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Personal Authentication by Hand Recognition using LabVIEW

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Abstract: ***This paper presents a new Hand Geometry based human verification technique which is efficient, simple, fast, easy to handle and cost effective compared to other verification techniques. Hand Geometry is a popular biometric type in verification process. Hence the proposed system is a restriction free verification system which utilizes these hand geometry features for user authentication. It consists of a database where all the information about the authenticated users is stored. The system extracts the features from a test image and compares it with the stored information on the database. The paper proposes and uses some distinct features that enhance the accuracy of the recognition. The proposed system is reliable and user friendly as it is developed in LabVIEW.The availability of datalog files in LabVIEW makes it one of the most promising candidate for its usage as a database. Datalog files can access and manipulate data and complex data structures quickly and easily. It makes writing and reading much faster. The system developed in LabVIEW detects the user in almost real time with a reasonable accuracy and repeatability.***
Keywords: Biometric, Verification, Identification.

I. Introduction

Biometrics, by definition, is a word whose origins related with the ancient greek language."Bios" which means life and "metron" which means measure. For that reason biometrics is the emerging technology for distinguishing individuals based upon recognition of one or more traits. Physical and behavioral characteristics areacquired by Biometric Systems. Biometric technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solutions.

Typical architecture of all biometric systems consists of two phases:

• Enrollment,

• Recognition.

In the phase of enrollment, several images of hand are taken from the users. The images, called templates, are preprocessed to enter feature extraction, where a set of measurement is performed.

Final model depends on the method used for recognition. Models for each of the users is then stored in the database. In the phase of recognition, a single picture is taken, preprocessed, and features are obtained. In the proposed system, the process of verification is used, where the input template is compared only with the model of claimed person. The feature vector is compared with features from the model previously stored in the database. The result is the person is either authorized or not authorized [1]. There are several reasons for developing hand-based authentication systems. First, hand shape can be easily captured in a relatively user friendly manner by using conventional CCD cameras. Second, this technology is more acceptable by the public in daily life mainly because it lacks a close connection to forensic applications. Finally, there has been some interest lately in fusing different biometrics to increase system performance [2,3]. The ease of use and acceptability of hand-based biometrics make hand shape a good candidate in these heterogeneous systems. Although hand-based live verification has a long history and a considerable market share [4], most studies addressing enhancements of this technology are rather recent .Increases in computing power and advances in computer vision and pattern recognition are expected to facilitate the implementation of easier to use systems with higher accuracy. Removal of pegs, to improve convenience, and use of more principled feature extraction techniques to capture the shape of the hand in more detail represent promising research directions in this area[5]. The focus of this work is on improving the efficiency, accuracy, and robustness of hand-based verification. One can imagine utilizing various shape descriptors to provide a more powerful representation of the shape of the hand, replacing the conventional geometric features.

II. THE DESIGN OF THE SYSTEM

Hand Geometry

A biometric verification system based on hand geometry is designed. This system uses natural fusion approach as both of the biometric features originate from the same part of the body. Apart from that, unlike the other multimodal biometric system that required multiple input devices, only a single image capturing device is needed in this system. With this, the users do not need to go through the inconvenience of using several different acquiring devices for security access[6].

They can be captured completely from the complexity of verification system by using a single scanner.
It includes the following steps:

- Image Preparation
- Image Preprocessing
- Hand Feature Extraction
- Matching process
- Decision

Image Preparation

Image acquisition is the first step in a hand geometry biometrics system. The image acquisition involves capturing and storing digital images from vision sensors like color digital cameras, monochrome and color CCD cameras, video cameras, scanners, etc. In the proposed system images are acquired through a digital scanner [7]. It is necessary that the fingers are separated from each other. However it is not required to stretch the fingers to far apart as possible. The hand should be placed in a relaxed state with fingers separated from each other. There are various formats stored for the images such as .jpeg,.tiff,.png,.gif and .bmp. The captured images are stored in one of the following formats on the computer for possible image processing.

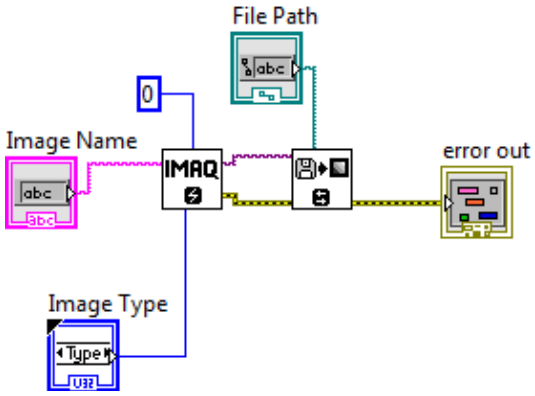
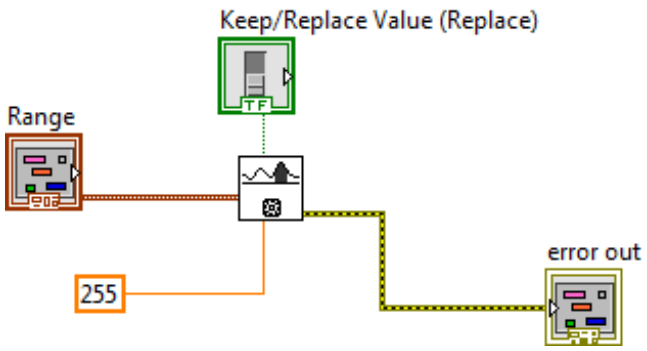


Image Preprocessing

The next stage is image preprocessing module. Image preprocessing relates to the preparation of an image for later analysis and use. Images captured by a camera or a similar technique are not necessarily in a form that can be used by image analysis routines. Some may need improvement to reduce noise; other may need to be simplified, enhanced, altered, segmented, filtered, etc.The role of the processing module is to prepare the image for feature extraction. In order to extract geometric features of the hand it is required that the image contains only edges. Edge detection is the process of localizing pixel intensity transitions [8]. The edge detection has been used by object recognition, target tracking, segmentation, etc.An edge is a collection of connected high frequency points in an image.Visually,an edge is a region in an image where there is a sharp change in intensity of an image. Detecting edges of an image represents significantly reduction in the amount of data and filters out useless information, while preserving the important structural properties in an image [9]. For the same reason thresholding is done in the proposed system. The images are first converted to double precision format within range [0,255] before calculating its histogram. The threshold problem is substantially simple in this case as the images were taken against dark background [10]. As we can see the foreground (gray) pixels are well separated from the background pixels at an intensity value of 80. Thus a threshold value T=80 was chosen and this value works well for all the images in the data set. Any intensity value greater than T is assigned the value '1' and anything lower than that is thresholded to '0'.



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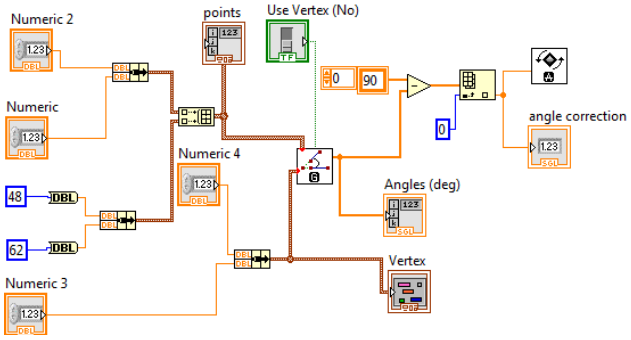
Before going over to feature extraction the orientation of the sample taken is to be considered. If there is variation in the orientation, it will result into errors. To overcome it the image registration is done in a manner that the sample align itself to the same orientation as the database is.This is done as shown:



Hand Feature Extraction

The hand geometry-based authentication system relies on geometric invariants of a human hand. Typical features include length and width of the fingers, aspect ratio of the palm or fingers, thickness of the hand, etc. [11]. To our knowledge, the existing commercial systems do not take advantage of any non-geometric attributes of the hand, e.g. color of the skin.

Preprocessing simplifies a measurement algorithm and enables us to get features of the hand. An algorithm for feature extraction was created in programming environment

LabVIEW and it is based on counting pixel distances in specific areas of the hand. Since the system uses special surface without pegs to fix the appropriate position of the hand, it can obtain pixel distance of the given measurement more accurately.

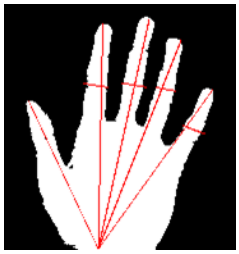
The algorithm looks for white pixels between two given points and computes a distance using geometrical principles. And these distances can be calculated as:

$$D_e = \text{sqrt}\,[(x - s)^2 + (y - t)^2\,]$$

Where, D_e= Euclidean distance

(x,y) and (s,t) are the two coordinate points.

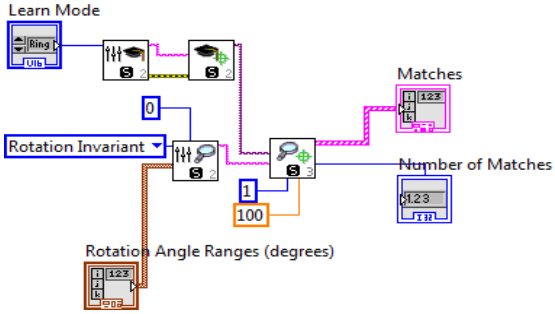
Having known these set of distances a database can be prepared which can be further used for verification purpose.



The figure above shows the distances we are considering in the algorithm.

III. Matching process

The matching stage provides the means to determine the identity of a user. When a user attempts recognition in a biometric system, the user's generated features template will be compared against the templates stored in the database. In one-to-one verification, this comparison is done only against the claimed identity's template, whereas in a one-to-many identification it is done against the entire database. Since the case of verification is just a subset of the identification case, only the later is described and reported in this work – verification will typically yield better results [12].



The matching stage is based on a classification algorithm that generates a distance score for each template comparison using a feature vectors' *similarity measure*. The score with the lowest distance value indicates the best match. Unnecessary template matching comparisons are avoided by also taking into account if the templates being compared both belong to the right or left hand, information which is obtained from the pre-processing stage.

IV. Decision

After running the matching algorithm, a recognition decision is made whether to accept or reject the best match found. If the distance score exceeds a predefined threshold, the recognition attempt is considered as an impostor access, otherwise the recognition attempt is considered a client access and the system assumes the user has been correctly identified [13].

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