

## CERTIFICATE

This is to certify that the Thesis entitled “An Optimized Convolutional Neural Network-based Ensemble Classification and Regression Framework for Classifying the Stages of Diabetic Retinopathy” submitted to Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, in partial fulfilment of the requirements for the award of the **Degree of Doctor of Philosophy in Computer Science**, is a record of original research work done by **Valarmathi. S** during the period of her study in the Department of Computer Science at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, under my Supervision and Guidance and the thesis has not formed the basis for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar titles to any candidate of any University.

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## DECLARATION

I, Valarmathi S, hereby declare that the thesis entitled “**An Optimized Convolutional Neural Network-based Ensemble Classification and Regression Framework for Classifying the Stages of Diabetic Retinopathy**” submitted to Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, in partial fulfilment of the requirements for the award of the **Degree of Doctor of Philosophy in Computer Science**, is a record of original research work done by me during the period of my study under the Supervision and Guidance of **Dr. (Mrs.) R. Vijayabhanu, MCA, M.Phil., Ph.D.**, Assistant Professor (SG), Department of Computer Science at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, and it has not formed the basis for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar titles to any candidate of any University.

  
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## LIST OF ABBREVIATIONS

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ABBREVIATION	DESCRIPTION
<b>DL</b>	Deep Learning
<b>DR</b>	Diabetic Retinopathy
<b>CNN</b>	Convolutional Neural Network
<b>MSA</b>	Multi-Scale Attention
<b>ResNet</b>	Residual Neural Network
<b>GAN</b>	Generative Adversarial Network
<b>MLP</b>	Multilayer Perceptron
<b>MBA</b>	Mine Blast Algorithm
<b>OD</b>	Optic Disc
<b>CAD</b>	Computer Aided Design
<b>SVM</b>	Support Vector Machine
<b>KNN</b>	K-Nearest Neighbor
<b>ML</b>	Machine Learning
<b>NN</b>	Neural Networks
<b>DNN</b>	Deep Neural Networks
<b>BP</b>	Back-Propagation
<b>FC</b>	Fully Connected
<b>ReLU</b>	Rectified Linear Unit
<b>BN</b>	Batch Normalization
<b>SM</b>	Soft Max
<b>ILSVRC</b>	ImageNet Large Scale Visual Recognition Challenge
<b>MA</b>	Microaneurysms
<b>HE</b>	Hemorrhages

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<b>ABBREVIATION</b>	<b>DESCRIPTION</b>
<b>EXs</b>	Exudates
<b>DWT</b>	Discrete Wavelet Transform
<b>K-SVD</b>	K-Singular Value Decomposition
<b>DWT_K-SVD</b>	Discrete Wavelet Transform with K-Singular Value Decomposition
<b>HE</b>	Histogram Equalization
<b>AHE</b>	Adaptive Histogram Equalization
<b>CLAHE</b>	Contrast Limited Adaptive Histogram Equalization
<b>GB</b>	Gradient Boosting
<b>RF</b>	Retinal Fundus
<b>MSFP</b>	Multi-Scale Feature Pyramid
<b>MSA-ResNetGB</b>	Multi-Scale Attention-based Residual Network with Gradient Boosting
<b>ASPP</b>	Atrous Spatial Pyramid Pooling
<b>SGAN-ECR</b>	Special Generative Adversarial Network with Ensemble Classification Regression
<b>SGAN-OECR</b>	Special Generative Adversarial Network with Optimized Ensemble Classification Regression
<b>APTOS</b>	Asia Pacific Tele-Ophthalmology Society
<b>IDRiD</b>	Indian Diabetic Retinopathy Image Dataset
<b>GPU</b>	Graphics Processing Unit
<b>DME</b>	Diabetic Macular Edema
<b>NPDR</b>	Non-Proliferative Diabetic Retinopathy
<b>PDR</b>	Proliferative Diabetic Retinopathy
<b>MSE</b>	Mean Square Error
<b>PSNR</b>	Peak Signal-to-Noise Ratio
<b>SSIM</b>	Structural Similarity Index Measure

<b>ABBREVIATION</b>	<b>DESCRIPTION</b>
<b>WF</b>	Wiener Filter
<b>GOMP</b>	Greedy Orthogonal Matching Pursuit
<b>db2</b>	Daubechies 2
<b>IDWT</b>	Inverse Discrete Wavelet Transform
<b>BE</b>	Blood Vessel Enhancement
<b>CDF</b>	Cumulative Distribution Function
<b>BS</b>	Block Size
<b>CL</b>	Clip Limit
<b>dB</b>	Decibel
<b>TP</b>	True Positive
<b>TN</b>	True Negative
<b>FP</b>	False Positive
<b>FN</b>	False Negative
<b>IR</b>	Instance Regularization
<b>MBOA</b>	Mine Blast Optimization Algorithm
<b>EMBOA</b>	Enhanced Mine Blast Optimization Algorithm