

Retina Identification Algorithm Based on Bifurcation Points and SURF Descriptor

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Abstract

The recent advanced developments in the research have enabled the industries to find more complex methodologies for personal authentication. Biometric authentication has become more important because of the increasing activities of terrorists and hackers. Retina biometric security system is one of the more authoritative security systems, because no two people have the same retinal pattern. This research proposed an idea for human identification model instituted on retinal images. Despite the images of digital retina constantly sustain from distortion, the Speed Up Robust Features (SURF), that is famed for its disparateness and invariability for gauge and turn over that is inserted to retinal instituted consistency. To fix the hurdle, a new pre-processing technique instituted on detecting the Bifurcation Points (BP) that are detected with the help of structure process. By this BP, it is allocate the important points that are used in SURF descriptor for more similarity transformation. In accordance with more transference by the repeated of locative substance sleek technique, the issue of not useful SURF key points is reduced significantly. Experiments display the results of the proposed model is around 98% exact so it became outstanding to a mighty range against former systems.

Keywords : *Retinal identification, SURF, descriptor.*

خوارزمية تحديد شبكية العين استنادا الى نقاط التشعب والوصف SURF

الخلاصة:

لقد مكنت التطورات الأخيرة في البحث الى إيجاد منهجيات أكثر تعقيدا من أجل التوثيق الشخصي. وأصبحت المصادقة البيومترية أكثر أهمية بسبب تزايد أنشطة الإرهابيين والقراصنة. نظام الأمن لشبكية العين هي واحدة من أنظمة الأمن الأكثر موثوقية، لأنه لا يوجد شخصين لديهم نفس نمط الشبكية. اقترح هذا البحث فكرة عن نموذج تحديد الهوية البشرية على صور الشبكية. على الرغم من الصور من ان الشبكية الرقمية تتعرض للتشويه باستمرار، فان سرعة ميزات (SURF)، التي تشتهر بتباينها للقياس و التسليم، التي يتم إدراجها إلى الشبكية. لإصلاح هذه العقبة، اقترحت تقنية جديدة قبل المعالجة التي تكشف عن نقاط التشعب (BP) والتي بينت نتائجها تلك الفائدة. بواسطة هذا BP ، فإنه يتم تخصيص النقاط الهامة التي تستخدم في وصف (SURF) لمزيد من التشابه. وفقا لنتائج هذه التقنية، يتم تقليل مسألة النقاط الرئيسية غير المفيدة في (SURF) بشكل ملحوظ. التجارب عرضت نتائج النموذج المقترح والتي هي حوالي 98٪ لذلك أصبح تتقدم على مجموعة قوية من النظم السابقة.

1-Preface

Biometric Feature Extraction (FE) is single correspond savor of a personage that are extra suitable and securely than conventional authorized techniques. In conventional authorized methods, consistency is depending on property or information, but if biometrics is utilized in state, lack of incoming cards or omit passwords can be evaded [1]. Biometrics indicates to technical manner of distinguishing an individual by physiological countenance, such as fingerprints [2], recognition the faces [3], determine the gaits [4], irises [5], localize the veins [6], etc.

Through these FE, the retina supplies the first degree of security due to its ingrained durability versus impersonated. Now a day, recognition the retinal has mostly been utilized in mixture with monitoring designs at high authorize contrivance such as martial appliance and experimental [7].

Also sometimes distortions may found in the image of retina, the SURF [8] descriptor is an arbitrary perfect nominee for recognition. The proposed system introduces a retinal recognition model instituted on SURF and BP proposed. SURF is a good and favorable algorithm for recognizing these types of images to transact with distortions such as region of interest image geometry. Moreover, SURF is durable to diseases and aging because diseases may erase some of tags, while with retina based identification methods, both diseases and non-diseases don't affect on vessel segmentation and later process steps. In spite of that, the l images of retina constantly sustain from depressed gray level contrast and effective domains [9] which can impact key point matching and drive to needy showing in SURF-based recognition. So, a method based on BP is presented for sizing the points of the images of retina is proposed, and the backbone is arranged altogether. The following sections are overview of retina

devices, SURF algorithm idea, proposed system, experimental results and finally conclude the paper.

2- Retinal Devices Types [10, 11]

Retina is the biometric features that are more trust worthy one because of its innate properties and minimum potential of swindle because modality of person's retinas scarcely changes through their life time and also it is settled and could not be tampered. Figure 1 determines a pattern of the blood vessels for a person [8].

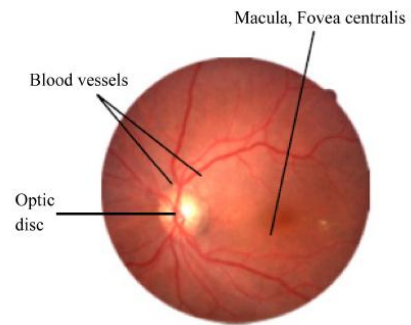


Figure 1: Retinal Vein.

A limited number of the feature vector is other utility of retina to another biometrics; this feature reach to quicker identification and authentication from another biometrics. The identification and recognition systems that are based on retina have distinction and particular constancy because retina's vessels patterns are unrivaled and stationary. Although with these suitable assign, previously retina has not been used frequently because of technological restriction and its costly devices. In those days, because of various technological progress and retina scanners was available, these determinants have been trimmed [11].

The retina coating the internal part at the end of the eye and it has "0.5 mm" thick. Optical nerve with about " 2×1.5 mm" towards is placed internally the major portion of the retina. Blood vessels compose a linked pattern such as an arbor as root above the exterior of retina. The rate concentration of these vessels is

around “250 μm ”. These vessels compose a singular pattern for each person which could be utilized for identification. In Figure 2, one can see four types of retinal scanners for human and animal retinal scanner [10].



Figure 2: Some retinal scanners.

VARIA [13] retinal info base that’s particularly utilized for identification. For the greatest of knowing, VARIA data is that the entirely out there available retinal data in the main for recognition, as completely different public retinal databases, like Digital Retinal Images for Vessel Extraction (DRIVE) [14], unit of measurement designed for vasculature division with standard, however, there is not any group distance to the photos of retina. The more prevailing recognition of retina doings unit of measurement experimented on photos from restricted building DB or mannered photos from these available DBs.

3- SURF Descriptor

SURF algorithm is concentrated on multi-scale range theory and the feature retriever is concentrated on “Hessian matrix”. Since “Hessian matrix” has perfect achievement and precision. SURF creates a “stack” about 2:1 downing for higher grade in the pyramid performing in images of the identical decision. Using integral images, SURF candidate the stack using a collect filter parataxis of second-order Gaussian partial derivatives. Since

integral images permit the calculation of orthogonal box filters in close to fixed time (constant).

The processes can be divided in to three overall algorithm steps:

1. Detection automatically identifies interesting features, interest points this must be done robustly. The same feature should always be detected regardless of viewpoint.
2. Description each interest point should have a unique description that does not depend on the features scale and rotation.
3. Matching Given and input image, determine which objects it contains, and possibly a transformation of the object, based on predetermined interest points.

In descriptors, Scale Invariant Feature Transform (SIFT) is good accomplishment resemble to another descriptors. The overall steps of SIFT algorithm is described by the following steps:

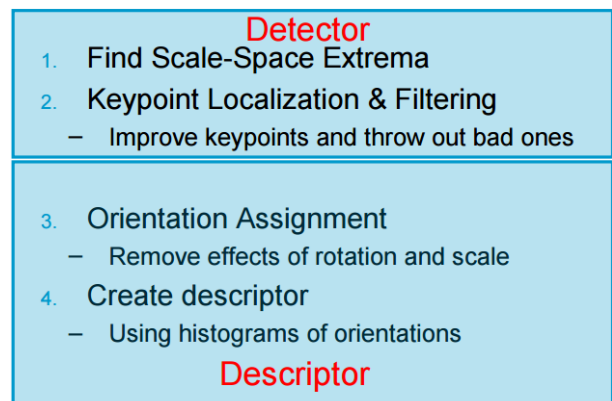


Figure 3 show the up-scaling idea [15].

5-The proposed Model

The proposed model is established on the noticing that adversity in a comparatively little space is treated in separable manner, in spite of this parable case of the consistency in the digital image. We first detect the BP in the image to localize the neighborhood around a

detected pixel. The specifics of the image that contain retina are modified to be better after being eliminated by the BP; simultaneously with discard the degradation in the image, which raise the no. of key points excessively. So, this points that allocated form feature can be appeared well and the unnecessary points are eliminated.

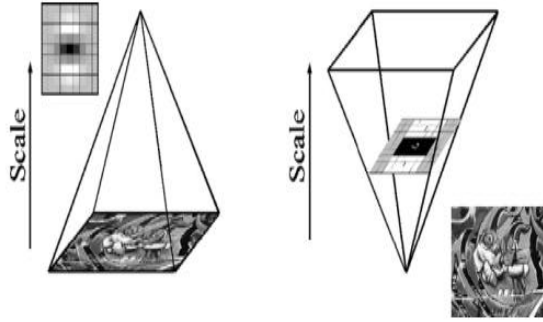


Figure 3: The scaling intensity in SURF descriptor.

Revelation of BP: Bifurcation is the extreme authoritative and considerable feature in important images. The retinals BPs are singular for each individual, so they are utilized for sequential operation of identification of individual. In this paper, it reevaluates BP with the assistance of skeleton key operation. In line with this operation a pixel in image will be discarded if achieve the following provision:

For pixel $X(i,j)$:

1. The number of pixels connected must be equal to 1.
2. It should have at least 2 near pixels and at the latest 6.
3. The pixels in location $(i,j+1)$, $(i-1,j)$ and $(i+1,j)$ should be white.
4. The pixels in location $(i-1,j)$, $(i+1,j)$ and $(i,j-1)$ should be white.
5. The pixels in location $(i-1,j)$, $(i+1,j)$ and $(i,j-1)$ should be white.
6. The pixels in location $(i,j+1)$, $(i-1,j)$ and $(i+1,j)$ should be white.

If there is no pixel that achieves the previous provision, then the algorithm will

be stopped. For determining BP, the program accumulates the Threading Number (TN) of each pixels existent in skeleton initial-image. The classification of pixels for BP location is setup on TN as shown in Figure (4).

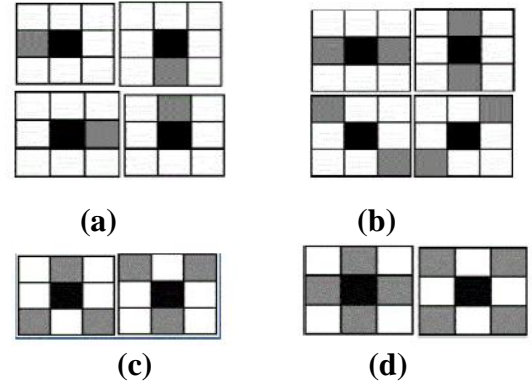


Figure 4: The TN evaluation; (a) If $TN=1$; it is an end point (b) if $TN=2$; it is an inside point (c) if $TN=3$; it is a bifurcation (d) if $TN=4$; it is a crossover.

If the BP is institute in the trend of other point, then find angle (∞) between them. The BPs are shown in Figure (5).

Figure (6) represent the whole block diagram of the model. These phases are then decomposed into different steps, as shown below:



Figure 5: BP spread.

Pre-processing:

This step smoothes the non-uniformly divided setting by discarding the alignment area such as part that is no

heritable by deforming the first image with the BP elimination, from the first image of retina. After that the concentration of the initial image is specified to ranges from zero to 255.

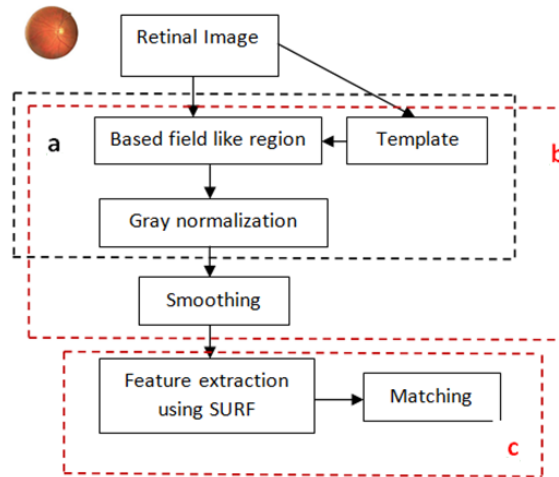


Figure 6: The block diagram of the identification system. (a) Setting information (b) Pre-processing; (c) SURF recognition algorithm.

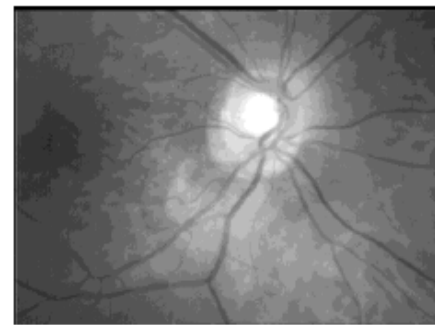
Smoothing:

Minimize the distortion in homogeneous areas victimization the iterated special allotropic sleek technique. What's a lot of, little components of retinal vessels area unit increased.

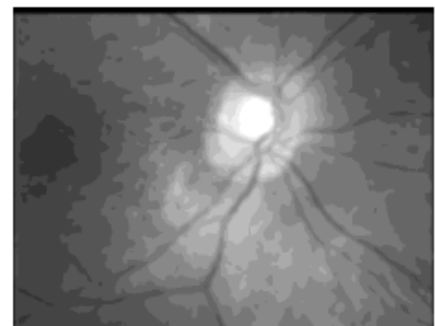
Identification:

In extracting the features, steady key point's area unit extracted by changing the SURF algorithmic program, the key points will characterize the distinctiveness of every category. Conjointly matching notice the amount of matched pairs in two retinal pictures.

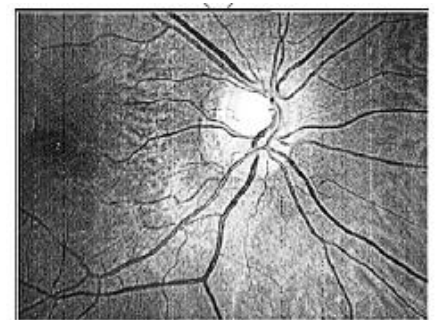
From Figure (7), it ought to be prominent that for seeing suitability, P is instilled to values from zero to 255. In Figure (7 b) we can show that P may be an alignment like image created from the first image of retina. Also, the image processed a dense gray level distinction than the first image of retina, and features a well regular gray intensity allocation.



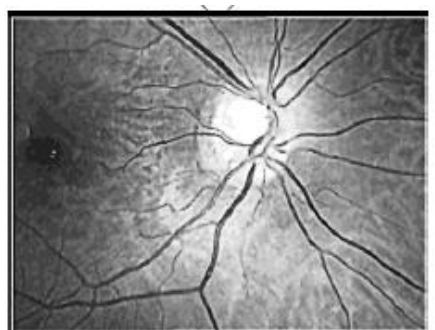
(a)



(b)



(c)



(d)

Figure 7: Retina image processing; (a) the first tissue layer retina image; (b) Skelton image that is the first image followed by smoothing; (c) (a) work out (b); (d) pre-processing step that is (c) once non-linear spread of the anisotropic.

This technique, unruffled is developed as a spreading method that is penned or ended at outlines by choosing regionally adjective spreading forces. Native extreme unit detected from convolved pictures by examination a pixel with it's nearby in three dimensions located that associate degreed if it's an extreme, this pixel is chosen as a key-point. Within the second phase, the filter of the key point's area unit reiterated by deleting the points of little deleted. If the documents worth at one nominee key purpose is beneath a definite threshold to imply that the key points is of depressed distinction and also the key purpose are removed. Within third phase, additional direction area unit allotted to every key points supported native image gradient directions. Within the last, native area neighborhood feature descriptor is computed for every key purpose supported a stain of pixels in its local nearness. Figure (8) gives the allocation of key points in images that contain retina.

In the match in the stage, feature descriptors extracted from two images of retina area unit matched. Supported the taken away the descriptors of the feature, the quantity of convenient geminate are employed to live the resemblance of the two images of retina. So, the acceptable value accepted (the variety of convenient geminate) is chosen when the full retinal info experiments. Two images of retina are categorized into an equivalent category if the quantity of identification pairs is larger than threshold; so, these images of retina are categorized as totally diverse categories. Figure (9) represent the results of matching operation.

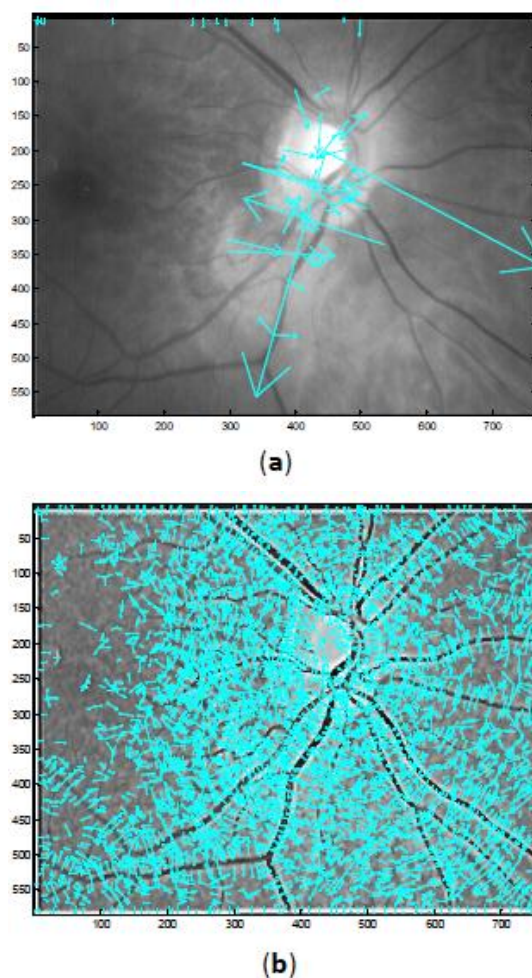


Figure 8: Distributed key points. (a) before enhancing; (b) after enhancing.

To verify the effectiveness of our methodology, we have a tendency to tend to check our methodology on the VARIA and DRIVE DB. For more checks, the durable to translating and rotate alterations of the proposed our system, we have a tendency to tend to research different simulated DBs from VARIA with different shapes of these images and with different angles. The herein planned identification methodology depends of two basic parts: pre-processing and SURF descriptor for recognition.

6- Results and Discussion

In most biometric authentication systems, the precision of enforced systems is incredibly necessary and that they should be experimented duly. During

the paper, the results were run on two retinal DBs. The first information could be a set of the VARIA information that is made for the recognition systems. This information includes 233 images of retina and a resolution of 680×584 from 195 completely various images, fifty nine of that has a minimum of 2 samples.

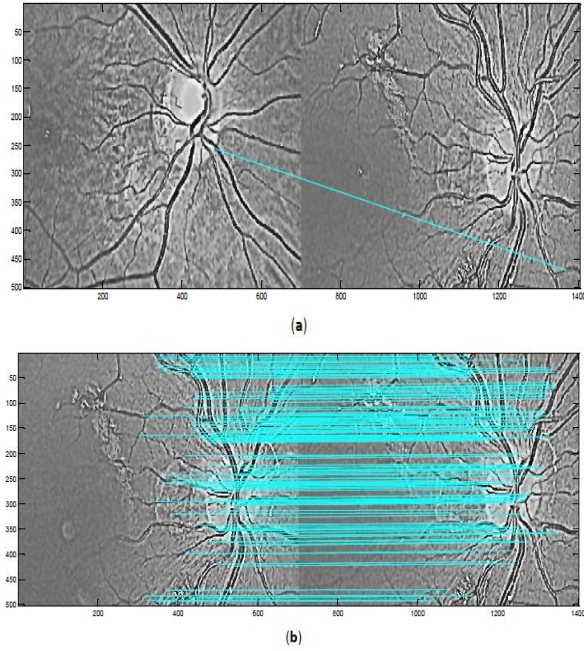


Figure 9: The matching between the two images. (a) very little pairs; (b) large matching pairs.

The pictures are no heritable over a time span of many years. These measure points targeted and with a high changeability in distinction and lighting. As an identification drawback, each image should have quite one pattern, thus we decide the on top of aforesaid fifty nine images to incorporate 153 patterns in average.

Also we have different angles that is used for testing, the angles that we used are $\pm 20^\circ$, $\pm 30^\circ$, $\pm 40^\circ$ and $\pm 50^\circ$.

Each step is analyzed using the testing that is concluded form the system to verify it. The experiment is

completed on the first information within the verification mode. During the verification phase, the matching operation is done between every pairs of images. Some class gives matching results with high accuracy and there is also unsuccessful matching with 2% range. The matching similarity distribution is shown in Figure 10, where x-axis represent the matching similarity and the y-axis represent the frequency.

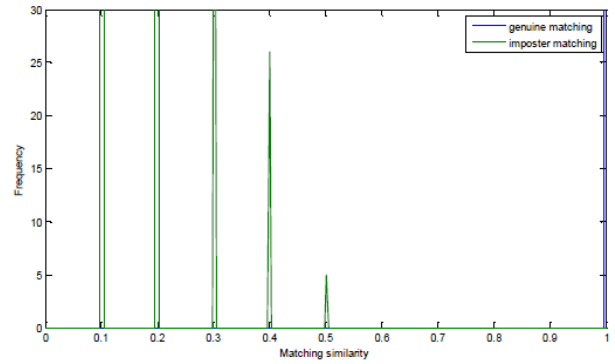


Figure 10: The proposed method distribution.

7- Conclusions

Retinal identification gives a good system for authentication with good results of matching. SURF with a support by BP gives a strong system for identification and matching. SURF identification algorithm gives a reliable partitioning algorithm if we compared with segmentation techniques. In addition, from the angle of the common key point's analysis, the given BP augmented the common range of stable key points regarding ninety times by enhancing the main points of the photographs. Once being around, the proportion of a mean range of matching pairs is greatly augmented with degradation reduced and little structure increased. This algorithm may be used for alternative biometric systems like iris or vein.

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