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Skin Lesion Classification using Transfer Learning

S. Naveen Prasad, E. Logesh, P. Kalpana

Sri Krishna College of Technology

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Abstract

The core module of this paper is the classification of skin lesions based on the Transfer Learning method. Malignant Skin lesions are one among the deadliest cancers in today's world. Analysis of the image dataset boosts the accuracy by a large amount for the classification of malignant skin lesions. The latest solution for classification of skin lesions is the use of a neural network, trained from huge amounts of data, but it greatly blocks the scalability of the neural network. The proposed method for classification of skin lesions is performed with labelled image dataset and EfficientNet as the base model to firmly represent discriminatory data from different visual perceptions.

Keywords: Deep Learning, Data Augmentation, EfficientNet.

1. Introduction

Melanomous Skin lesion is one of the deadliest cancers. Melanoma is the reason for 75% of cancer deaths, despite being a very rare skin cancer.

One of the most common dermatologist procedures is Dermoscopy. It aggravates the skin lesion and a dermatologist will be the first to detect it when he examines. Because it relies on the user's visual perception and experience, this method can only be utilised efficiently by competent physicians. These difficulties inspire scientists to devise novel methods for detecting and diagnosing skin lesions.

The automated method could help in quick and early diagnosis of the cancer which will help the patient's treatment to begin early. Thus in the clinical work of skin disorders, automatic skin lesion classification plays a significant role. Thus the proposed transfer learning method aims to differentiate melanoma skin cells with greater accuracy using Deep Learning. This proposed system integrates the various features required for classification and performs a detailed analysis on various aspects of the input and ensures finesse of the output and establishes appropriate results.

2. Associated Works

This section highlights the research on classification of skin lesions that have been proposed in the recent years, including several machine learning and deep learning.

A.Medical image analysis using CNN

This paper [3], which focuses on convolutional neural networks [1], suggests that machine-learning techniques are utilised in medical image processing and stresses the clinical aspects of the subject. "CNNs preserve spatial relationships when filtering input images and these spatial images are of crucial important in the radiology."(Justin Ker, 2017) The CNN takes a pixel input picture and transforms it using Convolution, Rectified Linear Unit and Pooling Layers before feeding it into the Fully Connected Layers (FC) [2] which results a score or probability. The advantage of this method is that CNN takes in raw input and preserve the spatial relationships. The disadvantage of this method is we have to build more and more layers and train more to produce a better model.

B. Computer aided detection using CNN based transfer learning

This paper [6] proposes that in transfer learning fine-tuned CNN models are used which are pretrained from natural image dataset and explored different CNN[4] architectures, Models with 5000 to 160 million parameters are checked out to see how dataset scales and the spatial picture context affected the performance and examined the transfer learning[5] from ImageNet. Two specific automated detection which are thoraco-abodomial lymph node detection and interstitial lung

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disease classification are studied and monitored. This approach has the benefit that when trained with more number of parameters it yielded early promising results. The disadvantage of this method is that it could easily overfit on the dataset.

C. Natural image denoising with convolutional networks

This paper [9] proposes two different approaches namely convolutional networks for image processing architecture [7] and an unsupervised learning method to synthesize images. The use of convolutional network is stated to be more superior in performance than the Markov random field (MRF) [8] method. A formula for image denoising to train the convolutional network with SGD learning method was formulated which was more capable learning method than the standard gradient learning method. The Berkeley segmentation database was used for testing the proposed denoising process. This approach has the benefit of being able to provide more accurate results and being able to be used to innovative kinds of pictures that have quite different statistics than natural images. The downside of this method is that it results in an architecture with more free parameters, making its performance harder to comprehend.

D. A deep learning-based computer-assisted diagnosis system for multiclass skin lesion classification

This paper [12] proposes a series of procedure where augmentation was performed at first and then the deep learning models are fine-tuned on the augmented [10] datasets and finally a modified serial-based technique. Features were retrieved and fusion was done and the fused vector was further refined by picking the best features using the skewness-controlled SVR approach. The proposed architectural model was evaluated on augmented HAM10000 dataset. The advantage of this method is the augmentation of the dataset and the use of ResNet-50 [11] in transfer learning helps greatly in models performance. The disadvantage is that this method lacks some fine-tuning and the accuracy for feature selection is only 91.7%.

E. Skin lesion classification with multi-view filtered transfer learning

The paper [15] proposes the use of two skin image datasets and one contains the annotated source domain with both domain and label and the second dataset is an unlabeled dataset. Multi-View Weighing representation was done which was followed by FDA. In filtered domain adaptation [13] a sequence of separate feature extractors are assigned and to enter the target code in the source feature field the source samples filtering was done and followed by "Source sample distilling strategy is proposed to select more valuable source samples" (Jianxiao Bian, 2021). Found the final forecast of the provided target picture skin lesion. AUC score of 91.8% [14] was reached. The advantage of this method is that it has source samples filtering and also uses multiple transfer learning models which would boost the models performance considerably when compared with the other traditional approaches.

3. Our Proposed Transfer Learning Method

Our proposed method is a transfer learning method with a base model as Efficient Net and images where hair is removed using different techniques so that the hair does not have a negative impact on our model and train these images with better hyperparameter tuning and training methods. This model can take a picture of a skin lesion and details about the patient can distinguish a skin lesion whether melanoma or not in a short period of time. We have trained our model with SIIM-ISIC Melanoma Classification 2020 dataset.

Figure 1 the proposed transfer learning method

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A. Analyzing data

The process of reviewing, cleaning, changing, and modelling data in order to extract usable data, inform conclusions, and help taking a decision is known as data analysis. Analysis of data has a variety of features and approaches, which include a variety of tactics referred by different names which are utilised in a variety of business, scientific, and social science fields. In today's corporate environment, data analysis is critical for making more scientific judgments and assisting firms in becoming more efficient. The splitting of everything into discrete sections for independent investigation is referred to as analysis. The process of gathering raw data and converting it into valuable information for decision-making is known as data analysis. Data analysis in this dataset showed us the missing values in different columns of the dataset and also on further data analysis on plotting columns like frequency of target variable(benign or malignant) which represented that the dataset is imbalanced and other plots like gender plot for target variable give an insight that males are more affected than females which helps in the preprocessing module to fill the null entries in the gender column with male, rather than filling a random or leaving it as a null value.

B. Data preprocessing

Data pre-processing can refer to manipulating or discarding data before it is used to verify or improve performance and is an essential procedure in the process of mining of data. Pre-processing of the data will help the training model to find better tuning parameters that will improve the test results of the model. Different data analyses performed in the previous module helped to fill the missing values in the gender column when we changed the input to the male as the male is more likely to get both melanoma and nonmelanoma skin lesions as in Figure 2. In the data analysis, we also found that the data was inconsistent which may affect our model during training so we can solve this problem by the data augmentation technique. Hair in the pictures of skin lesions adversely affected the model so we removed the hair from the photos by changing the threshold and image morphology as seen in the following figures.

Figure 2 Original hairy images

Figure 3 Modified hairy images

C. Training

The model was created with EfficientNet as a base model as so the Transfer Learning Technique. EfficientNet is a CNN architecture and scaling strategy that scales all depth, breadth, and resolution dimensions using a compound coefficient. With EfficientNet as a base model when input parameters reach our custom built-in model, it will have important features that we need to train so the efficiency of the model will be greatly increased. The model is trained in the K-Fold method where different data encoding is used as model input so that we can avoid overfitting and create a more efficient model.

D. Evaluation

1. Datasets

The proposed method is tested using the ISIC 2020 melanoma dataset created by the International Skin Imaging Collaboration, found on kaggle.

2. Evaluation metrics

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The accuracy, sensitivity, specificity, and AUC-ROC curve are used as assessment measures in this paper to assess the performance of our proposed network.

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{FN} + \text{TN} + \text{FP}}$$

$$\text{AUC} = \int_0^1 \text{tpr (fpr)dfpr} = \text{P}(\text{X1} > \text{X0})$$

Where FN is False Positive, TP is True Positive, FP is False positive, TN is True Negative and FPR is False Positive Rate and TPR is True Positive Rate represent the true positive rate and false positive rate, the confidence ratings for a negative and positive samples are X0 and X1.

4. Results

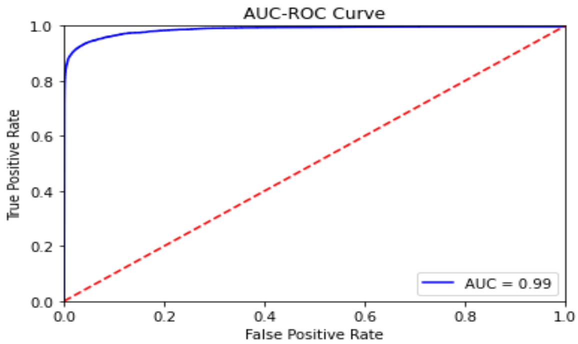

Figure 4 AUC-ROC Curve

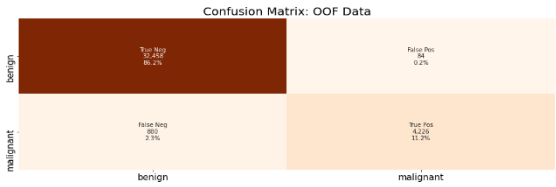

Figure 5 Confusion Matrix

The AUC-ROC score is 98.65 and we can also visualize the AUC-ROC curve which can be seen in Figure 4 and the confusion matrix can be seen in Figure 5.

5. Conclusion

In this work, we have presented a transfer method based on the study of melanoma skin lesions in medical imaging. We have built the Efficient Net Transfer Learning network, which has shown good results in the classification of the lesions. An important architectural aspect of the network is it exploits information from different image views and chooses useful source samples without negative effects from the source domain. To test it we used the ISIC 2021 dataset available to the public at Kaggle. To validate the algorithms, we used the AUC-ROC curve since it measures the ability of the classifier to distinguish between the classes, and more the AUC-ROC score more the model is good at classification. Our proposed model has a score of 98.35% as stated in Figure 4. In contrast to current approaches, our suggested method swiftly and accurately identifies and segments the melanoma skin lesion.

References

[1]. Litjens, Geert, et al. "A survey on deep learning in medical image analysis." *Medical image analysis* 42 (2017): 60-88.
[2]. O. Russakovsky et al., "ImageNet large scale visual recognition challenge", *Int. J. Comput. Vis.*, vol. 115, no. 3, pp. 211-252, Dec. 2015.
[3]. Ker, Justin, et al. "Deep learning applications in medical image analysis." *Ieee Access* 6 (2017): 9375-9389.
[4]. Y. LeCun, L. Bottou, Y. Bengio and P. Haffner, "Gradient-based learning applied to document recognition", Proc. IEEE, vol. 86, no. 11, pp. 2278-2324, Nov. 1998.
[5]. R. Girshick, J. Donahue, T. Darrell and J. Malik, "Region-based convolutional networks for accurate object detection and semantic segmentation", IEEE Trans. Pattern Anal. Mach. Intell., vol. 38, no. 1, pp. 142-158, Jan. 2016.
[6]. Shin, Hoo-Chang, et al. "Deep convolutional neural networks for computer-aided detection: CNN architectures, dataset characteristics and transfer learning." *IEEE transactions on medical imaging* 35.5 (2016): 1285-1298.
[7]. Y. LeCun, B. Boser, J.S. Denker, D. Henderson, R.E. Howard, W. Hubbard, L.D. Jackel. Backpropagation Applied to Handwritten Zip Code Recognition. Neural Computation, 1989.
[8]. S. Roth. High-order markov random fields for low-level vision. PhD Thesis, Brown Univ., 2007.
[9]. Jain, Viren, and Sebastian Seung. "Natural image denoising with convolutional networks." *Advances in neural information processing systems* 21 (2008).
[10]. H. Younis, M. H. Bhatti, and M. Azeem, "Classification of skin cancer dermoscopy images using transfer learning," in *Proceedings of the 2019 15th International Conference on Emerging Technologies (ICET)*, pp. 1–4, Peshawar, Pakistan, 2019.
[11]. J.-A. Almaraz-Damian, V. Ponomaryov, S. Sadovnychiy, and H. Castillejos-Fernandez, "Melanoma and nevus skin lesion classification using handcraft and deep learning feature fusion via mutual information measures," *Entropy*, vol. 22, no. 4, p. 484, 2020.
[12]. Arshad, Mehak, et al. "A Computer-Aided Diagnosis System Using Deep Learning for Multiclass Skin Lesion Classification." *Computational intelligence and neuroscience* 2021 (2021).
[13]. I. J. Goodfellow, J. Pouget-Abadie, M. Mirza, B. Xu, D. Warde-Farley, S. Ozair, et al., "Generative adversarial nets", *Proc. Adv. Neural Inf. Process. Syst. Annu. Conf. Neural Inf. Process. Syst.*, pp. 2672-2680, 2014.
[14]. N. C. F. Codella, D. Gutman, M. E. Celebi, B. Helba, M. A. Marchetti, S. W. Dusza, et al., "Skin lesion analysis toward melanoma detection: A challenge at the 2017 international symposium on biomedical imaging (ISBI) hosted by the international skin imaging collaboration (ISIC)", *Proc. IEEE 15th Int. Symp. Biomed. Imag. (ISBI)*, pp. 168-172, Apr. 2018.
[15]. Bian, Jianxiao, et al. "Skin Lesion Classification by Multi-View Filtered Transfer Learning." *IEEE Access* 9 (2021): 66052-66061.
[16]. Naeem, Ahmad, et al. "Malignant melanoma classification using deep learning: datasets, performance measurements, challenges and opportunities." *IEEE Access* 8 (2020): 110575-110597.
[17]. Devi, S. S., Anto, S., & Ibrahim, S. S. (2021). An efficient document clustering using hybridised harmony search K -means algorithm with multi-view point. International Journal of Cloud Computing, 10(1-2), 129-143.
[18]. Kalpana, P., Vignesh, S. S., Suriya, L. M. P., & Prasad, V. V. (2021, May). Prediction of Heart Disease Using Machine Learning. In Journal of Physics: Conference Series (Vol. 1916, No. 1, p. 012022). IOP Publishing.
[19]. Devi S S and Shanmugam A 2014 Hybridisation Journal of K - means and harmony search method for text clustering using concept factorization. International Journal of Physics: Conference Series (Vol. 1916, No, 1, p. 012235). IOP Publishing.
[20]. Kumar, A. S., Kalpana, P., Athithya, K. S., & Sundar, V . S. A. (2021, May). Fake News Detection on Social Media Using Machine Learning. In Journal of Physics: Conference Series (Vol. 1916, No. 1, p. 012235). IOP Publishing.
[21]. P.Kalpana, P. Tamije Selvy, 2019, A Probe on Document Clustering Methodologies and Its Performance Metrics, International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issuse-2, July 2019.
[22]. Jashwant, K., Jaswant, R., & Devi, S. S. (2021, May). An efficient machine learning approach for activity recognition. In Journal of Physics: Conference Series (Vol. 1916, No. 1, p. 012160). IOP Publishing.

[23]. p. Kalpana, R. Kirubakaran , P . Tamije Selvy, 2019, Hybrid SVD Model for Document Representation, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 - 8958, Volume-8, Issue6S3, September 2019.

[24]. Kalpana, P., Anitha, M., Tamije Selvy P., An intelligent and effective model to recognize the duplicate products in catalog management system, International Journal of Scientific and Technology Research, 2020, 9(2), pp. 5104–5107

[25]. Kalpana, P., Nivetha, A.M., Madhumitha, R., Tamijeselvy, P., Devi, S.S., Improvisation of spectral clustering through affinity propagation,AIP Conference Proceedingsthis link is disabled, 2021, 2408, 030004