Deep Learning could help doctors detect breast tumors faster

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Object detection in medical imaging

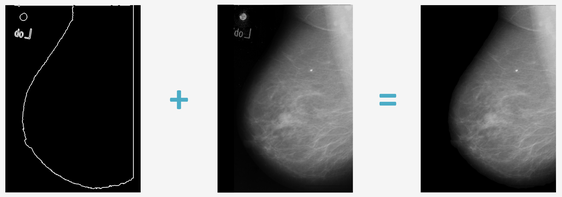
The use of **convolutional neural networks** for efficient and automated analysis of **medical imaging** products (X-ray, CT-scan, MRI, ultrasound…) has seen a surge in the recent years due to the progress of **object detection** frameworks.

Faster R-CNN is a neural network architecture composed of a pretrained backbone component (ResNet, VGG…) with two object detection heads:

- a position regressor
- an object classifier

Here, we tried using this architecture to **detect tumors on mammography IRM images.**

Data Preprocessing

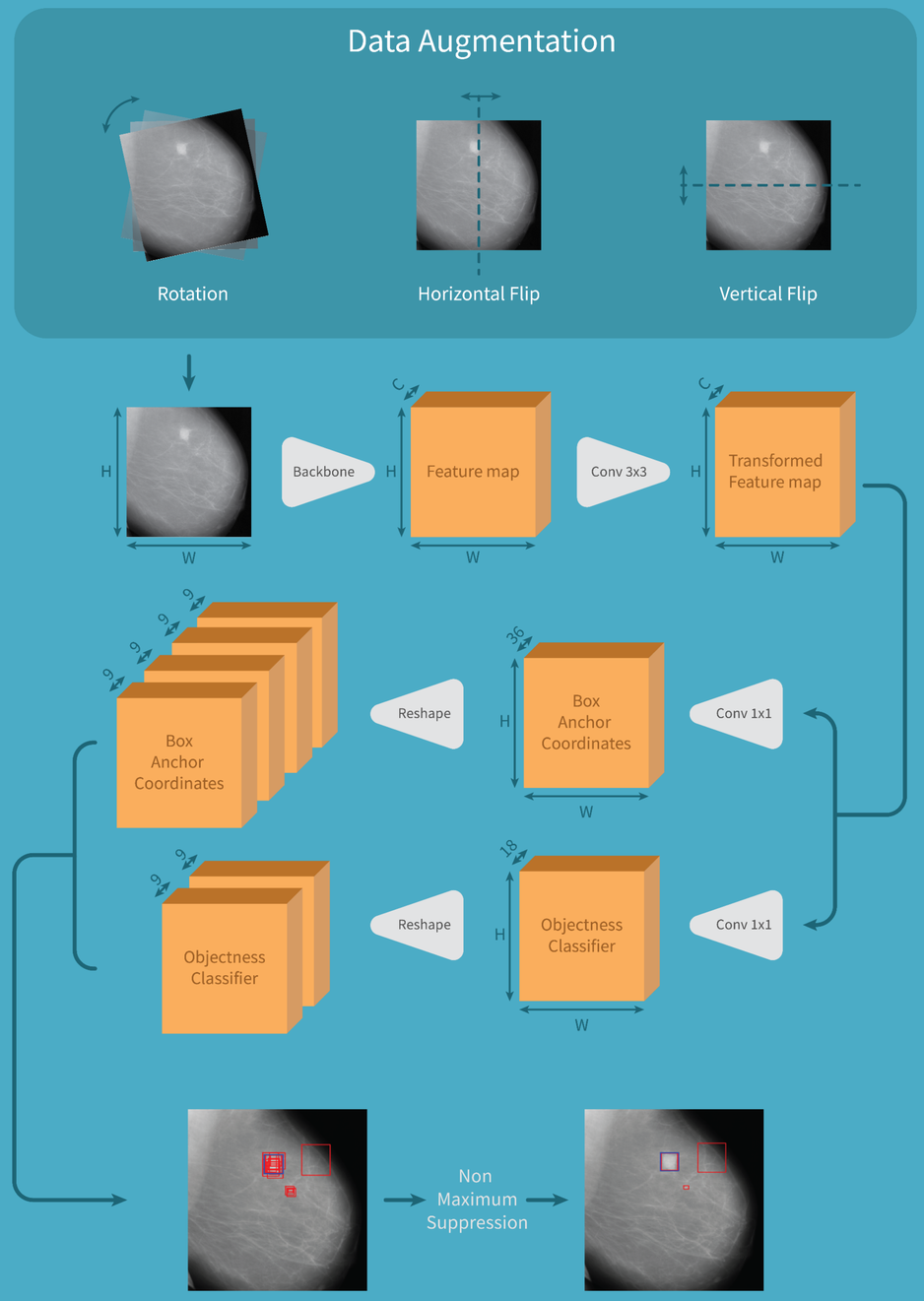


Calculate the local gradient to find transition between different image regions. Thus, apply the watershed morphological transformation and extract the biggest bright area. [2]

Training Faster-RCNN

Trained on an augmented data, because the original dataset is small. (322 images)

Dataset & training	
Backbone network	ResNet
Trainable parameters	14M ==> Very high compared to the size of our data
Optimizer	Momentum SGD
Learning rate (adaptive)	0.005
Batch size	2
Epochs (iterations over training set)	22



Faster R-CNN architecture [1]

Model Performance and analysis

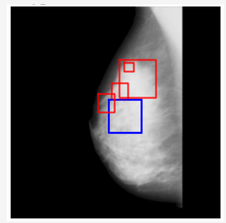
The **FN rate is low** which is a good thing: we don't want to miss any tumors in real life.

The **FP rate is quite high** but that's expected given the small dataset size. This can be addressed later with post processing (NMF) and hyperparemeters finetuning.

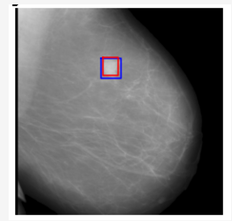
Evaluation Metrics	
Precision	38% => High FP rate
Recall	96% => Low FN rate
Average IoU	0.12 => Low Bounding box detection

Some samples are better predicted:

FP prediction
dense-granular background



TP prediction
fatty-glandular background



Next Steps

Attribute **adapted weights** to the NO-TUMOR class in the loss function in order to increase our model's precision.

Include the **character of background tissue** (Fatty, Dense-glandular) in the classification task.

Study the effects of **adversarial training** on the attempt to improve model robustness when applying transfer learning.

References

[1] Faster R-CNN : Towards Real-Time Object Detection with Region Proposal Networks.

[2] Preprocessed Mias dataset https://github.com/gpspelle/clean-mias-dataset/blob/master/clean-mias-dataset.zip

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