# Analyzing the User Inactiveness in a Mobile Social Game

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***Abstract*—This paper analyzes and evaluates the factors that affect the inactiveness of users and how they are related to inactiveness. A higher inactiveness indicates a user is more likely to be inactive. The analysis locates inactive users, who have not logged in to the system for some time, and evaluates the relationship between inactiveness and three dimensions: social networking, time, and in-app purchase. Based on the operational data from a mobile social game, Barcode Footballer, with more than 100k users and 1 million friendships, it is concluded that social networking, time and in-app purchase are all important factors in inactiveness. The results can be applied to mobile social games to detect potential inactive users such that their operators can retain those users by using encouragements.**

***Keywords*—game, inactiveness, operational data, friendship, social, purchase**

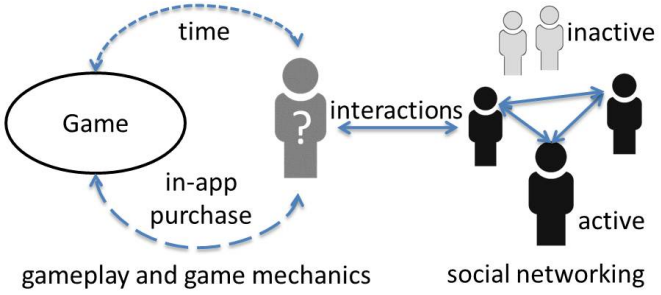


Fig. 1: Design of Social Mobile Games

## I. Introduction

With the fast development of mobile technologies, the use of smartphones has become part of our life. The smartphone has become so powerful it can run complicated graphics and other computations. The advance in mobile communication has also enhanced the trend in use. Smartphones can access the Internet at any time and from any where, which creates a huge opportunity for new applications. People can access and share on social networks, watch streaming videos and enjoy many location-based services. One of the most popular applications is gaming. ARM (Acquisition, Retention, Monetization) is one of the analytic frameworks in game development. Acquisition is the operators' growth strategy to attract users to play the game, Retention is connected with how to keep users in the game, and Monetization refers to the ways operators generate revenue. These are the most important considerations for any operator in game development. They affect the elements in game design namely: game mechanics, gameplay, in-app purchase and social networking. Fig. 1 shows these 4 elements. The game mechanics facilitate and encourage players to explore and learn specific topics or messages delivered through the use of interactive mechanics. Regarding resource management in a real-time strategy game is an example of game mechanics. The gameplay is the overall game experience or essence of the game. It relates to the interactions inside the game related to choices, challenges, and players. A well designed gameplay and sound game mechanics can keep users in the game. Users are likely to spend more time on the game, which can help acquisition and retention. In-app purchase is also important for both operators as well as for users. Operators can generate revenue and those purchased items can also keep users in the game by providing the users with extra features and unique advantages. Nowadays, popular games usually have gaming designs with these three elements. Angry Bird and Flappy Bird are examples of popular mobile games. They have very attractive gameplays and/or game mechanics, which attract millions of users. Angry Bird also offers in-app purchases for extra features. The forth element in game design is the social element. Sharing scores and interaction among users are examples of the social element of gaming. It provides a platform for competition which encourages users to stay in the game. By studying the three aspects: time, in-app purchase and social networking elements of the users in a game, it is possible to predict if a user is likely to be inactive. It helps retention and hence it increases the life time and revenue of a game. This paper analyzes users based on the operational data of a mobile social game, Barcode Footballer, using the three aspects.

Barcode Footballer is a popular football game, which was originally launched by Cybird in Japan, and has already received 60 million downloads in less than a year. nxTomo Games, a Hong Kong based company, was authorized to launch it in 2013. It is a mobile social game, in which a user plays as a football team manager. Users can create their soccer clubs, and have a collection of football players from a pool of millions of players. They can enhance the strength of the club and players by beating other clubs, and by getting better players in the game to become the best team in the world. In the game, social networking is not only needed for the leader-board and competition, but also for interaction among users. Users can post the add-friend code and button onto their Facebook timeline to connect the game with their friends on Facebook. They can play against friends to have more fun than playing against computers only. However, social mobile games are


Fig. 2: Game screens on: (a) gameplay: team formation, (b) in-app purchase, (c) social networking for Facebook Sharing.

similar to other social media content, which follow the growth pattern described in the Bass model. After the explosive phase, the burnout phase comes and the number of users grows slowly while existing users may give up the game. How to keep those existing users active is the most important question to game operators. This paper focuses on retention, which ascertains the factors that cause users to become inactive. It investigates the user data from Barcode Footballer and tries to discover the factors keeping users active and how they are related to inactiveness.

The main stream papers carry out testing with well established procedures [1]. They create an in depth conclusion by interviewing users that has been in the game, but the number of users is limited. As far as we know, there has been no investigation on a real dataset to predict the behavior of a user. The contributions of this paper are summarized as the following:

1) Investigate a social mobile game with 100k+ users, Barcode Footballer;
2) Analyze the user behaviors using the operational data of Barcode Footballer;
3) Determine and verify the relationships between various user properties and user inactiveness.

This paper is organized as follows: Section II describes the previous work, Section III details the game and the behavior of the users, Section IV introduces an analysis of inactiveness, and the paper is concluded in section V.

## II. Previous Works

Research on gaming has become a very hot topic. One of the reasons is the possibility of the games being used as a learning tool [2] [3]. Mobile games are a platform for students to gain knowledge and they have been proven to be more effective than lecturing. The reason behind this is that games present information in an interactive manner, which helps users learn in a fun way. A fun game attracts users and also keeps them in the game. However, it is always a challenge to understand what makes a user enjoy a game. The attractiveness of a game can be measured by the widely used term "Immersion" [4] [5] [6]. In [4], the authors define a ground for immersion. They explore different levels of engagement and propose that initial engagement is followed by engrossment and total immersion. To be in the first level, gamers need to spend time and effort. Once they have invested more time they become focused and more immersed and less likely to stop playing the game. Besides the time and effort spent on the game, social interactions are also important for a user to stay in a game [7] [5]. In [8], the authors concluded that only showing the social context not only increases the social interaction, but also possibly increases the growth of the popularity of the game. In [9], the authors divide social interaction into two aspects, social influence and critical mass, when they investigate why people play on-line games. They apply the concept of technology acceptance model (TAM) and conclude that when the friends of a user are players of a game, the user is also likely to be a player through informational influence. The second factor is critical mass, where a large population increases the number of adopters. The game could be more fun when players are against other and not just competing against computers [10].

When a user starts to lose interest in the game, it may be possible to identify this by those factors. For example, when the user spends less time on the game, it indicates that the user may want to give up playing. A similar effect may be observed with social interactions. When the friends of a user start giving up the game, the user may follow. In this paper, the time a user has spent in the game is measured by the time since registration and the level of the user. The social interactions are reflected in the social networking elements of the game, where the number of new friends as well as the percentage of active friends are used in the analysis. The third element is the in-app purchase where users pay for items in the game, which indicates that they have a high interest in the game. By considering those factors, it is possible to detect potential inactive users.

## III. Mobile Social Games

This section introduces the details of the game, the dataset and the corresponding user behavior.

### A. Design Elements

Besides the attractive gameplay and game mechanics, a social mobile game also consists of social networking elements, which allow users to connect and interact with their friends. As introduced in the previous section, the gameplay of Barcode Footballer is a football simulation game, in which the goal is to be the best football team by managing the best football players in play matches with others. Fig. 2 shows four screens in the game. Users can change the formation

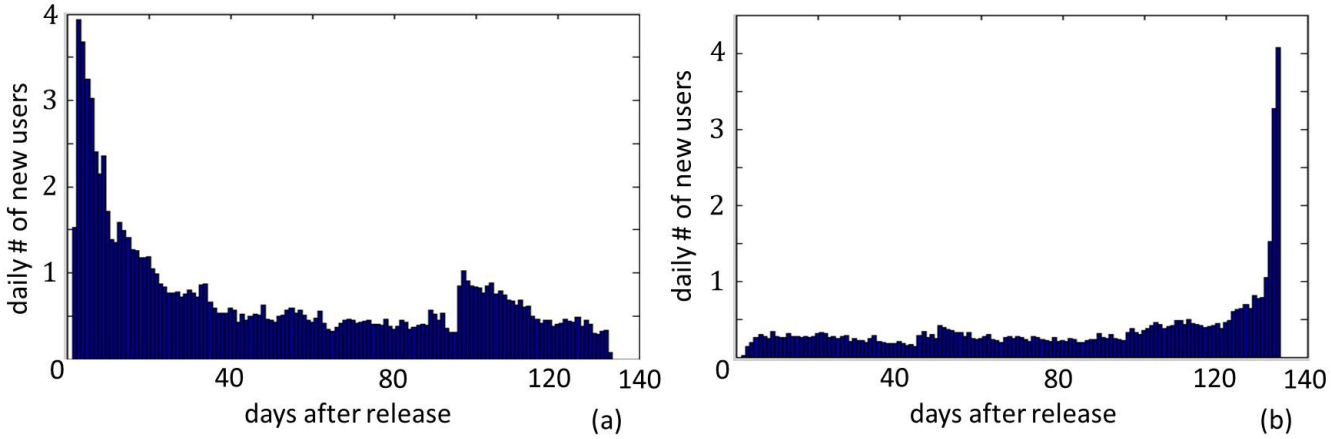


Fig. 3: Access pattern of users: (a) registration, (b) last log in time.

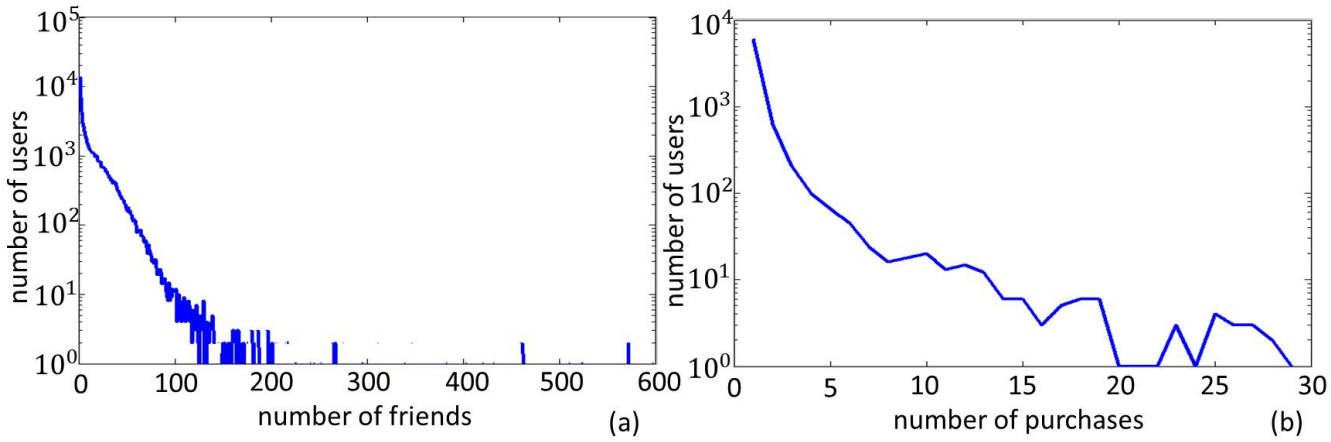


Fig. 4: Histogram of number of: (a) friends, (b) purchase, follow power law distribution

and their players as shown in Fig. 2 (a). The game consists of four different consumable points, they are training point, gaming point, money and BFB, the credits used for in-app purchasing. The training point and gaming point are required in the gameplay, and regenerate gradually with time until it is full. The money is earned when playing the game, while BFB requires purchasing, as shown in Fig. 2 (b). The game also provides a platform for social interactions. Users can connect their friends through sharing an invitation code and get a reward as shown in Fig. 2 (c), or directly connect to other users. As previously introduced, users are encouraged to invite their Facebook friends. This connects the network on Barcode Footballer to their Facebook network. The game also enables users to get new players by reading a barcode, or via a daily lucky draw. These actions consume money and BFB, so that users need to actively play the game or purchase those points. The game mechanics encourage users to login regularly to gain a maximum amount of prizes and ranks. An active user would log in several times each day in order to make their team competitive.

### *B. Dataset*

The data is collected from 7 August 2013 to 16 December 2013, and consists of more than 100k users. It is anonymous data, meaning the identity of the users is hidden from the analysis. Table I shows the major attributes in the dataset of a user. Besides the information on users, the dataset also includes

Table I: Major attributes in the dataset

| Attribute | Description |
|---|---|
| User ID | the unique user ID |
| Reg. time | the user registration time |
| Last login | the user last login time |

the purchase history and friendships. There are more than 1 million friendships and more than 10k purchasing records.

Analyzing this dataset offers a unique opportunity to have a complete check from the operator's perspective on how the user behaves in mobile social games. It is interesting to analyze and understand:

- what factors keep users playing the game and;
- how those factors affect the inactiveness.

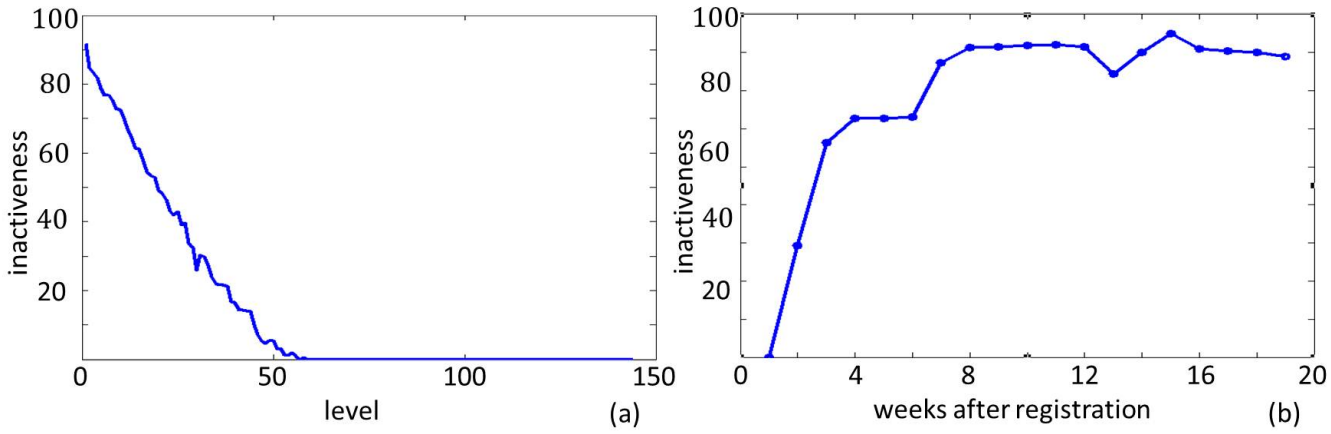


Fig. 5: inactiveness and (a) user level; (b) weeks after registration.

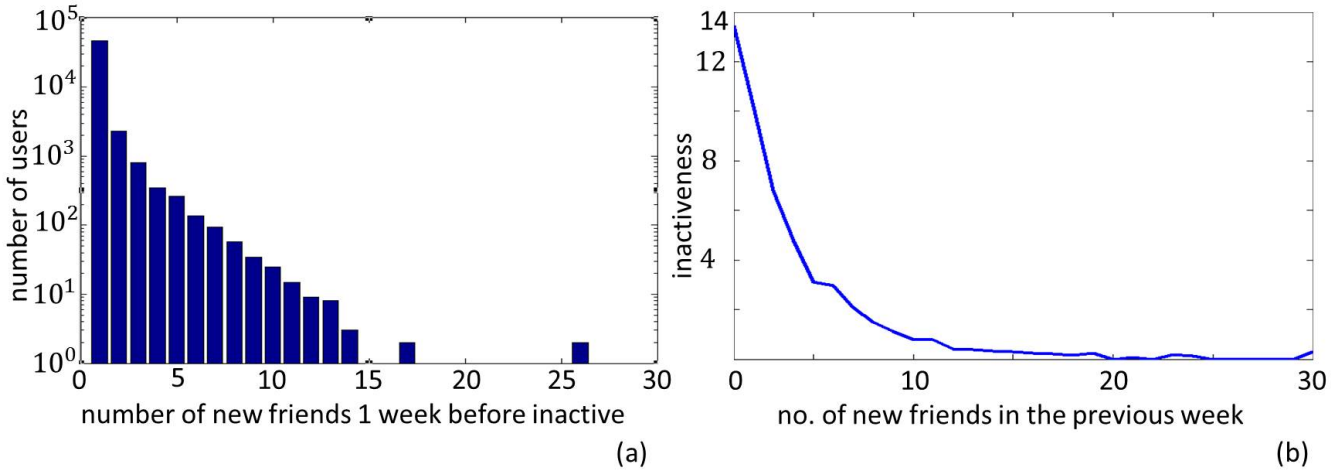


Fig. 6: Number of new friends: (a) histogram; (b) inactiveness.

### C. User Behavior

This section details how users behave and user pattern in terms of their level, purchase and the accessing pattern. Fig. 3 shows the daily new users and daily new inactive users after the game is launched. Note that the y-axis unit is arbitrary. It is observed that from Fig. 3 (a), the number of new users reduces with time, while the number of new inactive users increases with time. Fig. 3 (b) shows that the inactive pattern is relatively stable. Over time it becomes increasingly important for the operator to keep the users in the game.

Social element is a key element in the game. As introduced in the previous section, users can connect to their Facebook friends as well as other users and interact with them. This social behavior keeps the users playing the game. Fig. 4 (a) shows the distribution of the number of friends a user has. It is clear that it follows the power law distribution, in which most of the users have limited friends while only a small number of users have a large number of friends.

Another dimension of the users' behavior is the purchasing behavior. Users can buy items to enhance their ability in the game, or continue their playing when they are running out of gaming and training points. Fig. 4 (b) shows the distribution of number of purchases for the users. It is observed that most of the users have only bought a limited number of items, while only a few of them have purchased more.

## IV. Inactiveness Analysis

In this section, the accessing patterns of inactive users are investigated. By detecting these factors, it is possible to identify potential inactive users. As shown in Fig. 1, the analysis focuses on the three aspects: time, social networking and in-app purchase. The definition of inactive user is defined first in this section, followed by an analysis of the three aspects.

### A. Definition of Inactive Users and Inactiveness

A user is labeled as inactive when he/she has not logged in for a period of time. The inactiveness is measured by the percentage of inactive users given a parameter. A higher value of inactiveness indicates that the user is more likely to become inactive. After a period of time, it is less likely for a user to pick up the game again. This period is affected by the gameplay and game mechanics, that is, how often a user logs in

for active playing. In some gameplays, users can play the game any time they want without losing any progress. However, the game mechanics of Barcode Footballer encourages users to log in daily. As introduced in the previous section, the gaming and training points in the game have a storage limit and are regenerated with time, active users will need to login multiple times a day to utilize the gaming and training points. Daily login is also rewarded by getting an random item. In this paper, the period is set to be one week. A user that logs in at least once in the past seven days is defined as active. At the same time, when a user has not logged in at least once in a seven days period, he/she will be labeled as an inactive. The evaluation in this paper is by the the inactiveness, which is the percentage of inactive users when given certain variables. A higher value of inactiveness indicates that a user is more likely to become inactive.

### B. Time

The time a user spends on a game is an important factor for a user to decide if they want to continue to play the game. A user who has played the game for a long time should have a higher tendency to stay in the game. This can be reflected in the level of the user. Although the difficulty in achieving a level depends on the gameplay, it is a good reference for the time a user has spent on the game. A user in a high level has spent more time on the game. Fig. 5 (a) shows the percentage of inactive users at different levels. It is observed that when the levels of the users are higher, the percentage of inactive users is smaller. The physical meaning of the graph is that when the level of a user is higher, the probability of the user becoming inactive is lower. A higher level can be considered that the user has invented more time in the game and therefore is less likely to become inactive. The relationship between the level and the inactive rate is linear.

Another good indicator of the time spent is the time a user has played since his/her registration. Although the inactive rate is higher since more people give up after a period of time, those that keep playing are more willing to continue and are less likely to be inactive. Fig. 5 (b) shows the plot of inactiveness against weeks after registration. It is observed that at a few weeks after user registration, the percentage of users that become inactive grows fast. However, after a period of time, the remaining users keep playing the game, and the inactive rate becomes stable. This implies that the same percentage of users are inactive after the game have been played for eight weeks. The active users are the core players of the game and are not likely to quit the game. It can be concluded that when user has been active for some time, it is likely that he or she will remain active.

### C. Social Networking

This sub-section focuses on measuring how the social networking elements affect the inactiveness of users, where social networking elements refer to the interactions among users. For example, when a user is willing to make new connections, it is less likely that he/she is going to become inactive. Fig. 6 (a) shows the histogram of the number of new friends one week before becoming inactive. It is the number of new friends that an inactive user makes one week before his/her last log in. It can be observed that most users stop making new friends before they become inactive. Fig. 6 (b) shows the percentage of newly inactive users in the current week with a different number of new friends in the previous week. It is observed that the more friends a user makes in the previous week, the probability of the user becoming inactive is smaller.

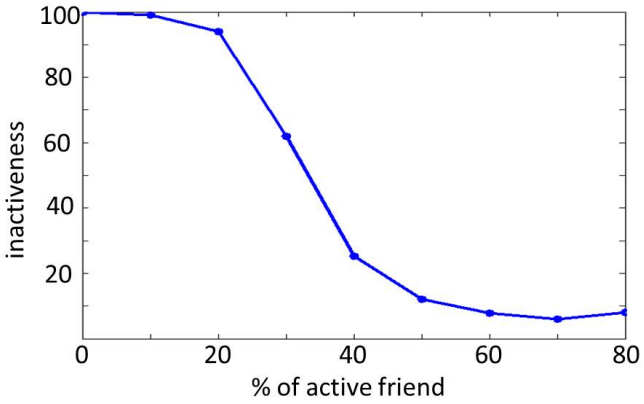


Fig. 7: Percentage of active friends vs. inactiveness

Besides the number of new friends a user makes, the percentage of active friends is also one of the most important factors that keeps the user in the game. The game entices users to encourage their offline friends to join by rewarding them with good players and game items if their friends join. Their friendship in the game can reflect the offline network that a user has. If most of a user's friends are no longer active, the users may also be influenced to become inactive. Fig. 7 shows the relation between the percentage of active friends and the percentage of inactive users. In the figure, the x-axis is the percentage of active friends that users have. It is obvious that when users have a higher percentage of active friends, the percentage of inactive users decreases. It implies that when a user has a higher percentage of active friends, the user is less likely to become inactive.

### D. In-app Purchase

The number of in-app purchases is also an important indicator of how likely it is that a user will stay active, as only active users purchase items in the game. Although the majority of users play the game for free, those who are willing to pay have a higher tendency to stay in the game. Among those available in-app purchases, a list of 5 items is selected for analysis in this section. These are consumable items that are used to refill the gaming and training points spent in the game. Users can consume them and play the game more frequently by refilling the gaming points and training points. Once those items are used, the users need to buy more. A user that buys those consumable items indicates that they are willing to stay in the game. Fig. 8 shows the relationship between the number of purchases of the specified items and the inactiveness. It is observed that when the number of purchases is higher, the inactiveness is reduced linearly. It is concluded that a user that buys more items is less likely to become inactive.

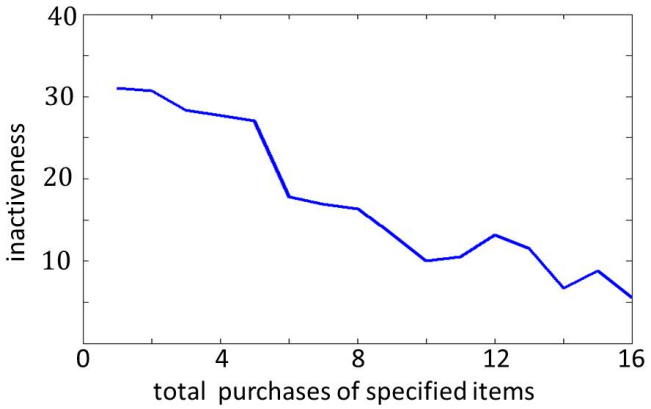


Fig. 8: Inactiveness vs. number of purchases

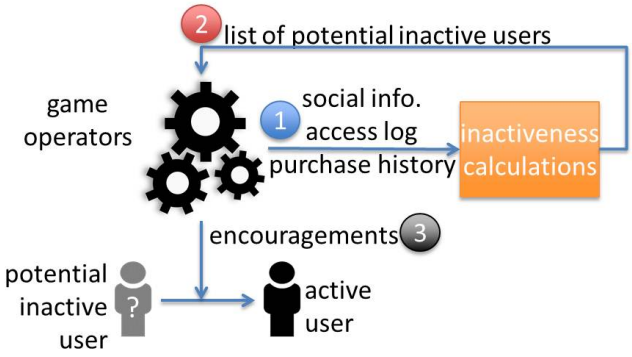


Fig. 9: A Potential Application

### E. Discussion

In this paper, an inactive user is defined as a user who has not logged in for a week. As discussed in the previous sections, this depends on the game mechanics. In Barcode Footballer, as the game mechanics encourage users to play the game regularly to maximize their resources, a duration of a week is a suitable time frame. An important research direction is how game mechanics affect the access pattern and hence the duration that defines an inactive user.

The results also provide grounds for further research on locating potential inactive users. A proposed application is shown in Fig. 9 to help operators keep their users. When users access mobile social games, the operators collect the access logs, social information and the purchase history. That information can be used to obtain a list of potential inactive users using the relationship among inactiveness and different factors discussed. The operators can then encourage the potential inactive users to stay in the game.

## V. Conclusion

This paper proposes an approach to measure the inactiveness of users in a mobile social game. The analysis focuses on three aspects: times, social networking and purchase. Based on the investigation and operational data from a mobile social game, Barcode Footballer, it is concluded that investments of time, money and social interactions keep users in the game. The analysis shows that after playing for a long time, users are less likely to be inactive. The total number of purchases and user inactiveness has a linear relationship. The social elements also affect the inactive rate. Making more new friends reduces the chances of becoming inactive, while more active friends keeps the user active. These three aspects give an insight into how to measure user inactiveness and help game operators identify potential inactive users and encourage them to stay in the game. This paper discovers what the factors are and how those factors affect the inactiveness of game users.

## Acknowledgment

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