Step by Step vs. Catch Me If You Can - On The Benefit of Rounds in Location-based Games

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Abstract—When adapting existing table games for the mobile setting, there is a choice of either keeping the round-based approach of such games or giving it up and optionally replacing it with additional "magical" features only available for the location-based version of the game. Based on our experience in building a hide and seek game using both approaches independently in two research groups, we compare the two alternatives regarding the design as well as user experiences. The results are a helpful guideline for other attempts to adapt table games for the mobile setting.

Keywords-Location-based Games, Mobile Computing

I. INTRODUCTION

Location-based Games (LBG) are among the most popular apps on mobile phones as well as a popular research area bringing together pervasive and social computing in a dynamic and appealing manner. A great source of inspiration for creating new LBGs are traditional table games. A lot of those games may eventually be transferred to the outdoors setting where the board is replaced by a defined area of ground (either in a city or somewhere in the open countryside) and tokens are replaced by the players themselves moving around tracked by GPS sensors in their mobile phones.

The LBG version of a table game may keep the round-based design where players decide on their actions in each round and every player has to wait until his fellow players made their turn. It can also drop this limitation as the physical space enables players to move in parallel rather than to wait for each other's actions.

This work is the first attempt to compare these two design approaches directly. We developed round-based and real-time LBG versions of a popular table game independently in two different research groups. Our work offers two main contributions: Based on the design and implementation experience we provide guidelines in how to design an LBG adaptation of a traditional table game either round-based or real-time in Section III. Based on an evaluation of both games with user groups, we discuss the pros and cons of each approach in Section IV. Related work in the area of Location-based Games is discussed in the following section.

II. RELATED WORK

Location-based Games are often designed to explore the natural surrounding of a place in a playful way, like the most popular LBG Geocaching. This can also be combined with purposeful tasks like the collection of geospatial data in CityExplorer [1]. Other games provide information about historical places like in Viking Ghost Hunt [2] or information about nature like in AnswerTree [3].

Another group of LBGs are adapted computer games. One of the most popular examples is Pac-Man which was realized as an LBG version by Pac-Manhattan [4] or PAC-LAN [5] in an outdoor setting thus placing virtual collectibles on the street. Those can be grabbed just by logging your own positions or reading RFID tags attached to real collectibles. Another example are botfighter games like Botfighters [6] and Alien Revolt [7], where players try to locate and destroy other bots to earn credits. Early attempts used SMS communication, but with the rise of smartphones they mostly use native mobile apps and GPS sensor data.

While both groups naturally translate to direct gameplay, a round-based approach could also be considered for some of these games. Imagine Pac-Man as a less stressful version where both the player and the monsters move for 30 seconds alternately. Thus the findings of our work can be considered helpful also for these types of LBGs.

Nevertheless, the focus of our work is on the third group, namely adapted table games as LBGs. Examples are CityPoker [8], where players have to find poker cards hidden in public locations, Mobile Monopoly [9] where real geographic places can be bought virtually and other players have to pay rent, or GeoTicTacToe [10] where players have to reach virtual squares on a map to set an *X* or an *O*.

The question whether to keep or drop the round-based approach in this case has already been studied before. Nicklas et al. [11] recommend to give up the turn-based character and replace it with geographical zones or a parcours where the players can move freely. Schlieder et al. [10] point out that a challenging location-based game must balance reasoning skills and motor skills of the players during
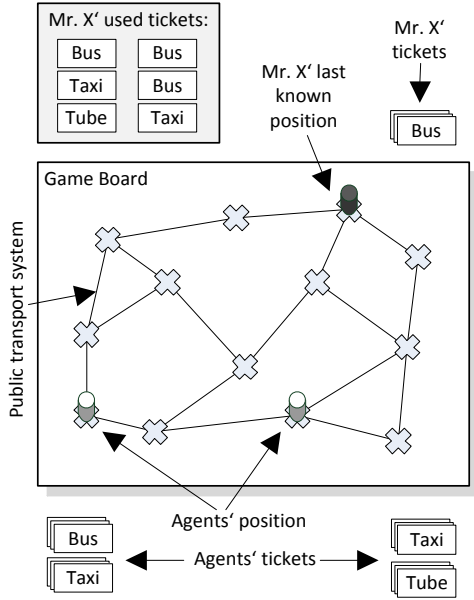
Figure 1.   Schema of the original board game.

Scotland Yard	Mobilis XHunt
Game Board	
city of London	map overlay of any city
positions	real stations of the transportation systems
Game Items	
tickets	tickets of real transport vehicles
list of used tickets	
-	multi-user chat
-	departure monitor
Game Piece	
player token	geo position of the real player
Action	
choose next position	
use ticket	
move token	real player movement
Turn	
actions: choose next position; choose ticket; move to next position	
Activity Phase	
consists of one `Turn`	
Round	
Mister X starts	
agents active in sequence	agents simultaneously active
ends if last agent finished	ends if players reached target positions

gameplay. If one player has better motor skills, he should not always be able to take advantage of that. Schlieder et al. propose a certain waiting time (maybe while solving some mini puzzles) after each move of the faster players to solve this synchronization problem. Their GeoGames framework helps to find out the best value for the synchronization time.

All the works mentioned above only implement one of the two versions, i.e., round-based gameplay or direct gameplay thus making a comparison of both approaches difficult. Our work is the first attempt to develop two variants of an adaptation of the same table game with either of the two approaches. Thus, the pros and cons of each of the two alternatives can be compared more directly.

III. DESIGN ALTERNATIVES

In this section we want to discuss the different design approaches of the two Location-based Games. Both LBGs are based on the board game "Scotland Yard".

A. Original Board Game

The original board game "Scotland Yard" published by Ravensburger[1] was awarded "Game of the Year" in 1983. The general idea of the game is that Scotland Yard agents try to track down the wanted criminal Mister X in London. Mister X and the agents use the public transport to move within the city. The city of London and its public transport system (with a reduced set of stations) are projected to the game board as sketched in Figure 1. As Scotland Yard is a round-based game, the players move their tokens one

after the other, according to the transport tickets they have left. There are four kinds of transport means: taxi, bus, underground and water bus.

The current position of Mister X is only revealed periodically, but the agents do always know the transport means he chose, as they can see the used transport tickets. Once an agent arrives at a station where Mister X resides, the game is over because Mister X was caught. Mister X wins, if he does not get caught in 24 rounds. The board game can be played by three to six players.

B. Round-based Gameplay - Mobilis XHunt

By designing the round-based version Mobilis XHunt, we resolved the game into its basic elements like in [11]. To adapt the game flow of a turn-based game, we had to extend this definition by the following elements:

Action An action describes a single act of a player in respect to the game rules, e.g., move the game piece.

Turn A turn is a sequence of actions a player can make in regard to the game rules.

Activity Phase An activity phase is a part of a round which determines which player is allowed to move and which players have to wait. In a usual turn-based game, each player gains one activity phase per round in which he can perform a sequence of turns.

Round A round itself is therefore defined as a sequence of activity phases defined by the game rules. There also has to be a rule for the order of the activity phases and the end of a round.
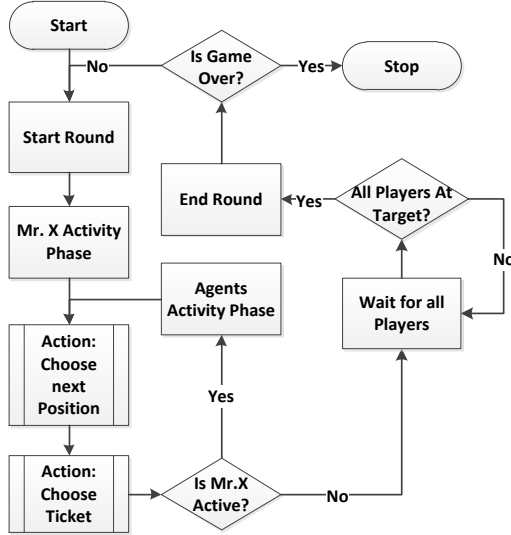
Figure 2. Flowchart of the turn-based approach.

Table I provides the mapping of the above elements from Scotland Yard to Mobilis XHunt. Creating such a mapping is the first recommended step in the design of an LBG adaptation of a board game (either round-based or direct gameplay).

The location of each player in Mobilis XHunt is tracked by GPS and reported to the game server. If a player is on the move to his next target position, the game server checks if he is in geographical range and notifies all players when he reaches his position. If there are still players on the move, the players which are already at their target location have to wait until each player is in range of his target position. To move forward it is required to use a public transportation vehicle of the transportation system. Like the original game rule, Mister X will only be visible in special rounds at his current position.

In our approach we lifted up the constraint of only one activity phase at a time for the agents. Therefore we had implemented the following two game states: Mister X can choose his next target and the agents can choose their next target. The movement of all players happens simultaneously. To synchronize all players, we introduced synchronization points at the beginning of each round, e.g., to update all players' tickets. The complete game flow chart of our rule-based design is shown in Figure 2.

From the developer's perspective there is a lot of time saving while using an existing game concept and just adapt the location-based elements. While this implies some waiting time for synchronization, we implemented a chat which enables the players to communicate with each other and discuss the game strategy in the group of agents.

C. Direct Gameplay - Mister X® mobile

For Mister X® mobile, the fundamental game idea of "Hunting Mister X" shaped the development of the mobile version more than the board game's rules and limitations: How would a group of detectives chase the suspect in the real world, given that they have a "magic tool" – their smart phone? How would they interact? Can they be successful in their hunt?

We transferred the general concept of revealing Mister X's location in regular intervals and the visualization with colored tokens on a map, but dropped the board game limitations of rounds, discrete map positions and transport restrictions. The position revealing was defined in time intervals instead of round multiples, players are displayed in near real-time[2] with exact GPS locations on a continuous map.

To recover the game balance required to create a satisfying experience for all players, additional – magical – elements had to be added to the game: A circular game border projected on the map visualizes the game play field. Mister X is displayed for all players in real-time when leaving the field. This restricts the game to the designated area and prohibits "foot races" (Mister X runs only in one direction, everyone else follows).

Additional variants have been introduced via "virtual gadgets", available as a limited resource upon game start and collectable within the playing field. These gadgets include among others a "magic hat" (to make the player's pointer on the map transparent for a short time, thus the player becomes somehow invisible), "smoke screens" to disable the players' maps temporarily in a small area and "the scream" to initiate a displeasing sound and disclose physically hidden players. To simplify player coordination, telephone conferences can be initiated between the detectives (and consciously eavesdropped by Mister X).

An important element of the mobile game is its embedding in the social interaction: the game is supported by technique, but realized in the players' world and imagination. Therefore, many elements of the game are based on the players' common agreement, e.g., the choice (and exclusion) of means of transportation, the handling of temporarily unavailable GPS and the game's termination before end of game time by the capitulation of Mister X. More details on Mister X® mobile can be found in [12] and [13].

D. Technical Issues

In order to compare both location-based games, we have to point out the different stages of development. Until now, Mobilis XHunt is just a prototype, that needs some more fine-tuning to make it ready for the market. On the other hand Mister X® mobile is advanced enough and can already

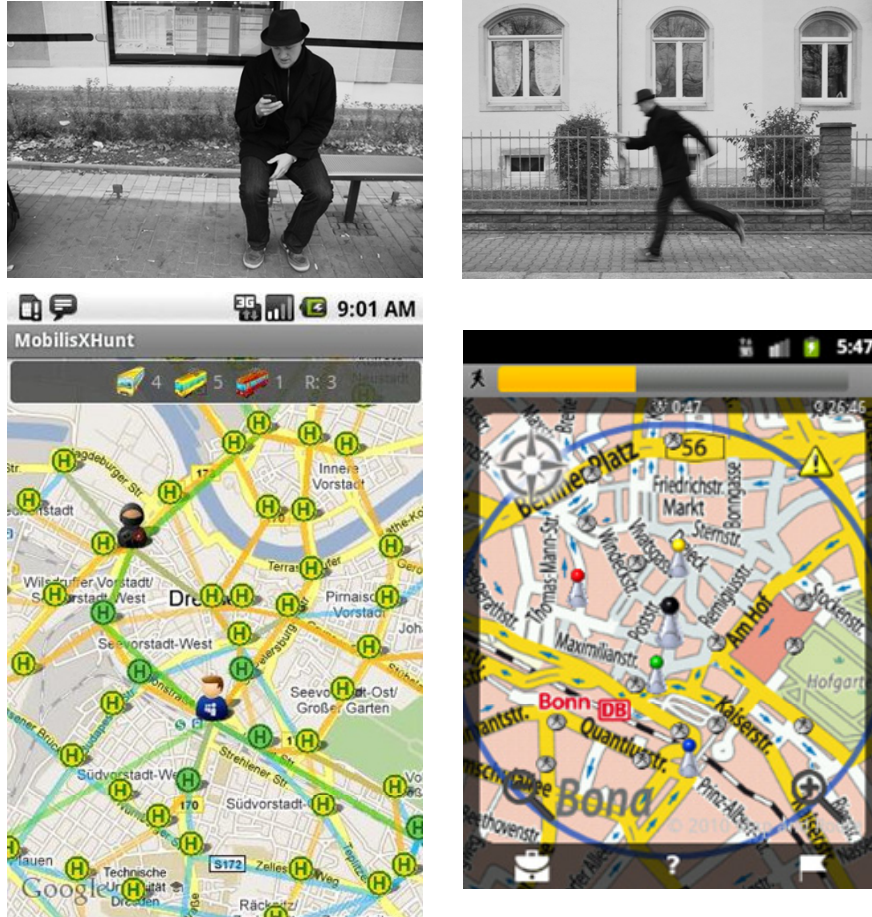[2]5-10 seconds delay for detectives, revealing interval for Mister X.

Figure 3. Screenshots and typical user experience of Mobilis XHunt (left) and Mister X$^{\circledR}$ mobile (right).

be downloaded from the Android Market and Apple's App Store.

Apart from this, the setup of both games is comparable. Both use a dedicated game server which handles the gameplay. Mobilis XHunt is based on the Mobilis platform [14] and thus uses XMPP-based comunication while the communication of Mister X$^{\circledR}$ mobile consists of HTTP messages. The communication cost of both games is comparable, as most of the traffic is caused by the location updates (every 5-10 seconds from each player). Mobility issues like short phases of disconnection are handled inside the game servers.

IV. USER EXPERIENCES

We performed a field trial, in which we wanted to find out the differences of both games from the users' perspective. This section describes the gameplay of both games in the real world, examines the evaluation results of the field trial and discusses these results.

A. Playing the games

The first difference of the games can be found already before playing. With Mobilis XHunt the user finds a list of all nearby games, which have not been started yet. The user can join one of these open games or just create his own game. In the lobby all participants of a game can communicate with each other in the multi-user chat room and decide whether to be the hunted Mister X or an agent.

Mister X$^{\circledR}$ mobile realizes a slightly different approach for the game start. It shows all available players within a defined radius (100m to 10 km) on the map. The initiator of a game invites some (or all) of the nearby players to his game. If all participants are ready, the initiator starts the game.

The course of both games highly differs. Mobilis XHunt only allows the players to use the public transport to move from one station to another. As it is round-based, the players have to get to their starting stations in the initial round. After all players reached their initial target station, the actual game begins. The turn-based game flow was described before and is visualized in Figure 2.

Mister X$^{\circledR}$ mobile on the other hand has no restrictions on how the players move. The players can set up a common set of rules (e.g., no bikes, no buses) on their own, but these

rules are not enforced by the game application. As all players (including Mister X) usually start the hunt from one location, Mister X gets a certain amount of time in advance to run and hide from the agents. After this time, the agents can start to pursue Mister X.

Both games end like the original board game. The game is over, if the wanted Mister X was caught by the agents or he managed to escape. In Mobilis XHunt Mister X gets caught by staying at the same public transport station like one of the agents. In Mister X® mobile he literally gets caught by the agents and has to capitulate then.

The user interfaces of both LBGs are shown in Figure 3. As the public transport plays an important role in Mobilis XHunt, the transportation system is presented beside the current positions of the players. Mister X® mobile shows the game field as a circle on the map. Additionally it shows special gadgets on the map that the players can collect.

B. Evaluation results

To emphasize the strengths and weaknesses of both design approaches, we defined a set of properties to characterize this kind of games. On the basis of the Likert rating scale method the participants had to rate different properties of the games from 1 to 5, where 1 means the property was evaluated as very bad and 5 as very good. The following properties build the basis of the evaluation, where the numbers in the braces determine the points:

- Fun: How much fun (5) was the game or was it boring (1)?
- Smooth progression: How smooth (5) or sluggish (1) was the game progression?
- Dynamic gameplay: Does the game evolve self-dynamism (5) or was it just static (1)?
- Easy to play: How easy (5) or difficult (1) was the game concerning game structure and process?
- Stressless gameplay: Was the player more relaxed (5) or in hurry (1) while playing the game?
- Communication: Was there a lot (5) or no (1) communication during the game?
- Strategy: Was it possible to evolve complex strategies (5) or not (1) while playing?
- Clear rules: Were the rules of the game perspicuous (5) or ambiguous (1)?
- Low risk: Are there low risks (5) while playing or could it be dangerous (1)?
- Education: Does the player learn a lot (5) during the game or nothing (1)?

The application tests and questionnaire were performed with 7 participants who played Mobilis XHunt and 15 participants who played Mister X® mobile. Six of the participants had a direct comparison of both games. To regard the properties in an overall context of each approach, Figure 4 visualizes them using a radar chart.
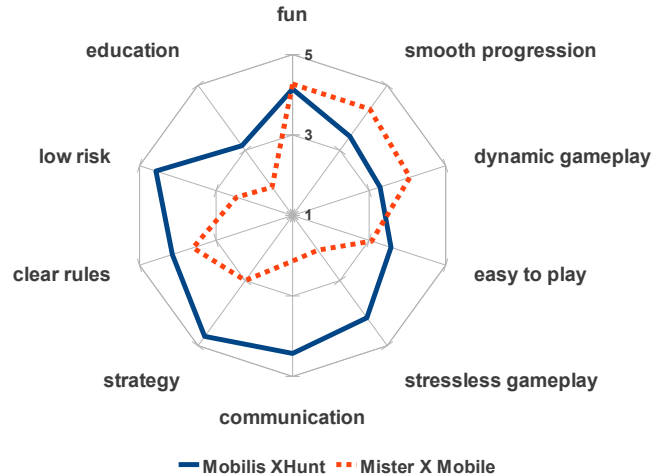

Figure 4. Radar chart of evaluation results. Better scores do not necessarily point to a better user experience (e.g., stressless gameplay may be considered boring by some players).

C. Discussion

As can be seen from the results, none of the two approaches is superior in all the categories. While the users experienced direct gameplay as a little bit more funny, they especially acknowledged the smooth progression and dynamic gameplay of the direct approach.

On the other hand, educational aspects, clear rules, strategy and stressless gameplay were the main points users liked about the round-based approach. A special indicator is low risk, as Mister X® mobile requires the players to run fast and thus they sometimes crossed streets in a dangerous way. But the "low risk" and the "stressless" criteria could also be considered as describing a boring game by some players. Communication among the players was better in the round-based approach as they had enough time waiting at the stations to use the chat. With direct gameplay, users are more concerned running fast to reach Mister X than communicating with their teammates to discuss a certain strategy.

It is important to mention, that there are no weights given with the criterias. Although round-based gameplay was rated better in 7 out of 10 categories, all the players playing both games did not have a clear favorite. This assumes that the categories fun, smooth progression and dynamic gameplay have a higher individual weight to players than the other criterias.

This is in line with the findings of Schlieder et al. [10] argueing both reasoning skills and motor skills should be balanced for a game to be most challenging. Thus a hybrid approach combining the strengths of both approaches would be most desirable.

One possibility is to use direct gameplay but force people somehow to use public transport which will give them some moments to rest and thus reduce stress. This also

strenghtens the role of place, which is important when designing successful LBGs (see Reid [15]). Another idea is to use a strength variable like in [9] where players loose strength whenever they are moving too fast and thus have to slow down from time to time.

Another option is to keep the round-based approach but enhance the waiting time of the players with some additional game elements. This could be small games or quizzes attached to the location (see [16]) or the city where players can earn points that may optionally be traded against tickets or the ability to uncover Mister X.

A third approach is to completely drop the session-based character of the game and make it pervasive thus interweaving with a person's normal activity (see [17]). In this case, the game would be played through the course of a longer period (e. g., a week) and the goal would be to catch Mister X occasionally while roles of agents and Mister X could change periodically. A score would be given for each successful catch.

V. Conclusions

This work investigated on the role of rounds in Location-based Games, especially when adapting table games as an LBG. It is the first attempt to compare two versions of a popular table game as an LBG with direct gameplay vs. round-based gameplay.

Evaluation showed that the benefit of rounds depends on the weights of the criterias like smooth and dynamic gameplay, low risk, clear rules or role of strategy. LBGs should unify both approaches to best match their player's expectations.

Besides the short-term criterias used in the evaluation, there are more possible mid-term or long-term criterias related to gameplay, i.e., balanced chances for all players to win the game, fun over a longer period of time, variability of the gameplay from game to game, or the ability to develop good strategies when playing the game frequently. To evaluate these criterias, a long-term field study should be carried out with a panel of players playing both games frequently over a longer period of time.

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