Touch and Share: Intuitive Peer Selection

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ABSTRACT
In this paper, we propose intuitive interaction with other people through mobile devices. By toughing RFID tag attached to each device, user can select nearby people in the most natural way, and this physical interaction promotes social connections. We implemented file sharing application and supporting framework to demonstrate the interaction scheme.

Categories and Subject Descriptors
H.5 [**Information Interfaces and presentation**]: User Interfaces – *User-centered Design*

General Terms
Management, Design, Human Factors

Keywords
Mobile Interfaces, RFID, Social Applications, P2P, Identity Management.

1. INTRODUCTION
Peer to peer ad-hoc networking systems allow people can interact with other people in more natural way. Most of information and contents are digitized and are stored on the device nowadays. People with mobile device can exchange their content on the spot, and collect information about the people they met on the go. Without ad-hoc networking, one should have postponed the digitized content sharing and aggregating until he/she gets back to the wired home computer.

When interacting with others, the initial step is "specifying peer" to whom to connect. Current models are divided into two categories, Search and Bookmark. Bluetooth pairing implements search based peer selection. User initiates search to find who is available and choose one of the list. It is most useful to select unknown, first-met peer in the range. The weak points are ambiguity and the lack of scalability. When tenth of devices are found, which should be normal case in pervasive environments, it becomes hard to fit the device lists into the small mobile screens. Moreover, there is no guarantee that each of those devices have distinctive user-friendly names.

On the other hand, bookmark is fast when selecting known peers. Contact application in cell-phone belongs to this category. The benefit is that peer can be referred by more user friendly name, not series of number but the real name. This can be good approach in most cases if properly implemented. Remembering previously connected Access Point list with their current availability check in WIFI connection manager application is a close example. But no known deployed social applications adopted this buddy management scheme so far.

In this paper we propose Touch as more intuitive interaction model in social settings. Touching two mobile devices is a good metaphor to handshaking, a signal to begin relationship. We implemented Touch metaphor using RFID technology.

Figure 1: Handshaking and Touch

In our implementation, mobile device with RFID tag will be the device holder's ID. People always carry their mobile devices. Its collocating characteristic draws the statement – someone can be well identified by his/her device. For example, when I notice the presence of the cell phone of my friend on the table, I can guess he is in near place with good confidence. When I receive a phone call from specific device, I assume the device owner is calling me. Thus, using mobile device as an identification medium is socially acceptable in casual application.

This paper will address the case where people are within the proximity (PAN area) before initial interaction begins. The focus of the work is on the evaluation of efficiency in peer selection.

2. RELATED WORK
RFID research has mostly explored to interact with environment. [1] demonstrates typical application of RFID named 'Physical Browsing'. They built prototypical poster browsing system. Distinctive point of their work is focus on the sensor-equipped passive tag to enable 'pointing at the tag' with infra-red beam.

In the Web community there have been notable attempt to bring the web information to the real world through RFID. [2] They consider real world objects as web pages or web links that people can interact with. RFID tag was good medium and metaphor to realize their vision.

Nokia was the frontier in mass-market deployment. They introduced NFC shell in 2004. They categorized key 3 interaction modes – 'Select', 'Select-and-Launch', and 'Select-Drag-and-Drop'. [3]

All of above focus on the environmental static object, or other digital devices. No much consideration on person to person interaction was given. There was good comparison of mobile interaction methods [4], scanning, pointing, and touching. The user study shows touching is less preferred method in usual case, because people do not want to move to approach to the tagged object. That is true in smart environment for the purpose of controlling CE devices. But when the person to person interaction

is the concern, situation becomes different. People have the gravity to pull each other. It is no wonder that one approaches to the other to begin communication.

Synchronous action is another research stream in device to device pairing. [5] implemented secure device pairing by shaking two devices together. They authenticate each other based on the same accelerometer values. Using physical motion in authentication as well as interaction command is interesting aspect in their work.

SyncTab [6] introduced key-input based device pairing for normal devices. When designated buttons are pressed in two devices at the same time, multicast packets are sent on the network, and each device identifies the proper peer based on time stamps. This scheme best fits in the case when user has the control over two devices. But this assumption may be awkward in person to person interactions.

In fact, the suitability of interaction method highly depends on the scenario, and careful mix of interaction models should be considered rather than one solution.

3. SCENARIOS

The assumption is that people are in the visible area, less than 100m at the most. Exceeding that boundary makes it technically unable for ad-hoc networking. On the other hand, this is a good range for people to move closer to talk to others. In this range, approaching to peer is faster and more natural than SMS or voice call. Common situation we initially considered is people are already in the same spot, and conversations are on going.

The focus of comparison is in the peer selection stage. Afterward, linking to consequent action would be implemented in the same manner in any cases.

3.1 Search

Setting: John, Mike, Kathy sitting around the table. John is about to share new mp3 music with Mike and Kathy.

1. John initiates device search. Any nearby devices using same ad-hoc networking medium are found.
2. John scrolls down to look for Mike, and Kathy. Assuming that Mike and Kathy's devices are user identifiable name. Unless, John has to ask them their device names.
3. Select multiple peers in the list.

Most of current mobile P2P application implements search.

3.2 Bookmark

Setting: John, Mike, Kathy sitting around the table. John is about to share new mp3 music with Mike and Kathy.

1. John launch the address book
2. John scrolls down to look for Mike and Kathy in the list. It assumes Mike and Kathy are already in the list. Unless John has to do initial search to bookmark them.
3. Select multiple peers in the list.

Keyword search can be introduced to reduce the scrolls, but typing is not negligible effort though it can be less boring in user's perspective. Moreover, user interface becomes complicated to support multi-selection combined with search.

The benefit of bookmark over search is that user friendly name can be assigned. Name can be override in the bookmarker's side for better remembrance.

3.3 Proposed - Touch

Setting: John, Mike, Kathy sitting around the table. John is about to share new mp3 music with Mike and Kathy.

1. John enables the RFID reader.
2. John touches Mike's and Kathy's devices in consequent to select them.

The eliminated step is the scroll. In fact, the user's effort is not in the scroll, but more in the user's intensive attention to find the targeted peers.

4. DESIGN & IMPLEMENTATION

Nokia N800 internet tablet and MAEMO SDK was used as a development environment. With WIFI and BT integrated, N800 is good to provide ad-hoc networking. Custom-built sensor board is connected to the internet tablet. In Figure 2, right-side device is equipped with the sensor board through USB. RFID is included in this sensor board.

Figure 2: Right-side device with Sensor Board read the RFID tag on the left-side device

Alternative approaches, search, and bookmark are implemented as well. The comparison will be provided at the end of this paper.

4.1 User Interface

In this prototype, RFID reader is always activated with the application launch. When touching other device, peer name appears on the screen. If the device is unknown or first-met, "unknown peer" appears. User has option to exclude the unknown device from the collaboration member by unselect the combo-box. But possibility of accepting the device is very high, because the user did intentional-touch to the device after facial recognition of the device owner. Multiple touching is possible. Consequent reads are added to the detected peer list until the user presses the next button.

The next dialog asks the group activity. File sharing creates ad-hoc group with the members, and exports its local folder that every member can browse. Once the connection was established,

the unknown peer information is kept locally and appears by name in the next encounter.

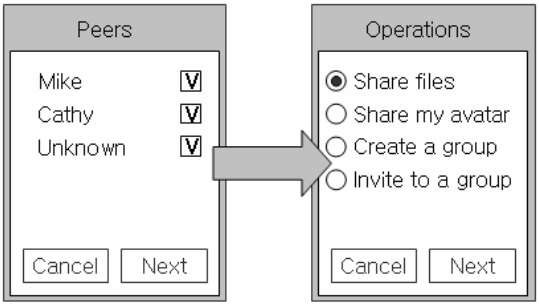

Figure 3: User Interface Design

4.2 System Design

Each device has unique ID which can be retrieved by device search. RFID tag should contain the device ID. Additional information about the device can be retrieved by service invocation once the device ID is obtained.

The walk flow is as follows.

1. RFID tags are read to collect device IDs
2. File sharing operation is selected.
3. Creates ad-hoc group
4. Device does actual scan for the list of devices, and sends group invitation message to them.
5. Exports local folder to the group members

Step 1, 2, and 5 require user inputs. 3 and 4 are hidden steps to the user. Entire system components to implement the walk flow are depicted below.

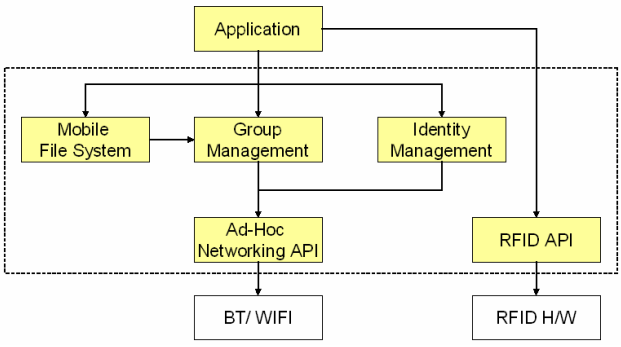

Figure 4: System Components

4.2.1 Identity Management

One device holds two IDs, device ID and User ID. Device ID is the one found by ad-hoc search. We invented user ID concept, because each user has multiple devices. Trust is based on the user, not based on each device. Both device ID and user ID is encoded into URN. We provide tool to generate IDs.

Device ID is advertised through ad-hoc networking layer. Associate user ID and other information such as user name and her location can be retrieved by service invocation.

4.2.2 RFID

Sensor board communicates to the N800 via USB port. NFC chipset used in this system is ARIGON APDA2UA33. RFID APIs are implemented in C under the guideline of 'JSR 257: Contactless Communication API'.

RFID tag should contain the device ID. Device can write the data onto the tag using its own RFID reader.

4.2.3 Ad-Hoc Networking

Ad-hoc Networking module implements 'JSR 259: Ad-hoc networking API' in C language. It works over BT and WIFI. This is the core layer enabling P2P group activities. Group Management and Mobile File System are built on top of it.

4.2.4 Group Shared Storage

Group Management module provides group coordination service, which is in charge of membership management, message relay, and group lifecycle. Once a group is established, participating devices exchange their profiles and each of them are stored as a trusted user. Trusted device can join the group without explicit permission later on.

Mobile File System provides File Server based on WebDAV protocol. Device can export a local folder to the group, then all the group members can browse the shared folder. Figure 5 shows the remote folder browsing screens.

Figure 5: Right-side device is browsing Left-side device's local folder

5. EVALUATION

Alternative approaches are implemented as well for comparison. We summarized the steps involved to achieve the same goal – 'Share the image folder with buddies' in Table 1.

Bookmark eliminated the 'start search' operation, while Touch squeezes all the 3 steps, 'search, find, and select', into one simple 'touch' action. When the list is small, Search and Bookmark performs fine. But as the list size grows, 'find' phase will be the pain. With the growing popularity of WIFI and BT enabled mobile devices, device search will return more and more unrelated peers. If the targeted device is unknown peer, Bookmark gets worse. User has to manually check which unknown device is which from several search returns.

Table 1: Number of User Inputs Comparison

Mode	Search	Bookmark	Touch
Steps to Peer Selection	Launch App	Launch App	Enable RFID
	Start Search	Find	Select
	Find		
	Select	Select	

Another important characteristic of Touch is that user needs not care about the device ID. This results in loose coupling between the user and the specific device. The purpose of touching is sharing file with the person through the device she is currently holding. It does not really matter weather she brings new PDA or her brother's mp3 player. By touching the device, user can achieve the goal without any confusion.

Therefore, Touch is not just efficient but more intuitive peer selection mechanism, especially suitable in person to person interactions.

6. CONCLUSION

In this paper, we described the touch based social interaction as a metaphor to human handshaking. Using RFID tag in person to person interaction was not much explorer until now. It may be due to the fact that attaching tag to human body has high social resistance. However, attaching tag to the device is easily acceptable.

Evaluation shows touching is a promising peer selection method in social applications. Intuitive and efficient interaction model will promote the social connections, and enlarge the opportunities of new application areas.

6.1 Future Works

Enhancement in social connections is on-going task currently we work on. If user rejects a connection request from specific person, device can classify that person with negative factor. This information can be used in managing device holder's social network. If user does repetitive task with someone, device can recommend that application when the peer is identified nearby, and activity (task) information can be input to build more rich social relationship map.

User study in terms of cognitive aspect must be conducted. Bringing tag with the mobile device may streamline the self expressive nature of human. We need to look at how people react, and what additional information people carry on the tag to advertise to the public.

The initial prototype has large sensor board, which makes less convenient when touching or sweeping devices. Sensor board is larger than normal mobile RFID reader, because it contains several environmental and inertia sensors as well as GPS. Dedicated RFID enabled mobile device will be used for more accurate experiment.

Security and privacy is another issue related to the digital ID. We invented home-made, user generated ID for P2P social activities. That does not reveal user's sensitive information, such as bank account or security number. But still there are possibilities of mal-use by hacking the tag content.

7. ACKNOWLEDGEMENT

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