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Retina Authentication System using Inspired Algorithms

A thesis

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

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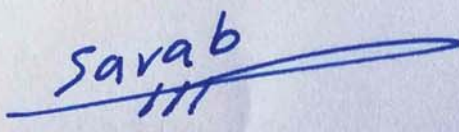
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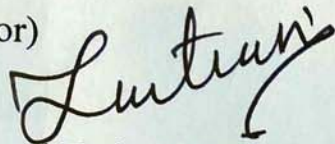
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Abstract

Retina authentication technology captures and analyzes the patterns of vascular on the thin nerve on the back of the eyeball that processes light entering through the pupil. Retinal patterns are highly distinctive traits; it cannot be gotten or stolen. No, two people have same retinal pattern and the features extracted from retinal image are the most stable and reliable than other biometrics features. Due to these reasons the retina is chosen as robust source in the proposed authentication system.

In this thesis , a system for recognition based on vascular pattern of human retina is introduced. This system contains three stages (preprocessing, features extracting , and matching). Preprocessing stage is used in order to make retina image more clear by using Gaussian and canny filters and Haar wavelet transformer. Features extracting phase is done using three types of inspired algorithms (PSO, Bat, and Harmony). Each extracted feature list is assembled as a feature vector, which is used in order to distinguish between different retinal images. Finally, the discrimination analysis of features is evaluated in matching phase by using Euclidean distance measure.

The results from this work declared that the best inspired algorithms for the proposed retinal authentication system are Harmony and PSO algorithms in which the obtained accuracy is (100%), while the accuracy of Bat algorithm (98.65%). However, Harmony algorithm is the best for the proposed authentication system in time consuming which is (3.0 sec), while PSO consuming time is (3.5 sec) and Bat consuming time is (7.3sec).

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Chapter One

Introduction

Chapter one

Introduction

1.1 Introduction

Information is stressed about the affirmation of protection, trust worthiness availability in information, There are various mechanical assemblies and strategies that can reinforce the organization of information security [1].

A validation procedure sets up the identity of some component under security . For example, an explorer confirms herself/himself to a fringe protect by displaying an international ID. Ownership of the international ID and likeness to the connected photo is viewed as adequate verification that the voyager is the recognized individual . The demonstration of approving the visa by checking a database of known international ID serial numbers for the voyager is a type of validation [1]. Therefore, confirmation is the procedure by which the personality of a substance is approved. Validating substances present qualifications, for example, passwords or declarations, as affirmation of their character . The substance is viewed as bona fide if introduced certifications are real and sufficient. Note that validation does not figure out which substances ought to be given access, but rather just checks that an element is who they claim to be. Be that as it may, it is simply after an element is verified that their rights to assets can be surveyed. Subsequently, inability to effectively confirm clients on the Internet can leave online resources frail against manhandle [2].

A biometric system can give two limits . One of which is verification what's more, the other one is validation. So, the techniques used for biometric authentication has to employ tow jobs in meantime. [3].

1.2 Related Work

During the last years, an increase is noticed in the research efforts toward developing systems dedicated to recognize humans through retinal images due to the increased need for a reliable system that is to identify the person stable with low error. Many researches appeared in the literature. These studies introduced different methods which vary in terms of processing time and efficiency. Some of the published works are listed in the following:

- **Morales.S[4]** Programmed Disk; The calculation proposed in the paper permits to naturally portion plate picture. These objective encourage identification specific completely computerize these procedure in order maintain a strategic distance from authority mediation. The strategy plate shape for the most part in light of numerical morphology alongside vital segment examination (PCA). It makes utilization of various activities, for example, summed up separate capacity ,variation change,. These contribution division strategy. The motivation behind utilizing PA accomplish dim picture speaks to first picture. executed calculation approved open acquiring outcomes. These normal qualities, separately, a precision , and a genuine portions of exhibit strategy hearty apparatus programmed division circle. In addition, genuinely solid appropriately an extensive level fluctuation enhances consequences best in class strategies; using Drions dataset ; accuracy of their system is 94%.

- **Frazin et al.** [5] presented a novel retinal identification method; it consists of three modules; which are: (i) vascular grids segmentation, (ii) feature extraction, and (iii) matching stage. At the initial step, the localization of optical disc and removal of its effect from retinal image is accomplished using template matching technique; that is the vascular and background contrast was enhanced by local contrast enhancement (LCE). Then, morphological operations were applied to fill those blank spaces between them two parallel bends after LCE process. The histograms thresholding method used to accomplish twofold picture containing them vascular example. In the next stage, the features are generated; which are the vascular diameters and their relative angles and locations. The features extraction stage implies four sub modules: (i) vascular covering in the region of optical disc, (ii) planar change, (iii) multistate examination of the polar picture by utilizing wavelets changes, lastly (iv) highlight vector developments from three picture, each containing vascular with determined scope of measurements estimate. In the last stage, the modified correlation measure is used in order to obtain the similarity index between the feature vectors for each scale, then the total value of the likeness records is computed by summing scale weights closeness files. Their proposed method was evaluated on Computerized, got recognizable identification accuracy rate was 99%.
- **Barkhoda et al.** [6] proposed a new retina identification system using angular partitioning. The first stage of the proposed system is the preprocessing step in which the additional edges of the retinal pictures are edited and the boundary box of retina is separated from the input retina to achieved translation invariant

features. Then the edited picture is standardized to achieve the scale invariant, and the adopted a similarity approach applied to extract the vascular pattern. Then, the extracted vascular pattern is passed through a morphological thinning process. After thinning, the produced vascular network is fed to features extraction stage to produce the feature vectors relying upon them precise parceling of them design pictures. The removed feature vectors have been broke down utilizing discrete Fourier's Transform and Manhattan measurements keeping in mind the end goal to quantify the closeness of the component vector. Their proposed system was tested on 360 images belong to DRIVE dataset, the achieved accuracy rate 98%.

- **Qamber et al.** [7] proposed a system for individual distinguishing proof in light of retinal veins. At first, the enhancement stage is done using wavelet transform, then the vascular network is extracted by applying multilayer thresholding on the enhanced pattern. Next, the vessels endings and bifurcation points are extracted and used as highlight focuses to establish a include vector that in view of distance and edges. Finally, matching process is performed utilizing Mahalanobis distances. The proposed method was tested using the samples belong to public datasets (i.e., DRIVE, STARE and VARIA). The attained recognition rate was 96.29% for STARE database, 99.57% For VARIA dataset and 100% for DRIVE dataset; the proposed method had achieved an overall recognition rate 98.87%.
- **Sabaghi et al.** [8] proposed another biometrics ID frameworks in light of combinational of Fourier changes and specials dividing and wavelets changes. At first, optical plate was limited utilizing format coordinating procedure with a specific end goal to

pivot them retinal pictures to reference position, at that point they utilized wavelets change and rakish apportioning of the recurrence ranges data of retinal picture for feature extraction. At long last, Euclidean separations metric was utilized for highlight coordinating. This proposed framework was tried utilizing DRIVE dataset, and the accomplished 99.1% for accuracy rate.

- **Sasidharan et al.** [9] presented a retinal personal identification system by using skeletonization and similarity transformation. At first stage, retinal image is acquired, then vascular enhancement and segmentation is done using resolution hierarchy creation, hessian vessel ness extraction, back sampling, hysteresis thresholding, and image fusion. In third stage, the detection the bifurcation points with the help of skeletonization process is done using the segmented image. Finally, similarity transformation was used to check the similarity between patterns. The system was tested using 400 retinal images and found it achieve extremely lower error rate.
- **Monisha et al.** [10] presented a hearty strategy for human's confirmation in light of them retinal vascular patterns. First, top halt and bottom halt filtering are applied. Then, median filtering is applied repeatedly for smoothing, then the thresholding process is connected to section the vascular network from the retinal picture. After that thinning is performed to extract the skeleton of the veins in light of them morphological pictures examination. A set of feature points (i.e., vascular bifurcation and ridge ending) is extracted using crossing number method. Finally, the Euclidean distance measure is utilized for coordinating between all the element vectors. The proposed method was tested on DRIVE and

STARE datasets. The attained recognition rate was 96% for STARE dataset, 97.5% for DRIVE dataset.

- **Vidya et al.** [11] presented a method for human identification by the blood vessel in retinal image. The presented method consists of image acquisition, preprocessing, feature extraction and matching stage. First, image resizing is done, then an image processing stage is done to enhance the input retinal image; it implies many steps: (i) convert color image of the retinal into gray scale image, (ii) histogram equalization, (iii) noise removal and filtering, and finally (iv) image sharpening and smoothing by using adaptive filters and median filters. In next stage, features (i.e., corners) are extracted using accelerated segment test feature algorithm. Finally, artificial neural network was used in the matching stage. The method tested on 580 retinal images belong for 58 different person. Their proposed system obtained a high accuracy rate for identification.
- **Waheed.Z** [12]; displayed; Biometric innovation enhances the exactness of the individual's distinguishing proof framework rather than the ordinary recognizable proof advances, for example, utilization of passwords, PIN, token and so on. Biometric advancements are robotized validation strategies, which recognizes individual's character in view of his particular physiological or conduct qualities. Among all biometric frameworks, for example, iris, hand vein, fingerprints, face, hand geometry, voice, gait, signature etc., human retina provides the most reliable and almost impossible to forge biometric trait. Most of the previous work carried out on retina recognition involves vessel based matching by using feature points i.e. minutiae points. Vessel segmentation and minutiae point extraction is a time consuming process. This motivates us to perform retina recognition matching without using

minutiae points. This paper exhibits a straightforward and quick non-vascular based retina acknowledgment framework. It figures similitude measure utilizing novel highlights in view of auxiliary data of an image. It extracts IL luminance, contrast and structural features from a color retina image and combines these extracted attributes using an observationally streamlined capacity to create a likeness score between two applicant pictures. Finally matching decision is obtained on the basis of highest score value. The proposed system is tested on two retinal image databases collected from local source i.e. RIDB and AFIO. The local databases are also made available online for other researchers. Efficiency of the proposed framework is tried by the calculation of false dismissal rate (FRR) and false acknowledgment rate (FAR) and test results demonstrate the legitimacy of the proposed framework. The method achieves an average identification rate of 92.50% on both databases .

- **Manjiri. B** [13] ; Individual Identification calculation in light of Retinal Blood Vessels Bifurcation ; Biometric identifiers are the one of a kind, quantifiable qualities used to tag and portray people. Physiological qualities are identified with the state of the body. Cases of biometric recognizable pieces of proof are, unique mark, confront, acknowledgment, wellspring framework gives solid methods for verification. another calculation recognition estimation veins purposes veins individual recognizable proof. particulars procedure discovering purposes veins as per focuses distinguishes unique . Execution methods utilizing.
- **M Islamuddin Ahmed** [14] ; Biometric Authentication utilizing Circular Segment around Optical Disk ; In this paper we have

proposed a strategy for biometric validation utilizing semi-roundabout fragment around retinal fundus optical plate. It is noticed that thickness and thickness of veins are most unmistakable in closeness locales around the optical plate since veins enter retina through optical circle. Using these spatial courses of action of veins as highlight furnishes us with uniqueness. Pictures in RGB and YCbCr shading spaces are tried in two separate investigations. The main trial (Exp-I) brought about 84.2% exactness utilizing RGB and in the second analysis (Exp-II), 89.2% precision was accomplished, in YCbCr shading space.

1.3 Problem Statement

Literature survey shows that the current trend in authentication is depended on biometrics such as retina. Therefore, the first problem of this thesis is to build an authentication system using retina characteristics. But, the accuracy and the speed of finding these characteristics are still as a problem. Therefore, the second problem of this research is to find a suitable search algorithm for the proposed authentication system. This study investigates nature inspired algorithms field in order to find the suitable search algorithm.

1.4 Aim of Thesis

The aims of this research are:

- 1- Design and implement retina authentication system using PSO algorithm.
- 2- Design and implement retina authentication system using BAT algorithm.

- 3- Design and implement retina authentication system using Harmony algorithm.
- 4- Making a comparison and evaluation between (PSO, BAT, and Harmony) in extracting retina features.

In other words, this thesis is concerned with building retina authentication system depending on three nature inspired algorithms.

1.5 Outlines of Thesis

The rest of this thesis is:

Chapter Two: Inspired Algorithms

This chapter gives the background and review of some inspired algorithms especially: (PSO, BAT, and harmony).

Chapter Three: (The Proposed Systems: Retina Authentication System using (PSO, BAT, or Harmony))

This chapter describes the proposed retina authentication system with their designs and implementations.

Chapter Four : (Results)

This chapter explains the results that have been gotten from the proposed system.

Chapter Five: (Discussion, Conclusion, and Suggestion for Futures works)

Chapter Two

Inspired algorithms

Inspired Algorithms

2.1 Introduction

Algorithm from the fields of computational insight, naturally motivated figuring, and met heuristics are connected to troublesome issues, to which more customary methodologies may not be suited. These algorithms are called inspired algorithms. Inspired algorithms include: stochastic Algorithm , transformative Algorithm , physical Algorithm , probabilistic Algorithm , swarm Algorithm , insusceptible Algorithm , and neural Algorithm [15].

Three inspired algorithms are adopted in this study: PSO (swarm algorithm), bat (metaheuristic algorithm), and harmony search (physical algorithm). Therefore, this chapter presents inspired algorithms in section (2.2). PSO algorithm is presented in section (2.3). While, section (2.4) clarifies bat algorithm. At last, section (2.5) describes harmony search algorithm.

2.2 Background

This section covers theoretical background of some subjects that are used in this thesis.

2.2.1 Biometrics

Individuals see each other according to their diverse traits for quite a while. Individuals perceive each other by their face or voice. Things like credit cards, at any rate are tend get stolen lost passwords are neglected or uncovered. achieve trustworthy, something that truly portrays the given individual ought to be utilized. mechanized recognizable guideline social attributes[16].