LISTEN: Contextualized Presentation for Audio-Augmented Environments

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Workshop on Adaptivity and User Modelling in Interactive Software Systems
Karlsruhe, Germany
Overview

• LISTEN - Audio-augmented environments

• Models in LISTEN

• User Modelling in LISTEN

• Evaluation
LISTEN – Audio-Augmented Environments

- Audio-augmentation of real and virtual environments
- Physical environment augmented with a dynamic soundscape
- Total immersion through context-sensitive personalized audio information
- Fine grained motion tracking
  - Spatial Position
  - Orientation
- 3-dimensional spatial audio reproduction
  - Speech
  - Music
  - Effects
- Only user interface is the user’s motion
Models in LISTEN

World Model

Physical environment

Geometric Information in a Virtual Reality Model

Augmentation Layer

Definition of Zones, Segments and Triggers

Meaningful constraints between location and orientation

Domain Model

Sound pieces are connected to the physical space

Meta data for describing domain objects

User Model

User interacts with the system and events are sent to the user model
World Model and Augmentation Layer

User

Near-Field

Visual Object

Virtual Sound-Source

Object-Zone
User Modelling Components

- Distributed virtual reality framework
- Serves as the target application for the user modelling component

AVANGO

LISTEN User Modelling

Data Collection

Rendering

Modeling

Controlling

is triggered by external events

controls the external rendering component by delivering commands

Database
Information Collection

A network of Sensors:

• Recognizes changes within the environment

• Receives all incoming events sent by the application

• Perception of the user’s interaction with this environment, implicitly expressed by
  
  o Spatial position
  
  o Orientation of the head
  
  o Time-information
Analysing implicit feedback

User’s Location, e.g.
- Zone-ID
- Near-Field-ID

Spatial position

Augmentation Layer
Analysing implicit feedback

Augmentation Layer

User’s Location, e.g.
- Zone-ID
- Near-Field-ID

The focused Object, either:
- Object-ID
- "None"

Spatial position

Orientation of the head

For how long?

Time-information

User’s Location, e.g.
- Zone-ID
- Near-Field-ID

The focused Object, either:
- Object-ID
- "None"
Analysing implicit feedback

User’s Location, e.g.
- Zone-ID
- Near-Field-ID

The focused Object, either:
- Object-ID
- “None”

Histories of
- Visited objects
- Played Sounds

Augmentation Layer

Spatial position
Orientation of the head

For how long?
How often?

Time-information

Spatial position
Orientation of the head

User’s Location, e.g.
- Zone-ID
- Near-Field-ID

The focused Object, either:
- Object-ID
- “None”

Histories of
- Visited objects
- Played Sounds

Augmentation Layer
Modelling Stereotypes

- Visitors do not like to be clustered and classified, e.g. as „emotional“ or „fact-oriented“
- LISTEN does not provide any input devices (neither desktops nor handhelds)

The stereotypes express the visitor’s style of motion:

- **Sitting** The visitor is sitting on the bench.

- **Walking** The visitor is walking
  - through the exhibition.
  - towards a certain art object.

- **Focused** The visitor stands in front of an exhibit and looks at the object.

- **Unfocussed** The visitor stands with his/her attention changing between objects.
Controlling

• Decide what consequences must be taken

• Assemble commands to adjust environmental parameters

• Choosing expressive methods:
  • Adaptation of the presentation
  • Adaptation to the social context
  • Adaptation to the level of immergence
  • Adaptation to movement and perception styles
Adaptation Strategies

Adaptation of the **Sound Presentation**

- Tailor information selection and presentation to the individual user

Adaptation of the **Space Model**

- Tailor the shape of virtual zones to the user’s behavior

Adaptation of the **Social Context**

- Build clusters of similar users listening to the same presentation to enable subsequent discussions

Adaptation of the **Level of Immergence**

- Tailor information depth and complexity to the user’s knowledge

Adaptation to **Movement and Reception Styles**

- Adapt guidance and recommendations to the users stereotypical movement and preferred perception style
Controlling by Stereotypes

• Sitting The visitor is sitting on the bench.

• Walking The visitor is walking
  • through the exhibition.
  • towards a certain art object.
⇒ Background music is played

• Focused The visitor stands in front of an exhibit and looks at the object.
  ⇒ The system presents object-specific audio information.

• Unfocussed The visitor stands with his/her attention changing between objects.
  ⇒ The audio presentation is depending on the visitor’s location.
Rendering

• Handles the connection back to the domain

• Translates the assembled sequence of domain-independent commands into domain-dependent commands

• Changes variable parameters of the domain according to the users’ behaviour

⇒ The decisions taken by the controlling component are to be mapped to real world actions.
Evaluation

- Two expert-workshops in with testing visitors, art curators, sound designers, and artists
- Two public presentations at the Kunstmuseum Bonn

- enjoyed the combination of audio-visual perception
- felt as the interaction with the real visual objects was augmented
- Especially, curators appreciated the possibility to deliver content concerning the artworks in an innovative, enriched and less descriptive way
Evaluation – Critical points

• The zones of interaction surrounding each artwork were sometimes too small

• The boundaries of the object zones were hardly localizable by the user

• Need of more flexible “breathing” zones, in which a sound is more attached to the user’s behaviour in observing visual objects

• Some visitors could not realize whether the changes in the audio virtual environment were due to their movements in the space or were part of the audio sequence.
Thank you for your attention!

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