SIGNIFICANCE OF SPECTRAL CURVE IN FACE RECOGNITION

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ABSTRACT: In this paper, we present the introduction and significance of spectral signature and recognition of skin from hyperspectral face imagery for Face Recognition (FR). In the acquisition step, hyperspectral cameras are used to capture multispectral or hyperspectral images of faces for skin recognition. The developed signature may either be stored in a database for forthcoming testing or be used for purposes of identification. The spectral properties of human tissue are approximately invariant to face orientation and expression which allows hyperspectral discriminants to be used for recognition over a large range of poses and expressions.

Keywords: Hyperspectral, Spectral, Face Recognition

1. INTRODUCTION
Biometrics is the technical term for body measurements and calculations. It refers to metrics related to human characteristics. Biometrics authentication is used in computer science as a form of identification and access control [1]. Examples include, but are not limited to fingerprint, palm veins, face recognition, DNA, palm print, hand geometry, iris recognition, retina and odour. Behavioral characteristics are related to the pattern of behavior of a person, including but not limited to typing rhythm, gait, and voice. Among the various biometric identification methods, Face Recognition (FR) is one of the most flexible, working even when the subject is unaware of being scanned [2].

1.1 Face Recognition
FR is a significant research problem covering many fields and disciplines. This because FR, in additional to having frequent practical applications such as bankcard identification, access control, Mug shots searching, security monitoring, and surveillance system, is a fundamental human behaviour that is essential for effective communications and interactions among people [3]. Progress has advanced to the point that FR systems are being established in real-world settings. The rapid development of FR is due to a combination of factors: active development of
algorithms, the availability of a large databases of facial images, and a method for evaluating the performance of face recognition algorithms [4].

FR is a biometric approach that employs automated methods to verify or recognize the identity of a living person based on his/her physiological characteristics [5]. In general, a biometric identification system makes use of either physiological characteristics or behaviour patterns to identify a person. Because of human inherent protectiveness of his/her eyes, some people are reluctant to use eye identification systems. FR has the benefit of being a passive, non-intrusive system to verify personal identity in a “natural” and friendly way [6].

The application of face recognition technique can be categorized into two main parts: law enforcement application and commercial application. Face recognition technology is primarily used in law enforcement applications, especially Mug shot albums and video surveillance [7]. The commercial applications range from static matching of photographs on credit cards, ATM cards, passports, driver’s licenses, and photo ID to real-time matching with still images or video image sequences for access control. Each application describe diverse restraints in terms of handling.

1.2  Hyperspectral Face Imaging

Hyperspectral facial data presents creative information, taken with Hyperspectral camera, as compared to the traditional camera and images. This facial spectral dataset is a rich source of information extraction and analysis over traditional single band data with constant wavelength of Electromagnetic Spectrum (EMS) [8]. A hyperspectral image is a data cube with two spatial dimensions and one spectral dimension. It is captured by a hyperspectral camera which operates in multiple narrow bands and densely samples the radiance information in both space and wavelength, producing a radiance spectra at every pixel [9].

Although the high dimensionality of hyperspectral data is a desirable feature for separating the different identities, at the same time it poses new challenges such as interband misalignments and low signal-to-noise ratio (SNR) in certain spectral bands [10].

1.3  Significance of Hyperspectral Imaging in FR

Using Hyperspectral Images for FR is reasonable by two principal reasons: Narrow spectral bands display more relevant facial information compared to orthodox broadband color and black and white images [11]. Certainly, we obtain a unique spectral signature of the facial tissue. Such information can be employed to improve the accuracy of FR. Second, by using Hyperspectral images, we are able to distinct the illumination information from object reflectance in distinction to broadband images where it is almost unbearable to do so. This separated information can be used to normalize the images. For example, Near-Infrared (NIR) spectral band can be joined
with the visible image. This method has been widely used to build more operative biometric systems [12].

1.4 Spectral Curves
Reflectance of the surface of a material is its effectiveness in reflecting radiant energy. It is the fraction of incident electromagnetic power that is reflected at an interface. The reflectance spectrum or spectral reflectance curve is the plot of the reflectance as a function of wavelength.

The measurements can be made with various instruments, including a task specific spectrometer, although the most common method is separation of the red, green, blue and near infrared portion of the EM spectrum as acquired by digital cameras. Calibrating spectral signatures under specific illumination are collected in order to apply an empirical correction to airborne or satellite imagery digital images [13]. Spectral Curves for different facial attributes are shown with Figure 1[14].

Figure 1. Spectral Curves for different Face Attributes [14]

2. SIGNIFICANCE OF SKIN SPECTRAL CURVES IN FACE RECOGNITION
Spectral dimensions from human tissue, for example, have been used for numerous years for characterization and observing applications in biomedicine. In remote sensing, scholars have shown that hyperspectral data are operative for material identification in scenes where other sensing modalities are unsuccessful. The introduction of hyperspectral cameras has led to the expansion of methods that syndicate spectral and spatial information. As hyperspectral cameras have become accessible, computational methods developed primarily for remote sensing problems have been moved to biomedical applications. Since the vast person-to-person spectral variability for different tissue types, hyperspectral imaging has the capability to expand the capability of automated systems for human identification [11].

Numerous of the boundaries of current FR systems can be overwhelmed by using spectral information. The interface of light with human tissue has been studied widely
by several researchers and concludes tissue spectral properties. The epidermal and dermal layers of human skin establish a scattering medium that comprises numerous pigments such as melanin, hemoglobin (HbO\textsubscript{2}), bilirubin, and carotene. Minor variations in the distribution of these pigments make significant variations in the skin’s spectral reflectance. Recent research has measured skin reflectance spectra over the visible wavelengths and proposed models for the spectra [11].

Scholars have used a skin reflectance model to propose method for skin detection under changing lighting circumstances. A skin reflectance model has also been used to synthesize face images after changes in lighting and viewpoint.

3. CONCLUSION
We have proven the utility of hyperspectral imaging for face recognition over time in the presence of changes in facial pose and expression. The hyperspectral imaging provides accurate recognition performance for expression changes and for images acquired over several week time intervals.

REFERENCES


