Automatic Face Recognition System Architecture for CVEs

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Introduction

- Collaborating participants are represented in virtual world by Avatars
- Avatars must be correctly assigned to participants, as they
  - Enter
  - Leave
  - Navigate

Identifying / tracking participants

- Tagging
  - Participants wear sensor or tag
  - *Simple*, but *unnatural* inconvenience
- Identity
  - Biometric identification and tracking
  - Facilitates *naturalness* which is goal of virtual environments.

Biometrics

- *Identification or identity verification of an individual based on physiological or behavioural characteristics*
  - Fingerprint pattern
  - Face Image
  - Voice Characteristics
  - Iris image
  - Gait
  - Typing Dynamics, etc.

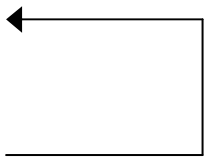
Automatic *Face Recognition*

Advantages:

- AFR is the most *mature* of appropriate technologies
- Allows sufficiently *high speed* operation
- Requirement for *cooperation* of participant is minimized

Face Recognition Operation

- Acquire image.
- Evaluate quality



- Locate image landmarks (eye locs.)
- Rotate / Scale → Cannonical Image
- Create *template*
- Compare *live* template to *stored* template

Biometric Application Types

- Verification (1 to 1)
  - *Is this the person they claim to be?*
- Identification (1 to Many)
  - *Is this person in this list?*

  Or
  - *Is this person* not *who they claim* not *to be?*

Types of biometric identification

- 1 to Few
  - Search list is relatively small (<1,000)
  - Each record can be compared in seconds
  - This application
- 1 to Many
  - Search list is too large to search quickly
  - Specialized “binning” techniques to minimize direct biometric search space

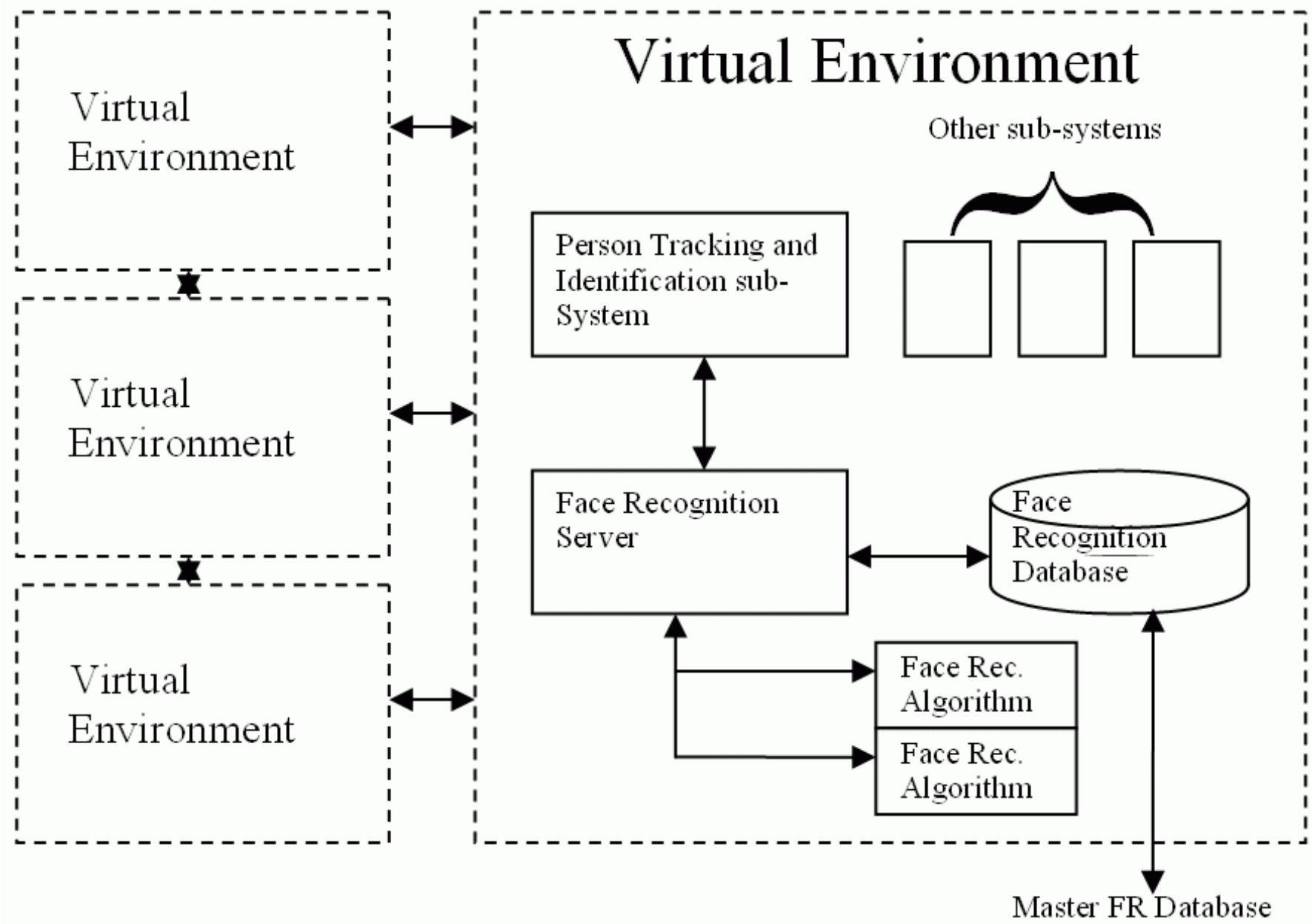
AFR Requirement for CVE

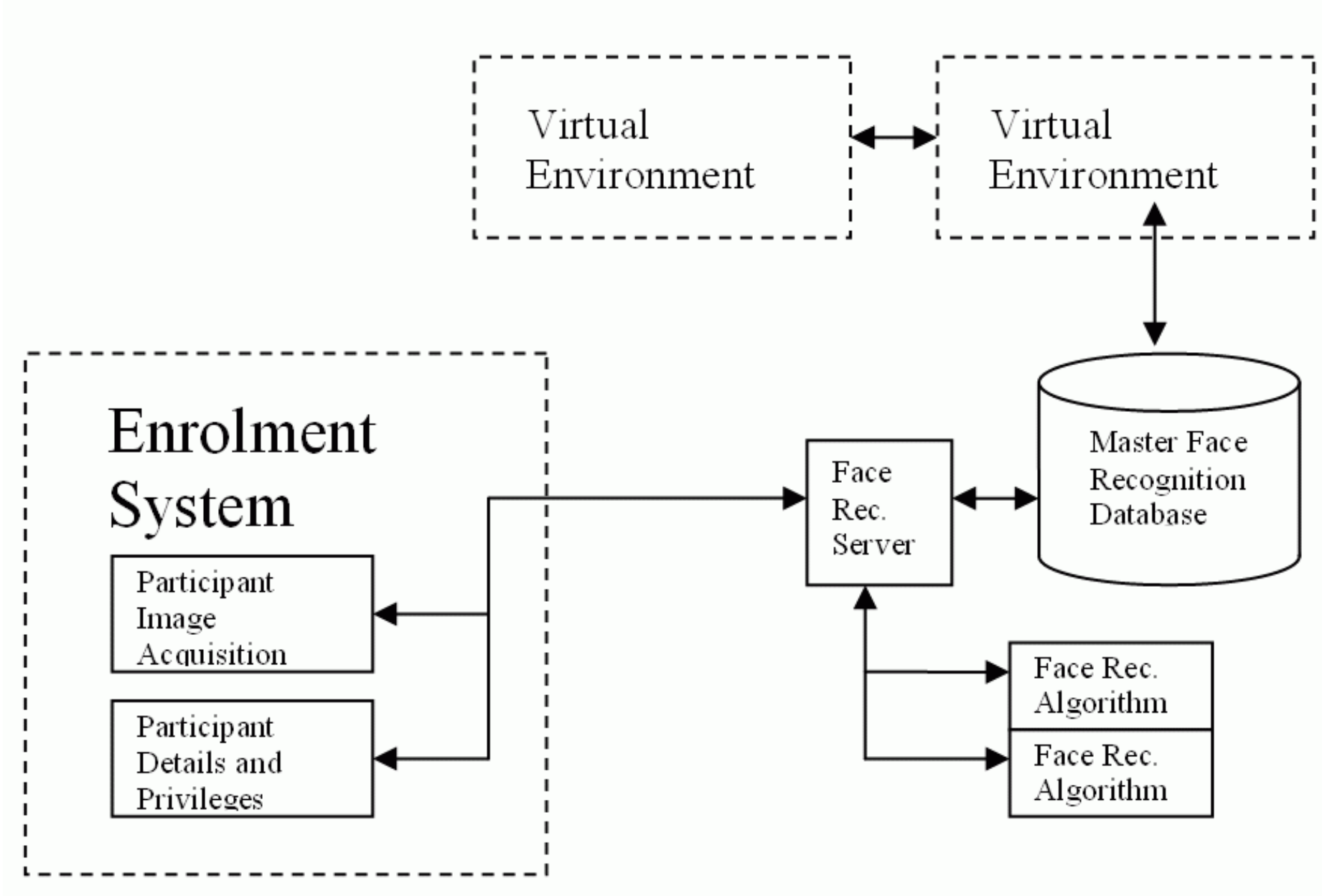
- *Template Ageing* is low
- Variability in *pose*
- *Video* available
- Extra image areas may be considered
- Security policy linked to identity
- Processing speed

AFR Requirement (cont'd …)

- "Fuzzy" requirements for identification
- Network architecture
- Works with multiple FR algorithms

Following slides shows FR components in CVE


Virtual Environment
Virtual Environment
Virtual Environment
Virtual Environment
Other sub-systems
Person Tracking and Identification sub-System
Face Recognition Server
Face Recognition Database
Face Rec. Algorithm
Face Rec. Algorithm
Master FR Database

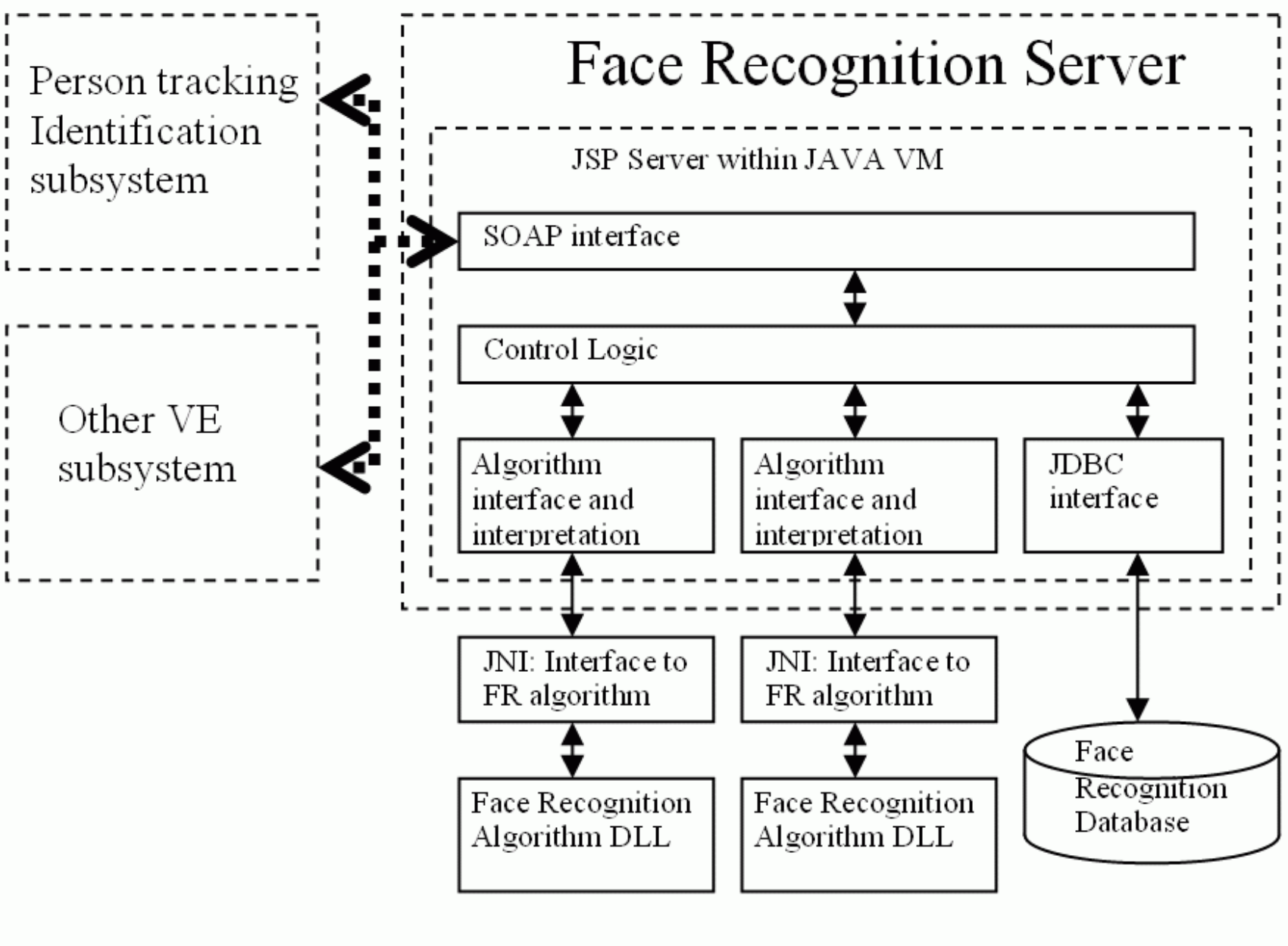

Virtual Environment
Virtual Environment
Enrolment System
Participant Image Acquisition
Participant Details and Privileges
Face Rec. Server
Master Face Recognition Database
Face Rec. Algorithm
Face Rec. Algorithm

Design of AFR architecture

- Currently, AFR algorithms are available in the form of SDK or library code. There are no network biometric API specifications.
- In order to meet system requirements, a networked identification architecture is required
- Design uses SOAP interface to JSP engine.
- Interface to AFR components is via Java Native Interface

Some API design details

- Make easy things easy, make hard things possible
  - Hide biometric details at basic level
  - XML encoding allows extensibility of protocol
- Minimize network traffic
  - Allow chained requests: *encode* → *compare*
  - Operations on *Image clusters* of same person


Person tracking
Identification
subsystem
Other VE
subsystem
Face Recognition Server
JSP Server within JAVA VM
SOAP interface
Control Logic
Algorithm
interface and
interpretation
Algorithm
interface and
interpretation
JDBC
interface
JNI: Interface to
FR algorithm
JNI: Interface to
FR algorithm
Face Recognition
Algorithm DLL
Face Recognition
Algorithm DLL
Face
Recognition
Database

Discussion

Automatic Face Recognition

- Allows identification of participants in CVE
- Can disambiguate participant movement for complex interactions.
- Is non intrusive to the participant
- Is sufficiently rapid for this application

Discussion

Face Recognition Server Architecture

- Networked approach, with simple API to allow easy integration of FR technology into CVE software components
- Extensible to allow management of security and policy information linked to identity

Abstract

In a collaborative virtual environment (CVE) participants are represented by icons called avatars. In order to correctly assign these avatars, participants must be identified as they enter, leave and navigate within the CVE. We present an approach and systems architecture for the use of automatic face recognition (AFR) to accomplish the task of participant identification. The requirements for AFR within a CVE are discussed and distinguished from those for general applications of AFR. A face recognition server has been developed to implement these requirements, and is described. The system is implemented in a Java Server Pages environment, using Java Native Interface to interact with individual face recognition algorithms, and interacts with other CVE components using messages in the SOAP protocol format.