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Incorporating Separable CNN in Inception Network with Residual Learning for Enhanced Breast Cancer Classification

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Abstract

Breast cancer is a critical global health issue requiring accurate and timely diagnosis. This project aims to enhance breast cancer diagnosis using an advanced deep learning model integrating **VGG16, Inception, ResNet, and CBAM attention mechanism.** Utilizing the **BreaKHis_400X** dataset from Kaggle, the model was designed and optimized through comparative analysis and trained with various optimizers and epochs. The resulting model achieved impressive performance metrics, including **96.4%** accuracy, **0.96** sensitivity, **0.97** specificity, **0.974** precision, **0.971** F1 score, and **0.968** recall**.** These results highlight the model's efficacy in diagnosing breast cancer from histopathological images, promising improved diagnostic accuracy and treatment outcomes, thereby reducing the global burden of breast cancer.

Test Result

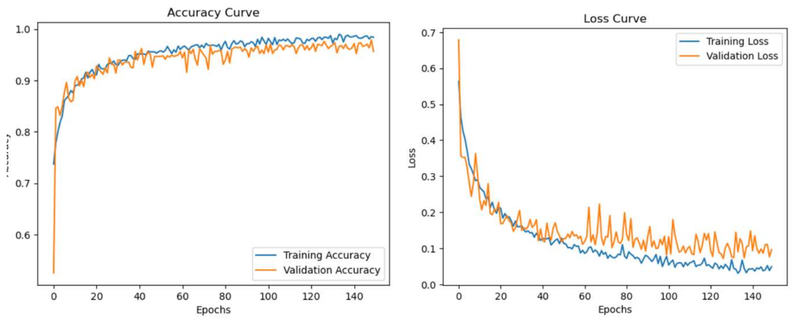


Fig.1 Valid Acc = 95.5% and Valid Loss = 0.11

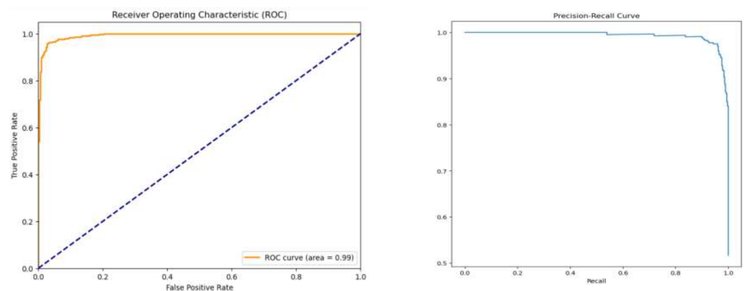


Fig.2 ROC and Precision-Recall Curve

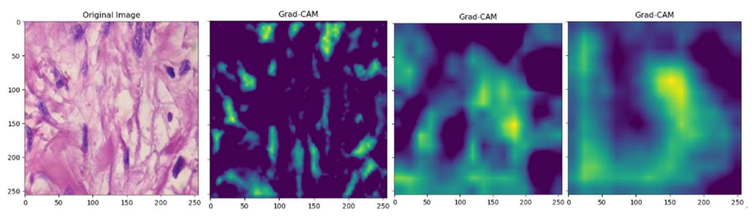


Fig.3 Grad-CAM from attention layer (from shallow to deep)

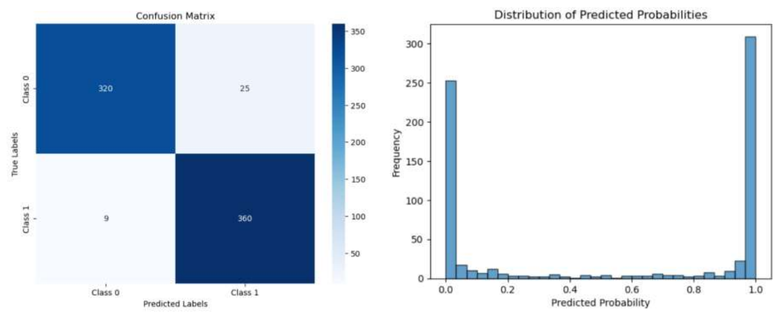
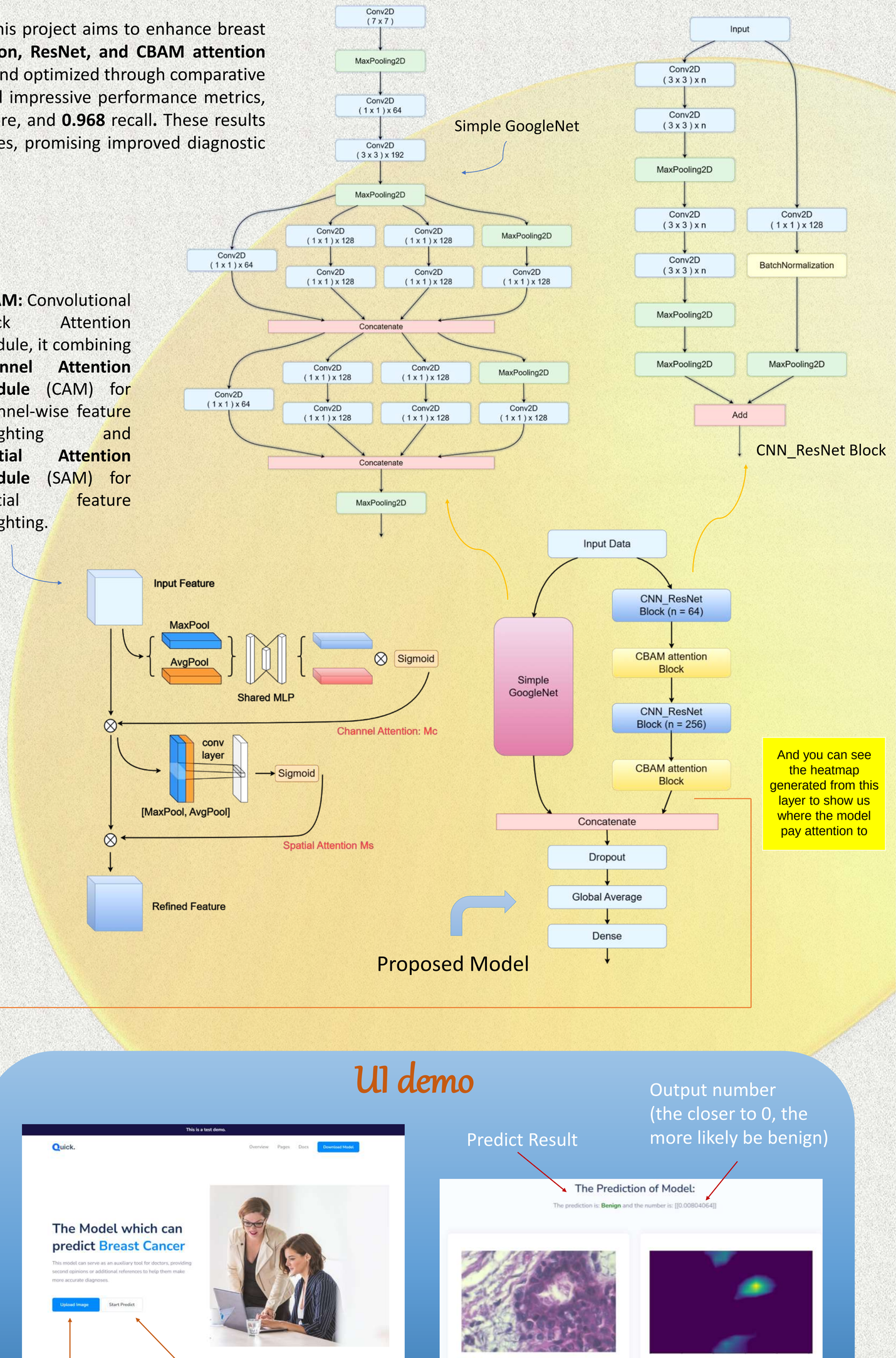


Fig.4 Confusion matrix and Distribution of Prediction

AI Model	Recall	Precision	Sensitivity	Specificity	Accuracy
DenseNet121 [6]	66.96	57.95	-	-	66.96
EfficientNetB5 [6]	66.83	56.55	-	-	66.83
SCAE_maxpooling [1]	-	-	-	-	81.88
SCAE_avg [1]	-	-	-	-	80.13
DenseNet_with_DFT [2]	-	-	92.13	91.40	94.34
ResNet_with_DFT [2]	-	-	95.26	92.75	96.03
Wang et. al. [3]			94.31	93.03	93.54
Adeshina et. al [4]			76.67	63.36	91.54
Spanhol et. al [5]			-	-	85.10
Proposed Model	96.81	97.43	96.80	97.74	96.49

Table.1 Compare to related work



UI demo

Choose image

Start Predict process with the image selected

Predict Result

Output number (the closer to 0, the more likely be benign)

Selected image

Heatmap of that image

Future work

Optimize Model Performance: Refine architecture, explore advanced algorithms, and experiment with data augmentation.
Enhance Generalizability: Validate across diverse datasets and medical contexts for robustness.
Validate Real-World Performance: Collaborate with healthcare institutions for clinical trials and practical validation.

Conclusion

In conclusion, this project has made a contribution to the field of AI-assisted medical diagnosis by developing a highly accurate deep learning model for breast cancer classification. The success of the proposed model lays the foundation for further research and development in this area. It is believed that early detection of the disease through such models can significantly reduce resource wastage and improve patient survival rates

Reference

[1] Haryoko, E Seniwati, T. B. Sasongko, A Lukman and F. A. Gunawan, "Stacked Convolutional Autoencoder (SCAE) for Breast Cancer Classification," 2023 International Conference on Informatics, Multimedia, Cyber and Informations System (ICIMCIS), Jakarta Selatan, Indonesia, 2023, pp. 410–414, doi: 10.1109/ICIMCIS60089.2023.10349046.
[2] A A Adeniyi and S. A Adeshina, "Automatic Classification of Breast Cancer Histopathological Images Based on a Discriminatively Fine-Tuned Deep Learning Model," 2021 1st International Conference on Multidisciplinary Engineering and Applied Science (ICMEAS), Abuja, Nigeria, 2021, pp. 1–5, doi: 10.1109/ICMEAS52683.2021.9692303.
[3] P. Wang, J. Wing, Y. Li, P. Li, L. Li and M Jiang, "Automatic Classification of Breast cancer histopathology images based on deep fusion and enhanced routing", Elsevier:Biomedical Signal Processing and Control, no. 65, 2021.
[4] S. A Adeshina, A P. Adedigba, A A Adeniyi and A. M Aibinu, "Breast Cancer Histopathology Image Classification with Deep Convolutional Neural Networks," 2018 14th International Conference on Electronics Computer and Computation (ICECCO), Kaskelen, Kazakhstan, 2018, pp. 206–212, doi: 10.1109/ICECCO.2018.8634690.
[5] F. A Spanhol, L. S. Oliveira, C. Petitjean and L. Heutte, "Breast cancer histopathological image classification using Convolutional Neural Networks," 2016 International Joint Conference on Neural Networks (IJCNN), Vancouver, BC, Canada, 2016, pp. 2560–2567, doi: 10.1109/IJCNN.2016.7727519.
[6] A Gautam and S. K Singh, " Analysis of Deep Learning Models to Detect Breast Cancer from Histopathology Images," TENCON 2023 – 2023 IEEE Region 10 Conference (TENCON), Chiang Mai, Thailand, 2023, pp. 438–443, doi: 10.1109/TENCON58879.2023.10322406.