

Content Based Analysis of Biometric Dataset for Information Retrieval

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Abstract: Biometric identification systems are the commonly used systems for automatically identifying human beings based on behavioural and physiological features. The information generated by such systems involves iris, faces, palm prints, fingerprints, signature, voice, gait, facial and gesture expressions. Such dataset content-based analysis needs efficient and effective techniques for information retrieval. Biometric identification can be performed efficiently using content-based image retrieval techniques. The content-based image retrieval is a technique which involves feature extraction, system, design and high dimensional indexing which has attracted several areas of research nowadays. The feature extraction plays an essential part in content-based image retrieval whose effectiveness relies on adopted approaches for the retrieval of features from the trained and test images. This retrieval depends on the features such as texture, shape and color. Thus, searching the dataset of biometrics for fine matching is a big barrier. In this paper, a focus has been made on content-based analysis of biometric data set for information retrieval, and discuss about biometric identification and content-based image retrieval. Further, we also address efficient approaches of content-based image retrieval namely SURF Technique and Bag of Words technique and their usage in face recognition.

Keywords: Biometric Identification, CBIR, SURF Technique, Bag of Words Technique.

1. Introduction:

Biometrics is an integration of two words of Greek mythology namely Bio which denotes life and Metric which denotes to measure. Biometrics has been employed for several purposes involving recognition of human specifically identification of an individual through behavioural and physiological attributes or traits. The behavioural biometrics are those which are associated to the behaviour of an individual. Hence such biometrics verification can hinder an individual from accessing or authenticating if her or his behaviour is varied from the stored behaviour profile or pattern (Dasgupta, 2018). Similarly, physiological biometrics involves an individual's physical characteristics such as structure of body, appearance and other perspectives. The algorithms of computation are employed to retrieve different features of biometrics such as face image, two-dimensional ridge maps in fingerprints, iris near infrared images, audio recordings of voice, gait motion video, etc. While biometric applications are huge and these fall mainly in government, commercial and law enforcement applications (Naidu and Govindarajulu, 2016). The best and effective way through which an individual could be identified varies across the globe (Reddy and Goutham, 2018).

Tiwari et al (2015) has stated that the biometric identification systems can be classified into many types but the major types of biometric identification which are used often are face recognition, voice recognition, fingerprint recognition, signature identification and iris identification. Face is an essential part of how people recognize an individual and who they are. Humans have the capability to differentiate and identify various faces for several years since PCs are just now developing to capture the image of face (Bobde and Deshmukh, 2014). Face recognition examines the facial features of an individual. It needs a digital camera to evolve a face image of an individual for authentication. This technique has attracted considerable concern although several people do not wholly perceive their capabilities (Priya, 2017). Similarly Shukla et al (2014) has stated that fingerprint identification is one of the much reliable and oldest form of biometrics which is employed for personal identification. Fingerprint identification has been used for nearly hundred years and is still continuing from tedious matching of manual fingerprints. The fingerprint of an individual is comprised of valleys and ridges. The pattern formed by valleys and ridges are distinct to each individual. In order to represent the pattern, the biometric system traces the ridge points recognizing minutiae points namely the ridges split (Mani and Nadeski, 2015). According to Arul and Marimuthu (2014) voice or speech is one of the innovative modalities for machine interaction of human. Voice conveys vast number of data to the listener. The spoken language, likes of information, gender, emotions and usually the appropriate identification. The main purpose of voice recognition system is to identify the spoken words by retrieving, identifying and characterizing the signal. Gupta et al (2014) has stated that the main aim of voice recognition is to decide which speaker is present based on the

characterization of an individual. Many techniques have been suggested for compensating the mismatch existing between the training and testing sessions. Shah and Shah (2015) has stated that signature is the most similar entity of identification that has been employed for various confidential needs from the perspective of user. Signatures perform as a strong feature of authentication for signers. The signature is verified and enrolled for identification system for security. Sulong et al (2014) has mentioned that signature identification is carried out using the identity of an individual based on measurements of biometrics. Signature verification is the method employed to identify the handwritten signature of an individual for forgery or genuine signs. Signature verification and identification system are classified into offline and online signature. Iris recognition is an automated biometric identification method that employs the techniques of mathematical pattern recognition on iris images of the eyes of an individual whose complicate random patterns are distinct and can be viewed from certain distance (Thirumurugan and MohanBabu, 2014). Sangwan and Rani (2015) have mentioned that the Iris recognition changes the traditional identification system like one required to remember password, PIN or to possess tokens. Iris handles in human being identification based on their physiological features. The universality, quality, collectability, permanence and distinct data estimated in an individual iris are much larger than other biometric data.

Verma et al (2014) has defined content-based image retrieval as a technique which utilizes visual contents referred as features to browse images from big scale image databases according to the requests of user in query image form. CBIR predicts images which have low level visual image characteristics relevant to those of the query image namely texture and shape, color histogram so that visual characteristics are retrieved automatically from images. Much effort can be saved and the issue of browsing images from huge database can be avoided by constructing the database of image for content-based image retrieval systems. Paulraj, Geetha and Jacob (2017) has stated that biometric identification can be carried out efficiently using CBIR techniques. The extraction of feature plays an essential part in content-based image retrieval systems whose effectiveness relies on adopted methods for feature extraction from the trained and test images. This extraction depends on features namely texture, color and shape. Abdu et al (2013) has stated that CBIR technique is applied to the issue of face image extraction particularly when browsing for digital face images in an extensive DB with relevant features which makes the actual extraction of target face impossible or difficult through traditional techniques namely face recognition technique and content-based image retrieval. This study uses SURF technique and Bag of Words technique in CBIR techniques. Dar et al (2017) has mentioned that speeded Up Robust Features is a robust detector of local feature presented first by Bay et al in tasks of computer vision as object identification or three-dimensional rebuilding. Speeded Up Robust Features is based on addition of two-dimensional responses of haar wavelet and makes an effective use of integral images. It employs an integer approximation to hessian blob detector determinant which can be evaluated rapidly with an integral image where for features it employs the addition of the response of haar wavelet around interest points. According to shodhganga (2013) the standard version of SURF retrieves minimal points which are the powerful features of an image. The interest points are estimated by evaluating the image variance. A vector is created in the next image to retrieve the needed features of image. So, the number of interest points and number of SURF features are always relevant. Bakshi et al (2016) has stated that the SURF is an in-plane rotation and scale invariant descriptor and detector. SURF detectors predict the image interest points and descriptors are employed to retrieve the feature vectors at every interest point. The Speeded Up Robust Features are used to retrieve the features from facial images for efficient recognition of face. Sarwar et al (2018) has stated that the bag of words is used for retrieval of documents. In a traditional bag of words model the image features are retrieved using feature descriptors. The single visual vocabulary is built by applying a quantization algorithm like k-means on retrieved features which changed high dimensional space of feature into low dimensional space of feature. Suharjito et al (2017) has mentioned that Bag of visual words is a familiar technique for solving the issues of content-based image retrieval. Bag of visual words imitates the text retrieval method which is known as bag of words. Bag of visual words performs properly not only content-based image retrieval but also in image classification, subject recognition and annotation of image. Bag of visual words is a method that handles an image as a local feature descriptor distribution where every descriptor was given a label known as visual words. Alchanti and Caplier (2018) has stated that the steps for deriving the signature for face image using bag of visual words are: 1) key points localization from the image, 2) key points explanation using local descriptors; 3) vector quantization for descriptor; 4) setting up the signature of every image by collecting visual words into a histogram; 5) normalizing the histogram by dividing the visual words frequency over total number of visual words; and 6) training a classifier using the obtained signatures of image for task of classification. This study evaluates the Content based analysis of biometric data set for information retrieval.

2. Literature Review:

2.1 Biometric Identification:

The science of estimating behavioural and/or physical features that are distinct to every individual is referred to as biometrics. Biometrics verify that an individual is who she or he claims to be. Biometrics means measurement of life but the phrase is related with the use of distinct physiological features to recognize an individual. The application which several people relate with biometrics is the security (Sareen, 2014). According to Phadke (2013) a biometric identifier is a measurement of objective of a physical feature of an individual which when seized in a database can be used to verify the identification of an individual or verify against other database entities. Biometric identification systems can be classified based on major physical features that lends itself to biometric identification namely hand geometry, fingerprint identification, palm print identification, retina scanner, face recognition, voice recognition and signature recognition. Biometric identification assures to offer the global people with a sound management system of identification. Buciu and Gascadi (2016) has mentioned that iris recognition is the most applicable kind of biometric identification and it is regarded to be the unique biometric systems in terms of its stability and uniqueness leading to huge deployment for big scale systems that proved to be effective. The iris is the colored part of eye closed by several ridges and furrows. The general steps of iris recognition are acquisition of image, localization of iris using segmentation and landmark characteristics, biometric template matching and biometric template generation. Kaur and Verma (2014) have stated that face recognition is based on the location and shape of the eyes, nose, eyebrows, chin and lips. It is non-intrusive approach and very familiar also. Face recognition is undertaken in two ways: 1) eigen faces which examines the overall image of face as a weighted combination of canonical face numbers; and 2) facial metrics measures the shape and location of facial attributes. Another developing technique is to use face recognition integrating with visual skin details known as skin texture analysis (Sharma et al, 2014). According to Singla and Sharma (2014) fingerprint identification is the most familiar techniques of biometrics and have been used over a century. Fingerprint identification is used mainly in artificial intelligence. Fingerprints are graphical flow like valleys and ridges present on human fingers surface. A fingerprint can be indicated by the locations, attributes and types of minutiae. It is familiar because of ease of access, non-intrusive scanning., low cost of fingerprint sensors and relatively better performance. The fingerprint of an individual is different and remains unchanged over a lifetime. O'Neil King (2014) has mentioned that voice recognition is a modality of biometrics that employs the voice of an individual for purposes of recognition. It is explained as a method by which a program or machine interprets and receives dictation as well as perceives and undertakes spoken commands. The techniques of voice recognition support consumers comply with security, safety and privacy needs ruled by user expectations and by law. The processes of voice recognition depend on features impacted by both the behavioural features of an individual and physical structure of vocal tract of an individual. Pal et al (2014) has stated that signature verification examines the way a user signs her or his name. Signing characteristics such as acceleration, velocity, pressure and speed are as essential as the finished static shape of signature. Signature based identifications performs a synergy with existing methods that other biometric based identification approaches do not. Signature identification devices are exact in operation and lend themselves to applications where a signature is an accepted personal identifier. The below table shows the reviews of biometric identification:

Table 1: Reviews of Biometric Identification

Type of Biometric identification	Description	Characteristics of Biometric identification	Author	Year
Face Recognition	Face recognition is an application of computer that verifies or identifies an individual automatically with the support of a digital video or image frame from a source of video.	Universality, Collectability, acceptability and circumvention	Sharma et al Kaur and Verma	2014 2014
Fingerprint recognition	Fingerprint identification defines to the automated method of verifying a match between two images of fingerprint	Uniqueness and Acceptability	Singla and Sharma	2014
Voice Recognition	Voice recognition is a modality of biometrics that employs the voice of an individual for purposes of recognition	Uniqueness, Acceptability and circumvention	O'Neil King	2014

Signature Verification	Signature verification examines the way a user signs her or his name	Uniqueness, Collectability, Acceptability and Circumvention	Pal et al	2014
Iris Recognition	Iris recognition is the most applicable kind of biometric identification and it is regarded to be the unique biometric systems in terms of its stability and uniqueness leading to huge deployment for big scale systems that proved to be effective	Uniqueness, Permeance, Universality. Invasiveness and performance	Buciu and Gascadi	2016

2.2 Content Based Image Retrieval:

Madhu (2014) examined two characteristics for CBIR query image, query by texture and query by color. These characteristics have various features to extract the much similar images. The process of extraction is carried out on the basis of invariant histogram for query by texture and color histogram in Red, Green and Blue space for query by color. The outcomes of an evaluation of user reveals that query by texture performs outstanding than query by color. Kothiyari and Dwivedi (2016) proposed an approach for retrieval of image using the shape and texture feature of an image. This study uses color histogram statistical feature for texture characteristics and Hu moments were used for retrieving shaping features and by integrating both the characteristics the precision rate has been improved in this study. The proposed approach provides 86 percent of rate of precision and it can be employed for real time applications namely web engine.

According to Khan and Kulkarni (2014) due to the huge raise in sizes of image database as well as its wide deployment in different applications the requirement for content-based image retrieval growth arose. This study uses clustering technique for content-based image retrieval and their main purpose of image clustering is to eliminate the loss of data and retrieve the meaningful data to the expected needs of human. The images are pre-processed with different techniques and images are clustered based on components of red, green and blue, K-means algorithm and texture values. Huneiti and Daoud (2016) proposed a content based image retrieval by retrieving both texture and color feature vectors using the Self Organizing Map and Discrete Wavelet Transform ANN. The texture vectors are contrasted using a measure of similarity at query time which is the Euclidean distance and the most relevant image is extracted. Other similar images are extracted using neighbourhood of the relevant image from clustered set of data through Self Organizing Map. The proposed approach explained promising results of retrieval on the database of Wang compared to existing methods. In the study of Saini and Mourya (2016) CBIR is implemented using the content of image texture and color. This study have implemented an integrated approach by using 2 techniques namely color moment and local binary pattern. Color moment is used to retrieve the image color feature and local binary pattern is used to retrieve the image texture feature. The below table shows the reviews of the content-based image retrieval:

Table 2: Reviews of Content Based Image Retrieval

Technique Used	Description	Author	Year
Query by Color and Query by Texture	Query by texture is much efficient than query by color for extracting general images	Madhu	2014
Statistical Feature and Shape Extraction	uses color histogram statistical feature for texture characteristics and Hu moments were used for retrieving shaping features and by integrating both the characteristics the precision rate has been improved	Kothiyari and Dwivedi	2016
Clustering Technique	image clustering eliminates the loss of data and retrieve the meaningful data to the expected needs of human	Khan and Kulkarni	2014
Self-Organizing Map and Discrete Wavelet Transform	content based image retrieval by retrieving both texture and color feature vectors using the Self Organizing Map and Discrete Wavelet Transform ANN	Huneiti and Daoud	2016
Color Moment and Local Binary Pattern	Color moment is used to retrieve the image color feature and local binary pattern is used to retrieve the image texture feature	Saini and Mourya	2016

2.3 Techniques of CBIR:

According to the study of Deole and Longadge (2014) CBIR is a method to predict the relevant image in database of image when query image is provided. In this study color feature extraction is used where the color feature are retrieved by using 3 techniques namely color moment, HSV histogram and colorcorrelogram. This study uses K-NN classifier for the image classification and Relative Standard Deviation is employed to estimate the difference between two images and lastly computes the value of recall and precision. Patel and Yerpude (2015) used a new approach for CBIR that integrates both the shape and color features. The proposed scheme uses haar wavelet transformation and color edge detection based on process of feature extraction. The proposed algorithm retrieves the edges from the RGB image's color luminance part by transforming the target RGB image into YCbCrcolor spaces. Similarly, the shape feature is acquired by retrieving the RGB channels of color and uses histogram and decreases the size of the feature vector by using haar wavelet transform.

Imran et al (2014) proposed a new efficient and effective technique of content based image retrieval based on color histogram using First Order Statistics and Hue Saturation Value referred fos-HSV. First order statistics is employed for retrieval of texture characteristics while color histogram manages with color data of image. The output of the study reveals that fos-HSV technique accomplished 15 percent greater accuracy compared to Histogram and Variance segment-based techniques. These techniques can be used in forensic departments for suspect identification. Alsmadi (2017) proposed an efficient content-based image retrieval using memetic algorithm to extract images from database. Once the user provides query image as an input so that the proposed content-based image retrieval retrieved image features namely texture and shape color and color signature from the image. Then using the memeticalgorithm-based measure of similarity images similar to query image were extracted effectively. Jenni et al (2015) proposed approaches focused mainly on effective representation of image and database classification. This study provides a method for CBIR based on SVM classifier. In this approach the extraction of feature was carried out based on the string comparison and color string coding and this research succeeded in transforming the image extraction issue to comparison of strings. Thus, the complexity of computation is reduced evidently.

The below table shows the reviews of techniques of CBIR:

Table 3: Reviews of Techniques of CBIR

Technique Used	Findings of the study	Author	Year
K-NN classifier and Relative Standard Deviation	K-NN classifies an object based on training and attribute samples whereas relative standard deviation provides	Deole and Longadge	2014
Color Edge Detection and Haar Wavelet Transform	Color edge will be used to predict the color descriptor feature vector and haar wavelet transform is used to reduce the size of feature vector	Patel and Yerpude	2015
FOS (First Order Statistics) and HSV (Hue Saturation Value)	First order statistics is employed for retrieval of texture characteristics while color histogram manages with color data of image	Imran et al	2014
Memetic technique	Memetic algorithm has strong ability to discriminate the shape, color and texture features	Alsmadi	2017
SVM classifier with color string coding	SVM classifier with color string coding developed the accuracy in acquiring image retrieval results	Jenni et al	2015

2.4 SURF Technique in Face Recognition:

Singh et al (2016) proposed a novel technique for face recognition to develop the parameters of quality using SURF (speed up robust features) and LDA (Linear Discriminant Analysis) for optimal output. SURF is used for matching features and LDA is used for the dimensions of edge reduction to live image of face from datasets. The proposed method reveals better result and better quality in live face images. The method used in this study reveals good outputs as compared to former approaches in entire cases such as psnr, error rate, accuracy, ssm

and mse. Sharm and Sachdeva (2015) focuses at PCA alongside SURF and SVM for recognition of face. Principal Component Analysis reduces feature extraction and dimensionality to reduce the highlights. SVM classifier is used as part of this research for carrying out the capacity of recognition and SURF is used for matching the source image with database. This results in a sufficient accuracy and error rate furthermore this provides good PSNR and MSE outputs.

Vinay et al (2016) proposed face recognition using Speed Up Robust Features in integration with Singular Value Decomposition which is 5 percent much accurate than Speed Up Robust Features with Principal Component Analysis. It is found that Singular Value Decomposition technique is much efficient in securing the original information after decreasing the input image dimension. The average number of key points predicted in SURF-Principal Component Analysis technique is 7 percent greater than the SURF-Singular Value Decomposition technique. Anand and Shah (2016) proposed a face recognition approach using SVM classifier and SURF features. SVM is a vastly used technique for data regression as well as classification. This study have used the features of Speed Up Robust Features as image features as Support Vector Machine as classifier. But instead of performing face image classification as a whole this study carried out feature wise classification to determine the image label. The results of the study reveals a better accuracy with images having difference in perspective movement, illumination, scaling and facial expression. Chandrakala and Ravi (2018) provides a time conserving system of face recognition for three dimensional images based on Linear Discriminant Analysis and SURF features. This study reveals better outcomes in terms of sensitivity, accuracy and specificity with reduced consumption of time. It is proved that the proposed technique performance is fulfilled and it outperforms the already existing techniques.

The below table shows the SURF techniques used in face recognition:

Table 4: Reviews of SURF Techniques used in Face Recognition

Technique Used	Advantages of the technique	Author	Year
SURF and Linear Discriminant Analysis	SURF used for matching features and LDA provides better quality in live face images	Singh et al	2016
Principal Component Analysis and Support Vector Machine with Speed Up Robust Features	PCA is invariant to maturing, brightening and posture, SVM is used for organizing the likeness in the middle of images and SURF is used for coordination.	Sharma and Sachdeva	2016
SURF-Principal Component Analysis and SURF-Singular Value Decomposition	SURF-Principal Component Analysis has reduced accuracy in matching different people images whereas SURF-Singular Value Decomposition reduce the requirement of storage	Vinay et al	2016
SURF (Speed Up Robust Features) and SVM (Support Vector Machine) classifier	The features of SURF offers benefit of invariance of rotation, scaling, partial invariance and shifting to affine transformation and illumination whereas SVM classifier performs well on classification issues	Anand and Shah	2016
SURF (Speed Up Robust Features) and LDP (Local Derivative Pattern)	The integration of LDP and SURF features are retrieved from three-dimensional face images and the integration of these features proves better ability of discrimination	Chandrakala and Ravi	2018

2.5 Bag of words in Face Recognition:

Montazer et al (2015) proposes a new method for detection of face using extended version of Bag of visual words. This study uses two extension of the actual BoVW where one extension is using Fuzzy C-means clustering and second extension is by constructing words histogram using numerous dictionaries for every image. The output of the research shows promising outcomes. Zhao et al (2015) proposed a block-basedBoW structure using bisecting K-means clustering technique which could enhance the codebook generation process. The revised structure not only has better performance of recognition on face images from ORL, FERET and AR databases but also decreases the time of execution essentially. The results reveals that the revised model is robust for expression, illumination, partly occlusions, posture, etc. Yang et al (2016) proposed representation of face through spatial pyramid-basedBoW for recognition of face and then additive kernel based linear support vector machine has been established for effective classification that a new method for the issue of face recognition is proposed. The proposed method can accomplish better performance and performs better than other state of art techniques. The proposed method is much robust to difference of poses, expressions and illuminations, etc.

According to the research of Nasr et al (2017) representation of face through bag of words features for recognition of face has been proposed and then linear support vector machine has been employed for effective face classification. In conventional bag of words method the features of SIFT are employed for creating dictionary in this study's proposed method. The features of SIFT are changed with features of SURF for accurate and fast extraction of feature. The proposed method is very robust to different poses, expressions and illuminations, etc. This study will be examined to manage the mobile robots for disabled persons like a wheelchair. The robot will correctly identify the movement of face and move backward, right, forward, left and stop when the user movement was predicted. Gabryel (2018) proposes a new technique of image search and classification based on BoW technique. This technique takes a good account of particular perspective of the representation of image. Among the other things it permits for numerous kinds of image feature characteristics to be used simultaneously. The algorithm comprises several changes that facilitate several kinds of characteristic features application retrieved from an image, analysis of image representation and an adaptive clustering algorithm to create image features dictionary.

The below table shows the Bag of words techniques used in face recognition:

Table 4: Reviews of Bag of Words Techniques used in Face Recognition

Technique Used	Benefits of the technique	Author	Year
Extended version of Bag of Visual words	The EBoVW shows promising performance because of its reduced needs of storage and rapid time of run	Montazer et al	2015
K-Means clustering and Block based Bag of words	Block based Bag of words technique is used for better rate of recognition and K-means clustering algorithm accelerate the codebook generation process	Zhao et al	2015
Bag of Words and Support Vector Machine	Bag of features and SVM accomplishes better performance and outperforms several state of art techniques	Yang et al	2016
Bag of Words Features and Support Vector Machine	Bag of words features is used for extraction of feature and multi class support vector machine is used to verify the query and this system can be employed for offline or real time recognition of face	Nasr et al	2017
Bag of words and Image classification and search	Bag of words is beneficial and can be implemented successfully in both non-relational and relational databases.	Gabryel	2018

3. Discussion and Conclusion:

In this study SURF technique and Bag of words technique is used as content-based image retrieval for face recognition. The reviews discussed in this research used SURF and Bag of words techniques separately with some other techniques for example Singh et al (2016) used SURF for matching features and uses LDA for better quality images in live whereas Yang et al (2016) used Bag of features and SVM techniques to accomplish better performance and outperforms several state of art techniques. So, there are no researches which combine the SURF and Bag of words techniques for face recognition. This study proposes SURF and Bag of words Content Based Image Retrieval techniques for face recognition. Content based image retrieval is still a developing science and it maintains a stable space of growth in the field of research. The growth of strong power of processing, cheaper and faster memories contribute heavily to the growth of content-based image retrieval. This growth assures a huge number of future applications using content-based image retrieval. Content based image retrieval has become a very familiar system for browsing, retrieving and searching images from a huge database of digital images with small intervention of humans. It has been proven to be a strong technique and has become a main focus of research in present years. The basis of content-based image retrieval is feature extraction. These features are often low-level features which can be extracted from the set of datasets. Content based image retrieval makes the search and retrieval of images in a database rapidly. Face recognition is interpreted as an issue of content-based image retrieval. An arbitrary input of face image is handled as a sample for search within a database comprising huge number of images for every face of interest of human. Thus, it can be concluded that content-based image retrieval is one of the most important techniques for face recognition that would yield better accuracy of results.

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