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**D8.4 Field trials method**

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| **Abstract** |
| This document describes the validation plan for CultAR prototypes. The components that are identified as relevant for validation here are: the recommendation engine, the tactile vest and glove as navigation devices, and the vibrotactile vest as an affect device. Analysis of the visual interface was conducted in T8.3 (see D8.3) and, previously, in T8.2 (see D8.2).The studies focus on effectiveness of the device to deliver their support to the user, in case of navigation aid; the effectiveness o the device in offering relevant recommendations in case of the recommendation engine; and a specific aspect of the user experience connected to the affective value of haptic stimuli, namely the contextual circumstances able to moderate the positive effect of that stimulation on the pleasantness of the experience.  |

Contents

1 INTRODUCTION 6

2 Effect of affective vibrotactile stimulation on user experience 7

2.1 Role of task type and administration modality 7

2.1.1 Setting 7

2.1.2 Tasks 7

2.1.3 Data collection 7

2.1.4 Data collected 7

2.1.5 Planned analysis 8

2.2 Role of situational affective connotations 8

2.2.1 Setting 8

2.2.2 Task 9

2.2.3 Data collection 9

2.2.4 Data collected 9

2.2.5 Planned analysis 9

3 Utzon park trial 10

3.1 CultAR component trialed 10

3.2 Equipment 10

3.3 Session duration 10

3.4 Procedure 10

3.5 Data collection 10

4 Recommendation engine 12

4.1 Participants 12

4.2 Scenario 12

4.3 Data collection and system configuration 12

4.4 Task and Materials 13

4.5 Planned analyses 13

5 Assessing the effectiveness of the vibrotactile stimulation as a navigation aid: vest 14

5.1 Setting 14

5.2 Task 14

5.3 Data collection 14

5.4 Data collected 14

6 Assessing the effectiveness of the vibrotactile stimulation as a navigation aid: glove 15

6.1 Setting 15

6.2 Task 15

6.3 Data collection 15

6.4 Data collected 15

7 References 16

# INTRODUCTION

This document describes the validation plan for CultAR prototypes. The components that are identified as relevant for validation here are: the recommendation engine, the tactile vest and glove as navigation devices, and the vibrotactile vest as an affect device. Analysis of the visual interface was conducted in T8.3 (see D8.3) and, previously, in T8.2 (see D8.2).

The studies focus on effectiveness of the device in supporting the user, in case of navigation aid; on the effectiveness of the device in offering relevant recommendations in case of the recommendation engine; and on the pleasantness of the user experience connected to the affective value of the haptic stimuli. An overview of the plan is offered in Table 1 below.

|  |  |  |  |
| --- | --- | --- | --- |
| Component | Validation goal | Setting | Materials |
| **Vibrotactile vest as affective device** | Assessing the moderating effect of task type and administration agent on pleasantness  | Laboratory | * Questionnaire
* Interview
* Frequency of users’ affective states (via FaceReader)
 |
| Assessing the moderating effect of consistency with situation on pleasantness  | Field | * Questionnaires
* Interview
 |
| User experience (Uzton park trial) | Field | * Interviews
* User experience and spatial presence questionnaires
* Heartbeat and breath rate
 |
| **Recommendation Engine** | Assessing the relevance of the recommendations | Laboratory | * User experience questionnaire
* Relevance scores
 |
| **Vibrotactile vest as navigation device** | Assessing the effectiveness of the tactile vest as a navigation aid  | Field | * Questionnaire
* Interview
* Users’ performance grid (success rate)
 |
| **Haptic glove as navigation device** | Assessing the feasibility of the tactile glove as a navigation aid | Field | * Questionnaire
* Interview
* Users’ performance grid
 |

In the following sections the method for each study is sketched. However, methodological choices and protocols might be subject to adjustments as the studies are actually implemented. Their final procedure will be described in D8.5

# Effect of affective vibrotactile stimulation on user experience

##  Role of task type and administration modality

In the present experiment we will address the affective states associated with the delivery of the tactile stimulations. Two different situations will be considered: in one case the participant will be engaged in an amusing activity, in another case she will be engaged in a boring activity.

### Setting

The experiment will take place in the laboratory, mainly because of the equipment required (described below).

### Tasks

Participants will be divided in two groups, each one involved in either an amusing or boring task. In the amusing task condition, participants will play a video game. While in the boring task condition, participants will insert some data in a spreadsheet. In both cases participants will use a desktop PC to complete the tasks.

Both groups will perform the tasks in three different conditions:

* no stimulation, in which they will not receive any tactile stimulation;
* self-delivered stimulation, in which they will activate by themselves the vibrotactile pattern and
* stimulation delivered by the experimenter, in which the experimenter will trigger the stimulations at pre-fixed time intervals.

### Data collection

The data collection will take place in a single experimental session. Participants will first wear the vest and then they will undergo a short training phase, in which they will try the different tactile stimulations, they will learn how to operate the application for controlling the vibrotactile patterns and finally they will practice with the assigned task.

The overall session will be divided in three phases consistently with the experimental conditions. Each phase will have a fixed duration (10 minutes). After each phases will finish, the participants will be asked to complete one, two or three questionnaires, depending on the experimental condition (see section 3.3.5 for a full description).

### Data collected

For each experimental condition, participants’ performances will be recorded as number of cells completed (in case of the boring task) and as the number of levels participants achieved (in case of the amusing task).

In addition, participants’ emotional reactions will be recorded by means of FaceReader by Noldus, which a software for the automatic recognition of the emotional states through the interpretation and classification of the users’ facial expressions.

After the participants will have completed the condition with no tactile stimulation, they will be administered a questionnaire built *ad hoc* assessing the respondents’ feelings regarding the task. After the participant will have completed the condition in which she will self-deliver the vibrations, she will be asked to complete a questionnaire created *ad hoc* assessing her feelings regarding the pleasantness of the task and of the vibrations. Finally, the participant will be asked to complete the questionnaires assessing the user acceptance (the one published in Spagnolli et al. 2014) and the pleasantness of the task and the vibrations, following the condition in which the experimenter will have triggered the stimuli.

### Planned analysis

As a comparison between the two different task conditions, we will compare the frequency of the emotional states recorded by the FaceReader, in order to assess if the tactile stimulations affect the affective states.

Regarding the comparisons within groups, a first analysis will be run to test whether the presence or absence of the tactile stimuli affect the overall emotive state. In addition, we will compare participants’ impressions about the vibrations across the three different conditions of stimulation.

## Role of situational affective connotations

In the present experiment we aim to assess the effect of the tactile stimulation during particular moments in a touristic visit. The experiment will have a preliminary and a main study. In the first one we will involve tourists in order to identify the salient events in which a vibrotactile stimulation would be desirable during a tour. With the main study we will assess the pleasantness of the vibrations delivered to a groups of tourists during a visit.

### Setting

The data collection will take place in the field, that is in the center of the city, and will involve tourists in both the activities. In particular, in the preliminary study, the interviews will be conducted in the three areas of the city: the area surrounding the Botanical Garden, the surroundings of Piazza Eremitani and the area comprised within Piazza delle Erbe and Piazza della Frutta.

In particular, in the main study, a realistic touristic visit will be recreated in the surroundings of Piazza delle Erbe, Piazza dei Signori and Piazza della Frutta.

### Task

In the preliminary study, tourists will be simply asked some open questions.

In the main study, participants will follow the experimenter in a brief tour. At the end of the tour, tourists will be asked to answer a brief questionnaire and to comment the activity in the form of a semi-structured interview.

### Data collection

Regarding the preliminary study, participants will be simply approached in the field and they will be asked to answer to a series of open questions.

In the main study, tourists will be recruited in the field. They will first wear the vest and instructed on its functioning. The will be then asked to follow the experimenter thru a predefined itinerary until they will reach the destination. Along the itinerary, they will be administered tactile stimulations by the experimenter. Once the tour will be finished, participants will be asked to complete a brief questionnaire and to comment their experience.

### Data collected

Concerning the preliminary study, participants’ answers to the interview will be collected.

In the main study, we will administer a brief questionnaire to assess users’ impressions regarding the vibrotactile stimulations and another questionnaire will be used to assess the user acceptance of the technology (Spagnolli et al., 2014). In addition, we will collect participants’ impressions by means of a semi-structured interview.

### Planned analysis

For preliminary study, participants’ answers will be transcribed and coded in order to determine the events tourists consider more salient during a touristic visit.

In the main study, we will analyze participants’ impressions collected by means of the questionnaires. In addition, participants’ answers to the interviews will be transcribed and coded to determine the most frequent themes.

# Utzon park trial

## CultAR component trialed

vest that housed an inner harness and a padder outer shell to keep the actuators close against the body.

## Equipment

The Humming Wall installation and the BioHarness for collection of psychophysiological data

## Session duration

1.5 to 4 hours per pair, averaging 2.5 hours.

## Procedure

(1) Fitting: participants fills the informed consent and demographic info, fit the BioHarness, harness and vest and test for accurate actuator placement on their body; this phase takes place in a private room with a privacy screen, (15-35 mins);

(2) Training: participants walk up and down in the park (1 researcher guided & 1 videoed), experience 10 vibration patterns (3 times for each pattern) and describe their sensations. Participants and researchers then stop and participants articulat their responses to a repeat of each individual pattern, walking slowly while experiencing and discussing those related to motion, (10-15 mins);

 (3) Interaction: Participants and their pair then interact with 5 zones of activity at *The Humming Wall*. They make a repeat visit to each of the two physiology zones—one displaying heartbeat, the other breath rate, making 7 stops in all. The other three zones respond to gestures. The participants are instructed on what to do in each zone (e.g., knock on these 3 panels; swipe these 3 panels; sit & breathe). It is left to them how to do this—fast, slow, or with rhythms. Participants move clockwise around the wall, (20-90 mins);

(4) Evaluation: participants remove the vest and BioHarness, are administered post-trial questionnaires and semi-structured interviews, while their pair begins the fitting phase, (15-40 mins).

## Data collection

* demographic questionnaire asking about fitness levels and experience with IT, vibrotactile technology, embodied interaction, large public displays and playing musical instruments
* adapted versions of items from MEC Spatial Presence Questionnaire (Vorderer, Wirth, Gouveia et al., 2004) measuring concentration, errors, activated thinking, and imagining space
* adapted version of items from the Flow State Scale (Jackson, Marsh, 1996) measuring challenge-skills balance, goals, autotelic, concentration on task, and sense of control.
* adapted version of items from the Intrinsic Motivation Inventory (Deci, Ryan, 2000) measuring interest/enjoyment, perceived competence, pressure/tension, and effort/importance
* 10 semantic differential scale items and semi-structured recorded interviews measuring the overall experience
* activity data from the actuators
* heartbeat and breath rate from the BioHarness

# Recommendation engine

Goal: to compare the relevance of the recommendations produced by different algorithms, assessing whether the recommendations produced by taking into account the users' profile are considered as more relevant than the other.

## Participants

The participants to be involved in the experiment are people with a fairly good knowledge of the city of Padua in a wide age range. The first requirement is motivated by the need to populate the database of the ratings of the POIs in the city with realistic ratings. Therefore the volunteers participating in the study need to have some knowledge of the POIs listed.

In addition, we aim to address a wide age range because people of different age and with different lifestyles will have a varied knowledge of the POIs and will therefore provide consistent ratings. Finally, because the system is supposed to be used by ideally everyone.

## Scenario

Participants will be proposed a scenario, that is a narrative describing a specific situation in which the user is asked to imagine she is living at the moment of the experimental trail. We will ask participants to imagine that the purpose of their visit is religious, that is to say that they are interested in the religious arts, buildings and masterpieces. We chose the religious theme, because it is quite restrictive and we expect it will be easier for the user to decide regarding the relevance of the item suggested by the system.

## Data collection and system configuration

The experiment will unfold in two experimental sessions. During the first session the participant will create her user profile in the CultAR website, she will be asked to fill in the form inserting her own personal data with the exception of the purpose of the visit, which will be indicated by the scenario. After that, the user will be asked to rate each POI on the list assigning five stars for the those she liked the most and one for those she did not like or she does not know. The POIs are grouped in three categories, according to their location (Santo, Eremitani, Ragione). Participants will be sub-divided in two groups, each rating the POIs belonging to two out of three groups.

In the second session, the participant will access the CultAR recommendation engine with the user profile created in the first experimental session. She will be asked to perform a series of searches with the recommendation engine in the POI category she had not rated in the first session (Table 1). This way the recommendations provided by the system will not be biased by the participant’s direct evaluation of them. Nevertheless the database will be populated by real data and the system will output recommendations based on real ratings.

|  |  |  |
| --- | --- | --- |
|  | Session 1 | Session 2 |
| Group 1 | Rating | Ragione | Searching | Santo |
| Eremitani |
| Group 2 | Santo | Ragione |
| Scrovegni |

Table 1 A summary of the structure of the experiment

The participant will be asked to perform a number of searches with the four different combinations of data overlays implemented. These are:

* T, that is only the tags overlay;
* TP, that is the combination of the tags and personal data overlays;
* TR, that is the combination of the tags and the ratings overlays and
* TRP, that is the combination of the tags, ratings and persona data overlays.

The order with which participant will use the different versions of the system will be counterbalanced across participants, to prevent order effect.

## Task and Materials

As anticipated above, the participant will be asked to perform a series of searches. After that, she will be asked to examine the items output by the recommendation engine and to judge the relevance of each recommendation on a scale ranging from 1 (not pertinent) to 5 (fully pertinent). The participant will be instructed to evaluate the relevance of the results with respect to the scenario proposed (that is a visit with a religious purpose).

After the participant will have fulfilled the task with each combination of data overlays, she will be asked to complete a questionnaire based on the one published by Pu, Chen and Hu (2011) assessing various aspects of the experience of using a recommendation engine. In total each participant will complete four questionnaires.

## Planned analyses

The scores of relevance will be compared across the four versions of the systems, as to assess which combination of data overlays output the most pertinent recommendations.

In addition, the overall experience of use assessed by the questionnaires will be compared across the four versions of the system.

# Assessing the effectiveness of the vibrotactile stimulation as a navigation aid: vest

## Setting

The experiment will take place outdoors, preferably in the city center. An urban setting is in fact an environment rich in narrow streets and possible turns, forcing the participant to focus on the navigational directions in order to follow the correct itinerary.

## Task

The participant will be asked to walk through a pre-defined itinerary by following the directional navigation indications delivered by the experimenter.

## Data collection

The participant will wear the vest and she will receive instructions regarding the meaning of the different directional tactile stimuli the vest delivers. Once the participant will have a clear understanding of the stimulations, the experimenter will guide her through a pre-defined itinerary in the city center. After the participant will have reached the destination, she will be asked to complete a questionnaire for assessing her experience and the comfort of wearing the vest. In addition, the experimenter will also ask her to comment on the experience following a semi-structured interview format.

## Data collected

First, the experimenter will note down if participants could successfully reach the target. Also the experimenter will note down eventual errors occurring during the experimental session. One type of error will include participants’ failures in perceiving the stimuli (omission) a second type of error will consist in participants’ misinterpretation of the stimuli (misunderstanding). Also, the experimenter will note the time required to complete the itinerary. In addition, a questionnaire assessing the experience of use and the comfort of wearing the vest will be administered. Finally the interviews will be recorded.

# Assessing the effectiveness of the vibrotactile stimulation as a navigation aid: glove

In the present experiment we aim at assessing if the vibrotactile stimulations delivered on the users’ fingertips can effectively lead the user in a navigational task.

## Setting

The experiment will take place in the center of the city. In an urban setting there is in fact a large number of narrow streets and corners and the user forced to carefully focus on the tactile guidance in order not to take a wrong turn. In addition, we are interesting in assessing the feasibility of using the glove as a navigational tool in a touristic setting, such the one of a historic city.

## Task

 The participant will be simply asked to walk through a pre-defined itinerary following the vibrotactile stimulations delivered by the experimenter.

## Data collection

The participant will first wear the glove, then she will try the different tactile stimulations. Once the participants will have a clear understanding of how to operate the system, the actual experimental trial will begin. The experimenter will guide the participant through a pre-defined itinerary by delivering her proper tactile stimulations. After the participant will have reached the target destination, she will be asked to complete a brief questionnaire and to comment her experience by answering to some open-ended questions.

## Data collected

 The experimenter will note down participants’ success rate, that is to say if they could successfully reach the target. The experimenter will also take note of failures in achieving the tasks and of errors occurring along the itinerary. For instance, omissions, that is the participants fails to perceive the stimulation and consequently to follow it; and misunderstanding, that is the user can perceive the stimulus, but misinterpret its meaning, resulting in a wrong behavior. The overall time to complete the itinerary will also be noted.

A questionnaire assessing the experience of use and the comfort of wearing the glove will be administered. In addition the interviews will be recorded to allow off-line transcription and analysis.

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