Head Motion Signatures from Egocentric Videos

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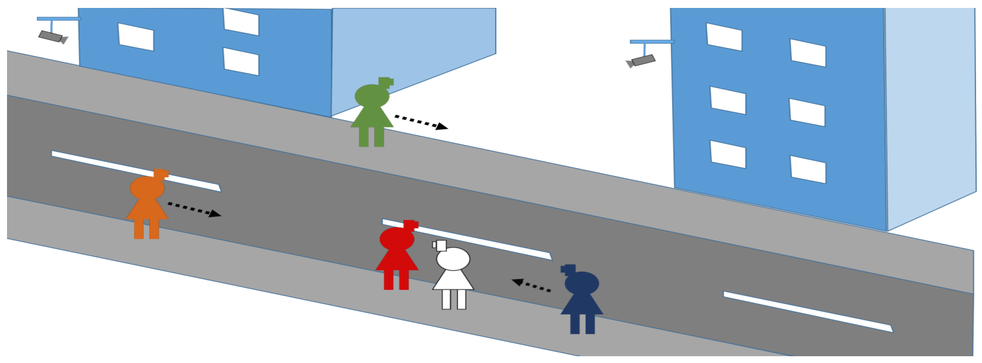
1. Motivation

❖ Egocentric cameras are becoming increasingly popular.

❖ Increasing number of cities are coming under 24X7 video surveillance.

❖ The following scenario is becoming increasingly likely: people ("subjects") using egocentric cameras are captured on security cameras, or by other people ("observers") with egocentric cameras.



❖ Subjects would like to query if they were captured in observer's video, without revealing identifying information about themselves.

2. Approach

A protocol and an algorithm for privacy preserving querying and certifying the identity of a person (subject) captured in a video.

Approach

Subject computes signature for his head activity

↓

Subject sends the signature to observers present nearby

↓

Observer computes head activity signatures of the person he sees in his video

↓

If any signature computed by observer matches with the one sent by subject, a match is declared

↓

Observer sends his video clip to the subject if a match is declared

Why not 'standard' biometric methods?

❖ Face Picture: Observer learns the identity of subject in the query. He can use the face he received to search for the subject in other videos.

❖ Biometric Signatures like gait pattern etc. can also be used to search for the subject elsewhere

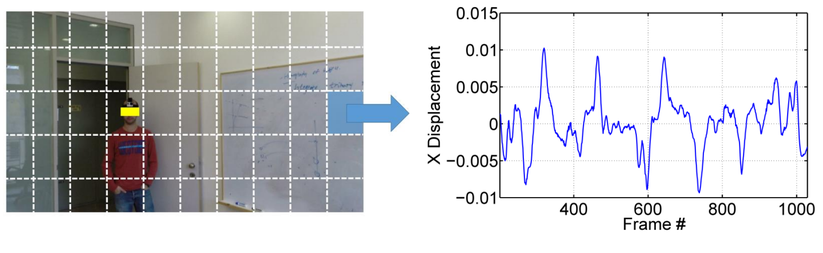
❖ Face Classifier: Subject may be impersonating someone else.

3. Subject Signatures

❖ Subject is wearing an egocentric camera on his head/glasses. Optical flow as seen in subject's video is dominantly due to his head movement.

❖ Compute optical flow for each pair of adjacent frames in the video.

❖ Optical flow over time represents subject's head activity and is the subject's signature.



4. Observer Signatures

❖ Observer sees a person in his video, and finds feature points on the face and torso of the person.

❖ The person's signature is the variation over time of the relative displacement between the face and the torso

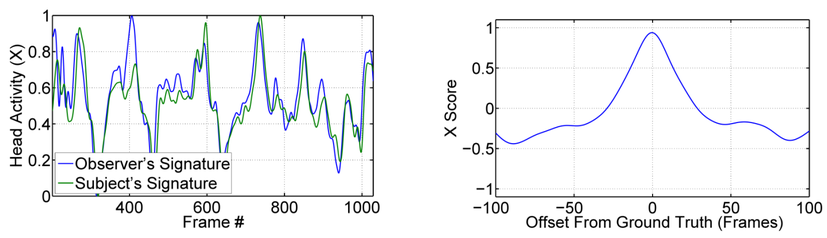
5. Matching Score

❖ Pearson Correlation Coefficient

$$\rho(X,Y) = \frac{Cov(X,Y)}{\sigma_X \sigma_Y} = \frac{E\,[(X-\mu_X)(Y-\mu_Y)]}{\sigma_X \sigma_Y}$$

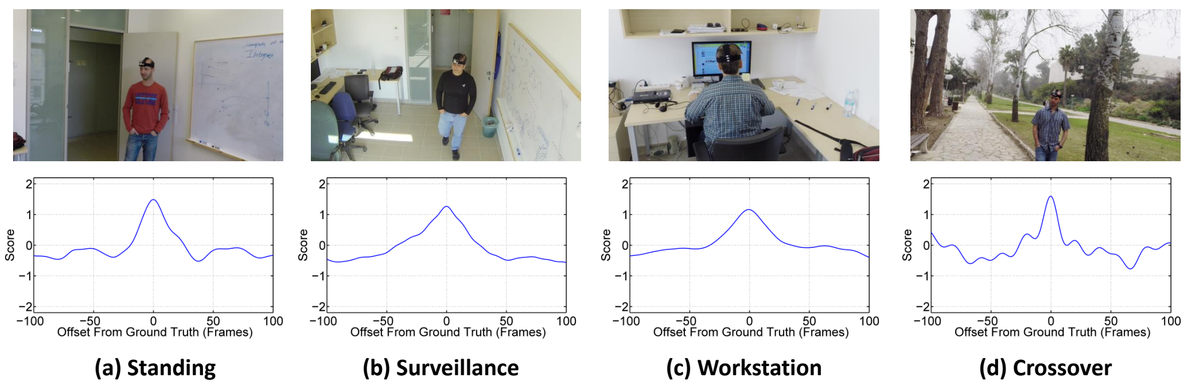
❖ Subject's signatures: S_x and S_y. Observer's signatures: O_x and O_y.

❖ $Score = |\rho(S_x, O_x)| + |\rho(S_y, O_y|$



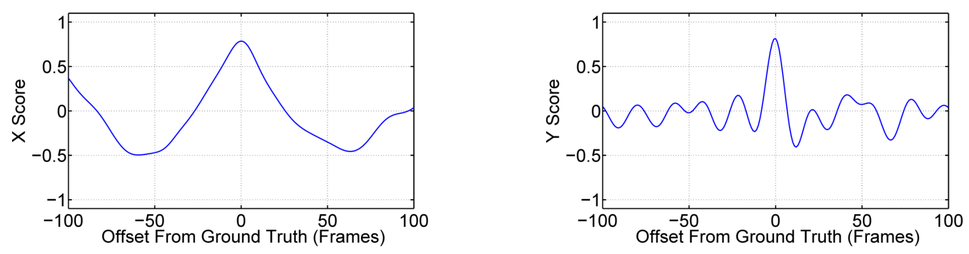
6. Experiments

Different Scenarios

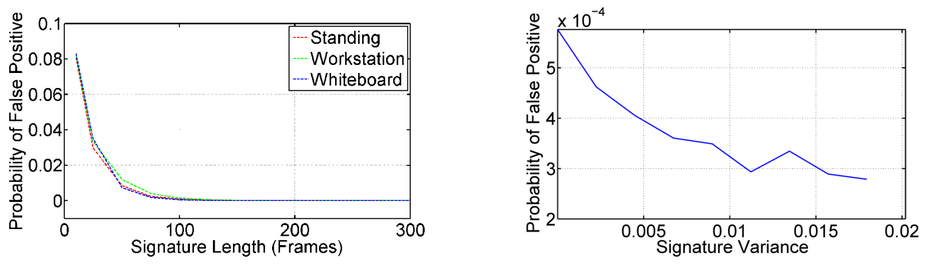


(a) Standing (b) Surveillance (c) Workstation (d) Crossover

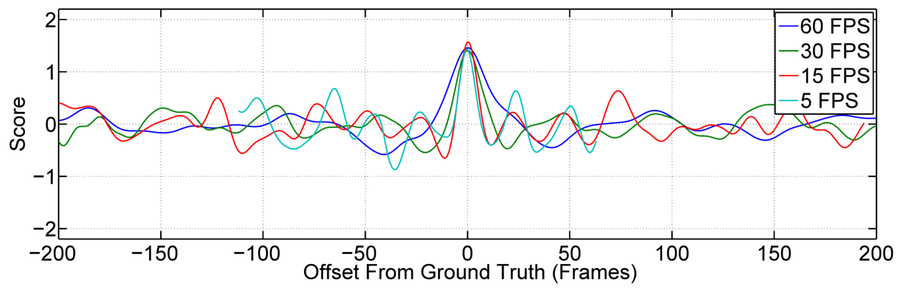
Walking Experiment



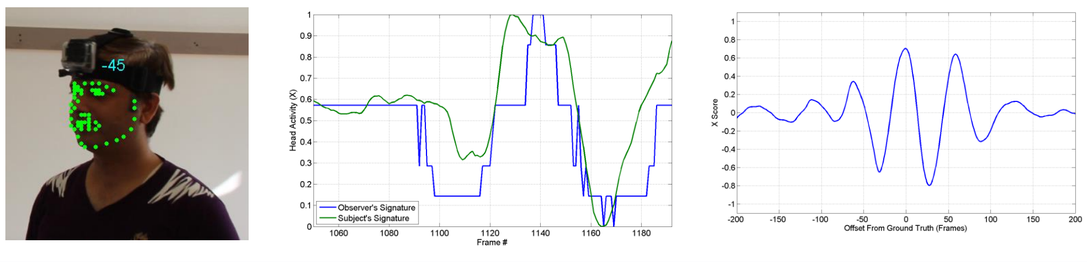
Signature Uniqueness



Effect of FPS



Comparative results using face pose estimation



Acknowledgement

This research was supported by Intel ICRC, The Israel Ministry of Science and The Israel Science Foundation.