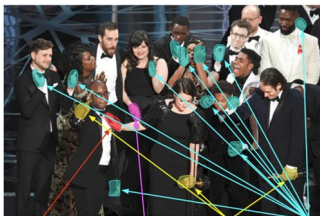


Detecting Hands and Recognizing Physical Contact in the Wild

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Goal

1. Detect hands
2. Recognize Physical Contact state: No-Contact, Self-Contact, Other-Person-Contact, Object-Contact



Other-Person-Contact Self-Contact Object-Contact No-Contact

Applications

1. Computer Vision: Action/ Gesture Recognition
2. Augmented/ Virtual Reality: Smart glasses (Oculus, Hololens)
3. Robotics: Robotic arm grasping and object manipulation
4. Societal: Hand contact tracing (virus spread mitigation), Harassment detection

Contributions

1. CNN-based architecture to jointly detect hands and recognize physical contact
2. Large-scale in-the-wild dataset annotated with hand locations and their contact states
3. Two attention methods for hand contact recognition

Approach

Based on RCNN framework

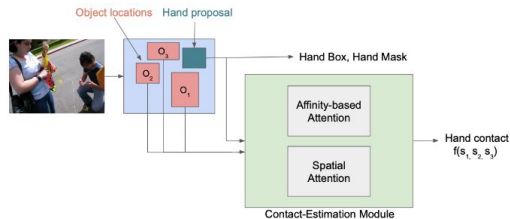
To Detect Hand

1. Generate hand bounding box and hand mask from hand proposals

To Recognize Hand Contact State

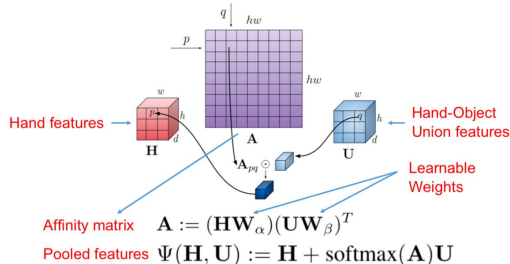
1. Detect other objects
2. Obtain score for each hand-object pair
3. Combine scores to obtain contact state score for the hand

Architecture



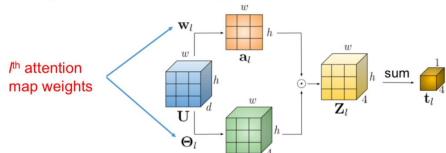
Score for each hand-object pair

1st score: Using Cross-feature Affinity-based Attentional Pooling
Pool hand-object union features $U \in \mathbb{R}^{n \times d}$ to the hand features $H \in \mathbb{R}^{n \times d}$ based on affinities, $n := hw$ is the number of spatial locations



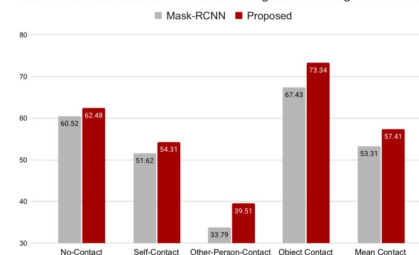
2nd score: Using Spatial Attention

- Learn L attention maps to select salient regions from hand-object union features
- For each attention map, sum scores from all spatial locations weighted by attention map
- Average scores corresponding to all L attention maps



Experiments

Joint Hand Detection and Contact Recognition Average Precision



Qualitative Results



No-Contact Self-Contact Other-Person-Contact Object-Contact

Failure Cases



No-Contact Self-Contact Other-Person-Contact Object-Contact

Code & Data



<https://github.com/cvlab-stonybrook/ContactHands>