COMP6016 Project Scoping Proposal

Skin cancer image classification

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Introduction/Project Description

Melanoma is a type of skin cancer that influences public health. With the incidence of skin cancer gradually increasing in developed countries, early diagnosis plays an important role in decreasing the death rate of skin cancer patients. However, the hallmarks of skin cancer are very similar to common moles. For dermatologists, diagnosis of skin cancer is a challenging task, especially under the situation of many countries lacking dermatologists. Computer-aided diagnostic techniques have been developed to solve the dermatologist shortage, which can improve the speed and accuracy of manual diagnosis. Although computer-aided diagnostic techniques can provide accurate results for skin cancer prediction, they were still underestimated in the practicals because dermatologists may not trust the model when they do not understand its working principles. Therefore, this project aims to classify the skin cancer image datasets using convolutional neural networks, focusing primarily on distinguishing melanoma from benign nevi. This project will also explore new feature extraction methods and models, which combine artificial neural networks (ANN) and convolutional neural Networks (CNN) to improve the accuracy and reliability of skin cancer image classification.

Deliverables/Outcomes expected

The project will produce the following deliverables and outcomes expected:

Implementation: Initially, the focus will be on implementing the pre-train models of the convolutional neural networks using public large-scale skin cancer image datasets. Though pre-training models on large-scale datasets, focusing on improving the features learning ability of models for skin cancers.

Optimization: Following the implementation phase, models will undergo optimization. By adjusting the network structures, parameters setting and training strategies, models' accuracy and interpretability will be further enhanced. Systematically exploring various optimization techniques aims to make models perform well on skin cancer image classification tasks.

Comparison: A comprehensive performance comparison will be conducted on optimized models. The comparison will be made to other current skin cancer classification methods, including traditional medical diagnostic approaches and machine learning technologies. By comparing the experimental results, the effectiveness of the pre-trained convolutional neural network models will be evaluated in the skin cancer classification tasks, and it will ensure the practicality and feasibility of pre-trained models in real-world applications.

Through the process of implementation, optimization and comparison, it aims to provide proven pre-trained convolutional neural network models as effective tools for automatic skin cancer detection and classification, promoting progress and innovation in the field of medical detection.

Meeting schedule/arrangement

Weekly face-to-face meetings in the supervisor's office have been planned from 2:30 to 3:00 each Friday afternoon to ensure clarity and accountability in project management. However, alternative arrangements can be organized for a catch-up session or other channels to communicate relevant information in case of inevitable conflicts.

Weekly meetings will review progress, assess challenges, and strategize the next steps. In weekly meetings, the project leader will provide updates on the task status and discuss encountered obstacles with the supervisor to seek guidance and support.

Data management plan

The project's data management involves using secure and accessible platforms to store and share multiple data types. The project's source code and development logs will be stored on the GitHub platform, which provides version control to ensure the project's codebase remains organized, accessible, and easily traceable. Weekly work reports and the final report will use Google Drive to store and share. Google Drive provides an easy creation, editing and sharing platform for documents, ensuring the project leader can easily manage and share project documents.

The project leader will provide regular updates on the project's progress to the supervisor, which can be realized by regularly submitting codes, updating development logs on GitHub, and sharing progress reports with the supervisor through Google Drive. The supervisor can check the newest codes and submission records in the GitHub repository anytime. The project leader will share weekly work reports with the supervisor to summarize the week's progress, completed tasks and next steps. All these reports will be stored in the project leader's Google Drive and sent to the supervisor through emails to show the project's progress.

Upon completion, the project leader will prepare the final report and send a copy to the supervisor through Google Drive. The supervisor can read the final project report at any time and discuss the project's result, effect, and future direction with the project leader.

Previous Work

In the previous COMP6015 unit, my project topic was 'self-supervised learning for coral reef image set classification'.

Background and goals: Coral reefs were called "Forests in the ocean", one of the most diverse and complex marine ecosystems on earth. Although the coral reefs only cover 0.1 per cent of the ocean surface, they still play a significant role in maintaining the diversity of ocean creatures. However, the traditional coral reef classification methods, including manual observation and labelling by marine biologists, are time-cost and labour-intensive. Many coral reef images have been provided to the researchers, followed by the proliferation of digital images and underwater photography techniques. Based on the provided coral image data, developing an automatic classification system became one of the hopeful solutions to solve the restriction of manual labelling. This project explores coral reef classification methods through deep learning models to build efficient, accurate, and automated coral reef classification systems and contribute to marine ecosystem research and protection.

Specific tasks and results achieved:

1. **Adapting Resnet for coral classification**: Changing the Resnet model for adapting coral reef classification tasks, including adapting datasets and output layers, to meet the requirements of different numbers categories.
   Result: The adjusted Resnet model achieved 97.2 per cent accuracy on the test sets, performing a strong classification capacity.

2. **Comparing linear classifier and Resnet 18 on the coral dataset:** Training linear classifier on the raw images and comparing the performance of the Resnet 18 on the coral images dataset.
   Result: The linear classifier achieved 94.25 per cent accuracy on the test set, but an overfitting issue could exist.

3. **Leveraging Resnet 18 features to improve coral image classification:** Extracting features of the trained Resnet 18 model and using these features to train a softmax model for performance comparison.
   Result: Features extracted by the Resnet 18 achieved 99.56 per cent accuracy, which presents better performance than linear classifier.

4. **Self-supervised learning (SimSiam) for coral dataset feature extraction:** Using a self-supervised model (SimSaim model) to extract features from coral reef datasets and training a softmax model using extracted features, then performing a performance comparison.
   Result: The Simsiam model achieved 75.83 per cent accuracy, but there are fluctuations in the training loss.