Mobile and Ubiquitous Computing
CS 525M: P2P Micro-Interactions with NFC-Enabled Mobile Phones

Hiromu Enoki

Computer Science Dept.
Worcester Polytechnic Institute (WPI)
Introduction

- **Near-Field Communication**
  - Standardized in Dec. 2003 (ISO/IEC 18092)
  - Combination of three existing technologies
Introduction

● “NFC is a short-range wireless technology to exchange data among various devices with various usages.” - SONY NFC Website
Introduction

- **Frictionless Micro-Interactions**
  - Sharing information with other devices
- Bluetooth? -> Requires pairing
- Wi-Fi ad hoc? -> Requires settings
- IrDA? -> Requires Aiming and Steadiness

- NFC
  - No pre-configuration
  - Transaction in less than a second
Related Work

• Device to Phone Micro-Interaction
  • Reach Out and Touch: Using NFC and 2D Barcodes for Service Discovery and Interaction with Mobile Devices
    • Comparison between NFC and QR codes for posters
  
• Bump application
  • Phone to Phone
  • Computer to Phone

• ...and various other commercial products
  • Rice-cooker? Washing Machine?
Types of Micro-Interactions

- Multi-Party (e.g. Phone to Phone)
  - By touching two phones, user can share files, contact information, and application
  - Can download application on the fly
- Self across interactive devices (e.g. Phone to PC)
  - Borrow keyboard on PC for phone
  - Using password manager on phone
  - Confirmation is not required, possible white-list for security
Types of Micro-Interactions

- Remote Control (e.g. Phone to TV or Car)
  - Displaying a photo on TV
  - Loading music preferences and seat position for a car
  - Phone initiated interaction

From NFC & Smart WORLD 2013 – Kakaku.com Magazine
Methodology - Junction

- Dodson et al. constructed multiple libraries for NFC and a platform Junction

- Junction was inspired by Android’s NFC implementation, using NDEF[1] messages

- Junction allows establishing a session (Wi-Fi, Bluetooth) across devices after a NFC “touch”

[1] - NFC Data Exchange Format
Methodology - Junction

- Junction uses a Interaction Manifest to represent dispatching application
  - One way communication, avoiding request/response
- Contains:
  - Platform Identifier (e.g. Android, iOS, Web)
  - Platform-specific application reference (installed and installable programs)
  - Application arguments
  - (Optional) Device modality for different devices

[1] - NFC Data Exchange Format
Methodology - Junction

- **Context-rich**
  - Application on foreground wishes to use NDEF

- **Context-bare**
  - Application cannot or does not use NDEF

- Two context-rich applications?
  - Exchanges the applications’ Interaction Manifest

- Two context-bare applications?
  - Exchanges handover address and device type
  - Prompts user what to do
Methodology - Handover

- What about phones that does not have NFC?
  - Affix a *passive* NFC/QR tag, and initiate a handover
- After handover, exchanges NDEF messages
Methodology - Handover

- **EasyNFC library for Android**
  - Requires Internet and Bluetooth permissions
  - Simplifies connection between phones using NDEF

- **LegacyNFC service for Android**
  - Listens on Bluetooth for NDEF handover responses
  - Acts like a NFC chip for non-NFC phones
Methodology - Handover

● DesktopNFC service for PCs and TVs
  ● Supports Bluetooth and TCP/IP handovers
  ● Similar to LegacyNFC

● Activity Director
  ● Supporting application for previous libraries
  ● Upon receiving NDEF message
    ● If supporting application is installed, launch it
    ● If not, prompts to install application on Google Play
Results - Applications

- **TapBoard**
  - Can use PC keyboard to input text
  - Uses connection handover to share a URL

- **PocketSlides**
  - Scan NFC/QR tag for a display
  - Phone is a remote control for display
  - Uses connection handover for sharing a URL
Results - Applications

- **Hot Potato**
  - Application that can share files from existing apps
  - Larger files can be transferred with handover
  - Supports “copy and paste” by handing a reference

- **weHold’Em**
  - Uses Junction, JavaScript and HTML
  - Touching phone invites player to game
  - Touching the TV shows the chips and community cards
Future Work

- Security for NFC transactions
  - Eavesdropping, Man-in-the-middle attacks, losing the phone
- More devices with NFC support
  - Train route information, Air conditioners?
- Micro-Payments and Tickets
  - Buying coffee with NFC prepaid card
  - Train ticket, Airline ticket, Hotel check-in, etc....
- User Study???
Conclusion

- Junction allows a simple method for micro-interactions using NFC
- Not only for phones, but for any device with Internet or Bluetooth capabilities
- Libraries allow abstraction of NFC hardware from the application programmer
- Infinite possibilities of applications using NFC technology
Thank You!

- Questions?
References

- FeliCa – About NFC – Definition of NFC, http://www.sony.net/Products/felica/NFC/
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