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Interaction Spaces: Interactive Spatial Areas to Control Smart Environments

Abstract. Throughout recent years new input modalities found their way into consumer electronics. Recognizing body posture and gestures in the three dimensional space is now possible using hardware that is available for about 100 EUR. We aim at providing a system to convert any environment into an interactive space. Hence, we created a system that is able to detect the user's body in three dimensions and to determine the presence of body parts at pre-defined/user-defined locations in order to trigger actions of the environment. We built a first Kinect-based prototype where users can define trigger areas and link them to suitable actions. We then conducted a study to evaluate the usability of the system and how size and memorability of spaces affect user performance with regard to trigger area tasks. Results show that with increasing area size the task completion time goes down while error rates go up.

A user is able to control the smart home environment by placing parts of the user´s body into trigger areas to trigger actions such as changing the TV channel.

Concept

- Idea: turn any ordinary (physical) space into an interactive, "smart" environment
- Main input: 3D sensor to track user's position & posture
- Event-based interaction:
  - *Trigger areas*: Interactive spatial areas of arbitrary shape (e.g., cubic boxes) can be defined to detect the presence of a user's body parts in order to trigger actions
  - *Actions* reflect the intended behavior of the user, such as switching on a lamp, controlling the hi-fi system
  - *Mappings* connect trigger areas, body parts, and corresponding actions, hence the presence of a user's elbow in a dedicated trigger area may result in switching the TV channel

By mapping trigger areas to certain actions, different user controls are available for the TV, hi-fi system, heating, or window blinds. In a living room it may make sense to create interactive areas in the couch's vicinity for controlling the hi-fi system for example.

Evaluation

User study with 18 participants (22-42 years old).

Hypothesis 1: Users are capable of memorizing spatial positions.

- Users should define three spatial cubes and trigger them twice: directly after the creation and after the second task.
- Measuring Task Completion Time (TCT) and Error Rate (ER).

Results

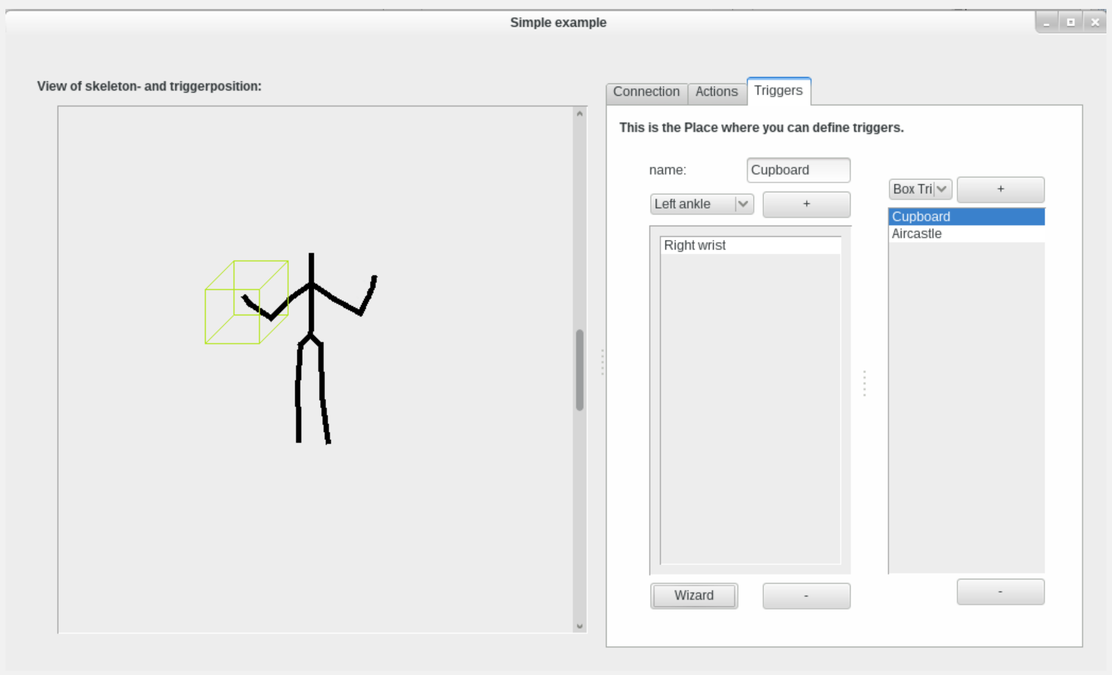
- TCT and ER decrease
- TCT not statistically significant different ($Z = -0.308$, $p = .758$)
- ER statistically significant different ($Z = -2.362$, $p = .018$)

Hypothesis 2: The size of the trigger areas is important.

- User should define spatial cubes for controlling a HiFi system three times by using cube sizes of 10, 20, and 40 cm edge length.
- Measuring Task Completion Time (TCT) and Error Rate (ER).

Results

- TCT decreases with increasing size of trigger areas
- ER increases with increasing size of trigger areas



Interface of our Prototype. Users can create trigger areas, map them to body parts, and in the next step to predefined actions.

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