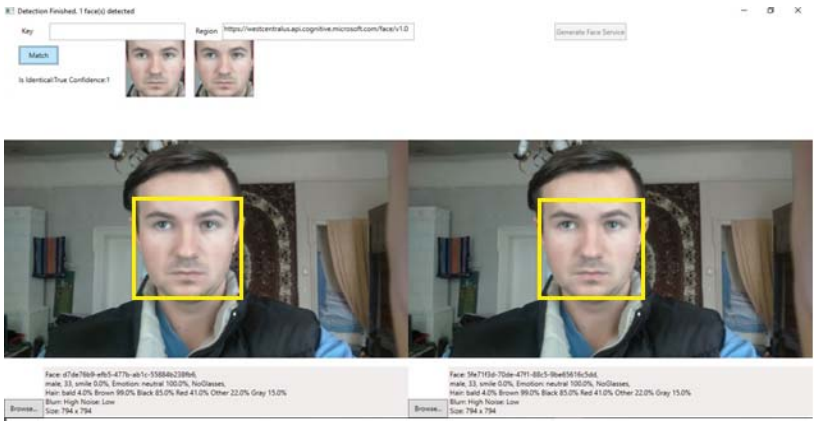

Figure 3: Results of the recognition for two identical images of the same person.

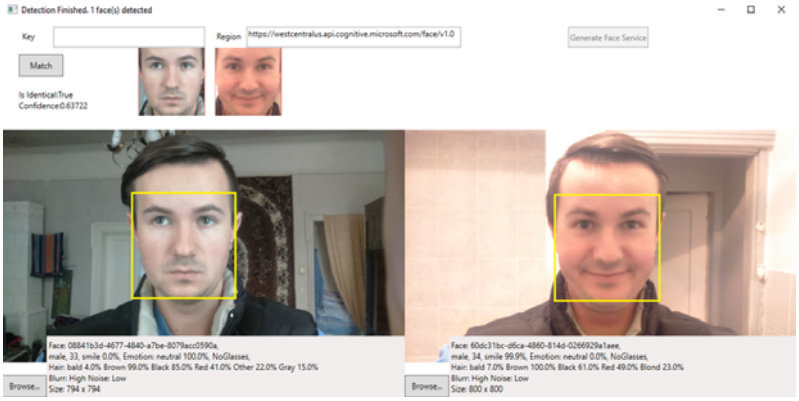

Figure 4: The results of the facial recognition of images of one and the same person with different emotions and under different filming conditions.

As you can see, the value of the parameters of the attributes on which the recognition is made, in this case, differs significantly. The smile parameter, which is one of the attributes that reflects the presence of emotions on the face, is fundamentally different and is the opposite of two recognized images – 0.0% and 99.9% respectively. Also, the values of attributes that take into account the illumination conditions and the colour gamma in images are quite different. In particular, the values of the parameters that characterize the colour of hair, for the compared images are differing by tens of percents. Despite the difference in these parameters, the compared images are identified as belonging to the same person. With the corresponding value of the "Confidence" parameter, equal to 0.63722, this allows the Microsoft Face API to accept the value “True” of the “isIdentical” parameter. This indicates with accuracy 0.63722 that both faces viewed represent one and the same person, despite the fact that the conditions for fixing

these images, including the background, as well as the presence or absence of emotions, differ significantly.

When comparing the images of two different individuals (see Fig. 5), one can see that the values of the attributes which are defined by the Face API service (a certain age, the presence or absence of emotions on the face, the colour of hair, the quality and size of the image, the background on which they are recorded) is fundamentally different for selected images. The probability of similarity between two facial images that are being compared is determined as 0.06759. This is a very low value of the "Confidence" parameter, which indicates actually absolute difference between the images of two compared individuals. Accordingly, such a low value of the "Confidence" parameter causes the corresponding "is Identical" parameter value to be "False".

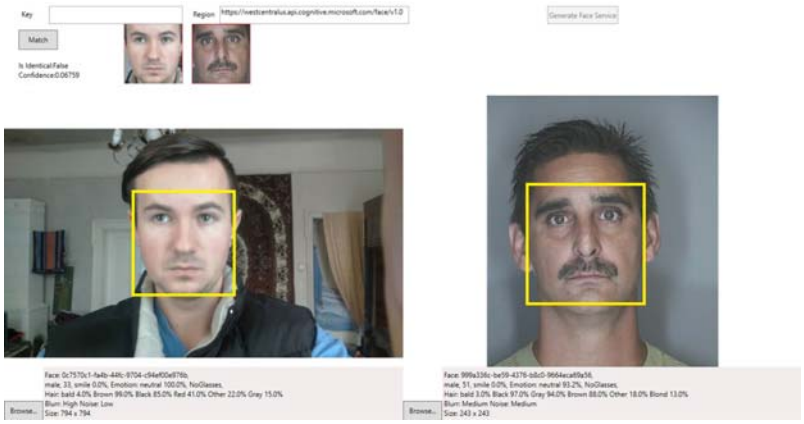

Figure 5: Results of the recognition for the images of two different individuals

A similar approach is used when identifying both the same faces and faces of different people on group photography.

Conclusion.

An interface program that allows you to use the capabilities of the Microsoft Face API to recognize individuals on single and group digital images has been created. With the help of the features provided by this service, the recognition of faces belonging to different individuals and the same person is realized. The Microsoft Face API approach allows the service to determine the meaning of a range of arguments (including age, person's gender, hair colour, presence or absence of emotion, etc.), the use of which ensures a high reliability of determining the authenticity of identifying a recognizable person.

The testing of the work of the created program showed the reliability of the identification of images of different individuals and one and the same person in the presence and absence of manifestations of emotions on the face. Aas well as under different conditions of filming the image itself and under the presence of quite significant differences in its colour range.

Considering that in general the Microsoft Face API is a commercial service, the opportunity to use the service free in 30 days, which company's is provided to the user, can also be considered as a positive point. Because this option provides users with additional convenience

when developing and testing a custom program before making a commercial decision to purchase a API service access key.

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РОЗПІЗНАВАННЯ ОБЛИЧ З ВИКОРИСТАННЯМ СЛУЖБИ MICROSOFT FACE API

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Представлені результати створення та тестування програмного забезпечення для розпізнавання та порівняння облич людини. Додаток був створений для роботи в Windows та реалізований з використанням функцій служби розпізнавання облич Face API, які надаються компанією Microsoft. При виборі служби для створення додатку були прийняті до уваги наявні у вільному доступі дані щодо особливостей служб розпізнавання, створених різними фірмами (Amazon, Google, IBM, OpenCV, Affectiva та ін.) для використання у додатках розпізнавання лиць, та особливості їх використання.

Проаналізовано особливості роботи та використання сервісу розпізнавання облич Microsoft Face API для створення програм користувача. Відмічено деякі переваги практичного використання послуг цієї служби. Зокрема, безумовно позитивним аспектом є можливість безкоштовного використання користувачами послуг служби Face API протягом 30 днів, що дозволяє їм розробляти та тестувати власний додаток для розпізнавання та оцінювати якість його функціонування перед придбанням у Microsoft комерційних прав на практичне використання відповідної служби.

Інтерфейс взаємодії користувача зі службою Face API компанії Microsoft реалізований з використанням технології побудови інтерфейсів користувача WPF та класів System.Windows.Media. Застосування створеного інтерфейсу дозволяє користувачеві використовувати набір функцій, які надає вказана служба розпізнавання та порівняння облич, а також ідентифікувати обличчя людей з різними емоціями та мімікою, представлені у різній кольоровій гамі, розпізнавати їх на зображеннях, представлених як без посередньо користувачем, так і отриманими з інших джерел, зокрема – з Інтернету.

Робота створеної програми була перевірена на прикладах розпізнавання облич на зображеннях, що належать як одній людині, так і різним особам. Для розпізнавання були використані зображення осіб, отримані як авторами особисто, так і взяті з веб-простору. Результати розпізнавання і порівнянь зображень як різних осіб, так і однієї і тієї ж особи, дослідження впливу на їх результати наявності емоцій на обличчі та різних умов зйомки (різного фону, на якому зображена особа, відмінностей у кольоровій гамі зображень), а також розмірів використаних зображень показали надійність результату їх ідентифікації.

Ключові слова: розпізнавання обличчя, Microsoft Face API, виявлення обличчя, орієнтири обличчя

Стаття: надійшла до редакції 25.10.2019,
доопрацьована 29.10.2019,
прийнята до друку 10.11.2019.