Application of neural nets and deep learning in clinical screening systems

CHALLENGES: Health, demographic change and wellbeing

PRODUCTIVE SECTOR: medical sector

PROBLEM DESCRIPTION

Project to develope a clinical decision support system using machine learning based algorithms regarding the fields:

- Skin lesion detection
- Retinal image analysis
- Cytology screening

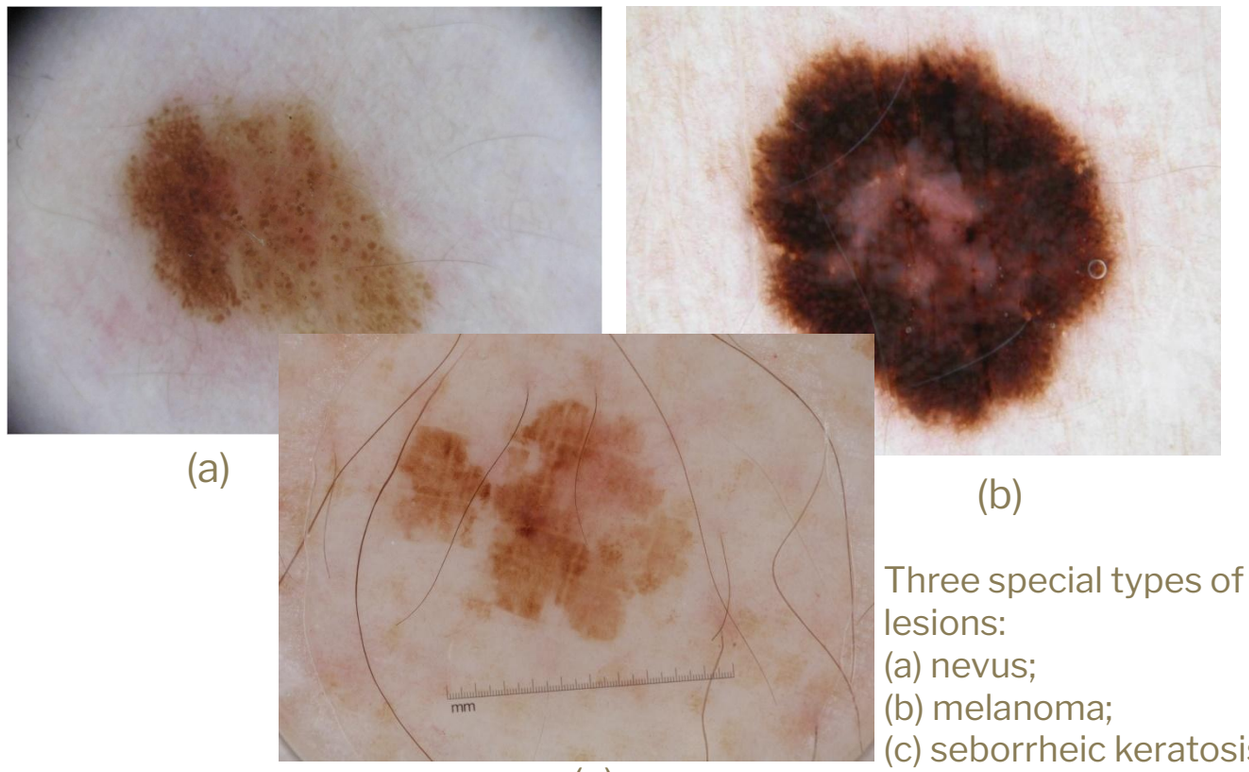
CHALLENGES AND GOALS

The project's aim was that to develop a marketable results in clinical decision support/automatic screening systems. For this, we had to worked out the appropriate machine learning based solution to reach enough high accurate evaluation system.

MATHEMATICAL AND COMPUTATIONAL METHODS

We have investigated possibilities about how we successfully improve the accuracy of CNNs when we could not extend the size of training image set.

- We investigated how we create an ensemble of CNNs in order to outperform the accuracies of the individual ones.
- We worked out the theoretical background of the fusion of CNNs in the training stage
- We examined the combination of the features extracted by CNNs and other conventional methods



Three special types of skin lesions:
(a) nevus;
(b) melanoma;
(c) seborrheic keratosis.

CATCHY TITLE OF THE SUCCESS STORY

Include a subtitle of the problem if necessary

Results and Benefits

We developed an ensemble of deep convolutional neural networks to improve further their individual accuracies in the task of classifying dermoscopy images into the three classes melanoma, nevus, and seborrheic keratosis when we had not got opportunity to train them on adequate number of annotated images. To achieve high classification accuracy, we fused the outputs of the classification layers of four different deep neural network architectures. More specifically, we proposed the aggregation of robust convolutional neural networks (CNNs) into one framework, where the final classification is achieved based on the weighted output of the member CNNs. For aggregation, we considered different fusion-based methods and select the best performing one for this problem. Our experimental results also proved that the creation of an ensemble of different neural networks is a meaningful approach, since each of the applied fusion strategies outperformed the individual networks regarding classification accuracy.

We have developed an automated screening system which is built into a **mobile application** to provide a self screening tool for the users in the world-wide.

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