UNIVERSITY
OF TRENTO - Italy

Department of Information
Engineering and Computer Science

Discriminate between posed and spontaneous smile

Project report - Multimedia Data Security
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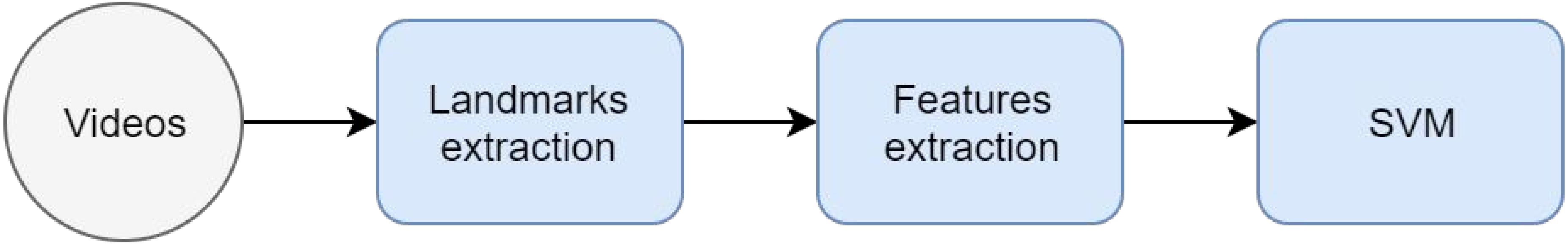
The problem

Main Reference: **Recognition of Genuine Smiles, Hamdi Dibeklioğlu et al**

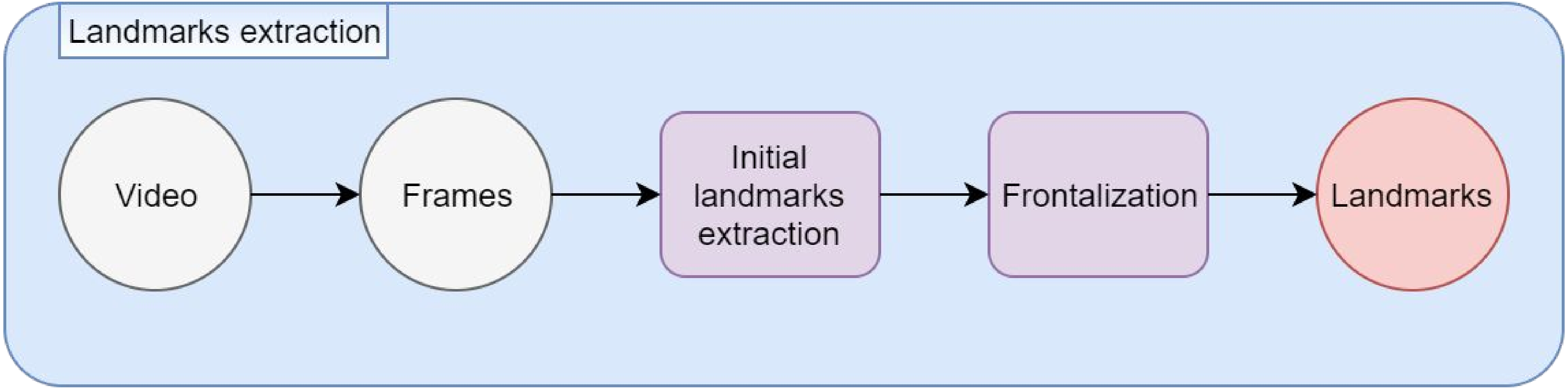
Pipeline



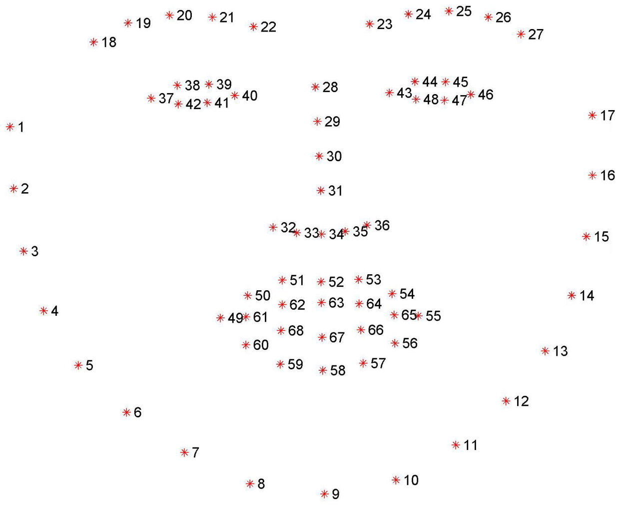
Dataset: UvA-Nemo

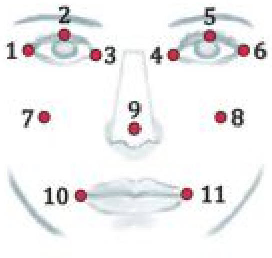
- 1240 videos
- 597 spontaneous and 643 posed
- 400 subjects: 149 young people and 251 adults, 185 women and 215 men

Landmarks and Features



Landmarks extraction



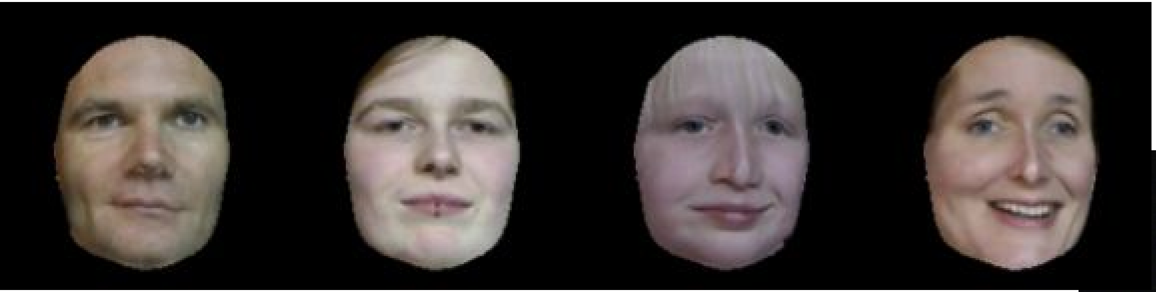


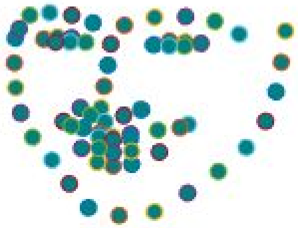
- DLIB extracts 68 points
- 11 points needed

Frontalization

Two methods:

1. Method 1: Effective Face Frontalization in Unconstrained Images
2. Method 2: Learning Spatially-Smooth Mappings in Non-Rigid Structure from Motion

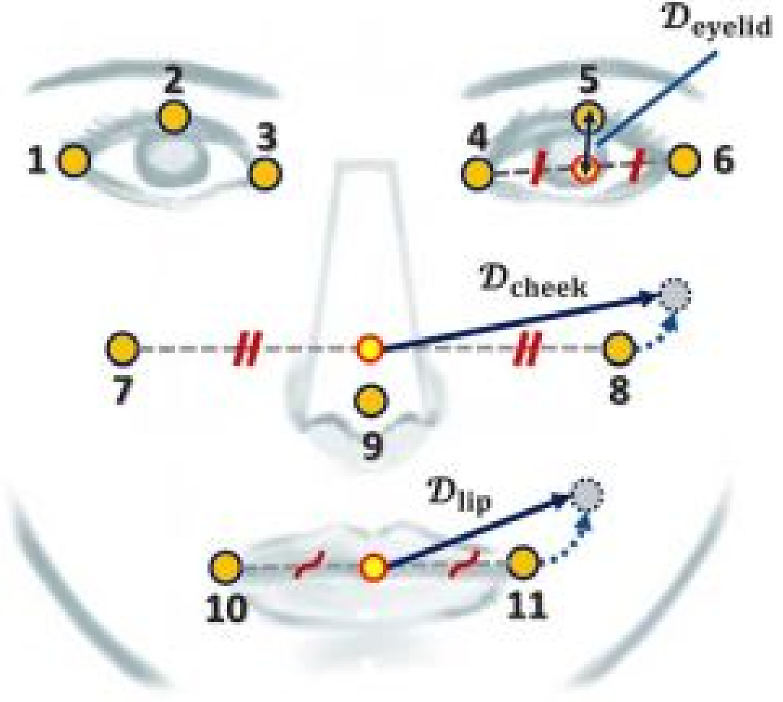




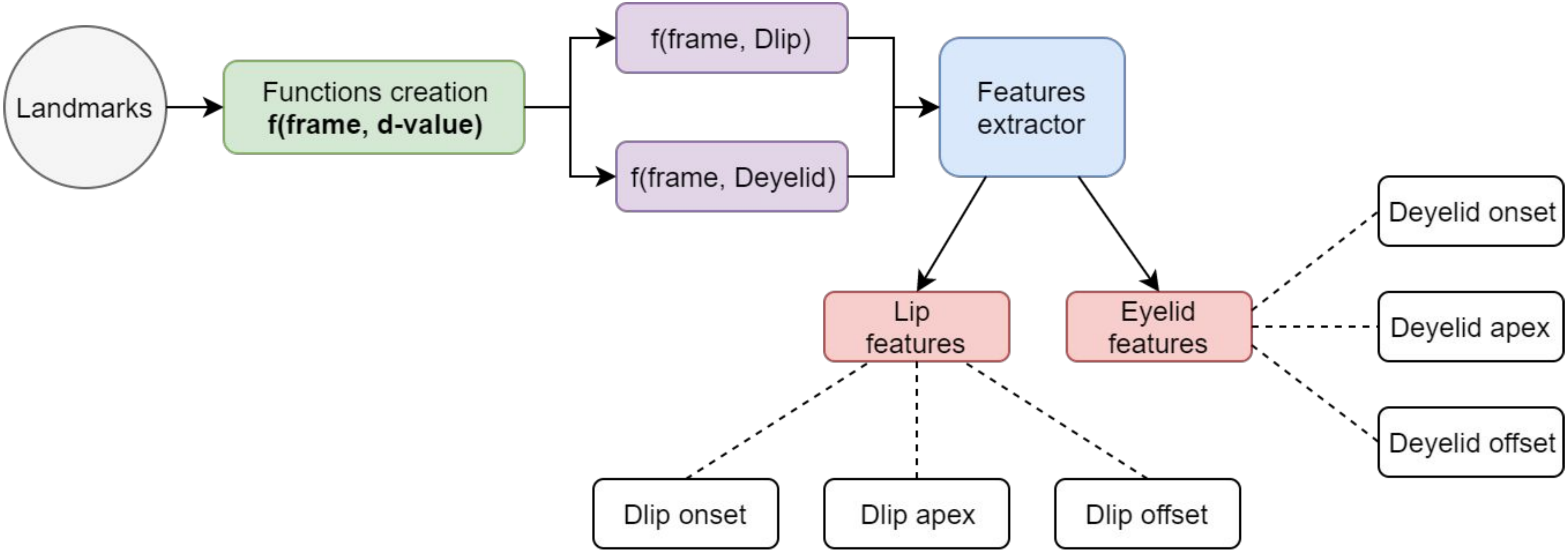
Dlip & Deyelid

$$\frac{\rho\left(\frac{l_{10}^{1}+l_{11}^{1}}{2}, l_{10}^{t}\right)+\rho\left(\frac{l_{10}^{1}+l_{11}^{1}}{2}, l_{11}^{t}\right)}{2\rho\left(l_{10}^{1}, l_{11}^{1}\right)}$$

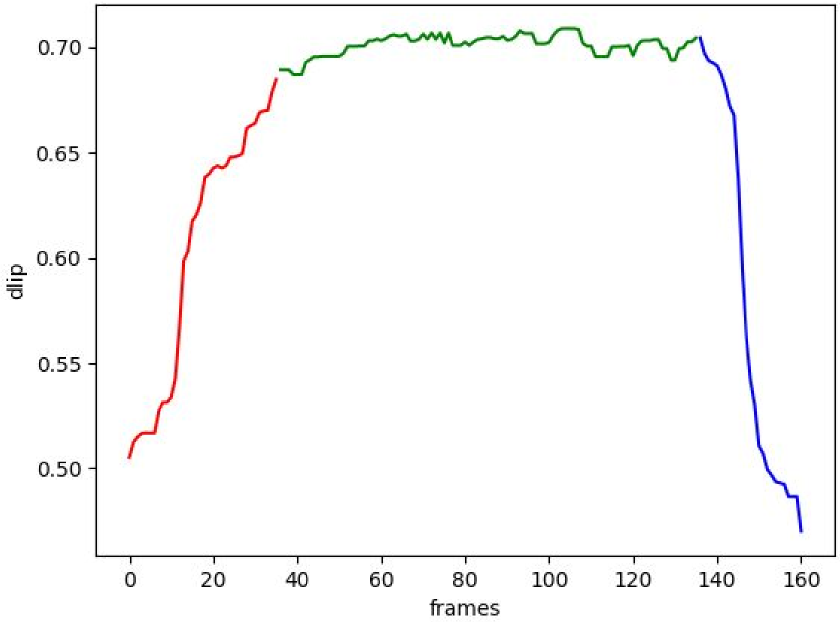
$$\frac{\tau\left(\frac{l_{1}^{t}+l_{3}^{t}}{2}, l_{2}^{t}\right)+\tau\left(\frac{l_{4}^{t}+l_{6}^{t}}{2}, l_{5}^{t}\right)}{2\rho\left(l_{1}^{t}, l_{3}^{t}\right)}$$



Features extraction



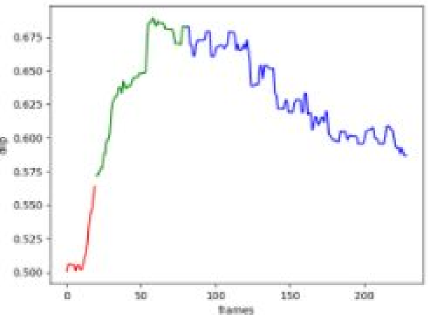
Temporal phase division - 1

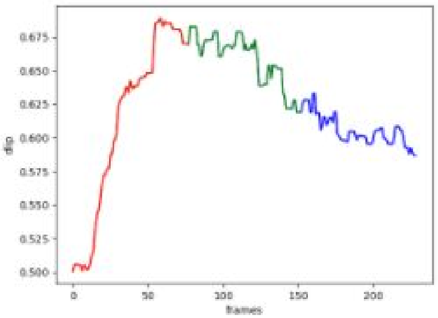


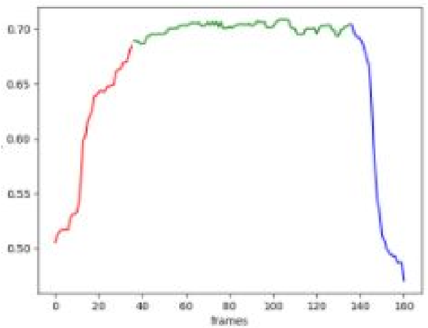
Phase division algorithm:

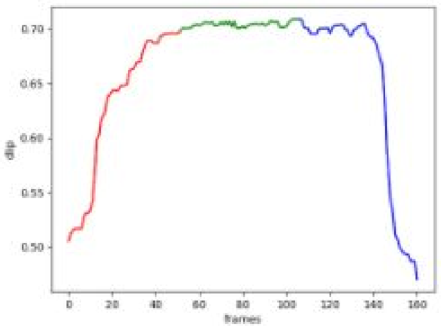
1. Longest run (longest sequences)
2. Clustering based (K-means)

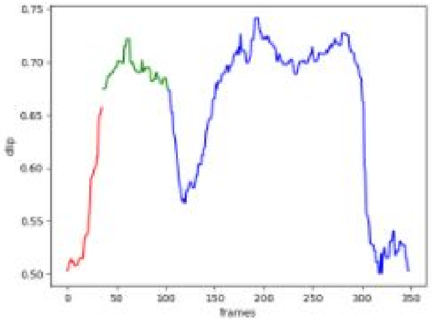
Temporal phase division - 2

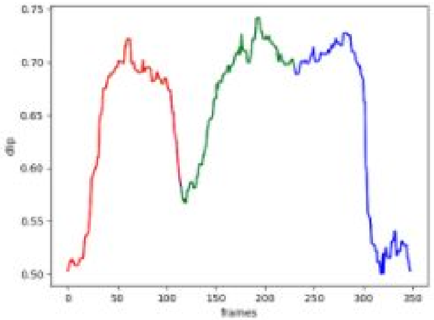








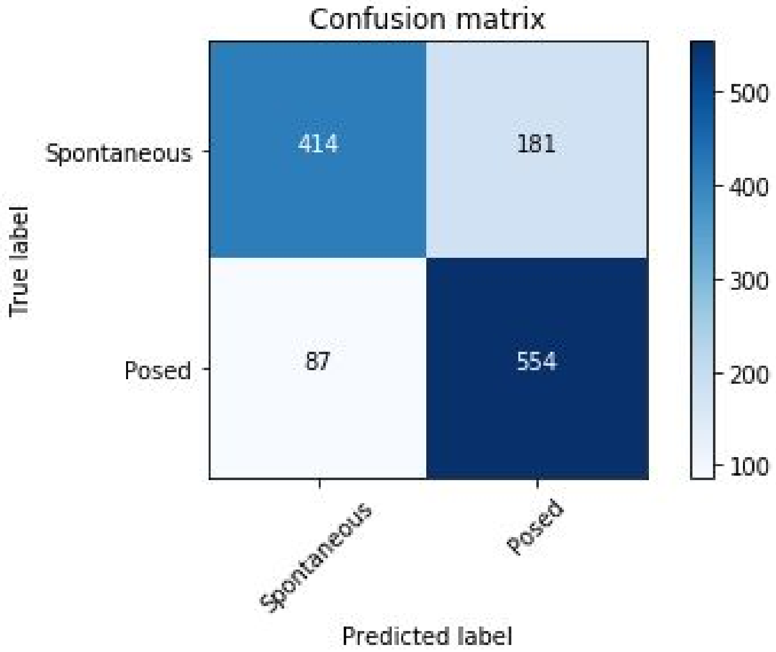




Features to extract

Feature	Definition
Duration^{d}:	$\left[\frac{\eta(\mathcal{D}^+)}{\omega} , \frac{\eta(\mathcal{D}^-)}{\omega} , \frac{\eta(\mathcal{D})}{\omega} \right]$
Duration Ratio^{d}:	$\left[\frac{\eta(\mathcal{D}^+)}{\eta(\mathcal{D})} , \frac{\eta(\mathcal{D}^-)}{\eta(\mathcal{D})} \right]$
Maximum Amplitude^{d,m}:	$\max(\mathcal{D})$
Mean Amplitude^{d,m}:	$\left[\frac{\sum \mathcal{D}}{\eta(\mathcal{D})} , \frac{\sum \mathcal{D}^+}{\eta(\mathcal{D}^+)} , \frac{\sum \lvert\mathcal{D}^-\rvert}{\eta(\mathcal{D}^-)} \right]$
STD of Amplitude^{d}:	$\mathrm{std}(\mathcal{D})$
Total Amplitude^{d}:	$\left[\sum \mathcal{D}^+ , \sum \lvert\mathcal{D}^-\rvert \right]$
Net Amplitude^{d}:	$\sum \mathcal{D}^+ - \sum \lvert\mathcal{D}^-\rvert$
Amplitude Ratio^{d}:	$\left[\frac{\sum \mathcal{D}^+}{\sum \mathcal{D}^+ + \sum \lvert\mathcal{D}^-\rvert} , \frac{\sum \lvert\mathcal{D}^-\rvert}{\sum \mathcal{D}^+ + \sum \lvert\mathcal{D}^-\rvert} \right]$
Maximum Speed^{d}:	$\left[\max(\mathcal{V}^+) , \max(\lvert\mathcal{V}^-\rvert) \right]$
Mean Speed^{d}:	$\left[\frac{\sum \mathcal{V}^+}{\eta(\mathcal{V}^+)} , \frac{\sum \lvert\mathcal{V}^-\rvert}{\eta(\mathcal{V}^-)} \right]$
Maximum Acceleration^{d}:	$\left[\max(\mathcal{A}^+) , \max(\lvert\mathcal{A}^-\rvert) \right]$
Mean Acceleration^{d}:	$\left[\frac{\sum \mathcal{A}^+}{\eta(\mathcal{A}^+)} , \frac{\sum \lvert\mathcal{A}^-\rvert}{\eta(\mathcal{A}^-)} \right]$
Net Ampl., Duration Ratio^{d}:	$\frac{(\sum \mathcal{D}^+ - \sum \lvert\mathcal{D}^-\rvert)\omega}{\eta(\mathcal{D})}$
Left/Right Ampl. Difference^{s}:	$\frac{\lvert \sum \mathcal{D}_L - \sum \mathcal{D}_R \rvert}{\eta(\mathcal{D})}$

Results



Frontalization 1	~50%
Images not frontalized	~74%
Frontalization 2	~75%
Frontalization 2 with optimizations	~78%

Conclusions

Problems:

- dlib is slow
- not-optimal frontalization and phase division algorithm

Improvements:

- other concatenation method
- test with ranges of age
- improvement of dlip
    - real-time analysis
    - end-user application (classify a new video)

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