

## ABSTRACT

Vein patterns can be used for accessing, identifying, and authenticating purposes. In this work, an image acquisition system is implemented in order to acquire digital images of people hands in the NIR. The system consists of a CCD camera and an IR light source. The enhancement of acquired images is achieved by spatial filters. After that, adaptive thresholding and mathematical morphology operations are used in order to obtain the distribution of vein patterns. The above process is focused on people recognition through of images of their palm-dorsal distributions obtained from the near infrared light. The classification task is achieved using Artificial Neural Networks.

### IMAGE ACQUISITION SYSTEM PROPOSED



Image acquisition system of the palm and back of the hand vein distribution.

### ROI EXTRACTION

Steps to calculate the ROI:

1. Calculation of the centroid of the palm and back of hand.

$$cx = \frac{m_{10}}{m_{00}}, \quad cy = \frac{m_{01}}{m_{00}}$$

2. Obtaining points E1, E2, E3, E4.

$$E1 = cy - d2$$

$$E2 = cx - d1$$

$$E3 = cy + d2$$

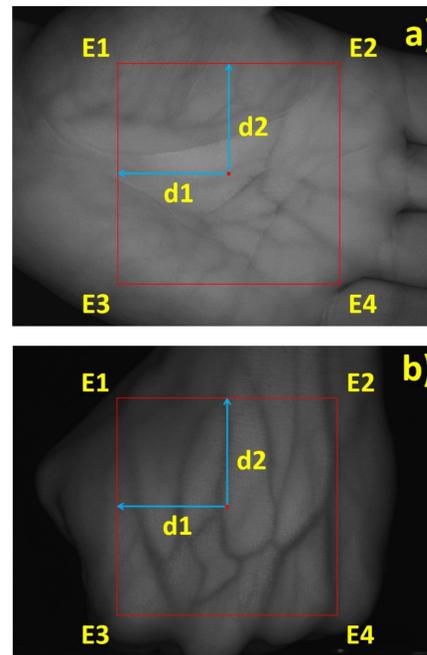
$$E4 = cx + d1$$

3. ROI extracted

$$ROI = (E1, E3) (E2, E4)$$

a) ROI of the palm.

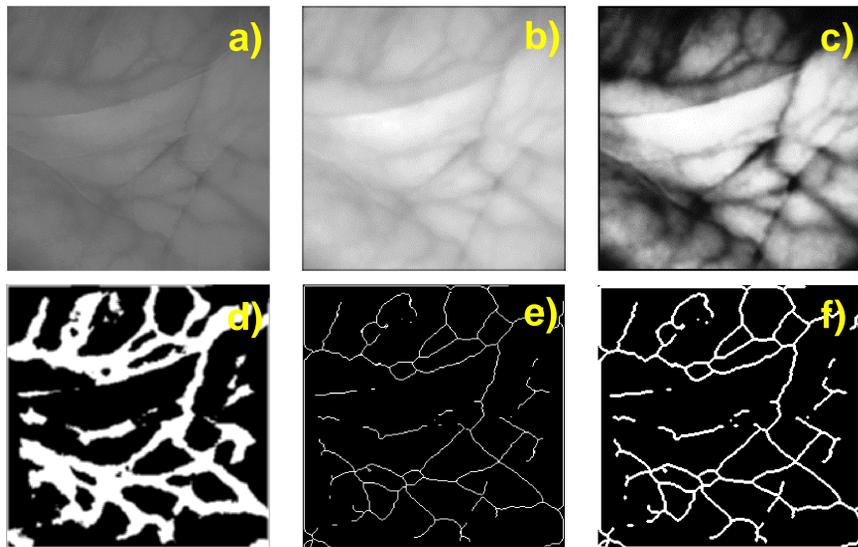
b) ROI from the back of the hand.



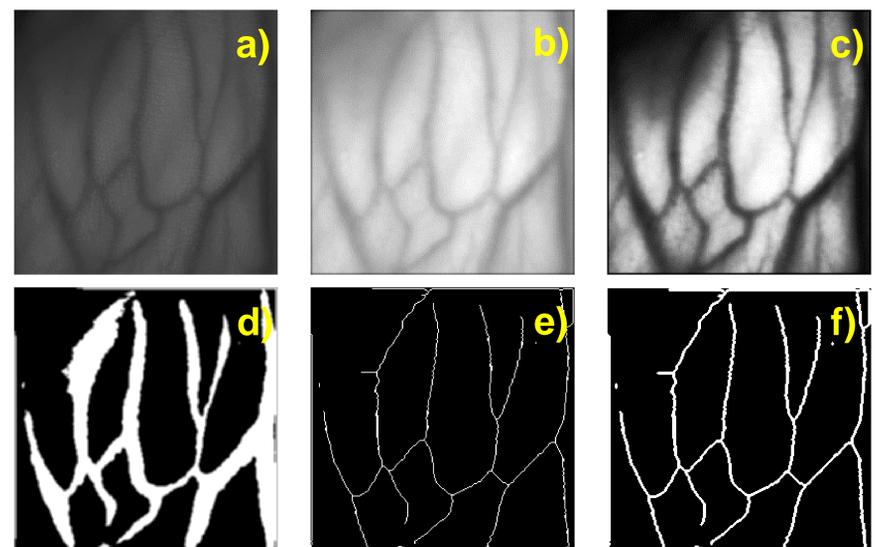
### PRE-PROCESSING OF ACQUIRED IMAGES

The pre-processing of acquired images is given by: a) ROI extracted for the original image, b) Spatial filtering, c) Histogram Equalization, d) Adaptive binarization, e) Thinning and f) Dilation.

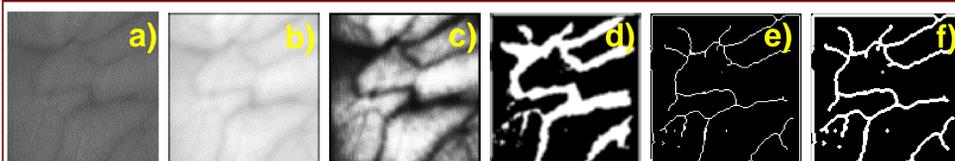
#### PALM VEIN DISTRIBUTION



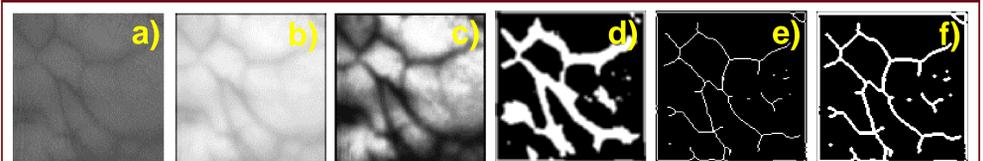
#### BACK OF THE HAND VEIN DISTRIBUTION



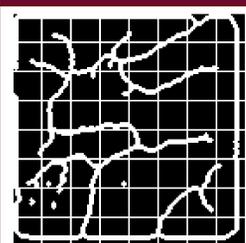
#### SUBJECT 1



#### SUBJECT 2



### FEATURE EXTRACTION



$$VeinCode = \begin{cases} 1 & \text{if } Np \geq \delta \\ 0 & \text{other case} \end{cases}$$

$$m_{pq} = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} x^p y^q f(x,y) \quad p, q = 0, 1, 2, \dots$$

### CLASIFICATION RESULTS USING ANN

# Of People	Geometric Moments	Hu Moments	VeinCode Method
	Correct Classification	Correct Classification	Correct Classification
25	72 %	16.33 %	98.33 %
50	55.67 %	9 %	96.5 %
100	49.92 %	6.25 %	96.17 %
150	45 %	5.06 %	95.72 %
200	---	---	94.83 %

### CONCLUSIONS

Near infrared images were processed for people recognition using the vein distribution as unique pattern to each person. We implemented an algorithm for ROI extraction and feature extraction. For 200 people with 12 versions each one and 64 descriptors, were used 2400 test images of the palm of the hand giving a percentage of correct classification of 94.83%, from VeinCode method.

### REFERENCES

- [1] Qiushi Zhao, Wei Bu, Xiangqian Wu, and David Zhang, "Design and implementation of a contactless multiple hand feature acquisition system," Proc. Of SPIE vol. 8371, 2012.
- [2] Lingyu Wang, Graham Leedham and David Siu-Yeng Cho, "Minutiae feature analysis for infrared hand vein pattern biometrics," Pattern Recognition, vol. 41, pp. 920-929, 2008.
- [3] Yun-peng Hu, Zhi-yong Wang, Xiao-ping Yang and Yu-ming Xue, "Hand vein recognition based on the connection lines of reference point and feature point," Infrared Physics & Technology, vol. 62, pp. 110-114, 2014.