

CERTIFICATE

I certify that the thesis entitled “**Finger Vein Biometric Authentication using Deep Learning Techniques with Hybrid Labelling and Data Augmentation**” submitted for the degree of **Doctor of Philosophy (Ph.D.) in Computer Science and Engineering** is the record of the research work carried out by **Mrs. Amitha Mathew (18PHEOP002)** during the period of her study from **January 2019 to May 2025** in the Department of Computer Science and Engineering at Avinashilingam Institute of Home Science and Higher Education for Women Coimbatore under my guidance and supervision, and the thesis has not formed the basis for the award of any Degree / Diploma / Associateship / Fellowship or other similar titles of any candidate of this institute or any other University / Institution of Higher Learning.


Signature of the HoD
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Signature of the Supervisor


Signature of the Dean

DECLARATION

I, **Mrs. Amitha Mathew** hereby declare that the thesis entitled “**Finger Vein Biometric Authentication using Deep Learning Techniques with Hybrid Labelling and Data Augmentation**” submitted to the Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, in partial fulfillment of the requirements for the award of the **Degree of Doctor of Philosophy (Ph.D.) in Computer Science and Engineering** is a record of original and independent research work *carried out by me during the period from **January 2019 to May 2025** under the guidance of **Dr. P. Amudha B. E., M. Tech., Ph. D**, Professor, Department of Computer Science and Engineering, School of Engineering, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore and has not formed the basis for the award of any degree / Diploma / Associateship / Fellowship or any other similar titles in this Institute or any other University / other similar Institution of Higher Learning.


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Signature of the Supervisor


22/5/2025

Signature of the Candidate

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LIST OF ABBREVIATIONS

akNCN	Adaptive K-Nearest Centroid Neighbour
AUC	Area Under the Curve
BMP	Bitmap Image
CASA	Convolution and Self-Attention
CCD	Charge-coupled device
CLHE	Contrast Limited Histogram Equalization
CMOS	Complementary Metal Oxide Semiconductor
CNN	Convolutional Neural Networks
CNN-CO	Convolutional Neural Networks -Competitive Order
DBC	Discriminative Binary Codes
DBN	Deep Belief Network
DCT	Discrete Cosine Transform
DenseNet	Densely Connected Convolutional Networks
DL	Deep Learning
DNN	Deep Neural Network
DSP	Digital Signal Processing
EER	Equal Error Rate
ELM	Extreme Learning Machine
F1 Score	Fidelity Measure
FAR	False Acceptance Rate
FBF	Feature Block Fusion
FCL	Fully Connected Layer
FCN	Fully Convolutional Networks
FPR	False Positive Rate
FRAB	Fusion Residual Attention Block
FRR	False Rejection Rate
FV	Finger Vein
FV-GAN	Finger Vein - Generative Adversarial Networks
FVR	Finger Vein Recognition
cGAN	Conditional Generative Adversarial Networks
GAP	Guided Attention Path

GLCM	Gray Level Co-occurrence Matrix
GLLBP	Generalized Local Line Binary Pattern
GNN	Graph Neural Networks
GWO-SVM	Grey Wolf Optimization-based SVM
HOG	Histograms of Oriented Gradients
KNN	k-Nearest Neighbours
LBC	Local Binary Convolution
LBP	Local Binary Patterns
LDC	Local Directional Code
LDP	Local Directional Pattern
LEBP	Local Enhanced Binary Pattern
LMC	Local Maximum Curvature
LPQ	Local Phase Quantization
LSTM	Long Short-Term Memory
L-VGG16	Labelled- VGG16
LA-VGG16	Labelled-Augmented VGG16
MRAC	Multistage Residual Attention Connection
MSE	Mean Square Error
MSRC	Mutual Sparse Representation Classification
MVP	Main Vein Path
NIR	Near InfraRed
ONPP	Optimal Neighbourhood Preserving Projections
PCA	Principal Component Analysis
ReLU	Rectified Linear Unit
ResNet	Residual Neural Network
RGB	Red, Green, Blue
RLT	Repeated Line Tracking
RMSE	Root Mean Square Error
RNN	Recurrent Neural Networks
ROC	Receiver Operating Characteristic
ROI	Region of Interest
SAM	Spectral Angle Mapper or Spectral Similarity Measurement
SDUMLA-HMT	Shandong University Homologous Multi-modal Traits Database

SIFT	Scale-Invariant Feature Transform
SRC	Sparse Representation Classification
SSIM	Structural Similarity Index Measurement
SVD	Singular Value Decomposition
SVM	Support Vector Machines
THUFV	Tsinghua University Finger Vein
TPR	True Positive Rate
UNET	U shaped Network
VAE	Variational Autoencoders
VGG	Visual Geometric Group
VIF	Visual Information Fidelity
WLD	Wide Line Detector
