Towards the Design of a Persuasive Technology for Encouraging Collaborative Prototyping

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Abstract. The idea of designing a collaborative electronics prototyping toolbox as a persuasive technology is the guiding vision of the study at hand. Building on the state-of-the-art of current electronics prototyping toolboxes for laymen and makers, the study aims at developing a set of prototyping tools that encourages co-creation in contexts of collaborative innovation prototyping, e.g. in workshops or maker events.

Keywords: prototyping tool, persuasive technology, collaborative innovation, electronics toolboxes.

1 Introduction

Electronics can be intimidating. Until recently, manipulating electronics would have implied visiting the benches of technology classes or having the passion and the patience for making and inventing electronic systems. Even though electronic devices have invaded both the professional and personal spaces, the user-device interaction rarely goes beyond the screen or the casing to explore the internal structure and composition of the device. In order to get more acquainted with the technology and explore new paths for innovation, users need special encouragements.

With the advent of crowdfunding platforms, we witness the proliferation of campaigns for prototyping tools and kits with the noble intention to bring electronics to the general public by reducing the complexity involved in designing electronic systems, lowering the level of required knowledge and by harboring, most of the times, a friendly colorful design. Examples of such kits are littleBits [1], SAM [2] and LightUp [3]. As much as these tools meet the mission and goal they are designed for, the message of these kits remains targeted to the individuals and there is very low focus on collaboration.

In this paper, we present a concept of a new electronic prototyping toolbox that aims at encouraging co-creation in contexts of collaborative innovation prototyping.

The argument in the paper is driven as follows. First, we present the adopted design process to develop the artifact and argue about the persuasion elements

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involved in the design and the qualification of the prototyping toolbox as a persuasive system. Then, we focus on the most critical persuasion element that is the message of technology under study and detail the specificities and challenges of innovation collaboration. Finally, we explore the tailoring of the artifact in order to address these challenges to fulfill our objective.

2 Design process of the prototyping toolbox from the point of view of persuasive technology

The idea of designing a collaborative electronic prototyping toolbox has been largely inspired by already existing toolboxes. The design of the prototyping toolbox involves the analysis of use and user context by determining the roles of the persuader, persuadee, message, channel, and context [4]. To this end, we follow the design process described by Fogg to create a persuasive technology [5].

The first step of the process is to identify the behavior to target. As introduced earlier, the artifact under study addresses collaborative innovation. It invites heterogeneous groups of people to work together to create viable novel or improved solutions to solve certain problems or to creatively react to certain existing designs, when technological complexity is involved.

The audience to be targeted by the persuasive technological artifact consists of the stakeholders involved in the co-creation process of a technological innovation and who have dissimilar technical background and knowledge. We are essentially targeting outside innovators i.e. the entity of external partners [6], precisely the customers and users of an innovation. The persuader in this setting is the entity with the intention to benefit from the innovative attitude and behavior of the group of customers [7], namely the company featuring the innovation.

Regarding the third step of the design process, we need to identify the challenges related to users' innovation collaboration that will be addressed by the persuasive technology. It is primarily assumed that the innovation collaboration activity is undermined by a combination of the three challenges identified by Fogg, namely lack of motivation, lack of ability and lack of well-timed performance triggers [5]. Nevertheless, after running experiments we aim at identifying which of these factors are the most critical to our situation. By observing and interviewing the participants we will seek to better understand how to target the challenges with our artifact.

Some previous research on innovation collaboration with users demonstrated the positive impact of prototyping [8][9]. Indeed, pursuing an innovation activity by using physical and tangible tools as a channel influences the group's performance in three main ways [8]. First, prototyping enables the creation of shared mental models between all the participants and clears misunderstandings. Second, it creates emotions through haptic experience which has a positive impact on the group's cohesion. Finally, prototyping helps fostering coordination between the participants. By this

means, a prototyping toolbox is perceived to be the right technological intervention channel for our situation.

Several examples of prototyping tools already exist on the market but each one of them covers a certain scope of the problematic explained earlier and does not fully consider the challenges related to co-creation for innovation. Some of these tools target collaboration, others address innovation and some tackle the technology abstraction to drive a faster and less demanding innovation activity. These examples are detailed further in the last section.

The sixth step of Fogg's design process advocates the analysis of the strengths and gaps of these examples so that to build on the key features and develop the collaboration dimension targeting the enhancement of the innovative behavior of groups. What the electronic prototyping tools have in common is that they consist of a set of elementary pieces that when assembled together constitute a computing entity that processes elementary signals to deliver fundamental information that help users physically represent their ideas. This conceptualization will be the basis for our prototyping tool. And since persuasive systems are defined as "computerized software or information systems designed to reinforce, change or shape attitudes or behaviors or both without using coercion or deception" [10], we consider our artifact under study as a persuasive system. The next section will deal with this item in more detail and will discuss the persuasive dimensions of the systems applied to the innovation collaboration context.

After building a first version of the prototyping toolbox based on the results of the abovementioned steps, we will test it by running experiments to understand people's reactions to the overall innovation experience, and then iteratively inform the persuasive design of the artifact. At the end, we expect to develop a comprehensive method to be used during innovation workshops that leverages the prototyping toolbox under study.

3 Conceptualizing collaboration as objective for persuasive technology

The concept presented in this paper calls for the origins of persuasion where a persuader attempts to influence others by modifying a persuadee's way of thinking, feeling, or acting [11]. In our case, the prototyping tool will be used by the stakeholders of a considered innovation in order to drive the group's innovative behavior. By stakeholders we refer in this study to the customers of a company that expects feedback from its users. The persuasion message would be "innovate together".

Since the prototyping toolbox is intended to collective workshops, it is important that it addresses the specificities of each stakeholder involved, such as the technical background, level of interest in the designed artifact, age, knowledge, etc. These characteristics need to be evaluated to inform the design and the content of the

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prototyping toolbox so it can embody a platform for hands-on communication by providing the expression space and tools for all the involved stakeholders in the sociotechnical system defined by the innovation workshop. This aspect is particularly critical when the users haven't been involved with any electronic prototyping activity before and may consider the task as dreadful. Some existing prototyping tools addressed this critical aspect by lowering the barriers to adoption and by steepening the learning curve [12].

4 Tailoring for innovation collaboration

White boards and post-its remain ubiquitous creativity and innovation tools when it comes to generating solutions in group. Through a more serious version of the popular toy, LEGO has developed a methodology designed to enhance innovative thinking and creativity, and improve communication and teamwork, where recreation is combined with imagination, hand-mind connection and constructionism [13]. Capitalizing on the success of the littleBits, Bdeir [12] defends the modular electronic prototyping kit as a design material to drive creation and innovation. Similarly to the littleBits, our prototyping kit aims at positioning itself as a relevant co-creation design material for various group settings and workshop contexts. In fact, it is tailored in a way that the potential needs, interests, personality, usage context, or other factors relevant to a user group can be satisfied by choosing certain elements of the toolbox over the others. Particular attention is brought to the contextual dimension since the main purpose to be served by the box is co-creation between the several stakeholders involved in the design of the prototype.

From a primary comparative analysis with the electronic prototyping tools existing on the market, it is already observed that the main available examples have combined several elements of simplicity factors of the Fogg's Behavior Model (FBM) [14]. By isolating electronic functions in individual building blocks that do not require additional media of connection - such as breadboards and cables - and that can be assembled without requiring any necessary engineering knowledge, three main elements have been optimized: time, physical effort and brain cycles. This key characteristic emphasizes the main purpose of the tool. In collaborative settings of innovation prototyping, the creation and co-creation process needs to be sufficiently simple so that the participants can create a shared understanding while concentrating on key issues such as the use, the value proposition, or the integration of customer feedback. Besides, the artifact designed using the toolbox's building blocks needs to be flexible enough so that it is easy to be altered and modified by the co-creators. It should also be robust enough so that it is not easily damaged by the iterative manipulations of the group. These two last aspects will also contribute to reducing the physical effort and cognitive involvement required from the participants. Regarding the two remaining factors of the FBM, and as a starting point of this study, the prototyping toolbox will feature elements that drive behavior change through cues to action. Indeed, some elements of the toolbox will act as behavior triggers where they suggest to the user, for example, to start the prototyping activity. Other elements will act as core motivators to signal self-efficacy to the users so that they get acknowledged about their ability to perform well using the kit at a very early stage of the workshop. Additional cues to action, such as blinking green lights, will support the prototyping progress of the users [15]. These features will be improved and enhanced along the design process, essentially trough the conclusions extracted from the experimentation with the users.

5 Conclusion

This study aims at exploring and designing a new prototyping toolbox for collaborative innovation workshops or maker events as an alternative to other existing tools. By analyzing currently used material, the design will build on already proven features and will be completed with elements that particularly address the co-creation dimension required by the collaborative settings, by considering the heterogeneity often involved in such endeavors. Through a design science research approach, the toolbox will be improved by testing it in workshop settings to draw the optimal design principles that drive the desired behavior. Building on the success of the toolbox and learning from its failures, we will seek to progressively enhance the artifact until the technology weaves itself into the natural behavior of the users. Ultimately, we would develop a comprehensive method around the toolbox to guide the users during their innovation prototyping activity.

Besides, once the objective is realized, other circumstances or contexts would be tested to explore co-creation outside of the firm's boundaries such as in situations involving common goods and public wellbeing, where the level of interest would be distributed more evenly than within corporate settings.

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