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Virtual Bodystorming: Utilizing Virtual Reality for Prototyping in Service Design

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Abstract. The paper describes our ongoing work on a new prototyping method for service design, Virtual Bodystorming. Virtual Bodystorming utilizes Virtual Reality (VR) and enables the user to role-play the service scenario in a fully immersive and collaborative VR environment. In this environment, various service-related areas and objects can be recreated with 3D graphics, while distant service users, providers, designers, and facilitators can communicate and collaborate. Virtual Bodystorming aims to minimize the gap between the actual service environment and its prototype by contributing to the development of fully immersive and highly-engaging service simulations. To illustrate the practical implementation of Virtual Bodystorming, we describe its main characteristics and present a first prototype version of the method. The method was evaluated by three experienced service designers, who highlighted the strengths of Virtual Bodystorming for service prototyping, regarding immersion and engagement, while emphasizing the service designer's significant role in directing the user interactions of the VR scene. The method was considered to be suitable for prototyping services that include human interaction and/or spatial aspects.

Keywords: Bodystorming; Service Design; Service Prototyping; User Experience; Virtual Reality;

1 Introduction

Service design is a young discipline, which departs from the standard managerial perspectives and focuses on the interactional experience of services [10]. Services consist of hundreds or thousands of components that are often not physical entities, but rather are a combination of processes, people skills, and materials that must be appropriately integrated to result in the "planned" or "designed" service [6].

A service prototype is "a simulation of a service experience" [20] and an important service design tool for making services visible and helping communicate service concepts at the early stages of the new service development process [1]. Service prototyping contributes to the service design process by i) defining the service design problems to be solved, ii) evaluating the usability and effectiveness of a service concept, and iii) enabling collaboration between different actors (e.g. users, stakeholders, service providers) [19]. The most crucial factor in the service prototyping process is the ability to create a realistic sensation for the users and immerse them in the service experience [9, 19].

However, conventional service prototyping methods, such as scenarios, videos, cardboard, role-playing, storyboards, and others, are limited in their ability to relay information associated with specific service periods and interactions with users at touchpoints [9, 8]. The need for new service prototyping methods that could offer more realistic simulations has been reported. The use of virtual elements for developing new service prototyping environments has been suggested as a way to address the limitations of the conventional methods and optimize the service prototyping process [9, 13, 19]. Virtual Reality (VR) can fulfill the conceptual framework for service experiences, as well as overcome the limitations of conventional simulation methods by simulating visual, audio, and haptic interaction [18, 9]. Virtual settings have already been used to analyze and evaluate services in a more realistic environment, as these technologies could "minimize the gap between the practical and service prototyping test environments" [9]. These virtual environments for service prototyping have been under development at the laboratories of Fraunhofer IAO's "ServLab" [13], KITECH's "s-Scape" [9], and University of Lapland's "SINCO" [19, 14].

Nevertheless, the utilization of VR in service prototyping faces certain issues. Primary obstacles include the high development cost of the earlier VR systems and their resource-demanding or even limited networking capabilities [9, 11, 5]. Furthermore, there have been difficulties in connecting the service prototyping method with the underlying VR technology. Establishing a VR system that supports design, realization, evaluation, optimization, and detailed management procedures for service prototyping processes is a challenge [9]. Because of those issues, VR implementation in service prototyping has not matured enough to reach the theoretically praised, fully immersive and collaborative VR capabilities that would allow for a higher degree of realism in the simulation of service environments [9, 13].

Over the last few years, major changes in the VR technology field have taken place, allowing the development of affordable, high-quality, immersive, and collaborative 3D virtual environments. This opens the way for the use of fully immersive, collaborative VR in service prototyping [7, 11, 9]. Naturally, the level of immersion and interaction in a VR environment directly affects user engagement [4, 16]. Therefore, it can be hypothesized that a fully immersive VR environment with collaborative aspects could minimize the gap between the actual service environment and its prototype, thus allowing the user to have a more representative and complete service experience and, consequently, enable the service designer to extract high-quality user feedback. Based on this hypothesis, we address the need for a new, fully immersive and collaborative VR-enabled service prototyping method.

Fig. 1. An example of a bodystorming session, role-playing the service scenario in a simulated service environment, using props and mock-ups (image under CC BY-SA 2.0 license by Unsworn Industries) [21].

1.1 Virtual Bodystorming, contribution, & paper organization

In this ongoing work, we propose a new service prototyping method, "Virtual Bodystorming", and we present its first, prototype version. Virtual Bodystorming is based on the popular service prototyping method of bodystorming, also known as service role-play [20].

Bodystorming enables the user to enact and role-play the service scenario in various prototyping environments (Fig. 1), such as the original service location (high-fidelity prototyping), a similar service location (medium-fidelity prototyping), or an office/lab space equipped with mock-ups (low-fidelity prototyping) [3, 15, 17]. Overall, bodystorming attempts to "place" the user in the service environment, empathize with the user, and get valuable feedback about the experience [15, 17, 19]. Due to its theatrical nature, experiential and spatial qualities, bodystorming can provide the infrastructure and the management procedures from which a new, VR-enabled service prototyping method can be built.

Virtual Bodystorming utilizes fully immersive, collaborative VR technology that enables the user to role-play the service scenario in a VR environment. In that environment, various service-related areas and objects can be recreated with 3D graphics, while distant service users, providers, designers, and facilitators can communicate and collaborate.

The goal of Virtual Bodystorming is to improve service prototyping by creating an affordable, collaborative, and highly engaging method. The method is destined to enable agile development of medium-to-high fidelity prototypes and easier involvement from different user groups. The first version of Virtual Bodystorming is developed to exclusively support service design by targeting to recreate the experiential representations necessary for successfully conveying an experience with a service.

The contribution of this work is summarized as follows:

– Introduce a new experience prototyping method for service design, utilizing a fully immersive, collaborative VR environment to implement and advance the related literature's theoretical suggestions regarding the use of VR for service prototyping.
– Describe the implementation of the fully immersive, collaborative VR system for service prototyping, analyze its attributes, and demonstrate its suggested use, thus enabling researchers to reproduce it and potentially build on its implementation.
– Assess the user experience with the first version of a new VR service prototyping method through a preliminary expert evaluation.

The rest of the paper is organized as follows. Section 2 presents the main requirements on which we based the development of the prototype version of Virtual Bodystorming. Section 3 describes the prototype, focusing on the hardware/software aspects, networking attributes, VR maps, and proposed user roles and interactions. At the end of Section 3, the expert evaluation of the Virtual Bodystorming prototype is presented. The paper concludes in Section 4.

2 Virtual Bodystorming Requirements

The design of Virtual Bodystorming should satisfy established bodystorming principles (cf. [3, 15, 17, 19]) combined with our objectives for an affordable, engaging, and agile tool for creating medium-to-high fidelity prototypes. Therefore, we pose the following requirements for the Virtual Bodystorming method:

– *The method should enable the user to explore and experience the service scenario, while role-playing and interacting with the virtual artifacts and other users.* This requirement is in line with the main properties of bodystorming [3, 15, 17], as implemented in a virtual environment.
– *The method should technically support all the user roles of a bodystorming session, such as service users, service providers, et. al.* Bodystorming is a process that involves various user types for the service scenario to be better enacted and for the feedback to be useful [15, 19]. Moreover, Virtual Bodystorming, due to its technical nature, demands the additional role of the VR system operator, i.e. an experienced programmer who handles the VR-related technical aspects and supports the agile development of the process.
– *The method should enable direct communication and collaboration to promote participatory design.* Bodystorming is inherently a participatory and collaborative method since it is based on role-playing, simulating multi-user service environments, and establishing meaningful collaborations between users, service providers, and stakeholders [3, 15, 17]. For Virtual Bodystorming, communication and collaboration are translated into a virtual networking element where distant bodystorming users log into the virtual environment and experience the service scenario together.
– *The method should enable the agile development and editing of the virtual environment and its contents.* Prototype development agility is a crucial property

of experience prototyping; it enables flexibility to modify the service experience and rapid visualization of user feedback [19]. In the case of Virtual Bodystorming, large 3D asset libraries and of an experienced VR system operator are of the essence for ensuring the agility of the process and the fidelity of the visualized service.
- *The method should be affordable (low-to-medium cost) and user-friendly.* Because Virtual Bodystorming depends on VR technology, there is the need for a VR platform that is easy to access and does not burden users with high costs. The fact that VR recently became more accessible to the average consumer [7] can help fulfill this requirement.

3 Prototyping Virtual Bodystorming

To better illustrate the implementation of Virtual Bodystorming, we develop a prototype version of the method based on the requirements above.

3.1 User roles

At first, we define the core roles and interactions for users of the Virtual Bodystorming session based on the main user roles and interactions in typical service design cases:

- *Service designer:* the designer is responsible for organizing the Virtual Bodystorming sessions. The designer assigns service users to their role-playing characters, provides ideas and suggestions on the acting, and collects the feedback from the users and the service provider.
- *Service users:* the end users of the service, who, in the Virtual Bodystorming session, role-play the service scenario in the virtual environment, while communicating and collaborating with other service users. Service users provide the service designer with feedback about the service prototype and their experience.
- *Service provider:* the provider supplies the designer with service design tasks and problems and observes the Virtual Bodystorming sessions in the virtual environment, as a spectator, communicating feedback about the service prototype and the way users respond to it to the service designer.
- *VR system operator:* the system operator is responsible for developing the virtual environment and making changes to it according to the service designer's feedback. The system operator also participates in Virtual Bodystorming as a spectator, looking for usability flaws of the system while in use.

Naturally, other user roles can be added, such as service and product developers, service managers, stakeholders, and third-party businesses. In the first version of Virtual Bodystorming, the core users are described, bearing in mind that additional user types may be covered by the existing core roles (e.g. the service provider). Moreover, Fig. 2 makes clear that the service designer plays a central role in Virtual Bodystorming, since the designer mediates the process and elicits service users' feedback, which will consequently drive the service provider's decisions.

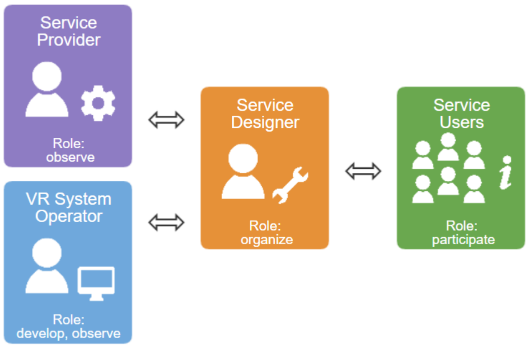

Fig. 2. The core user roles and interactions (visualized as arrows) in Virtual Bodystorming.

3.2 VR development

The choice of Virtual Bodystorming software and hardware was based on facilitating the agile development of VR environments and offering robust networking and easy access to end users while maintaining the costs at a low-to-medium level (following the requirements of Section 2).

VR hardware & game engine: The VR prototype of Virtual Bodystorming was developed using the Unreal Engine game engine by Epic Games and the HTC Vive VR headset. The interaction utilized the HTC Vive controllers and the teleportation VR locomotion technique was implemented [2]. HTC Vive (*vive.com*) is a medium-cost VR headset that is designed to utilize "room scale" technology for turning a room into 3D space via sensors. Unreal Engine supports our future plan of designing and exporting the VR scenes to Google Android smartphones, thus enabling users with a low-cost, generic VR headset, a Bluetooth controller (for navigation purposes), and an Android smartphone to access the virtual environment.

Networking: The use of the Unreal Engine also allowed us to create a multi-user VR environment since the networking functionality is an intrinsic feature of the game engine. Users can navigate through the VR environment, represented as avatars; they can see each other, and communicate via audio chat. The system also supports spectators, i.e. users overlooking the VR environment and observing other users navigating and interacting.

Asset library: A low-cost, large 3D asset library was built to facilitate the creation of various VR service environments. Naturally, VR environments will be created and edited ad hoc, depending on the service scenario, user feedback, and progress of the Virtual Bodystorming session.

3.3 Virtual environment

The virtual environment of the Virtual Bodystorming prototype is divided into two levels: the Lobby Level and the Service Level (Fig. 3). The Lobby Level is

Fig. 3. Prototype screenshots (*left to right*): the Lobby Level, the map of the Service Level where Virtual Bodystorming takes place, and meeting another user while navigating the Service Level.

a virtual meeting room for discussion and feedback. At this Level, the service designer welcomes users in the VR space, presents the service scenario, explains the goals of the session, assigns the role-playing characters, collects and discusses user feedback, and provides an overview of the Service level. The Service Level is the main level of the Virtual Bodystorming where the service prototyping takes place. Naturally, each cycle of the service prototyping process requires going back and forth between the Lobby and the Service Level, while the presence of users at the Lobby Level gives the VR system operator time to prepare the next iteration of the Service Level, based on the user feedback.

3.4 Expert evaluation

As a preliminary evaluation of the Virtual Bodystorming method and its virtual environment, we conducted an expert evaluation with three service designers (Fig. 4). The use of expert designers for the preliminary evaluation would allow us to utilize their experience in dealing with service prototyping methods for reliably identifying the pros and cons of Virtual Bodystorming, as well as receiving useful feedback about future improvements and potential. The aim of this evaluation was to assess overall user experience, reveal possible problems with the method, and gather recommendations for its further development. We used a cognitive walkthrough method followed by semi-structured interviews [12]. All the experts had more than ten years' experience in Human-Computer Interaction and more than five years' experience in service design.

A service scenario was presented to the participants. The service scenario was exploring the idea of attracting newspaper subscriptions, using a new service path in a shopping mall. At first, the participants acquired the role of service users, while one of the authors acquired the role of the service designer. Other users were represented by virtual agents. Then, the participants began to go through the service scenario, starting from the Lobby Level. At that stage, the service prototyping goal was presented, bodystorming properties were defined, and preliminary ideas were introduced (e.g. placing a digital newspaper stand by the grocery store of the shopping mall). One of those ideas was implemented at the Service Level, where

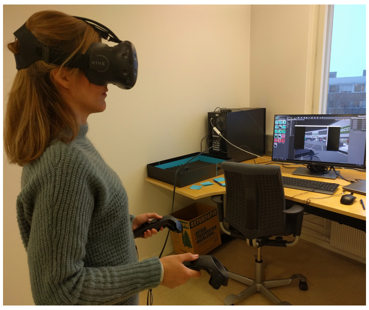

Fig. 4. Evaluating the Virtual Bodystorming prototype.

participants could navigate as spectators, witnessing the interactions. Each session lasted between 35 to 40 minutes. At this stage, the networking/collaborative element, even though implemented, was not evaluated due to the small sample size and the limited number of user roles.

At the end of the session, the semi-structured interviews were conducted. Participants were asked about: i) their overall experience, focusing on the elements of positive/negative affection, engagement, and immersion, ii) problems they might have experienced during the session or potential issues of the method, and iii) their recommendations about future development and application of the method, focusing on how they would improve the method and what kind of applications they foresee for it.

The participants' overall impression was that the interaction and the navigation in the VR environment were user-friendly, and that the two-level structure of the method was useful. The method achieved a satisfying level of immersion, while the design of the VR environment elicited positive feelings.

– *"It gives you a feel of space which is better than seeing photos or projections ... it is more like being there."*
– *"It has a game-like feeling that makes it more attractive and engaging."*

However, participants also stated that the service designer should have an active role in controlling the game-like feeling coming from the environment and that being immersed in the VR environment for a long period of time may lead to cognitive overload.

– *"Specific task-related guidelines and directing the VR scene are necessary since users may play around in the VR environment, instead of focusing on the task."*
– *"It is too immersive and I would definitely need a break after using it for some time."*

Participants considered Virtual Bodystorming to be ideal for prototyping services that include human interaction (human touchpoints) as well as services that take place in open spaces (e.g. public transport, airports, warehouses, etc.) As for the future, participants suggested focusing more on telepresence features (e.g. users creating customized avatars) and ensuring that the method is technically robust enough to support a large number of users and efficiently handle fail states.

4 Conclusion

In this work, we introduced a prototyping method for service design which applies the bodystorming concept in fully immersive VR settings. The method aims at optimizing the service prototyping process by contributing to the development of high-fidelity service prototyping environments, which can offer better service simulations, high user engagement and, ultimately, lead to useful, high-quality feedback.

The presentation of the Virtual Bodystorming method focuses on covering the method's main infrastructure (bodystorming, design requirements, user roles) and the enabling technology (VR hardware/software, networking, VR environment, 3D asset library). Expert evaluation of the prototype helped us concretize the strengths of the method, discover potential pitfalls, and plan the next step in its development phase.

The current work and the introduction of Virtual Bodystorming provide the opportunity for organizations, businesses, designers, and researchers to reproduce and further advance the method. Furthermore, we hope that this work will trigger a discussion around the potential of VR in service design, which, so far, is an under-researched field [9].

Future work will focus on: i) iteratively refining the method based on experts' and users' comments, ii) testing its performance through case studies, iii) measuring user experience and engagement while using the method, and iv) comparing the method with other widely-used service prototyping methods.

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