IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)
e-ISSN: 2278-1676, p-ISSN: 2320-3331
PP 32-36
www.iosrjournals.org

Finger Vein Recognition

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ABSTRACT : *As per the development of electronic world it is quite impossible to secure the personal information. Considering the shortcoming of the unimodal biometrics authentication the proper selection of modality plays important role for authentication. Hence it is essential to develop safe and authentic recognition system to protect the privacy about the person. This paper proposes a recent authentication system using finger vein. The vein pattern present beneath the skin of finger is distinctive and stable. It can be used for personal authentication that provides high security and reliability because of its positive characteristics over the others biometrics modalities. This paper explores the IR based finger vein capturing device and different algorithm for feature extraction of finger vein used for authentication. The paper highlighted the finger-vein framework, its recognition performance parameter i.e. false acceptance rate (FAR) and false rejection rate (FRR). The characteristics of finger vein authentication shows that it is more secure than the other correlated modalities.*

Keywords *-Biometrics modality, finger vein, authentication, FAR, FRR*

I. INTRODUCTION

Many biometrics authentication systems have deployed but every type of unimodal biometrics have its own demerits based on the traits, capturing device, database and feature of that traits. Finger print is a popular trait for recognition but it can be easily spoof using dummy fingerprint, sensitive to dirt, wet and age[1,2]. Facial recognition is sensitive to the face expression and age [5]. Voice recognition is also depends upon the environmental condition and not secure from the recorded voice [4]. Considering the Challenges in the current recognition system now time is come to design the robust unimodal recognition system to secure the privacy.

The first issue is the choice of trait the paper focuses the finger vein trait for personal identification. The proposed system explores that how the finger vein is useful for secure personal identification, capturing finger device that provide more privacy than other devices, samples of finger vein and mainly the feature of finger vein pattern. Vein pattern present under the skin of finger is unique for everyone. The main characteristics like universal, uniqueness and permanence is high as compare to the uncorrelated modalities. Performance and acceptability is medium because it not as popular as like that fingerprint. Hence the main objective of this paper to highlight the simplicity and flexibility of finger vein modality for personal authentication that makes it user friendly like fingerprint.

II. FEATURES OF FINGER VEIN

Vein pattern is the networks of blood vessel under the skin of finger. These vein patterns are unique to individual even among the twin. Correlated traits such as hand vein and palm vein have deployed but still not popular because of large space for database and high cost. Finger vein patters have merits as compare to other popular biometrics traits as follows [3, 6].

1. Protected by skin hence less chances of damage
2. Unique pattern for like twins
3. Not sensitive to the finger condition(dry,wet,dirt)
4. Vein pattern is persevere throughout the life
5. Live vein pattern identification.
6. Non contact acquisitions hence no problem of sanitary
7. No Failure to enrolled rate (FER)
8. Highly secure and reliable

Due to this additional feature finger vein pattern is the correct choice for designing the secure unimodal recognition system.

III. VEIN IMAGING

Vein images in medical using X ray and ultrasonic are not used for authentication due to the health case. Safe IR based imaging techniques are used for personal authentication. IR regions is divided into near, mid and far-infrared w.r.t. optical region. As per survey following are the vein imaging techniques.

IR Thermal Imaging-[17]

- Thermo graphic cameras detect radiation in the infrared range of the electromagnetic spectrum 9000–14000nm
- IR camera operate in wavelength14000nm
- Depends on the absolute T
- Nonzero temperature object emits all wavelength
- Get true thermal images under certain circumstances possible by (NIR), and CCTV camera
- Expensive

IR Imaging-[7]

- The infrared radiation is defined by having the wavelength 0.7 - 300 micrometers.
- Superficial human veins have higher temperature than the surrounding tissues
- Sensitive to humidity and temperature of surrounding
- Preferred for in-hand dorsa and finger vein imaging.

Near Infrared Imaging-[7]

- The NIR light is not thermal it is based on photobiology
- Wavelength is between about 700 nm to 1400 nm.
- CCD camera to capture images in which vein appears darker.
- Not deep penetration hence will recognize the superficial veins
- It is a non invasive technique.
- Not a temperature based technique
- Preferred in all veins imaging in hand.

NIR Laser-[11]

- Based on the light source NIR laser(Wavelength =830nm) IR pass filter and NIR CCD
- Laser Line generator-To make line laser from spot laser
- Evenly distribution of power along the laser line.
- The incident light laser barely diffract within 5-10cm
- IR pass filter filtered the transmitted light through finger
- Expensive

IV. principle OF VEIN acquisition

Haemoglobin in the blood of human tissue absorb the infrared light of wavelength 700nm ~ 1000nm and penetrate the finger [14]. NIR light is absorbed in the forward direction is look in darkener. NIR light scattered in all directions in skin look like lighter. The absorbed and scattered pattern is captured by CCD .The tip of finger is kept in such a way that the middle finger knuckle is exactly on the NIR led circuit. When the light is pass through the finger adjust the camera in such a way that it will capture the exact vein patter from upper to lower knuckle of finger [8]. The tip of finger is nail where no vein pattern the interested part is from the upper to lower knuckle of finger out of this part the upper is just near the nail hence less chances of vein pattern while lower part of finger is occupied by ring. The most details of vein pattern are present from lower to middle knuckle of finger. When the NIR light passes through the finger the human tissue absorbed the light shows darker than the other part is actually the vein pattern of that finger captured by the camera as shown in Fig.1.

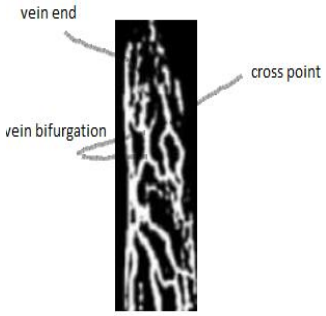

Fig.1 Finger vein pattern

V. Proposed Finger vein acquisition DEVICE

The paper focuses the contactless, compact and inexpensive finger vein acquisition device The capturing device is not fully developed it is in process of stage 1. It is based on the NIR Led of 750 nm and eyeball web camera as shown in fig.2.

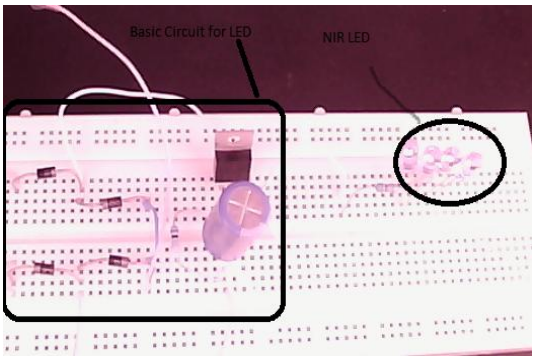

Fig. 2 Set up of proposed Finger vein capturing device Stage I.

The cost of actual CCD is high so CCD is replaced using the web camera without IR filter which is inexpensive. Each camera has the CCD and IR filter that block the infrared and gives natural image. Once the IR filter is removed from the web camera and click the picture it not gives true color image means it block the visible light and passes only infrared light [17]. After removing the IR filter from the web camera we have seen the small square component that is CCD.Then this web camera turning to IR camera i.e. Web cam without IR filter[18].There are two types of CCD i) TTL ii) CMOS here the web camera using the CMOS CCD that capture the actual vein pattern . Tip of Finger is kept exact on the NIR source that is LED connected in series when light is passes through the finger the web camera is adjusted in such a way that it will capture most informative region that is approximately up to middle part of knuckle as shown in fig. 3.

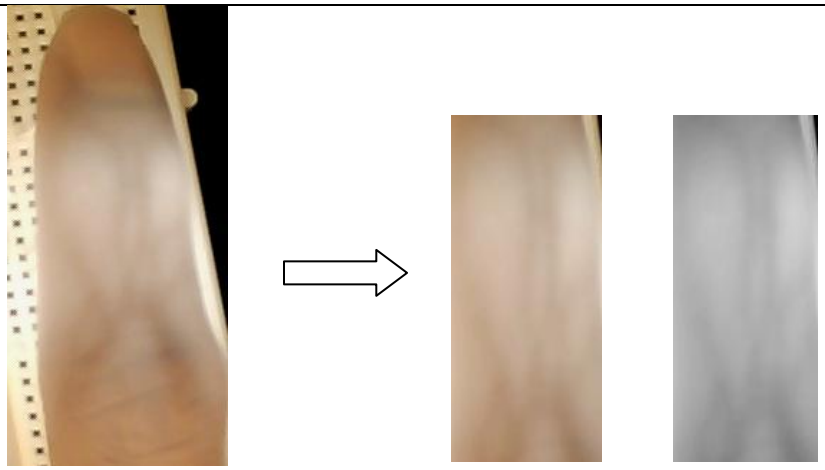

Fig.3 Captured vein pattern of right index finger

One important point we observed that when camera location is fixed the thick finger gives better vein pattern as compare to thin finger. Hence camera location should be adjusting that can gives better vein pattern for all types of finger. Proposed device is based on NIR led and NIR webcam because NIR LED have been secure for human eye exposure. Not possibility of threats to human tissue, not carry the risks due to powerful burst [8]. NIR capture the exterior vein pattern not deep penetration. IR radiation from human body and environment prevented by light within the near infrared region.

Vein pattern is sensitive to orientation and thickness of finger. But it can be overcome by proper location of camera and fixed size unit on which finger is located. Full capturing device of finger vein will take care of finger orientation and the global illumination level by adjust the exposition time of the camera in order to improve the vein visibility.

VI. FEATURE OF FINGER VEIN

Naoto Miura, Akio Nagasaka, Takafumi Miyatake extract the vein pattern using line tracking method and showed the equal error rate was 0.145% in personal identification [3]. Method that extracts the centrelines of the veins consistently regardless in vein width and brightness, experimental result showed that error equal error rate was 0.0009%, which is much better than that of conventional methods [16]. Feature extraction from low quality of finger vein using wide line gives precise width information of the vein and increase the information of the extracted feature a new pattern normalization model reduce the distortion. Method shows advantages with the low quality data for authentication system [14]. Finally, to improve the reliability of identification, finger-vein features are extracted in Gabor transform domain, and a fusion scheme in decision level is adopted. Experimental results demonstrated that the proposed method performs well in personal identification[15].A new finger vein IR capturing device and feature extraction regardless of thickness or brightness method using gradient normalization, principal curvature calculation, and binarization have implemented and demonstrated improvement as compared with the existing methods[13]. Duque Vehils, Jose Miguel proposed vein capturing device based on the NIR based light source and camera. Feature extraction using the segmentation and thinning algorithm using 8 Kernel and proved that more than one samples improved accuracy [6]

As per literature survey it is proved that the finger vein recognition is more reliable and secure than the conventional modality but the error equal rate is not equal to zero. We are going to implement the feature extraction of finger vein in wavelet domain and will obtain the less EER as compare to conventional feature extraction technique. We have already implemented wavelet domain on finger knuckle and showed better performance.

VII. ACKNOWLEDGEMENTS

The author would like to thank the Kailash Sharma for technical suggestions and staff of the organization for database collection.

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