INFORMATIK

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TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

2D Image Processing & Augmented Reality
Winter Semester 2019/2020
Survey on Face Tracking with Deep Learning

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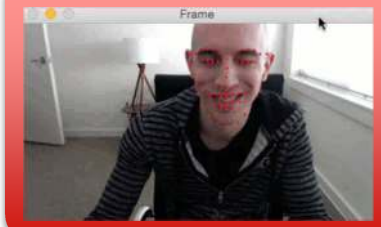
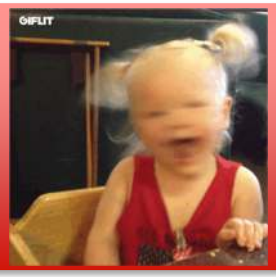
Outline



Face tracking is a computer vision task that involves tracking a specific number of landmarks(keypoints around facial components) on the face detected across all frames of a video.

Applications include Face analysis, Person identification, Activity recognition, Expression analysis, Face modeling etc.



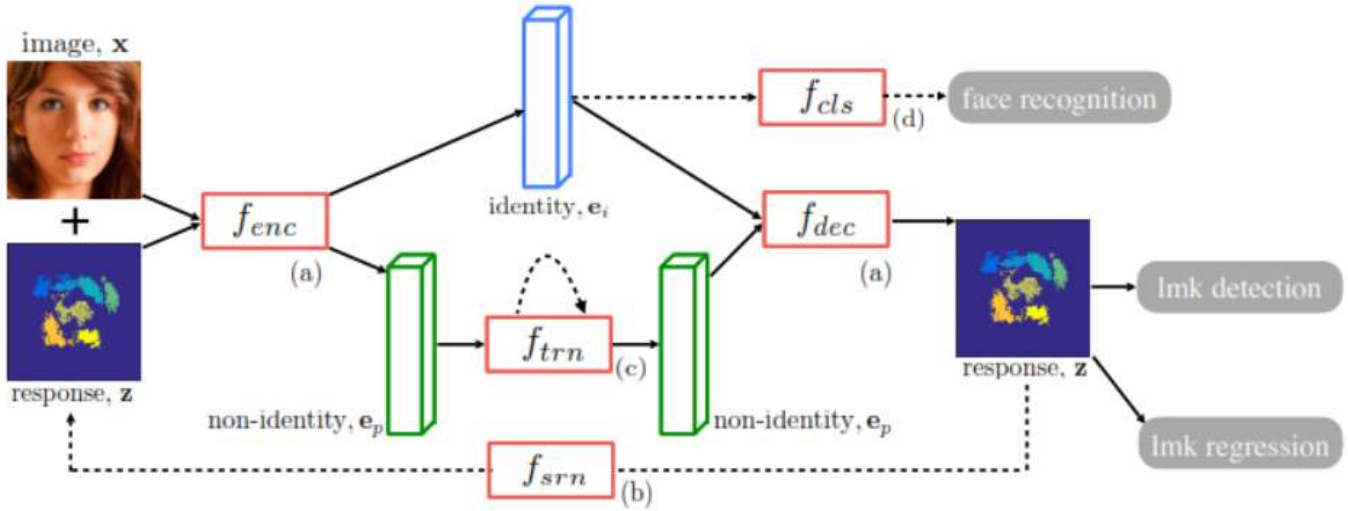
It is a challenging problem as the videos can be captured in unconstrained conditions which may include illumination variations, large head poses, occlusions, etc.

Image source: Google

Methods

- **Image-based methods use models trained on still images in each frame.**
- **Video-based methods make use of temporal information to predict facial landmarks in each frame.**
- **Various approaches –**
  - **Regression-based methods**
  - **Video-based face alignment**
  - **Encoder-Decoder Networks**

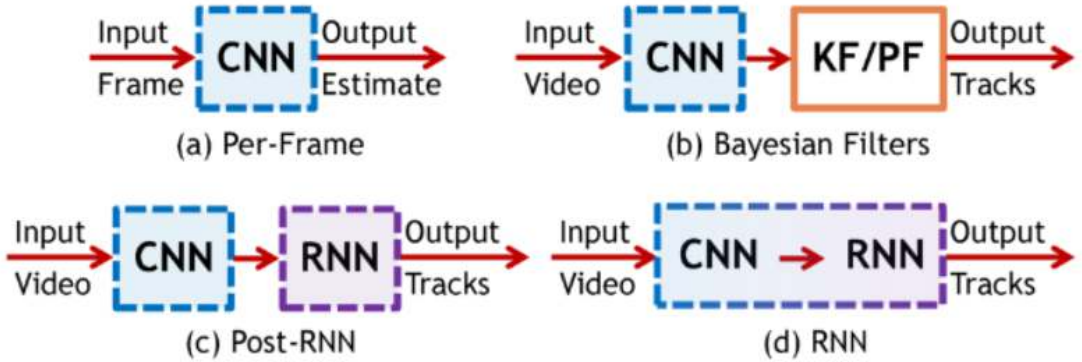
1. Recurrent Encoder-Decoder Network for Video-based Face Alignment



- Employs recurrent learning at both spatial and temporal dimensions.
- At spatial level, face alignment is done in a coarse-fine manner.
- At temporal level, Temporal-variant features such as pose and expression are separated from Temporal-invariant features such as facial identity.

Image source: Xi Peng, Rogerio S. Feris, Xiaoyu Wang, Dimitris N. Metaxas: RED-Net: A Recurrent Encoder-Decoder Network for Video-based Face Alignment(2017).

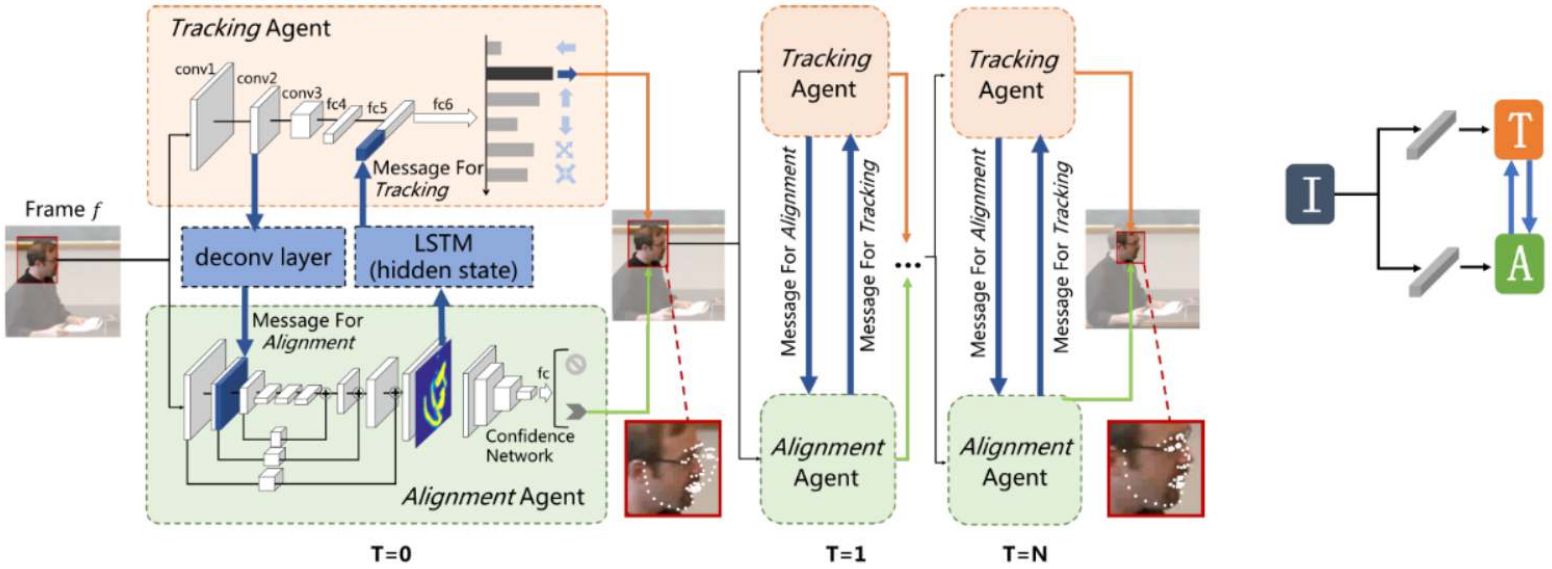
2. Dynamic Facial Analysis: From Bayesian Filtering to Recurrent Neural Network



- Previous approaches for dynamic facial analysis use Kalman/Particle filters.
- Bayesian filters require problem-specific design and tuning.
- This RNN based method avoids tracker engineering by learning from data (sufficient data).
- CNN layers followed by recurrent layers as dense layers.

Image source: Jinwei Gu, Xiaodong Yang, Shalini De Mello, Jan Kautz: Dynamic Facial Analysis: From Bayesian Filtering to Recurrent Neural Network(2017).

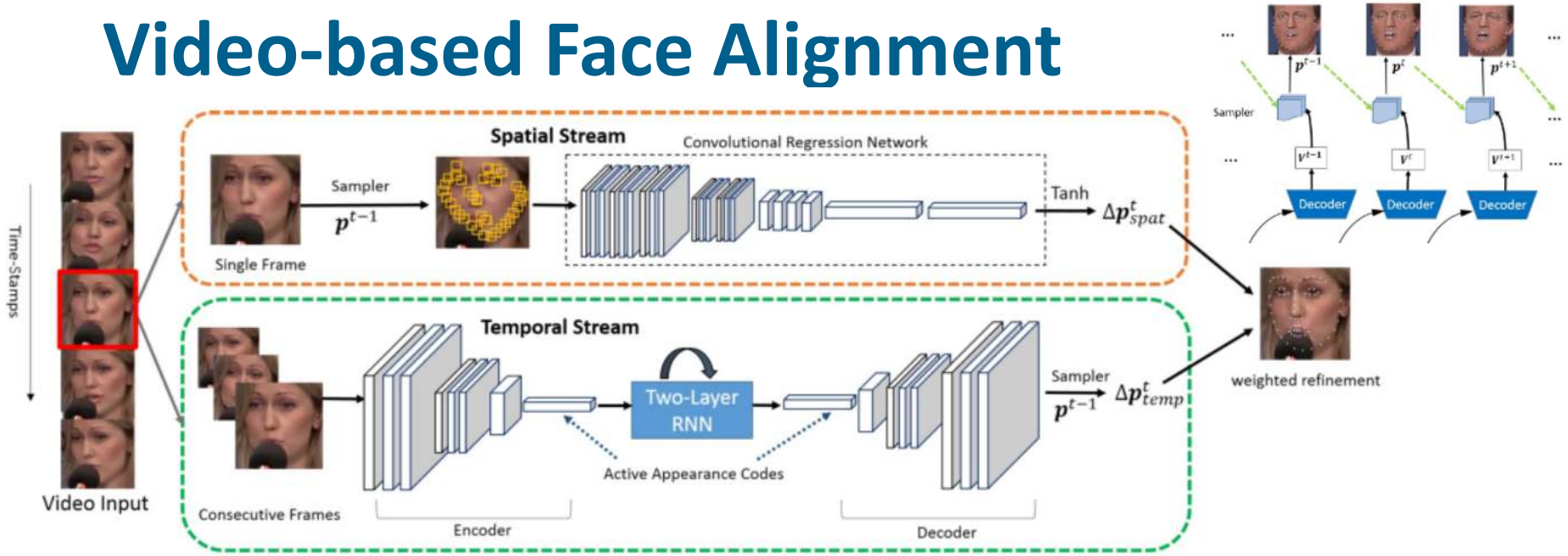
3. Dual-Agent Deep Reinforcement Learning for Deformable Face Tracking



- Exploits the fact that bounding box tracking and landmark detection tasks are dependent.
- The two tasks are modeled in a probabilistic manner by following a Bayesian model.

Image source: Minghao Guo, Jiwen Lu, and Jie Zhou: Dual-Agent Deep Reinforcement Learning for Deformable Face Tracking(2018).

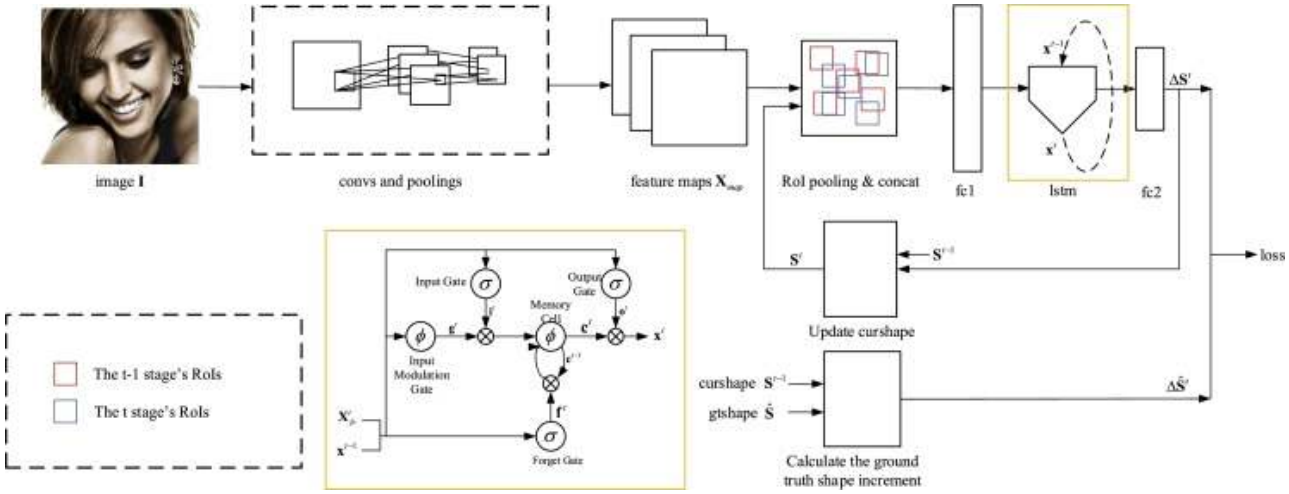
4. Two-stream Transformer Networks for Video-based Face Alignment

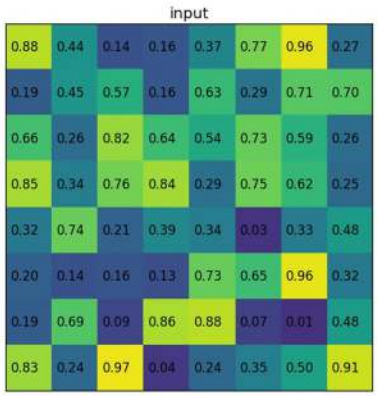


- Two stream deep learning method to capture spatial as well as temporal information.
- Facial landmarks are determined by a weighted fusion of spatial and temporal streams.

Image source: Hao Liu, Jiwen Lu, Jianjiang Feng, Jie Zhou: Two-Stream Transformer Networks for Video-based Face Alignment(2017).

5. Face Alignment Recurrent Neural Network





- Recurrent regression based approach
- Uses LSTM to exploit both spatial and temporal information.

Image source: Qiqi Hou, Jinjun Wang, Ruibin Bai, Sanping Zhou, Yihong Gong: Face Alignment Recurrent Network(2017).
ROI pooling - https://i.stack.imgur.com/rJL7D.gif

Comparison metrics

Following are some of the metrics that will be used to compare the various methods in this survey :–

- **Dataset used for training (In the wild vs constrained)**
- **Evaluation metrics**
- **Number of landmarks tracked**
- **Kind of landmarks retrieved (2D or 3D)**
- **Robustness to large pose variations, illumination changes**

References

1. Xi Peng, Rogerio S. Feris, Xiaoyu Wang, Dimitris N. Metaxas: RED-Net: A Recurrent Encoder-Decoder Network for Video-based Face Alignment(2017).

2. Jinwei Gu, Xiaodong Yang, Shalini De Mello, Jan Kautz: Dynamic Facial Analysis: From Bayesian Filtering to Recurrent Neural Network(2017).

3. Minghao Guo, Jiwen Lu, and Jie Zhou: Dual-Agent Deep Reinforcement Learning for Deformable Face Tracking(2018).

4. Hao Liu, Jiwen Lu, Jianjiang Feng, Jie Zhou: Two-Stream Transformer Networks for Video-based Face Alignment(2017).

5. Qiqi Hou, Jinjun Wang, Ruibin Bai, Sanping Zhou, Yihong Gong: Face Alignment Recurrent Network(2017).

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Thank You