Literature Review on Hyperspectral Face Recognition

Siddharth B. Dabhade, Research Scholar, Nagsen S. Bansod, Research Scholar, K.V. Kale, Professor, Dept of Computer Science and IT, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, MS, India, dabhade.siddharth@gmail.com, nagsenbansod@gmail.com, kvkale91@gmail.com

Abstract: In the last two decades, biometric user authentication techniques for better access control and security have evoked an enormous interest from industry, science and society. Environmental factors, i.e. illumination may vary in outdoor or semi-outdoor for face detection it is challenging task. Lighting conditions vary with the outdoor environment, therefore in the face recognition system is concentrated on in the indoor environment in which illuminations is under controlled. Normally faces are in the 3D format it may affect by the lighting variation. But the use of artificial illumination does not useful in the surveillance system. Hyper- Spectral is a technique firstly used to integrate spatial and spectral information for remote sensing; this data is very effective for material identification in scenes as compared to other sensing modalities. There are various biomedicine applications where spectroscopy is used measurements for spectra, for example, human tissue. Face recognition using Hyperspectral face images gives more accuracy.

Keywords —Biometric, Face Recognition, Hyperspectral, Security, Image Processing, Pattern Recognition

I. INTRODUCTION

Face recognition is the identification of the person on the basis of physical appearance of the human front elevation. Any creatures are used this techniques to findings the known things on their previous storage memory. In human being this process is start from the childhood. When small baby recognize you it gives very cute smile on his/her face. On the basis of recognition two terminologies are used i.e. identification and verification. Identification is used for recognize the person on certain previous knowledge and verification is the authentication of the person's identity. In identification person is identified from N number of peoples (1 to N) or database whereas in verification (1 to1) we have to match with certain parameters such as tokens, cards, etc. Person identification technique is very old but technically computer scientist had started the work on it in mid of 1960 for automated face recognition. At that time it was semi automated system was developed and administrator used to calculate the distances on photograph of ear, eyes, and nose, etc. these system was not fully automated because to localization of landmarks and measurements human interaction was required. In 1970 some solution was provided by the Goldstain and others with more facial features. After that paradigm get changed and scientist was interested in face recognition through the system without human interference till date work is in progress.

Researchers have given more concentration on face recognition because it is very easy to capture the image. In the last 3-4 decades scientist has discovered the various solutions for the fully automated face recognition system. For automated face recognition system special points are identified as unique property of the human being called as features. Features are considered whole image captured from the camera.

As the world is becoming increasingly more insecure, people are looking for new forms of security which are more reliable and less vulnerable against intruders' attacks. One such emerging technology is the field of Biometrics. The main reason for the acceptance of the biometrics as a tool for security is its universality, distinctiveness, permanence and collectability. Main issues to be considered when implementing a biometric system is performance, acceptability, and circumvention.

Based on measurements of physiological or behavioral traits of humans, scientist and researchers have pursued the automated technology for confirmation of the subject identity. Now a day's biometrics face recognition system is based on geometric spatial features of faces are under controlled conditions [3], [4], [5], [6], [7], [8], [9]. The performance of face recognition system is reduced when the orientation of face changes more than 32 degrees from normal image [10]. Changes in [11] show that the variation of pose with light-field 60 degree rotation, and it requires manual work for 3D transformation. The features calculated by geometric algorithms and occlusion [12] are gives poor result when the imaging session time is

more than 2 weeks [10]. Thermal Infrared imaging gives alternative for this problem [13], [14], [15]. But though the techniques used in thermal imaging for extracting spatial features for face recognition do not give good result when poses are vary, for that [16] has used 3D morphable face model.

Biometrics is a science which deals with identification of a person on the basis of his or her physical, behavior or chemical characteristics [18][19]. In day to day life due to increase use of electronic banking, e-commerce, and smart card the importance of the privacy and security has become mandatory. As networking grows, so does the number of electronic transactions used for both conducting business and gathering information. This fact has led to the realization that the traditional methods involving passwords and pin numbers used to gain entry in these networks, no longer provides adequate security against unauthorized access to sensitive or personal data [20]. Users PIN and passwords can be forgotten and token-based ids such as smart cards, employee badges, passports and driver's license can be lost, stolen or forged [20]. Biometric identification systems provide a solution to these problems, since they require the user to be physically present at the point of identification and unique biometric identifiers are based on who you are, as opposed to what you know or have in your possession. Hence it is a robust authentication method and it cannot be lost, forgotten or guessed by any imposter. Now in India and many other countries in the world have established the identity of their citizens with biometric identifiers and maintain identity databases. This is extensively used at airports and other entry points to regulate public movement across borders and single out suspicious elements. USA, Brazil, Germany, United Kingdom, Iraq, Israel, Australia, New Zealand countries have already started issuing passports containing digitized biometric data like signature, photographs, iris, fingerprint information. Many other countries are following the same path to maintain digital records of its population and are in the process of issuing passports with embedded biometric data.

II. Related Research Work

According to [1] Hyper- Spectral is a technique firstly used to integrate spatial and spectral information for remote sensing; this data is very effective for material identification in scenes as compare to other sensing modalities. There are various biomedicine applications where spectroscopy is used measurements for spectra, for example, human tissue. Face Recognition using Hyperspectral images gives high accuracy [2] [21].

Face recognition is an active research area for pattern recognition and computer vision and it is a difficult and complex problem and due to its potential use in a wide variety of commercial and law enforcement applications including access control, security monitoring, and video surveillance. Unlike other biometric identification systems based on physiological characteristics, face recognition is a passive, non-intrusive system for verifying personal identity in a user-friendly way without having to interrupt user activity [17]. It has many application areas, i.e. human computer interaction, security, person identification [34, 35]. One of the factors that affect the performance of the recognition system is the training sample size [36–38]. Sufficient number of training samples are always needed to train the classification system well [39]. If only one image per person is available, the recognition process gets more difficult. This problem is called one sample problem [40]. Traditional methods will suffer or fail when a single image per person is available [41–43]. Several algorithms have been proposed to overcome this difficulty [33, 36, 44–47].

III. Methodology

Face recognition is very interesting area in biometrics, [17] show the sensor imaging with different modalities. There are various electromagnetic spectral bands are used for different purposes; in biometrics visible spectrum band is used because below the visible band radiation is very harmful to the human body such as X-rays, ultraviolet, etc. Some researcher used Thermal IR imagery as an alternative source [22]. For face recognition visible spectrum is apply in which the range of electromagnetic energy of camera is 0.4–0.7μm. The infrared spectrum comprises the reflected IR and the thermal IR wavebands. The reflected IR band (0.7–2.4 μm) is associated with reflected solar radiation that contains no information about the thermal properties of materials. The near-infrared (NIR) (0.7–0.9 μm) and the short-wave infrared (SWIR) (0.9–2.4 μm) spectra are reflective and differences in appearance between the visible and the reflective IR are due to the properties of the reflective materials. This radiation is for the most part invisible to the human eye.

To overcome the limitation of existing face recognition system spectral information is used [21]. Some researcher studied on reflection of light return by the human tissue which identifies the spectral properties [25], [26], [27]. Human body tissue contains several layers of epidermal and dermal like hemoglobin, melanin, β-carotene, etc; if any small amount of changes in any of pigments of the skin it gives different spectral reflectance [28]. The effects of reflection are very large therefore automated system can easily find the hemoglobin and melanin from color image [29]. Skin reflectance spectra is used [30], [31], [32] in visible spectrum for detection of skin under various lightning composition. In [32] for face synthesize they used lightening and viewpoint. Fig.1 indicates the generic structure of Hyperspectral face recognition system. Some of literature survey is shown in the

table no.1.

A. Hyper-Spectral Images

Take the input as Hyper-Spectral face image database. Details of Hyperspectral database is shown in the table no.1. For reading the image use any image editor though support the Hyperspectral image or use Matlab to read the image.

B. Separation of Band

After taking the input from the system separate 33 bands on the basis of band region. Each band having certain reflection in a specific visible spectrum.

C. Band Selection for Face Feature Extraction

Feature extraction play an important role for finding any pattern, face features will be extracted by using statistical techniques from separate band. Features will show the exact reflection and region of active spectra where we are interested. Then we will make the fusion of features of all bands and make the single feature for single image to take the decision.

D. Matching

The main outcome of overall process is to find the person is genuine or not for that we have to use classification or distance matching techniques therefore we can match with existing database template. Matching decision will be depending on features are related to the person or not.

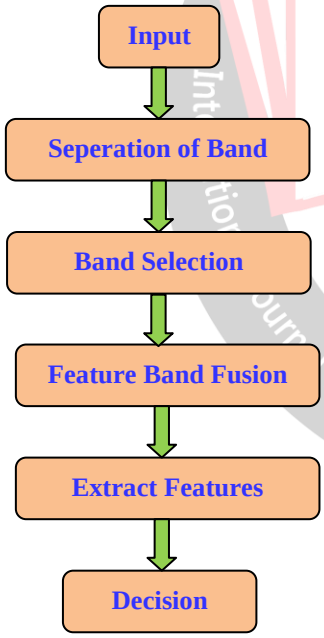

Fig.1 Generic Structures of Hyperspectral face recognition system.

TABLE 1. HYPERSPECTRAL DATABASES

Sr. No	Database	Sub jects	Spectral Range	Year
1.	CMU HYPERSPECTRAL FACE DATABASE	54	450-1100 nm	2001
2.	THE HONG KONG POLYTECHNIC UNIVERSITY HYPERSPECTRAL FACE DATABASE (POLYU-HSFD)	25	400-720nm	2010
3.	UWA Hyperspectral Face Database (TIP 2015 and BMVC 2013)	78	400 - 720nm	2013
4.	Hyperspectral Imaging Database Stanford Center for Image Systems Engineering	70	400-1000 nm	2013

IV. CONCLUSION

Face recognition using Hyperspectral Face Data is recent research area therefore very few research papers are produced. Hyperspectral provide fine detail information of the persons from his face therefore it can be useful for high security.

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TABLE 2. LITERATURE SURVEY

Sr. No.	Author	Title	Vol	Issue	Journal/Publisher/Conference	Page No	Month	Year
1	Muhammad Uzair, Arif Mahmood and Ajmal Mian	Hyperspectral Face Recognition with Spatiospectral Information Fusion and PLS Regression	24	3	*Image Processing, IEEE Transactions on*	1127-1137	March	2015
2	Linlin Shen; Songhao Zheng	Hyperspectral face recognition using 3D Gabor wavelets	11	15	*Pattern Recognition (ICPR), 21st International Conference on*	1574-1577	Nov.	2012
3	Wei Di; Zhang, D.; Zhang, D.; Quan Pan	Studies on Hyperspectral Face Recognition in Visible Spectrum With Feature Band Selection	40	6	*Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on*	1354-1361	Nov.	2010
4	Zhihong Pan; Healey, G.E.; Prascad, M.; Tromberg, B.J.,	Face recognition in hyperspectral images," *Computer Vision and Pattern Recognition*	1		*Computer Vision and Pattern Recognition, Proceedings, IEEE Computer Society Conference on*	334-339	June	2003
5	Hong Chang, Andreas Koschan, Mongi Abidi, Seong G. Kong, Chang-Hee Won	Multispectral visible and infrared imaging for face recognition			2012 IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops	1-6		2012
6	Bharadi, V.A.; Mishra, P.; Pandya, B	Multimodal face recognition using multidimensional clustering on hyperspectral face images			*Confluence The Next Generation Information Technology Summit*	582-588	25-26 Sept.	2014
7	Kishore, P.V.V.; Sastry, A.S.C.S.; Krishna, C.B.S.V.; Vikas, Y.; Aneesh, C.S.D.	Hyperspectral face data reduction and classification with multiresolution wavelets			*Signal Processing And Communication Engineering Systems (SPACES),International Conference on*	260-264	2-3 Jan	2015
8	Cong Phuoc Huynh; Robles-Kelly, A	Hyperspectral imaging for skin recognition and biometrics			*Image Processing (ICIP), 2010 17th IEEE International Conference on*	2325-2328	26-29 Sept.	2010
9	Robila, S.A.,	Quo vadis face recognition: Spectral considerations			*Systems, Applications and Technology Conference LISAT '09. IEEE Long Island*	1-5	1-1 May	2009

