
BinCam: Waste Logging for Behavioral Change

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Abstract

We present BinCam, a personal informatics system to monitor individuals' food waste and recycling behavior. As such, it uses an augmented kitchen bin to automatically capture and log an individual's waste management activity. Each time the bin is used, a mobile phone installed in the inside of the lid captures an image of the contents and uploads it to a Facebook application. The application offers various visualizations of individuals' bin usage to increase their awareness of the items they disposed of. Applying Facebook as a platform for reflection offers the potential to engage individuals to regularly use the application. In addition, we regard the social network of Facebook, with its communication dynamics and social influences, as a powerful source in changing personal attitudes and behavior. In this scope, the paper discusses several challenges for designing and evaluating persuasive personal informatics systems.

Keywords

Personal informatics, behavior change, life logging, visualization, reflection, social network

ACM Classification Keywords

H5.2 Information Interfaces and Presentation: User Interfaces



Figure 1: Kitchen bin augmented with Internet-enabled mobile phone (Sony Ericsson Xperia X10 mini).



Figure 2: Captured photo of bin contents.

Introduction

Disposing of waste is a common part of our everyday life, yet we do not pay much attention to the process. Once an item is thrown away it falls into oblivion; with the closure of the bin lid it escapes our awareness. Disposed goods and materials, however, do not simply disappear. In the UK alone, individuals discard 5.3 million tons of food each year, which could have been consumed, and improperly disposes of 4.9 million tons of recyclable packaging. In particular young people between the age of 18 and 34 are either recycling unaware or not seriously contemplating become active in this regard [7]. Creating an interest for their own waste management behavior poses several challenges for the design and evaluation of a personal waste logging system, e.g.: How can the gathering of personal data be of minimal cost to the individual? How can individuals be engaged in reflecting on their behavior, or be persuaded to change for the better? Which ethical and social implications do we have to consider related to the collection and display of this personal information? How can we evidence reflection, or evaluate changes in attitude and behavior?

Collection of Personal Data

As defined by [4], personal informatics systems are composed of two core aspects: *collection of*, and *reflection on*, personal data. Both aspects involve the user and entail their own burdens and potentials depending on the required level of involvement. Compliance to collect personal data through users is higher if it demands rather little effort on the the user's behalf, and if the system is easily accessible and usable for them. In life logging research, this is often achieved through an automatic and system-driven collection process. An automatic capturing of data bears

advantages in terms of time and simplicity, however manually entering data into an application can encompass rich information unable to be tracked through an automatic system in the same way (e.g. own thoughts, emotions). Such self-made and effortful user input can add to the overall understanding of personal data and has the potential to enable deeper levels of reflection [6]. Designing personal informatics systems allowing the collection of rich meaningful user data to reflect on, without requiring a large contribution of the users demonstrates a complex challenge.

Taking into account that information about one's own waste and recycling activities is of minor interest to many young people, their motivation to manually collect and prepare data is assumed to be quite low. In BinCam, we therefore suggest an automatic capturing of thrown away items through digital photos taken with a 3G enabled mobile phone installed on the inside of a users bin lid (Figure 1). An accelerometer within the phone senses the movement of the lid and triggers the taking of a photo (Figure 2). Objects are then identified and tagged in each image using the crowd-sourcing capabilities of Amazon Mechanical Turk¹. With BinCam, the collection of individuals' waste related behavior takes place in situ, is system-driven and does not require extra effort of users in terms of time, attention or motivation. This considerably facilitates waste management life logging, especially when compared to previous attempts using 'waste diaries' [5]. However, to allow users to enrich their collected personal information and to meaningfully explore their data, pictures taken with BinCam are uploaded and integrated into a Facebook application.

¹ <https://www.mturk.com/mturk>

Engagement in Reflection on Personal Data

How can users be engaged to reflect on their waste and recycling management behavior? In this regard, adopting Facebook as platform for self-reflection on personal behavior has several motivations: firstly, as an online application it is easily accessible, familiar and widely accepted by our young target users, which minimizes usage burdens; secondly, Facebook provides a well-established social network structure that we hope will engage individuals to use the application regularly and serve, through various forms of social interaction, as a valuable source of reflection and behavioral change. For this purpose, the interface offers diverse possibilities to review, analyze and comment on one's own and other peoples' bin pictures and related behaviors. Even though Facebook may be engaging to use the BinCam application, it can distract from the actual waste management topic. Do people really reflect on whether they correctly disposed of or do they rather comment on the garbage of others?

Social Influence and Behavioral Change

What might be the potential of the Facebook application and its social dynamics in changing individuals' attitudes or behavior? Based on findings in social psychology, social behavior is influenced, amongst others, by three fundamental goals: to develop and preserve meaningful social relationships, to form accurate perceptions of the reality as base for own behavior, and to maintain a favorable concept of oneself [1]. To fulfill these goals individuals very often *comply* with or *conform* to a group.

Compliance refers to individuals' responding in a socially desired way to a certain request, coercion or group pressure. This compliance with others, however,

does not necessarily reflect an internal change. Related changes in expressions of attitudes or behavior are rather superficial, only publicly shown, and transitory [3]. Behavioral changes in this context usually persist only while the individual is under surveillance. BinCam monitors individuals' bin behavior and displays it to their network of friends. This *public* visibility of own behavior may enforce them to behave in a socially desirable manner, but presumably only for the duration of the project.

Conformity to others refers to the change of one's behavior in order to match the responses of others. Here, changes in attitudes or behavior can be deep-seated, *private* and enduring [3], as individuals are driven by the desire to behave correctly in order to obtain social approval from others [1]. Knowing how to behave correctly requires an accurate interpretation of reality. In BinCam, individuals' awareness and knowledge of their own waste management behavior is increased. This makes users' own values more salient and may motivate the reconsideration of own attitudes and behaviors in order to enhance and affirm positive aspects of oneself.

Personal Data in Public

The sharing of personal information on a public platform raises several privacy and ethical concerns. Thrown away items are normally objects that people have disposed of and do not necessarily want to be identified with anymore. Thus, how can the risk for individuals to feel publicly humiliated be minimized or even eliminated? One possibility to address this issue could be the creation of *bin identities* that only refer to a bin instead of referring to a specific person. This means the person to whom a bin belongs can stay

anonymous unless s/he wants to admit ownership. Another possibility could be that a bin is shared between many users (e.g. in multiple occupancy houses), so that its content cannot directly be attributed to the individual. The blurring of identities behind the collected bin data, however, carries the risk of minimizing the social influence effects described above. Individuals, if living in shared houses, may feel less responsible for the common bin, and, instead of reasoning about their bin activities, fall for a behavior of 'social loafing'. In this regard, finding a trade-off between the privacy of personal data and its exposure in public poses another challenge, if we aim to engage and socially persuade users to change for the better [2].

Evaluating Reflection and Behavioral Change

How do individuals really use the BinCam system? Does it have an impact on their behavior or everyday life? How can we evidence mere awareness, knowledge and reflection of users related to their food and waste management behavior? Are potential effects only short-term or do they last?

For the next stage, we suggest evaluating the BinCam system through a user study spanning 6 weeks in duration. To explore individuals' experiences with the project, their personal opinions and thoughts, interviews and focus groups are planned. Potential changes in participants' attitudes and behaviors towards food waste and recycling will be assessed using quantitative scales, and compared to a control group. To detect long-term effects, 3- and 6-month follow up evaluations are planned. The evaluation will be supplemented by participants' collected BinCam data.

Conclusion

Using BinCam as design example for a personal informatics system - targeted on increasing users' awareness and reflective processes on their food waste and recycling behavior - opened up space to discuss significant design challenges and limitations for personal informatics systems. The paper considers in particular issues of data collection, user engagement, stimulation of reflection on own and others' behavior as well as behavioral change through social persuasion. Related social implications of publicly shared personal data are discussed. The different sections further highlight that developing personal informatics systems very often requires the designer to find careful trade-offs in each of the challenges presented, with particular consideration of the respective context.

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