User-Centered Design Guidelines for Developing Single-Purpose Apps in an Industrial Context

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Abstract. Single-purpose apps (SPAs) are mobile applications that target one central functionality, where the app's purpose is well defined and solves a single task. This paper describes the user-centered design process of a SPA for documenting incorrectly discarded waste in organic waste garbage cans. Out of the results of the usability evaluation a set of guidelines was developed for designing SPAs for an industrial environment.

Keywords: single-purpose app, usability, digitization, user-centered design

1 INTRODUCTION

When implementing new technologies in organizational processes, it is important to design applications with the users in mind [1]. User-centered design is a critical process in software development for creating intuitive, usable, and satisfying services [2], [3]. However, this approach has been largely ignored in organizational settings, where employees are given on-boarding training and are expected to become experts through daily use. Single purpose mobile apps (SPAs) can automate time-consuming and repetitive business processes and integrate into work processes but must be user-friendly and not generate extra workload [4], [5]. Developing SPAs in a user-centered design approach can ensure fast execution and uncomplicated handling even by less trained personnel [6]. This paper describes the development and evaluation of a SPA for waste management using a user-centered design approach and presents guidelines for designing and implementing SPAs for industrial processes. The paper concludes with actual findings and future research directions.

2 BACKGROUND & THEORY

2.1 ORGANIC WASTE MANAGEMENT

Efficient recycling and resource-conserving organic waste management are crucial for sustainable resource use and climate protection. Organic waste makes up a significant portion of residual waste (25.6%-36.5%), with avoidable food waste accounting for up to 47.9% (urban) and 29.9% (rural) of it [7]. Biowaste can be converted into compost or energy, particularly through anaerobic recycling, which is faster and can process biogenes with strong odors. Proper waste separation is thus essential [8]. The SPA described in this paper helps waste management workers document incorrectly discarded waste, promoting long-term environmental benefits.

2.2 SINGLE PURPOSE MOBILE APPLICATIONS

Single-purpose apps (SPAs) are (mobile) applications that target one central functionality,

where the app's purpose is well defined and solves a single task. A single-purpose app is not an entry point to an ecosystem of functionalities that incorporates many functions and is, therefore, not an application like Instagram's mobile app. Examples of single-purpose apps are parking apps, store-queue apps, call-center apps, and ticket apps [5].

3   USER-CENTERED DESIGN PROCESS

To understand how to support the waste management logistics companies in the documentation process as well as their employees in this context, we performed a problem characterization and abstraction, defined as the first contribution of a design study [9]. To ensure knowledgeable results for the domain of waste management, along the triangle of data, users and tasks [10], we followed a user-centered design process [11]. Information was gathered primarily from focus group meetings [12] combined with domain-specific literature research.

3.1   FOCUS GROUPS

To gather information about documenting and handling impurities in organic waste, a focus group was formed, consisting of stakeholders from municipal associations, waste management logistics companies, and an environmental company. Three meetings were held to identify problems and framework conditions related to the documentation process, involving politicians, the general public, property managers, and waste transport employees. It was found out that smartphones are already in use for documentation, but inconveniently through apps like WhatsApp or e-mail, taking up significant working time and requiring intensive administration. The desired solution should be easy to use with low extra effort for the waste truck team.

3.2   PROTOTYPE

After finding no suitable SPA on the market, a prototype was developed to meet user requirements for reporting misfills in organic waste bins. The prototype was designed to provide an efficient reporting process with two images, automatically added meta data, and sent to an endpoint. It can be used while wearing gloves and does not require touch interaction. It is also designed for use by less trained personnel and logs the duration of the documentation process to track extra time needed for each report.

3.3   EXPERT INTERVIEWS AND USABILITY TEST

Expert interviews and a usability evaluation were conducted to evaluate the first prototype of the SPA. The expert interviews revealed issues with handling wrong reports, unclear hardware button usage, and insufficient guidance during the documentation process. Based on this feedback, the user interface was revised. The usability evaluation showed that most participants found the app easy to use and had a positive experience. However, the size and hardware specifications of the smartphone were important factors in the user experience, and the contrast of the user interface was crucial under different weather and lighting conditions. The workers wore gloves, so the hardware button needed to be prominent enough to interact properly. Overall, the results of the expert interviews and usability evaluation helped to improve the usability of the SPA.

3.4   FIELD TEST

A seven-week field test was conducted to determine how the SPA could be integrated into the workflow of waste management employees and its impact on existing processes. Two teams (they are working together in the same truck) were equipped with smartphones, as can be seen in Figure 1 to document misthrows in organic waste bins, with a WhatsApp group created for the teams and a group admin to send out weekly status reports and challenges.

Figure 1. The developed prototype used to make one documentation with gloves in working environment.

The participants were highly satisfied with the ease of use, which was reflected in the high number of messages sent. The weekly summary of incoming messages showed an increase of reports for team 1 after a challenge was published, while team 2 had more reports in the beginning, but then decreased. The median time for the documentation process was around 22 seconds for both teams, with times in a range from 12 to 62 seconds. The workers had high intrinsic motivation to document incorrectly discarded waste since their problems in everyday work life were made visible. The SPA integrated well into the daily work routines, with the documentation carried out by the driver in one team and by a garbage collector in the other. The dispatchers were relieved by this direct communication, as they did not have to forward the sent reports.

4   CONCLUSION & FUTURE WORK

This article discusses the design and evaluation of a user-centered single-page application (SPA) for documenting impurities in organic waste bins. The lack of existing SPAs for this process led to the development of an optimized prototype for smartphones, which was

evaluated through expert interviews and usability studies. The findings suggest that workers are willing to use such an application if it does not interfere with their daily work routines and is simple to use. Based on the results of the study, a set of guidelines were defined to help developers create SPAs for industrial processes:

1. Use gamification elements to make tedious tasks more attractive and positively influence usage behavior.

2. Show users the impact of their work to increase effectiveness through transparency.

3. Keep the process simple and user-centered with the right equipment and interface.

4. Intrinsic motivation is key, provide appropriate tools for easy issue forwarding to prevent omissions.

5. Define benefits for all stakeholders to ensure added value for all user roles.

6. Leave room for variation to accommodate individual needs while still ensuring process success.

To further evaluate the effectiveness of the application, it is planned to be used in four teams over one year, and the outcomes of the field test will be compared with the data from the live phase. Additionally, the application will be further developed to implement a configurable documentation process, making it suitable for other use cases that require a simple and reliable documentation process.

Overall, the development of a user-centered SPA for documenting impurities in organic waste bins has shown promising results in terms of usability and user acceptance. The guidelines developed through this study provide valuable insights for developers creating SPAs for industrial processes, with an emphasis on simplicity, effectiveness, and user-centered design.

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