

NFC Heroes - Observing NFC Adoption through a Mobile Trading Card Game

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ABSTRACT

Near-field Communication (NFC) technology finally starts to proliferate on modern smartphones, enabling researchers to conduct research in the large in the real world. The research question for this work is to learn about the distribution of NFC tags in the wild. As there is, for good and for bad, no central registry or database of NFC tags, we propose a game-based approach to capture the adoption of NFC solutions and technologies.

We report on the development process and the lessons learnt from developing a NFC-based game. We present describe the game logic and implementation, share our experiences from two release cycles on Google's *Play Store* and finally report on initial results and lessons learnt during the whole process.

Author Keywords

mobile games; apps; research in the large; barcode; NFC

INTRODUCTION AND MOTIVATION

The number of products using NFC [6, 8] technology is increasing rapidly. As there is no central registry or database of NFC applications or tags, the goal of our project is to capture the current state of deployment of NFC solutions.

NFC is used in a wide range of applications, from gaming consoles like the upcoming *Wii U* [4] to payment solutions like Google's *Wallet*¹. There is an increasing number of (as of mid of 2012 only) Android smartphones that incorporate NFC readers² and recent versions of the Android SDK provide libraries that provide easy access to the underlying hardware. To learn about the situation 'in the wild', we release our research app to the public via the *Play Store*, disguised as free game, called *NFC Heroes*³.

We describe how we designed an approachable game for Android that makes use of the platform's NFC capabilities and gives users in-game incentives to scan and upload NFC tags.

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Figure 1. The player has selected three spells and fights a randomized opponent.

We will present the process from publishing the game on Google's *Play Store*, how we integrated Facebook as an identity provider, and share the lessons we learned from bringing a research application to a consumer platform to conduct actual studies on human-computer interaction (HCI), e.g. with respect to the number of users for gathering feedback.

RELATED WORK

The idea we follow here to use app stores and markets for UbiComp research has been discussed by Cramer et al. [3].

Gaming systems have been integrating physical or virtual tag readers since the early 90's. As cameras and tag readers are now ubiquitously available in smartphones, developers finally start implementing many of the concepts known from previously dedicated gaming consoles on mobile devices. At the same time, HCI researchers develop games to evaluate new interaction methods made possible by NFC sensors or other sensing technologies, such as accelerometers [5] or capacitive sensors [9], incorporated in pervasive mobile devices.

Barcodes and Visual Codes

In the early 90's, the *Barcode Battler*⁴ handheld devices were released in Japan and later also in Europe and the US. Players

¹<http://www.google.com/wallet>

²<http://www.nfcworld.com/nfc-phones-list/>

³<https://play.google.com/store/apps/details?id=com.heroesgame>

⁴http://en.wikipedia.org/wiki/Barcode_Battler

could swipe special cards with barcodes to unlock items in the game. The first *Barcode Battler* was a stand-alone console, but the *Barcode Battler 2* could also be connected to the NES and SNES gaming consoles⁵.

Nintendo pursued the idea of using real-world, physical cards to influence game events further. In 2001, they released the e-Reader⁶, an accessory to the Gameboy Advance that could read proprietary visual codes.

Recent games do not rely on dedicated hardware to read barcodes, but make use of the camera integrated into modern smartphones. In *Barcode Empire* [2], players can collect real-world product in order to expand their 'Empire'; *Barcode Beasties*⁷ is a fighting game that lets players improve their avatar (beast) by scanning barcodes before they battle against a randomized opponent.

NFC

The Mattel *Hyperscan*⁸ released in 2006 was a gaming console featuring an NFC reader that could read game-specific NFC cards. The cards were sold in separate booster packs, very much like traditional trading cards.

Broll et al. experimented with NFC-based games on public displays [1]. Nokia Research launched a website dedicated to NFC-based games [7]. At the time of this writing, three games are featured. With the *Wii U*, Nintendo will allow mobile games to interface with real-world objects through an NFC reader in the console's controller [4].

CONCEPT

NFC Heroes is a virtual trading card game for Android phones, slightly inspired by the game *Heroes of Might and Magic*⁹. Users can scan NFC tags to unlock more powerful spells or heroes in the game. The spells can then be used to fight against monsters, collect coins, and compete against other players on a leaderboard. The integration with Facebook lets players share their victories and collected cards.

Core Game Design

NFC Heroes is a fast-paced fighting game where a computer-controlled monster competes against a hero controlled by the player (see Fig. 1). The player must choose a hero and can then set three spells from his card deck to be active in the game. There are a variety of different spell types available: Players can optimize their selection of shield, offensive, and healing spells and whenever they unlock a new spell, it might be necessary to adjust the set of active cards in order to make room for the new spell. This cycle of incremental improvements is intended to motivate the user and the tradeoffs between the different spells add tactical depth to the game.

⁵See barcodebattler.co.uk for more information

⁶http://www.nintendo.com/consumer/downloads/ereader_english.pdf

⁷<http://barcodebeasties.com>

⁸http://service.mattel.com/instruction_sheets/k4386-0920.pdf.

⁹http://en.wikipedia.org/wiki/Heroes_of_Might_and_Magic

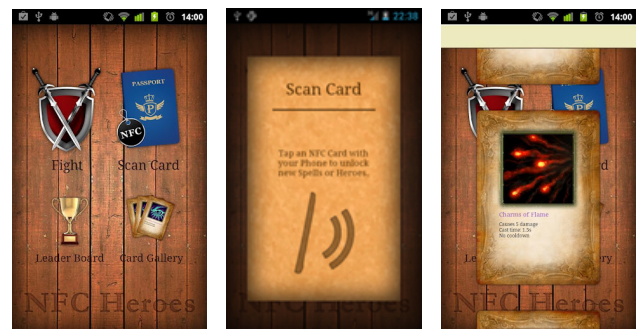
Installation and First Start

To reach a large number of players for our initial studies, the game was made available on Google's *Play Store*. As most users are unaware of the game's purpose as a research project and expect the same level of visual quality than from any other free game offered in the smartphone's application store, particular attention was given to the design of promotion graphics and in-game screenshots.

When users first start the game, they are asked for a name or alias to appear on the game's leaderboard. They can now start playing with an account tied to their smartphone. Alternatively, they may choose to link their game progress to a Facebook account and will then be able to continue playing on other devices. The two authentication methods were chosen to pose the lowest possible barrier of entry. In neither of the methods are users required to enter account information or passwords. When they choose to start playing without Facebook, a unique ID is stored on the device and will subsequently be used for authentication. When they authenticate through Facebook, the authentication steps are delegated to the *Facebook for Android* application. A local account can be upgraded to a linked account at any later point.

Using NFC to unlock new Spells and Heroes

After logging in, the users can start fighting monsters, climb up the leaderboard, and share their progress on Facebook. Ultimately however, they will want to use their NFC-enabled phone and scan NFC tags which will reward them with more powerful spells, and rarely an additional hero.



(a) Main activity (b) Scanning the card (c) Receiving a bonus

Figure 2. The user selected 'scan card' from the main activity, scans the card, and received three spells and fights a randomized opponent.

Once users touch an NFC tag with their smartphone, the tag's unique ID, manufacturer, and standard compliance is uploaded to the *NFC Heroes* server and added to the user's tag collection (see Fig. 2(a) for an example). The ID is used as a seed for the random card generator algorithm. The algorithm tries to generate more powerful cards for rare NFC tags in order to incentivize users to look for tags even in unlikely locations.

Back on the phone, the generated card is shown to the users who can now optionally upload a photo and description of the tag they just scanned. Finally, they are offered to share the new addition to their card deck with friends on Facebook.

In case they did not link their account with Facebook yet, they can choose to do so now.

Progress and Leaderboard

Games that aim to provide long-term motivation to players must provide ways for player to progress in the game [10]. *NFC Heroes* provides two ways how player can measure their progress: first, they can collect more powerful spells and heroes, similar to a role playing game.

Second, we added a more immediate and visible progress indicator: For every defeated monster, a player will be awarded a number of coins proportional to the strength of the opponent. At the same time, the more coins a player collects, the harder the randomly generated opponents will become. A player's amount of earned coins can be shared with friends on Facebook and is shown on an in-game leaderboard.

IMPLEMENTATION AND TECHNOLOGIES

As NFC is the focus of our research, Android was the only viable mobile platform for our game. For the implementation of the web server, we used a setup consisting of Node.js¹⁰ for our application logic and MongoDB as a non-relational database.

Android Client

NFC Heroes supports Android Devices running on Android 2.3 or higher and thus more than 76.6% of all devices that were active in July 2012¹¹. All Android phones with NFC support (Android version 2.3 or higher) and are thus supported by our game.

The Facebook SDK¹² was used to facilitate the integration of social features and the use of Facebook as an identity provider. We further used Google Analytics to gather information beyond our server logs and the data that is available from Google's *Play Store*.

Server

The *NFC Heroes* server was written in JavaScript using the Node.js platform. All communication between client and server is secured by TLS encryption. Node.js is a rather young technology, but it is easy to learn and allowed us to develop the server component in very little time. Its event-based IO system is particularly suited for real-time application like games and allows developers to handle HTTP requests, as well as socket-based communication in the same process.

Data about scanned tags and user progress is stored in a MongoDB database. Just as Node.js, MongoDB was chosen because of its ease of use and short development cycles. There further exist good support libraries for using MongoDB from Node.js and an active developer community provides documentation and example code.

¹⁰<http://nodejs.org>

¹¹<http://developer.android.com/resources/dashboard/platform-versions.html>

¹²<https://github.com/facebook/facebook-android-sdk>

LESSONS LEARNED

We take some key learning about the release of this research projects on Google's *Play Store* with us.

App Stores make short development cycles possible

We learned that Google's *Play Store* allows researchers to release applications in an early state and take feedback from actual users into account.

We split the development phase of 9 weeks into two iterations. A preview version was released after only five weeks, so that we could already take first user feedback into account while implementing the remaining features and apply an iterative user-centered development process.

An early release can give guidance in the design process, but may cause mediocre first reviews

In our case, the preview version consisted of just the features identified by us as key features for playing the game, so that we could evaluate feedback relating to the core game mechanics. In the preview, the player started out with a fixed set of three spells and two predefined heroes. Neither Facebook integration, nor the leaderboard where players can compare their progress was implemented in this version. We were curious how many players would actually download what we announced as 'Gameplay Preview' and how the initial reviews on the store would be.

The preview version attracted a fair number of users with 80 users downloading it during the first week. Some of those were attracted by a post we did in a popular web forum on Android, some were users that stumbled upon the game while browsing the store, and a small number were hand-picked testers that we contacted via email.

However, the reactions on this preview were mediocre. Some users really liked the idea, giving it 5 out of 5 stars, another user liked the idea, but gave it only 3 stars because of the missing features, and yet others seemed almost offended by the early release, rating it with the minimum number of one star. Our takeaways here are that the store can be used to distribute preview versions of the application and store ratings will provide researchers with honest feedback. One has to be aware of the risk of bad reviews, but as the total number of reviews for such early releases is rather small, they will have only little impact once the app is completed and more and more reviews are added.

A visually appealing presentation will attract enough users for medium-scale observations

For both our preview version and the feature-complete release, we created promotional graphics and chose a neutral name for our game that did not disclose its nature as a research project, but did rather seem like a game of an independent development studio. Making an offer on the Store appealing to users in this way has shown to be enough to make several hundred users download and try the app. We thus learned that the sole appearance in Google's *Play Store* provides an application with enough visibility to attract enough users for a medium-sized study.

Many downloads on non-NFC phones

Statistics from the app store indicate that many downloads and active installations are on non-NFC phones. This is due to the fact that the many successful Android phones (e.g. HTC's Desire HD) do not come with an NFC reader.

However, our data also shows that the two device models the app is installed on the most both support NFC: Samsung's Galaxy S2 and Google's Nexus S. We take away that support for non-NFC phones helps increase the number of downloads, but users of those phones are likely to uninstall the app soon. Uninstalls on NFC phones occurred much less often. We from this conclude to make your app only visible to supported devices.

Scaling the game will require a fair amount of marketing and maintenance effort

At the time of this writing, the feature-complete version of *NFC heroes* has been available for download for one month. The release of the gameplay preview has been slightly more than two months ago. The number of total downloads during this time is increasing at a rate at 10 downloads per day. However, we at the same time face uninstalls (constant rate of 8 uninstalls per day), so that the total number of active installations is increasing rather slowly, totaling at 100 installs one month after the feature-complete version was released. We take away that in order to increase the growth of our game we have to fine-tune our game mechanics to reduce our relatively high bounce rate of up to 80%. Once more downloads turn into active installations, we will acquire users more actively and emphasize the game's viral aspects.

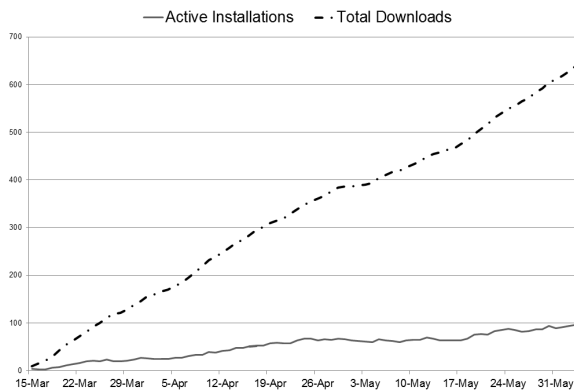


Figure 3. Total number of downloads and active installations are growing at a constant rate.

We acknowledge the fine-tuning of our game mechanics and the marketing efforts required to grow our total number of users will require roughly the same amount of resources as the initial development of the game. Researchers interested in performing large-scale studies with the help of app stores should carefully watch how many downloads actually turn into active installations and plan how they will scale their application once they are satisfied with those key metrics.

CONCLUSION

As illustrated by Fig. 3, the number of active *NFC Heroes* installations is growing at a constant rate. Still, the goal of the

project, to create an engaging game with a significant number of users that will help create a database of NFC-enabled products, has not been achieved yet.

So far, 180 NFC tags (including duplicate tags with IDs already known to the server) have been uploaded and for 40 tags an additional photo or description was provided. Users have fought a total number of 706 battles; the most active day was on May 28 2012 with a total of 54 fights on a single day.

We still find ourselves early in the life cycle of the game, and Android phones with NFC support are only starting to gain traction. Still, initial reactions on version 1.0 have shown good receptions among interested users who have spent a significant amount of time playing the game.

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