Designing the User Interfaces of a Behavior Modification Intervention for Obesity & Eating Disorders Prevention

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Abstract. The recent immense diffusion of smartphones has significantly upgraded the role of mobile user interfaces in interventions that build and/or maintain healthier lifestyles. Indeed, high-quality, user-centered smartphone applications are able to serve as advanced front-ends to such interventions. These smartphone applications, coupled with portable or wearable sensors, are being employed for monitoring day to day health-related behaviors, including eating and physical activity. Some of them take one step forward by identifying unhealthy behaviors and contributing towards their modification. This work presents the design as well as the preliminary implementation of the mobile user interface of SPLENDID, a novel, sensor-oriented intervention for preventing obesity and eating disorders in young populations. This is implemented by means of an Android application, which is able to monitor the eating and physical activity behaviors of young individuals at risk for obesity and/or eating disorders, subsequently guiding them towards the modification of those behaviors that put them at risk. Behavior monitoring is based on multiple data provided by a set of communicating sensors and self-reported information, while guidance is facilitated through a feedback/encouragement provision and goal setting mechanism.

Keywords. User Interface, Smartphone App, Eating Disorders, Lifestyle, Obesity

Introduction

Young adults (up to 35 years old) belong to an age group with increased risk for weight gain and loss, which potentially leads to obesity and eating disorders (ED). Thus, many interventions have been proposed aiming at preventing – or tackling – obesity and ED. Among these, the lifestyle interventions, which attempt to build and/or maintain a healthier lifestyle by taking measures for modifying the eating and physical activity behavior of the subject, are probably the most efficient and widely-used. The extensive use of mobile phones provides opportunities for supplying a lifestyle intervention with a modern, multifunctional user interface (UI), whose virtues, such as usability, intuitiveness, and attractiveness, may impact the overall adoption of the intervention.

In this scope, this work focuses on the design methodology – and the resulting outcome – of the mobile UI of SPLENDID, a novel, sensor-oriented intervention for detecting, monitoring and preventing obesity and ED in young populations. SPLENDID attempts to realize long-term modifications of the eating and physical activity behaviors of young people at risk to fence off their progression to obesity and
ED. This will be materialized by an information & communication technology (ICT) system – the SPLENDID system. The presented UI is the front-end of the SPLENDID system and is implemented as an Android application, namely the SPLENDID app. The app will monitor the eating and physical activity behaviors of its users, with the use of novel sensors and self-reporting, and also guide them to permanently change the susceptible behaviors, mainly via personalized goal setting and feedback provision.

Concerning related work, the emergence of smart devices has yielded dozens of smartphone apps that facilitate monitoring and/or modification of targeted eating and physical activity behaviors, employing several behavior modification techniques and demonstrating some positive results in the prevention and treatment of obesity [1] and ED [2]. BeWell [3] is an application, aiming at monitoring, modeling and promoting wellbeing. SapoFitness [4] has similar objectives, i.e. to motivate a healthier lifestyle through dietary and physical activity evaluation. Regarding apps that target obesity, Fitness Tour [5] proposes activity exercises and/or games while monitoring and verifying their execution. mCHOIS [6] is a mobile application that facilitates the entry of biometric data for obesity surveillance. In [7], the design and development of 4 smartphone applications (namely ePASS, eVIP, eSIYP and eTIYP), is presented, each one modifying risky nutrition or physical activity behavior.

1. The SPLENDID Intervention

The SPLENDID intervention is targeting two distinct age groups, which, in turn, determine two distinct target uses. In the first use, which addresses adolescents (10–17 years old) with normal or mildly overweight BMI, the system will initially record individual eating patterns during one school meal for the entire school population to automatically evaluate the risk for future development of either obesity or ED; clinical experts will confirm/contradict the automatically-generated risk. The users at risk will continue to the next phase (1 week long), where they will be monitored in their real-life and home environment to discern their extended behavioral profile. At the end of the monitoring period, the system will evaluate the acquired data (sensor data and self-reports) to generate an updated risk assessment, to be confirmed/contradicted by the experts. The users with confirmed risk will continue to the third phase (3 weeks long), where several personalized behavioral goals will be set for them with the help of the clinical experts. The system will evaluate the compliance level to the set goals and generate reports to be reviewed by the experts. The second target use of SPLENDID attempts to prevent overweight young adults (18–30 years old) from obesity. This is very similar in terms of monitoring and guidance mechanisms as well as expert involvement to the first use after the screening phase at school.

Concerning the SPLENDID system, Fig. 1 provides a high-level overview of the proposed hardware architecture. The system employs three sensors: The Mandometer scale measures the food weight on a plate, the Activity Meter monitors physical

![Figure 1](image-url)
activity, and the Chewing Sensor detects snacking events. The sensor measurements are transmitted via Bluetooth to the SPLENDID app on the smartphone for further processing (e.g., extraction of behavioral indicators such as total food intake, food intake rate deceleration, number and time of snacking events, daily activity level). At the decision support server (DSS) side, the extracted indicators are integrated with user input and subsequently analyzed for the purposes of risk assessment and goal proximity evaluation. Based on the evaluated goal proximity, the system will provide motivational feedback through the SPLENDID app for behavior modification.

Thus far, the critical role of SPLENDID app in the system has become clear: The app is not only the interface of the user to the entire system exposing a list of system functionalities but also the communication mediator between the other SPLENDID subsystems. The participation of the app in the promising SPLENDID intervention (introduction of the chewing sensor, usage of validated behavioral modification techniques, etc.) is what distinguishes it from previous related apps. A profound presentation of the envisioned intervention can be found in [8].

2. Methods

The design methodology/process that has been followed for the UI of SPLENDID adheres to standard UI and ICT system design guidelines and is presented in Fig. 2. “Step 0” (i.e., a precondition) of the process has been the identification and detailed description of the use cases (UC) of the SPLENDID app, according to the conventions of the Unified Modeling Language (UML). Based on the UC, the screens comprising the app were identified, along with their main functional elements; the screen flows necessary to carry out each UC were also specified (Step 1). Then, a mock-up of each identified screen was designed (Step 2). A representative subset of the first version of mock-ups was presented to the project consortium, which includes the representatives of the intervention end-users; the consortium reviewed the mock-up screens and proposed modifications (Step 3). Subsequently, all the screens were revised according to the suggestions of the consortium. Generalization of the consortium suggestions was used to extract general modification patterns for the non-presented screens (Step 4).

Next, a workshop was organized at Mando Clinic (Stockholm, Sweden) with the participation of health professionals (clinicians, dieticians, and researchers) and UI designers for presenting the revised screens. A subset of the mock-up screens was presented and the attendees were asked specific questions on various UI design aspects (Step 5). The collected feedback was quite detailed and thorough. Although the screen flow and structure met the health professionals’ expectations, essential modifications to specific screen elements and the overall look-and-feel of the UI were proposed. Based on the feedback from the workshop, a third version of the mock-up screens was developed with the help of an UI expert (Step 6). This mock-up version is quite mature and very close to the final screens of the app; however, it should be mentioned that the final review of the mock-up screens by a group of end users (circa 60 students of the International English Gymnasium in Stockholm) is planned to take place in March 2015 as part of a pilot study in Stockholm (Sweden) – future Step 7.

Regarding the tools that were employed for executing the described UI design methodology, Microsoft PowerPoint was used for sketching the identified screens and the flows between them in Step 1. Then, the preparation of the first two versions of the mock-up screens (Steps 2, 4) was performed in Fluid UI, a web-based UI prototyping tool.
tool, supporting smartphone apps. Fluid UI allowed the use of Android app building elements to produce mock-up screens visually very close to the real application. After the workshop, the third mock-up version was designed in Adobe Photoshop to provide higher detail and resolution to the graphic elements. Additionally, new icons and GIF animations were designed, while the element color pallet was also upgraded, offering significantly better appearance and sense. The application screens were implemented using the Android Development SDK (Software Development Kit) plugin set up for the Eclipse IDE (Integration Development Kit) for Java.

3. Results

In total 16 unique screens were designed for the SPLENDID app. These have been compiled into screen flows that carry out the functionality of the 14 use cases of the
application. Fig. 3 presents the screen flows for the functionality (UC) called “Record meal with Mandometer”. Moreover, it should be noted that the top-left screen in Fig. 3 depicts the default view of the Main Screen of the app, which presents the daily usage of the sensors and the answered questionnaires - by sliding and pressing the available buttons the user can access the other views of the main screen. All the designed screens have been implemented as separate Activities and/or Fragments of an Android Application Project in Eclipse. In fact, Fig. 3 includes screen captures from an Android Smartphone displaying the implemented screens.

4. Discussion

Since the UI of the SPLENDID app has already been implemented, the next step is the implementation of the business logic (i.e., back-end) of the smartphone app following the requirements of the intervention. Subsequently, the application can be evaluated as a whole; performance will be measured via a series of planned pilot studies. The evaluation will address not only the mere technical virtues of the app (e.g., its functionalities) but also its HCl-oriented qualities, such as usability and intuitiveness. The finalization of the SPLENDID app's UI relates to its persuasiveness, yet a challenge. SPLENDID is a promising preventive intervention approach using high-end technology against obesity and ED in young populations. Effectiveness will be mainly measured by the front-end, since this is the system part interfacing with the users. Taking this into consideration, the UI needs to be fine-tuned with value-added visual and textual elements aiming at increasing the overall attractiveness. By achieving the aforesaid, the potential that the app will persuade the users to include it into their daily lives becomes more vivid.

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References