Face Recognition for Smart Interactions

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Abstract

The face recognition efforts in the research group "Computer Vision for Human-Computer Interaction" (CV-HCI) at the Universität Karlsruhe (TH) concentrate on the development of a fast and robust face recognition algorithm and fully automatic face recognition systems that can be deployed for real-life smart interaction applications. Our face recognition algorithm is based on appearances of local facial regions that are represented with discrete cosine transform coefficients. Many fully automatic face recognition systems have been developed based on this algorithm. Among these systems two of the portable ones - an open-set verification system, and a system for interactive person retrieval in multimedia - will be shown as interactive demos. Moreover, demo videos will be shown for the other systems. This paper, we give a short overview of the systems that will be presented.

1. Introduction

Person identification is one of the most crucial building blocks for smart interactions. We classify the smart interaction applications we have developed into three groups[1]:

1. Face recognition for smart environments: This application group comprises the identification tasks at a constant location [6, 8, 10, 11, 13]. For example, in a smart home, family members can be identified while they are entering the rooms of the house and their location can be determined in order to automatically route incoming phone calls. This application group requires identification of people without any cooperation, and under uncontrolled conditions, without any constraints on head-pose, illumination, use of accessories, etc.
2. Face recognition for smart machines: In this application group, a machine identifies the subject that it interacts with. For instance a car that identifies its driver [9], a laptop that recognizes its user, or a robot that recognizes the person it serves [4]. In this application group an implicit cooperation exists between the person and the machine due to the standard actions the person performs, e.g. the driver looking at the road, or the computer user looking at the screen. Therefore, the head pose variations are limited in such systems. The difficulty in this group arises due to changing environmental conditions.
3. Face recognition for smart image/video retrieval: In this application group, face recognition is used as a search tool to retrieve relevant images or videos. It is the most difficult application case, since all the conditions are completely unconstrained.

In the demo session we will show two interactive demos, as well as the demo videos of the systems that are not possible to transport.

2. Systems

In this section an overview of the developed systems, that are not possible to transport, is given. Only demo videos of these systems will be shown.

2.1. Identifying Subjects in a Smart Room

This system is deployed at a seminar room. Four cameras are mounted at the corners of the room. Identification is done using video-streams acquired from these four cameras [6, 8, 10, 11, 13].

2.2. Recognizing Individuals Entering a Room

The system is deployed at the entrance door of a seminar room. The camera is located opposite the door at a distance of six meters. Individuals are recognized automatically when they enter the room [6].

[1]The videos of the systems can be downloaded from http://isl.ira.uka.de/~ekenel/ICBvideos.zip

2.3. Face Recognition for Humanoid Robots

The system is deployed on a robot and uses a stereo camera for image acquisition. It identifies the person interacting with the robot [4].

2.4. 3D Face Recognition

In the system, 3D point clouds are registered to provide dense correspondence between faces. Depth images are constructed from the corresponding well-registered point clouds. The system utilizes depth map images to extract local features and performs identification using local appearance-based face recognition [5].

3. Demos

There will be two demos. They can be shown alternatively or, if the space permits, simultaneously.

3.1. Portable Open-set Face Recognition

In the system, faces are automatically detected and registered. The local appearance-based face recognition method is utilized for representing the faces [12, 14]. An identity verification component is trained for every known subject in the database. Open-set identification is performed via a series of verification processes.

The system has been developed as a visitor interface, where a visitor looks at the monitor before knocking on the door. A welcome message is displayed on the screen. While the visitor is looking at the welcome message, the system identifies the visitor unobtrusively without needing person's cooperation. According to the identity of the person, the system customizes the information that it conveys about the host.

In the demo, the persons can interact with the system. They can try whether the known/unknown person discrimination works properly. If they want to be recognized, they can train themselves on the fly.

3.2. Identity-based Interactive Video Retrieval

The system automatically detects and tracks persons in video sequences of TV series, and extracts features from these tracks which can be used to reliably identify the persons in the video.

In the demo, the user of the system selects a person from a scene and the system returns scenes in the video that contain the same person. The user can refine the search interactively by simply clicking on the falsely retrieved faces.

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