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РАЗРАБОТКА НЕИЗМЕННОЙ СПЕКТРАЛЬНОЙ БИБЛИОТЕКИ PALMPRINT С ПОМОЩЬЮ SPD4 СПЕКТРОРАДИОМЕТРА SPEC4

Биометрия – это метод расчета и измерения тела, биометрия, используемая в информатике для идентификации личности людей в группе. В биометрии существует ряд методов, доступных для автоматической проверки и идентификации человека. Инструмент аутентификации включает в себя проверку того, какие люди знают пароли, ПИН-коды, какие люди имеют токены, смарт-карты и какие имеют черты лица, распознавание рук, отпечатки пальцев, геометрию рук, рисунок радужной оболочки глаза. По сравнению с другими биометрическими характеристиками отпечатки пальцев являются более точными, надежными, изображения отпечатков пальцев дают больше информации по сравнению с отпечатками пальцев. Hypherspectral Palmprint система распознавания является многообещающей биометрической технологией, которая получила чрезвычайно большой интерес исследований. В последние десятилетия было предложено и построено много различных алгоритмов и систем. Несмотря на то, что был достигнут большой успех в исследованиях отпечатков пальцев, тем не менее, точность и механизм подделки в некоторых случаях ограничены, поскольку функция отпечатков пальцев может быть аналогичной для данного спектрального анализа; HyperSpectral Palmprint является хорошим методом распознавания для решения этой проблемы, он может предоставить более точную информацию при различном освещении в короткие сроки. Были проведены исследования, которые используют изображения для идентификации и аутентификации людей, поэтому изображение человека легко взломать с помощью каучукового цемента, желатинового носителя и т.д. В этой статье мы решаем эту проблему с помощью спектроскопического устройства, которое генерирует спектральные сигнатуры ладоней, и эти спектральные сигнатуры являются уникальными для каждого чело-

века. Следовательно, это дает высокую безопасность, и механизм спуфинга также избегается. В этом документе описывается разработка спектральной библиотеки Palmprint, для которой используются прикладные программы ENVI 5.5.

Спектральная библиотека Palmprint; ASD FieldSpec4; биометрическая; ENVI 5.5.

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DEVELOPMENT OF NON-IMAGING PALMPRINT SPECTRAL LIBRARY VIA ASD FIELD SPEC4 SPECTRORADIOMETER

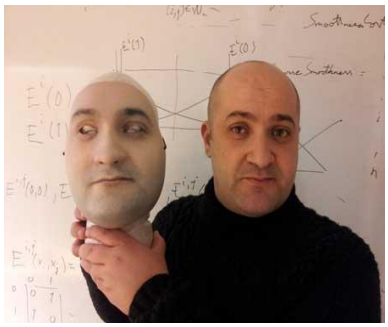
Biometrics is the method for body calculations and measurement, biometrics used in computer science to identify the identity of persons in group .In biometrics there are number of methods and techniques are available for automatic person's verification and identification. The authentication tool involves verification of what individuals knows passwords, PINs, what individuals has tokens, smart cards, and what individuals is facial feature, hand recognition, fingerprint, hand geometry, iris pattern. As compare to the other biometric characteristics the palmprint are more accurate, reliable, palmprint images gives more information as compare to fingerprint. Hypherspectral Palmprint recognition system is a promising biometric technology which received extremely large interest of researches. In the past decades many different algorithms and systems have been proposed and built. Although, great success has been achieved in palmprint research, however, the accuracy and spoofing mechanism are limited in some cases, as the palmprint feature may be similar for a given spectral illumination; hypherspectral Palmprint is a good recognition method to address this issue, it can provide more discriminate information under different illumination in short time. Work was already done by the researches they all use images for persons identification and authentication, so the image of the person is easily hack with the help of rubber cement, gelatin copy medium, etc. In this paper, we solve this problem with the help of a spectroscopic device, which generates spectral signatures of palmprint, and these spectral signatures are unique for every person. Hence it gives high security and spoofing mechanism is also avoided. This paper outlines the development of palmprint spectral library, for ENVI 5.5 applications software's are used.

Palmprint Spectral library; ASD FieldSpec4; biometric; ENVI 5.5.

1. Introduction. In our society, person identification and their authentication play a vital role and biometric is the most reliable and important method. Biometric technology especially used for security, based on their physiological and behavioral modality. Physiological modality gives the information about the shape of the body for example face, fingerprint, iris, palmprint, hand, etc. while behavioral modality as the name indicates, the behavior of the persons for example keystroke, signature gait, etc. Palmprint physiological biometric modality has several advantages as compared to other biometric modality, like reliable, more accurate in nature, low-resolution images also give good recognition accuracy, as the surface of palmprint is large it gives a large number of features [1, 2]. The people who work in the company, they use their hand continuously to do work, they are not providing their fingerprint clearly, but they can provide their palmprint very clearly for authentication.

In the palmprint recognition system, the recognition accuracy and spoofing are limited, currently available biometric system provides images for a person's identification and recognition [3]. Whatever work done by the researches, they use images like white image, multispectral and hyperspectral images, these images are easily hacked with the help rubber cement, gelatin, copy media, voice recording, makeup, photography, ink, artificial biometric modality, etc., for example, if impression of the palmprint modality may be left on any surface then by using gelatin or rubber cement anyone easily hack the palmprint device. Fig. 1 shows an example of biometric hacking (Fingerprint, 3D face login, Face mask).

a – Fingerprint Spoof by Gelatin



b – Face Mask

c – 3D Face Login

Fig. 1. Examples of Biometric Spoofing

These spoofing techniques directly attack biometric authentication systems, therefore the recognition accuracy and biometric spoofing mechanisms are limited in a biometric authentication system [4]. To solve this problem spectroscopy method (ASD FieldSpec 4 Spectroradiometer) come into the pictures. In this method, the spectral signature of palmprint biometric modality is generated and this spectral signature is unique to differentiated two persons, even identical twins also generate a different spectral signature pattern, and it's a very difficult job to hack the spectral signature of palmprint, automatically the problem of spoofing is decreases and human get strong authentication system for person identification and recognition.

2. Field spectrometry. Spectroscopy is the interface between matter and electromagnetic radiations of input objects. Spectroscopy is also called as field radiometry, reflectance spectroscopy, field spectroradiometry, ground radiometry, Field Spectrometry, handheld radiometry, etc., and this term is mainly used for measurement of radiance, irradiance, and reflectance using spectral signature [5], and also used to measure the reflectance properties of any objects under solar illuminations for example soil, plant, water bodies, biometric modality etc. In this paper Analytical spectral device (ASD) Field spec 4 spectroradiometer are used to capture the data of palmprint in dark room multispectral laboratory, this device is used to acquires continuous spectrum for lab and field measurement. In field spectroscopy, there is an interaction between mass and energy from small to large scale alignment [6]. Field spec 4 spectroradiometer contains fiber optic cable with three different fields of view (FOV), 25 deg, 8 deg, and 1 deg, Battery, Laptop, Pistol grip, Charger, Carrying case, AC power supply.

3. Methodology. The following fig. 2 shows the methodology for building a spectral library for palmprint recognition system.

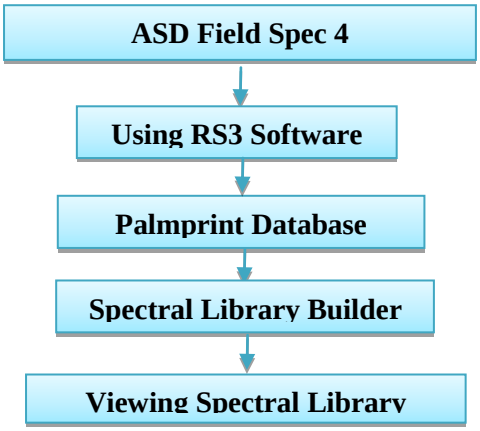


Fig. 2. Proposed Framework for Building Spectral Library

3.1. ASD Field Spec 4 Spectroradiometer. ASD FieldSpec 4 Spectroradiometer is non-imaging, portable, faster, full wavelength range (350 nm to 2500 nm), real-time, and more accurate device [7]. The main function of this device is to collect the spectral signature of any objects which has the reflection property. ASD Spectroradiometer device specially used in identification, quantification, and detection of objects, the spectral resolution varies from 3nm at 700 wavelengths and 8nm at 1400 nm to 2100 nm wavelength [8], for detail specification of ASD FieldSpec 4 shown in tabl. 1. The ASD FieldSpec 4 Standard-Res is the correct choice for remote sensing applications such as multispectral and hyperspectral sensor calibration, ground truthing, agriculture analysis, snow analysis, person authentication. ASD is a hyperspectral sensor with high resolution and greater precision for remote sensing applications.

This device gives more information about every pixel in the image this is the main advantages of the ASD FieldSpec 4 device. The spectrum (Spectral Signature) of any reflected objects is collected using the FieldSpec 4 Hi-Res and this spectrum are smooth in nature and provides more detail information. ASD provides two software one is RS3 [9, 10], in this software we collect and store the database, and second is view spec and indigo pro, where we analyze data and also perform preprocessing operation. We collect the palmprint database in dark room multispectral laboratory. Fig. 3 shows the laboratory experimental setup of palmprint database collections.

Table 1

ASD FieldSpec 4 Specification [11]

Spectral Range	350-2500 nm
Spectral Resolution	3 nm @ 700 nm 8 nm @ 1400/2100 nm
Spectral sampling (bandwidth)	1.4 nm @ 350-1000 nm 1.1 nm @ 1001-2500 nm
Scanning Time	100 milliseconds
Stray light specification	VNIR 0.02%, SWIR 1 & 2 0.01%
Wavelength reproducibility	0.1 nm

Wavelength accuracy	0.5 nm
Maximum radiance	VNIR 2X Solar, SWIR 10X Solar
Channels	2151
Detectors	VNIR detector (350-1000 nm): 512 element silicon array SWIR 1 detector (1001-1800 nm): Graded Index InGaAs Photodiode, Two Stage TE Cooled SWIR 2 detector (1801-2500 nm): Graded Index InGaAs Photodiode, Two Stage TE Cooled
Input	1.5 m fiber optic (25° field of view). The optional narrower field of view fiber optics available.
Noise Equivalent Radiance (NEdL)	VNIR 1.0 X10^{-9} W/cm^2/nm/sr @700 nm SWIR 1 1.4 X10^{-9} W/cm^2/nm/sr @ 1400 nm SWIR 2 2.2 X10^{-9} W/cm^2/nm/sr @ 2100 nm
Weight	5.44 kg (12 lbs)
Calibrations	The wavelength, absolute reflectance, radiance*, irradiance*. All calibrations are NIST traceable. (*radiometric calibrations are optional)
Computer	Windows® 7 64-bit laptop (instrument controller)
Warranty	One year full warranty including expert customer support

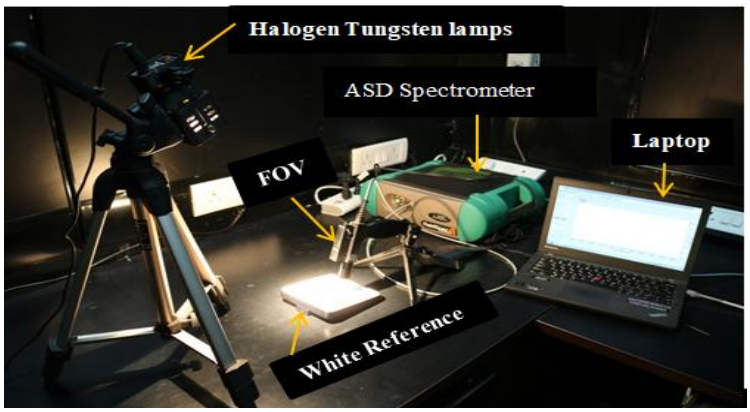


Fig. 3. Laboratory Setup of the ASD FieldSpec 4 Spectroradiometer

3.2. RS3 Software. RS3 software is mainly used for database collection, when this software collect database, before database collection it is very necessary to perform the following steps. Initially when RS3 software is connected to ASD instrument, then in the main window the current measurement option is displayed, we can manually enter the count of the spectral signature measurement [12, 13].

3.3. ASD Spectroradiometer Warm Up. Before collecting the reflectance spectra of palmprint, it is very necessary to warm up the instrument, depending upon the lab and field measurement the warm-up time changes. For lab measurement 15 minute and for field measurement 1 hour time is required. Visible-infrared (VNIR), Short wave infrared 1 and 2 (SWIR 1 and SWIR) these three detectors are overlapped to each other so to avoid that overlapping, a warm-up of the instrument is needed [14, 15].

3.4. Optimization. The next step of RS3 software is optimization, the ASD device needs to adjust the integration time [16]. Optimization processes adjust the sensitivity of FS4 device, in main window "OPT" button is provided to performing the optimization process. Fig. 4 shows the sensitivity of the detectors for each wavelength (350 nm to 2500 nm), at the lower and upper end of the spectral signature there are four minima of sensitivity, and these four values are again pre-calibrated to get proper reflectance spectra [17].

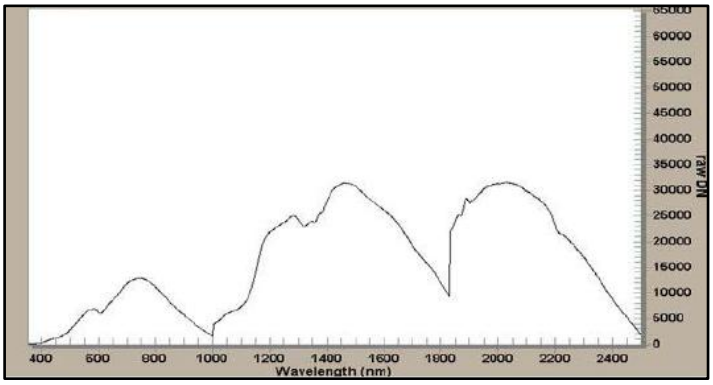


Fig. 4. Optimization Spectrum

3.5. White References. White reference is also called a calibration panel, which gives 100 % reflectance property. As shown in fig. 5 the one straight line indicates the white reference is reflected completely and now the user is ready to take ridings of spectral signature [18].

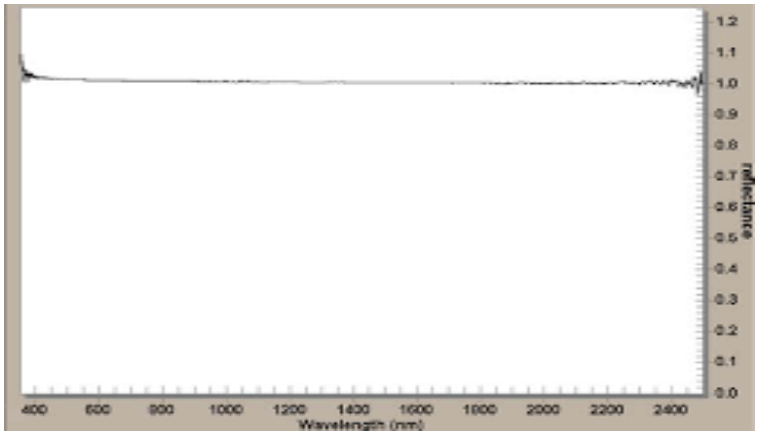


Fig. 5. White References

Then these spectral signature or spectrum is stored (see fig. 6), the spectrum is save with path name, base name, the total number of count of the spectrum, the time interval between two spectra and if a user wants to give any comment then comment option is also provided by the RS3 Software.

Fig. 6. Spectrum save Template [8]

3.6. Palmprint Database Creation. Palmprint database is collected by using RS3 software and ENVI 5.5 applications. The Spectral Palmprint database from 100 persons was built in a multispectral research lab, Dr. Babasaheb Ambedkar Marathwada University. The age range of the persons varies from 20 to 40 years old; the database was collected by using 1 deg, FOV, in this process the persons asked to give 10 spectral palmprint signatures of his/her left palm and right palm. So total database is 2000 reflectance spectra of palmprint (350 nm to 500 nm).

Fig. 7. Laboratory Experimental Measurement Setup of Palmprint Spectra

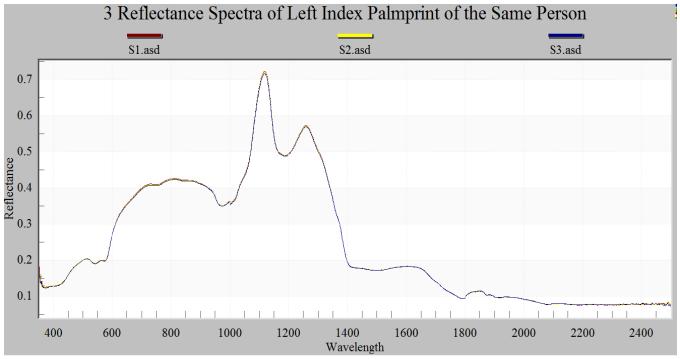


Fig. 8,a. Reflectance Palmprint Spectra of Same Person

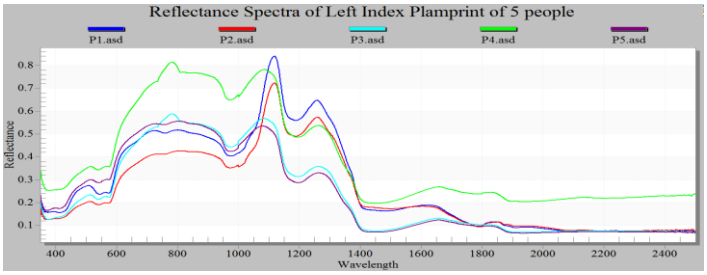


Fig. 8,b. Reflectance palmprint spectra variation among different person

Fig. 8,a,b shows the clear difference between reflectance spectra collected from the same person and reflectance spectra collected from different spectra. The palmprint spectral signature of the same person mostly overlapping to each other because these came from same persons while in fig. 8,b the reflectance spectra are collected from different five persons so the spectral signature is also different.

3.7. Spectral library builder. We developed a spectral library of palmprint in ENVI, in this software initially all the palmprint spectral samples then select spectral library function from a toolbox, and then choose select library build option [19]. Fig. 9 and 10 shows the palmprint selected samples for building the spectral library and plot selected samples on the graph.

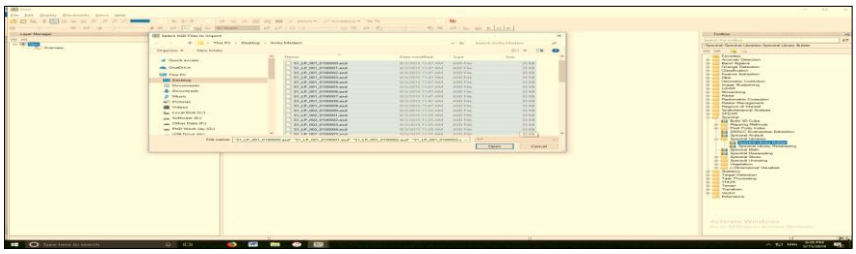


Fig. 9. Palmprint Sample Selection in ASD format

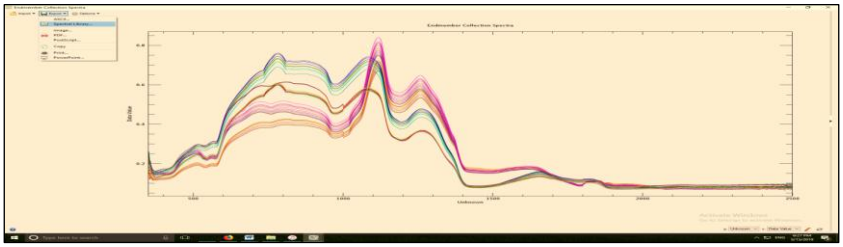


Fig. 10. Plot Selected Palmprint sample

3.8. Viewing spectral library. Once the spectral library is created then we want to show that library by using spectral library viewer function see fig. 11.

In ENVI software some other inbuilt groups of the laboratory from NASA are also available, like U.S. Geographical Survey (USGS), Jet propulsion laboratory (JHU), ASTER spectral laboratory, etc. Such types of the spectral laboratory are very useful for further analysis such as feature extraction, classification, and recognition accuracy [20, 21].

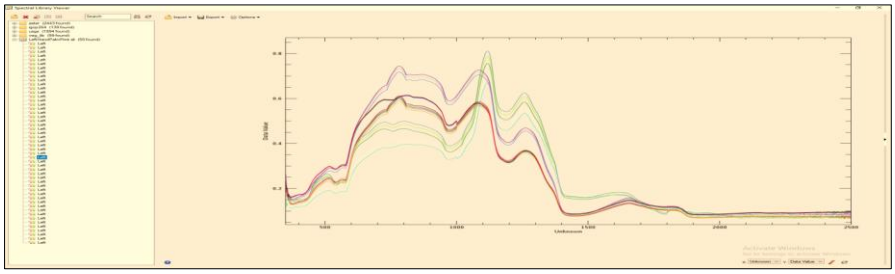


Fig. 11. Palmprint Spectral Library Viewer

Conclusion. Existing biometrics technologies enhances by using palmprint spectroscopic method in order to prevent spoofing, palmprint spectral signature varies from person to person and makes spoofing a very difficult task. In this paper, we create a palmprint spectra library, by using ENVI 5.5 Application software, ASD FieldSpec 4 Spectroradiometer device. The standard spectral library creation is the basic and most important requirements for further research work such as feature extraction and classification.

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