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Poster: Discovering Requirements of Behaviour Change Software Systems from Negative User Experience

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ABSTRACT

Behavior Change Software systems (BCSSs) have shown promising outcomes in terms of promoting healthy behaviors. However, a negative User Experience (UX) can be induced by BCSS if designers do not have clear understanding of the requirements that factually help in changing the user behavior that achieves a sustainability goal.

In order to get insights into how to discover such sustainability requirements, we propose a discovery approach, whose emphasis is placed on negative UX assessed through attitudes and behaviors expressed by users due to the lack of fulfillment of actual user needs. The approach is tested on existing software systems designed for preventing or reducing Repetitive Strain Injury as a particular category of BCSS. Twelve requirements that contribute to social sustainability were discovered.

CCS CONCEPTS

• Software and its engineering → Designing software; Human-centered computing → User studies

KEYWORDS

Requirements discovery, UX assessment, user needs, Social sustainability requirements.

1 INTRODUCTION

A number of software systems that attempt to help people achieve behavior change have been proposed in various domains such as health and wellness (e.g. [1],[2]). Despite advancements from the field of psychology to understand user behavior according to the changing demand (e.g. [3]), a negative user experience can be induced by Behaviour Change Software Systems (BCSSs) if designers do not select the right persuasive strategies [4]. Nevertheless, to find the right way of persuasion, it is important to have first a clear understanding of the requirements that factually help in changing the user behavior to achieve sustainability goals. To date, few works have been published that aim to contribute to the agenda of requirements engineering concerned with sustainability (e.g. [5],[6]). Among them, Mahaux et al [5] assessed how different techniques (i.e. stakeholders analysis, context and scope definition, use case analysis and goal modeling) can help in discovering environmental sustainability requirements. Raturi et al. [6] proposed a nonfunctional requirement framework that can serve as the basis to elicit and classify sustainability requirements for the software systems to be built.

This paper is concerned with the discovery of social sustainability requirements emerging from an empirical UX assessment of BCSSs. The approach is presented and illustrated with a BCSS designed to recover and prevent Repetitive Strain Injury (RSI) in office workplaces.

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2 REQUIREMENTS DISCOVERY

2.1 Negative UX-based discovery approach

Our approach for discovering requirements lies on the importance of understanding how user experienced with an interactive software and gain more insight into useful user feedback. Our approach consists of two phases:

An **empirical UX assessment process** which is supported by a wide range of research methods available, ranging from attitudinal evaluations (e.g. UX questionnaire, think-aloud) to behavioral evaluations (e.g. eye-tracking). In this phase, in contrast to Sonnleitner et al [7], we focus on *negative User Experience* (NUX) that is caused by the *lack of fulfillment of needs* during the interaction with a software product (e.g. BCSS). The effect of this cause is the user attitudes ("what people say") and user behaviors ("what people do").

Requirements discovery process which is supported by techniques used by analysts or requirements engineers to identify user needs from the attitudinal and/or behavioral data collected during the user interaction with a software product. Then needs that were not fulfilled are translated into requirements that contribute to social **sustainability** dimension [8].

2.2 The case of RSI

In order to test the approach described above, we have first conducted a user study in the context of BCSSs for preventing RSI to **empirically assess UX**. We targeted office employees working with computers (i.e. desktop, laptop) as RSI typically

arises among this kind of user. Twelve participants out of 30 accepted our invitation. 3 were female and 9 male, whose age ranged from 21 to 45 years old.

The study was conducted in the natural settings of the subjects for 1 week (5 working days), carrying out their own work as usual. Participants got either Workrave [1] or Smartbreak [2] installed by themselves, which are RSI prevention software alternatives available in the market. Workrave does include training support, which is a feature missing in Smartbreak; meanwhile Smartbreak introduces biofeedback to try raise awareness on user's stress state, although it is based only on keyboard and mouse usage. The 8 subjects with a Windows computer installed Workrave, whereas 4 users who had a laptop with Mac OS installed SmartBreak.

Before starting the empirical study, participants filled in an initial form regarding demographics. Then they answered a questionnaire at the end of the first and fifth day, to self-report their joy and pleasure using the software, as well as usefulness, understandability, mental demand, among a few others, based on the User Needs Questionnaire (UNeeQ) adapted from [7]. An important part of the questionnaire corresponds to positive/negative feelings and experience. All the items [3] were measured on a five-point rating scale (0-4) ranging from "not at all" to "highly". Additionally, open questions were included to capture in free form text issues regarding user experiences and feelings, either positive or negative.

Overall UX frequencies suggested that at the beginning there were not much NUX (46% replied *Not at all*), but participants manifested that negative experiences and feelings became more intense at the end of the study (17% replied not at all). Table 1 summarizes the scores for both positive and negative UX at day 1 and day 5, calculated as weighted average ratings (the higher score, the better).

Table 1: Overall UX scores on day 1 and day 5

	Day 1	Day 5
Positive	1.4	1.73
Negative	2.68	2.51

Secondly we proceed to **discover sustainability requirements** of RSI software, by analyzing user's comments and ratings collected from UX assessment, we get a better understanding on user needs that were not fulfilled and what people would like to have. From the comments given by users and ratings on feelings and experiences (attitudinal data), we found out twelve social sustainability requirements arranged in three dimensions of a BCSS: dialogue support, primary activity support, and credibility.

Three requirements that could contribute to *dialogue support* feature were identified. These requirements, such as *awareness, engagement and consistency*, enable BCSS to provide relevant, motivating and adequate feedback to its users to foster a behavior change for reducing RSI. The second dimension consists of requirements that contribute to *primary activity support*, which enables the achievement of the BCSS goal. Based on the comments and UX ratings, we found that activities like the break reminder could not have a positive effect on the user's behavior if *enjoyment and fun* requirements are not taken into consideration. Other important requirements such as *Usefulness, Unobstructive, Timely, Tailorability, Learnability, and Adaptability* were also inferred from users feedback on their NUX.

Finally the third dimension, *credibility*, consists of two requirements that relates to the *trustworthiness* (confidence on software systems that behave as intended) and *transparency* of the system (implications and consequences of functionality such as skipping or postponing breaks or when they will be offered should be clear to the user regardless of the internal details on how they are being handled or implemented).

3 CONCLUSIONS AND FUTURE WORK

We have introduced a negative UX-based approach for discovering requirements of software systems aimed at changing the user behavior. Through an empirical UX assessment focused on two popular software systems for preventing RSI, we found out twelve sustainability requirements that could help the achievement of a better physical and mental well-being. For instance, addressing requirements such as awareness, engagement and consistency, BCSSs will be in a better capability to provide relevant, motivating and adequate feedback to users.

As our empirical UX assessment was limited to the collection of attitudinal data, we are going to replicate the user study by involving different user profiles and applying a framework that focuses also on monitoring behavioral data (i.e. negative actionable emotions [9]).

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