Advanced Technology for Recognizing Faces from Fingerprints

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Abstract: In the literature, many successful techniques, approaches and algorithms for biometric recognition systems have been developed and implemented. When these studies are examined, there is no study to analyse the relationship between biometric properties. The present study discusses the existence of any relationship between biometric features such as fingerprint, face, iris, retina and hand geometry, and introduces a new and intelligent system based on artificial neural networks to estimate the faces of individuals using only their fingerprint. The results are presented in this study are in the crudest form without any final treatment, the success of the study is acceptable and will contribute to the development of different studies on the subject in the future.

Keywords: Biometric technics, fingerprint verification, face recognition, artificial neural network, intelligent biometric systems.

I. INTRODUCTION

Biometry science, which can be defined as the recognition / approval of individuals using physical or behavioural characteristics, is reliable enough to be easily identifiable from person to person, able to represent a person like a finger, face, ear, iris, retina, hand geometry, voice with a physiological or behavioural characteristic. It includes permanent properties that do not change until the end [1]. Biometry, which has been used in areas where high security is required in the first days and where identification of individuals is very important, has become a technology that is frequently encountered today [2]. Biometrics in the tourism sector, identification of entry-exit gates and similar security functions, provision of computer and computer network access and sharing of resources, network security, physical entry and exit check points, personnel attendance control systems, commercial transactions and many other similar fields, bank security and electronic transactions such as transfer of electronic funds or ATM security, check and credit card transactions, customs and migration processes for safer and faster transactions, national identification systems for more reliable and regular identification, voters and driver records, Internet operations and the efficient implementation of human a technology that offers a wide range of solutions in life [2,3].

In this study, eye, ear and eyebrow information can be obtained from fingerprints. The most important priority in the analysis and analysis of the relationship between fingerprint and face is the creation of a real multi- biometric features database (MBFD). For this reason, the study was started by creating an MBFD with fingerprint and facial biometric features of the same individuals. The fact that such a database is not already on a platform that people can access or use has made it necessary to start the study here. Therefore, scientists who work with multiple biometric features often; As in the study [12], it is possible to establish its own MBFDs within its own means, and as a result, the MBFDs found in the literature cannot be found on the platforms available to all people. In addition, databases created by everyone's efforts are not at international standards and they are insufficient in evaluating the results because they are small in size.

In the presented study, a new and intelligent system is designed which has the facial biometric with fingerprint and a relationship search and switch between these features. The results obtained by this system are evaluated for future research and an important work to pave the way for the application of this system.

II. OVERVIEW OF BIOMETRY SYSTEMS

A biometric system that takes the biometric feature of the individual in the most general sense, extracts the feature set that will be used in the identification of the person from this feature and represents a person, and a recognition / validation or classification that makes a comparison between the data set (s) and the data set (s) that were previously obtained with the same principles and recorded in the database system [13].

An automatic fingerprint recognition and validation system (AFRVS) identifies the features in the fingerprint image and the similarities and differences of the parameters of these properties [9,14]. End points and fork points that can be described as sudden termination or split-off in the fingerprint lines known as local characteristics and used in the identification process, and the midpoint and delta points known as global features

An automatic face recognition and authentication system can be defined as identifying people using stationary images or video images of people using their pictures stored in the database. Facial recognition is a complex and difficult task due to the changes in facial expressions that change the facial features of a person,

1

such as 3-D exposures, make-up, accessories covering a part or all of the face, hairstyle and many other factors [16]. A facial recognition system consists essentially of three steps, distinguishing faces from a complex background, identifying facial features and face and direction with these features, and performing recognition / validation [16]. When the literature about facial recognition is examined, it is seen that the methods related to facial recognition are mainly composed of 4 main groups [6]. These methods are outlined below.

i. Knowledge-based methods: They are also known as rule-based methods. These methods, which are generally designed to be used to determine the facial focus and to obtain the facial feature set, have been developed by considering how a typical face is encoded in the human brain.

ii. Approaches based on invariant properties: These algorithms are methods developed for face detection and performing face recognition by using the existing features that have constant percentage, exposure, perspective, and various properties. Features belonging to the face, tissue analysis, skin colour or studies using more than one feature is included in this group.

iii. Template comparison methods: It is a method of storing and comparing a large number of standard templates of parts of a face or parts of a face. It is tried to determine the face position and face recognition by looking at the similarity ratio between the entry picture and the registered templates which can be pre-defined or deformable.

iv. Appearance-based methods: In contrast to template comparison, models or templates are learned from a data set. The relevant data set is a set of pictures taken in various forms of the face, in various conditions and in various positions. These learned models are then used for face recognition. Operations are performed using various methods such as self-face method and improved versions of self-face (linear discriminant analysis, distinctive vector method etc.), distribution-based methods, artificial neural networks, decision support mechanisms, hidden Markov models.

III. INTELLIGENT SYSTEM GENERATING FACES FROM FINGERPRINTS (ISGFFF)

It is possible to recognize and identify people with high accuracy by using biometric features which are used for a long time in the identification of the person and which are identified with the concept of "Personal". In many studies, the idea of finding or retaining genetically specific characteristics in nano-specific properties has led to the idea that there may be a transition between biometric properties. In the presented study, a clever system that recognizes the face from the fingerprint has been realized.

This intelligent system has been created using a multibiometric features database (MBFD) consisting of fingerprints and face images of 120 people. This picture pairs were processed as necessary and feature sets of fingerprints and faces were obtained. An intelligent system based on artificial neural networks (ANN) has been established in order to conduct research on the existence of any relationship between fingerprint and facial feature sets. While creating ANN architecture, a study has been done about ANN structure and its details and it has been decided to use Multilevel Perseptron (MLP) structure as a result of the experiments. In subsequent experiments, appropriate MLP structure and parameters were obtained. 80 records were selected randomly from the database of 120 persons and the training of ANN was carried out. During the training, the input and output of the system are the feature sets of the fingerprints and faces, respectively. The orientation field of a good quality fingerprint image can be reasonably estimated with an algorithm called the Rao's algorithm.

An automatic fingerprint reader is used as an introduction to the system. For the determination of eyebrows, eyes or lips, the coordinates of the marked points were used. The system was tested and the system performance was achieved by using the 40 fingerprints other than those used for training in the fingerprint-face database. The desirable output m values of the 40 people used in the test were used only in the analysis of the accuracy of the system outputs obtained from the ANN, the calculation of errors and the evaluation of the system performance. The accuracy analysis of the system was evaluated with parameters such as mse (mean square error), sse (sum square error), absolute percentage error per person and correlation. In addition, the results of the system to be expressed in a more realistic and visual expressions are expressed.

The analysis and examination of the relationship between the fingerprint and the face was started by creating an MBFD with fingerprint and facial features. In the present study, a fingerprint face database of 120 people was created. In this study, only one fingerprint and only one face image of each face were used. The relationship between the righthand forefinger and eyebrows, eyes, nose and mouth as the basic components of the face were considered.

The second priority for investigating and investigating the existence of any relationship between the fingerprint and the face is the correct and reliable acquisition of the fingerprint and facial feature sets. Accurate acquisition of these feature sets are factors that will directly affect the success of the study and the system. In the creation of the fingerprint feature sets, it was deemed appropriate to use a program which is known to everyone who is interested in the subject, its accuracy and reliability is approved, commercially active in the biometrics sector, easily accessible from the internet, and VeriFinger 4.1 SDK developed by Neuro technologies was used. This way, a selection will eliminate the prejudices and doubts

that may arise for the ISGFFF, so that the study can be evaluated more objectively.

SCG (Scaled Conjugate Gradient) learning algorithm was used to train the ANN. The SCG algorithm is a learning algorithm that can be used in the training of all artificial neural networks that have weights and input values and have transferable and removable transfer functions. Weight and bias values are changed according to the Conjugate Gradient algorithm. SCG is a learning algorithm that was developed by Moller to improve the complexity of this algorithm.

The completed ISGFFF has become ready for training. 80 out of 120 individuals were randomly selected from the MBFD and 40 were used in the system. The input output of the system is the feature sets belonging to the fingerprints and faces respectively. These sets of sizes 298 and 132 represent the same person's fingerprint and face. In this way, the training process is carried out by entering the feature sets belonging to the fingerprints of the persons and entering the feature sets of the faces. After testing the system, the test results should be evaluated and the performance of the ISGFFF should be calculated. In the evaluation of the test results, mean quadratic error (mqe), total square error (tse), absolute percentage error (ape) and average mqe for each test person were used. However, the lack of a classical biometric recognition / validation system of the presented system has led to the conclusion that these criteria alone are not sufficient in the evaluation of test results and that some parameters must be used in addition to these criteria. In addition to these parameters, the results obtained from the ANN are presented on the same platform as the desired results and the test persons are drawn on the real face images and the system success can be evaluated visually.

IV. EXPERIMENTAL RESULTS

In this study, only an intelligent system with an ANN design was designed to obtain one hundred sketch pictures without any knowledge of the face using fingerprint pictures. A software has been developed in order to perform all the operations required to perform the ISGFFF correctly, quickly and efficiently and all operations have been carried out with the help of this software. Assessing the accuracy of facial data for the presented study is critical. Because the system output is the feature set of the face and the more accurate the system is, the more accurate the performance. In other words, the accuracy analysis of the results obtained for the face actually indicates the accuracy of the complete system.

The results obtained with the use of MSCT for the successful design, presentation and evaluation of ISGFFF results in mqe, tse and ape mean values are 0.0011, 5.6280 and 6.195175, respectively. It is not

possible to display all of the test outputs as a result of problems in the number of pages.

These results indicate that there is a relationship between fingerprint and facial biometric features, and this relationship may also be among the other biometric features in the field of identification and security. ISGFFF is very important in terms of examining a subject that has never been investigated by a scientist before.
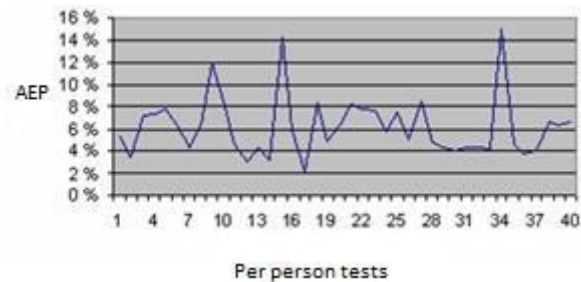

Figure 1: Absolute errors in percentages for all test results

V. CONCLUSION AND DISCUSSION

In this study, a system is presented as a whole to draw a face sketch of the same person using a fingerprint picture of the person. The results show that there is a close relationship between two biometric characteristics such as fingerprint and face. Discussions on the subject are given below.

- The presented study is pioneering in analysing any relationship between other biometrics.
- The approach used in ISGFFF is able to add new areas of research to biometric systems, security, identification, crime and criminal pursuit, and so on.
- This study presents interesting ideas that will attract the interest of researchers in biometric systems.
- The results obtained in the present study are in the form of a robot image and these outputs are presented with their raw materials without any final processing. These outputs can be improved by subjecting them to some final processing.
- It is possible to increase the visuality and accuracy by converting the figures in the form of robots into images by using various techniques and programs which are known and used in the literature.

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4