Real-Time Display of Regions of Interest with Future Event Risk in Angioscopic Images using Deep Machine Learning on Mobile AI Device in Patients with PAD

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Disclosure

Speaker name: Naoto Miyagi

I have the following potential conflicts of interest to report:

- [ ] Consulting
- [ ] Employment in industry
- [ ] Stockholder of a healthcare company
- [ ] Owner of a healthcare company
- [ ] Other(s)

- [✓] I do not have any potential conflict of interest
Introduction

- Angioscopy is a useful device. However, clinical judgment is not technically straightforward.

- This study aims to design classification models by deep machine learning in mobile AI device, and every operator can receive the benefit.
Purpose

Data into a Trained Neural Network

Images → Prediction value of the outcome
Materials and Methods

Critical limb ischemia
Rutherford $\geq 4$
$n=12$

Endovascular therapy (EVT) + Angioscopy

Amputation
re-EVT
Death
$n=5$

Healed
Survive
$n=7$

Positive case

Negative case
Workflow chart (pre-processing of images -> training on the cloud)

Edit video file from angioscopy

Feature Engineering

RGB to HSV
2-dimensional color histogram

Training Data (n=4849)
Validation (n=300)
Test (n=1212)

Data Augmentation

Ubuntu on Azure
MobileNet V2 Model

OpenCV(C++)

Images into the neural network

OpenCV(Python)

Convert to PNG

Python

Prediction of Prognosis

Nvidia Xavier

Rotation
Width shift
Height shift
Flip
Shear
Zoom
Nvidia Jetson Xavier is an AI Edge device

Specs

- GPU: 512-core Volta GPU
- CPU: 8-core ARM 64bit CPU
- Memory: 16GB
- Others: Deep learning accelerator, Video encoder/decoder
- Size: 105mm x 105mm
- Price: 2300 EUR
Mobile Prediction System Chart

- Files or USB camera
- Video Capture
- Preprocessing
- Nvidia Xavier
- MobileNet V2 model

- Prediction -> Poor / Good prognosis
- 2-D color histogram
- Grad-CAM
Class Activation Map (Grad-CAM)

Dogs or Cats?

Class Activation Map can be used to visualize where the neural network was strongly interested in the images.

Results: Lightweight Mobile Model

For mobile

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Sensitivity(%)</th>
<th>AUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>87.0</td>
<td>87.0</td>
<td>0.87</td>
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</tbody>
</table>

For Desktop PC

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Sensitivity(%)</th>
<th>AUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>97.6</td>
<td>94.0</td>
<td>0.93</td>
</tr>
</tbody>
</table>
Results

FPS: 13.9
Positive: 0.9753
Negative: 0.0247
Conclusion

- Nowadays, AI can be used in locations closer to operators by using a mobile device with excellent mobility.
- This study has the potential to make diagnostic technologies familiar to operators and catheter Labs. that were previously unrelated to the use of artificial intelligence.
Okinawa island, my hometown
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