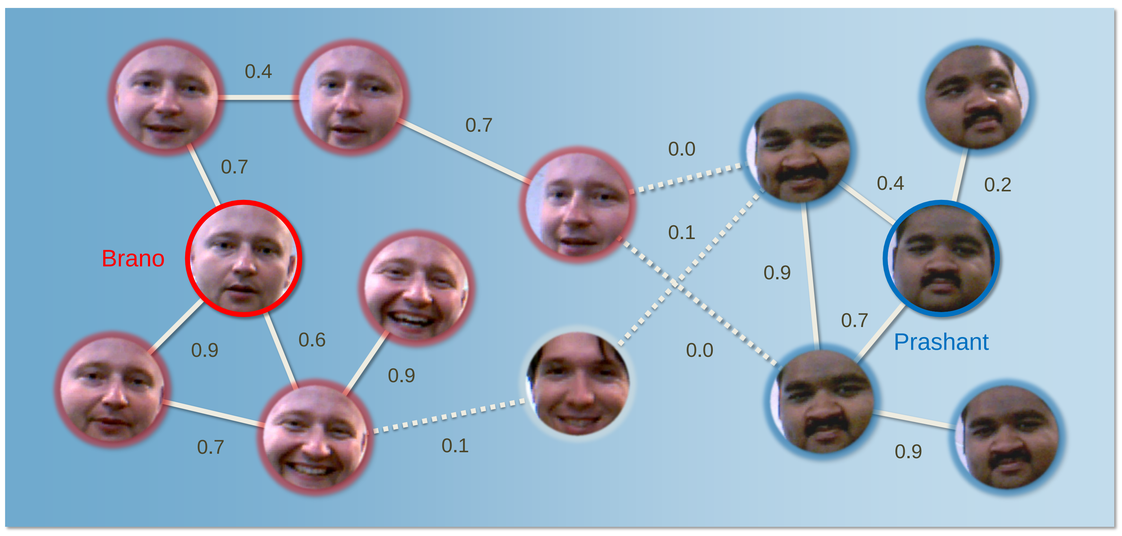
Robust Face Recognition Using Online Learning

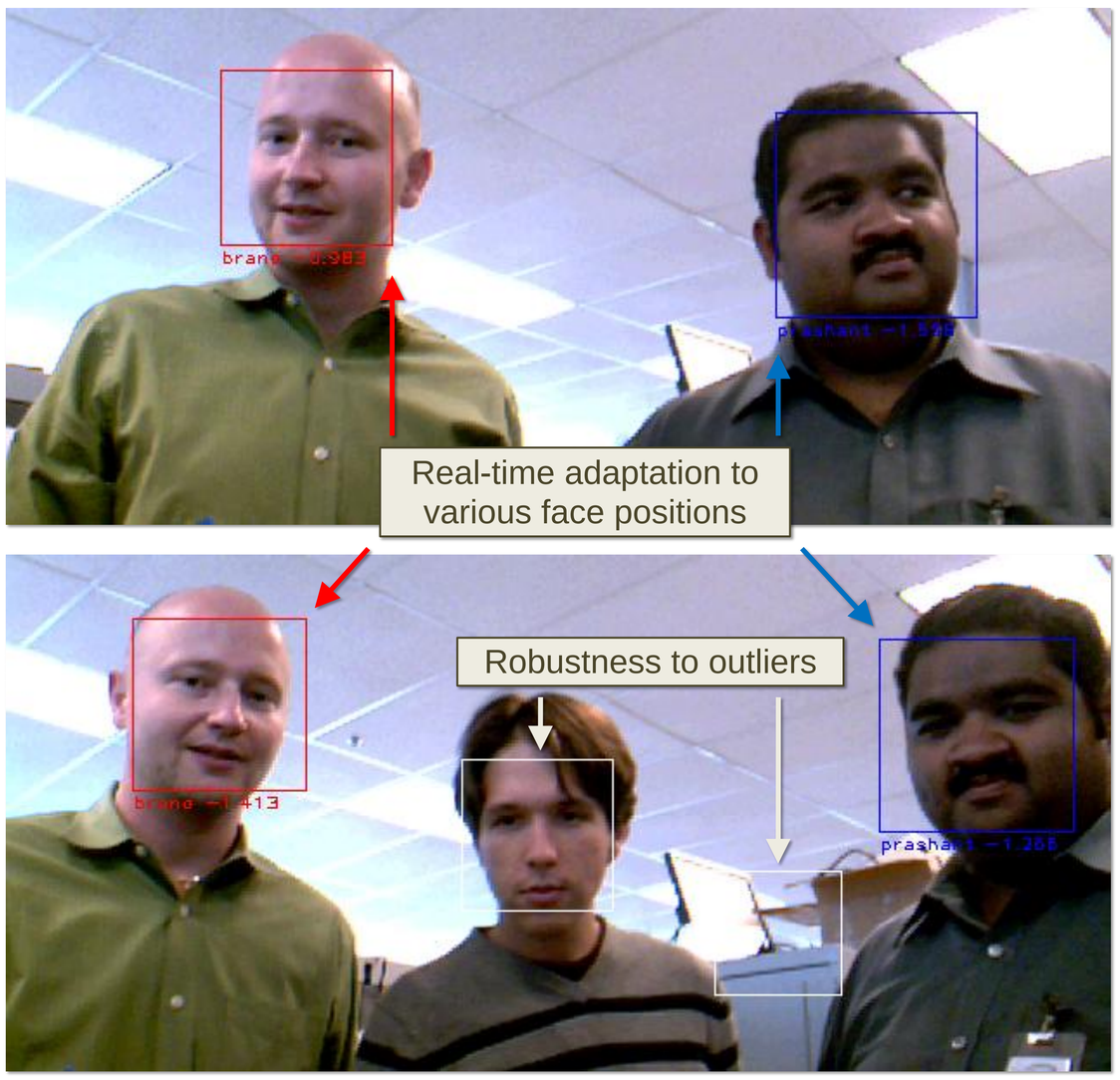
Everyday Sensing and Perception

REAL-TIME LEARNING WITHOUT EXPLICIT FEEDBACK

High-accuracy face recognition with a sufficiently high recall (90/90) is a challenging problem. This project investigates how to achieve this efficiently with just a few labeled examples, streams of unlabeled data, and state-of-the-art machine learning techniques.



An example of a similarity graph over faces. The faces are vertices of the graph. The edges of the graph connect similar faces. Labeled faces are outlined by thick solid lines.



Two real-time video sequences and the corresponding face IDs inferred by our online face recognition algorithm.

Goal

A face recognition algorithm that:

- Has a high accuracy
- Has a high recall
- Is robust to outliers
- Runs in real time

Approach

Online (real-time and incremental) learning of a similarity graph over observed faces and inference of face IDs based on the structure of the graph.

Challenges

High accuracy and a high recall are contradicting objectives. Achieving both with standard ML algorithms is typically impossible (unless the training set closely resembles the test set).

Adaptive ML algorithms can help to achieve this objective. The problem is that no explicit feedback (labels) is provided in real time.

Algorithm (time step t):

- Remove outliers from the graph
- If the graph is too large, merge the two closest vertices of the graph
- Add the new face to the graph
- Infer the ID of the face based on the structure of the graph (a random walk that starts at the new face and terminates at the labeled faces)

Other Results

On a real-time video from ILS Open House 2008, the algorithm can recognize faces of 3 people (Matthai, Xiaofeng, and Sunny) with 90+ percent accuracy over 90+ percent of time. The accuracy is more than 10 percent higher than the accuracy of a state-of-the-art solution.

PROJECT TEAM

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