

Tremor Detection Using Motion Filtering and SVM

Bilge Soran, Jenq-Neng Hwang, Linda Shapiro, ICPR, 2012

Tremor Detection Using Motion Filtering and SVM [Soran et al., ICPR'12]

- Problem: Automatic hand tremor detection using a static camera

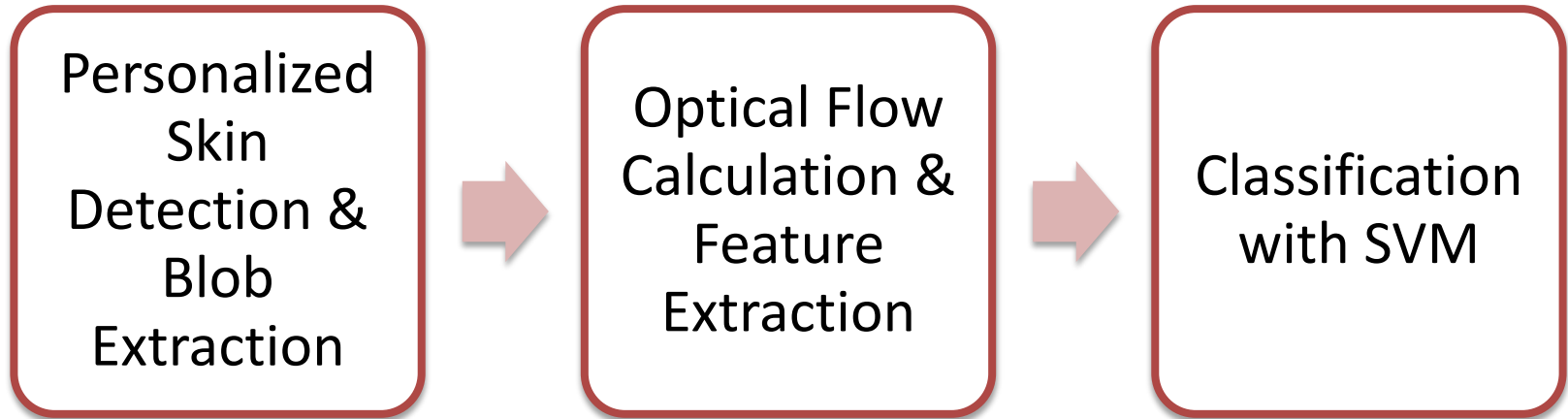


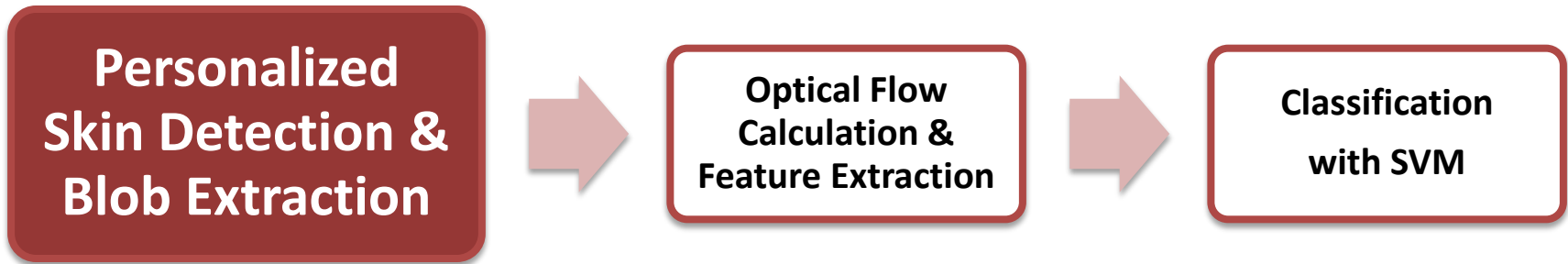
- Motivation: Providing doctors objective information for diagnosis

Related Work

- [Garg et al., 2009] categorize the hand gesture recognition approaches into 3D model-based and appearance-based.
- [Murthy and Jadon, 2009] adopted an appearance based approach based on low-level hand features from intensity images.
- [Uhrikova et al., 2009] measures the hand tremor frequencies. They compared their calculated frequencies with those measured by an accelerometer.

Method



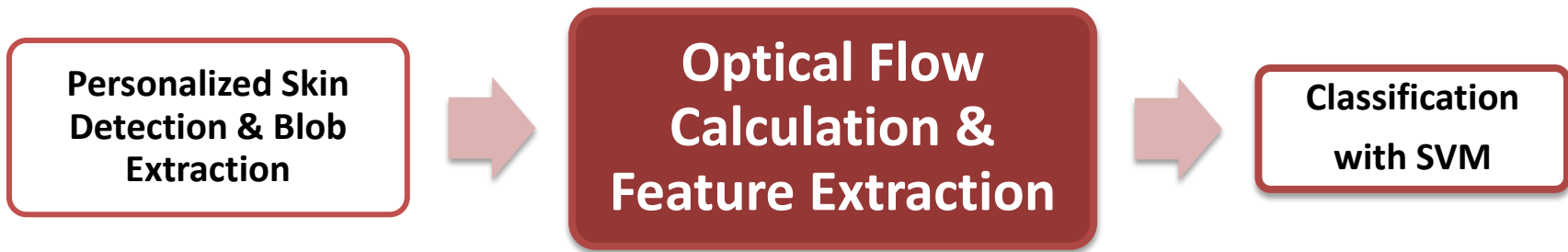


Input:

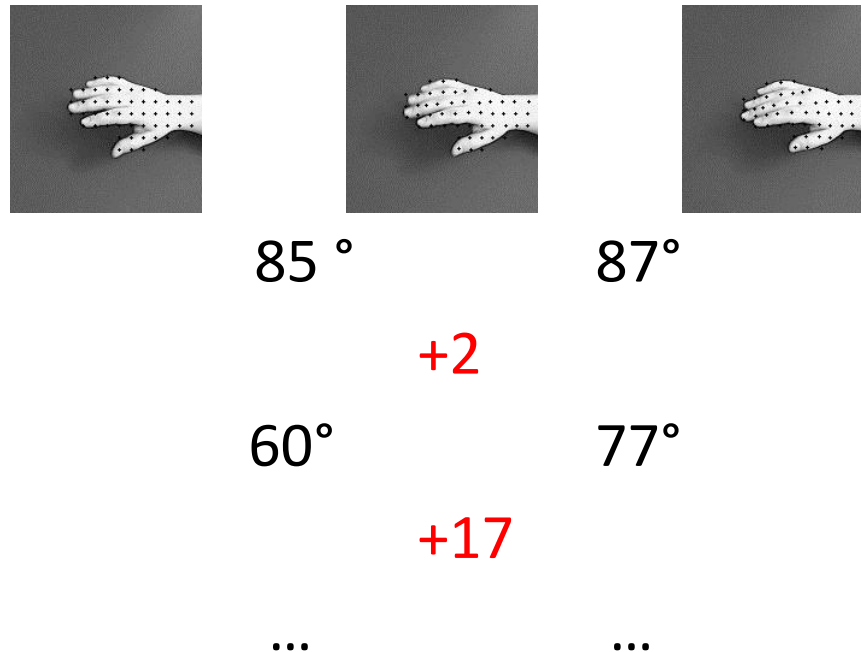
- Video of a patient waving his hand for ~3 sec

Method:

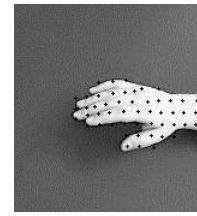
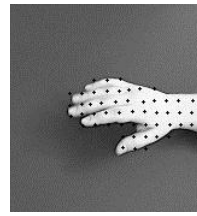
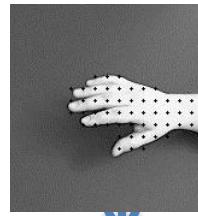
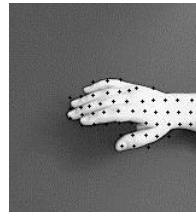
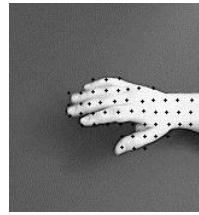
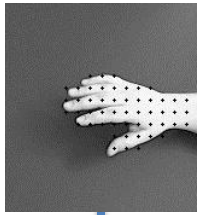
- Apply skin color thresholds
- Compute optical-flow and extract moving regions
- Merge regions and compute color histograms
- Fit Gaussian function to use as personalized skin model
- Perform Blob Detection, discard small regions.



For each blob compute optical-flow direction and direction change using 3 consecutive frames:



1. Calculate sum of motion direction change: **+19**
2. The sign of the sum shows the general direction change of the flow: up or down.



This becomes our feature vector from one video

+32.28

-25.41

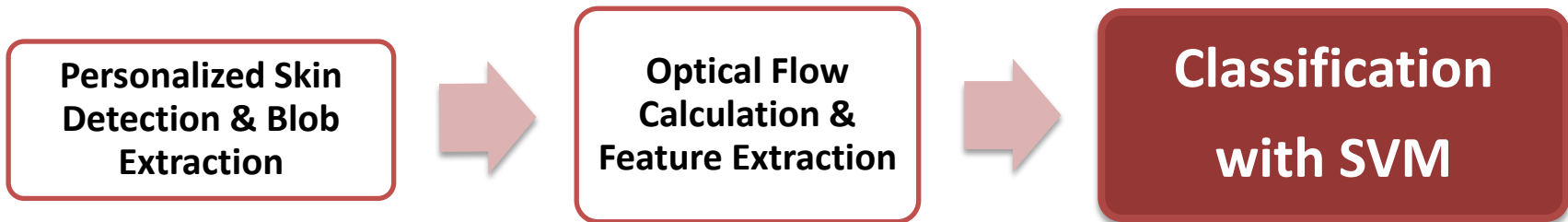
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- Sort the direction changes descending. If sum is (-) use average direction change of the last 25% points, else use that of the first 25% points as the feature component.
- Start the process from the next frame with a new blob extraction, since optical flow accumulates error.
- Apply Discrete Cosine Transform
- Apply MDL Discretization [Fayyad and Irani, 1993] obtaining final Motion Direction Change (MDC) features.

Dataset

- 90 positive (simulating tremor), 83 negative
- Static camera, 30 fps
- Indoors, static background
- 6 human subjects





% of MDC Features from Hand Region	LOOCV
10 %	79.2 %
10 % with MDL discretization	89.6 %
25 %	86.7 %
25 % with MDL discretization	95.4 %

Discussion

- Requires a single short video, minimizes diagnostic discomfort
- Automatically detects hand tremors with 95.4% accuracy using LOOCV
- Distinguishes very subtle motions and tremor-like movements from tremors
- False negative rate is close to zero

