Computer Assisted Medical Diagnostic Tool for Medical Ultrasound Images

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Introduction

- Nowadays, it is proven that Breast Cancer is the most common cancer among women and survival rates are vary widely by many factors. Two of the most important factors are the type of cancer and the stage of the cancer at the time of diagnosis.
- Hence it is very crucial to detect and classify the cancer at early stages to avoid next phases.
- Thus, this project presents a software tool to process medical breast ultrasound images by using Deep Learning methods to provide faster and more accurate detection and classification.

Specifications and Design Requirements

- The data collected at baseline include Breast Ultrasound Images among women in ages between 25 to 75 years old. The data was collected from an open-source image databank.
- The number of patients is 600 female patients. The dataset consists of 780 images with an average image size of 500*500 pixels and bit depth of 24 bits. The images are in PNG format.
- The ground truth images are presented with original images. The images are categorized into three classes, which are normal, benign, and malignant.
- The programming language of the software is Python™.
- The Keras (2.4.3) framework was applied, and the TensorFlow GPU (2.5.0) backstage was called to implement the segmentation, recognition and training parts for the both classification and prediction of breast ultrasound images.

Solution Methodology

- Project mainly utilizes a Deep Learning algorithm called ‘’U-Net’’.
- U-Net is a type of convolutional neural network with no dense layers.

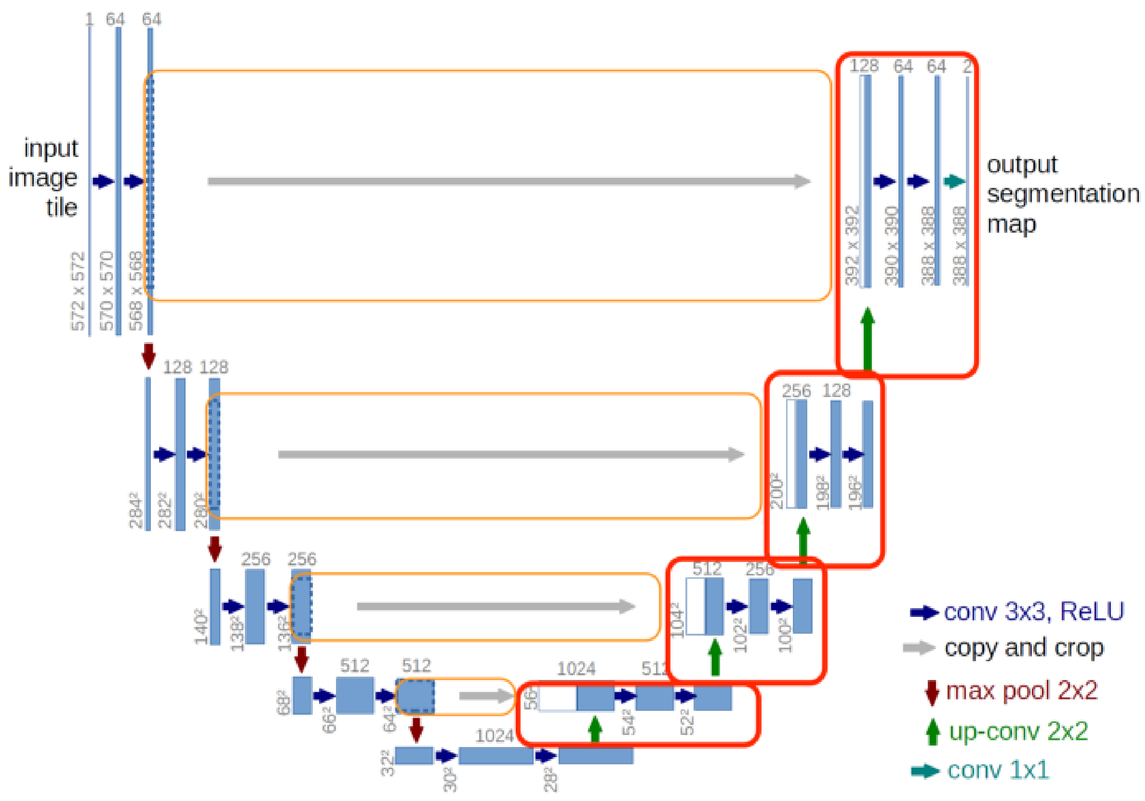
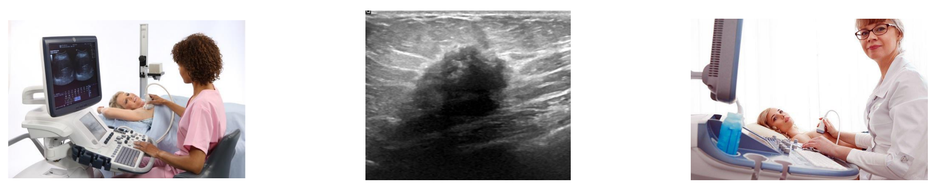


Figure 1: U-Net Architecture (32x32 pixels in lowest resolution)

- By applying this method, software can predict the tumor in the breast by doing semantic segmentation and can also classify what type of tumor, patient has.
- The method provides more accurate and precise results with small datasets than other methods and it is very specialized in the biomedical image segmentation area. Therefore, it is chosen to be used in this project.

Application Areas

- As the technology progresses, the need in computer aided diagnostic tools has risen to very demanding levels.
- Application areas of this software is related to the medical area such as ultrasound monitoring devices, medical diagnosis computers etc.



Results and Discussion

- Here are the final prediction and classification results:

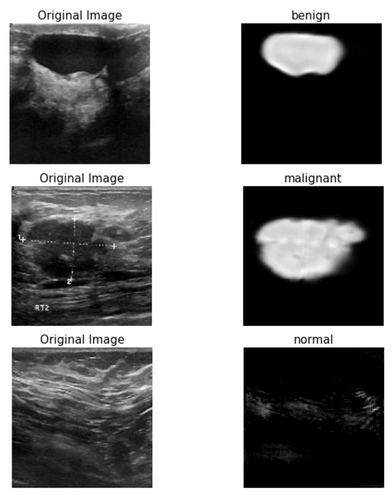


Figure 2: Examples from Classifier Part Results

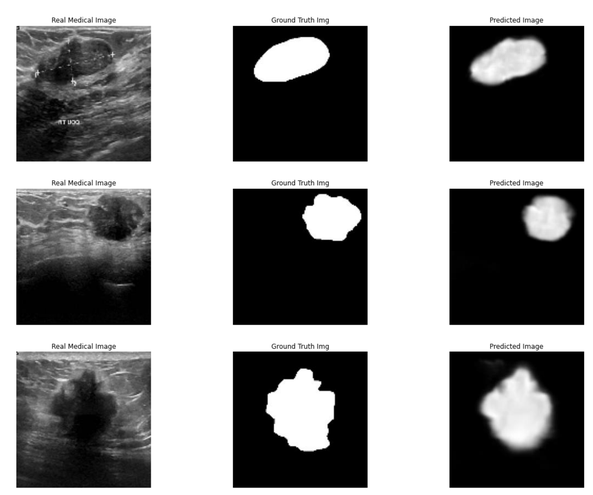


Figure 3: Examples from Prediction Part Results

- The goal was to reach %80 accuracy and it is satisfied. In this proposed model, we can detect and classify the cancer with %82 accuracy rate.
- Experimental results proved that this proposed method can be further improved in higher accuracy rates by adjusting the neural network and increasing the dataset size.

```
In [79]: print('Accuracy : ' + str(accuracy_score(y_test, y_pred)))
         print(classification_report(y_test, y_pred, target_names = info))

Accuracy : 0.8205128205128205
              precision    recall  f1-score   support

      benign       0.85      0.83      0.84        42
   malignant       0.72      0.78      0.75        23
      normal       0.92      0.85      0.88        13

    accuracy                           0.82        78
   macro avg       0.83      0.82      0.82        78
weighted avg       0.82      0.82      0.82        78
```

Figure 4: Accuracy report of the software

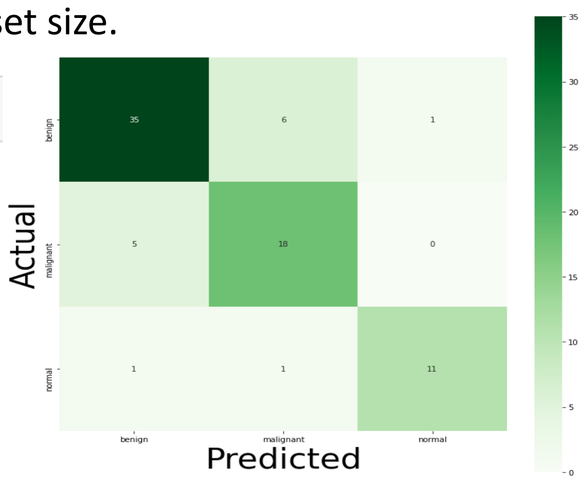


Figure 5: Confusion Matrix of the final design

- In future works, project has great potential to have more than %90 accuracy and a simple-to-use user interface can be added.

References

- **[1]** Al-Dhabyani W, Gomaa M, Khaled H, Fahmy A. Dataset of breast ultrasound images. Data in Brief. 2020 Feb;28:104863. DOI: 10.1016/j.dib.2019.104863.
- **[2]** Olaf Ronneberger, Philipp Fischer, Thomas Brox,U-Net: Convolutional Networks for Biomedical Image Segmentation , Medical Image Computing and Computer-Assisted Intervention (MICCAI), Springer, LNCS, Vol.9351: 234--241, 2015

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