

Investigating Clientless Mobile Phone Interaction with a Bluetooth Public Display

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ABSTRACT

Interactive public displays are becoming more prevalent than ever before. The costs of large displays are coming down and the ubiquity of mobile devices allows for novel interactions with such displays. Bluetooth has been used to interact with such displays in the past, but sharing of complex information with the display has required a phone application. Not all phones however can utilise Bluetooth via an application. This paper investigates the feasibility of sharing complex notices found on traditional notice boards with a public display without using a phone application, as well as the interaction design process in creating a display with such a novel interaction method. The notices use standard data formats such as vCards, vEvents and photos.

1. INTRODUCTION

Technologies such as instant messaging and SMS have been embraced for their ability to connect people and communities. Interactive public displays can fill a similar role by leveraging technology to bring co-located communities together.

Interactive public displays allow digital information to be shared among a co-located community. These displays are usually large and placed in a public space to entice people to interact with them[6, 23].

The means of interaction with such displays are numerous. Most displays utilize some kind of touch screen [8, 9, 23], and recently public displays have become multi-modal, allowing interaction both by touch and using a mobile device [8, 9]. The device can be used to navigate the content on display or to submit information. Usually this interaction occurs via an installed application on the mobile device [8, 9]. Displays use various communication methods with mobile devices including MMS [5], SMS[16], GPRS [20], or Bluetooth [8, 9].

Bluetooth is an appealing communication method for such displays as it offers free connectivity within a short range and it is becoming increasingly pervasive among new mobile phones[2].

Previous Bluetooth-enabled public displays have used the OBEX push protocol to implement a clientless communication solution [8, 9]. These displays have allowed only pictures, but most Bluetooth-enabled mobile phones support other standard data formats such vCard [3] and vCalendar [4] objects. The fields provided in these file formats could be used to support a wider variety of content, by allowing images and text to be combined into one item. Thus the usefulness of the display can be extended without requiring a phone application. This is preferable to requiring an application which would raise the

technological literacy and emotional investment required, discouraging potential users.

The main aim of the Bluetooth Notice Board project is to allow sharing of information among a community by utilizing shared-space displays and mobile phones without using an application. Interaction will occur via a combination of a touch-style interaction and Bluetooth mobile devices. This specific implementation is designed for use in location-based communities, such as at tertiary institutions. These institutions have many public notice boards for advertising accommodation, goods, services, and events, as well as notice boards for smaller communities such as clubs and societies. Nevertheless, the findings should be useful in designing similar Bluetooth-enabled notice boards for other co-located communities.

1.1 Project Aims

1.1.1 *Sharing information via a public display and mobile device without a phone application*

Bluetooth mobile phones should be able to send notices to and receive notices from the display, using only the standard data formats for storing contacts, events, and photos. This would allow ‘walk-up’ use of the display without the “buy-in” of downloading an application.

1.1.2 *Facilitate target audience so that they achieve their end goals more effectively*

To offer value to the target audience, the notice board should fit into the context of their lives and allow them to achieve at least some of their goals more effectively than using a traditional notice board. This involves ensuring the information and tools needed to complete their goal are available to them in context they need to use it.

For receiving notices, the Bluetooth Notice Board should offer advantages over having to write down the relevant information or inputting it to their mobile phone manually. These advantages could be psychological, convenience or task completion time.

1.1.3 *Provide a pleasurable user-experience for target audience*

Three important facets of the user-experience are Information Architecture, Interaction Design and Identity Design[13]. Information Architecture involves structuring the underlying information to match the mental model of the audience. Interaction Design deals with how users navigate the underlying Information Architecture. Identity Design relies on the Interaction Design and Information Architecture, but also the visual themes, features and other properties that determine the emotional response to the system.

A User-Centred-Design approach should ensure a user-experience that balances those facets. This makes certain that the final system will be close to what users need to achieve their goals in a pleasurable manner. Usability interviews and questionnaires can determine whether this aim is being achieved.

1.1.4 Determine if the standard OBEX data formats offer enough flexibility to be used for a variety of notices

The vCard and vCalendar formats are well supported by mobile phones. vCard objects are used in contact software to represent contact details of people or organisations, while vCalendar objects represent meetings or events in calendar software. It is hoped that users' familiarity with their own mobile phones will help them understand the interaction process between their phones and the display.

However, there are only a limited number of data fields in the vCard contact and vEvent event formats. It needs to be determined if the formats allow enough flexibility to cater for the creation of suitably complex content.

1.1.5 Address issues with replacing traditional notice boards with an electronic display

Certain affordances of traditional notice boards might not translate to a public-display version. The resulting differences need to be investigated, to determine how it is affecting the audience. For example, those without a Bluetooth mobile phone cannot post a notice when they are at the notice board. In addition, the limited resolution of the display will affect the visual quality of notices compared to paper, as well as the number of notice that can be displayed. The possibility of many users at the display might affect an electronic notice board differently from a paper-based notice board; consequently, the interaction design needs to be carefully considered.

This paper examines the user-centred design process used in creating and implementing such a Bluetooth display: the Bluetooth Notice Board. Evaluation of the implemented system and the issues surrounding it are discussed.

2. BACKGROUND AND RELATED WORK

2.1 Touch Screen Interaction

Touch screens are one of the most widespread interaction methods for public situated displays [23, 10, 12, 18], often allowing a "walk up and use" [23] interface. This is an important criterion for interactive displays in a public setting, but is difficult to achieve with other input methods. Touch screen displays limit the number of users that can physically interact. Interestingly, input methods that are closer to the display are more effective [11], which can justify the limits of touch screens in some circumstances.

2.2 Mobile Device Interaction

The ubiquitous nature of mobile devices such as mobile phones and PDAs has allowed designers to experiment with new methods of interaction for public displays[8, 9]. Usually displays leveraging a mobile device for input are multi-modal,

allowing for touch screen interaction as well[7, 8]. This creates new opportunities for collaboration and allows more than one user to interact with the display simultaneously even with the limitations of touch screens. Mobile devices can interact with situated-displays via one or more of SMS[16], MMS [5], Bluetooth [8, 9], phone cameras[14, 17], GPRS [20] and mobile Java applications [8, 9].

2.2.1 Bluetooth

Bluetooth is one of the more interesting interaction methods. It allows interaction to occur no cost compared SMS, MMS and others, which can incur a cost for both a user and the display's maintainer. The Hermes Photo Display[8] utilises Bluetooth for sending and receiving of photos which are presented on the display. Browsing of photos occurs using the touch screen display or a mobile phone application.

Despite its promise, Bluetooth poses significant technical challenges as the tools and devices are unreliable[8], and only a subset of Bluetooth phones are supported by some of the more advanced toolkits which allow Bluetooth communication via a Java application[8]. In particular, the creators of the Hermes photo-display encountered significant problems with device discovery.

The Hermes browsing application gave a more synchronous experience, allowing browsing, and downloading on their mobile phone. Not all users though, were comfortable downloading foreign applications to their devices. The Hermes team found that 75% of participants had a positive response to downloading applications to enhance their experience. Although, it is important to note that the participants were self-selected computer science students, which may account for their willingness to download a phone application.

Despite the technical shortcomings of Bluetooth and compliant devices, it is a promising technology for interacting with public displays.

2.3 Interactive Display Design

The process used to design and develop public-situated displays is important to ensuring its success. Good methodologies, heuristics and design tools can ensure that the product delivered fulfils the users' real needs in an effective, efficient, and appropriate manner.

2.3.1 User-Centred-Design

User-centred-design, an iterative design process where real users are consulted at multiple stages, has been used and recommended by a number of designers of interactive displays [8, 19, 23]. Including users from the beginning ensures that direction can be changed if problems are encountered early and the design meets users' needs and expectations.

The Vista interactive display used UCD through a combination of interviews, personas, scenarios and prototypes during their design, but felt that user profiling was one of the most important aspects [23]. Having a better user profile can result in having less iteration to achieve a quality interactive display.

2.4 Background Summary and Applicability

The Hermes Photo Display[8, 9] has shown a proof-of-concept that Bluetooth can work with public displays and simple media

such as photos. This work will be extended to allow the creation and display of more complex content.

Unfortunately, acquiring a touch screen was not feasible, so a projector and web camera were used. An image-processing module will interpret the camera feed to determine placement of interaction with the display. The use of a projector could introduce obfuscation troubles.

The UCD process minimises the risks associated with developing displays for novel uses, such as the Bluetooth Notice Board. It will be used to help deliver a system that closely matches user needs and expectations.

3. SPECIFICATION OF SOLUTION

The Bluetooth Notice board will be projected onto a blank wall space. Users will be able to interact with the notice board using a touch screen interaction that will be simulated using a computer vision module that processes a web camera feed of interaction with the notice board. Notices will be uploaded to and downloaded from the notice board using Bluetooth mobile devices. These notices will be persisted to a database, so they can be retrieved and displayed by other notice boards. Notices will be constructed using the vCard data format for contacts, the vEvent data format for calendar appointments, and uploaded photos.

4. UCD APPROACH

A User-Centred-Design process will be used; UCD is an iterative process that ensures the system is being self-corrected, by involving users often and early. This process helps to deliver system that meets user needs as closely as possible. This will involve an ethnographic study of the notices at the University of Cape Town, holding focus groups, generation of scenarios, and then a number of iterations of low and high fidelity prototypes with usability testing.

4.1 Ethnography

A short ethnographic study of the notice boards was undertaken at the University of Cape Town's upper campus.

Notices posted to public boards by students and outside organisations officially need to be signed by a UCT body. Notices for advertisements and events need to be stamped by the Student Representative Council. Due to the limited board space available, there is a cost of R50 for between 10 and 50 notices. The number of notices that can be posted depends on their page size. Although official notices are stamped, they are not dated, making it difficult to determine which notices are still current. According to an SRC representative interviewed, the notices usually stay up until they are taken down by cleaning staff. The same representative also said, "The notices are very difficult to monitor."

4.1.1 Findings

The notices posted on the public boards fell into a few main categories; advertisements for goods, services, accommodation, events and requests for study participants.

Popular goods advertised included computer systems, flash disks, used cars, second hand textbooks and mobile phones. Advertisements for accommodation were also popular all around campus. Guest speakers, career opportunity talks and

social events were often advertised as well. It was noted that very few of these notices were stamped by the SRC.

4.1.1.1 Goods and Accommodation

Notices for sale of goods such as textbooks, flash disks as well as notices for accommodation available were often on small A5 paper with only the most important details given in a short description. Usually the details included a short title, a summary, the cost and contact details. For accommodation notices, there was almost never an attached photo, as seen in *Figure 1*, while advertisements for cars often had an attached photo, also shown in *Figure 1*. Contact names were omitted for approximately half of these notices, but a contact number was given, as seen in *Figure 1*.



Figure 1: Sample advertisements

Sales of Computer Hardware however were usually on A4 paper, and contained detailed specifications of the hardware components.

4.1.1.2 Request for participation in studies

Requests for participation in studies were mostly on A4 paper, with far more details. Usually a long textual description as well as many different contact details such as home, mobile and email address were given. It was also noted that other notices of a more serious nature, such as lost items, or therapist services also had more contact details than other types of notices. Some of these requests for participation notices were sensitive in nature, for example a request for interview with females in abusive.

4.1.1.3 Events

Typically, notices for events, such as guest speakers and social events, would contain the date, the time, the venue and a 10 to 50-word description of the event. Social event posters however, usually attempted to be more visually appealing, as seen in *Figure 2*.

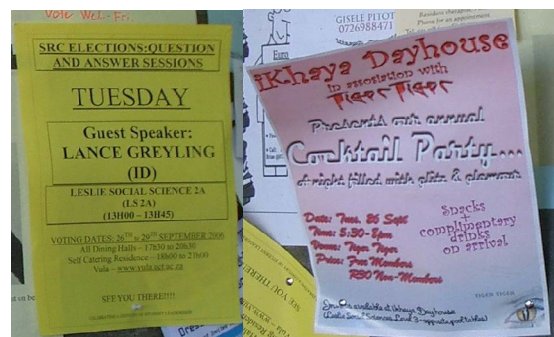


Figure 2: A guest speaker notice compared to a social event notice

4.1.1.4 Distribution by location

Buildings for the various departments contained very different types of notices. Unsurprisingly the Computer Science building had a large proportion of notices advertising computer hardware, while a building like the Arts Block had only a few notices for flash disks. The Computer Science building also advertised a number of books for various science courses such as chemistry; possibly, due to the fact the general computer labs for the Science Faculty are located in the building.

4.1.1.5 Notice board clutter

Many of the notice boards in busy areas were extremely full. Often many notices were hidden under other notices that had been put up later, as seen in *Figure 3*. The pins holding notices up would often be reallocated by posters of new notices, leaving some notices upside down or drooping.



Figure 3: A cluttered notice board in a busy public area

4.2 Focus Groups

Focus groups are a quick and powerful means of determining desires and motivations of a target user group [13]. This can help guide the design process to develop something that users actually want and would use.

The focus group held was of an exploratory nature. It helped in determining what the target audience's views are on the notice boards around the University of Cape Town's campus, on electronic public-situated notice boards, and how they feel about interacting with the board using mobile technologies. It is important to note that while the qualitative data gathered is helpful, it is not statistically significant.

Participants were all students of the University of Cape Town, between the ages of 19 and 23. Participants were recruited from the Humanities and Commerce faculties, ranging from second to 4th year. Mobile technology literacy was also varied.

At various points in the following sections direct quotations are used to illustrate ideas. Where a quote is given it is preceded by an initial indicating the speaker, in order for readers to follow the flow of ideas from one member of the focus group to another.

4.2.1 UCT Notices

Nearly all participants had used public notice boards to some extent. Uses cited included finding accommodation, second hand textbooks, and talks by guest speakers as well as society

notice boards. One participant, who enjoyed going to the talks, commented that she probably misses many talks that would have interested her because she did not see the notice.

A concern noted by a number of the participants was that notice boards get very full, and often very quickly:

R: "Notices get lost in the clutter."

K: "The library entrance is a good place to put notices; you get lots of responses until it gets covered up."

Age of the notices was also raised as an issue. Two participants noted that when they contacted regarding notices for digs, the rooms were already filled, and in one case the textbook being enquired about was already sold.

Privacy was not a large concern for the group. One participant said the notices he was looking at were "generally just varsity stuff" or otherwise not sensitive.

The SRC notice limit of approximately 30 notices was seen as problematic. Especially for notices aimed at the public. Participants would like to put up more notices than that for public notices in order to help with the response rate.

Most participants responded positively to the use of removable tabs with contact details for a notice. One focus group member saying, "It just looks more fun!" while gesturing with her arms.

Participants noted that they would be more interested in notice boards that were for smaller communities and would prefer notices that were targeted as S noted, "The only time you look is idle time".

4.2.2 Mobile phone usage

Participant comfort levels with mobile technology were varied, from those who use Bluetooth to copy files to their computer and share photos between friends, to those who have no idea about Bluetooth or what downloaded phone applications are.

K on the question of having ever downloaded an application to her phone: "I have no idea."

Only two participants used their mobile phone's calendar application, mostly for reminders of birthdays, tests, and course deadlines.

4.2.3 Bluetooth Notice Board

The participants viewed sending and receiving notices with their mobile phone favourably. Most participants viewed touch interaction more favourably than using an application.

S: "I would prefer to go up to the notice board."

K: "Touch would be better than using my phone, I'm so illiterate."

While the participants favoured the touch interaction concern was raised about many people interacting with the board at one time.

The possibility of having events added to your calendar was seen as "seriously convenient", but K noted, "I'd have to learn how to use my calendar".

Registering your mobile device to use a notice board was not viewed very favourably.

K: "Not many people would want go through the effort of getting their phone registered."

4.3 Exploratory Hypotheses

4.3.1 Clutter reduces efficiency

The clutter on the notice boards requires sifting through many notices that may be unimportant to a person looking for specific notices. In addition, some of the notices may be out of date. The goods or services no longer available, resulting in time and money wasted contacting regarding such notices. Other relevant notices however, could very well be lost under the clutter, resulting in a lost opportunity for both posters and viewers.

4.3.2 Certain notice types do not translate well to vCard or vEvent

While the specifications for vCards[4] and vEvents[3] do not mention limits on the lengths of any of the fields, it has been seen in practice that most phones have limits of between 50 and 100 characters per field. To adapt notices, such as requests for participation in studies, would require a significant change of the description to fit within these limits.

In addition, some event notices are visual in nature, which makes them more appealing to passers-by. Unfortunately, while vEvent officially supports embedded images, very few phones actually support this. Even so, it would be possible to create an image as a poster, and upload that to the notice board via mobile phone.

4.3.3 Audience wants targeted notices

Notices that might interest people are often overlooked. Having the notices being more targeted could make them more useful. This is especially relevant for events such as guest speakers as people probably will not go out of their way to look through the clutter of notices just in case there is an interesting speaker. Unless the student had a specific goal, they might only look at the notices in idle time, so it is important that the notices they do see are those most likely to interest them. If the notices were more likely to be of interest, this might motivate them to view the notice board more, as there would be a higher return on investment for the time spent viewing notices.

Notices that fall into specific categories, such as flats for rent for example, could be grouped together. When someone is looking for a flat, it would be useful to see all flats available in one place, rather than looking at multiple notice boards to collect all the information. Another possible solution includes keeping a profile for each phone's Bluetooth ID and displaying a higher proportion of possibly interesting notices. Yet another solution could be having students provide information about what notices would interest them, preferably without them having to register explicitly. This could for example happen at the notice board, without knowledge of which student is related to the Bluetooth ID.

4.3.4 Audience wants to place public notices in many places

The distribution of the target audience of notices such as flats to rent is distributed around campus. The notices thus need to be distributed as well to reach this audience.

4.3.5 Audience wants information to be stored in a context where it will be useful to them

The convenience of having reminders of events on your phone is that most people nearly always have their phone on them.

Similarly, mobile phones are one of the best mediums to receive contact details, as it is the device used to get in touch with the poster of the notice. Cameras are becoming standard issue with new mobile phones, so the phone is being used for both taking and storing photographs.

4.3.6 Audience wants low cost of entry

Registering a mobile phone to use a notice board was seen as a hassle. If this were to be done, there would have to be a good enough value-proposition to justify it, or at least it should be for posting notices only. This would be similar to how public notice boards on campus work currently.

4.3.7 Technological literacy required should be kept at a minimum

Keeping knowledge requirements to a minimum ensures the largest possible audience. New concepts could confuse a potential user and raise the mental investment required.

4.3.8 Physical interaction is preferable over an application

Visceral interaction such as touching or tapping would be preferable to using an application, but it should still allow multiple people to view at a single time. Apprehension may be shown if an application needs to be downloaded.

4.4 Designing the Paper Prototype

Paper prototyping is a low-cost way to quickly create, test and design user interfaces [21]. The low fidelity interface is a combination of paper widgets such as post-its and pieces of paper, attached to a large white board. Interface elements can be repositioned or replaced quickly, allowing for rapid iterations. Usability testing can be done on such a prototype using Wizard-of-Oz testing. This entails having a human acting as the "computer", changing the interface to respond appropriately to user interaction. This is especially useful in the early phases of design, helping to prevent early mistakes that could be costly or impossible to fix at a later stage in the process.

4.4.1 Prototype Design

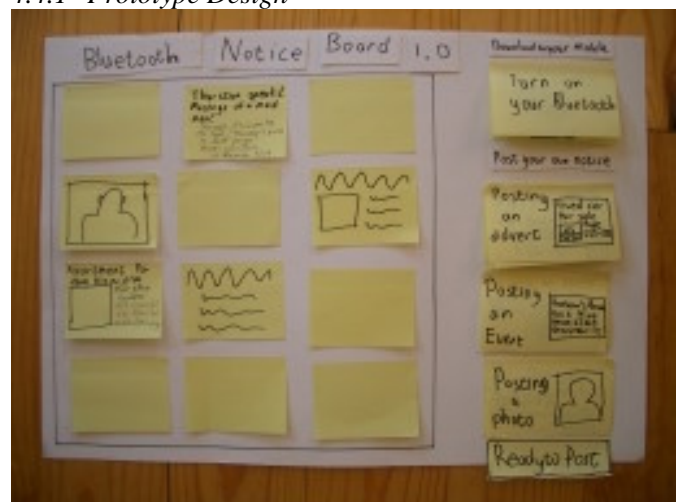


Figure 4: Initial Paper Prototype

The initial paper prototype had notices on the left, with a bar on the right with short 'video' tutorials. In order to ensure

minimum initial interaction, these tutorials would already be playing, allowing users to get an idea of the system before attempting to interact.

4.4.1.1 Receiving Notices

Downloading notices to a mobile phone required the following four high-level steps:

Turning on Bluetooth

Tapping the notice with mobile phone

Choosing mobile phone from list

Accepting the Bluetooth message

4.4.1.2 Posting Notices

Posting notices required the following high-level steps:

Create/edit a vCard, vEvent or take a photo.

Tap the “Ready to Post” button

Send the notice via Bluetooth to “Notice Board”.

The notices are ordered in chronological order, starting at the top left.

4.5 Evaluation of Paper Prototype – Usability Testing

Usability testing was carried out on this paper prototype. A human assistant acted as the “computer”, sending and receiving the Bluetooth messages and updating the interface appropriately.

The participants were instructed that the panel on the right contained videos and that they should flip through them as necessary. After an initial interview, they were asked to download a notice regarding an apartment and call the number. They were then instructed to download an event regarding a guest speaker and set a reminder for it so they do not forget. The next task was to post a notice about a party and then another to advertise a second hand textbook.

The results from this prototype were used to implement a high fidelity prototype.

4.6 Designing a High Fidelity Prototype

The high fidelity prototype implemented was designed using the Flash 9-based Flex 2 application framework. Many of the changes necessary made apparent from the paper-prototype usability test were implemented in this prototype. Section 4.8 gives an overview of this interface.

More feedback was added allow users to know the state of the system. Indeterminate progress bars were added when the system was waiting for messages, or sending messages. Appropriate error messages were added when there was some kind of Bluetooth failure.

4.7 Evaluation of High Fidelity Prototype – Usability Testing

At this stage, the Bluetooth and backend database to store the notices was working well enough that it could be used for testing purposes. Touch screen interaction was simulated again using a Wizard of Oz process, with a human “Computer” clicking a mouse when and where appropriate to interact with

the interface on behalf of a user. The same tasks used in the paper prototype testing were used.

4.8 Improving the High Fidelity Prototype

Changes based on feedback from the first high fidelity user tests were implemented in a new prototype, as seen in Figures 5, 6 and 7.

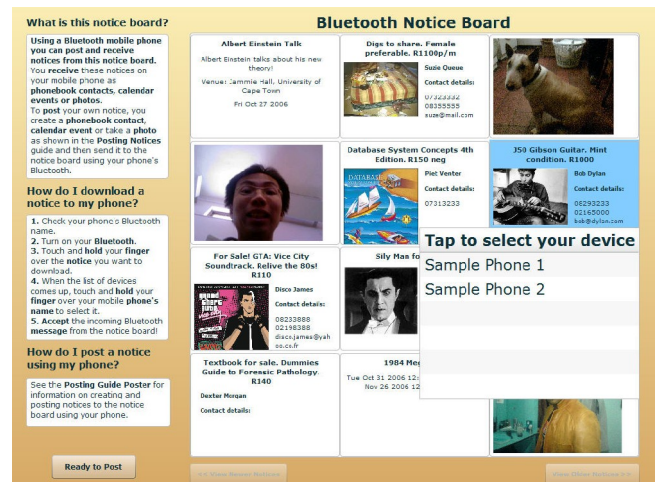


Figure 5: The new interface, with the static help bar on the left.

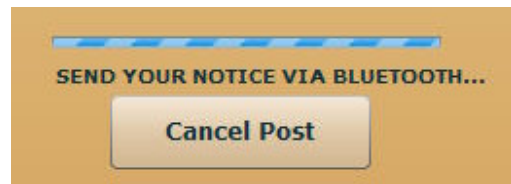


Figure 6: Improved notifications

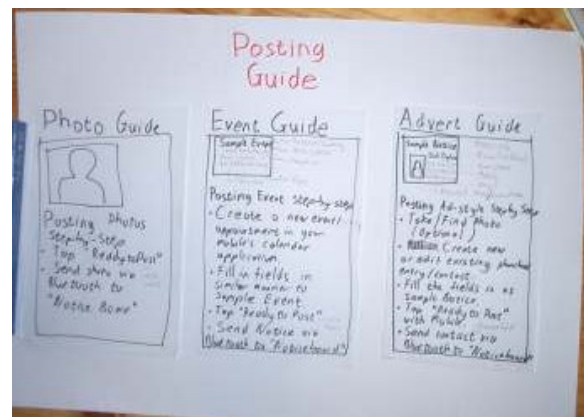


Figure 7: The detailed posting guide mock-up

5. Final Evaluation

The final usability test was run with six users in the same manner as the previous test, utilizing Wizard of Oz to simulate the touch interaction, and following the usability test script outlined in with the paper prototype. Users were asked to complete a questionnaire on their experiences regarding the notice board.

The questionnaire contained seven sections, including evaluator's background, thoughts on notice board interaction, general assessment, community, social aspects, future possibilities and a final section for additional comments.

Most questions were based on a 5-point Likert scale and space was provided for comments.

5.1 Usability Testing Results

The notice creation process can be lengthy and frustrating, especially as many phones do not support predictive text when creating contacts and calendar entries.

The vocabularies used by mobile devices are varied. For example, the vEvent calendar entry has been seen named as appointment, event, and meeting.

Notices with images draw the most interest and crowd out those without images. This is problematic for event notices, where phones typically do not support an embedded image.

M: "The ones with photos really overshadow the others. I don't really want to read these ones." (M points at an event notice while saying the second sentence.)

Bluetooth phones with phonebook memory set to SIM card only have trouble viewing or creating vCard contacts. vCards are only supported when phone memory is used.

The fields of the vCard format supported by mobile devices vary. *Name* is the only mandatory field, and mobile phone manufacturers can optionally support the other fields. This results in many phones not being able to create and receive notices with contact details successfully.

The fields of vEvent supported are more consistent. All of the fields useful for creating event notices are mandatory, except for *location*. This results in these notices being easier to make on the majority of mobile devices.

While typical users would potentially want the contact information for an advert on their phone, some view it as more convenient simply to manually enter the data.

D before attempting the first notice download task: "You know, I would probably just type this right into my phone."

5.2 Questionnaire Results

5.2.1 Notice Board Interaction

All of the evaluators found creating an event notice to be of similar difficulty or easier than creating a contact advert notice (Questions 2.1 and 2.2).

D: "Better than advert, but still a pain to do on phone"

M: "After figuring out event was "meeting" on my phone (easy)."

This was possibly because more of the useful fields in the vEvent format are mandatory, which makes it easier to author such notices on a variety of mobile phones.

L on posting an advert: "Didn't have relevant fields"

Five of the six evaluators agreed that the process of download notices was easy (Question 2.4).

5.2.2 General Assessment

Five of the six evaluators agreed that they liked the idea of receiving notices on their mobile phone via Bluetooth, with one

evaluator answering neutrally (Question 3.1). One subject wondered if he would be able to find the contact later.

L: "Could be hard to find a contact advert if you forget the name. Advert was not stored in separate list."

All but one evaluator agreed that they enjoyed interacting with the notice board, with the evaluator who disliked the interaction having tested the more frustrating first high fidelity prototype (Question 3.2).

Half of the users were frustrated by the time taken to create notices, while one evaluator was neutral and two disagreed (Question 3.3).

A majority disagreed that to upload or download times were frustrating (Question 3.4). It is noted though, that the one evaluator who agreed that the times were frustrating was quoted as answering "Not really" in the comment.

All the subjects agreed that they would like to add a photo to an event (Question 3.5).

D: "Yes – pictures make the notice stand out."

M: "Not essential, but could be a nice feature to stop ad from being visually "crowded out" by picture ads."

The subjects were split on whether or not the fields for notice creation were sufficient (Question 3.8).

Preview of notices before posting was seen as an important feature, with all respondents agreeing. (Question 3.9)

5.2.3 Community

All except one evaluator agreed that an electronic notice board would be useful for a society, with the remaining participant giving a neutral response (Question 4.2).

5.2.4 Future Possibilities

All of the participants responded positively to having notices posted automatically distributed to other notice boards (Question 6.1).

D noted regarding automatic distribution, "Doing this from a computer would be MUCH easier."

One-third of the respondents would feel uncomfortable downloading a Java application to help the process (Question 6.2).

D who was a proponent of the Java application said "Not really. More of a mission though."

5.2.5 Other comments

M: "Nice colour scheme. Very clean-cut look, not too busy or plain. Very easy to use if you know how to use your phone... LOVE the fact that you can get info from notices "normally" if you don't have Bluetooth."

6. FINDINGS SUMMARY

6.1 Ethnography

The locations of notice boards affect what notices are posted, by virtue of the communities that frequent this location.

A number of notice types will fit into the proposed fields of vCard and the vEvent subtype of vCalendar. These include advertisements for events, accommodation, second-hand textbooks and vehicles.

Certain notices that contain long textual descriptions, such as requests for study participants, do not map well to the vCard or vEvent formats. This is due to the limitations that most mobile phones place on the field lengths.

Notice boards that are very cluttered have reduced effectiveness. It requires an extra effort to find interesting notices, and a number of the notices are no longer relevant. This could result in wasted time contacting regarding those notices.

6.2 Focus Groups

Targeted notices are needed. Students usually only spend idle time looking at notices, and the clutter makes it difficult to find notices of interest. Often notices are no longer relevant, which wastes time when contacting regarding the notice.

Students want to post public notices in many locations in order to increase response rates.

Information is needed in a context where it will be useful. For example, contact details should be stored on a mobile phone, as that is the context it will be used.

Audience wants low cost of entry, so interaction with the notice board should be able to occur with minimum mental and emotional investment. Consequently, a potential user should be able to interact nearly immediately with the notice board using the tools already at their disposal.

Technological literacy required of users should be kept at a minimum, allowing the maximum proportion of the target audience to interact.

Physical interaction with an electronic notice board is preferable over application-based interaction.

7. CONCLUSIONS

7.1 vCard format not suitable for a Bluetooth Notice Board

Only the Name field is mandatory in the vCard specification. Many newer phones support the more useful fields such as note and contact photo, but a large number of Bluetooth phones do not support either of these. As the note and contact photo fields are not standard in all phones, ensuring compatibility would require use of only the *Name* field. This seriously limits the flexibility of notice creation. It can frustrate both notice posters and those who have downloaded the notice who now have incomplete information.

Even if the phone supports the necessary fields though, if it is not explicitly set to utilize phone memory, the contact will not be viewable, as SIM cards do not support vCards objects.

7.2 Mandatory vEvent fields are flexible enough to create most event style notices

The *subject*, *description*, *start* and *end date* fields are mandatory for vEvents. *Location* is the only other valuable field that is not mandatory. The description field however could be used to contain information relevant to the location. This allows the vEvent field to be feasibly used for an electronic notice board. To allow an event notice to be visual, a separate photo could be added, which would not be downloaded along with the event, but simply displayed alongside the notice.

7.3 Downloading contact notices has questionable value

Notices with contact details for advertising goods, services or accommodation are less useful than might appear. In most cases, it would be quicker to type information manually into a mobile phone, especially as only relevant information would be typed in. In addition, the name used could closer fit the mental association with the advertisement, allowing it to be more easily retrieved from their contacts list when it is needed.

7.4 Events and photos are more useful for smaller co-located communities

For smaller communities such as society's adverts regarding their events and photos of those events would possibly be more useful for fostering their community than contact advert notices. Societies generally hold frequent events, and it would be useful for members to share their photos.

7.5 Major value lies in reduced clutter, targeted notices and automatic notice distribution

The value of a Bluetooth Notice Board for most notice viewers lies in its ability to reduce clutter by having an effective dating mechanism and its possibilities for grouping notices to provide notices that would more likely interest the viewer.

For posters of notices it is seen as extremely valuable to be able to distribute the notice to multiple physical locations. This could also allow distributed removal of such notices, resulting in less time wasted by interested parties contacting the poster.

8. FUTURE WORK AND MAINTENANCE

8.1 Allow for notices to be previewed before they are posted

Notice preview was deemed highly important by all participants in the questionnaire. The current implementation would not need to be altered drastically to provide this feature.

8.2 Provide downloadable templates for notice types

By downloading templates of the notices with instruction in the usable fields will help overcome the vocabulary difference seen among the mobile phones. Potentially users will pay more attention to instructions on their phone because it is in the same context as the notice they are authoring.

8.3 Provide a web interface to allow distributed posting of richer notices

While it is useful to construct a notice at the context of the notice board, posters might find it simpler to create a notice from a computer. Computer labs are available for all UCT students, and it would allow posters to create richer notices in a more intuitive fashion.

8.4 Divide into two separate projects, a society and a public notice board

Potentially the Bluetooth Notice Board should be divided into two separate projects.

8.4.1 Society or Small co-located community notice board

This notice board would support photo and event notices. These are two of the most useful features for societies. It would help foster a sense of community by sharing photo of the events that were advertised on the notice board. Sharing photos among small communities is generally seen as highly valuable.

8.4.2 Distributed Public-Display

The distributed public-display would not be Bluetooth enabled. Instead, users would create their notice through a web interface. This could be part of the tertiary institutions system, where their institution credentials are used to logon. This would allow bodies such as the SRC at UCT to more easily monitor and control the notices displayed, as currently it is very difficult to monitor.

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