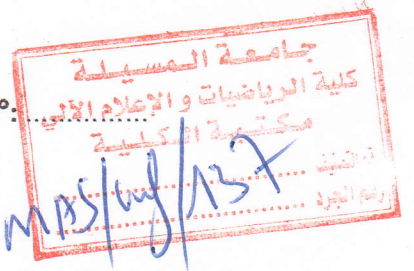




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**TOPIC**

**Identifying Individuals using Robust Face  
Recognition Techniques**

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## General Introduction

Biometrics is the science of establishing the identity of an individual based on the physical, chemical or behavioral attributes of the person, including fingerprint, face, hand/finger geometry, iris, retina, signature, gait, palm print, voice pattern, ear, hand vein, odor or the DNA information of an individual to establish identity. In the biometric literature, these characteristics are referred to as traits, indicators, identifiers or modalities. While biometric systems have their own limitations they have an edge over traditional security methods in that they cannot be easily stolen or shared.

The human face is the primary focus of attention in social relationships and plays a major role in the transmission of identity and emotions. Therefore, face recognition is applied in many important areas such as security systems, identification of criminals, and verification of credit cards and so on. Also, the face recognition system is economic with the low-cost of cameras and computers. One of the grand challenges for computational intelligence is to understand how people process and recognize each other's face and to develop automated and reliable face recognition systems. In its simplest form, the problem of face recognition involves comparing two face images and determining if they are of the same person. While humans seem to be adept in determining the similarity between two face images acquired under diverse conditions, the process of automated face recognition is beset with several challenges. Unfortunately, many face features make development of facial recognition systems difficult. The biggest difficulty in developing a robust face recognizer is that a human face can undergo several transformations. The same person may use different face accessories like glasses, earrings, piercings and makeup. He can change his hair into long/short/skin/fringe and even dye it. He can also wear beard and mustache. Besides, he can be at many facial expressions like smiling, sad or doing a grimace and he can be at many different ages. These facial changes make the recognition task very difficult even human beings do some recognition mistakes from time to time.

Many methods of face recognition for still images have been proposed. Basically they can be divided into three categories:

- ✚ Global-Appearance-based methods, where the whole image is used as a raw input to the learning process.
- ✚ The local appearance-based methods can be divided into two groups: The ones that require the use of specific regions located on a face such as eyes, nose and mouth, as

well as their relationships with each other and the ones that simply partition the input face image into blocks without considering any specific regions.

✦ Hybrid methods try to use the best of the holistic and feature-based approaches combining local features and the whole face to recognize.

A face recognition system generally consists of four modules: Acquisition, preprocessing feature extraction, and recognition.

Information fusion refers to the reconciliation of evidence presented by multiple sources of information in order to generate a decision. In the context of biometrics, evidence reconciliation plays a pivotal role in enhancing the recognition accuracy of human authentication systems and is referred to as multibiometric. Multibiometric systems combine the information presented by multiple biometric sensors, algorithms, samples, units, or traits. Besides enhancing matching performance, these systems are expected to improve population coverage, deter spoofing and impart fault tolerance to biometric applications.

Based on the nature of these sources, a multi biometric system can be classified into one of the following six categories: multi-sensor, multi-algorithm, multi instance, multi-sample, multimodal and hybrid. And based on the type of information available in a certain module, different levels of fusion may be defined. The various levels of fusion are categorized into two broad categories: pre-classification or fusion before matching, and post-classification or fusion after matching. Pre-classification schemes include fusion at the sensor and the feature levels while post classification schemes include fusion at the match score, rank and decision levels.

In this work we have utilized multi-algorithm systems that consolidate the output of multiple feature extraction algorithms at score levels. We have used the fusion of two types feature vectors and we present a system of fusion multimodal between Face and Iris, with the goal of improving recognition.

The manuscript has been divided in four chapter detailed below the first chapter is an introduction to biometric recognition systems. Chapter 2 provides a brief background of the field of face recognition, including a description of various existing techniques and then presenting adopted methods. An overview to multibiometric presented in Chapter 3. Chapter 4 discusses the experimental results of the methods described and presents the graphical user interface application for testing the different methods. In the end, conclusions over the project are taken, results are presented and solutions and future growth lines are proposed.

## General Conclusion

Biometrics systems are going to get more and more common in everyday applications due to the fact that new technologies are rapidly developing and the price and size of the hardware is constantly dropping. Face recognition is one of the most relevant applications of image analysis. It's a true challenge to build an automated system which equals human ability to recognize faces. The goal for researchers was to try to implement recognition algorithms that are more accurate in terms of face identification.

In this work, we have implemented some of the popular face recognition methods which are PCA, LDA and LBP. To evaluate the effect of different facial details (glasses, and no glasses), different facial expressions (happy, sleepy, sad, surprised, and winking), different illumination on the system performance, using measure distance (L1, L2, COS, Mah, L1+Mah, L2+Mah, COS+Mah) and the experiments are carried out on the ORL face database.

We have introduced as well as the multibiometric system since unibiometric systems fail in some cases. We have utilized multi-algorithm systems that consolidate the output of multiple feature extraction algorithms at score levels. We have used the fusion of two types of feature vectors Using four fusion rules minimum, maximum, mean, and product. To improve the performance of the identification system, we have used multimodal fusion scenario between Face and Iris.

All of our experiments are programmed in the C# language. We have developed a graphical user interface (GUI) for testing the algorithms implemented.

Many experiments were carried out on the ORL face database:

- We have compared between PCA, LDA and LBP methods; we have found also that LDA 92% outperforms PCA 87% and LBP 69%.
- Each fusion method is compared separately using minimum, maximum, mean, and product rules. we found that PCA+LDA using max rule give the best result 94%.
- The adopted scenarios of fusion multimodal associated with mean rule and Cos, L2 with PCA and L1, L2 with LDA gives the best result 95%.
- Experimental results show that the multimodal fusion scenario (Iris + Face) with the application of LBP and LDA on the iris and face respectively has gives a recognition rate of 98.33% using mean rule of fusion.

• The performance of multimodal fusion scenario outperforms the multi-algorithm one.

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Some perspectives that may help extend the work in this work are:

✓ In this work we have chosen the face as biometrics, we propose to see other biometrics such as iris, retina, etc.

✓ The current face recognition systems take the face images for testing from files of an existing photograph. We suggest implementing a system that identifies the persons automatically after capturing its image with the camera.

✓ In the implemented system the recognition was done without detection of the face. We suggest adding the detection part to obtain a more robust system.

✓ The implemented methods in this study are for still images we can use video instead.

✓ We have also used PCA and LDA as dimensionality reduction technique we can try other techniques such as SVD or EBGM.

✓ Use another database like Yale and FEI for evaluate the effect of facial details (glasses, and no glasses) and different illumination (left light, center light, and right light) on the system performance.

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## Abstract

In recent years, there has been a growing interest around biometrics. Facial recognition, as a biometric technology, has played an increasingly important role in the field of research, because of its non-intrusive and contactless.

This work is proposed the face recognition method using component analysis(PCA) , linear discriminant analysis(LDA) and local binary pattern(LBP) with measure distance. During testing, In addition, we have introduced the multi biometrics system particularly multi-algorithm and multimodal systems. To improve the performance of the identification system. For the validation of this work, we use database ORL and Yale. Experimental results show that the multimodal fusion scenario (Iris + Face) with the application of LBP and LDA on the iris and face respectively has gives a recognition rate of 98.33% using mean rule of fusion.

**Keywords:** Face recognition, Iris, Biometrics, PCA, LBP, LDA, Multibiometric, fusion.

## Résumé

Au cours des dernières années, il y a eu un intérêt croissant autour de la biométrie. La reconnaissance faciale, comme étant une technologie biométrique, a joué un rôle plus important dans le domaine de la recherche, en raison de son contact et non-intrusive.

Ce travail propose la méthode de reconnaissance de visage en utilisant trois méthodes différentes: analyse de composantes principales (ACP), analyse discriminante linéaire (LDA) et le modèle binaire locale (LBP) avec différentes mesure de distance. Ensuite, nous nous sommes intéressés au système multi-biométriques et plus précisément aux multi-algorithmes et multimodal afin de consolider les différents résultats obtenus en niveau des scores et aussi dans le but d'améliorer la performance du système de reconnaissance du visage. Les tests ont été réalisés en utilisant la base de donnée ORL et Yale. Les résultats expérimentaux montrent que le scénario de fusion multimodale (Iris+Visage) avec l'application de LBP et LDA sur l'iris et le visage respectivement a permet de donner un taux de reconnaissance de 98,33% en utilisant la règle de fusion moyenne.

**Mots clés:** reconnaissance faciale, iris, biométrie, PCA, LBP, LDA, multi biométrie, fusion.

## ملخص

خلال السنوات الأخيرة، هناك اهتمام متزايد حول القياسات الحيوية. وقد أخذ نظام التعرف على الوجه، كقاعدة التكنولوجية الحيوية-أهمية متزايدة في مجال البحوث، بسبب عدم التدخل والتماس.

ويقترح هذا العمل طريقة التعرف على الوجوه باستخدام تحليل العنصر، نمط ثنائي المحلي و تحليل التمايز الخطي مع قياس المسافة. واقترحنا استخدام طريقتين من متعدد القياسات الحيوية، إستراتيجية متعددة الخوارزمية مستوى نتيجة الانصهار كوسيلة و لتحسين أداء نظام الوجه. ، تم إجراء عدة اختبارات باستخدام قاعدة البيانات اورال و يال. وقد اظهرت النتائج ان الاندماج المتعدد الوسائط السيناريو (ايريس + الوجه) مع تطبيق نمط ثنائي المحلي على القرنية و تحليل التمايز الخطي على الوجه يعطي معدل الاعتراف من 98.33% باستخدام قاعدة دمج المتوسط.

كلمات البحث: التعرف على الوجه، قرنية، القياسات الحيوية، تحليل العنصر ، تحليل التمايز الخطي، نمط الثنائي المحلي، متعدد القياسات الحيوية، والاندماج.