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Biometric Iris Recognition Approach Based on Filtering Techniques

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Abstract

Recently, the huge extension of Internet and Internet of Things (IoT) leading to millions of different types of data circulated all over the world. This data need to be secure and acceptable for those authenticated persons. So, it is important to develop an efficient and acceptable security approach in order to work at this environment with an acceptable security. This was the main objective of this research. The implemented approach concentrated on Iris recognition, which is an important part of biometrics. This approach including many steps such as: preprocessing, filtering, feature extraction and decision-making. The correlation operation was applied to measure the difference between the two samples. According to a certain threshold, the recognition rate was reached to 76%.

Introduction

Biometrics refer to biological characteristics, which taken from human to identify their identity. Most security oriented researches focusing on biometrics to improve the performance. Biometrics is an important type of security now a day compared with the traditional security such as user name and password that can be easily attack by hackers. One type of modern security is via applying pattern recognition that achieve better defense compared with the traditional security [1,2,3].

Biometrics apply a unique pattern identification for each person in which it will led to high authentication and verification for security, so every person has different biological characteristics such as: voice, iris, face, fingerprint, palm print and DNA. Biometrics can be classified into physiological and behavioral characteristics. Physiological pattern can achieve high security compared with the others. According to the recent researchers, iris has high

security characteristics because Pattern cannot be duplicated [4,5,6].

There are two kinds of biometric security which are addressed by most researchers; uni-model and multi-model. In the uni-model only one type of pattern is used, which provides low security level when compared with multi-modal biometric. Mutli-model biometrics uses two or more patterns that achieves high security level [7,8,9,10].

Iris is part of eyes that has different properties according to structure of iris that is so complex compared to other types biometric security [11,12,13].

Existing several definitions of biometrics and the most popular one focusing on merging between biometrics and new technologies. This type measures the characteristics of various parts of human body. The most important biometric characteristics are obtained from voice and face characteristics. So, via these features, the user can detect the owner of the scanned face within the group of people. Biometrics can be used with other characteristics such as fingerprint, DNA, Iris, hand palm … etc. [14,15,16,17].

The accuracy of biometric recognition system is belongs to its successes experiences because every person in the world has own biometric characteristics which means that never two people have the same genetic. So, this is the main reason of biometry's successes and also it is a most common way for recognizing objects. Biometric system is used to compare, detect and recognize persons in which these systems are applied in different organizations [18,19,20, 21].

Different types of biometrics are used in different application, most of these applications concentrated on security part. This research aims to introduce an efficient biometric approach based iris characteristics.

This research emphasis of uni-modal biometric method to achieve the human iris characteristics. In this approach images were obtained from different volunteers with different ages that concentrated on iris photo. Then, these images are cropped by specifies size in different location for iris. Next step, images are converted into gray scale to start the recognition procedure.

Literature Review

In an integrated approach of physical biometric authentication system, the researchers used powerful biometric identification based on palm print, fingerprint and iris for online shopping and net banking. The biometry system uses two phases of procedure the first one is registration stage, in which the samples are inserted into database system. The second stage is pre-registered the samples are looked up in database system [22]. The algorithm that used to hide information was discrete wavelet transform algorithm that provides high capacity to hide data. Then they applied RC4 algorithm for user information encryption and decryption at the bank side that was designed by Ron Rivet that is better than the DES algorithm. Then to extract the image, the minutiae algorithm was used which is a new technique. In addition, support vector machine technique was applied to categorize finger, iris and palm print. Finally, the biometric system was implemented via MATLAB simulation environment [23].

Biometrics system has two general areas namely unimodal and multimodal biometric systems, uni-modal system have some disadvantages due to its lack of no universality and unacceptable error rate. Then they introduced multimodal which is the better system because of its two or three level of identification and verification [24].

For instance, this research paper showed a design of an adaptive multi-modal biometric system that combined face identification and iris verification in a serial mode. Testing was done so far on publicly available databases that confirmed the advantages of using two different types of biometric parameters that differ in invasively and precision. In the iris verification, testing a very high percentage (about 23%) of comparisons had to be done again because the applied images were not in good quality. The implementation of the iris verification was not capable of obtaining useful information from very noisy images, because they cannot be properly segmented or encoded [25]. A pre-processing phase can be added to filter the samples that are not acceptable for processing. This will result in saving time while testing, but also in the real specified situation: each time a user submits to the iris verification they are instantly informed if their

acquired image is not acceptable to be segmented or encoded, so that they can repeat it again immediately [26].

Another research proposed a solution of two problems that affects iris recognition rate and the two problems are (Segmentation of iris from the eye and varied background illumination) [27]. Their idea is to do two phases feature optimization to develop the recognition rate. First phase, they improved the sharpness of the image by uprising the peak pixel values and they reduce the crest pixel values based on the thresholds found by the tests. In the second phase, they improved the feature vectors beforehand to feature selection. This was done by matching the ranks of the pixel values in the feature vectors. Then, Pixel values that are similar in their ranks are improved and others are penalized [28]. The proposed method were tested on CASIA database. In their test process, they used training phase and recognition phase that were done using MATLAB simulation environment. The results that they got were the peak recognition rate (RR) of 100% and the average RR (for 25 trials) was 98.6661% [29].

Another research, a multi-modal system was used by combining face and iris biometrics to get an accurate recognition system. For both face and iris biometrics local and global feature extractors and various normalization methods were used. For extraction of facial features and to erase portion corruption local feature extractors as spPCA, mPCA and LBP, are fulfilled [30]. Also for iris extraction global feature extractors as CA and subspace LDA are implemented by Tanh score normalization and weighted sum rule method. The tests were accomplished on different subsets of ORL, FERET, CASIA and UBIRIS datasets to show the efficiency of the proposed technique. The same exact sets of face and iris images were used in the experimental process [31].

Methodology and Discussions

Implemented Data Collection

For collecting data to be prepared for the analysis process via visiting eye center hospital in sulaimani city to get some data sets, this was the first step of data collection. However, most of the obtained samples are incompatible with our work, due to the image samples those are captured using black and white device are of less clarity and corrupted, so that we decided to use other device to collect iris image data set.

In addition, using digital camera device, some challenges appeared during the procedure of getting new data set. Therefore, mobile phone camera will be the last attempt that can be used in a natural environment (without any lighting factor or other aid technologies) to create a data set from volunteer that is compatible for our processing. Preparing suitable environment is very important for image acquisition and avoiding volunteer mobility during capturing became an important issues.

The tested sample are ten volunteers between 20 – 30 years of age in both genders. By using double lens of a HUAWEI Y6II mobile phone camera with resolution 4160 x 3120 13 mega pixels, in a distance of 1cm used for iris acquisition, for each volunteer. Four image of eyeball are captured to be the ready data for processing on iris as shown in figure 1.

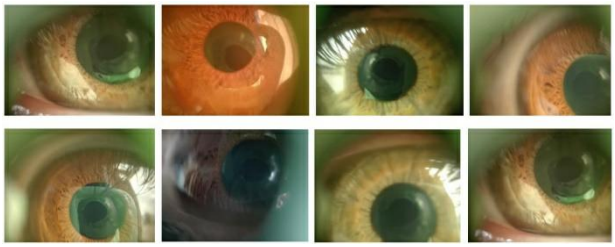


Figure 1: Iris image dataset

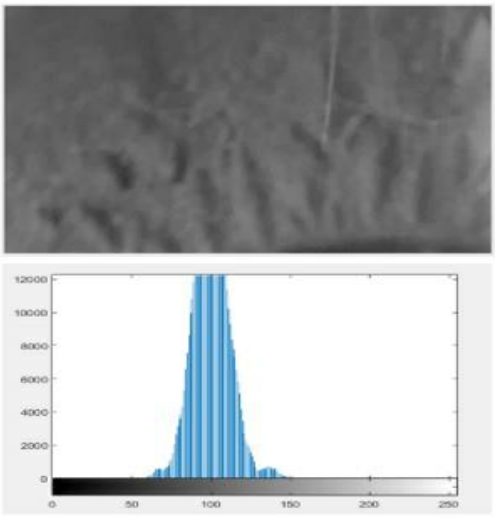
Implemented Approach

The proposed approach is implemented via many steps: Image acquisition, converting color images to gray scale images, cropping images using rectangle of 1000 x 500 pixels for iris images.

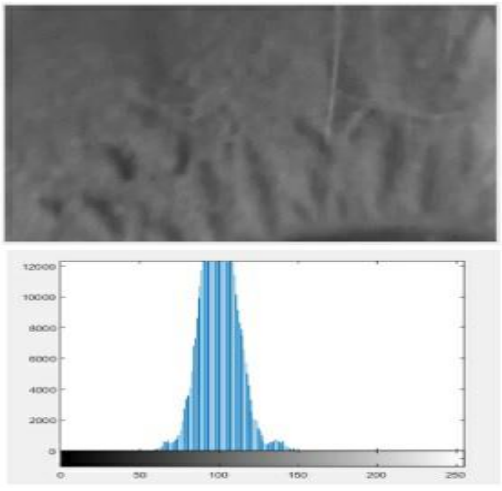
The obtained iris image passed via filtering process using median filter (which is non-linear digital filter used in a stage of preprocessing to remove noise from images). According to the research procedure of data collection, we collected 40 iris images. The values of correlation between each pair of images are recorded to each volunteer. The correlation value is calculated separately for both iris and face as shown in figure 2.

Figure 2: Implemented approach

To demonstrate the effects of filtering process, figure 3 shows the iris image before and after applying filter and their histogram in each case. This figure indicated a slightly difference between the two cases. Although the variance between both images is small or big depending on the details of the image, in this issue, median filter plays an important role to identification process.



a. Iris before filtering



b. Iris after filtering

Figure 3: Iris image before and after filtering

Table Design

When the result value (RV) was obtained for each pair of images, consequently added to a table to show the degree of similarity among all pictures that taken for each volunteer as shown in table 1.

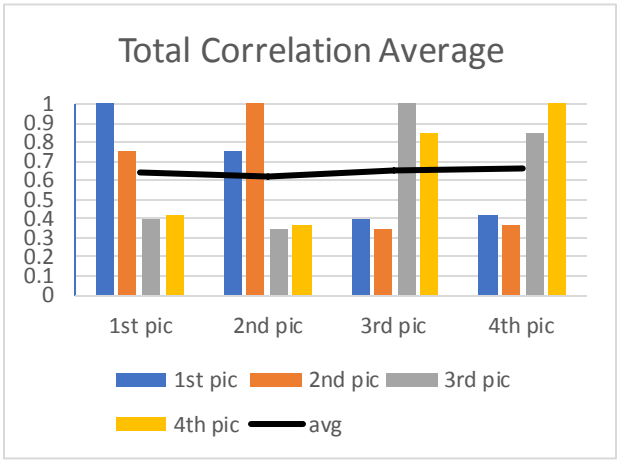
Nth Volunteer Iris Images		1ST PIC	2ND PIC	3RD PIC	4TH PIC
	1st pic	Result value1	Result value2	Result value3	Result value4
	2nd pic	Result value1	Result value2	Result value3	Result value4
	3rd pic	Result value1	Result value2	Result value3	Result value4
	4th pic	Result value1	Result value2	Result value3	Result value4

Table 1: The result values of correlation

- Nth: number of volunteer (we have 10 volunteer).
- 1st pic: volunteer first picture.
- 2nd pic: volunteer second picture.
- 3rd pic: volunteer third picture.
- 4th pic: volunteer fourth picture.
- Result value: correlation value between each image in a row with its corresponding image in a column.

To be more familiar with understanding the results, we make a chart graph for each table of result value to show the similarity between images as shown in figure 4.

Figure 4: The result average value of correlation



- Blue column represents correlation result value between volunteer first pictures with other pictures in first column of the table.
- Brown column represents correlation result value between volunteer second pictures with other pictures in Second column of the table.
- Gray column represents correlation result value between volunteer third pictures with other pictures in third column of the table.
- Yellow column represents correlation result value between volunteer fourth pictures with other pictures in second column of the table.
- Each aggregated four columns in x-axis represents unique row of the table.
- The degree located at Y-axis represents the result value.
- Black line above all of them represents the average of correlation result value.

Results

According to the implementation of the proposed system, many results were obtained regarding to the tested samples. These results are the correlation between different images, similarity and differences to achieve the identification process. Considering the range of (1.0 – 0.5) enumerate as a positive correlation, which indicated the best identification result between different tested images. Then considering the range from 0.5 to the minimum value, this means negative correlation that has no relation between the tested images. According to the obtained results from ten samples of iris images, the result is 76% for all correlation result values for iris after applying filtering process with median filter. Good results of identification and differentiation in biometric process were obtained.

Correlation average for 1st volunteer Iris images shows result value of 0.6 for each image with its corresponding person images, which is a positive result according to the range mentioned above.

Table 2

Correlation value for 1st volunteer IRIS images

1st volunteer IRIS Image	1st pic	2nd pic	3rd pic	4th pic
1st pic	1	0.7521	0.399	0.4175
2nd pic	0.7521	1	0.3491	0.3682
3rd pic	0.3999	0.3491	1	0.8503
4th pic	0.4175	0.3682	0.8503	1

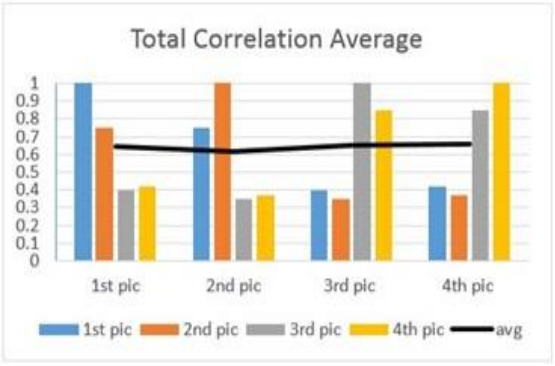


Figure 5: Average of correlation value for 1st volunteer IRIS images

Table 3

Correlation value for 2nd volunteer IRIS images

2nd volunteer IRIS Image	1st pic	2nd pic	3rd pic	4th pic
1st pic	1	0.5698	0.4066	0.5205
2nd pic	0.5698	1	0.5302	0.8715
3rd pic	0.4066	0.5302	1	0.5735
4th pic	0.5205	0.8715	0.5735	1

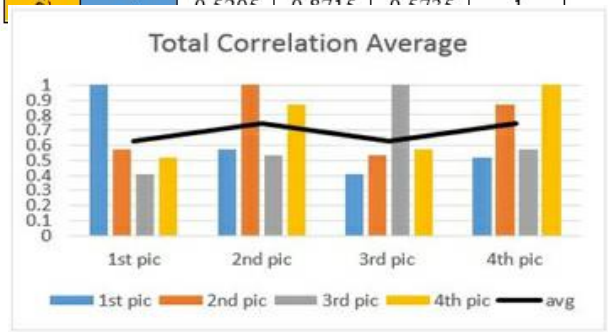


Figure 6: Average of correlation value for 2nd volunteer IRIS images

Correlation average for 3rd volunteer Iris images

Table 4

Correlation value for 3rd volunteer IRIS images

3rd volunteer IRIS Image		1st pic	2nd pic	3rd pic	4th pic
	1st pic	1	0.5612	0.6864	0.7242
	2nd pic	0.5612	1	0.7528	0.796
	3rd pic	0.6864	0.7528	1	0.7879
	4th pic	0.7242	0.796	0.7879	1

shows result value of 0.8 for each image with its corresponding person images, which is a positive result according to the range mentioned above.

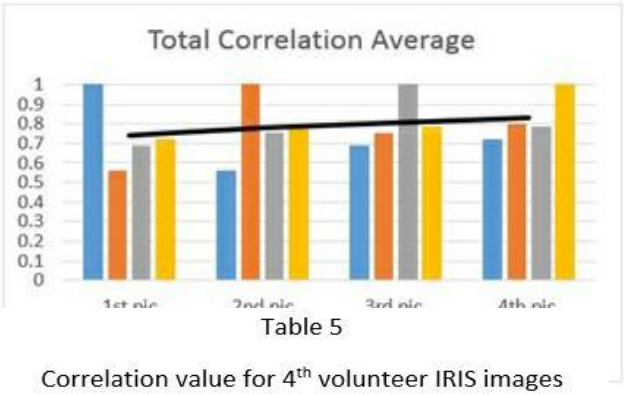


Table 5

Correlation value for 4th volunteer IRIS images

4th volunteer IRIS Image		1st pic	2nd pic	3rd pic	4th pic
	1st pic	1	0.4474	0.2043	0.3987
	2nd pic	0.4474	1	0.3044	0.2634
	3rd pic	0.2043	0.3044	1	0.1544
	4th pic	0.3987	0.2634	0.1544	1

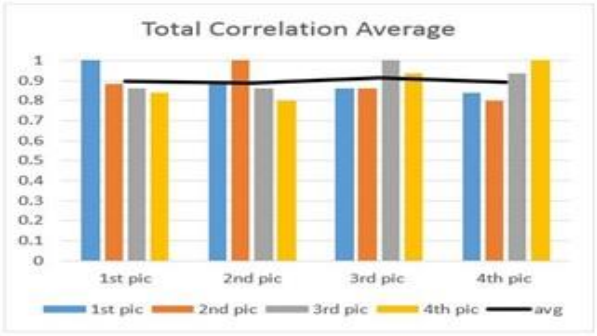
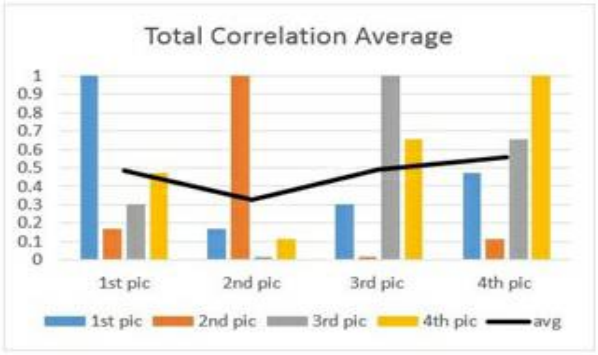


Figure 8: Average of correlation value for 4th volunteer IRIS images

Correlation average for 5th volunteer iris images shows result value of 0.5 for each image with its corresponding person images, which is a positive result according to the range mentioned above.



Correlation value for 5th volunteer IRIS images

5th volunteer IRIS Image		1st pic	2nd pic	3rd pic	4th pic
	1st pic	1	0.1675	0.3015	0.4719
	2nd pic	0.1675	1	0.0155	0.1116
	3rd pic	0.3015	0.0155	1	0.6543
	4th pic	0.4719	0.1116	0.6543	1

Figure 9: Average of correlation value for 5th volunteer IRIS

Correlation average for 6th volunteer iris images shows result value of 0.9 for each image with its corresponding person images, which is a positive result according to the range mentioned above.

Table 7

Correlation value for 6th volunteer IRIS images

6th volunteer IRIS Image		1st pic	2nd pic	3rd pic	4th pic
	1st pic	1	0.8834	0.862	0.8368
	2nd pic	0.8834	1	8627	0.8
	3rd pic	0.862	0.8627	1	0.9357
	4th pic	0.8368	0.8	0.9355	1

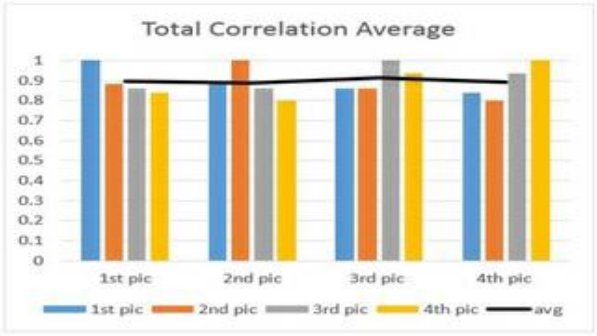


Figure 10: Average of correlation value for 6th volunteer IRIS images

Correlation average for 7th volunteer iris images shows result value of 0.5 for each image with its corresponding person images, which is a positive result according to the range mentioned above.

Table 8

Correlation value for 7th volunteer IRIS images

7th volunteer IRIS Image		1st pic	2nd pic	3rd pic	4th pic
	1st pic	1	0.533	0.2542	0.167
	2nd pic	0.533	1	0.0672	0.6149
	3rd pic	0.2542	0.0672	1	0.2937
	4th pic	0.167	0.6149	0.2937	1

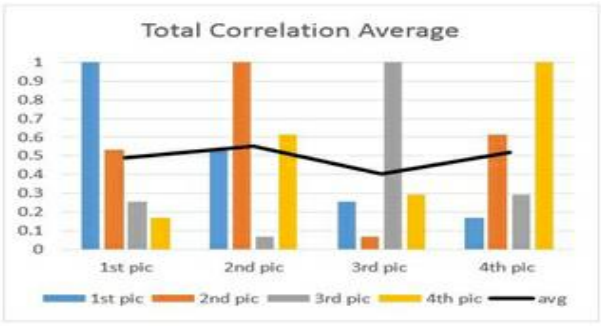


Figure 11: Average of correlation value for 7th volunteer IRIS

Correlation average for 8th volunteer iris images shows result value of 0.7 for each image with its corresponding person images, which is a positive result according to the range mentioned above.

Table 9

Correlation value for 8th volunteer IRIS images

8th volunteer IRIS Image		1st pic	2nd pic	3rd pic	4th pic
	1st pic	1	0.7321	0.5174	0.6776
	2nd pic	0.7321	1	0.5	0.6367
	3rd pic	0.5174	0.5	1	0.5387
	4th pic	0.6776	0.6367	0.5387	1

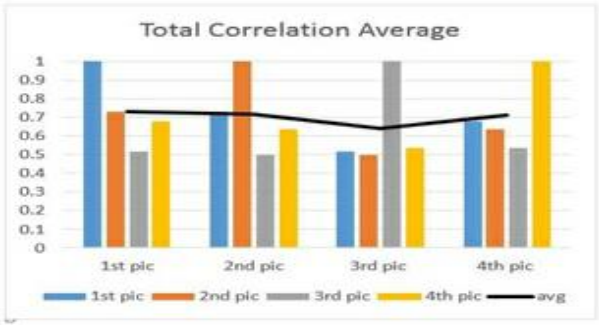


Figure 12 : Average of correlation value for 8th volunteer IRIS images

Correlation average for 9th volunteer iris images shows result value of 0.8 for each image with its corresponding person images, which is a positive result according to the range mentioned above.

Table 10

Correlation value for 9th volunteer IRIS images

9th volunteer IRIS Image		1st pic	2nd pic	3rd pic	4th pic
	1st pic	1	0.6306	0.6116	0.6223
	2nd pic	0.6306	1	0.7968	0.7127
	3rd pic	0.6116	0.7968	1	0.8063
	4th pic	0.6223	0.7127	0.8063	1

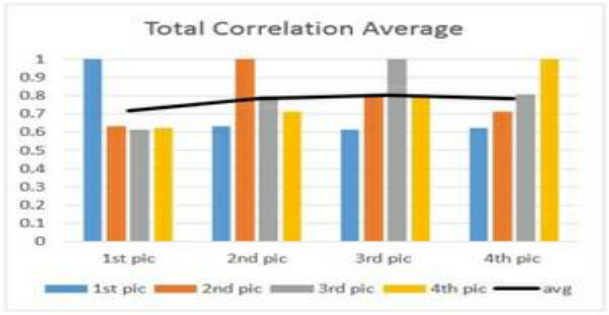


Figure 13 : Average of correlation value for 9th volunteer IRIS images

Correlation average for 10th volunteer iris images shows result value of 0.8 for each image with its corresponding person images, which is a positive result according to the range mentioned above.

Table 11

Correlation value for 10th volunteer IRIS images

10th volunteer IRIS Image		1st pic	2nd pic	3rd pic	4th pic
	1st pic	1	0.7392	0.8452	0.648
	2nd pic	0.7392	1	0.8809	0.7711
	3rd pic	0.8452	0.8809	1	0.8738
	4th pic	0.648	0.7711	0.8738	1

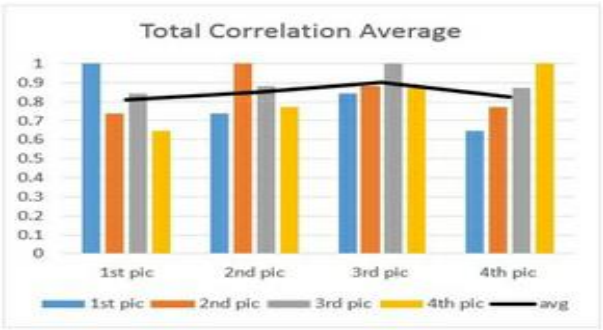


Figure 14 : Average of correlation value for 10th volunteer IRIS images

Conclusion

Biometrics is an effective method for identification and differentiation among humans, it has done either on physiological properties such as iris, face, finger…. or on behavioral properties such as voice, signature…. Median filter technique is one of the most effective techniques that can be used in biometrics with efficient result to remove noise and correctness of images. The obtained identification results for iris biometrics are 76% of accuracy. Due to persisting physiological property within live, external factors will not affect the result significantly. And there is ability to combine more than one physiological or behavioral properties to get more accuracy degree and strong Identification process. Face or sweat or voice could be a good choice for combination and it will be an aid for Identification in those cases are being a victims of disasters (ex: eye or face surgery).

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