
Exploring Social Awareness: A Design Case Study in Minimal Communication

Torben Wallbaum

OFFIS - Institute for IT
Oldenburg, Germany
torben.wallbaum@offis.de

Wilko Heuten

OFFIS - Institute for IT
Oldenburg, Germany
heuten@offis.de

Maria Rauschenberger

Universitat Pompeu Fabra
Barcelona, Spain
Maria.Rauschenberger@upf.edu

Susanne CJ Boll

University of Oldenburg
Oldenburg, Germany
susanne.boll@uni-ol.de

Janko Timmermann

BTC Embedded Systems AG
Oldenburg, Germany
janko@dzitrone.de

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CHI'18 Extended Abstracts, April 21–26, 2018, Montreal, QC, Canada
ACM 978-1-4503-5621-3/18/04.
<https://doi.org/10.1145/3170427.3174365>

Abstract

Computer-mediated communication technology is ubiquitous in today's society. However, the design of these technologies often takes a screen-based approach and requires users to adopt new usage conventions. While these methods have been widely successful in helping individuals communicate, we take a step back in this paper and explore the design implications of a simpler tangible system for keeping in touch. This system consists of a pair of artificial electronic flowers, which connect and transmit information to each other. Our contribution is not in the actual implementation, but rather in the design implications that follow. In our modest evaluation we found participants using our system in informal, relaxed and sometimes novel ways.

Author Keywords

Design case study; Ambient artifacts; Tangible interaction; Social awareness; Contextual awareness

ACM Classification Keywords

H.5.m. [Information Interfaces and Presentation]

Introduction

Since computers have become a ubiquitous part of our everyday life, it is increasingly important to create technology that integrates with our daily environment. The typical trend of research has often been to create faster and more ef-

ficient screen-based tools. This demands users to adopt new and sometimes unnatural conventions. Weiser et al. and Hallnas et al. have presented new views on technology which focuses on the creation of calm and slow technology [31, 9] to encourage the design of products that interweave with users routines and allows for a smooth integration of digital information into the peripheral space [19]. Shifting digital interactions into aesthetic everyday objects can be used to design simple, intuitive and engaging interactions [14], which can ease an interaction and increase user experience. These artifacts can convey information in an unobtrusive way and can, for example, support a user to keep track of her posture [12] or provide information about a users physiological data [32].

In our work, we step away from the typical screen-based solutions and explore simple solutions to human issues. In this case study, we tackle the issue of social awareness by designing an artifact to connect loved ones living over a distance. Communication and awareness technologies are a wonderful example, because they are widely used nowadays while being often obtrusive and overwhelming but crucial for wellbeing and health [4, 11, 15, 26] at the same time.

Based on previous works covering systems to create social awareness between people living over a distance, we have designed a simple tangible artifact named SocialFlower (see Figure 1). A interconnected pair of flowers lets people share their physical activity and send greetings by touching the flower. We designed SocialFlower to blend into people's everyday lives without being too obtrusive or make users feel obliged to get in touch with a connected partner. In this work, we want to research how a very simple artifact can be designed to create a feeling of awareness and what we can learn designing such a simple solution. We further want



Figure 1: The Social Flower presenting a high activity-level with a green light color. A user touches the leaf of the Social Flower to send a greeting to a connected loved one.

to explore how the design of simple semantics in artifacts enables users to re-purpose technology and adapt encoded information to their needs.

Related Work

In the following subsections, we address three areas that shaped our work: (1) requirements for communication, (2) activity sharing devices and (3) information encoding for light displays.

Requirements for Communication

Previous work has explored communication needs and patterns of social interaction between close friends, partners or families [28]. Tee et al. showed that people often miss opportunities to communicate with their family members due to the asymmetries in the daily schedules. This creates a strong need for a more frequent communication with family members. Kaye et al. & Kjeldskov et al. have researched

the needs and requirements for technologies to support a feeling of closeness to understand the role of intimate communication in the users' lives [17, 18, 16]. Their research shows a desire for new technologies to support communication by providing presence information and activity awareness for a loved one. Further, the presented requirements for such communication devices suggest simple designs and interactions based on *minimal communication*. Using these requirements, we have designed our prototype to support an asymmetric way to share activities and greetings by an easy-to-use device.

Devices for Sharing Activities and Experiences

Many different awareness systems that facilitate social connectedness, support interaction with a user's social network. These systems use various technologies to create awareness and enable communication in different ways, such as the representation of presence or availability by an ambient light display [2, 24], presenting the activity level through light [3] or detecting and conveying activity and emotional states using ambient lighting [6, 30]. Davis et al. have presented a display to convey activity information between elders and caregivers [7]. However, many of these systems do not consider important design aspects or challenges as presented by Markopoulos [21], e.g., privacy, seamless integration into the environment, effort reduction or have not been evaluated in a realistic environment.

Information Encoding for Light Displays

The use of ambient and wearable light displays to convey encoded information has gained attention in recent years [25]. Ambient light as an output modality has an advantage of conveying information in a non-distracting way [22]. Previous work has researched how to encode information using light displays in different contexts of use. Fortmann et al. have presented guidelines for light-displays integrated

into wearable technologies [8]. Various works have researched and presented classifications and guidelines for information encoding on ambient information systems, including ambient light displays [1, 27, 29]. We use encoding for activity information and greeting notifications based on these works.

Concept Design & Prototype

We aimed to design an artifact, which integrates well into the everyday life environment of users and provides a simple interaction to keep in touch with loved ones. The Social Flower visualizes physical activities via ambient light. The flowers may vary in appearance such as roses, tulips or others. Each Social Flower is wireless connected with another flower, located at the home of a loved one. Both flowers visualize the physical activity for the connected partner received from fitness trackers. To update the activity information, the system recalculates steps taken every 15 minutes. To adapt the maximum steps within 15 minutes for each participant, we used two days as baseline and calculated the average. To represent the activity, we used a light pattern that linearly fades from red (low activity) through yellow to green (high activity) based on the work of Matvienko et al. [23]. A user can touch a leaf to send a greeting to her/his partner. The greetings are represented via pulsing light that slowly fades over time. The color of the pulsing light can be selected by the user.

We based our prototype on Arduino Mega and used RGB-LEDs to represent light patterns¹. Communication between flowers is realized using wifi. To enable touch input, we use a spiral made out of wire to detect touch interactions on the leaf. All electronics are enclosed within a laser-cut wooden box. The leaf is made out of foam rubber. For the flower we used a manufactured artificial flower.

¹<https://www.adafruit.com/product/1734>; last retrieved: 01-10-2017

Methodology

We have taken a research through design approach, as presented by Zimmermann et al. [33], to explore: how well can we support social awareness using an artifact to convey activity information, and how do users utilize the ability to send greetings throughout the day.

We conducted a field study with 10 participants (8 female) aged from 19 to 61 ($M=27.0$, $SD=11.73$). None of them had vision problems, color blindness, or any other color recognition limitations. Three couples of the participants were friends, the other two couples were relatives (siblings and mother with son). Each participant received a Social Flower, a fitness tracker, a smartphone with a cellular data connection and used the system for 16 days. Participants could freely choose a location for the SocialFlower. To measure participants' physical activity, we used a FitBit fitness tracker².

We conducted semi-structured interviews with each participant before and after the study. We asked about their most common communication channel and their frequency of usage. Additionally, we asked questions regarding the flower's ability to support communication and their perception of the ambient light using a 5-point Likert scale (1 - strongly disagree, 5 - strongly agree). Participants used experience diaries to give in-situ feedback for situations that appeared using the prototype or remarks about the artifact in general. We used server-side logging to receive usage data for each participant.

Results & Reflections

Usage Behaviors

To gain insights into the usage behaviors for SocialFlower, we analyzed log files from the server application. Overall,

the participants interacted 156 times with a Social Flower to send a greeting to the connected person. We found, that, on average, greetings were distributed over each day of the week, with a maximum on Thursdays and often sent between 11 am till around 3 pm. The amount of greetings sent during the weekends was lower, since the peers were spending time together. We found, that for most groups the interaction decreased after the first days, but kept up over the period of the study. This is considered as common with newly introduced artifacts, due to novelty effects.

Based on the logging analysis and conducted interviews, we found users to perceive the SocialFlower as an artifact of everyday life early on. This reflects in how the device was used throughout the day and in how users reported to perceive information about connected persons. Often participants mentioned to glance at the flower when they pass by instead of focusing their attention, like they would with a screen-based device. Greetings were sent throughout the day, but did not necessarily ended up in explicit conversations. They were rather used to express a positive feeling with a connected person. We see interesting changes in the way, participants used the device. During our interviews, we found indications that the simplicity of the artifact and its low barrier to communicate has an impact on how users integrate the interaction in their everyday life compared to screen-based devices. Such as checking for availability of the partner through a greeting, perceiving activities without focused attention or re-purposing the device to inform the partner about events e.g., time to communicate.

Send and Receive Greetings

All five couples tended to send most of the greeting in the first half of the day. *P1: "In the morning I send a greeting from time to time. When I get a greeting back, I know that she is already up"*. In the evening hours participants used

²<https://www.fitbit.com>; last revised: 01-10-2017

it to wish the partner a *"good night"*. We could find half the participants mentioning that they like to use this function to *"just say hi"* every once in a while or when they pass by the SocialFlower. It was further used to *"make the other one happy"*, out of curiosity, or to express *"that I would like to hear something from him"*. Greeting someone was especially valued, if the sender got a response: P2: *"I am very happy when I receive a greeting back after sending one"*.

Contrary to results found by Kaye et al. , when researching minimal communication between partners in romantic relationships living over a distance [17], we did not find participants to feel obliged to send a greeting using the SocialFlower. Participants mentioned the SocialFlower was unobtrusive and something they use whenever their attention shifted to the device. Additionally, users did not feel that they are expected to answer a greeting from their connected partner but rather send something back whenever they felt like. These differences show some interesting insights, while it is unclear what the exact reasons are. It might be that the integration of Kayes *virtual intimate object* into users computer systems was more prominent during workdays and therefore created stronger expectations by users or the tangibility of our system created a different affordance. To be able to create deeper insights, more research is needed to explore detailed reasons for these differences.

Social and Contextual Awareness

Participants used the SocialFlower to estimate contextual information from the activity level of their communication partners and the current time of the day. P1: *"We can continue to watch our TV show soon, because she left her boyfriend's house."* Another one checked if her friend was already up in the morning: P2: *"[Name] is up now and maybe on her way to me, cause the light is green."* or estimated what

her friend is currently doing at the university: P2: *"She has her lunch break now at the university, because she is moving a lot."* Participants were also able to recognize where their close ones are and what they were up to: P7: *"The flower is red. She is sitting on the sofa most probably"*, P8: *"Seems that she is on her way home. Because the flower is green"*. The SocialFlower further helped to increase contextual awareness about upcoming events, e.g., a birthday party: P7: *The color is changing - the guests seem to have arrived.*

We showed that users can interpret detailed information about the connected persons day-to-day schedule by seeing their level of physical activity. For this, it is important that both users know each others overall activities and interests, e.g., working hours, time spent for commute, hobbies. This raises the following questions: how and to what extent do day-to-day rhythms and cycles influence each other? Are two persons aware of the partners activities? What is the influence of different time zones for long distances and how does this affect the perception of schedules? If users rely on known schedules, they may get worried if unexpected changes occur.

When using modern awareness and communication systems, people many people feel overwhelmed and have concerns with regard to their privacy. Our results indicate, that simplified and imprecise information about day-to-day activities can be sufficient for users to feel a sense of natural connectedness with a close person. This might help to improve acceptance of such application for above mentioned users.

Usability and Ambient Light Design

Some usability issues were related to technical problems with the SocialFlower, e.g., P8: *"The flower is showing a different light than normally. I had to unplug it twice. After that*

it started to work properly again". Some also did not like the design of the device. As one participant stated: P8: *"It [the flower] could have a little more beautiful design"*. One issue we found, was that participants reported that they had missed greetings during the day, because they are only shown for about 15 min on the flower. As a consequence, these participants asked for an additional notification: either using audio signals or as notifications on their smartphone.

With regard to the light design of the device, we received mostly positive feedback. One participant mentioned that the pulsing light for a greeting is well done and he can easily differentiate between greeting and activity information. Others asked if it would be possible to add additional light colors to express and invitation for coffee or to ask the other person to come over. Two participants mentioned, that the light color is too bright during the darker hours of the day, e.g., P2: *"At night the light disturbs me when I want to sleep."* and that they would place the SocialFlower in a room where there is no need for a calm light environment like the living room, but rather a neutral room like the kitchen.

The use of an ambient light display to convey information was perceived to be sufficient, although some participants had problems to identify the encoded information. Aesthetics and usability aspects are very important, when designing tangible artifact that are used everyday. Enabling users to personalize objects with regard to their preferences of appearance can raise acceptance and usage of the device. This also extends to technical reliability, especially when designing communication devices.

Encoding of information in is an important issue to be aware of, especially for light-displays. Although, we based out encoding on previous works and received mainly positive feedback from users, our findings clearly show different

preferences and interpretations for light-displays. The design for information displays should be as simple as possible and take previous works into account. However, we think that personalization is an important factor and user advanced users should be enabled to perform changes according their preferences.

Form Factor

From the interviews in our study, we can clearly see that participants associate a specific type of information with the form of an artifact. While a lot of participants expressed that they like the flower design as an ambient device, because it fits into a domestic environment, P3: *"I like the flower and its nice that you can use it s decoration in the home"* or P8: *"The flower is beautiful, it reminds me on the logo that ICQ used to have"*, half of the participants mentioned that the design is not well chosen to represent activity information. One participant suggested to use a form representing a physical progress-bar: P7: *"A flower does not represent activity, maybe a progress-bar placed on my Desktop"*. Other wanted to integrate the activity information into a form factor they already know: *"..maybe the activity could be shown within a desk lamp."* or P10: *"A glowing round lamp to show activity would be better"*. At the same time, representing the greeting through a flower was perceived to be a very good fit, with regard to the form factor, e.g., P5 stated: P5: *"For showing a greeting its great! I would bring flowers, when visiting someone"*.

When perceiving digital information, users have specific expectations on how these information are supposed to be presented and visualized. This is used in software systems, to design interfaces that are easy to understand and provide a good usability. When designing physical artifacts, the association with real life metaphors can be even stronger due to the physical appearance of a device. Our

work showed that, breaking these metaphors or overloading them with multiple information, e.g., activity information and greetings, people might perceive that some of the information is represented in a wrong way. This effect has also been shown in previous works with single or multiple metaphors and how these can help to express a systems functionality [10, 13, 20]. When designing artifacts, it is crucial to keep a clear mapping between the visualized information and possible metaphors. If multiple metaphors are present, it is advisable to keep the aesthetics of an artifact as neutral as possible.

Re-purposing Technology

The greeting function was intended to create a transition between the implicit sharing of activity to an explicit act of communication. This function was based on previous work as well as known functionality from social networks, e.g., poking someone on Facebook³. However, we could observe some of the participants to re-purpose this feature with new meanings. One pair of participants reported that they used the greeting to inform each other about time when their children are in bed, so they could communicate afterwards. Another participant mentioned P5: *"We have used it to remind each other to answer a question send via messengers. As some kind of notification."* Some participants used it to check the availability of their peers by sending a greeting and waiting for a answer P9 *"I use it to check, if the other person is at home and available"*.

When using the SocialFlower, we found multiple participants re-purposing the greeting function and adapting the technology to their specific needs. One can observe this behavior often in everyday life. Many people re-purpose objects to use them for different tasks then originally in-

tended. As an example, tools are often used different from their main purpose. Similar behavior is shown when using technologies. People often re-purpose apps or devices to fulfill a specific task or adapt them to their needs. Related work even takes advantage of this and enables the use of everyday objects to serve as input devices [5]. We see an interesting question evolving from this behavior, which is related to the simplicity or complexity of a system. Due to its simple design and clear understanding, users naturally adapt technology to their needs, e.g., create new meaning of greetings at specific times of the day. It is questionable, if this would be possible for more complex systems, where users are not able to understand the systems whole functionality.

Conclusion & Limitations

This paper reflects on how tangible information systems are designed to convey information. We present results from a case study, where we explore implications of a design in how tangible technologies are used in everyday life. Our study shows that users enjoyed using the artifact to get in touch with a connected person throughout the day. We found that simple activity information helps users to get a sense of a loved one's schedule. We observed the importance of aesthetics and simplicity of information encoding, when designing interactive artifacts that are supposed to visualize data in the peripheral. Our results show further the importance of a clear mapping between the visualized information and possible metaphors. Further results show that users re-purpose objects to use them for different tasks then originally intended. From this, we see interesting research questions for future studies to research the influence of design on how user adapt technology to their needs. It is hard to generalize our results based on a limited sample size, but it allowed us to draw rich qualitative data and interesting insights. In the future, we aim to extend our study

³<https://www.facebook.com/help/219967728031249>; last retrieved: 06-31-2017

into a long-term field study to investigate further design implications and compare these with technologies often used nowadays, e.g., smartphone applications.

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