Configuration Strategies of an AR Toolkit-based Wide Area Tracker

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Martin Wagner, Felix Loew
Lehrstuhl für Angewandte Softwaretechnik
Institut für Informatik
Technische Universität München
wagnerm@in.tum.de

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Summary

• Scenario: mobile user in intelligent “AR-ready” building

• AR Toolkit used for
  – High-precision tracking in small areas
  – Coarse room-based wide area tracking ("ID tags")

• Software architecture for
  – Dynamic context aware reconfiguration of AR Toolkit marker detection
  – Room-dependent choice of transition strategies
Outline

• Scenario: Intelligent Building
• System Components
  – DWARF overview
  – Configuration components
• Distributed Configuration
  – Description of concepts
  – Detailed example scenario
• Strategies for Using AR Toolkit as Wide Area Tracker
• Conclusion & Future Work
Scenario: Intelligent Building

- User walks around in an intelligent building, wearing mobile client with camera and AR Toolkit
- AR apps tied to specific rooms, i.e. table-based AR in Lab
- Mobile client has no a priori knowledge of environment
- Detection of current room triggered by sets of Toolkit markers
**Scenario: Requirements**

- No a priori knowledge about environment:
  - Distributed architecture
  - Dynamic configuration
  - Split AR Toolkit functionality in components
- Trigger detection of room changes using AR Toolkit markers
  - Allow varying room-dependent strategies to increase robustness
  - Provide flexible architecture to use additional information sources (RF ID tags, ultra wideband trackers, ...)

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DWARF Overview

- Distributed Wearable Augmented Reality Framework
- CORBA-based middleware dynamically connects *Services* (DWARF components) based on description of their *Needs* and *Abilities*
- Ability descriptions may be enhanced using *Attributes* describing contextual information
- Many communication protocols
  - CORBA method invocations
  - CORBA notification service (events)
  - Shared memory (for video transmission)
Components - Overview

**Video Grabber**: gets video image and puts it in a shared memory segment

**Marker Detection**: takes video image out of shared memory, detects AR Toolkit markers, sends events describing position and ID of markers

**Marker Loader**: configures the Marker Detection using remote method invocation with marker descriptions suitable for the current context

**Coarse Tracker**: listens for events from Marker Detection and changes the mobile client’s context according to the new room
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Distributed Configuration

• Basic Idea: distribute information processing
  – Video Grabber and Marker Detection on user’s mobile client
  – Marker Loaders and Coarse Trackers in rooms
• Environmental services run in multiple instances, one for each room
  – Room-dependent evaluation of Marker Detection events gets possible
  – Available more accurate tracking technology (i.e. ultra wideband tracker) can be integrated seamlessly
Distributed Configuration - Example

Mobile Client

VideoGrabber → MarkerDetection

Room 1

CoarseTracker

MarkerLoader

Room 2

CoarseTracker

MarkerLoader

Room 2 AR App
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Distributed Configuration - Example

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Room 1
- VideoGrabber
- MarkerDetection
- CoarseTracker
- MarkerLoader

Detect Room Change
- Send marker events

Room 2
- CoarseTracker
- MarkerLoader
- Room 2 AR App
Distributed Configuration - Example

Change Client’s Context to Room=Room2

Mobile Client
- VideoGrabber
- MarkerDetection

Send marker events

Room 1
- CoarseTracker
- MarkerLoader

Room 2
- CoarseTracker
- MarkerLoader

Room 2 AR App

Change Client’s Context to Room=Room2
Distributed Configuration - Example

Room 1
- CoarseTracker
- MarkerLoader

Room 2
- CoarseTracker
- MarkerLoader

Mobile Client
- VideoGrabber
- MarkerDetection

Send marker events
Distributed Configuration - Example

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Distributed Configuration - Example

Mobile Client

- VideoGrabber
- MarkerDetection

Room 1

- CoarseTracker
- MarkerLoader

Room 2

- CoarseTracker
- MarkerLoader
- Room 2 AR App

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Distributed Configuration - Example

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Room 1
- CoarseTracker
- MarkerLoader

Room 2
- CoarseTracker
- MarkerLoader
- Load Room 2 Context + App Markers
- Room 2 AR App
Distributed Configuration - Example

Mobile Client

- VideoGrabber
- MarkerDetection

Room 1

- CoarseTracker
- MarkerLoader

Room 2

- CoarseTracker
- MarkerLoader

Send marker events

Room 2 AR App

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Strategies for Marker-Based Wide Area Tracking

Factors influencing the choice of strategies:

- Light conditions
- Movement of user
- Marker position
- Camera
- Room properties

Basic strategies:

- Minimum number of frames
- Weighting number of frames by confidence value
- Detect multiple markers simultaneously
- Detect sequence of markers
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Conclusion & Future Work

• Prototypical implementation:
  – Proof of concept for configuration architecture
  – Demonstration within ARCHIE project

• Future Work:
  – Evaluate robustness of different strategies
  – Describe criteria for suitability of different strategies
  – Design combination strategies
  – Incorporate additional trackers/ information sources
  – Algorithms for detecting and reverting wrongly triggered context changes
Thank you!

See our website:

http://www.augmentedreality.de

Or send E-Mail:

dwarf@augmentedreality.de