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OLDER USER EXPERIENCE

An Evaluation with a Location-Based Mobile Multimedia Service

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This article reports a user-experience study in which a group of 18 older adults used a location-based mobile multimedia service in the setting of a rural nature reserve. The prototype system offered a variety of means of obtaining rich multimedia content from oak waymarker posts using a mobile phone. Free text questionnaires and focus groups were employed to investigate participants' experiences with the system and their attitudes to the use of mobile and pervasive systems in general. The users' experiences with the system were positive with respect to the design of the system in the context of the surrounding natural environment. However, we found some significant barriers to their adoption of mobile and pervasive systems as replacements for traditional information sources.

One market sector that has seen some research interest but little direct targeting of mobile and pervasive computing is that of older people. There has been relatively a little research on the overall user experience for older users, and the few attempts at designing systems with older users in mind have tended to focus on basic physical characteristics of the interface such as larger buttons and simpler displays. The few systems offered with this approach have seen a little commercial success.

It is clear from findings such as those of Ofcom's wide-ranging research [1], [2] that age is strongly correlated with attitudes to and uses of mobile phones. What is not so clear is the explanation for these effects. Rice and Carmichael [3] challenge the assumption that older people are generally technophobic. Like Mikkonen [4], they suggest that most older people are happy to embrace new technologies if they perceive a use for them and find them usable.

In this study, we evaluated older people's user experience of a prototype system offering location-based multimedia content on mobile phones. We worked with the

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SUPPORT FOR MULTIMEDIA FILE FORMATS VARIES ACCORDING TO HANDSET MANUFACTURER AND DEVICE SPECIFICATIONS.

Cotswold Water Park (CWP), a nature conservation area in southern England, and Walking the Land, an artists' cooperative, to develop an end-to-end system that provided visitor information via rich multimedia content on mobile handsets, linked to specific locations in the park. A key requirement was to provide accessible information and interpretation causing minimal disruption of the natural environment. Existing traditional signboards increase the visual clutter in the natural environment and are difficult and expensive to update. Providing multimedia content directly to the visitors' mobile phones offers a powerful means of providing rich, easily updatable content linked to locations within the water park while minimizing visual clutter and intrusion in the natural environment.

Observations at the park suggested that the visitor profile included a high proportion of older visitors. Using novel technologies in this kind of site is often considered as a potential means of attracting younger people and thereby broadening the visitor profile. Although this may be a useful approach, the introduction of such technologies must not alienate the existing older visitors and users of the site, and ideally it should bring the benefits of pervasive technologies to visitors of all ages.

Content Delivery Via Interactive Waymarkers

We designed, fabricated, and installed three oak waymarker posts at intervals of around 250 m along a lake shore in the Water Park (see Figure 1). The content delivered via each post related specifically to the location of that post and its immediate surroundings. The content was delivered to the user's mobile phone in the form of a Web page containing text and links to further text, images, audio, and video.

The posts offered four mechanisms for accessing digital content: a stainless steel button, a near-field communication (NFC) tag, a two-dimensional (2-D) barcode, and a three-dimensional (3-D) sculpture. The stainless steel button was specified as water- and vandal-resistant, whereas the 2-D barcode, NFC tag, and sculpture were protected behind an extremely tough clear polycarbonate screen built into the post.

A user of a mobile device equipped with an NFC reader simply brought the device within about 2 cm of the NFC tag. A uniform resource locator (URL) stored on the tag, and specific to that post, was read, and the device was then retrieved and presented content from that URL.

FIGURE 1 Installing a post by the lake shore.

A 2-D barcode was also attached to the post, and a 3-D sculpture was placed in a purpose-made cavity near the top of each post. For our prototype system, we used sculptures of a duck, a fossil ammonite, and an artist. These related respectively to the themes of the multimedia content associated with each post and its immediate surroundings: the local ecology, local archaeology, and the reactions of a number of artists to the location. A user of a mobile device equipped with a camera and object recognition software that we provided simply pointed the device's camera at the post.

Any recognized visual trigger, either a 2-D barcode or a sculptural identifier, in the camera's field of view prompted an immediate, prominent display of scrolling text giving the post's name superimposed over the standard video display from the phone's camera. While this text was displayed, the user could press a button on the phone to access the multimedia content associated with the post. A post-specific URL encoded in the barcode or represented by the sculpture was used by the phone's Web browser to retrieve and present the content.

A stainless steel button was embedded in the front of each post. Inside each post was an htc Jama mobile handset running the Windows Mobile operating system and powered by three large 12-V batteries inside the post. Pressing the button on the post triggered a Bluetooth scan by this handset. If the scan picked up a Bluetooth device in the vicinity of the post, the equipment inside the post pushed the introductory Web page for that post to the discovered device. The owner of the device then had the choice of accepting or rejecting the offered content. The precise details of this interaction on the user's device depend on the model of device and how it handles the incoming Bluetooth files.

To preserve battery life, the Bluetooth chipset operating inside the post would wake up on pressing the stainless steel button, perform a scan for nearby Bluetooth devices, broadcast the relevant content if a device was found, and then turn off the Bluetooth chipset. Among the alleged benefits of broadcasting content over Bluetooth's Object Exchange Protocol is its inherent compatibility across a large number of mobile devices with no client software needed to receive transmitted content. However, the vagaries of current Bluetooth implementations and file handling on diverse handsets mean that a cellular connection through a Web browser remains the most effective way of delivering rich multimedia content reliably to a range of handsets.

Therefore, this initial Bluetooth-delivered Web page included only plain text content and links to additional multimedia material (audio and video) via remote cellular download. When adopting this approach, the initial content should be engaging enough to be of value in itself without further downloads and to excite the users' interest enough to consider downloading the additional material.

A CELLULAR CONNECTION THROUGH A WEB BROWSER REMAINS THE MOST EFFECTIVE WAY OF DELIVERING RICH MULTIMEDIA CONTENT RELIABLY TO A RANGE OF HANDSETS.

Apache Web servers were used to serve up additional multimedia content (audio and video). Support for multimedia file formats varies according to handset manufacturer and device specifications, e.g., Nokia N95 devices supported MPEG videos while the Nokia 6131 NFC phones did not. To maximize compatibility, the Web servers were configured to serve handset-specific content for popular devices.

Recognition of the visual triggers (2-D barcodes and 3-D sculptures) was performed at video rate (around 7 frames/s) using real-time computer-vision algorithms. The barcodes were recognized using a custom algorithm for the Datamatrix format of 2-D barcode [5]. The reader was able to recognize codes at distances 30–70 cm, viewed at any orientation in bright light or in shadow. In the average case, camera angle could deviate from the optical center by around 20°. Depending on the length of URL, 15–25% of the code area could be obscured before reading became impeded.

The 3-D sculptures were recognized by the 2-D shape formed by their silhouette, which varied according to viewpoint. The high contrast of the dark sculpture against the light interior of the post mitigated the adverse shading effects between sunlight and shadow within the sculpture cavity, conditions that varied with the time of day and weather. We used a dynamic thresholding algorithm to extract a binary mask (silhouette) from each video frame, which was then preprocessed using morphological operators to clean up noise and imaging artifacts before recognition. The silhouette shape was then encoded using Fourier descriptors [6]. These were obtained from the periodic signal generated by traversing the exterior boundary of the silhouette mask and measuring distance from the centroid. Before the study, we recorded sample images of the sculptures from a variety of viewpoints. The descriptors obtained from these images were used to train a principal components analysis (PCA)/Eigenmodel classifier that was then able to determine the presence or absence of sculpture shapes in live trial images and discriminate between those sculptures. In the laboratory, the classification rate was approximately 95% over a viewing angle variation of up to 90°. However, in the field, variations in the lighting conditions, including harsh contrasts between sunlight and shadow within the sculpture cavity, caused the classification rate to fall to around 70%.

Each of the three posts had a different theme related to the location of the post. The "Archaeology" post provided content related to local archaeological finds including the remains of a large herd of woolly mammoths. The "Ecology" post provided content on the flora and fauna that could be seen in, on, and around the lake immediately adjacent to the post. The "Arts" post provided content on local artists' reactions to the location around the post. The content provided through the posts included video clips, audio commentaries, text, and images.

The initial presentation of the content was through a Web page presented in the mobile device's standard Web browser. This initial Web page contained text relevant to the location and embedded links to further location-based multimedia content (video, audio, text, and images). Clicking on a link to text or image content displayed another Web page containing the relevant text or image. At the top and bottom of this page were links back to the initial Web page. Clicking on a link to video or audio content played the corresponding video or audio in the mobile device's media player application. After viewing/listening to the audio or video, the user could close/save the audio or video using the mobile device's standard interaction techniques.

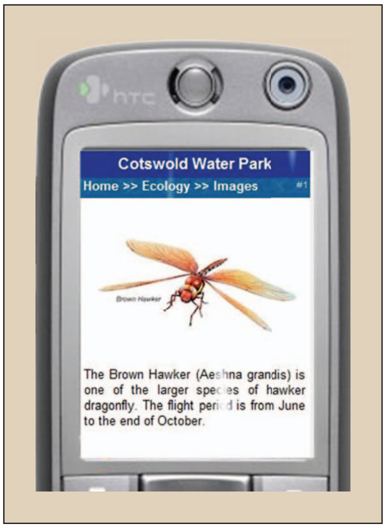

FIGURE 2 Ecology Web page showing location-specific content.

Evaluating the User Experience

Goodman et al. [7] argue that, although widely used and often useful in usability evaluations, laboratory based experiments are of limited use in evaluating location-based services with mobile devices because of the difficulties in simulating the context of use in a laboratory. They recommend field experiments as a useful alternative. Our study took place in the field at the CWP where we had installed the three interactive way-markers along the lake shore. This was an exploratory empirical study, rather than an experiment, designed to investigate the ways in which older users responded to the various aspects of our prototype system. Qualitative methods were therefore used with analysis

THE USER EXPERIENCE COULD BE IMPROVED BY THE INTRODUCTION OF FASTER CHANNELS AND PROTOCOLS SUCH AS HIGH-SPEED DOWNLINK PACKET ACCESS.

focusing on the nature of participants' interactions with the technology and their perceptions of, and attitudes toward, those interactions.

Goodman et al. [8] note that field evaluations of systems based on mobile devices can be time consuming and complicated, particularly with older participants. While acknowledging the importance of such field studies, they propose and discuss the alternative approach of using focus groups to collect qualitative data. In our study, we combined a field evaluation in which our older participants had hands-on experience with the system in its real context of use, with a follow-up focus group. The study consisted of observations of participants interacting with the waymarkers along the lake shore, followed by a free text questionnaire and focus group session held in a quiet area of the nearby CWP visitor center. Throughout the study, there were four main categories for data collection: 1) an evaluation of the user experience; 2) comparisons among the four interaction methods; 3) engagement with the multimedia content; and 4) participants' previous use of technology, particularly mobile devices.

Participants

There were 18 participants (16 male and two female) aged 55–67. All but two of the participants had visited the park previously and had used a mobile phone previously, at least to make a voice call. Eleven of the 18 participants had sent a text message. Experience of using a mobile phone for other purposes was low. Only one participant had previously used a phone to access the Internet or to watch a video. Three participants had experience of listening to music on a mobile phone. The participants completed their sessions in four groups to facilitate management of the field trials and observation of individual participants' activities and to encourage active participation by all in the focus groups.

Goodman et al. [8] suggest that homogeneity of focus group participants is desirable "in order to capitalize on people's shared experiences" [9]. They quote Morgan's [10, p. 35] suggestion that "meeting with others whom they think of as possessing similar characteristics or levels of understanding about a given topic will be more appealing than meeting with those who are perceived to be different." Goodman et al. [8] argue that this is particularly important when evaluating mobile devices, as the participants may feel embarrassed by their lack of confidence or familiarity with the technology. Our use of "naturally occurring groups" [8], [9] such as a walking club for older people provided this homogeneity of the participants. However, as Rice and Carmichael [3] point out, it would be naïve to assume that older people are an entirely homogeneous group, ignoring the diversity that is likely to exist even between the members of a naturally occurring group.

The age range of the participants obviously does not represent a sample of the overall mobile phone using population. Indeed, previous studies suggest that older people are not inclined to use mobile phones for services beyond making simple voice calls in an emergency [1], [2] and they may struggle with conventional interaction techniques on the limited hardware interfaces of small mobile devices [11], [12]. Thus, testing it with these users provided a particularly critical test of the prototype system.

Evaluation Procedure

The questionnaire was divided into four sections. The first section focused on preferences among the four interaction methods. The second section contained questions addressing the information content associated with each post. The third addressed the participants' usual level of mobile phone use. The fourth focused on the nature of the waymarker posts themselves, including aspects of their design and their positions around the lake.

The focus group schedule was designed to address the same issues explored in the questionnaire but to add depth through extended discussion. In discussing requirements gathering techniques, Rice and Carmichael [3] argue that using focus groups assumes that users know what they want and that this is problematic for older people who do not have an appropriate conceptual framework to articulate ideas about new technology. This is indeed a problem if the focus group is held ab initio with no concepts, designs, or experiences on which to base the discussions. Hence, we conducted our focus groups immediately after the users had direct hands-on experience with particular designs and concepts to help them articulate responses, suggestions, and discussion.

The participants were provided with two sets of mobile phones. The first set used the visual recognition software to identify the 2-D barcodes and 3-D sculptures. The second set used built-in NFC readers to identify each post via its NFC tag. The content was preinstalled on each handset. However, the NFC implementation on the handsets prevented a direct link from a tag to content on the device and these devices had to download the content for each post from a remote server on demand. This introduced a slight delay, but the user experience was otherwise the same.

The participants followed the footpath around the lake shore on which the waymarkers were installed, accompanied by three researchers. One researcher gave instructions regarding the use of the four interaction methods and provided support for any participants who experienced difficulties with the interactions. The other two researchers used video cameras to record activity. One camera focused on the use of the four interaction methods, and the other camera focused on the participants' experiences with the multimedia content.

There were technical difficulties with the Bluetooth delivery of content in response to pressing the button on the post. Despite its working perfectly in prestudy trials, only one participant, watched by two others, managed to receive the initial Web page directly to her phone via Bluetooth. There was no apparent response from the posts to further button presses, severely limiting the feedback we could collect on the user experience of the Bluetooth button option, but otherwise having little impact on our results since beyond the initial text-only page delivered by Bluetooth, the interactions and contents were the same as for the other three techniques.

Other than the Bluetooth button, each participant personally experienced all the post-based interaction methods during the session. Those for whom the Bluetooth button did not work were reminded how it was supposed to work. After the walk around the waymarker posts (which took approximately 40 min), the participants gathered around a table in the visitor center at one end of the lake, completed the questionnaire (approximately 20 min), and then took part in the focus group (approximately 60 min).

Goodman et al. [8] argue that focus groups have a particular difficulty in evaluating mobile systems because the focus group is static and usually indoors while the participants must remember and imagine situations and experiences in the, usually outdoor, mobile context. They note that "the challenge for those running such groups is to aid this remembrance" [8, p. 85]. In our study, this remembrance was facilitated because the participants had been in the real outdoor mobile context, using the system, moments before the focus group began.

Results of the Field Study

Four main themes emerged from the field study:

- physical aspects of the system and its users
- users' engagement with the system and with the park
- expectations, capabilities, and possibilities
- users' familiarity with mobile technology.

Each theme contained findings on both positive and negative aspects of the system for older users. Evidence for these is discussed below in relation to our four data collection categories: user experience, interaction methods, multimedia content, and previous technology use.

Physical Aspects of the System and Its Users

Some aspects of the system were difficult to engage with, because of the physical characteristics of either the system or its users. The most common example of this was the difficulty encountered by many participants in viewing material on the mobile phone's screen due to glare.

THE PARTICIPANTS WERE KEEN TO SUGGEST ADDITIONS AND AUGMENTATIONS TO THE INFORMATION CONTENT PROVIDED BY THE SYSTEM.

There was bright sunshine for much of the period of the study, and the screens were often very difficult to read, even when set to full brightness and shaded (by a tree or hand). This is a common problem when mobile phones are used for interactions in an outdoor location, because of the characteristics of current liquid crystal displays (LCDs).

In addition to the common problem of viewing content on mobile screens in bright sunlight, the difficulty of seeing the screen was a particular impediment to the use of both the sculpture recognition and 2-D barcode interactions. The users found it especially difficult to know when they had succeeded in reading the 2-D barcode. Visual feedback is important here first because the phone's display indicates when the barcode is appropriately framed by the camera's image and second because the name of the location is displayed on the screen to indicate successful reading of the 2-D barcode. A supplementary auditory notification (a quack) of successful barcode or sculpture reading helped a lot and was found to be very engaging by the participants. However, although this told users when they had succeeded in framing and reading the barcode or sculpture—and could therefore move away to a more shady spot to download and use the content—it could not help with the framing process itself.

Having accessed the content, the participants also found it very difficult to read the text on the handset screens, partly because of the glare but largely because of the small size of the text. The participants often referred to their failing eyesight, e.g., the need to wear a different pair of glasses for looking at the mobile phone screen than

FIGURE 3 The participants engaged with content at the "Ecology" post.

OLDER USERS HAVE HIGH EXPECTATIONS OF TECHNOLOGY AND ARE DISAPPOINTED WHEN A TECHNOLOGICAL SYSTEM OFFERS ONLY AN ANALOG OF EXISTING LOW-TECH ALTERNATIVES.

for the environment around them. This disrupted the aim for an integrated user/visitor experience in which the content provided via the mobile device augmented the experience of the surrounding environment.

A further example of a physical difficulty was in using the handset keypads. The participants often had difficulty in using the cursor and selection keys because of their small size. This was frustrating for participants when accessing the content, e.g., when trying to select images and videos.

The NFC tag interaction was the method preferred by the majority of the participants. This may be due to the very simple use of the NFC tag, just holding the phone close to it, and the corresponding lack of physical impediments to its use.

Engagement with the System and the Park

Some participants reported difficulty in engaging with both the park and system at the same time: "Concentration on the phone stops you looking at the scenery, however, with a sign you can look at both"; "Spent more time looking at the posts and mobile than looking at the environment." These participants felt that they visited the park to engage with the environment and that the system, rather than helping them to do this, actually prevented them from doing so. Their comments suggest that some participants have a very different conception of mobile technology and services than they do of fixed information points such as signs or posters, believing that somehow you can engage with a sign and the environment simultaneously in a way that you cannot do with a phone.

Other participants, however, responded that accessing information through a mobile device was no different from a sign or poster in terms of the extent to which it distracted attention from the environment. There is almost certainly an issue of familiarity here (see "Familiarity with the Technology" section). While the system is new, it requires a greater amount of attention, problem solving, and, at times, frustration to get the desired information from it. In an environment such as the water park, people are used to getting information from more traditional signs and therefore would not feel as though they were being unduly distracted from the environment by using them. Interactive mobile technologies are new to this group and setting, so their use inevitably will distract from the environment during the adoption and learning of the systems. How big the problem is depends both on the length of time required for use of the mobile system to become fluent and on the perceived added value of the system in comparison to traditional information sources.

Expectations, Capabilities, and Possibilities

Our participants had high expectations of the content that might be accessed through an interactive mobile system. This increased some users' feelings of frustration when they were either unable to access some content or managed access only after a struggle. A major issue here was with the length of time taken to download images and video. This caused frustration for participants in a number of ways; they became impatient as they expected information to appear immediately, they were often unable to tell whether the requested file was downloading or not, and the lengthy download time created high expectations for the material which eventually arrived. Given the remote rural setting of the trial, only general packet radio service (GPRS) access was available for downloads. Thus, the user experience could be improved by the introduction of faster channels and protocols such as high-speed downlink packet access (HSDPA).

The participants often interpreted failings of the system as being because of their own personal failings in using mobile devices. This often led the participants to compare the devices used in this study with the devices that they usually used ("Mine's a bit of a dinosaur," "It's a brick") or to suggest that this kind of system was for younger people who, it was implied, were more competent users of new technologies.

The participants had a number of ideas on how the system can be improved, particularly in relation to the information content. Many participants felt that there should be much less text (which some claimed could easily be provided on signs and posters, although this would conflict with the requirement to reduce environmental clutter and intrusion) and more audio. The vast majority of participants believed that audio was the best suited medium for the park context, as it did not distract so much from the surrounding environment (users could listen to the phone and look at the park at the same time), it did not suffer from the same impediments to access as text or images (e.g., screen glare), and it provided something that could not be achieved using signs and posters.

The participants felt that the system met or even exceeded expectations in the design of the posts and their placement around the park. It was generally considered that the posts "blended in and [were] not obtrusive," and that they were "very discrete and well placed." This was a very important aspect of any potential system for these participants. They felt that the park itself should always be the focus of any visit and that any addition to it, no matter what the potential benefits, should not detract from the aesthetic or ecology of the park itself.

Familiarity with the Technology

Some of the usability issues encountered during the study were at least partly due to a lack of familiarity with mobile technology in general and with the specific handsets used in this study. As noted earlier, our participants' usual level of mobile phone use was low. At least three said that if they brought a phone with them to visit the park, they would leave it in the car. Those who did regularly use a mobile phone tended to use older models. When asked which phone they usually used, the participants' responses included "Nokia dinosaur," "Old Nokia brick," "Nokia four years old." Fifteen of the 18 participants did not know the make and model of their phone. Some participants had more recent phones, but typically had not used some of the more complex features; "Sony Ericson [sic]—It's meant to be very good but I try not to use it."

Corroborating previous findings [11], some of the difficulties encountered involved functions such as scrolling through a list or text, or selecting items from a menu. These were functions that some participants felt they would have had few problems with on their own handset or if they had more time to familiarize themselves with the handsets used in the study. The long-term aim of this type of project would be for visitors to the park to interact with the posts using their own handsets, thus alleviating this type of problem.

Unsurprisingly, no participant had previously used any of the four interaction methods employed in this study; however, in contrast to the rather negative responses that participants had to the unfamiliar handset interface, they enjoyed the challenge of using the unfamiliar interaction methods. In particular, although framing the sculpture in the camera's field of view was intuitive, they had to learn how to frame the 2-D barcode successfully by holding the phone at the right distance and orientation. This was not obvious to the users at first but they quickly learned how to point the phone appropriately. This was reflected in the rapid increase in the ease with which the participants accessed information from the posts. By the third post, all the participants felt comfortable accessing the information associated with the post.

Summary and Implications for Design

Two common expressions heard from the participants during the study were "It's not for me/us" and "Younger people/children would like this." There were clearly some general problems with the use of the mobile handsets and some support and additional experience with some of the technology was required by some participants. However, their use of the novel interaction methods was enthusiastic and successful. Also, the participants were keen to suggest additions and augmentations to the information content provided by the system. So why did they assert the belief that the system was not for them?

First, echoing the findings of Rice and Carmichael [3], it was clear from this study that the participants did not represent an entirely homogeneous group. Although overall it was quite low, familiarity with mobile technology varied widely, as did facility with the interaction methods involved and enthusiasm for the technology's potential. However, for the vast majority of participants, the system presented in this study was not sufficiently attractive or accessible.

There appears to be a threshold beyond which older users are not prepared to cross without very high promise of reward. While experimentation and play with new technologies may often be reward in itself for younger people, this does not appear to be the case for older users.

Design must approach this issue from two sides, both by mitigating and removing barriers to entry and by promising access to information and resources unavailable through other means. The results of this study suggest that neither of these approaches in isolation is likely to be sufficient to engage older users. A system designed for older users must offer something that is not available through other channels, particularly from more traditional sources. The participants in this study were enthusiastic about the potential offered by the new technologies they were using but were not prepared to make the significant investment of time, effort, and perhaps expense necessary to make use of these new technologies if there was not a significant increase or improvement in the information to which they had access.

In terms of reducing barriers to entry, the system should demand as little as possible from a handset. The participants in this study certainly did not own the latest mobile technology. Neither did they enjoy navigating menus or scrolling through large sections of text. The use of audio as the main channel of transmission would have been very welcome within this group, removing the problems of screen glare and text size. A less obvious barrier to entry concerns the way in which the infrastructure of a system integrates with its environment. All participants were concerned that whatever system might be installed, it must not detract from the environment in which it was situated. If it did, this would be the sufficient cause for older users to resist engagement, confirming our initial key design requirement to provide accessible information and interpretation while causing minimal disruption of the natural environment of the park.

In summary, the participants in this study were excited about the potential of mobile interactions to add to their visit but were prevented from fully engaging with the technology by physical characteristics and lack of familiarity with and attitudes toward mobile technology.

Conclusion

We achieved one of the primary goals of our prototype system, which was to declutter the natural environment of the park by providing a less intrusive alternative to traditional signage. The participants felt that the posts "blended in and [were] not obtrusive" and they were "very discrete and well placed." They confirmed the appropriateness of this aim, proposing that the park itself should always be the focus of any visit and that any addition to it, no matter what the potential benefits, should not detract from the aesthetic or ecology of its natural environment. Of course, an interactive system will only be of value, however well it blends in, if it at least functions as an effective replacement for the traditional signage.

In general, older users have high expectations of technology and are disappointed when a technological system offers only an analog of existing low-tech alternatives (signs and posters). The aspects of a mobile information system that older users found most attractive were the opportunities for alternative media types (audio and video instead of images and text), for dynamic information (e.g., changing according to the season) and for interactivity. Older users in this study were unwilling to make a significant effort to learn a system or to make an investment in the technology required (e.g., a mobile handset) unless these expectations are likely to be met.

Increasing longevity and declining fertility rates have been leading to increasingly older populations in all industrialized countries, and this trend is predicted to accelerate in most industrialized countries in the next few years [13]. For this and other reasons, it is essential that we pay attention to the needs of older users during the design of mobile and pervasive systems. Hence, more research is needed on the older user experience and how we may improve it.

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