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Facebook in the Physical World

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Master of Science in Communication Technology
Submission date: July 2008
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Problem Description

Today online social communities are playing an increasingly significant role in people's lives. These communities involve everything from sharing content and interests to dating and making friends. So far there has been a distinct border between online communities and the physical world. You either access the communities on the computer or you meet people in the physical world – you rarely do both at the same time.

There are ongoing trends in creating offices that enables informal communication through coffee bars and designated relax areas where informal conversations easily can take place. Informal interaction helps forming relationships, and relationships again build a level of trust. Trust between employees plays a significant role when it comes to team work. Rather than setting up a conventional coffee bar in this thesis we explore a new concept for initiation of informal conversations.

The key concept involves extending the scope of online social communities further. We want to form a bridge between the online communities and the physical world – you will see content from a person's online profile at a big screen at the same time as you get to meet the person face to face. We believe that a system like this greatly will help people in initiating informal conversations and getting to know each other better.

We want to design and build an ambient public display system for Facebook. The system will sense what people are standing close to the display, and display content that relates to the respective persons. We will carry out a test run with a successive evaluation that hopefully will help us in determining if this concept leads people to get to know each other better.

Assignment given: 28. January 2008
Supervisor: Leif Arne Rønningen, ITEM

SUMMARY

This thesis investigates the process bringing an online social community into a public space, building a bridge between an online social community and the physical world. We identify the opportunity of extending the online social community Facebook into a real world setting. We describe a prototype public display capable of displaying pictures of people who are standing in front of the system, pinpointing people's hometowns on a map, and showing pictures that relate to their interests. The system makes use Bluetooth to recognize who is in front of the display. A one week test of the system was carried out. Next, the system was evaluated through log data, observations, and interviews. The results support that the system sparked conversations and led individuals to learn about each other.

PREFACE

This report is the result of a Master's thesis given by University of California, San Diego, on behalf of the Norwegian University of Science and Technology. The Master's thesis is mandatory and constitutes the 10th and last semester of the degree.

I would like to especially thank my supervisors at UCSD, Barry Brown, Bill Griswold, and Jim Hollan, for their support throughout the period.

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1. INTRODUCTION

1.1. Background and Motivation

Today, online social communities play an increasingly significant role in people's lives. These communities are based around sharing content and interests, dating, making friends, and the like. So far there has been a distinct separation between online communities and the real world. You either access communities on the computer or you meet people in the real world – you rarely do both at the same time. Today's technology enables us to bring these worlds closer. This is an opportunity we will investigate by extending an online social community into a real world setting. We believe that this will enhance the real world social experience and support informal communication.

Deutsch argues that there are ongoing trends in creating offices that enable informal communication through coffee bars and designated relax areas where informal conversations easily can take place [1]. Informal communication helps to form relationships, and build trust. Trust between employees plays a significant role in team work. Rather than setting up a conventional coffee bar, in this thesis we explore a new concept for the initiation of informal conversations.

Facebook [11] is the fastest growing online social network with over 80 million active users. Facebook allows people to define their own profile, which contains personal information such as hobbies, pictures, a collection of friends, and more. People are able to conveniently communicate with each other using either multimedia or text. Tags on pictures make it easy to keep track of who is in the pictures.

The motivation for the current work is to extend the scope of online social communities. GroupCast [2] uses digital media to display information of mutual interest to people passing by the display as a mechanism to spark conversations in front of it. This system does not utilize the online social communities. We form a bridge between an online social community and the physical world by displaying content from people's online profiles as they are

collocated in front of a display. This system will be more personal and the motivation is to help people in initiating informal conversations and getting to know each other better.

We proposed a design and developed an ambient public display system for social online community Facebook that brought the Facebook and the physical world closer together. The system sensed what people stood close to the display, looked up their respective user profiles on Facebook, extracted relevant information for further processing, and finally presented the information on the display. The system acted as a conversation starter, and led people to get to know each other better. People in general enjoyed the system.

1.2. Thesis Scope and Limitations

In this thesis we will develop a prototype system based on the concept envisioned in 1.1. The system will be designed and developed for use in the Computer Science Building at UCSD.

There will be performed a test run of the system with a following evaluation that hopefully will help us in determining if the concept was successful or not. We will only test the system in the Computer Science Building even though it would have been interesting to test it at other venues as well.

1.3. Outline

First, in chapter 2 we will get an overview of the system and present some scenarios to give an impression on how we want the system to be. Next, in chapter 3 we go through related work. Chapter 4 describes the system design including relevant technologies and requirements for the system. Chapter 5 goes through parts of the design process and presents what functionality we decided on including. In chapter 6 we are described the system as it was implemented and deployed. The evaluation of the system is found in chapter 7. Chapter 8 says something about the lessons learned during the period, and chapter 9 concludes the thesis.

2. HIGH-LEVEL DESCRIPTION OF SYSTEM

In this section we will first give you a brief description of the system, as shown in Figure 1. The description is meant to give the reader a brief description of the system before we will go through a couple of scenarios to get an impression of how the system might work in practice. All the scenarios are hypothetic and take place on the third floor of the computer science building at University of California, San Diego.

Figure 1: Facebook in a real-world setting

2.1. User description of how the system works

The system is to be run on a public display. The display shows information that is related to people standing in front of the screen. The system makes use of Bluetooth devices such as cell phones to determine who is in front of the system. Information about people is taken

from Facebook. In addition to showing pictures and getting information from Facebook, the information is enriched through use of flickr and Google maps.

After the user has associated their Bluetooth device with their Facebook account she can start to use the system. The users can not interact with the system. All they can do is to either keep the Bluetooth on their device on or off. If the Bluetooth is on, then the system will be able to detect the user in front of the display. The system will present content about users that keep their Bluetooth on and that are within range. Users' pictures from Facebook show up. Interests are shown through both text accompanied with related images picked from flickr. The users are also marked on a map. The system supports several active users at the same time.

For more details about the system please refer to chapter 6.

2.2. Scenario 1

Peter and Angela are both employees on the third floor. They have been colleagues for a while, but they do not know each other that well. They do have a lunch together from time to time, and then they usually only talk about news and work related stuff. Both of them are into using Facebook, but they are not friends on Facebook.

Peter and Angela are hanging out in the hall in front of the big display. Both of them have signed up with the system, so pictures of both of them are showing up on the big display. They seem to be excited. They comment on the photos as they pop up. The concept of a public display for Facebook is appealing to them. Their interests from Facebook are also shown on the display. Images that are relevant to the interests are rendered with a tag of the respective interest in the upper left corner. Peter pays more attention to the images that reflect interests than the Facebook pictures. Suddenly a picture of a diver shows up. And the text in the corner reads SCUBA. This is a popular form of diving. Peter has been thinking of taking a diving course for a while, but it has not been prioritized yet. He knows that SCUBA is not an interest on his profile, so he asks Angela if she is a diver.

A conversation about content shown on the big display has just been initiated.

Angela tells Peter about her interest in diving, and about the opportunities for diving in the San Diego area. After a few minutes of conversation Angela asks Peter if he would like to join her diving group on the upcoming weekend to get a feel on what it is about. Peter appreciates the offer and decides to join Angela's SCUBA diving.

2.3. Scenario 2

Dennis is a professor at the computer science department at UCSD. He is in his fifties. He has heard much about Facebook, but he has still not created an account. Last week he received a mail about a new system that was deployed in the hallway on the third floor in the computer science building. He briefly read through it and realized this was not his kind of a thing because he was not a Facebook user. Dennis has his office on the fourth floor, and he usually takes the elevator, so it is not natural for him to pass by the public display on third.

On Wednesday morning, a week after the system was deployed, the curiosity make Dennis take the stairs instead of the elevator. His colleagues have been talking quite a bit about the system, so he decides to have a look at it. By taking the stairs he will go past the big display.

When Dennis arrives on third floor what he sees are four big high definition resolution LCD displays that constitute one huge display covered with a dark world map. There are also some pictures spread around the map. Dennis finds this interesting, and moves closer to the display. He notices that there is a keyword written in the upper left corner of each of the pictures. It does not immediately strike him, but after seeing a handful of pictures he realizes that the pictures are related to the keywords. The pictures seem to pop up in a random fashion on the screen. The keywords are everything from RUNNING and COOKING FOOD to MUSIC and CARS. They seem like typical activities and interests, and he wonders if these keywords might describe the registered users.

Apart from the pictures he also becomes aware of a group of red dots that are scattered around the map. He guesses that these red dots indicate where the registered users come from somehow.

After Dennis has observed the system in action for a while he has to admit to himself that he like it. He wants try the system. Right next to the public screen he sees a poster that says something about registration. There is also a pile of sheets with instructions on how to become a user. He begins with step one and turns on the Bluetooth on his cell phone…

Dennis goes through all the steps of the registration and becomes a registered user of the system. He creates a Facebook profile so that he can start to use the system, and sets his interests and uploads some of his photos.

A few minutes later Dennis returns to the public display. The display looks almost the same as when he left it. Then he turns on the Bluetooth on his cell phone and waits, and after a few seconds things start to happen. First, the dot on this home town turns green. After a few more seconds pictures of him start popping up and his interests are presented as pictures.

3. RELATED WORK

Cheverest et al. [3, 5] investigate cell phone based Bluetooth interaction with the Hermes Photo Display. The Hermes Photo Display lets the users upload and download photos through the use of Bluetooth. The great plus of using Bluetooth, instead of for example GSM or GPRS, is that there is no connectivity cost. To upload pictures the users have to pair their Bluetooth cell phone with the system. To download pictures the users also will have to install an application on their cell phone. The implementers of the Hermes Photo Display encountered several problems with the Bluetooth device discovery. They also experienced difficulties in supporting all cell phones as not all cell phones come with support for the JSR-82 API. However, most new cell phones nowadays support this. Even though they had issues on implementing the system the users were satisfied. The evaluation revealed that the users in overall enjoyed engaging with the system and the idea of having a public screen displaying pictures or content uploaded by people from the community, and that they though that such a system would increase their sense of a community. The users appreciated the simplicity of using the system, and the system was being used actively during the test period. Users were generally a little concerned about privacy and wanted to be able to remove pictures from the system if need be. The fact that users have to download and install software on their cell phone to download pictures increases the effort of starting to use the system, and might result in fewer users.

In “Investigating Clientless Mobile Phone Interaction with a Bluetooth Public Display” [9] they elaborate a system that does not require the client to install any software on their cell phone in order to use the system. The system allows people to put advanced notices, advertisements, and pictures on a public screen. The communication technology was Bluetooth, and they were using formats as vCards, vEvents, and photos. The aims were to let people share information from their cell phone without using an application, to facilitate the target audience so that they could reach their goals more effectively, and to provide a good user experience for the audience. The system worked well during the test period. Although, there were issues since not all cell phones are implemented with support for all these formats. This, of course, is a drawback for the system. Another issue is that the functionality is spread around on the phone. There is no menu where a user can choose between all the

supported formats. The evaluation revealed that in small communities it would be more useful and interesting to present upcoming events and pictures instead of advertisements and contact information. All except one evaluator agreed that such a notice board would be useful in a community.

In “Subtle ice-breaking: encouraging socializing and interaction around a large public display” [8] they are presenting us the public display application called Opinionizer. It is a system that is built and intended to encourage socializing and interaction. The idea is basically that an opinion may be put on the screen, and if someone wants to comment on it they may do so. The purpose of the system is to make it easier to find something to talk about and to initiate conversations. They are interested in seeing how technology can be used to “break the ice”, and ease the awkwardness that might occur when initiating conversations. They first trialed it at a book launch party where several hundred people were mingling around. A honey pot effect was observed. People were gathering around the public display. The honey pot effect was interesting in the way that people had to be there, close to the display, in order to express their thoughts on the public display. There was no way people could anonymously post opinions to it from remote locations. The positive effect of this approach is that it provides a center of focus. They propose that technology-based solutions to support initializations of conversations in social gatherings should be tried in several other contexts like parties, cafes, shops and bars, where people might need help in sparking conversations and developing relationships.

4. SYSTEM DESIGN

Three months were spent on developing the public display application. In this section we will have a high-level look at this process. First, we will have a brief look at the components and technologies we make use of in this system.

4.1. COMPONENTS AND TECHNOLOGIES

Figure 2: Facebook logo

Developers from a wide range of platforms can build applications and easily get access to the data in the Facebook society. In the subject system we will make use of fb4j [16] in which is a Facebook API for Java. This API provides a single interface to the Facebook REST functionality.

Before you can use your Facebook application you have to register an application with your Facebook account, or create a profile dedicated for your application. When this is done you will be granted an application key that has to be used with your application.

The APIs only let you use a subset of the functionality you are offered in the web interface. You are able to perform the most essential functions though. Examples of things can not do include sending and reading messages, adding, requesting and removing friends, write and read from wall, and get captions from pictures. You have to keep this in mind when designing your application.

Figure 3: Google maps logo

Google offers a comprehensive API for maps. This API is tailored for web usage and is not originally intended to be used for other applications. Yahoo's API [14] is similar to Google's, and developers face the same problems when it comes to building applications on platforms other than the web.

In order to use the Google API you have to sign up at Google and apply for an application key. This key is needed to make API requests.

We are making use of the Static Maps [10] part of the Google Maps API. The functionality is limited highly limited compared to the full edition. You are able to retrieve static maps and to find the geographic positions for location addresses. In the case of the subject system we only need to look up geographic positions, so the functionality is sufficient.

Figure 4: flickr logo

Flickr is basically a web page where people can put their photos or images. In Flickr, photos are tagged by category tags. This makes it easy to search for or look up images relevant to a certain keyword or a group of keywords. Lately Flickr also opened for geographic location of pictures, so that you can retrieve pictures taken in a particular area.

To use the Flickr API you need an application key that is obtainable by registering for free.

We make use of the flickrj API [17] for this system. The Flickr API lets you use most of the functionality from the web page. However, the subject system is only making use of the keyword search function.

Figure 5: Bluetooth logo

Most cell phones nowadays come with support for Bluetooth. Bluetooth is used for short-range wireless communication between cell phones or other devices. The plus of using Bluetooth is that the connectivity is free of cost.

To get started you have to download an API. We chose to make use Bluecove's API [13]. This API supports the J2ME JSR-82 implementation.

In the subject system we want to use Bluetooth solely for the purpose of identification. Bluetooth is a prominent candidate for this since every Bluetooth device has their own unique ID. The devices have to be in visible-mode in order to be discovered.

The technologies and components mentioned above do all support Java through APIs and therefore fit well together.

4.2. Functional Requirements

- The user must be able to associate their Bluetooth enabled cell phone with the system.
- The system must recognize already registered users and associate them with their respective Facebook profile.
- The system must be able to pick users' geographical locations and mark them on a map.
- The system must be able to retrieve and show tagged pictures from Facebook profiles.
- User profiles on Facebook have fields for interests and activities, and the system must be able to look up and present pictures relevant to these fields.

4.3. Quality requirements

In order to get people to use the system we will have to work in a certain level of quality. In this section we will go through the most important aspects.

We want the system to be as appealing as possible for potential prospective users. To realize this we must aim for a solution where:

- The user does not have to install any software on their cell phone. The threshold for starting to use an application elevates rapidly if the user has to install a dedicated client.
- There is required little or no technical insight.
- The registration can be completed in few steps.

5. DESIGN PROCESS

In this section we will go through the functional requirements and elaborate a design that complies with the quality requirements.

5.1. User registering

There are a several different approaches on how the registration of new users may be carried out. We will go through a few different alternatives, and discuss pros and cons for each of them.

1. User friends the system. First, the user sends a friend request to the system. Next, the user shows up in front of the display with her Bluetooth-enabled cell phone. The system detects the cell phone and sees that it is not registered, so the system lists all recently received friend requests. Now the user has to select her profile from the list. The selection is done through the use of some kind of interaction method such as for example a keyboard or touch screen. When this is done, the user's cell phone and Facebook profile are associated, and the user is ready to use the system.

   This method works well if there is only one unregistered user in front of the system at a time. If there are more unregistered users we would need a mechanism that lets the users to distinguish between different devices. We believe that the Bluetooth addresses somehow might be used to determine the manufacturer of the phone. However, we have not been able to find any information about this. Note that this method also requires some form of interaction.

2. Facebook profile ID in Bluetooth friendly name. This method takes fewer steps to register than the former one, but it demand higher knowledge about how to use the cell phone. All the user has to do is to look up her Facebook profile ID, and put the ID in their Bluetooth friendly-name prefixed by a tag. If the system finds a Bluetooth ID that it has not already associated with a Facebook ID, it will scan the friendly-name of the device and look for a Facebook ID. When the system recognizes such an ID, the

respective Bluetooth address automatically will be associated with this Facebook profile.

For a person into computers and technology this is a method that probably would work well. It takes little effort to get the phone registered in the system. However, for people that is not that familiar with their cell phones, this method of registration is likely to be troublesome. Another issue is that not all cell phones let the user define a friendly name. These users would not be able to register their cell phone.

3. Using a (Faraday Cage) box for registration of new devices. In this method we will need two Bluetooth dongles for the system. One for detection of already registered users; and one for people that want to associate their cell phone with the system. The one dedicated for registration will be placed inside an EMP shielded box following the principle of a Faraday cage. This box should be small in size, and be placed right next to the big display. When the user puts their cell phone into this box the system will register the user and send a Bluetooth message with a token to the cell phone. Next, the user goes to the computer and requests to be friends with the system. Along with the request the user passes the token that was given in front of the screen. Now the cell phone and the Facebook profile are associated.

   Ideally this method would work well. We spent some time on building a prototype of the Faraday cage, but we weren't able to shield the signals sufficiently. However, if this is done properly, we would be able to perfectly shield the signals. Another possibility is to use a threshold value for the signal strength to distinguish between a device inside and outside the box.

4. Screen displays unregistered Bluetooth IDs. Another approach is to display unregistered Bluetooth IDs on the screen. In addition to the IDs we can see how long each of them has been active. This makes it possible to distinguish between different Bluetooth IDs, and makes it easy for the prospective users to find their ID. Close to the system there will be paper sheets with instructions and a field where they can fill in their address. The next phase of the association happens in front of the computer.

The user has to log into their Facebook account. Next, they look up the system's Facebook profile, and requests to be friends with it. The users also send their Bluetooth ID to this profile, so that the system can make the association.

Instructions are important to make sure the users go through all the steps.

We did not want to use solution #1 since it requires us to implement some form of interaction, and therefore makes the system more complex. Solution #2 would probably have been the best choice if it was possible to set the Bluetooth friendly name on all cell phones. Unfortunately this is not possible on all cell phones; hence we can not make use of this solution. Solution #3 is also a prominent candidate. Due to limited time for implementation this solution falls out. It would be interesting to see this solution, or something similar implemented later on. In the implementation we decided on solution #4 because it supports several users at a time, does not require interaction with the screen, and also fit the time frame of the implementation.

5.2. How did we decide on what to build?

During the design period we tried several different designs.

Our first design was capable of showing relationships between the people standing in front of the screen. So, if there were three people standing in front of the screen their profile pictures were drawn, and in between these pictures there were drawn lines if the persons were friends on Facebook. We figured that this design would not be interesting in the long run, and decided to look for other uses.

Our second design is closer to the final design. The big display is constituted by four smaller displays. In this design we had different applications on each display. The applications made use of the tagged pictures from Facebook, was showing images that related to interests from Facebook, and also allowed unregistered users to see their Bluetooth id on the big display.

We decided to run a trial run at this time. A group of approximately 15 people including PhD students and faculty from different departments took part in the trial. The trial run was carried out on the public display that the system was to be deployed on at a later time. The trial run resulted in valuable feedback. The second design had all the functionality we wanted. The participants in the trial run also agreed to this. Most of the feedback regarded the visualization part. The fact that each display showed different content on each screen made it look like four separate applications instead of one application running on the whole display. The participants wanted the system to look less divided, and to merge the functionality somehow. The feedback was taken seriously and appropriate changes to the system were carried out.

The third and final design let all the functionality make use of all the four displays at the same time. Content were shown across several displays. A few of the participants were presented the final design before deployment and they liked the result. In the following section we will see what the system was capable of.

5.3. Functionality

The following sections describe the functions we decided to include in our system.

5.3.1. Keeping track on users present in front of the system

The system needs to keep track on users in front of the system to know what profiles to show. Each registered Bluetooth device will be associated with a Facebook profile in a database.

5.3.2. Marking users on the map

A Facebook profile has fields for both a person's hometown and current address. We will make use of Google maps to convert postal addresses into geographical positions. A user's geographical positions will be saved to a database for quick lookup later. Markings for active users must differ from inactive ones. Inactive users will be marked for a period of time, and eventually fade away.

5.3.3. Slideshow of user pictures

A registered user is associated with her Facebook profile. A profile is linked to pictures through Facebook's tagging system. And the Facebook API lets us retrieve a list of pictures for a particular user. It is also possible to retrieve tag data for tagged pictures. The tagging data tells us where in the picture the person is located. We can use this information to focus on or highlight the person. The pictures may be presented in a smooth fashion; either by zooming in on them, or by gradually fading in and out.

To give people an impression on how old pictures are we can use different grayness levels. The older the picture is, the less color.

5.3.4. Looking up and presenting relevant pictures to a keyword

We will make use of flickr to look up images relevant to information from profiles. This information might for example be taken from the activities and interests fields in a profile. The pictures will be presented in a slideshow fashion. There will be a pool of pre-fetched images, and images for different keywords will be picked randomly and displayed. When a picture is shown the keyword will be printed as well. This makes clear what the picture is supposed to illustrate.

6. THE PUBLIC-DISPLAY FACEBOOK SYSTEM

This chapter describes the prototype system that was subject for the evaluation in chapter 7. We will go through the main features of the system.

6.1. Client

The clients for this system are represented through discoverable Bluetooth devices. The client side does not require any software at all. To begin using the system, the user has to register and associate their Bluetooth device and Facebook profile. When this is done the user can choose to be either active or inactive. The user is active when the Bluetooth is activated and within range of the system. If the Bluetooth device is deactivated or out of range, then the user will be inactive.

6.2. Server

The server side contains all the logic of the system. The server is represented through the application that runs on the public display and the database. The application is fully implemented in Java. The users will see the system in two different states. The first is when the user is not registered with the system. In this case the registration module handles the user. The other state takes care of registered users and features pinpointing of users on a map, showing Facebook pictures, and looking up relevant pictures on flickr. We will go through all these features in the following.

6.2.1. Registration

Figure 6: Unregistered device

The user must associate her Facebook account with her Bluetooth device before she can start to use the system. The registration is done in a few steps. First, the user has to activate the Bluetooth on her device, and then hold on for a few seconds until their Bluetooth ID shows up on the screen. Right next to the Bluetooth ID a timer and the friendly name of the device will be displayed to make the identification easier. The user will have to note down the Bluetooth ID for later use. The system is represented through a profile on Facebook. The user needs to look up this profile and become friends with the system. The user also passes along their Bluetooth ID to the system so that the user's Facebook profile and Bluetooth device can be associated. After this is done the user is registered and ready to use the system.

6.2.2. Marking of users on map

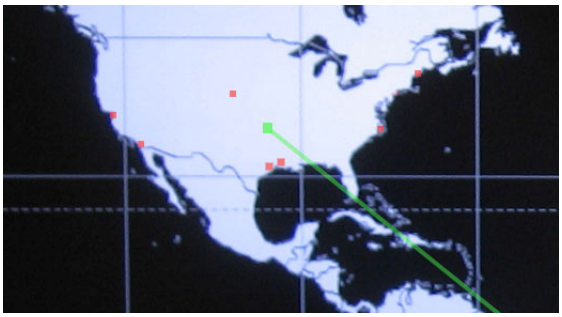

Figure 7: Marking of users on World map

All registered users are marked on the map. If a user has not set their hometown address on Facebook, then the location of the system will be used as default. The system differentiates between active and inactive users. Active users have a green mark and inactive ones have a red mark. The marks do not directly reveal the identity of the users. This function is meant to give an impression of where people come from around the world, and it is more exciting the more people are scattered around.

6.2.3. Tagged Facebook pictures

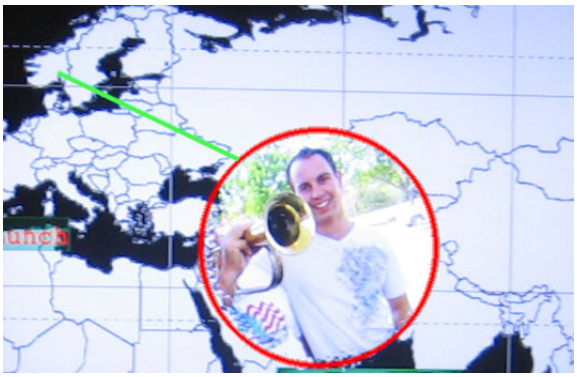

Figure 8: Tagged Facebook pictures

This function only applies to active users that have tagged pictures of them on their Facebook profile. During a user session pictures from Facebook are shown continuously. Pictures are picked from the profile in a random order, and they are presented one by one. Pictures start off as small and grow in size. They originate at the user's hometown on the world map in the background. As they increase in size they also rotate, and drift away from the hometown location. A green line is drawn between the user's hometown location on the map and the picture, so that it is easier to keep track on where the person in the picture comes from.

If users have private pictures of a character in which is not suitable for such a public screen they are recommended to change the privacy settings so that they are not accessible to the system.

6.2.4. Image lookup on flickr

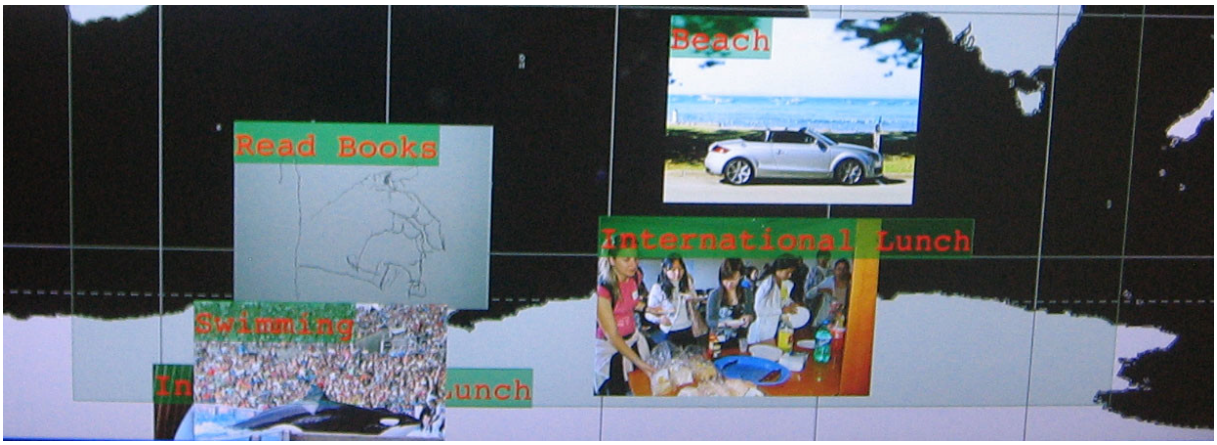

Figure 9: Image lookup on flickr

Most users keep information about their interests and activities on their Facebook profile. This function picks out keywords from these fields, looks up related pictures on flickr, and displays them along with the respective keywords on the screen. The more active users who are present in front of the screen the more of these pictures are shown. All active users' keywords are collected in a pool of keywords. When a user goes inactive their keywords in the active pool are moved into the passive pool. If there are no more pictures in the active pool, then the function picks keywords from the pool of passive keywords. In addition to the passive keywords the system administrator may add keywords that are relevant for the environment or community.

7. EVALUATION

As earlier stated the concept is about extending the online social community Facebook into the real world. We believe that this might enhance the real world social experience in the area where the display is placed. The evaluation will help us in determining if the concept is successful or not. We will log all activity on the system to get some numbers on how much the system is being used. Observations and interviews will in a higher degree help us in understanding if the concept is working or not. We want to see if conversations in front of the screen are sparked by the screen, and what the topics of the conversations are. If the system is successful, then we expect the system to spark informal conversations about people's private lives and lead people to get to know each other better.

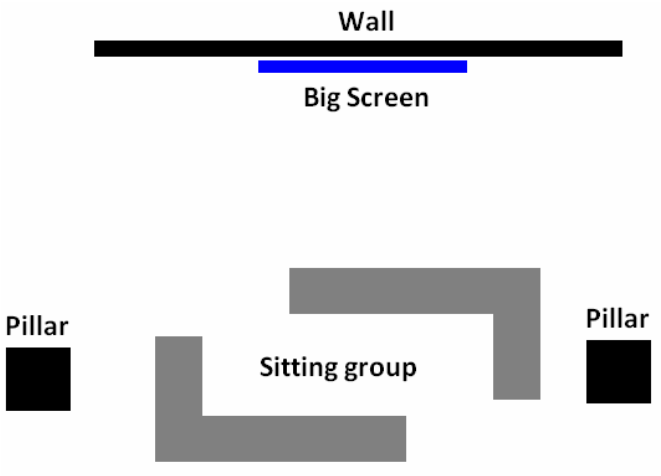

Figure 10: Hall Layout on Third Floor, CSE Building, UCSD

A test run of the system took place in the hall on the third floor in the computer science building at the University of California, San Diego. Since there were other people working on projects using the big display in the same period we were assigned a period of four hours a day from 11am until 3pm. The evaluation run lasted for one week. We would have liked the test period be longer. However, due to hardware problems (One out of the four screens were not working properly and were taken away for repairing, as shown in Figure 11), it seemed to be better to stop the test run rather than to continue. One week's run of the system gives us the initial response from the users. Even though the run lasted for only one week we managed to get valuable feedback on people's perception of the system.

Figure 11: Display out of order

Figure 10 shows us a sketch of the area the screen is situated in. Right in front of the big screen there are two couches. The closest one is about 10 feet away from the screen. The screen is mounted on a thin free-standing wall, and behind it there are restrooms. Figure 12 shows the promotional posters that were put on the pillars and on the wall beside the big screen. When people exit the elevator on third floor they face right on the big display.

Figure 12: Poster

A total of 26 persons registered and used the system during the test period.

7.1. Log data

7.1.1. Method

During the test period user activity and how a user changes their Facebook profile were logged to a database. For every user session there is a log entry. Parameters that have been subject to logging are:

- User login time. What time on the day took the session took place.
- Session lengths. Session lengths indicate if the users stop by in front of the system, or if they are just passing by. This gives us an impression of how popular the system is.
- Number of tagged pictures accessible to the system. A reduction in the number of accessible pictures to the system may indicate that the user has changed their privacy settings. Can it be related to the public display?

- Interest and Activity fields. Has the user changed their interests? May it be because of the public screen system?

In addition, we have logged activity for unregistered Bluetooth devices.

By making graphs out of these parameters we will get an impression of the tendencies.

7.1.2. Results

The diagrams in this section are created based on the log data during the test period. Some of the results are presented as text.

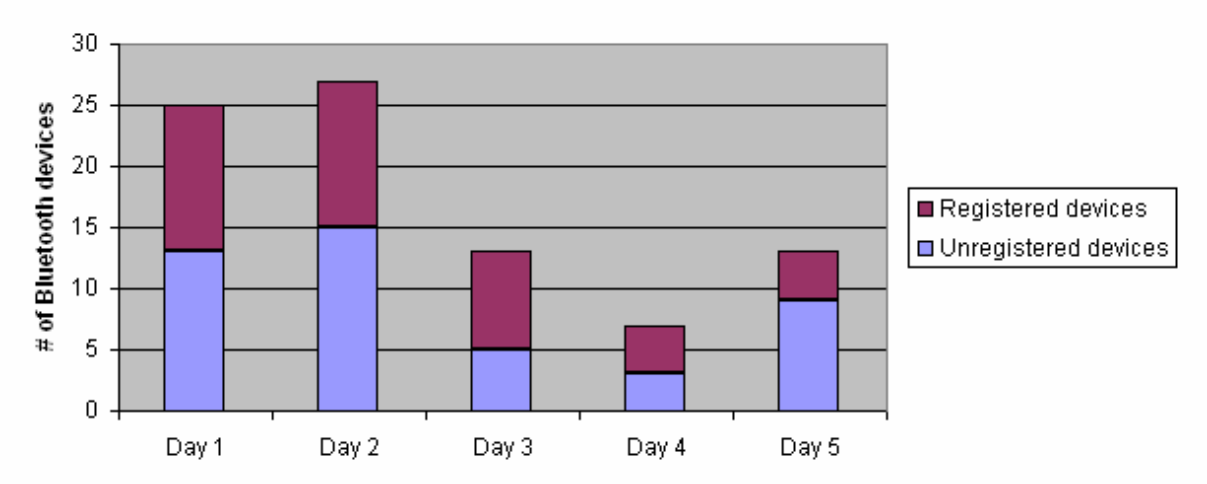

Figure 13: Daily activity

Figure 13 and Figure 15 show the total number of registered and unregistered devices that are active during the given time periods.

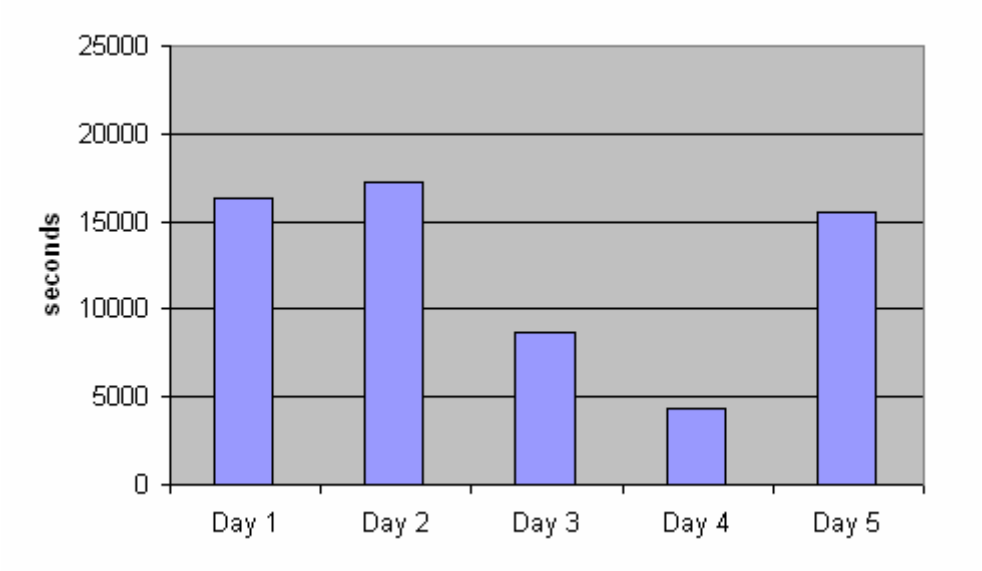

Figure 14: Number of activity seconds per day

Figure 14 and Figure 16 uses the notion activity seconds. For example, if two users are active for 15 and 20 seconds, then the number of activity seconds would be 35, regardless if they are overlapping or not.

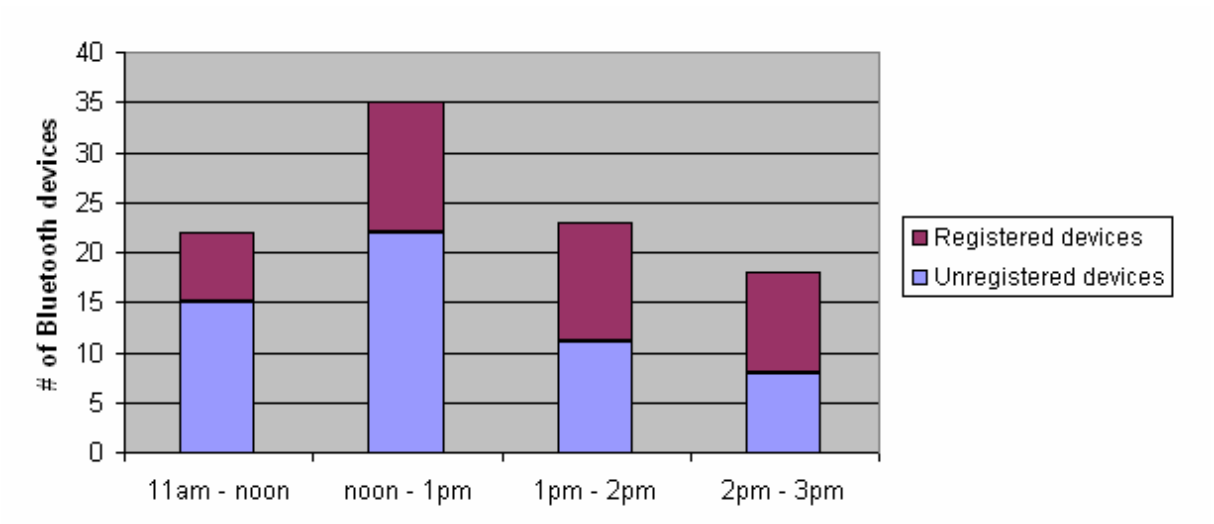

Figure 15: Hourly activity

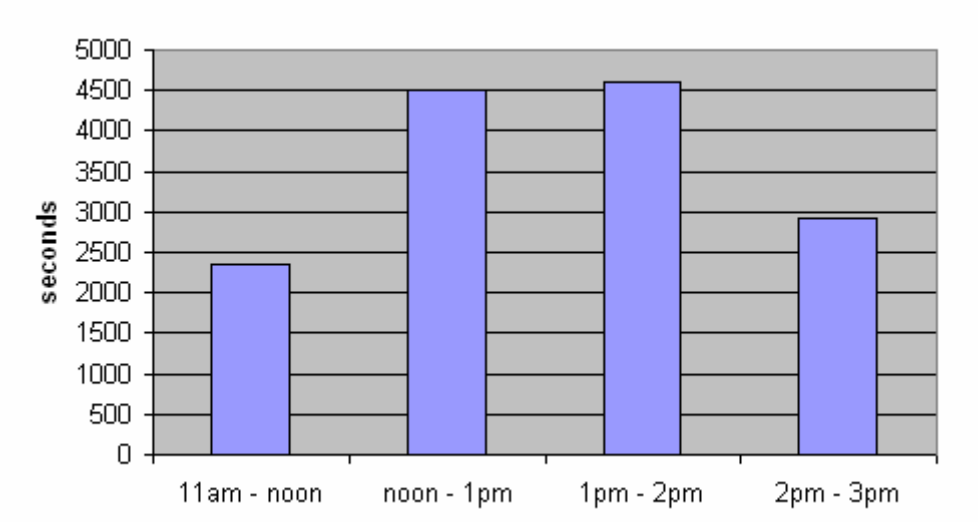

Figure 16: Average number of activity seconds per hour

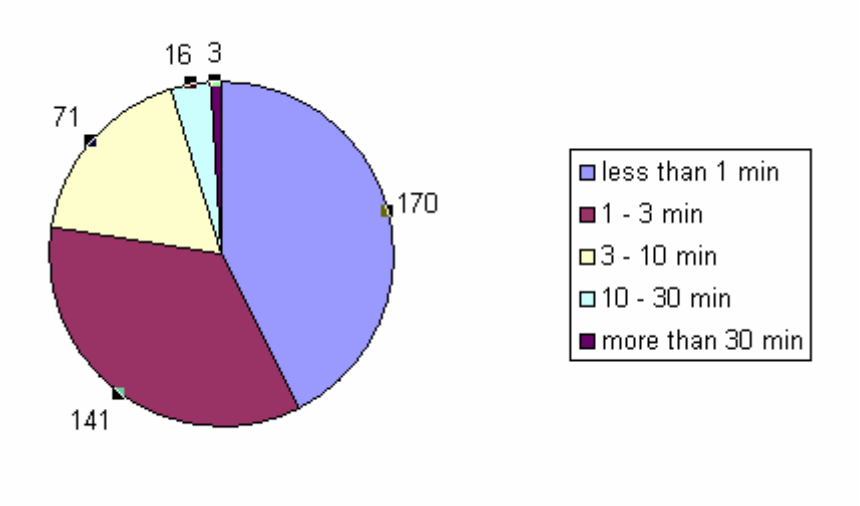

Figure 17: Sector diagram of session lengths

Figure 17 and Figure 18 were based on a total of 402 sessions. A session starts when the user's Bluetooth device is detectable by the system, and ends when the device is undetectable.

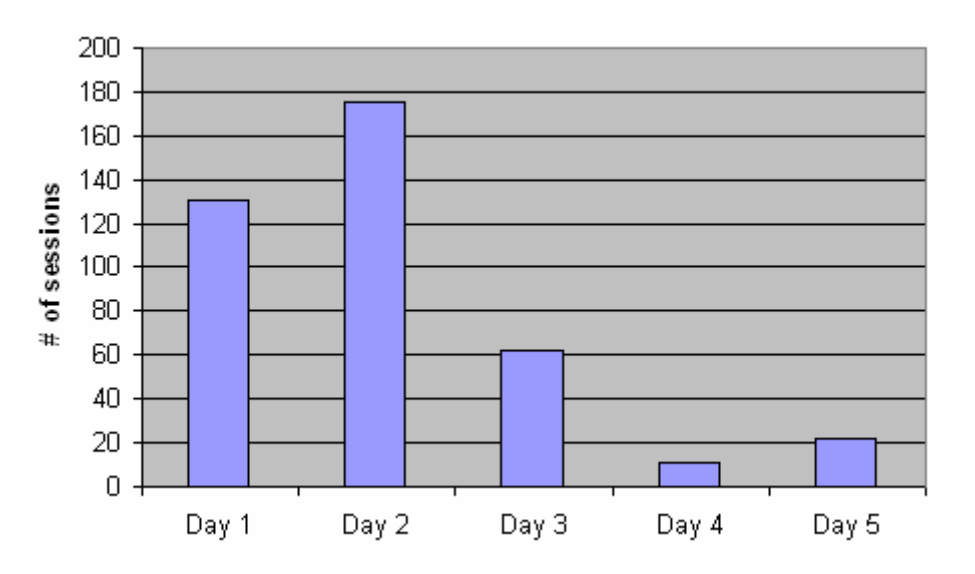

Figure 18: Diagram of the daily number of sessions

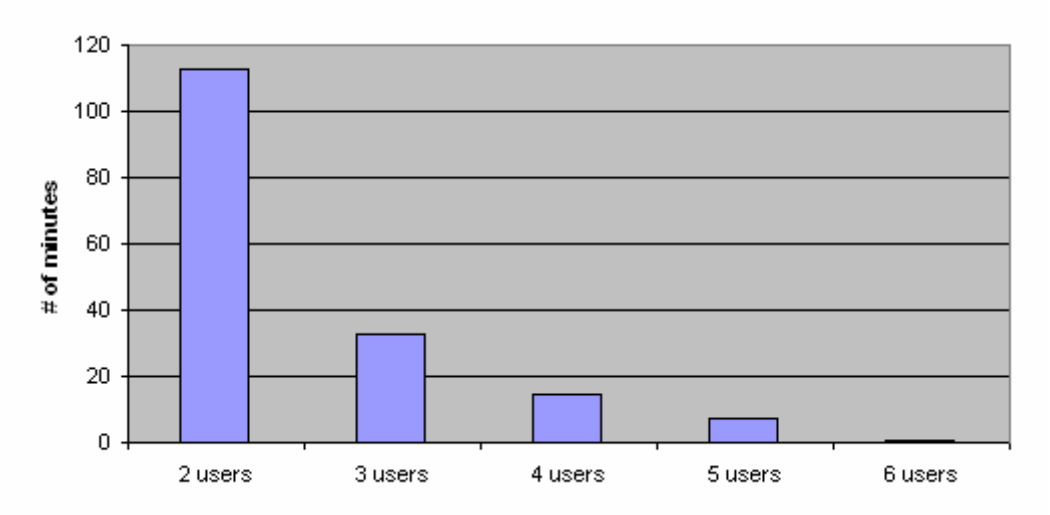

Figure 19: Diagram of total minutes for different numbers of users

Figure 19 shows us the number of minutes the system has been serving two or more users simultaneously. For 8 hours and 50 minutes of the time, there was only one user using the system. The total time the system has been serving one or more users is 11 hours and 20 minutes. The total time the system has been up and running is 18 hours. This means that the system has been utilized for about 64.8 per cent of the time.

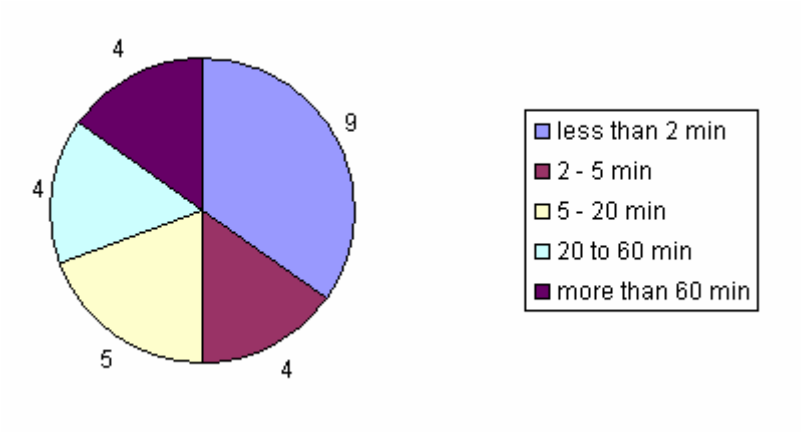

Figure 20: Diagram showing the total time of activity

The top user was in front of the display for 10 hours and 40 minutes. The second and third most active users spent 3 hours and 27 minutes and 3 hours and 23 minutes, in front of the display. There were four users from the faculty represented and all these users' registered Bluetooth devices were each detected for less than five minutes in total during the test period. All the other users were students.

The users did not reduce the number of accessible pictures during the test period. They did not change their interests or activities either.

7.1.3. Discussion

On day one people were invited to come and test the system. People from all over the department showed up. Many of these people were curious about the system and wanted see what it was about. This resulted in many people signing up. Many of the users who signed up did not know what the system was about and if it was something they would like to use. The impact of inviting people to come and try the system is that the activity level gets artificial high. Normally the activity level would not be that high. The positive effect of making people show up is that at least some of them will like the system, and continue using it. Since the test was going to last for a short period of time it was important to recruit people to use it early on in the period.

From Figure 15 and Figure 16 we can see the hourly activity. There is most activity between noon and 2pm. One reason might be that people are leaving and coming back from lunch, and stops for a session as they walk by.

Figure 20 shows the per user intensity in a sector diagram. It is clear that the activity levels differ from user to user. Half of the users were using the system more than 5 minutes during the test period.

Figure 17 gives us an impression of how much time people spend in front of the screen. It is apparent that most of the sessions are short. 170 of the sessions were less than a minute. These sessions might include users who just are passing by, or users using cell phones where the Bluetooth is timing out after a short period of time. It might also be users who just wanted to have a glimpse of what was going on on the screen. The majority of the sessions, however, lasted for more than a minute. In this case the users probably stopped by in front of the display.

The fact that there have been one or more active users for 64.8 per cent of the run-time of the system shows there was a certain interest for the system.

7.2. Observing users

7.2.1. Method

Throughout the test period we observed how people acted in front of the system. There was a couch nearby the system where it was easy to spot the activity in front of the display. We paid attention to people's behavior, how they moved in front of the public screen, saw if they are talking about the screen in general, and if they initiated conversations based on the content on the screen. This activity was mostly passive.

7.2.2. Results

During the test period about 80 per cent of all activity in front of the screen was observed. We will go through the main observations.

Before the system was launched a group of ten persons was already registered. These persons participated in the trial run. When the system was officially launched there was sent an e-mail to the building's mailing list to make people aware of the new system that was deployed. A total of nine new users signed up on the first day. The following two days four and three users signed up, respectively. So, after day three, a total of 26 users were registered.

The system was idle for about one third of the time. When people showed up they were usually on their own, or in groups of two or three persons. The time they spent in front of the screen varied. It ranged from less than a minute and up to over half an hour. The students seemed to be more active than the faculty.

Figure 21: People standing in front of screen

Figure 22: People sitting in front of screen

Sometimes people stood in front of the screen, and other times they had a seat in the couch. For long sessions people tended to sit in the couch. However, there were a few long sessions where people stood in front of the screen as well. The users were more active when they stood in front of and close to the screen. They pointed and gesticulated at the pictures as they commented on them. They also were more active when it came to keyword pictures.

In most cases when there were detectable registered Bluetooth devices present, people's attention was attracted by the screen. People talked about the content on the screen. The conversations usually started with someone asking about a picture. Then the owner of the pictures went on and told about the context, and the conversation was going. Sometimes people just laughed at or made fun out of pictures.

During the observations people commented on each other's pictures. Here are a few examples:

- "What are you wearing there?"

- “Where was that picture taken?”
- “I like your sweater!”
- “Look! Pat is well centered.”
- “That is funky.”
- “I didn’t know that you were a singer!”
- “That’s me!”
- “Is that you on last Christmas?”
- “You have to take me out for surfing someday soon!”

People also commented on the interest and activity pictures:

- “Who of you are cycling?”
- “Look! That’s what I do!”
- “Well, that picture doesn’t relate to running --- ahh, yeah, now I see how it relates!”
- “That kid knows how to do yoga!”
- “Tai Chi, what has that to do with that?” (the Flickr picture was not matching too well.)

There were also comments on the system:

- “This system looks awesome”, the electrician.
- “What determines where the pictures are put?”, student.
- “Will my pictures still pop up after I have left?”, student.
- “I really like the visualization!”, staff
- “Why aren’t my pictures showing up?”, student

On Facebook one of the users expressed their thoughts about the system. In the status field the person said that he “is saddened [sic] by the display wall - it has so many pictures of good times past, and people who aren't here right now.”

7.2.3. Discussion

Now let us discuss the observations. It seems clear that the users in general appreciated the system. We want to see if our observations support the purpose of the system, namely if the users get to know each other better.

From the observations it seemed clear that the students were more active than the faculty. Based on personal experiences we believe that students in general are more active on Facebook and that they keep their Facebook profile up to date in a higher degree. Due to this I think the students would find it more amusing to use the system.

The activity level was lower for people sitting in the couch compared to those who stood in front of the screen. One reason for this might be that the distance between the closest couch and the screen was about three yards. It was hard to read the text from that distance, and it also seemed hard to identify what the couch sitters commented on for the others.

The way people commented on each others' pictures appeared natural. People commented more frequently on each others' pictures when they stood in front of the screen. Commenting on pictures in front on the big display and on Facebook in front of the computer is two different activities. Text comments might be stored and retrieved for a long period of time while spoken comments generally are ephemeral.

People also commented on the pictures that reflected their interests. Most of the comments were about how well the pictures matched the interests. However, there were also comments that initiated conversations around the interests. It seemed like it was harder to start conversations about interests. One of the reasons for this might be that you did not know who had the different interests. And, if there were other people present with the same interests as you, there was no way you could tell if the interests belonged to you or someone else. It was only if the interests differed from your own interests that you could tell that they were someone else's. To somehow reveal the identity of who have the different interests might make it easier for people to talk about them, though this will reduce the level of privacy.

In the cases where there was only one registered user with their Bluetooth device in front of the system there were often several unregistered or inactive users (registered users with their Bluetooth device either out of range or turned off) present at the same time. So, pictures of one person showed up all the time while the others just watched.

There were often people in front of the screen who were either users in which had Bluetooth turned off or unregistered persons. These people still observed what happened on the screen. There may be several reasons why they did not use the system. One reason may be that they did not have that many pictures on Facebook. Another reason may be than people were different; the need for self-exposure is individual. Some people did not see any reason in exposing themselves on the screen even though they enjoyed watching others on the screen.

7.3. Interviews

7.3.1. Method

Two days after the end of the test period, interviews were carried out. The interview was intended to give us an impression on how the users conceived the system, how they used it, and if they used it the way we intended it to be used. The interview was informal and open ended.

7.3.2. Results

A total of six users participated in the interviews. Five of them were around 25 years old, and the sixth was in their fifties. Four of the interviewees were male, and two were female. How long the users had been users of Facebook varied, and ranged from a couple of days and up to almost five years. One of the users actually signed up with Facebook solely for the purpose of being able to use the system. The activity levels of the users differed; most of them used Facebook on a daily or weekly basis though. The users said that their main reasons for using Facebook were to keep in touch with, interact with, and reconnect with, and watch pictures of friends. They also appreciated the built-in event functionality of Facebook. All of the users had pictures of themselves on their profile. The users in general

did not think of their Facebook profile as private, though they did not necessarily want everyone to see the content. Most of them only let friends access the content on their profile. Five of them usually did not mind sharing their Facebook profile and photos as long as they were not taken out of context. One of them was reluctant to share too widely due to possible information consequences.

Five of the six interviewees signed up for the system on day one, and one on day two of the test period. All of them thought the system worked well technically. They were mainly in front of the system together with co-students or colleagues. Sometimes they were sitting in the couch, but for the most of the time they stood directly in front of the display. They said it was easier to point out something if they were close to it.

The users said that most of the conversations in front of the display somehow were initiated by some of the content that showed up on the display. The users were asked if they could remember any pictures in particular from the screen. Here are a few of the responses:

- "I saw Tom in a picture with a pretty girl. I know Tom has a girlfriend and that she definitely doesn't look like her. So I said 'who's that?'. It turned out that the pretty girl was his sister".
- "I can remember a bunch of pictures of Alex."
- "My friend's photo shoot popped up over and over again."
- "Oscar's Christmas photos."
- "I've put up some pictures from my wedding on Facebook. Many of my friends and colleagues weren't able to show up. I have had the pictures on Facebook for a while. However, it is different to see them together with someone as you may comment on them at the same time."

Five of six the interviewees learned something new about the people around them that they did not already know. They got to know each other better through both the Facebook pictures and the interests from Facebook accompanied with flickr images. The quotes in the former paragraph represent good examples of people that got to know each other better. One of the users pointed out that it might be more interesting or exciting if you do not know the other people in front of the screen already.

All of them had walked past and just glanced at the screen. Sometimes there were users with their Bluetooth on, and other times the system was idle and only showed interests from recently active users. Some of them stopped by only for a few seconds, and others observed the screen for several minutes.

Five out of six found it easier to find something to converse about when the system was running in the background.

Users in general did not mind if their pictures were shown even if they are not present. One of the interviewees said that whether they were there or not would have no relation to what people were able to see on the display. A few were worried that content might be taken out of context if they were not there though. They thought it was easier to control what were being said or thought about their pictures if they were present.

One of the interviewees kept the Bluetooth on all the time. The user said “I’m sort of attached to the display when I am around”. Another interviewee kept their Bluetooth on for other reasons. Four interviewees were not able to keep their Bluetooth on for a long period due to timeout issues.

None of the users changed their profile for privacy reasons during the test period. Though, three of them said that if the system were to run on a more permanent basis they would change it. They would try and make their profiles more interesting, for example make dedicated albums for the system or updating their profile more frequently.

A couple of the users said that they missed watching photo albums together with people. After the advance of online photo albums people no longer watch pictures together in the same way it was done before. It seems to be more common that people watch each other’s photos on their own, in front of the computer. They missed the stories that might come along with pictures when you were browsing them together with the owner. This system brought the photo albums back into a social setting again. The users had a similar feeling as

if they were browsing photos with someone. If there were an interesting picture from Facebook showing up, the owner sometimes started to tell a story around it.

The users were asked to tell about something negative about the system. Here are the main responses:

- "I think it is a little disjointed because things no longer are in context."
- "I didn't like that parts of the pictures were cut out." (The pictures from Facebook were automatically cropped so that it was easier to spot the tagged persons in the pictures.)
- "There was no interaction. Some sort of interaction might be good."

When the users where asked to mention something positive about the system they said:

- "A unique concept that definitely lightened up the hall."
- "It was interesting to see what pictures were found for interests, even though they weren't always matching too well."
- "I really like the concept! I like that the system shows pictures of the people who are present."
- "The social aspect! –It's like showing each other photo albums. You end up talking about each other's social life instead of computer stuff. This is more appealing than seeing research proposals."
- "It's nice to see what others are interested in."
- "It was well done, it looked cool, and it was a fun social center."
- "It's a good conversation starter!"

On the question about whether they wanted to see more of this kind of a system in the future the response was unanimous - they would like to see this system run in a more public space on campus or a true public space such as for example a train station or a shopping mall.

In the end of the interview the interviewees were asked to come up with suggestions on how to improve the system. Three of them came up with ideas on how to improve it:

- Some sort of interaction.

- Support for videos.
- Support for flickr account in addition to Facebook profile.
- Show small pictures of people instead of red and green dots.
- A Venn diagram that shows user interests and somehow tie users together.

After the interview was done three of the interviewees asked when the system was expected to run on a more permanent basis.

7.3.3. Discussion

Now let us discuss the results from the interview and see if they support the purpose of the system. One of the main purposes of the system was to get people to know each other better. The interviews give us reason to believe that the people had got to know each other better. People discussed the content from Facebook and had a good time together. The observations also support this. The system successfully brought the online community Facebook into the physical world.

The participants found it natural to converse about the photos on the display. They compared it to watching photo albums with a friend. The experience of watching albums with someone was something a couple of the interviewees missed, and something that they wanted to see more of.

Some of the users thought it was hard to identify the other's interests. There was no way to tell if an interest belonged to you or someone else as long as you had that particular interest. The users, and we, believed that it would be easier to talk about interests if they also were tagged with identities somehow.

To further support initiation of conversation we could perform comparisons of Facebook profiles. There are several ways to do this. It can be done through a Venn diagram as one of the interviewees suggested. Another way to do it is to show similarities from the profiles in a random fashion.

8. LESSONS LEARNED

In this section we will go through the main lessons we have learned.

8.1. Augmenting the experience of the content

The experience of watching content is more comprehensive when seeing it with the owner.

The interviews support that the experience of the content from facebook is being augmented on the big display. In a normal setting people access the information when they are alone in front of the computer. In this case the information is presented in a totally different setting, allowing for a different interpretation of the content. Now people might ask questions, and get answers right away. Instead of just getting a one-line caption for a picture the owner might tell you the whole story.

8.2. Enhancing the physical world communities

The physical world communities can be enhanced through technological support.

The results from the observations and interviews show that the technology can be used to enhance a social community. In this case we extend an online social community onto a public display. The display always shows fresh data taken from the online community. The physical world community benefit from this in the sense that the technology serves information that is relevant to the people around the screen, and as a result leads people to converse about the content. This improves the physical world community because it eases the task of getting to know someone.

8.3. Active vs. Passive participation

Not everyone enjoys participating when we go public.

Based on the evaluation it seems like about half of the people in front of the display preferred to just observe it without having information and pictures of them presented on the display. There might be several reasons for people not to participate actively. Reasons for this might be that people do not consider their facebook profile to be exciting enough, that they do not find the pictures appropriate for showing on a public display, or that they do not feel for exposing themselves on the big display.

In “Enticing People to Interact with Large Public Displays in Public Places” [7] they make use of Opinionizer, as mentioned in chapter 3, and present their findings in terms of the patterns and social engagement that took place around the system. The results from the study indicate that a reason people were not actively participating in their system was the embarrassment of going public. The same might apply for the user group subject for the evaluation in this thesis.

8.4. Privacy

People were not as concerned about privacy as expected.

Privacy is an issue when displaying people’s private pictures on a public screen. Showing pictures on a public screen is different from viewing pictures on Facebook in front of the computer. People usually sit alone in front of the computer when they watch the content. Usually your content is protected somehow, so that not everyone has access to it on Facebook. Often only friends are able to watch your content. When showing content on a public screen it is hard to tell who are going to be in front of it. Unless the public screen is situated in a building where there is some sort of access control, the content on the screen is available to anyone.

The public screen investigated in this thesis complies with the description of a public screen in the paragraph above. There is no way to be sure what people can see the content on the screen. However, in the case of this system, it is possible to enforce privacy settings. In the latest version of Facebook users are able to set privacy settings for individual users. As mentioned earlier, this public screen system represents a user on Facebook. Taking this into consideration a user of this public screen system can easily restrict access to certain pictures or content on their profile.

8.5. Available functionality in APIs

A design's ability to bridge the online community and the physical world is possibly limited by the restrictions in APIs.

During the development of the prototype application we encountered several issues regarding API functionality for web pages such as flickr, Facebook, and Google. We planned on including more features in the system. However, the functionality available through the APIs represents only a subset of the functionality available through the actual web pages. Do not take it for granted that a function or feature is supported before having it confirmed.

9. CONCLUSION

In the introduction we presented the concept of building a bridge between online social communities and the physical world, and hypothesis that this might lead people into getting to know each other better. Then we described a system and gave two realistic scenarios. We were not able to find a single paper on a system that present content from an online social community on a public display in this fashion. The system was built using easily available components and technologies after going through a thorough design process. We examined if the concept resulted people in getting to know each other better, and the results support that this system led individuals to learn about each other. We believe there should be conducted more research and investigations on this subject. In the following section we render a few ideas on future usage.

9.1. Future applications

In this thesis we have only tested and evaluated the system at one location – in a computer science department. The results from the evaluation show that the users appreciated to use it, and that it worked well as a conversation starter. However, this concept should be tested in other settings as well, even though a few adjustments might be needed. In public places like train or bus stations there is a great variety of people. The chance of seeing people you have not met before is significant. One of the interviewees in section 7.3.2 also pointed out that meeting new people through this system might be interesting. Common denominators for transport stations are often delay and waiting. People would not mind to get the wait time run faster. Usually people get irritated, and complain about the delays. Now imagine that we deploy this system at such a venue. Pictures of the waiting passengers would pop up on the screen, and people would be entertained through the activity of getting to know each other better…

To finance these systems, targeted advertisements can be put on the screens. We know about people's interests and can display appropriate advertisements accordingly.

It might be interesting to let the users perform some sort of interaction with the system. There are several ways interaction can be carried out. In “Sweep and Point & Shoot: Phonecam-Based Interactions for Large Public Displays” [4] we are presented an interesting concept on how to interact with the system using a cell phone. They describe a technique that lets the user control a cursor on the big screen by using the camera on their cell phone. In [6] we are presented an idea about an ambient display with different levels of interaction, depending on where you are placed in relation to the screen. The interaction was carried out using gestures with your hands and body movement. In their prototype they were using designated tracking sensors to keep track on the body movement. If they are able to find a way to do this without using sensors, this might be an interesting method of interaction.

Based on personal experience I believe that the interaction have to be really simple and intuitive in order to make people to use the system. In the case of this system a touch screen would probably be a neat way to interact with the system on. An alternative to have touch capabilities on the big display would be to have a smaller screen beside, or on a table in front of the system, that is dedicated for control of the system. The layout and control capabilities could dynamically change based on what people are present in front of the screen.

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