



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكروفيلم

# بسم الله الرحمن الرحيم



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# شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



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# جامعة عين شمس

## التوثيق الإلكتروني والميكروفيلم

### قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها  
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



### يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



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# **Developing a Smart Multimodal Biometric Authentication System based on Hand Vein**

A Thesis submitted to the Department of Computer Science,  
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*Mona Abdel-Aziz*





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# Abstract

Because of the uniqueness and complication of hand vein patterns the hand vein authentication gives a great level of recognition accuracy. The hand vein patterns are inside the body so that it can be a challenging technique to forge. Moreover, the system is contactless and hygienic for operate in society regions. The contactless hand vein recognition technology comprises of image sensor and software technology. The user's hand is hold under an infrared ray scanner to capture an image of hand. The illumination of the infrared beam is limited relying on the light round the sensor, and the sensor is capable of take the hand image in spite of the location and movement of the hand. Afterward, the software compares the decoded vein image with the enrolled images, though determining the location and alignment of the hand by a pattern matching technique.

This research reports a novel multimodal biometric system employing intelligent technique to authenticate human by fusion of dorsal hand, palm and finger veins pattern alternately. By explains an image analysis technique to detect the region of interest (ROI) from hand vein image. Once detecting ROI, construct a series of preprocessing steps for eliminate the transformation and rotation of hand vein images presented in the data gathering procedure and decrease several data quantity devoid of missing any effective information this stage done by used canny edge detector, dilation filter and erosion filter. Next construct a series of preprocessing steps to improve the contrast among hand vein patterns and background using median filter, 2D Wiener filter, Applied Contrast Limited Adaptive Histogram Equalization (CLAHE) filter and Homomorphic filter. Once hand vein pattern extracted it managed to obtain the features to use them in matching stage. This study use



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Principal Component analysis (PCA) algorithm to extract features. In matching step K-nearest neighbor (KNN) classifier with the Euclidian distance used as a similarity measure by one-to-one match method. Bosphorus Hand Vein Database, CASIA Multi-Spectral Palmprint Image Database V1.0 (CASIA database) and the Shandong University Machine Learning and Applications - Homologous Multi-modal Traits (SDUMLA-HMT) databases used in experiments in this study. Finally, fusion methodology adopted at the decision level which is a post-classification method, and it follows the AND rule. It compared the accuracy of the three unimodal (dorsal hand, palm and finger veins) and the four multimodal (fusion of finger and dorsal hand, fusion of palm and dorsal hand, fusion of palm and finger and fusion of dorsal hand, palm and finger veins) and the results showed that the fusion of dorsal hand, palm and finger veins has the best accuracy with correct recognition rate (CRR) 99.21%.

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# List of Abbreviations

## Acronyms

2D

ACO

ATM

AUC

CASIA

CCD

CCL

CDF

CED

CFS

CLAHE

CN

CRR

DNA

DoG

DWT

EER

FAR

FMR

FNMR

FRR

GAR

HD

HoG

HTML

ID

IGMF

IoT

IS

KNN

LBPH

LPV

LDPC

LEDs

## Terms

Two Dimensional

Ant Colony Optimization

Automatic Teller Machine

Area Under Curve

Central Asia Student International Academic

Charge Coupled Device

Connected Component Labeling

Cumulative Distribution Function

Canny Edge Detector

Correlation based Feature Selection

Contrast Limited Adaptive Histogram Equalization

Crossing Number

Correct Recognition Rate

Deoxyribonucleic Acid

Difference of Gaussian

Discrete Wavelet Transform

Equal Error Rate

False Accept Rate

False Matching Rate

False Non-Matching Rate

False Rejection Rate

Genuine Acceptance Rate

Hamming Distance

Histogram of Gradients

Hyper Text Markup Language

Identification

Improved Gaussian Matched Filter

Internet of things

Information System

K-nearest neighbor

Local Binary Patterns Histograms

Local Binary Patterns Variance

Low Density Parity Check

Light-Emitting Diodes

LLBP	Local Line Binary Pattern
LPQ	Local Phase Quantization
LRE	Local Ridge Enhancement
LRT	Localized Radon Transforms
MAD	Mean Absolute Deviation
MCP	Maximum Curvature Points
MLBP	Monogenic Local Binary Pattern
MMSE	Minimum Mean-Square Error
NIR	Near-infrared
OS	Operating system
PC	Personal Computer
PCA	Principal Component Analysis
PIN	Personal Identification Number
ROI	Region of Interest
SDUMLA-HMT	Shandong University Machine Learning and Applications - Homologous Multimodal Traits
SE	Structuring Element
SIFT	Scale Invariant Feature Transform
SMR	Spectral Minutiae Representation
SRC	Sparse Representation Classifier
SVM	Support Vector Machine
VP	Vein Pattern
VW	Visible Wavelength
WEF	Wavelet Energy Calculation