Deep Learning Algorithms for Recognition of Facial Ageing Features

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About us

Youth laboratories - the team of IT, biogerontology and machine learning experts, who are dedicated to developing effective interventions to keep people young, healthy and beautiful.

Projects

RYNKL

BEAUTY.AI

Others:
Ageing and disease features recognition

Kickstarter campaign

Agenda

1. Motivation and concept
2. Applied technologies and algorithms
3. Performance: GPU remarks
4. How to collect the datasets
5. Vision and plans

How do you evaluate your skin condition?

Cosmetologist Dermatologist or other doctors	Partial opinion Biased Variable Time + Money
Self (mirror)	Biased
Other people	Partial opinion Biased Variable

Tasks

1. A tool for measuring the changes of skin condition and appearance in general

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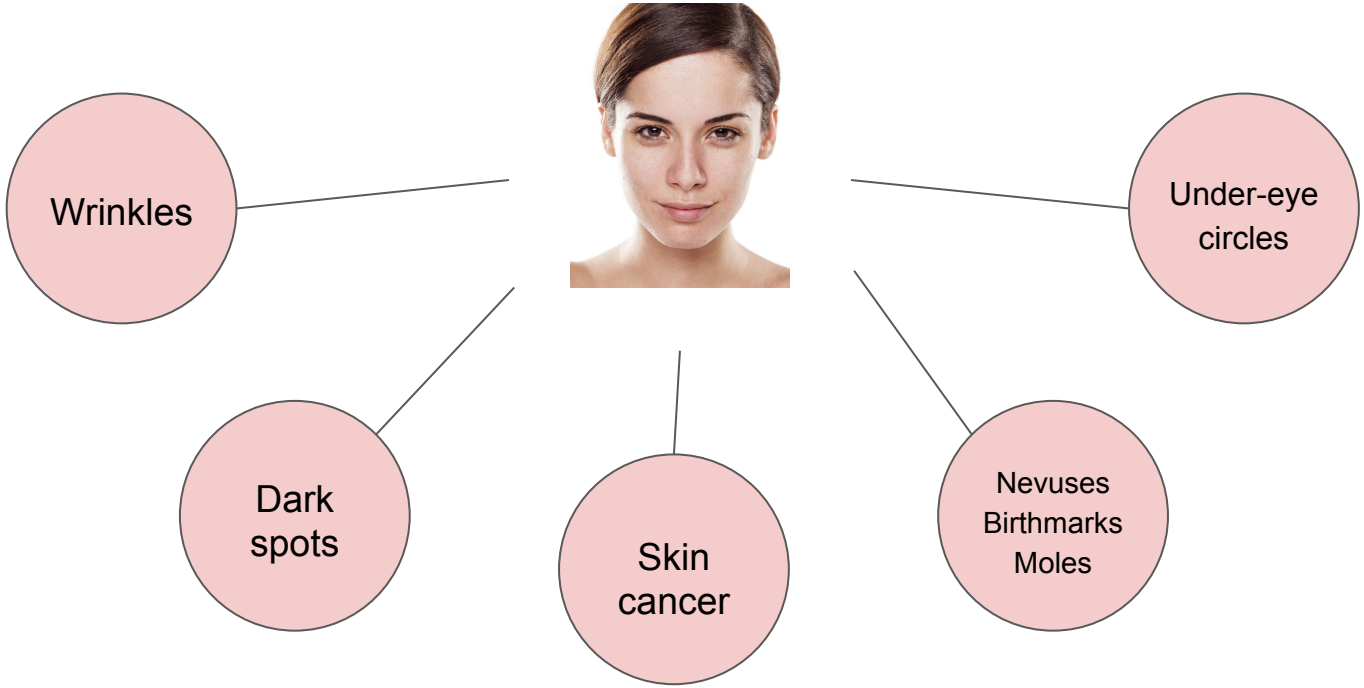
2. Mobility and availability
3. To track the effect of treatments and the reliable response on their efficiency
4. Recommend the most appropriate cosmetology or skin treatment type

Motivation: facial aging and diseases features



Motivation: facial aging and diseases features

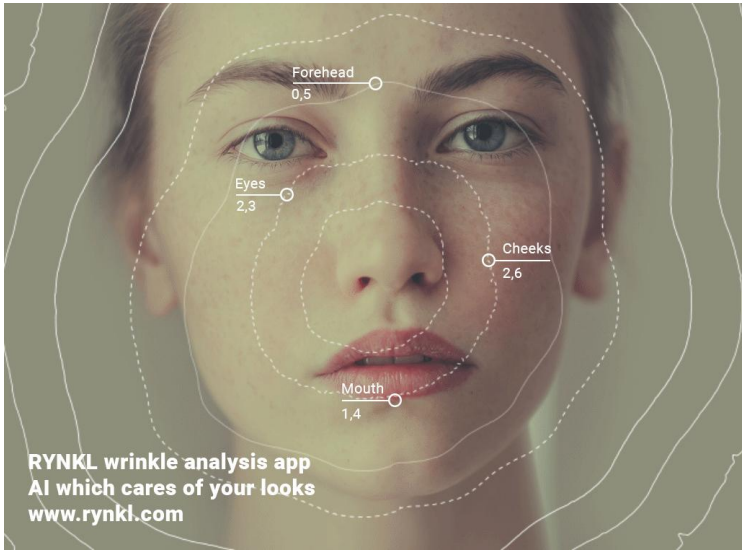
It’s important to be able to detect them at early stages when the probability to cure it without any consequences is high

Motivation: facial wrinkles

Your facial wrinkles are one of the key indicators people use to guess your age

How to distinguish and track the effect of various skin treatments?

Go further to recognize another biomarkers

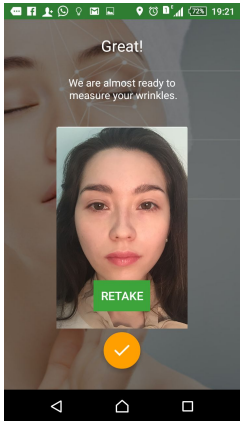


RYNKL app

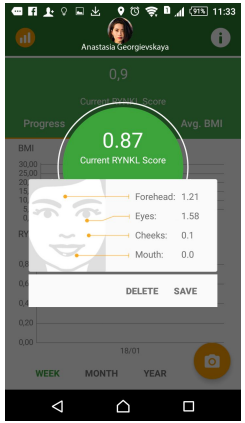
- application for tracking facial wrinkles

Android, iOS - beta version available

Now traditional approach is deployed
Deep learning approach is being researched



Cloud based system



Approaches and implementations

Implementations (Theano, OpenCV, Lasagne/Keras/Caffe):

- CPU
- GPU

Approaches:

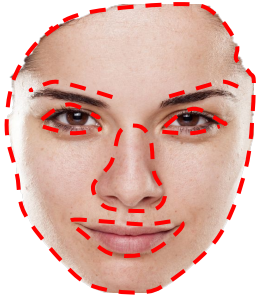
- Traditional computer vision and machine learning
- Deep convolutional neural networks

General process

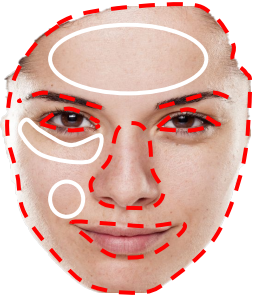
Photo preprocessing

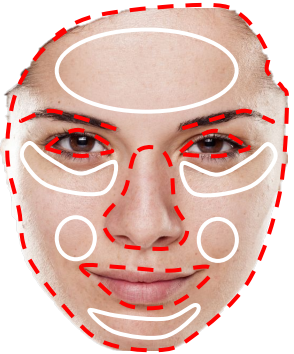
Face detection

Facial zone Alignment



Wrinkles area detection

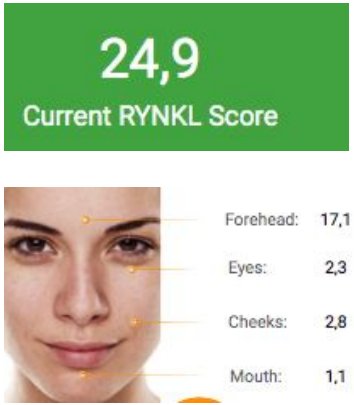




Make wrinkles map

Each zone is processed separately, wrinkle-related features are detected

Calculate wrinkle score

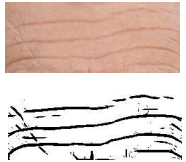


Traditional computer vision and machine learning

Face detection - retrained OpenCV cascade

Facial zone - ensemble of regression trees, retrained for 50 fiducial points (dlib implementation) + contours detection

Alignment - affine transformation
Wrinkles area detection - cut areas by support points



Wrinkles map - brightness normalization, several stages of Gabor filters, morphological transformation, adaptive thresholding.

Calculate RYNKL score

Traditional approach: problems

1. Facial areas detection - insufficient accuracy of detection of facial boundary points;
2. Impossible to select perfect parameters of the image processing for all cases of lightning and shadows;
3. Flecks of light erase information about facial wrinkles - impossible to recover!

Deep learning approach

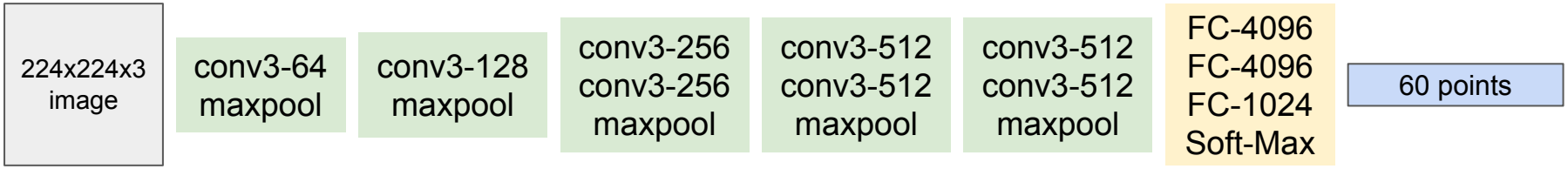
1. VGG-11 for facial areas detection
2. Two architectures for wrinkles score calculation:
   a. VGG-16 - predict RYNKL score
   b. SegNet* - build wrinkles map

* Alex Kendall, Vijay Badrinarayanan and Roberto Cipolla "Bayesian SegNet: Model Uncertainty in Deep Convolutional Encoder-Decoder Architectures for Scene Understanding." arXiv preprint arXiv:1511.02680, 2015.

Facial area segmentation

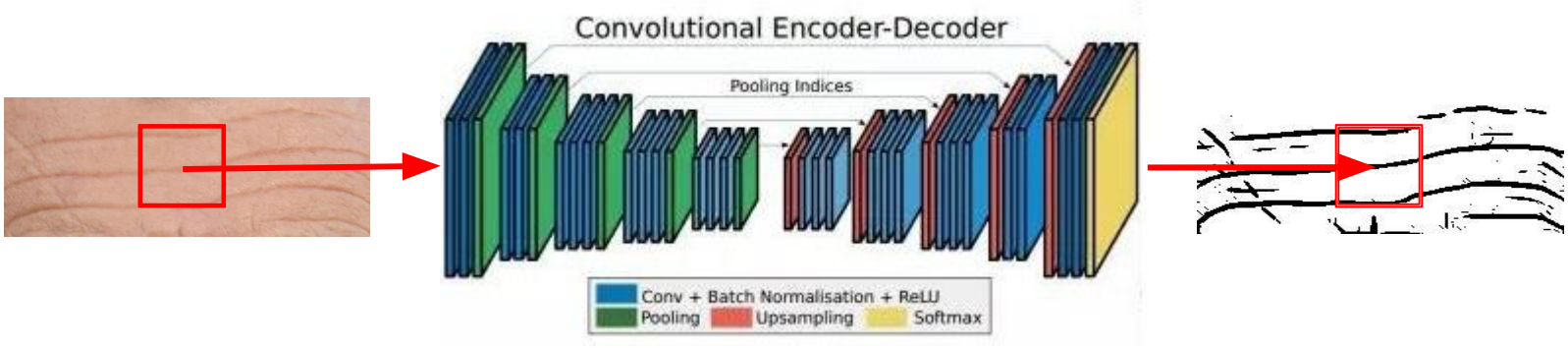
VGG-11:

- training set - HELEN, MUCT and others
- CNN architecture:



Building wrinkles map

Use SegNet with 112x112x3 -> (rescale) -> 224x224x3 input

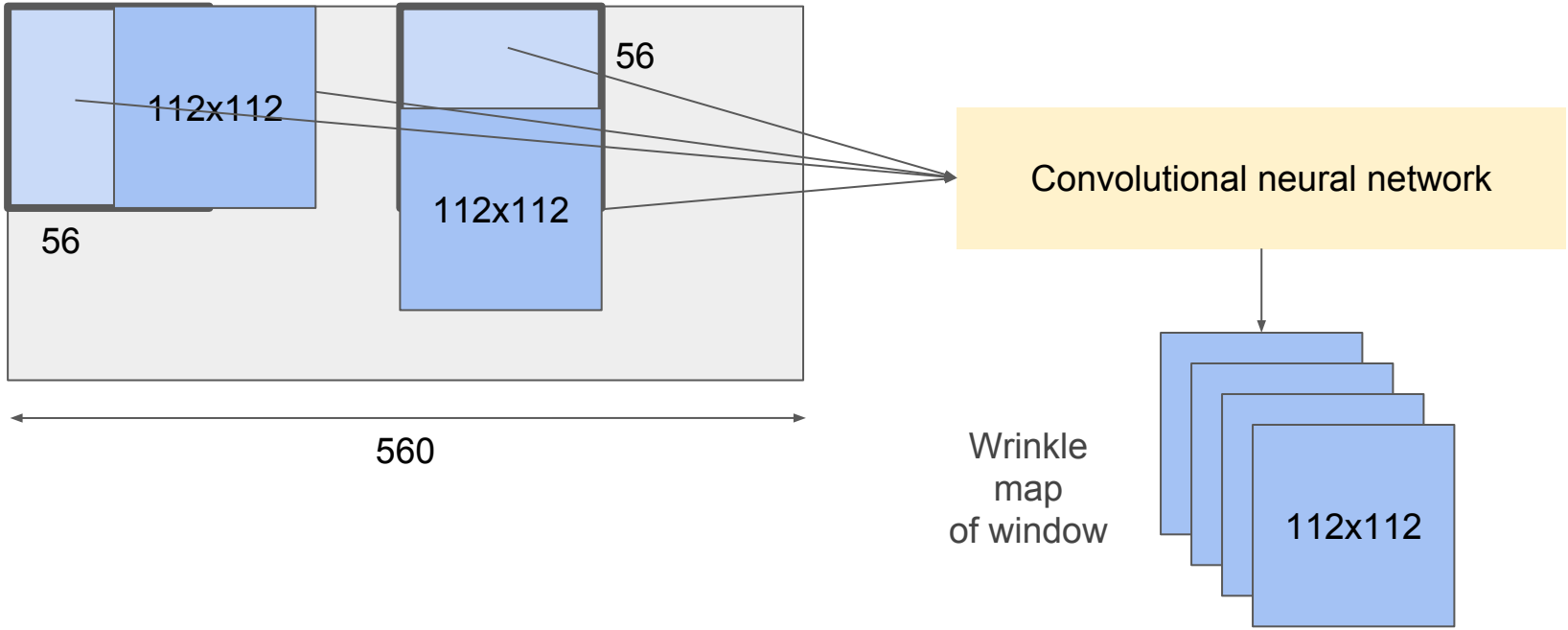


Encoder - VGG-16 without fully connected layers
Decoder - upsample the input

SegNet schema was taken from article
“A Deep Convolutional Encoder-Decoder Architecture for Image Segmentation”

Gliding window

Each area size is normalized to fixed width - unique for each area.
I.e. forehead's width is 560 px.



Train and test

Manually marked

- 100 images, 100 individuals
- 200 images, 20 individuals

Test (images-individuals):

- MSE (60-36): traditional - 0.39, deep learning - 0.32

Implementation

- Theano + Lasagne/Keras/Caffe for neural network implementation
- OpenCV for image processing
- GPU for train and test - Nvidia Tesla K80

Performance

Performance on Tesla K80

- facial areas points detection:
  - prediction - 0.02 s;
- building wrinkles map:
  - prediction - 0.04 s;

Compared with CPU (i7 Xeon) training on GPU (Tesla K80) is faster ~20 times!

How to collect the dataset

First international beauty contest judged by AI (1 Dec 2015 - 18 Jan 2016):

~3000 images (>2K resolution) + bio parameters (weight, height, age, gender, ethnicity, country)

The second contest is going to start on ~ 1 May 2016
It will include skin type in parameters

Plans and perspectives

Technology improvement:

- complete and deploy deep learning approach
- move some computation to device size

Directions of grows:

- another ageing biomarkers recognition
- skin diseases detection
- recommendation of skin treatments based on skin type and other bio parameters

Core idea - allow people to make self-test of their skin condition.
Application gives just recommendations - doesn’t diagnose.

Thank you for your attention!

Questions?

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