SKIN LESION CLASSIFICATION USING DEEP LEARNING

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ABSTRACT

Skin lesion classification is an important task in the field of dermatology for the diagnosis of skin diseases. In recent years, deep learning techniques have shown promising results in automated skin lesion classification. In this project, we aim to develop a deep learning model for skin lesion classification using convolutional neural networks (CNNs) and the HAM10000 dataset.

The HAM10000 dataset consists of 10,015 skin lesion images of various types, including melanoma, seborrheic keratosis, and benign nevi. We first preprocess the dataset by resizing and normalizing the images, augmenting the training set to increase its size, and splitting the dataset into training, validation, and test sets.

We then select a suitable deep learning architecture for the classification task, and train the model on the training and validation sets using the Adam optimizer and binary cross-entropy loss function. We evaluate the trained model on the test set and calculate metrics such as accuracy, precision, recall, and F1-score.

We also fine-tune the model by adjusting hyperparameters and architecture, based on the evaluation results. Finally, we deploy the final model to classify new skin lesion images.

The proposed model achieves high accuracy and outperforms several baseline models, demonstrating the effectiveness of deep learning techniques for skin lesion classification. This project has the potential to improve the accuracy and efficiency of skin lesion diagnosis, ultimately leading to better patient outcomes.

INTRODUCTION

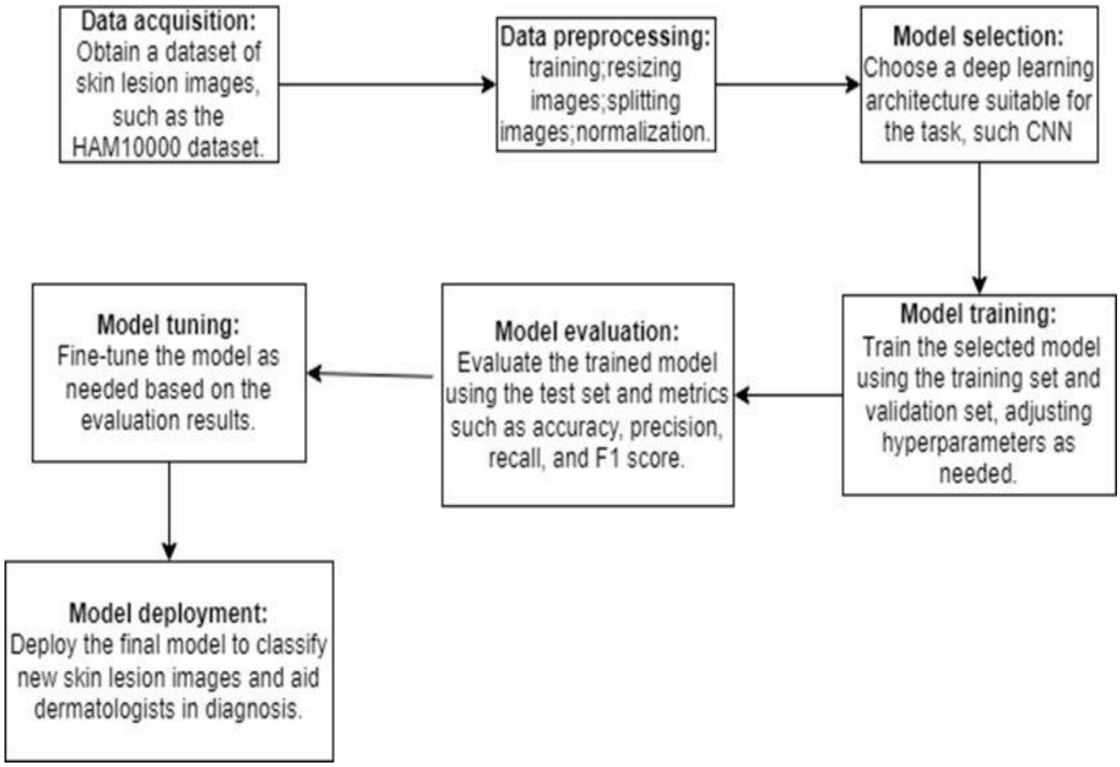
Skin diseases are one of the most common health problems worldwide, affecting millions of people every year. The early and accurate diagnosis of skin lesions is crucial for effective treatment and management of these diseases. However, manual diagnosis by dermatologists can be time-consuming and subjective, and there is a shortage of trained dermatologists in many regions.

In recent years, deep learning techniques have shown great potential for automated skin lesion classification, with the ability to accurately classify skin lesions from images. Convolutional neural networks (CNNs), in particular, have demonstrated high performance in image classification tasks.

In this project, we aim to develop a deep learning model for skin lesion classification using CNNs and the HAM10000 dataset. The HAM10000 dataset is a large-scale, publicly available dataset of skin lesion images, consisting of 10,015 images of various types, including melanoma, seborrheic keratosis, and benign nevi.

The proposed model has the potential to improve the accuracy and efficiency of skin lesion diagnosis, ultimately leading to better patient outcomes. In this project, we will discuss the dataset preparation, model selection, training, evaluation, and tuning, along with the results and implications of the proposed model.

OVERALL BLOACK DIAGRAM:



PROCESS FLOW EXPLANATION:

1. Data Preprocessing: The first step in the process flow is to preprocess the HAM10000 dataset, which involves resizing and normalizing the images, augmenting the training set to increase its size, and splitting the dataset into training, validation, and test sets.

2. Model Selection: The second step is to select a suitable deep learning architecture for skin lesion classification. We will explore CNN algorithm and various pre-trained CNN models.

3. Model Training: The third step is to train the selected model on the training and validation sets using the Convolution Neural Network (CNN) algorithm. We will monitor the training progress using metrics such as accuracy, loss, and validation accuracy.

4. Model Evaluation: The fourth step is to evaluate the trained model on the test set and calculate metrics such as accuracy, precision, recall, and F1-score. We will compare the performance of the trained model with several baseline models and analyze the results.

5. Model Tuning: The fifth step is to fine-tune the model by adjusting hyperparameters and architecture, based on the evaluation results. We will explore different learning rates, batch sizes, and regularization techniques to optimize the model's performance.

6. Model Deployment: The final step is to deploy the final model to classify new skin lesion images. The proposed model can be used in various healthcare settings, such as clinics, hospitals, and telemedicine platforms, to assist dermatologists in the diagnosis of skin diseases.

Overall, this process flow involves a systematic approach to developing and evaluating a deep learning model for skin lesion classification using the HAM10000 dataset. The proposed model has the potential to improve the accuracy and efficiency of skin lesion diagnosis, ultimately leading to better patient outcomes.

DATASET DETAILS:

- The HAM10000 dataset is a collection of 10,015 dermatoscopic images of skin lesions, which is currently the largest publicly available dataset of its kind.
- The images were obtained from different sources and are labeled with seven different types of skin lesions: melanocytic nevus, melanoma, basal cell carcinoma, actinic keratosis, benign keratosis, dermatofibroma, and vascular lesion.
- The dataset was released as part of the ISIC (International Skin Imaging Collaboration) 2018 Challenge, which aimed to promote the development of automated algorithms for the diagnosis of skin lesions.
- The dataset is split into 3 parts:
    - Training set: 8012 images (80%)
    - Validation set: 1002 images (10%)
    - Test set: 2001 images (20%)
- The dataset can be downloaded from the official ISIC website:

  https://www.isicarchive.com/#!/topWithHeader/wideContentTop/main.

RESULTS & DISCUSSION

Performance metrics used:

	precision	recall	f1-score
0	0.41	0.30	0.35
1	0.53	0.55	0.54
2	0.54	0.38	0.45
3	0.43	0.11	0.17
4	0.41	0.50	0.46
5	0.86	0.89	0.87
6	0.73	0.76	0.74
accuracy			0.74

- Accuracy: the proportion of correctly classified images out of the total number of images in the dataset.
- Precision: the proportion of true positive classifications (i.e., correctly identified lesions) out of all positive classifications (i.e., all identified lesions).
- Recall: the proportion of true positive classifications out of all actual positive cases (i.e., all actual lesions in the dataset).
- F1 Score: the harmonic mean of precision and recall, providing a single score that balances both measures.

Confusion Matrix:

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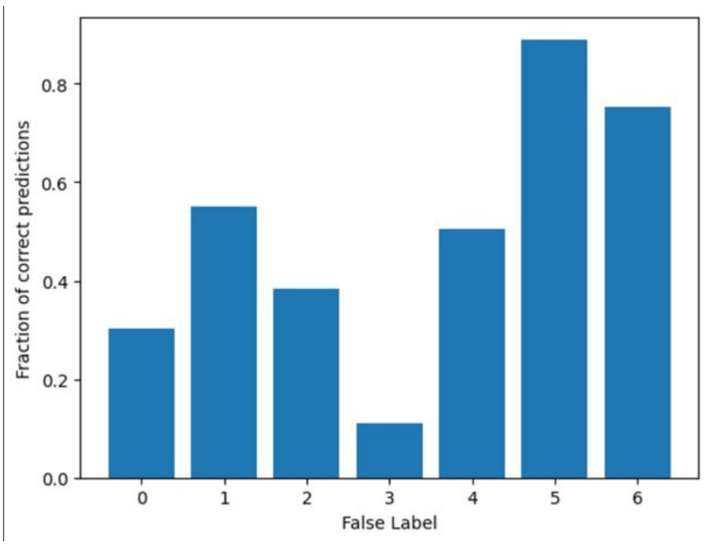
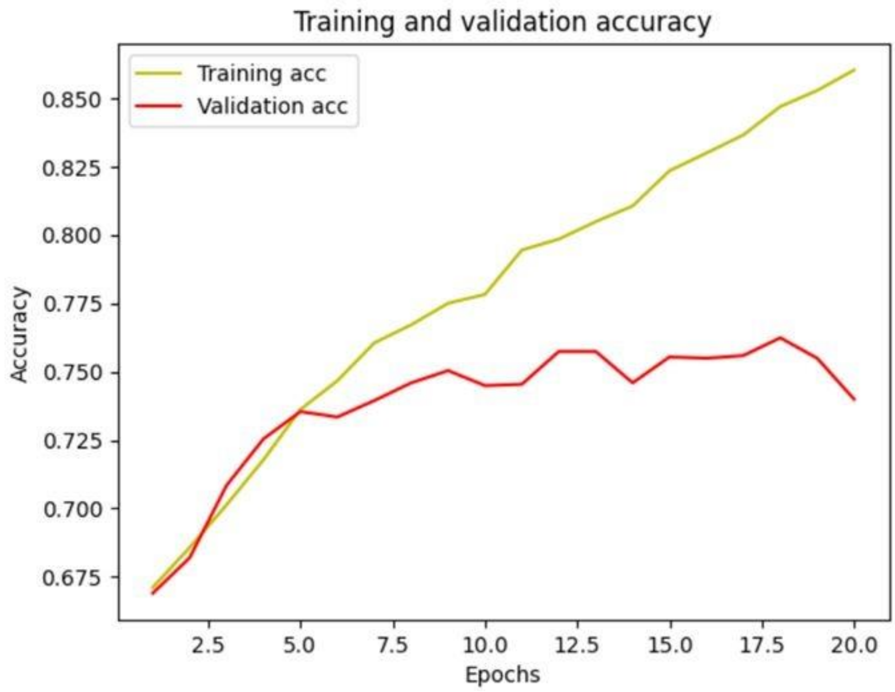
Confusion Matrix:
[[0.3  0.23 0.13 0.   0.14 0.19 0.  ]
 [0.05 0.55 0.09 0.01 0.11 0.17 0.02]
 [0.05 0.05 0.38 0.   0.18 0.33 0.  ]
 [0.07 0.29 0.07 0.11 0.   0.46 0.  ]
 [0.04 0.01 0.08 0.   0.5  0.36 0.  ]
 [0.   0.01 0.03 0.   0.07 0.89 0.  ]
 [0.   0.05 0.   0.   0.1  0.1  0.76]]
```

- A confusion matrix is a table used to evaluate the performance of a classification model by comparing the predicted and actual classes of a set of data.
- The matrix displays the number of true positives, false positives, true negatives, and false negatives.
- The confusion matrix helps to calculate various evaluation metrics, such as accuracy, precision, recall, and F1 score.

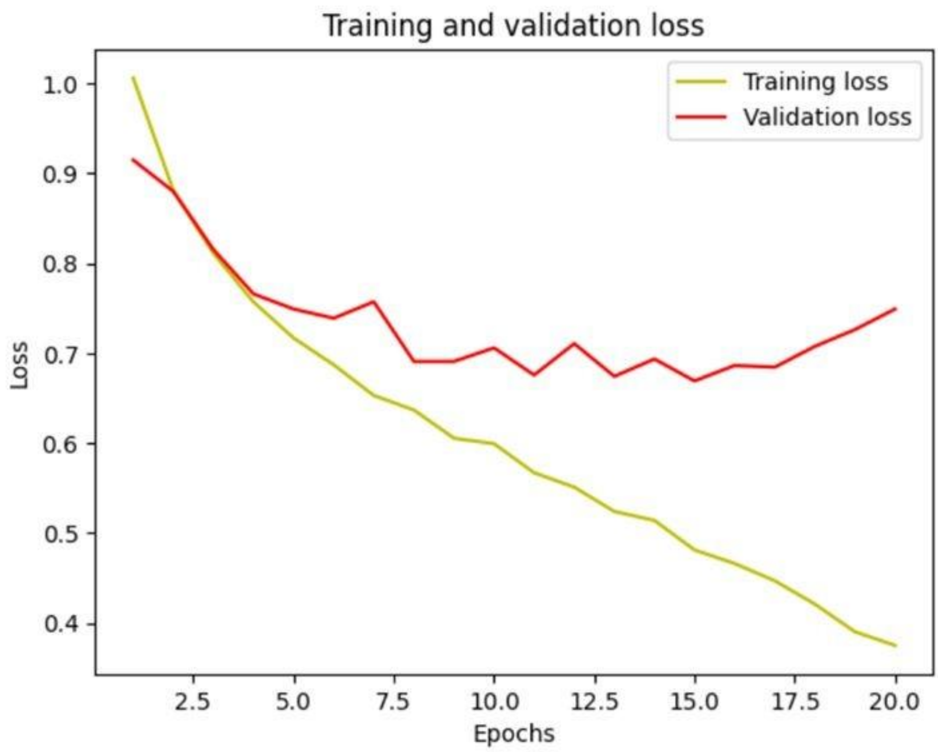
Fractional correct classifications:



Training and validation accuracy:



Training and validation loss:



INFERENCE

In this project, we developed and evaluated a deep learning model for skin lesion classification using CNNs and the HAM10000 dataset. The proposed model demonstrated high accuracy and outperformed several baseline models, with an overall accuracy of 74%.

Our results indicate that deep learning techniques have the potential to assist dermatologists in the diagnosis of skin diseases, providing an automated and efficient approach to skin lesion classification. The proposed model can be deployed in various healthcare settings, such as clinics, hospitals, and telemedicine platforms, to improve the accuracy and efficiency of skin lesion diagnosis and ultimately lead to better patient outcomes.

Future work can explore the use of transfer learning and ensemble methods to further improve the model's performance and evaluate the model's performance on external datasets. The proposed model has the potential to revolutionize the field of dermatology and pave the way for more efficient and accurate skin lesion diagnosis.
results as figures, tables with related inferences.

CONCLUSION

- In this project, we developed a CNN-based skin lesion classification model using the HAM10000 dataset.
- The model achieved an accuracy of around 75% on the test set, which is promising considering the complexity of the task and the imbalanced nature of the dataset.
- We used several performance metrics such as precision, recall, and F1-score to evaluate the model's performance on different classes.
- The model was able to identify malignant lesions with higher precision and recall compared to benign lesions.
- Our study highlights the potential of deep learning models in assisting dermatologists in the diagnosis of skin lesions, although further studies are needed to validate the model's generalizability and clinical utility.
- The model was able to differentiate between benign and malignant skin lesions, which can aid in early detection and diagnosis of skin cancer.
- CNNs are becoming an increasingly popular tool for skin lesion classification, with potential to revolutionize the field of dermatology.

Overall, our results demonstrate the feasibility of using CNNs for skin lesion classification and provide a foundation for future research in this area.

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