Playing on a line: Location-based games for linear trips

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ABSTRACT
Most location-based games are designed for players who move freely around a geographic game board such as a city centre or a campus. By contrast, we discuss design issues for location-based games played when traveling from *A* to *B* on a predefined route, e.g. when following a biking trail along a river. We present the results of a simulation study that compares different alternatives of adopting a two-dimensional location-based game to a linear feature. As our running example for a linear location-based game, we use a geographic version of the board game Alak, the most popular linear game from the family of Go games.

Categories and Subject Descriptors
K.8 [**Personal Computing**]: General – *Games*

General Terms
Design, Theory.

Keywords
Location-based games, game design, game theory, Go

1. INTRODUCTION
Most location-based games are played either on city-wide (e.g. [1]) or on campus-size game areas (e.g. [4]). All of them take place in two-dimensional space which implies that players are allowed and required to change their x- and y-coordinates freely. However, in many practically relevant use cases, a player may not be able or willing to leave a one-dimensional path during the game. This case arises especially in transportation situations where the player uses a bike or a car to travel from *A* to *B* on a predefined route. A typical example is a biking tourist on a bike path along a river whose major focus is directed towards the biking tour, and who is therefore not disposed to invest too much effort into playing (casual gaming). Such a player will only move along a well-defined spatial path that is known before the game starts. Locomotion is constrained to forward and – occasionally – backward movements along that path. However, backward movements are not really an option, as the players major goal consists in completing their trip from *A* to *B*.

Such linear location-based games have, for instance, been discussed by Gustafsson et al. who dealt with games that are played while sitting in the back of a car (“Backseat games”). Their focus was on the tangible device design for such games (e.g. [3]). The special constraints arising from the linearity of the game area were not discussed.

2. A LINEAR VERSION OF GO
We will use the board game Alak, a one-dimensional version of Go, as a use case for a linear game. In contrast to other board games, Alak is already a linear game in its original version. It was first described in a novel by A.K. Dewdney (see [2]). An Alak game board consists of n linearly ordered board positions. We choose a board of size seven (w.l.o.g.). Two players (black and white) take turns in setting markers on this game board. As in the two-dimensional Go, players strive for dominating the game board by removing the opponent’s markers. Also similar to Go, a group of markers is removed when it is enclosed by opposing markers and/or the edge of the board. Due to the one-dimensionality, “enclosing” in Alak is much simpler than in Go. When a player’s markers have been removed, he may not set a new marker at the same positions in his next move. The game ends when the player at turn has no more move options. The player with more markers on the board wins; an equal number of markers for black and white means draw.

In the location-based version of Alak, a player needs to move physically to a board position to set a marker. This means that setting a marker on a field close to a player’s current position consumes less time than moving to positions that are further away. All moves happen concurrently so that the turn taking of the original board game disappears. We introduce the synchronization interval (syncTime) typical for Geogames [5] into the rules: a player who has reached a location is required to spend at least the duration of syncTime there before the field becomes occupied.

For our analysis we implemented a spatio-temporal MinMax algorithm similar to that used in [5]. The algorithm takes as an

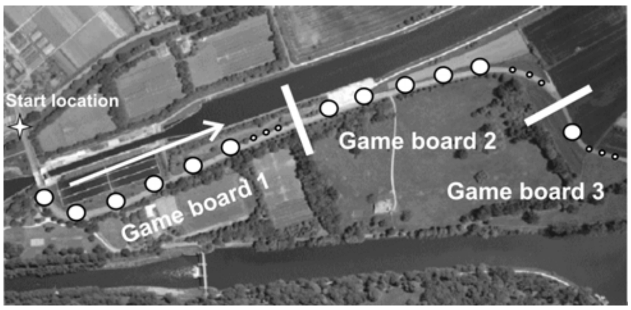

Figure 1: Linear location-based game played on repeating game board

input the distances between the board positions (measured in time units needed for moving there), the starting position for both players, the speed difference between the players, and the duration of syncTime. As an output, we get the optimal path through the game tree, i.e. what happens if both players act optimally, and the ways both players have totally covered during the game.

We analyzed three location-based variants of Alak: (1) Alak on a single game board. In this case, players are allowed and required to move in both directions. The syncTime interval is implemented as wait time on the location. (2) Alak on a repeating game board (similar to Fig. 1). In this case, players are only allowed to move forward. Again, syncTime is implemented as wait time. (3) Like 2, but syncTime passes while the player is moving on.

We arranged the seven board positions with distance 1 time unit between any two neighboring fields. The same distance is also used between the starting location and the first board position, as well as for the distance between the last location and the first on the next game board (for variants 2 and 3). In contrast to [5], we are not interested in varying syncTime and speed-difference here, so we fix them to syncTime=5 and speed-difference=9% (player white is 9% faster than player black). syncTime and the time needed to travel between fields are measured in abstract time units that can easily be converted to real times and real distances for a given average speed.

3. RESULTS AND DISCUSSION

Table 1 lists the results for the optimal path through the game tree for the three variants. The column "number of game boards" contains the number of repeating game boards needed for that game. In Alak (1) we do not have any repeating game boards. For the other variants, we need an additional game board whenever the way covered by a player has exceeded a multiple of seven. This is the moment the player crosses the boarder of a game board and enters the next one. Thus, we get the third column by calculating:

ceiling(max(totalWayWhite, totalWayBlack)/7).

Comparing variants (1) and (2) we notice that the total way covered by the players (totalWayWhite and totalWayBlack) does not differ considerably. That means that playing on consecutive game boards does not result in players having to travel longer. However, they certainly had a more diversified journey because they did not cover a way twice. Comparing variants (2) and (3) we notice that there is a considerable difference in the total ways covered and in the number of game boards needed. This gives us the possibility to adjust the game rules to the length of the journeys planned. For example, we could give the biking tourist the possibility to choose variant (2) or variant (3) depending on the length of his bicycle tour.

Let us assume, for example, we want to arrange an Alak (2) game on a bike path of length 21km, so that we get for 3 repeating game boards a distance of 1km between any two neighboring locations. Thus, 1 time unit is defined as the time needed for traveling 1km. We estimate the players' speed as 20 km/h and finally get 1 time unit = 3 minutes. A syncTime of 5 time units in an Alak (2) game would mean 15 minutes waiting. However, if we think that 15 minutes is too long, we can choose an Alak (3) game on the same 21km which would lead to a shorter syncTime (7,5 minutes) which, of course, passes by while traveling.

Although Alak is just one (very simple) game, playing on consecutive game boards is an option for all location-based games in which relevant game actions take place only at a certain number of discrete locations. Additionally, we can generalize by saying that all games that need a syncTime offer the possibility to adjust the length of the journey by switching from variant (2) to variant (3).

In this paper we have discussed critical design issues for location-based games played on one-dimensional game boards. The idea to use consecutive game boards combined with the spatial synchronization time lets also casual gamers participate in such location-based games. The analysis of the one-dimensional game Alak showed furthermore that such a linear location-based game can be played on a linear feature of given length, like a biking trail.

Our future work will concentrate on finding more appropriate game patterns to realize different kinds of games for the casual location-based player. A linear game concept that proved itself in theory needs to be embedded in an exciting story-board to become an interesting game. Especially an adequate real world embedding needs to be found, i.e. we must give the abstract game objects (like markers) a meaning beyond the logical game rules. In this context we are currently working on a location-based guide with an integrated location-based game for the biking trail along a river feature, especially tailored for biking tourists.

variant	totalWayWhite	totalWayBlack	#game boards
Alak (1)	16,10	11,99	1
Alak (2)	14,00	15,26	3
Alak (3)	37,10	35,26	6

Table 1: Simulation results for three versions of Alak

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