Towards an Affordance-Based Approach
for Scenario Modeling and Experience Assessment in VR

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Theoretical Background

Research Goals

Affordances raise relevant issues regarding user experience analysis, yet few studies adress UX focusing on J.J. Gibson's initial concept in the HCI field [1]. It is clear to us that affordance is a key argument to assess and offer tools for conventional or new practices. Therefore, we propose an affordance-based approach for scenario modeling and user experience assessment. We focus on VR devices as opposed to traditionnal interfaces for the encomparable sense of embodiment and immersion the user experiences during the task.

Affordances and Solicitations

Affordances are the multiple possibilities for action offered to humans by their environment. However, for an individual in a specific situation, only a subset of the landscape of affordances stands out as relevant, this subset can be referred to as solicitations [2]. Solicitations, as relevant affordances, are important constituents of the unique experience of individuals. From this concept we are able to define two approaches: scenario modeling and user experience evaluation in VR.

Our Approach

Scenario Modeling

1. Election of the field, according to the problem and its related implications. Impacts the whole VRTool design process.
2. Selection of a concrete situation that fits the given context (i.e., **1.**). Defined by a environment, its possibilities for action and a main task for the user.
3. Subdivision of the main task into situated sub-objectives for the user.
4. Identification of the objects involved in each sub-objective and the relation object-possibilities for action (i.e. object-affordances).
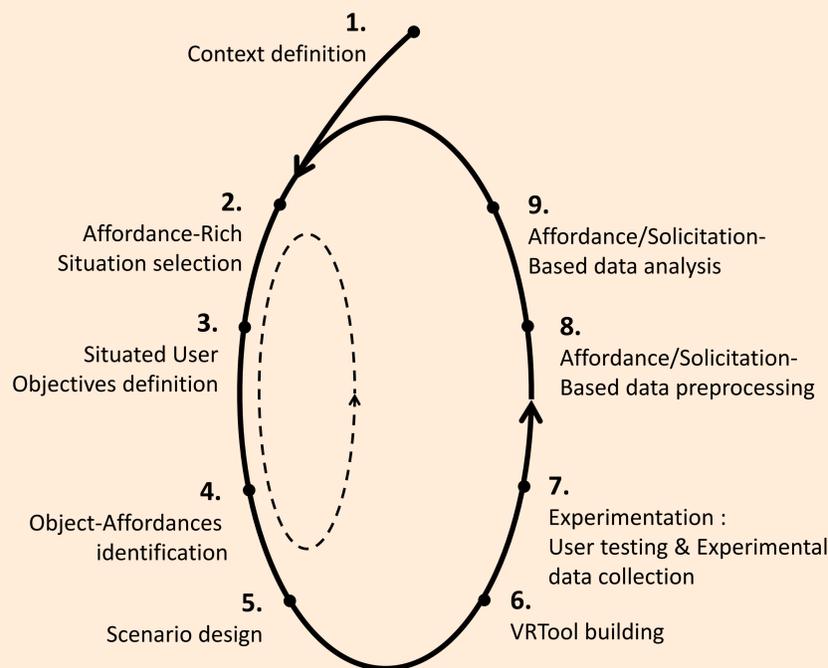**5.** Design of an affordance-based scenario by selecting the relevant objects and affordances.

1. Context definition
2. Affordance-Rich Situation selection
3. Situated User Objectives definition
4. Object-Affordances identification
5. Scenario design
6. VRTool building
7. Experimentation : User testing & Experimental data collection
8. Affordance/Solicitation-Based data preprocessing
9. Affordance/Solicitation-Based data analysis

Figure 1 : VRTool Assessment Process

User Experience Evaluation

6. Design of the virtual environment according to the scenario.
7. Assessment of the user experience. Can meet various purposes: virtual environment design or context goals (skills training, diagnosis, ...) validations. Can be conducted with various type of users (experts, learners).
Collection of objective (action logs, head and eye tracking) and subjective (questionnaire, explicitation interview) data of the experience.
8. Preprocessing of the objective and subjective data: identification of the solicitations in the experience.
9. Analysis of the triangular relationship: objective-subjective-solicitation. Definition of a measurable affordance-based user experience. Analysis of the affordance-solicitation relationship.

Case study : Application in Medical Context

An Affordance-Based Virtual Environment Design

1. Context definition: Psychiatric field - Solution for the lack of real-situation diagnosis tools in depression - Diagnosis based on the Research Domain Criteria (RDoC) dimensions (e.g., distractibility, flexibility, frustration sensitivity, ...) [3].

2. Affordance-Rich Situation selection: Kitchen environment and tasks offering rich landscape of affordances - Main task of baking a cake.

3. Situated User Objectives definition:
Bake cake

Prepare cake mixture -> *separate eggs white from yolks; mix yolks & sugar; ...*
Prepare cake icing -> *heat butter, sugar and food dye; Cool while mixing; ...*

4. Object-Affordances identification:
Whip -> *movable, usable to mix, ...;*
Phone -> *movable, extinguishable, ...*
Cabinet -> *openable, closable, ...;*
Pan -> *movable, usable to contain, ...*

5-6. Scenario design & VRTool building :

Expected: the individual with the **distractibility** related desease get distracted. She/He tends not to finish her/his current task when an object, like the sound of a phone call, becomes more soliciting (cf. opp. picture)

➡ Scenario to test the **distractibility** dimension: *at step 2 of the recipe, specified by the instruction « mix the egg yolks and the sugar », the phone rings spontaneously, loud enough to draw the indivudual's attention to it.*

◯ Strong solicitation (**not dist.**)   ◯ Strong solicitation (**dist.**)
◠ Poor solicitation (**not dist.**)   ◠ Poor solicitation (**dist.**)

Expected: the individual with the **flexibility** related desease is unflexible regarding an unrelevant detail such as « take the blue pan » while the pan is not blue. It might maintain her/him in an endless research. The cabinets become solliciting. The healthy individual might find another option (e.g., use the grey pan). The grey pan becomes solliciting (cf. opp. picture).

➡ Scenario to test the **flexibility** dimension: *step 1 of the recipe is specified by the instruction « take the blue pan to heat the butter », while the blue pan does not exist.*

◯ Strong solicitation (**flex.**)   ◯ Strong solicitation (**unflex.**)
◠ Poor solicitation (**flex.**)   ◠ Poor solicitation (**unflex.**)

Conclusion and Future Works

The purpose of this study is to explore the lived experience, through the concept of affordance and through a hybrid subjective/objective analysis. To this end, a virtual environment (VR Tool) is ongoing its final development (fig. 1, 6). Our next steps will consist of validations: of the RDoC dimensions evaluation (fig. 1, 7), and of the suitability of the VR Tool in terms of affordances (fig. 1, 8-9). The future works will consist of improving the VR Tool asessment process through a second iteration and applying the process in a different field such as training or culture.

References

[1] Lialina, O. (2019). Once Again, the Doorknob: Affordance, Forgiveness, and Ambiguity in Human-Computer Interaction and Human-Robot Interaction. Media Theory, 3(1), 49-72.
[2] Rietveld, E., Denys, D., & Van Westen, M. (2018). Ecological-Enactive Cognition as engaging with a field of relevant affordances. *The Oxford Handbook of 4E Cognition*, 41.
[3] The National Institute of Mental Health (2019) RDoC Matrix [online] available at https://www.nimh.nih.gov/research/research-funded-by-nimh/rdoc/constructs/rdoc-matrix.shtml (accessed september 19th 2019)

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