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ZENse - Supporting Everyday Emotional Reflection

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Abstract. Healthcare benefited greatly from the trend of self-quantification. However, emotional states and psychological health are more elusive and defy description by simple sensor data. In this paper we show how a user oriented design process resulted in ZENse, a wearable prototype for digitally supporting ideas of *Positive Psychology*, a psychological approach to help patients with mental disorders. A conducted user study shows promising results on the idea and the design. Despite it being only a small explorative study with healthy participants, we found that the prototype triggers situations and interactions that are known to have a beneficial effect on mental well-being.

Keywords: quantified-self; wearable; emotion; tracking; self-reflection

1 Introduction

A number of personal monitoring and feedback systems have been suggested for the management of a wide range of health-related conditions. These types of systems help users by enabling them to monitor and visualize their behavior, keeping them informed, reminding them to perform specific tasks, providing feedback and recommending healthier behavior or actions [2].

Sensors that are embedded in wearable devices such as smartphones, smart watches or jewelry are able to quantify, and thus monitor our physical activities and spatial locations. Reflecting on these data can change the way we organize and experience our daily life. In the context of health care, such wearable or ambient sensor systems may also help to bridge the gap between care-giving institutions and patients by actively involving the patient, monitoring multiple conditions in a long-term or continuous manner and providing real time information and timely feedback about a patients health condition [15]. Physical data are not only easy to collect, they are also quite meaningful, e.g., the amount of physical activity will assumingly correlate with the physical fitness of a person.

In contrast, emotional states and psychological health in general are more elusive and defy description by simple quantification of sensor data. As an example, mental diseases like depression or generalized anxiety spectrum disorders (GAD) exhibit very heterogeneous etiology [12]. However hard it is to collect appropriate data, patients suffering from above mentioned mental diseases can regain and improve their quality of life by quantifying their positive everyday experiences [14]. Such *Positive Psychology* emphasizes on the positive aspects in someone's life and thus, helps pa-

tients to develop and nurture resilience, identity and optimism among other beneficial psychosocial effects [7][18]. As negative experiences can lose their depressing and dreadful component, people, especially patients, are more willing to accept both emotional states as equivalent parts of a normal life.

Collecting experiences is only a first step, whereas reflecting on these experiences complements the procedure. Reflecting on someone's own experiences can offer insight to patterns and dynamics interweaved in a bigger picture. Self-reflection is an activity closely related to learning and can be seen as a form of processing and responding to experiences of any kind [3]. In psychological therapy, self-reflection is used as an intervention to gain influence over pathological patterns and eventually break these patterns [1][4].

Researchers have proposed various approaches for collecting experiences and to reflect on them. Hall et al. implemented a game-like Facebook application for the measurement of emotional states and concluded both, the underuse of social features as well as the rejection of comparative and evaluative features [10][11]. Lindström et al. proposed the Affective Diary allowing users to augment sensor data with pictures and comments. The user study showed that users value and log negative experiences as well as positive experiences [17]. Imbe et al. presented a service visualizing the users geo referenced points of interest and/or frequently visited places over a certain period of time [13]. This visualization allows the user to contemplate on past activities from a different and unusual perspective. However, as today's sensor technology is not able to record the users' emotional state unambiguously and adequately, Eichhorn argues for devices that allow users to record them manually [6].

A number of smartphone applications for tracking the emotional state have been designed such as *My Mood Tracker* [21] and *Emotionsense* [19]. Both applications aim at capturing mood and emotional experience by prompting the user with regular surveys throughout the day. In contrast, we suggest several design decisions currently not reflected in existing applications. First, applying a wearable wristband instead of a smartphone lessens the burden to pull out the latter repeatedly. Second, instead of a repetitive survey a pro-active, however facile user engagement is proposed. And third, location data for every recorded positive or negative experience is tracked and visualized in order to utilize the structuring power of location memory.

In this paper we present ZENse, an application that facilitates reflection on everyday emotional experiences supporting users to maintain a balanced lifestyle. It is based on the work of the aforementioned research and incorporates their findings and suggestions. ZENse consists of two components: a wristband for manually collecting experiences throughout a day and a web-based visualization to retrospectively reflect on these experiences.

ZENse was designed with a likeable and motivating interface and interaction design in mind. To reach this goal the ideas of gamification [5][16] and user oriented design were utilized. Thus, making the act of collecting the right data easy and playful for the users should support them to remain engaged in the activity.

A. How to Gather Data?

The first step when designing ZENse was interviewing a human computer interaction researcher focusing on wearable sensors and a psychotherapist with expertise in *Positive Psychology*. While the psychotherapist described her daily practice, she highlighted the constructive nature of emphasizing positive aspects of everyday life: “Everything I focus on, I enlarge, like with a magnifying glass. When you focus on something positive, the rest takes a back seat. The positive becomes augmented”. However, the ability to reflect on experiences needs cultivation and training and usually is underdeveloped among people, according to her experience. At the end, when she was asked how to collect positive aspects, she suggested a conscious interaction. This was in line with the statements of the human computer interaction researcher who recommended manual interaction techniques as he considered automatic biological feedback as not very reliable. Thus, focusing on positive experiences seems like a first obvious choice. However, *Positive Psychology* also argues for the multifaceted relevance of negative experiences in the activity of self-reflection. Negative experiences can serve as learning for future improvement, and ultimately, help to attribute relative value to their positive counterparts.

The heterogeneous etiology of mental diseases includes numerous possible physical causes identifiable by physiological data like the amount of sweat or the eye movement. Therapy, on the other hand, builds upon the person and the context in which the therapy unfolds. Biological data implies extrinsic evaluation or even classification in healthy and unhealthy, which clashes with the subjective nature of psychotherapy. A different approach is collecting and analyzing nonverbal communication as a source for honest human expression such as gestures, postures, face and eye behavior [8][20].

As the automatic collection of data is not reliable and the interpretation of such data is ambiguous we focused on collecting data manually for the support of personal wellbeing. This implicates an active involvement of the user in both, collecting good and bad experiences in their daily life and analyzing the collected data at a later point in time.

B. What Data to Gather?

To foster design ideas for ZENse a package with a cultural probe [9] (Fig. 1) was prepared. The cultural probe consisted of a city map, a set of blue and red mark stickers, two handheld counters, several emotion diary-postcards and an instruction manual. We invited four healthy persons with various backgrounds to use the cultural probes for six consecutive days to document their emotional daily life. Whenever the test- persons experience a positive or negative situation they were asked to mark these situations on the map using a colored sticker.

If participants felt the need to describe a situation in more detail they could do so by using emotion postcards. While the “emotion diary”-postcards were only used rarely the average map counted 38 markers after a six-day period. As the markers represent place and mood the interviews conducted afterwards revealed that the time, when the marker was set, also played a significant role for the participants. These results led to the design decision to focus on place, time and mood.



Figure 1. Cultural Probe (Counter, Emotion-Diary, etc.) [9]

C. What Interface?

The requirements for the interface were usability, wearability and compactness. After initial sketches we decided on the form factor of a wristband for the reasons mentioned above: it is wearable and compact and offers enough space to implement unambiguous interfaces. However, the interaction is reduced to two buttons in the shape of a plus sign and a minus sign. The design was to reflect the question of “How are you feeling”?

The design ideas were implemented iteratively as mock-ups and the interaction was developed and deployed as a technology probe. The early implementations were given to participants for three days. When we invited the users for de-briefing, we showed them their loggings on a map and asked for their general opinion. Feedback and suggestions from the users were incorporated into the final prototype.

2 ZENse Prototype

In general, the prototype should help users by enabling them to monitor and visualize their daily emotional life. To keep the costs low only standardized hardware components and open web techniques are used. To gather viable data in a user-study the portable part of the prototype must work for a whole day without the need for re-charging. The visualization, used for self-reflection should be generated automatically.



Figure 2. Using the ZENse wristband

To fulfill these requirements the prototype consists of a wearable wristband, an Android smartphone application and a web backend. The wristband (Fig. 2) is made of comfortable fabric to ensure wearing comfort. All electronic parts are mounted in the wristband, however, the battery can be removed for charging. The wristband allows users to self-monitor their positive and negative experiences by pressing the corresponding button. Whenever a button is pressed the wristband sends a signal to the smartphone via Bluetooth. The smartphone application then acquires the current location, associates it with the experience and uploads the record to the web backend.



Figure 3. Representations of experiences (circles) fade out over time.

The web application is designed to enable users to visualize their experiences on a web-based map and reflect upon them in hindsight (Fig. 3). Green dots represent positive experiences whereas red dots mark negative experiences. The web application has been developed utilizing Ruby on Rails and OpenStreetMap API. Any user input is sent to a smartphone utilizing the Bluetooth capability of the logic board.

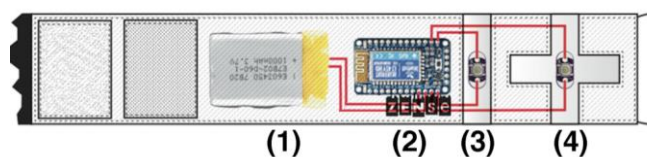


Figure 4. ZENSe is powered by a battery (1). The main unit is a Bluetooth enabled logic board (2) that handles all input and output of the wristband. Two buttons are connected directly to the logic board and as the logic board can track both buttons separately the user input can be identified as negative (3) or positive (4) emotion.

Due to the low power design of the logic board a standard Li-Ion battery with 3.7V and 1000 mAh allows the continuous usage for more than one day without recharging. The costs of the wristband including all components are below 100 Euro.

3 User Study

To gather feedback on the interaction and the representation graphics a small user study was conducted. As the aim was gaining a first insight on the design and on the reflection the prototype had triggered, the selection of the participants was not based on their specific medical records but rather on general diversity.

A. Study Setup

The user study consisted of five persons in the age of 17 to 59 years. The participants had diverse backgrounds (pupils, university student, school teacher, IT expert) and the sample featured mixed genders (three male, two female). Each user received one ZENse prototype in the morning and was briefed to use it throughout the day to document emotional experiences. When the users brought back the prototype after 12 hours, an individual visualization of their collected emotions was generated and shown to them. Finally, a semi-structured interview was conducted regarding the perception of the physical properties of the device and the overall experience.

B. Findings

In the interview three participants described the wristband as visually appealing and one described it as being “elegant”. However, the positive reactions were intermingled with critical comments. One participant mentioned the faint “click” sound as too loud during a visit in a library. While one participant felt no discomfort wearing the wristband four participants mentioned some issues like the weight (2 participants), the size (2 participants) and the fabric of the sleeve (1 participant).

However, all participants used the wristband for a whole day and collected their emotional experiences. The amount of recorded experiences ranged from 8 to 40 per person resulting in an average of 18.4 experiences per person. The average number of positive emotional reflections was 13.2 (72%) whereas the number of negative emotional reflections was 5.2 (28%).

When talking about the feeling the participants had during the day using ZENse we received a variety of reactions. One participant felt influenced by the wristband stating that he “[walked] around more consciously, [taking] a closer look at people and their faces”. He felt the need to constantly interpret his surroundings to log the situation appropriately. A second participant described his loggings intensifying his emotional experiences, positive or negative. The third participant described her daily life as rather stressful at the moment. Thus, ZENse invoked a quite active stance on her otherwise unquestioned and unreflected emotional experiences. The fourth participant described ZENse as “exciting”, however, she reported little activity of self-reflection. She missed a “neutral”-button in addition to + and - and would prefer ZENse to be “more like a regular diary”. The last participant was mainly impressed by the GPS-positioning functionality of ZENse and used it to satisfy his curiosity on seeing what route he’d follow all day. The visualization was positively commented as a useful source for recording daily activities and as tool for reconstructing past loggings.

During the user study ZENse invoked self-reflection in three of five participants, while the two noted the potential value of this technology as a tangible diary. The result shows the potential of tangible devices to support people in their everyday self-reflection. In contrast to existing wristbands like *fitbit*, ZENse prompts a user intervention linking a specific place and time with an emotional state. This active involvement of the user exhibited different approaches to and strategies of self-reflection during our study. While some users rely on the visualization others reflect more “in-situ”. This ambiguity of usage patterns is consistent with the empowering effect of a setting open to personal adaption argued for in [16].

4 Discussion and Future Work

Personal health technologies hold promises for improvements in medical healthcare. Even though this study did not provide clinical evidence the prototype has shown that it is feasible for everyday use with minor adaptations. A successful system must be easy to use and perceived as useful by the patients. Thus, beside the technical implementation the design of such personal health technologies is an important topic [2].

ZENse was designed to support the ideas of *Positive Psychology*, encouraging people to reflect on their daily lives in a playful, unobtrusive way. It can be worn on the wrist and therefore is easily accessible for interaction. With only minimal efforts from the user ZENse can provide beneficial insight through additional data that is automatically collected such as place and time.

However, encouraging participants to reflect on their daily emotional events could possibly lead to a situation where participants focus only on their negative incidents. This would be in strong opposition to the desired effect of juxtaposing negative and positive events. In an upcoming design this possible progress during an intervention should be anticipated.

The device and the study presented in this paper were focusing on the technology and the interaction. To gain more insight on various forms of self-reflection a larger study with more participants and longer duration - in conjunction with a hospital - is planned. This long-term study can provide more specific insights in the usage, practices and needs of patients suffering from mental diseases. The physical characteristics of the device should be advanced to get a smaller and lighter appliance. Future work had also to involve psychological researchers and therapists to built an interdisciplinary approach for a better understanding on *Positive Psychology*.

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