Product Empire - Serious play with barcodes

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Abstract **Despite the ubiquity of barcodes there exists no common product repository available today linking product master data to the corresponding barcodes. This paper proposes a social network game (Product Empire) that motivates users to scan barcodes and to enter basic product information, such as product name, brand and category and to upload a picture of the product. This user-generated product repository aims at providing a base to link real world objects with virtual information. After a first prototype has been implemented and applied in an informative user study we released an improved version to the public on the android market. Within 17 days 244 users have generated more than 990 product descriptions and cross checked product data 1230 times. These results show the potential of generating an open product repository by motivating users with a game approach related to social network games.**

Mobile Applications, Barcode, Internet of Things, User-generated Content, Crowdsourcing, Social Networks

I. INTRODUCTION

The Internet of Things aims at linking real world objects with the virtual information. The goal is to establish a more seamless exchange of information between virtual services and real items and products [15]. While the idea of linking information to real-world products has been around for more than a decade [16][17][18], only recently mobile phones' cameras have reached the capability to read 1D bar codes as the handheld lasers at the retail check-outs have been doing for the last forty years. Barcode reader software for mobile phones has quickly found its way from research [19] to practice[1][2]. As such, the fourty years old barcode technology has regained attractiveness regarding the aforementioned physical-to-digital linkage in contrast to the comprehensive item-level yet-to-happen roll-outs of RFID tags in retail supply-chains. Instead, 1D-barcodes are ubiquitous on retail products and can be read by any auto-focus camera phone immediately. This allows anybody to interact with almost any commercially available product.

Accordingly, applications such as ShopSavvy[3], Barcoo, My2Cents or CodeCheck, use barcode scanning on mobile phones in order to provide users with additional product information, e.g. price comparison, are widely used. As there does not exist a publicly, globally available barcode-product repository, each application re-builds its own data source. While ShopSavvy may have a rather good coverage of consumer electronics in the US its German competitor may own rich data about the German market, so data gets fragmented. This might be a competitive advantage for a company but the overall result is that users scan products of which the barcode cannot be resolved, as it is unknown to the application, even though the data is existent elsewhere. This problem can also be seen by looking at the user comments about theses application on the application markets. In bad ratings users often complain about unrecognized products.

Moreover, even the retailers themselves encounter problems with the accuracy of product master data. Inconsistencies of up to 80% [14] require costly manual workarounds to source missing data and to correct errors of wrong product displays or mismatches at the checkout. It is estimated that this incorrect data will cost the industry £700m over the next 5 years, and a further £300m in lost revenues according to [14].

Whereas Amazon Web Services already provide data on many items, the data set is still limited as it does not include grocery products. Furthermore, Amazon does not permit to "use any Content or Special Link, or otherwise link to the Amazon Site, on or in connection with any site or application designed or intended for use with a mobile phone or other handheld device"[4] without an explicit approval. Some mobile applications already had to be stopped due to this restriction[5]. Other databases such as the ones of the retailers or brand owners are proprietary and for internal supply-chain operations only.

The goal of this paper is to build an open product information repository following a crowdsourcing approach [6]. We apply motivational concepts from pervasive gaming and social networks, similar to FarmVille[6] or MafiaWars: by using virtual credits and status awards being shared over social networks we motivate mobile phone users to scan barcodes,

[1] ZXing Library: http://code.google.com/p/zxing
[2] Redlaser: http://redlaser.com
3 ShopSavvy: http://www.biggu.com

[4] Amazon: Associates Programme Participation Requirements, https://partnernet.amazon.de/gp/associates/promo/participationrequirements
[5] http://www.alwinhoogerdijk.com/2010/01/19/amazon-killed-our-iphone-apps
[6] FarmVille: http://www.farmville.com

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describe products, and check and revise descriptions of others. We build upon the experiences of a former implemented prototype and an informative user study involving 10 subjects that was conducted during one week and resulted in a collection of data about 80 products. In this paper we present our results about the improved prototype that has been released to the public on the android market to further evaluate the feasibility of our approach. Even though the time of the evaluation of the prototype on the market was limited to 17 days, we believe that crowdsourcing using pervasive games as motivation has a high potential to build an open product information repository.

The remainder of this paper is structured as follows. Section 2 provides related work. Section 3 explains the game concept of our approach and Section 4 depicts the technical setup up of our prototype implementation. Section 5 reports about the analyzed user generated data after we released prototype on the android market and Section 6 discusses the found results. Finally Section 7 gives a conclusion and an outlook on future work.

II. RELATED WORK

Over the past years social networks strongly aroused the interest of the internet community. According to the Financial Times[1] Facebook has already scored more visits than the Google search engine in March 2010. Facebook's popularity has grown rapidly and the number of users even doubled in the past year, from 200 million April 2009 to 400 million in February 2010. Social networks provide a base for online social interactions among users by sharing of comments, feelings and emotions but also by playing games specifically designed for these networks. Using social networks as platform for games allows companies to reach a huge community of casual gamers. For instance, one of the famous social network games is FarmVille - a real-time farm simulation. Each day 32 million users on Facebook [2] plant, grow and harvest virtual crops and trees. Most of these social network games make use of similar concepts in order to attract users as Aki Järvinen has analyzed [3]. Accordingly, successful games trigger immediate actions with simple clicks, reward actions abundantly, are simple to comprehend, follow a specific theme (e.g. farming) and can be played asynchronously. Furthermore, status awards are shared over social networks to attract new users and users are constantly persuaded to invite new users in order to gain extra credits. Product Empire applies the very same motivational concepts of social network games, by using virtual credits and status awards being shared over social networks to motivate mobile phone user to scan barcodes, describe products and crosscheck data of other users. Our game is integrated with Facebook in order to form a social game community and to foster the competitive aspect of the game.

Within our approach we want to build up a product repository with the help of users who add real product data as part of a mobile game. Therefore, we are using principles of social network games and the concept of crowdsourcing. In [6] Brabham introduces crowdsourcing as a model for problem solving. It is described as "a new web-based business model that harnesses the creative solutions of a distributed network of individuals through what amounts to an open call for proposals". For example a company posts a problem and let the crowd offer solutions. The best solutions are then awarded and finally the company uses the idea for its own profit. Thus, companies can outsource tasks that are costly or time consuming to a crowd which can be less expensive. Several applications such as Wikipedia [7], OpenStreetMap [8], iStockphoto[9], reCAPTCHA[10], and others show already the successful concept of outsourcing tasks to the crowd. Amazon even launched the platform Mechanical Turk[11] to provide on-demand workforce for tasks that require human intelligence. Approaches that combine the crowdsourcing approach with games already exists [20] and even for social networks. In [4] for example a social network game is presented, in which users collect tags for music. Another example is described in [5], that presents an application framework to develop games with a purpose on top of social networks. Our approach goes one step further and applies crowdsourcing in the real world, using mobile devices and involving real products by scanning their barcodes. The user incentive in our approach is not money, it is to get on top of the competition as well as to have fun.

Our approach covers also pervasive games referred as mixed reality games. These games distinguish themselves from classic games because they are "interwoven with the real world and potentially available at any place and anytime" [10] . One of the famous representatives of such games is "Can you see me now?". In this game online players are chased in a virtual model of a city by real players, who move on the actual city streets and are equipped with GPS and WiFi technologies. Another example for persuasive games is "PAC-LAN" [11] , a remake of the famous Pacman game as mixed reality game with RFID-enabled mobile phones. Our approach also plays in the real world but uses a more light approach, as it only requires a smart phone with internet connection and equipped with a camera, but no additional features such as RFID readers. There exist further mobile approaches that have also the purpose of gathering useful data during a game, for instance geo-related data [12][13].

The amount of mobile barcode "scanner" implementations and product related applications is also increasing. Besides price-comparision as mentioned in Section 1, also more playful and socially engaging applications around products exist. In Stickybits[12] users can attach digital content to any barcode and applications such as WhoisRich.me [13] and Hollrr[14] allow users

[7] Wikipedia: http://wikipedia.org
[8] OpenStreetMap: http://www.openstreetmap.de
[9] IStockPhoto: http://www.istockphoto.com
[10] Recaptcha: http://recaptcha.net
[11] Mechanical Turk: http://aws.amazon.com/mturk
[12] Stickybits: http://www.stickybits.com
13 Whoisrich.me: http://www.whroisrich.me
[14] Hollrr: www.hollr.com

to report about new discovered products. There are also game approaches such as Barcode Beasties[15], that takes scanned barcode numbers as a seed for generating beasts, such that two barcodes can virtually fight against each other - but this does not create any user generated content.

Our approach to build a product repository while users are playing a game touches several areas: Social Networks, which we use to make our game more social, competitive and to promote to new players. Crowdsourcing, which is used to collect data for our product repository by users and Pervasive Games, as our application is a game that is interwoven with the real world in which users scan products around them.

III. CONCEPT

This section presents the Product Empire game concept that was designed to motivate people to build a product repository. First an overview about the concept is given following by a more detailed description.

A. Game Overview

The main part of the game involves the scanning of product barcodes with the built-in cameras of a smart phone, entering product information, such as product name, brand name, and product category as well as uploading a picture of the product. Furthermore, cross-checking of user data is part of the game which will be explained later. The game concept is inspired by social network games such as FarmVille and MafiaWars and Järvinen's recommendations for designing social network games [3]. Users are constantly rewarded by a virtual currency and increased status rank in the virtual society for completing tasks and users can broadcast their achievements with feeds over the network which attract new players. The overall player's goal in the game is to build up an own empire of products and thus to climb to the top of a virtual high society. Therefore, the game was called Product Empire. Figure 1 shows a rough illustration of its underlying concept:

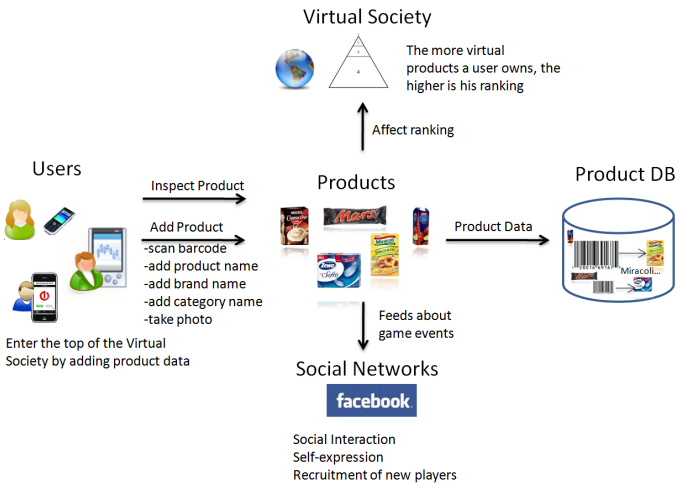

Figure 1: Game Concept

[15] Barcode Beasties: http://www.barcodebeasties.com

As depicted by Figure 1, users add products by scanning barcodes and entering product descriptions to increase their ranking in the virtual society. Additionally, they can post feeds in social networks to present their latest achievements. Moreover, the users can inspect product information that other users have added. Finally, all the scans and product information are collected in a database that can later provide a base for consumer applications.

B. Game Features

In the following the main features of the game are described:

Build an Empire: The more virtual products players own, the bigger their empire is. To acquire a virtual product, players use their mobile phone to scan the barcode of a real product with the phone's camera, enter product information and take a photo of the product (see Figure 2). This activity is rewarded by an amount of virtual coins. If the player is first to scan a certain product (barcode), he is announced as the virtual owner of this product. The user can choose to store the product in a virtual location, either in the players' home base or a virtual shop. The home base is placed on Google Maps by each user at the beginning of the game and cannot be changed and conquered by other users. In case the user is not the first, the product information is stored anyway and the user only obtains a certain amount of coins. After several entries about the same product exist, they can be matched for further validation.

Shops can be added at any time and play another role besides storing products. It is intended that user add counterparts of real shops and thus indicate from where they obtained their products. Each shop has an owner, the person who owns most products in the shop. Each day the owners of the shops get bonus coins depending on the amount of products that are within their shop. If another user wants to take over a shop, he needs to own more products in it and thus either add new products to the shop or steal products from the shop owner.

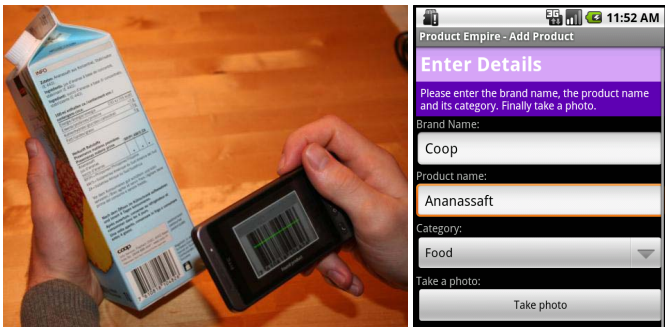

Figure 2: A player scans a product barcode (left) and enters the product information such as brand name, product name and category (right)

Climb to the top of the High Society: The goal of the game is to get into the highest class of a virtual society. To climb up in this society, players have to acquire products and

coins that together define their score. Depending on the scores each player belongs to one of the five virtual social classes, ranging from "Poor dogs" to "VIP". There is a society for each country and one world society (see Figure 3 left, names and profile pictures are automatically obtained from Facebook). The distribution of the social classes is percental to the amount of users in a ranking. For example only 2% of the users within a society can get into the highest society class. If more users join the game the number of seats in all classes are increased, thus the seats are always adapted to the growing user base. To get on top of the world ranking is more difficult, as all players of the game are represented in this ranking. The world ranking had been added to reduce the cold start problem, when not enough users of a country are present and also to make the game more exciting as players can compete within an international audience.

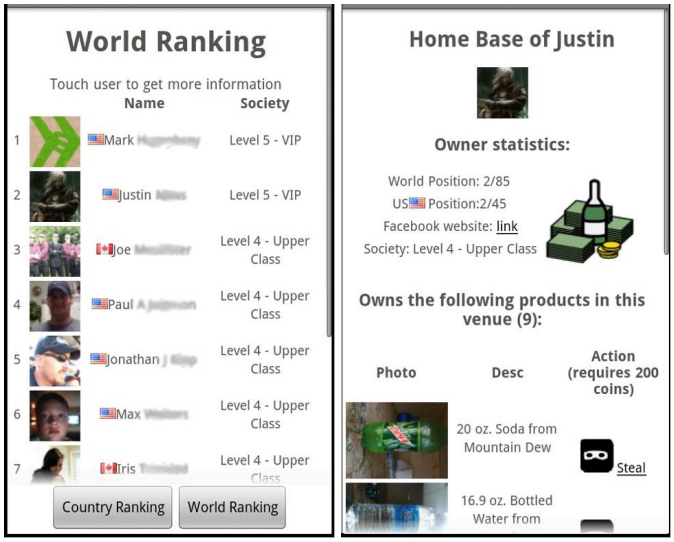

Figure 3: World Ranking with the users Facebook profile photo and Facebook name (left) and a user profile with ranking information and a list of owned products (right)

Interact with players around you: Players can interact with other players using a real map (see Figure 4 left) on which all players have their virtual home base and where virtual shops are displayed, that can be added by users at any time. The icon type of a home base depicts the social status of the player. Viewing the home base of a player shows the ranking within the country's highscore and within the world-wide highscore. Additionally, a list of all owned products (see Figure 3 right) and a link to the user`s Facebook page are shown.
Players can invest a certain amount of coins to steal products from each other using the steal link next to each listed product. Based on fortune, the player may either succeed in becoming the new owner of the product or may loose the invested coins. This investment ensures that users keep on scanning rather just relying on stealing from each others.

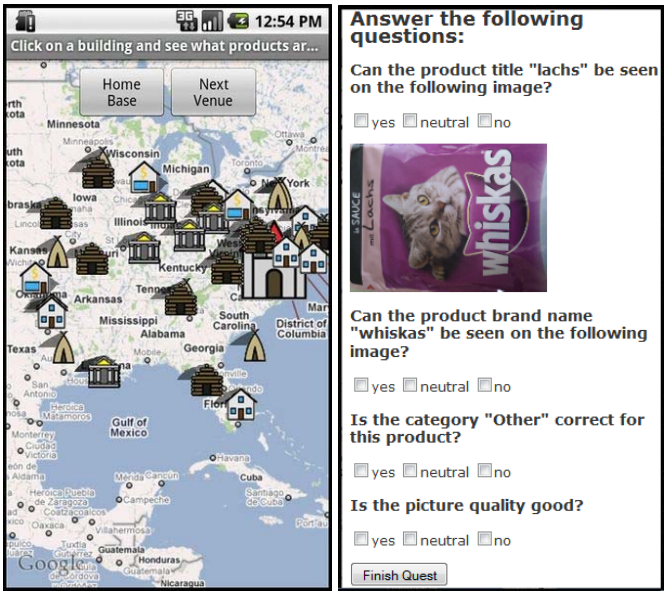

Figure 4: Map view of players' home bases (left) and a quest to cross check user data (right)

In some cases the virtual police catches a user while stealing. Then a trial is generated in which other users can vote to sentence the thief or to set him free. In the first case the product is returned to the original owner and the thief looses a certain amount of coins. In the latter one, the thief can keep the stolen product.

Play Quests: Users can also play quests to earn coins. In these quests players cross check product data which other users have entered (see Figure 4 right). Users can only participate in quests containing products that have been added by others and not by them. Whenever a new product is added into the game, a quest is created automatically to cross check the data by other users. Within the quest, a user is asked several questions about a shown product. First of all whether the product name and product brand name can be recognized on the product photo. Furthermore, if the categorization of the product is correct and if the picture quality is good. The user can choose for each of the question between yes, neutral (if he is unsure) and no. After answering all the questions the user is rewarded by coins. Users can do as many quests as they want.

IV. IMPLEMENTATION

On the client side the game was implemented on smart phones with the Google Android SDK 1.5 [16]. The ZXing library [17] provided the barcode scanning capability and the Android FBConnect [18] was used to access Facebook functionality. The server was developed with the Ruby on Rails 2.3.5 [19] framework. A running version of the Android client can

[16] Android SDK 1.5: http://developer.android.com/sdk/android-1.5.html
[17] ZXing Library: http://code.google.com/p/zxing
[18] FBConnect: http://code.google.com/p/fbconnect-android
[19] Ruby on Rails 2.3.5: http://rubyonrails.org

be obtained from the android market or our project homepage[20].

V. EVALUTATION

Before we released our implemented prototype on the android market, we conducted a informative user study involving 10 users in Zurich for one week. During this user study, more than 80 products had been scanned. Based on the lessons learned, e.g. adding the quest to cross check user data and adding the trial feature for fostering interaction among users, we built an improved version of Product Empire as described in the Section 3. This version was then released on the international android market to test the approach with a larger target group. Quantitative data from server logs as well as qualitative data from comments on the android market and from submitted user feedback within the game has been collected over a period of 17 days.

Quantitative Data:
Within 17 days, overall 244 users have joined the game. At the time of writing, the game has been ranked by 21 users with an average of 4 out of 5 stars on the android market. Each of the users logged in with a real Facebook account and placed his home base on Google Maps. Analyzing this data showed that most of the users are from the USA, see Figure 5 for details.

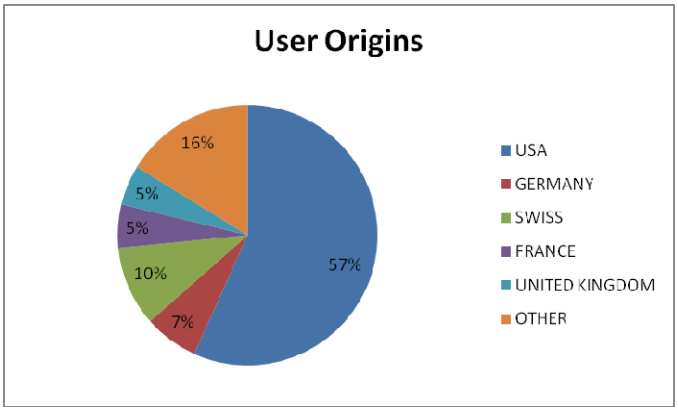

Figure 5: User Distribution by country

Overall, the users scanned more than 990 products and did more than 1230 inspections of other products within these 17 days. Figure 6 shows a diagram with the amount of users, products and inspections during the evaluation period. Although 244 users logged in, not all of them generated content. 126 users added all the products. The overall sum of inspections has been done by 121 users.

[20] http://dev.im.ethz.ch/wiki/ProductEmpire

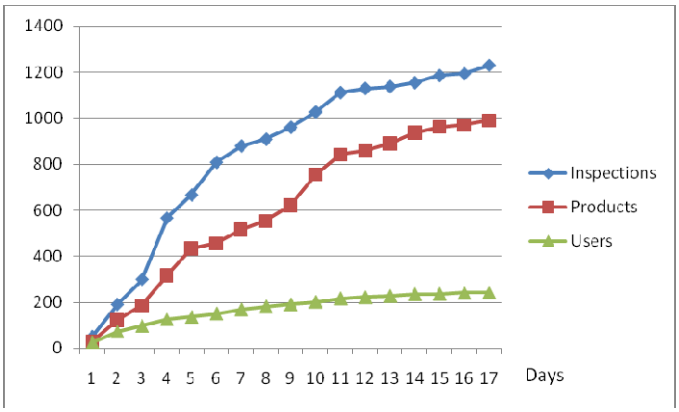

Figure 6: Showing the number of inspections, products and users during the evaluation phase

Analyzing the inspection data, revealed that the users found 13 fake or unrecognizable products, 4 of them were intentionally introduced as wrong by us to test the users. All other product descriptions matched with the submitted photos. We set the picture resolution to low in order to have better performance for users to upload pictures with slow internet connection on mobile devices. Regarding the type of products, Figure 7 shows the number of products of available product categories that have been added and in Figure 8 some collected product data is shown.

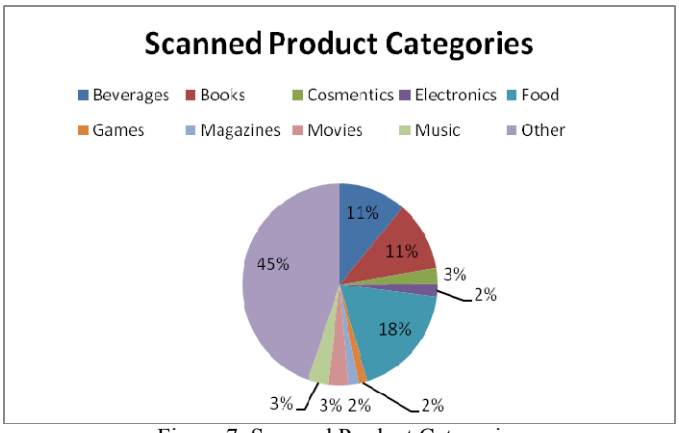

Figure 7: Scanned Product Categories

During the evaluation phase we also tried to persuade users to scan certain product categories. On random days we informed the users with a text message in the game, that special bonus coins are offered if the product category of the day is scanned. Some users responded to this by scanning many products of that type in a row. For example one day the special product category “beverages” was announced. Consequently, 80% of the scans were beverages, done by 50 % of the users that scanned products on that day. In comparison, the average percentage of scanned beverages on other days was 19 %. However, this feature was only added later at study run-time, thus only those user became aware of this feature who updated their application or joined afterwards the game. Accordingly, this behavior should be analyzed on a longer run with more users. Users mainly scanned everyday items, such as

food/snack/drink/cigarettess, games/CDs/books, or household items – just anything around in order to compete in the game successfully. But also specific products users had a high involvement with, e.g. selections of computer games, were scanned. It could be worth investigating whether people scanned certain items just to show off their belongings and to represent their personality.

Figure 8: User added products with photo, brand name, product name, category and barcode number

There was even one single user in the game who scanned more than 129 products and who did more than 160 product inspections. Another interesting aspect is that, out of the top 10 players, 4 players played also social network games such as FarmVille or MafiaWars. This information could be only acquired from players with public Facebook profiles, so potentially there may be even more Product Empire players, who play social network games. The number of virtual shops that users have created was 43, whereas we expected that users would create more of them. We assume that the concept of shops was not clear enough and we plan to conduct further interviews with users to find out the real reason for that. Furthermore, the action of stealing was although rather low (119 actions of stealing) compared to our informative study. It appears that stealing is more interesting among users knowing each other in real life. The voting about the penalty for thieves was done 320 times.

Qualitative Data:

From the android market we have received 11 positive comments (from overall 15) about the game such as "We are what we consume! It is real fun to compare your daily consumption products with people from around the world!" or "Fun and addictive. The world around you becomes your hunting ground for bar codes.". Even one underaged player wrote as comment that other users should look for his name within the top ranking. Within the game users submitted also feedback for which they earned coins. With the feedback system we also received suggestions how to improve the application:

Several users asked for a better user interface and more professional graphics. Due to the fact that the user name and the user's profile picture was taken directly from Facebook, a user suggested to have the possibility to choose a nickname and have an avatar instead of the profile picture.

Another proposition was to have more detailed description about the game, as in this prototype only the most important facts about the gameplay were explained.

Furthermore, pre-added real shops on the Google Maps were requested and to have protection against stealing of products. The latter were sent by the top players who owned most products. This issue was already raised in our informative user study and the stealing was limited to two actions a day per user.

The submitted feedback – there was an email feedback button embedded into the game - also revealed several new feature requests to make the game even more interesting. Trading products with other users, different kinds of quests like a scavenger hunt and tournaments were suggested.

VI. Discussion and first Experiences

Throughout an evaluation phase of 17 days we could attract 244 users – out of which 221 had been no Facebook friends to authors before – who 990 times scanned a product, added name and brand, entered the product category and took a picture. Only in 9 cases wrong data were intentionally entered. Accordingly, we reason that a well designed playful approach can provide incentives for users to create a product repository as a side-effect of a game.

We believe that the users did not abuse the system due to the fact that the real Facebook names and profile pictures of the users were shown and because every user could see that within the inspection quests their data will be checked by others.

From the 1230 quests where users cross checked the data and reported wrong scans we reason that a mechanism of mutual peer review can work sufficiently as quality control of data and that its integration as part of a game provides incentive to do this task. Nevertheless, it is worth to investigate how to further evaluate the data quality (e.g. cross check the data against other sources).

Furthermore, from the logs we could see that certain new players that joined the game suddenly scanned a huge number of products, just to get recognized in the top world ranking. So, this rather time-consuming unpleasant task of barcode-scanning was done by the top players even many times in a row on a single day, when they saw that other users overtook them in the ranking. That certainly shows that the principle of social competition with other users is an incentive to do rather unpleasant tasks of entering product data.

The decline of new users joining the game can be explained by one specific reason. Only six days after the game has been launched, a new update of the Facebook Api has disabled the game's post-to-facebook function till now and thus it could not be used to attract new users within the social network. Additionally, this limitation also yielded some negative user feedback. The lessons learned here is, in order to keep the game going, dependencies from bigger players, such as Facebook in this case, have to be carefully watched and maintained. For future releases we plan also to more actively

market the game on blogs and other social media to get more attention.

VII. Conclusion & Outlook

In this paper we have presented a playful crowdsourcing approach to motivate users to collect data about products. Users are motivated to scan barcodes and to take picture of products, enter product information and cross check the data of other users using incentives of virtual coins and status in a virtual society of a pervasive game. The game has been integrated with social networks to build a community around the game and attract new users. The underlying concept was presented and a prototype had been implemented on Android smart phones and integrated with Facebook. This prototype was finally made public on the Android Market.

We have shown that – despite a rather short testing period of 17 days – users can be motivated to participate and to create data in good quality which could be fed into an open product information repository for other barcode applications. The users perceived their activity as fun.

Whereas we could prove the feasibility of play data creation for barcode scanning, the successful creation of product repository has to yet be proven. At the moment we cannot yet evaluate the continuity of users adding new products. New incentives, such as product category of the day, should be tested. Rewarding scanning certain groups of products belonging together could be another approach worthwhile investigating. We also see potential in adding teamwork features to the game, where users could cooperate when adding products, or also when robbing other users. This could also help to restrict the emergence of uncatchable users, as the aforementioned 129-product-scan user. Finally, the entire visual appearance of the game should re-worked by a professional designer to make the look and feel more appealing.

Our next steps are to seek for cooperation with a local retailer to provide real rewards of scanning products. Then we will design an open product repository that can be accessed and fed by other barcode-applications. We plan also to release the application on the Apple's App Store as the user base there is still larger than on Android. Another interesting aspect would be to evaluate how suitable the uploaded product image data are for image recognition in order to link real objects with digital information using augmented reality.

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