Pigmented Lesion Classification

Project Proposal

Course: Applied Artificial Intelligence

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Background

A skin lesion is any area of the skin that differs from the surrounding skin. It may differ in color, shape, or texture. Multiple types of skin lesions exist, some are fatal while some are harmless. Lesions can be the result of localized damage to the skin which may be harmless, but they can also be manifestations of serious underlying conditions, this means that such lesions may also be malignant and lead to serious illnesses i.e. skin cancer. The pigmentation colors can indicate the possible causes and types of lesions, which serves as the basis for our project.

Objective

Our objective is to implement multi-class classification and train a model that can accurately detect different types of skin lesions by analyzing pigmentation and tell us whether they're malignant or benign. The model should be able to analyze images and identify the specific type of lesion present. It should also be able to tell us the probability associated with the identified lesion type being the correct classification.

Implementation

We will be implementing multi-class classification where the model predicts the specific class the input belongs to and outputs the probability of the input belonging to that class. The project will be implemented as a web interface where the user can sign up, login and consult the application, using images of lesions. The AI will detect and classify the lesion. If there is a possibility of the lesion being a specific type, the application will also present the probability of the lesion belonging to that class.

AI Techniques

1. **Deep learning Approach**: Deep Learning techniques particularly Convolutional Neural Networks (CNNs) which Automatically learns from the features of the images to classify the Images.
2. **Transfer Learning**: Rather than training a model from scratch, we leverage a pre-trained model. We further adapt this model to our specific use case by freezing the existing layers and only training the newly added layers. This approach allows us to benefit from the pre-existing knowledge of the model, thereby saving time and computational resources.

3. **Image Preprocessing**: Using techniques like image resizing, gray scale conversion, centering, and noise reduction.
4. **Data Augmentation**: Using data augmentation techniques to introduce diversity into our dataset.
5. **Uncertainty Estimation**: Using uncertainty estimation techniques like Monte Carlo Dropout to introduce confidence within our actual results.

Resources:

1. **Dataset**: A large, labeled dataset containing different types of lesions for supervised learning.
2. **Computational Resources**: A powerful computer with a good GPU to train the deep learning model.
3. **Software and Libraries**: Libraries like Pytorch and Tensorflow will be needed to implement and train the models. A python environment is also needed where all the necessary libraries will be installed.
4. **Web Development Tools**: Frameworks like NodeJS and Flask will be needed to develop the Web application and deploy the model.
5. **Database**: We will be using a database i.e. MongoDB to store data such as user credentials and images.
6. **Pre-Trained Models**: Using models either built into libraries like Tensorflow such as VGG16 or external models available on HuggingFace for transfer learning.

Dataset Link

https://www.kaggle.com/datasets/volodymyrpivoshenko/skin-cancer-lesions-segmentation