DigiDress: A Field Trial of an Expressive Social Proximity Application

Per Persson, Jan Blom, and Younghee Jung

Nokia Corporation
P.O. Box 100, FIN-00045, Nokia Group, Finland
{per.persson, jan.blom, younghee.jung}@nokia.com

Abstract. In May 2005 Nokia Sensor application (www.nokia.com/sensor) was launched, allowing mobile phone users to create digital identity expressions, seen by other users within Bluetooth range. This paper describes the design and mass-scale longitudinal field trial of a precursor prototype called DigiDress. 618 participants voluntarily used the application for an average of 25 days. The identity expressions created were both serious and playful, revealing and non-revealing. Factors influencing the identity expression included strategies for personal impression management, privacy concerns, and social feedback. The application was used with both acquainted and unacquainted people, and viewing the identity expression of people nearby was one major motivation for continued use. Direct communication features such as Bluetooth messages were not commonly adopted. DigiDress acted as a facilitator for 'real' social interaction between previously unacquainted users. Privacy concerns and their alleviations, as well as use barriers, were identified.

1 Introduction

With the prospect of small, wearable, power-effective and cheap computing devices equipped with some form of short-range radio, there has been increasing interest in how such devices can support encounters between collocated people. With appropriate software, handheld devices and mobile phones equipped with radios such as WLAN or Bluetooth, are able to broadcast information to and fetch information from nearby users directly without connection to a network or server. This type of technology creates a digital 'sphere', 'field' or 'aura' surrounding each user [1], leading to interesting possibilities for social interaction. The overall question for research in this area, which could be termed *Social Proximity Applications* (SPA), could then be formulated as follows: 'In an encounter between spatially proximate people, how can information in *digital* realm support and augment existing social behavior, practices and experiences taking place in *real* space?' The present paper describes a field trial that was performed to evaluate DigiDress, an SPA allowing digital identity expressions within user's proximity. Prior to setting out the design and the specific research questions, however, let us examine what previous work has been done in this application domain.

1.1 Previous Research on Social Proximity Applications

One type of SPAs is concerned with providing awareness of who is nearby. The Hummingbird radio device [2], carried by members of a closed group, emitted a notification when a group member was in 50-100m proximity and displayed the name of that member. More recent systems, for instance Jabberwockey (http://www.urban-atmospheres.net/Jabberwocky/), do not restrict themselves to pre-defined groups, but open up for awareness of unacquainted users as well (e.g. fellow commuters encountered during one's route to work via the Bluetooth radio of mobile phones).

A second type of SPAs allows users to create a more or less sophisticated identity expression, broadcast to proximate users to facilitate social interaction. NewsPilot allowed journalists in a broadcasting house to jot down the stories they were working on at the moment, which would then be shared with fellow journalists in range, supporting ad-hoc collaboration [2]. HOCMAN was a WLAN-based system for motor bikers, giving out a signal when another HOCMAN biker was encountered on the road, in addition to automatically exchanging HTML homepages that could later be browsed locally [3].

In the third type of SPA systems, some sort of intelligence is embedded in the exchange of data between collocated users, with the purpose of giving recommendations or supporting collaboration. The simplest system of this type comprises so-called dating applications in which the user fills out a personal profile, which will then be compared with the personal profile of another proximate user. If there is a 'match', users will be notified about it, possibly with a picture of the counterpart (e.g. proxidating.com, dreamlove.it and bedd.com). Serendipity is another example in the enterprise domain, although the actual profile match takes place on a server [4]. Similar but with a different purpose, WALID [1] allowed users to define tasks or errands they wanted to be done. Whenever two WALID devices met, their software compared each others' lists and suggested a trade of tasks if there was a match. Social net [5] collected time logs of co-present users and then compared such lists across two proximate users to find common acquaintances of newly acquainted users.

The fourth type of SPA systems involves proximity messaging, one-to-one or one-to-many. Cybiko's Wireless communicator application was a good example of this.

1.2 See and Be Seen: DigiDress Design Rationales and Principles

DigiDress application (DD) aimed to complement existing social practices rather than replacing them. At its core, DD aspired to augment one of the most basic social processes when two or more people gather: *see and be seen*. People express what they are or what they want to be through clothing, personal possessions and behavior. Even electronic products can convey personal identity [8]. Social encounters thus involve elements of identity expression, facilitating mutual evaluation of and inferences concerning personality type, sense of humor, ethnicity, class, taste and other factors [6, 7]. DD aimed to augment this reciprocal process by allowing users to create media rich digital identity expressions, in addition to finding others' identity expressions nearby and browsing them with mobile phones. Consistent with gazing behaviors in public spaces, it should not be possible to *push* the digital identity expression onto

others, but the access should be based on the principle of *pulling* information from nearby users. Another important principle, also derived from the sociology of public spaces [6], was to make the identity expression available to others before being allowed to access the identity expressions of others. At the same time, it should still be possible to take a sneak peak at another individual's identity expression without revealing one's own interest to that individual. Lastly, giving and receiving social feedback on identity expression should also be possible in the digital realm, since such a mechanism exists in real social space. Although these design rules were derived from social research, they were congruent with the principles of 'profile exchange' defined by [9].

Many of the SPAs mentioned above were intended for a quite specific target group or situation of usage (e.g. dating, task exchange, encounters among colleagues). In contrast we wanted DD to be an open expression tool suitable for a wide range of social encounters, social relationship types and contexts of use, particularly encompassing acquainted and unacquainted users in public or semi-public spaces.

Our work started with the following basic research questions:

1. What contents will users create with an expressive proximity application and what factors will influence the content creation?
2. How will users find and view others' identity expression and how will the proximity aspect influence the experience and behavior? How will DD experience be different from the experience of non-proximate expressivity systems such as personal web pages on the Internet?
3. Will the interaction in the digital realm trigger or facilitate social behavior in real social space?
4. Given the public nature of DD identity expression and viewing those expressions, will users experience privacy concerns?
5. What potential use barriers will there be for this type of application?

2 Description of the DigiDress Prototype

Usability tests in lab environment or focus groups based on usage scenarios were not thought to capture the issues arising from the social experiences of using DD over an extended period of time. In order to answer our research questions, we had to create environments in which participants would be motivated enough to voluntarily use the application in real social situations, giving rise to genuine social consequences. Among other things, this involved making a stable, easy-to-use prototype, deployed on a platform that would be widely spread among mobile users in order to achieve a critical mass of users, which is in fact a general comment for many SPAs (see [1]).

Series 60 platform (www.series60.com) provided such a possibility, with four phone models (Nokia 7650, Nokia 3650, N-Gage, Nokia 6600) being commercially available at the time of the trial, fall 2003. All of those devices were equipped with Bluetooth, with a range of approximately 10-20m depending on environment. Trial participants were able to install DD on their own S60 phones without having to carry a separate prototype hardware. Furthermore, designing the DD software according to the style of S60 user interface would spare users having to learn new interaction prin-

ciples before taking the application into use. The following section describes the features of the DD prototype.

Creating identity expression. Emphasizing identity expression, the editor was at the core of DD. Creating 'a DigiDress' on the mobile phone should be a media-rich, yet easy process, with templates assisting the creativity of the user.
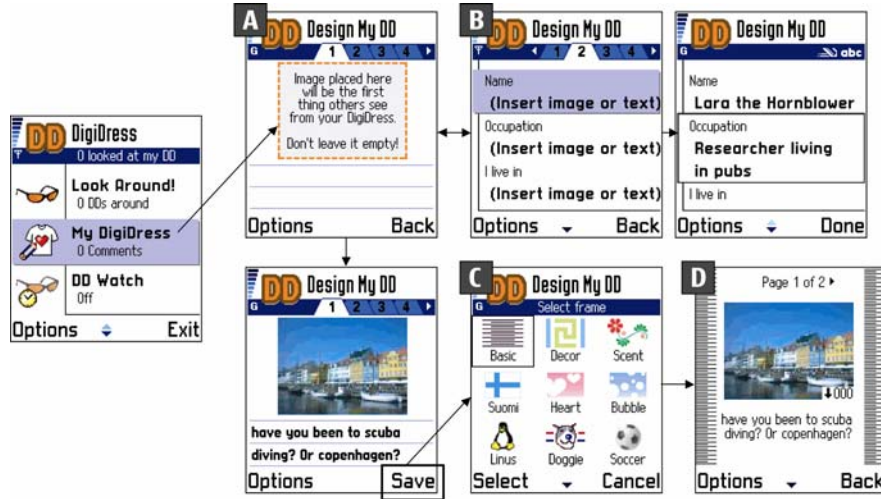

Figure 1. Creating and editing a DD page.

The editor comprised 4 tabs (Figure 1A). Tabs 1 and 3 allowed users to add free text and one image. Tabs 2 and 4 contained fields, each of which could be filled with either text or image (B). We provided suggestions for headings, in order to stimulate the imagination of the users, trying to balance light information with more serious and professional content.

- Tab 2 headings: Name, Occupation, I live in, Three items I cannot live without, Favorite food/drink, Favorite phone model, Favorite TV program.
- Tab 4 headings: Favorite motto, Person I admire, In five years I will, I laugh, I get upset, If I met Jorma Ollila I would, My contact information.

User could ignore the headings, change them or create new ones. While saving a DD, user was asked to choose one of 12 graphical frames (C), which would cover the margins (D). If no content was added to a tab or a field, that tab or field would not show up in the viewer mode (D). Since all but one of the supported phone models had camera, creating and adding images was an intuitive feature. Although users had to create a DD before viewing others' DDs, the obligatory content was minimized to the image in Tab 1 since this was the main element to be shown in the 'Lookaround' list on others' phones. The DD became immediately available to others when saved for the first time and later whenever the application was launched. At any time, users could come back and modify their DD. Having multiple DDs and easily switching between them was considered, but after some design iterations it was deemed too complex, causing more confusion than benefits considering the trial.

Lookaround. This feature (Figure 2) scanned the environment for other DD users and Bluetooth devices, and presented them in a list. The identification of users was not based on phone numbers, but on the unique Bluetooth device identifier (MAC address). If the identified device was running DD application, the Tab 1 image and the first 45 characters of text were automatically fetched and listed (Figure 2E). From the list, user could choose to open the full DigiDress (F). By scrolling sideways in the viewer (F), the full contents of the DD could be browsed. From the viewer, user could also save the DD locally, send Bluetooth messages, add public comments or view the comments this user had received from other users (G). If the device did not have DD application running, only the Bluetooth name of the device was listed.

Lookaround and viewing DDs were conducted without prompting the DD owner for authorization. As long as the DD application of any given user was running in the foreground or in the background, other users within Bluetooth range could fetch that particular DD. Thus, the DD owner did not have to actively use the application (or the phone) at the time of someone else downloading his/her DD. Neither were owners made aware that another user was downloading the DD pages. The only trace of someone's viewing the pages were provided in **My Popularity** feature, which listed the number of 'views' the DD had received as well as the timestamp of those. This rather 'public' design of the system aimed to be in line with the design principles presented above, mimicking existing social practices in public spaces.
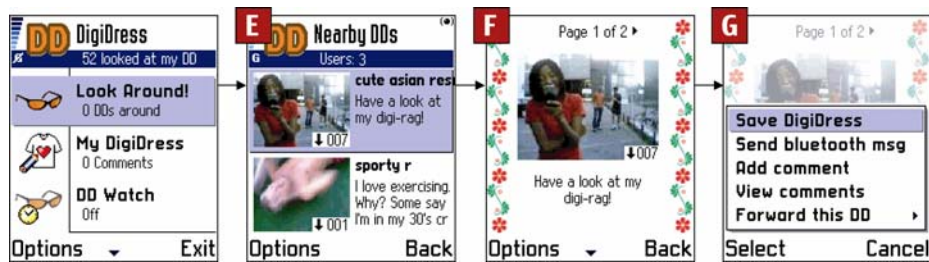

Figure 2. Lookaround, result list and viewing another user's DD.

Bluetooth messages. Bluetooth messages were simple and private text messages between two users (Figure 3J). Recipients, who were notified with a sound signal and a visual notification, could reply to an incoming message but not store them.

Comments. Comments provided a more public form of communication. Received comments were automatically stored in a list (Figure 3H and I). This list was available not only to the page owner, but could be accessed by any visitor to a DD (Figure 2G). In this way comments worked as a proximity 'guestbook'. Page owner could delete any comments, and also add own comments.

DD watch. The DD watch feature (Figure 3K), allowed users to set a time interval for automatic Lookarounds. If a DD device was found nearby, a sound notification would be delivered.

Leaving the DD application could be done in two ways. By 'shutting down', the application was closed and the pages were not made available to others anymore. In this mode, the device would be treated as any other non-DD device when scanned for. 'Exit' on the other hand, merely pushed the application into the background, allowing

the user to interact other applications on the phone. In this mode, DD was still viewable by others and the user could still receive comments and Bluetooth messages. In combination with Lookaround logic and DD availability described above, the application hoped to avoid most of the privacy pitfalls of [10], e.g. obscuring the nature of an application's disclosure potential or requiring excessive configuration to manage privacy.

Phone-to-phone distribution. DD application also allowed users to distribute the software to non-DD users via Bluetooth or infrared. This was thought to facilitate the uptake of the application which was critical to the success of DD.
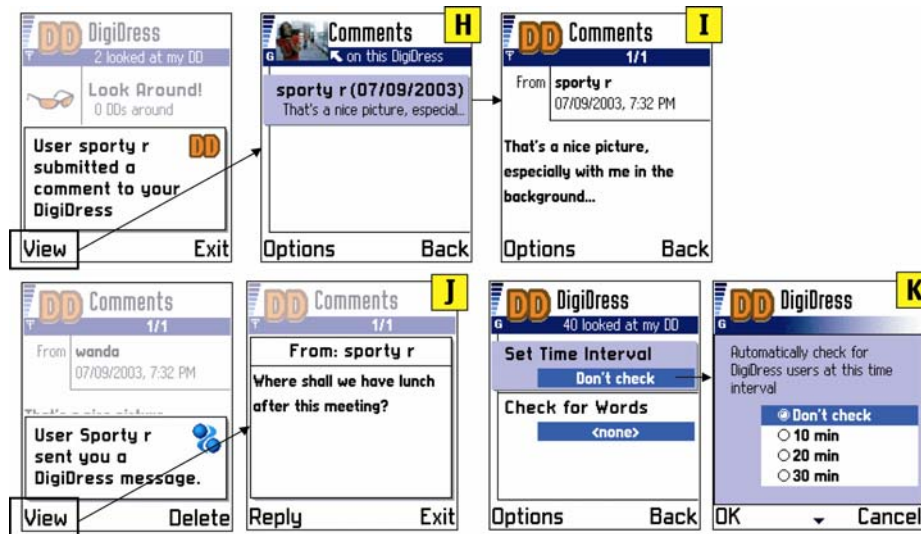

Figure 3. Comments, Bluetooth messaging, and DD watch.

3 User Trial Method

To maximize the saturation of DD, the most important criteria for the user trial was to find an environment with high density of the four phones compatible with DD application. At the time of the trial, employees of Nokia and the office sites in which they worked, provided the most saturated environment for the supported phones, in addition to including mobile-savvy and motivated users. Although such a setup would be slanted to professional environments, a company internal trial gave us a chance to establish a DD 'eco-system' to study the real application usage.

Recruitment. We aimed for voluntary adoption of the application, based on interest rather than trial 'enrolment'. In principle, the software was made available for download from the corporate intranet, along with the basic information on how to get started. No other training sessions or material were provided to users. First invitation to download the application was e-mailed to a selected group of 25 employees on September 15th 2003. Three days later, a mass e-mail invitation was sent to 1800

individuals using the compatible phone models. Four days after that, DD trial was featured on the corporate news service on the intranet portal. For reasons of confidentiality, users were instructed not to distribute the application to individuals not working for the company.

Logs. The DD prototype was equipped with a logging functionality that tracked its usage, e.g. number of application exits, amount of content in the DD, number of lookarounds performed, number of DDs found, downloaded and collected, number of messages/comments sent and received, etc. In total 36 such parameters were checked by the prototype. This data was inserted into a mobile text message (SMS) and automatically sent to a specified phone number every 72 hours (intervals were shorter during the first 72 hours after installation). A log SMS was also sent when distributing the application to another phone. If DD was not running at any of the times above, the message would be sent upon switching on DD, after which the order would resume the 72 hour interval. All log SMS sending took place in the background without interfering the user. During installation, users were informed about the logging functionality. The log SMS messages were all sent to a dedicated phone number. We used a Nokia 9210i Communicator to collect those messages and then exported them to PC for further analysis. SMS-based logging provided a unique opportunity to monitor application uptake and usage during the trial. Since the employer covered the phone bills of all employees, costs associated with the SMS logs was not likely to be an issue. This report includes data received from DD users between September 15 and December 12, 2003, which makes the user trial period 89 days.

Interviews. Since the SMS messages revealed the sender's phone number, we were able to identify the formation of DD communities and the most active users. 10 such users, 3 females and 7 males in Helsinki metropolitan area, were contacted and interviewed at the end of the trial period (not to interfere with their application usage). Interviews were individual- and group-based. Occupation ranged from sociologists and designers to marketing and corporate communication managers. Interviews were performed in English and lasted approximately 90 minutes, covering usage, motivations and general perceptions of DD.

Collection of created DDs. For content analysis, 46 DigiDresses were collected by the researchers in their everyday office life primarily at two major corporate office sites in Helsinki metropolitan area. This was done directly via Bluetooth, or indirectly via multimedia messaging service (approximately 50 users were e-mailed and requested to send their DDs). The DDs were subject to content analysis by two of the authors.

4 Results

During the trial period 618 users installed DD on their phones. 36,7% received it from another phone and the rest downloaded it from the website. Log files were received from phone numbers representing 23 countries, Finland being the dominant one (81% of total sample), indicating where DD was used. Number of installations per day was greatest in the beginning of the trial period with peaks of over 90 installations per day in conjunction with our mass e-mail and the corporate news flash.

Although the installation pace slowed down after the first four weeks, and never exceeded 10/day, it never stopped completely. This suggests that interest in the application was maintained by word of mouth.

Use span refers to the number of days from the first log file (installation date) to the last log file sent to us from a given individual. This gave us a rough estimation of how long participants showed interest in DD application after installing it. The average use span was 24.7 days (of a total of 89 days trial), with the standard deviation being 25.7. Approximately 20% of the population shut down or uninstalled DigiDress already after one day and never came back. See 'Use barriers' section for discussion on reasons. Users visited the application on average 16 times during the trial, which amounts to 0.7 visits/day of use span. This was measured by the number of 'exits' and 'shutdowns'. In all, these figures indicate relatively high activity levels with the application.

4.1 Creating and Managing Identity Expression Through DigiDress

4.1.1 Contents Created

Analyzing the last log file sent by each user having created a DD, on average 2.3 images and 100.6 characters were added, including the obligatory image on the first page. These figures show the amount of data in created DDs, but not the nature of the content. For this we had to analyze the 46 collected DDs. All but 2 of the collected DDs were in English, although users were predominantly Finnish. This might have been caused by the fact that the corporate language is English. Moreover, the DD prototype was only provided in English, which might have influenced users. In total, the 46 DDs contained 321 content-filled fields in tab 2 and 4, which mounts up to almost 7 filled fields per DD.

It is difficult to fully capture the rich, humorous and intelligent content created by users in a research publication. However, we found three dimensions to describe the characteristics of the DD content. First, *serious* vs. *playful* content was one distinct dimension. Some users presented themselves in a sober manner, often with the intent of enabling professional networking inside the company (e.g. Figure 4). On the other hand, many DDs contained light, playful and often humorous material. In these DDs, jokes, puns and comical use of imagery were common (Figure 5 and Figure 7). High degree of playfulness could involve play with real or fictitious identities, one's own or others'. One user pretended to be 'King of Bavaria' and provided information to fit with this character (e.g. "Three things I can't live without: crown, throne & BMW"). One user created her DD as if the owner of it was the Kanga character from Winnie the Pooh (Figure 6). In the interview she stated (Female 3): "*I like Winnie the Pooh characters a lot. I made a test on the Internet, where you can test which one of the animals you are, and I was the Kanga.*" When scoring each of the 46 collected DDs on the seriousness-playful scale (1 to 5), the average rating turned out to be 3.1 (standard deviation 1.1), i.e. almost at mid-point.
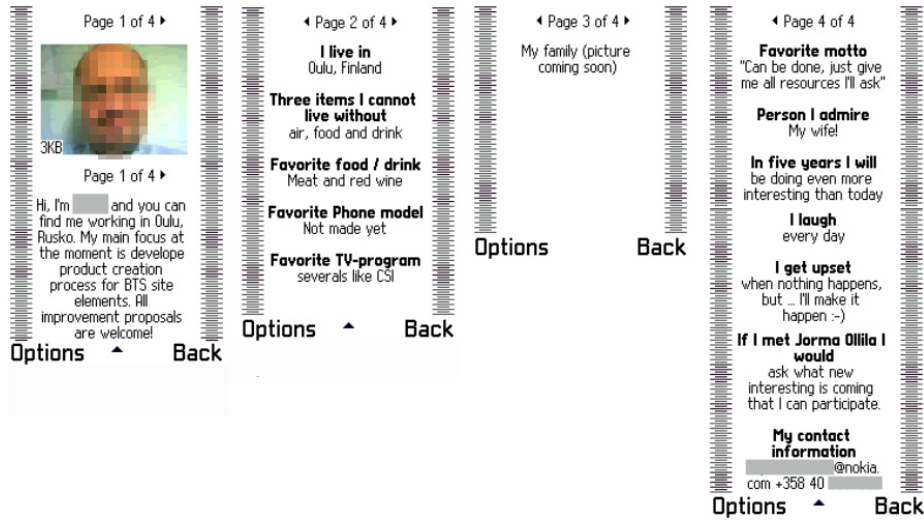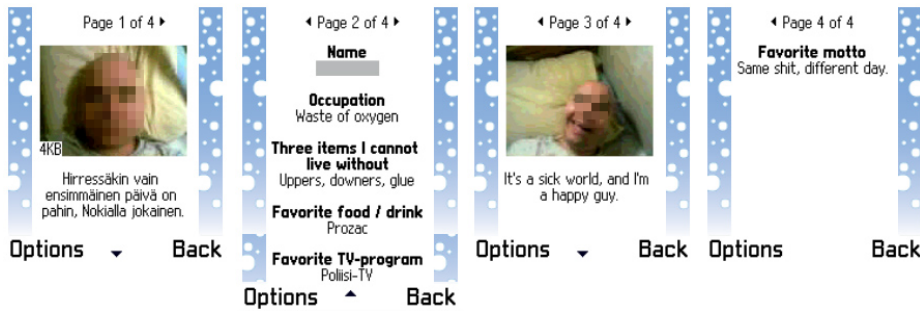
Figure 4. Serious DD.
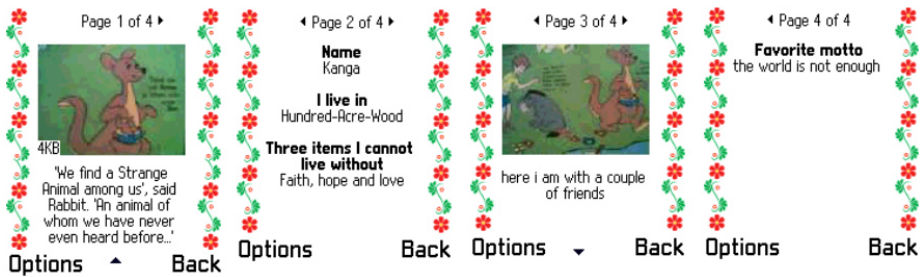

Figure 5. Playful DD.

Figure 6. Assuming fictitious identity in a DD.

The second extracted dimension characterized how users *revealed* or *held back personal information* about themselves. At the one end of this dimension, users distinctly revealed personal features, facts, interests, preferences, personality traits, habits and

even a facial image (40% of the collected DDs seemed to have recognizable facial image of its owner). This did not necessarily mean that the user's traceable identity (home address, phone number etc.) was revealed, but a clear sense of personality of the DD owner could nevertheless be detected. From the researchers' point of view, it seemed like the facts mentioned were true and honest. Pictures from travels, summer cottages or babies were common. Pride of oneself, one's life or accomplishment seems to have been one motivation. At the other end of this dimension, the DD owner explicitly withheld such information or even tried to conceal it in various ways. From our ratings of the 46 DD sample, revealing and holding back were equally common (on average 2.9 on a 1 to 5 scale with an SD of 1.1). Third, the content analysis also made it clear that users had quite different conceptions on what type of *audience* they expected for their pages. *Audience specific* DDs typically required a series of inferences based on quite specific knowledge about the DD owner or the subject matter for the reader to fully understand the intended meaning:

> Male 1 [describing his DD pages]: *The front image is from popular culture stuff that I really enjoy. Which are Wallace and Gromit animations. And cheese is a really basic pun. Cheese is English for 'smile you're in a photograph' and cheese is also one of the main things in this character's life.*
> Interviewer: *So you have to be a Wallace and Gromit fan to understand this?*
> Male 1: *Yeah this is an inside joke.*

At the other end of this dimension, DDs presented information so general that almost any adult could understand its meaning (e.g. Figure 7).
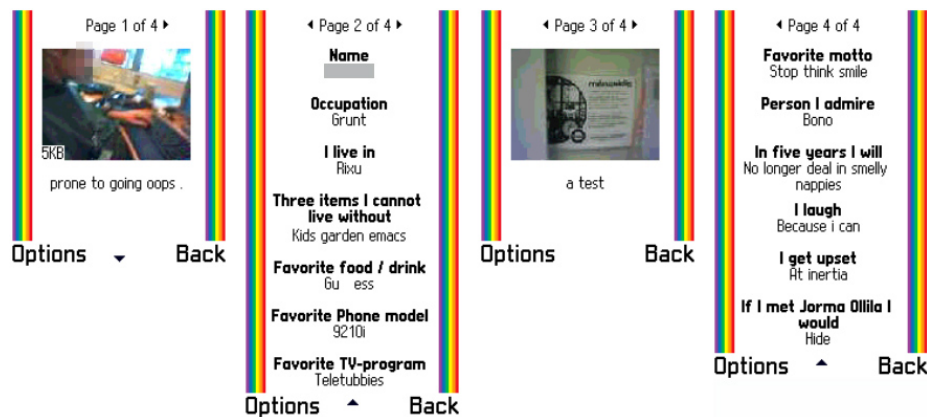

Figure 7. Audience general DD.

When rating the DDs on the specific-general audience dimension there was a clear advantage to the general end (3.4 on a 1 to 5 scale; SD 1.0). This suggests that users expected viewers to be not only familiar colleagues, but also unacquainted users and even strangers, possibly envisioning usage not only in office space but also in more socially open environments such as lunch canteens and cafeterias.

4.1.2 Factors Influencing Content Creation and Management

The interviews revealed motivations for and factors influencing the DD content creation. As expected, many of our interviewees considered DD to be a tool for *identity expression and impression management*. The social consequences of showing the DD page to others were experienced as real, as testified by an interviewee working in a building with a colony of DDs from acquainted and unacquainted people (Female 2): "*I thought it's quite important actually what you have in there [the DD]. Cause I didn't have enough time to think of funny answers. It's really the impression you want to give, I would like to do it properly and really think.*" For instance, playful content seemed to have been a way for people to avoid being categorized as 'boring' and 'uninteresting' (Male 6): "*I was thinking that other people would view it [the DD]. I don't want to have it boring, like: 'Profession: engineer' or 'I like: mashed potatoes and fish'. So then I added 'Three things I cannot live without: women, airplanes, and beer' [to my own DD].* "

The *assumed audience* also influenced the DD content. This related not only to general vs. specific audience, but also to the corporate environment in which the trial was set. Many interviewees believed that their DD content would have looked different had the application been used outside the corporate context. On the one hand office environment may have made content less playful than otherwise (Male 4): "*I want to be as honest as possible but I have to take into account the context. I cannot create a totally surrealistic DD that's accessible in an office environment.*" At the same time the corporate context created a reasonably safe social environment, encouraging somewhat more personal content (Male 2): "*Since you are within Nokia, you could leave personal info. Contact [info] especially. People can see it. But if it was public, I would not probably put those things.*"

Privacy concerns surely affected the ways user created DD content. By describing general, playful or fictitious content, for instance, users could express their personality in interesting ways without revealing too much personal data. Discussing the fact that she avoided putting her real name on her DD page, Female 2 stated that "*one option would be like [Female 3 – the Kanga DD] has done: she's not saying her proper name; she doesn't have a picture of herself. Just invent an imaginary thing. Whether it's funny or bizarre.*"

Another factor came from the *design of the application* itself. Although our pre-filled subject headings on tab 2 and 4 (see Figure 1B) were meant as *inspiration* for content creation and not *compulsory*, the design of editor gave the impression that these fields 'had to' be filled in. Moreover, the possibility to change the headings was hidden deep down in the application. This was commented by Male 2: "*It [pre-filled subject headings] is good. You see what you can do with it. But the thing is that you don't realize in the first place that you can change them. You may feel that you have to put something in so it's quite annoying. You don't have to in fact, but you feel that way.*" These design flaws clearly propelled users to follow the content specified by the subject headings: in our 46 DDs sample, only 21 of 321 fields headings (or 7%) could be considered to be new or user self-created. The headings surely influenced the content in the system as a whole.

Explicit and implicit *feedback from other users* also affected the DD content (Male 4): "*Part of the fun of using the DD is maintaining the different profiles [DD pages].*

Getting feedback from others and tweak in more." Via the 'My Popularity' feature, DD provided users with a indirect but still valuable social feedback. Female 1, for instance, realized that her playful DD received more views than a more serious version, which made her stay with the playful one. For most of the interviewees, the DD content was not static but constantly evolving. This was also reflected in our log files. 73.4% of the total user population modified their DDs at least on one occasion. Among these users, the average number of modifications was 2.9, the standard deviation 3.3 and the maximum value 44.

Finally, some interview participants reported that *watching others' DD pages* affected their content creation. Female 3, for instance, explained that *"when you see other people's DD's, you get more courage of the kinds of things you can put there."* Since DD and the ways in which pages were shared with others over Bluetooth were new phenomena to the users, there were no established conventions about appropriate/non-appropriate content types. The users, as a community, seemed to have developed such practices by observing the behavior and content creation of others. The emergence of these habits, conventions, do's and don'ts was likened to the evolution of sub-culture specific language or web pages (Male 1): *"It's like a language you're learning. It's language specific to some certain…like culture. You might learn new things later that if you do this then you signal that you're part of this culture. Like Web pages, they are evolving all the time. So this must be the same thing."*

4.2 Lookaround: Detecting Proximate Users

Interviews revealed a relatively homogenous path of events following the installation of the application. Here is one typical description, provided by Male 3: *"Originally I got a mail from you, and forwarded the application to all my colleagues I knew. It created a buzz immediately. People installed it on to their phones, we played around with it a bit, went to have lunch, put the search [DD watch] on, found some people in the canteen."* After creating the DD, the application was typically first explored together with colleagues after which usage spread into more open environments such as lunch canteens, where it was more likely to see and be seen by unacquainted users.

The Lookaround feature was of course at the core of all of these activities since it provided the means to discover nearby users and their DDs. Among the participants using the feature at least once during the trial (79.7% of the sample), the average number of 'Lookarounds' was 11.3 (standard deviation 16.9). On average 0.5 lookarounds were performed per day, assuming the average use span of 24.7 days. Figure 8 depicts the use of the lookaround feature on each day of the use trial, among the entire use population. We have not been able to identify the mid-trial peaks (e.g., Nov 3rd). They could indicate some corporate event. The figure suggests, however, that interest and active usage of DD was maintained over the course of the trial period. The average time required to generate the results of each Lookaround was 44.0 seconds. An average of 24.7% of the Lookarounds were cancelled.
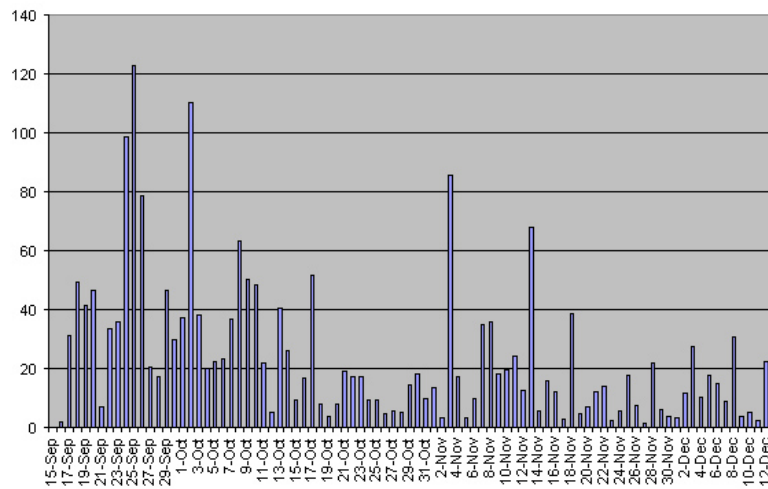
Figure 8. Number of times Lookaround feature was used. Log files were sent from users' phones every 72 hours. The increment from the preceding to the present message in the value of the variable has been divided by the number of days present in the gap between the present and the preceding message. The figures in the diagram thus represent averages for one particular use day.

It is difficult to know why users cancelled, but the time for Lookaround process to complete was dependent on number of nearby Bluetooth and/or DD devices. This suggests that users were not too keen on waiting to get the complete results. This was also expressed in the interviews (Male 3): "*The search process [Lookaround] is really slow. It's very annoying. [---] If you're in a bus, trying to find out if there are other people, it takes a lot of time. That's been the biggest turn-off for myself.*" The logs showed that on average 0.4 DD users were found for every Lookaround. From a trial point of view this 'saturation' is satisfactory although we do not know if lookaround were used in situations where the user was sure of the existence of a nearby user, or if the feature was used in more opportunistic situations ('is there a DD around?'). Locally, however, low saturation may have been a problem contributing to the figure of 20% 'early quitters' who used DD for a day or less. Not finding other DD users in Lookaround was a standard complaint among the interviewees (Female 2): "*My experience usually is that there is no one around. It is very funny and surprising when you find someone.*" This excerpt describes the turnoff for many users not finding anyone, but also great enjoyment when DDs were found in the list, motivating further usage. When asked to find a metaphor for what it feels like to use Lookaround, our interviewees suggested 'eavesdropping', 'spying with a good intention' and 'fishing'.

209 out of 618 participants used the automatic scan feature, DD watch. This shows that many users were eager to find other DDs without having to remember to perform lookaround consciously. Saving other users' DDs also turned out to be rare. Only 7.4% of the participants had at least one saved DD. Although some of our interview-

ees considered saving good DDs as important, the average use of this feature was low.

4.3 Social Interaction: See, Identify, Approach and Be Approached

The contents of DDs have already been described. Our interviewees characterized the DDs of other users with words such as "funny", "intelligent", "interesting", "boring", or "hasty". Viewing found DDs also involved the social guessing game of identify the owner of a DD in the immediate physical proximity, as well as matching the content with the appearance or behavior of that individual (Male 1): "*It's funny when you see the guy, the actual physical person and then you see his DD; how the hell do these connect? Because in web pages you never know who the person is. And also guessing who the hell the person is.*" This excerpt is interesting in two respects: it describes the ways in which the DD content gave new or different information about its owner, and thus may have influenced the social inferences made about that person. Negotiating between the appearance of the person and the DD content probably influenced the viewer's interpretation of both. Secondly, the comment clearly describes the different experiences of watching DDs and web pages: With DD, the physical person was likely available for visual inspection.

Lookaround feature was a 'socially safe' exercise, in the sense that the owner of the viewed DD was not made aware of the process. Some of our interviewees clearly expressed satisfaction with staying in this 'lurker mode' and not continuing to engage in direct communication through Bluetooth message or comments (Male 2): "*I started to use it with some colleagues and that's mainly it in the beginning. And then you start to look around during the lunchtime and these sorts of things. To see what people have been doing. But I never used this comment feature. [---] Just interested in looking around and see what people have been doing. [---] So it is a means to get to know someone without getting involved with him.*"

This attitude was consistent with usage of other features. Only 15.7% of the users had received comments, and only 11.2% sent comments to others. Among those that had received at least one comment, the average number was 1.3, SD being 0.7, and the maximum value 4. Sending Bluetooth messaging was more popular, with 19.8% of the users sending at least one. Based on these figures it could be assumed that users did not have much usage for direct communication via the application. Another speculative reason could be the short communication range provided by Bluetooth, making messaging suitable only for particular contexts.

Although the overall usage of direct communication was low, it facilitated face-to-face social interaction between unacquainted users as evidenced by the following episode (Female 2): "*I had a very interesting experience. Last Friday I and one of my colleagues were sitting in the coffee area of my floor. And there was nobody nowhere, no people. And I had my phone on the table. And suddenly I received that funny sound. And I was like: 'what'? And someone sent me a comment like 'hello funky kanga'. And I was like: 'who might it be'?, because no one was around. And after a couple of minutes a couple of guys came from some meeting room. We didn't know who they were but they were looking at us. And they went and came back, and one was asking: 'Who is kanga?'*"

Incidentally, the person coming back to Female 2 turned out to be another of our interview participants in another session. He also brought up this event, describing it from the other perspective: (Male 5): "*We had some fun with that, we were sitting in a meeting room so it was [Male 4] and myself. We were looking around and suddenly: hey there was a DD also. [---] They were sitting outside the door. It was Friday and we sent them a little note and then we got a note back. Because obviously she didn't know. First of all we didn't know if it was a he or she. That was quite fun. That was really funny [laughing].*"

These excerpts report not only the ambivalence in identifying the owner of the DD (he or she?), but also how the application became a tool – or an excuse – for approaching a unacquainted user. Here was a case of someone stepping out of the lurking mode to engage in digital and later real social interaction. Based on 10 interviews only, however, it is difficult to judge the commonality of this phenomenon.

Comments and Bluetooth messages provided direct communication channels to the user. The 'My Popularity' feature, offered a more implicit feedback channel. Most of our interviewees regarded this feature in positive terms since it proved to the user that their DD had in fact been viewed by others. One interviewee in one of the group sessions (Male 4) had missed this feature, but when instructed to check it in the interview he was overwhelmed by the popularity his DD had attracted:

Male 3: *How many people have downloaded your DD [turning to Male 5]*
Male 5: *It says '26 looked at my DD'*
Male 4: *[Looking at his phone] 65! [astonished]*
Male 3: *I have 48 also.*
Male 5: *Man!*
Male 4: *I think pretty many people have been peeping my DD. 65, hell what is happening?*

Since each DD download was marked with a timestamp, users were able to speculate about the context in which their DD had been viewed. At least one of the interviewees reported having done so (Female 3).

4.4 Privacy Concerns and Alleviations

The concept of DD, as well as many of the social experiences associated with it, were new to participants. This also meant that the social implications of making one's DD publicly available to nearby people may not have been fully understood at the beginning of the trial. At least Female 2 learned about these issues after some time: "*When I was doing my profile, I was thinking: 'I'll put a few pictures of myself'. I wasn't really thinking properly. It was too early. I didn't properly realize that everyone will be able to see this picture.*" It is possible that this user set up DD on her own, without being able to find anyone around her: without using Lookaround and finding another user nearby, it was difficult to appraise the implications of one's own DD and how it will be seen/accessed by other users. Informing the user about the social consequences of creating a DD should be more highly prioritized in future versions [cf. 10].

Being able to view a DD without the owner's consent concerned some users in the interviews. Male 4 suggested that viewing a DD should always be preceded with a request to its owner. This was challenged by the two other users in the interview:

Male 4: *I would always have this opt in functionality. If someone is requesting my DD: 'User this and this is requesting my DD'. If it's male, no way. If it's female, then perhaps. [---]*
Male 3: *It makes it too complicated if you have to approve those.*
Male 4: *But there should be an opportunity for those narrow-minded people who do not want to, who want to keep things under control.*
Male 5: *To get this [DD application] flying, I think part of the fun is the aspect of browsing around. If everybody blocks the thing, it's going to harm this.*

Accommodating Male 4's privacy concerns would compromise the satisfaction of the open information space created by the 'non-request design' of the DD prototype. As the complaints of Male 4 were not common, the design of the DD prototype seemed to have been appropriately balanced in this respect.

Another related concern was the shift DD created vis-à-vis the perception of the mobile device. The mobile phone and its content have traditionally been seen as genuinely private. Unless users explicitly hand over the phone to someone else, the content has 'stayed with the user' and the user has always been in charge of controlling the access to the content. DD challenged this in the sense that other users were allowed to fetch data from the device without the owner's immediate awareness. Male 4 compared this feeling with someone invading his personal space: "*This is a private device. Someone is basically violating my area.*" Female 2 also recognized this feeling, but in the end pointed out that DD-like applications will change those traditional perceptions of the mobile phone: "*I had web pages for many years and I didn't care about the fact everyone can see those. Maybe... as it [the mobile phone] is the personal device, it feels different. But, of course it is a question of education and thinking differently.*" Just like peer-to-peer file sharing systems changed the perception of the PC, so perhaps will future commercially successful SPA shift the view of the mobile device.

Our interviewees identified a number of alleviations to the various privacy concerns. We have already described the ways in which users adapted their DD content to balance expressivity and privacy concerns. One interviewee (Male 6) also pointed out that the personal content he put on his DD, such as phone number and home address, were already publicly available in various databases (at least in Finland), and putting it on his DD did not increase the risk of someone misusing that information. Also the office test environment seemed to have a remedying effect, in so far as users could rest assure that only colleagues could see the pages (Female 1): "*In this environment you are more secure. You know the people.*"

4.5   Use Barriers

As discussed above, low saturation of DD users nearby turned users off and posed perhaps the biggest barrier for users to adopt DD. If applications like DD are to suc-

ceed, they need to be launched on a widely spread platform, preferably be freeware and preinstalled and be subject to a coordinated marketing campaign.

The slow and occasionally unreliable Bluetooth performance was reported by users as a barrier. For instance, whenever a user engages in any Bluetooth communication, the device (and the DD) becomes invisible to other devices. In terms of saturation, however, Bluetooth is the only realistic alternative at the moment.

Another barrier identified by our interviewees was that our prototype required users to have the application running in order to make the DD available. Forgetting to turn it on in social situations or after phone re-boot seems to have been common, leading to fewer DDs available for others, which decreased motivation for using the application. One innovative user (Male 5) managed to install a separate auto-start application for DD. This radically changed his way of using DD. Auto-start of DD on phone re-boot should be implemented in future versions.

Before the trial we feared that Bluetooth would not provide users with enough range to create rich user experience we aimed for. Fortunately, none of our interview participants expressed any concern in this respect. In fact, Bluetooth provided the appropriate distance by which users most often had visual access to the other part, which was deemed to be valuable in the case of DD (Female 2): "*Making it shorter doesn't make sense. But if it were the whole Nokia house [Nokia headquarters in Espoo, Finland], it would be chaos. It increases the complexity and how you think about it. Instead of now...the real proximity... you know that it's just the people who you see. It's more controllable than the bigger range.*"

5 Discussion

The method of this trial had several limitations. It confined the potential usage of the application to professional context. The number of collected DDs for content analysis was small in comparison to the number of participants. Both interviewees and the collected DDs were selected from the most active users, providing limited understanding of e.g. why the application had so many early quitters. Nevertheless, the large number of users and the long use span suggest that DD generated positive user experience, and that the basic concept was on the right track. The study also revealed a number of design flaws. The expressivity of the DD and its editor should be strengthened. The field headings triggered users' creativity, but it must be made clearer to the user that headings can be ignored, changed and that new ones can be swiftly created. Also the DDs should display traces of social feedback from other users (e.g. by placing comments from other users directly into the DD pages). Future versions of DD must explain in simple way the principles according to which people have access to others' DD content (only in proximity, both users must run DD and have Bluetooth on, no request required, no differentiated access control between trusted and non-trusted peers etc.). Such explanation has to be done in the application itself (without interrupting the usage), in help files or marketing messages. Making the DD effortlessly available to others without having to remember to launch the application or to turn Bluetooth on, should be provided. This should also boost the critical mass of SPA content in public locations, facilitating the adoption of these

types of applications. Most of these issues (and many others) have been addressed in the design of Nokia Sensor application (www.nokia.com/sensor). Unleashing the creativity and social curiosity of users outside the office environment, Nokia Sensor will hopefully tell us the real potential - and concerns - with this kind of technology.

6 Acknowledgements

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