

# Electronic Augmentation of Traditional Board Games

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**Abstract.** Manufacturers of traditional board games are looking for ideas to innovate their products and keep up with the popularity of modern computer games. We developed an idea of how traditional board games can be augmented with modern technology and how electronics can increase the level of excitement and board game pleasure. The concept of a self-conscious gameboard is proposed and its viability demonstrated through a case study in which the popular board game *Settlers of Catan* was electronically enhanced.

## 1 Introduction

Modern technology results within the world of gaming almost solely in games that are targeted at the individual. On the contrary we find an enormous range of traditional board games that are played with family and friends around the table. Sales of board games in both Europe and the US have risen strongly since the year 1995 [1]. Some sociologists see this as a direct result of economic recession and the threat of terrorism and war [2]. Given the rise of computer games and the parallel revived interest in board games, crossover between both could be expected [3], but till now hardly seen.

In this paper we explore what value modern technology can add to the social-interactive character, the excitement and/or entertainment value, and also to the usability and flexibility of board games, played within the “traditional” context of family and friends. From our work we derived recommendations for electronically augmenting board games and we propose the concept of the *self-conscious gameboard*. Finally, these recommendations were applied to a case study in which we digitally enhanced the popular board game *Settlers of Catan* [4].

## 2 Exploring Electronic Augmentations

**Trends in Board Games.** From interviews and questionnaires that we conducted among the target groups of manufacturers, game authors and players, we identified trends in board games, market developments, past and future plans, opportunities and limitations of electronically augmented board games. Our findings are extensively reported in [5].

**Possible Electronic Augmentations.** Until recently, electronic game enhancements were limited to modest sound effects, lighting, or simple physical movements driven by servo motors. *King Arthur* of designer Rainer Knizia is currently one of the very few board games claiming to incorporate “intelligent electronics” that give feedback

depending on decisions made by players earlier in the game. Subjects in our questionnaire [5] were asked to consider among other things the following possible augmentations in board games: (1) integrated digital game rules enabling error detection and prevention, animated game examples, and electronic teaching of rules to players (2) randomization, e.g., changing the gameboard composition (3) automated administrative tasks, such as registration of time, scores, game movements, and player statistics (4) artificial intelligence, e.g., autonomously functioning game pieces, simulation of extra players, suggestions for game moves (5) audiovisual feedback in the form of light, audio effects, music, visual animations (6) saving and restoring game situations (7) automated physical tasks, like gameboard setup, dealing cards, actuating moves. These and additional possibilities are also discussed in [5] and [6].

**Conclusions and Recommendations.** From our survey [5] we conclude that innovations should have a clear added value to the game concept and introduce new elements. Most importantly, the pleasure of playing a board game should be increased, while the existing physical elements of the game are preserved as much as possible. Summarizing, one could say that the added technology should fill holes in the game concept, that cannot be filled using traditional manners. The electronic enhancements desired most by our subject groups are: (1) randomly changing gameboard composition (2) integrated digital game rules, automatic error detection and prevention (3) simulation of additional players. One should keep in mind that electronic augmentations do not solely bring advantages. For example malfunctioning of the electronics can be expected. Also, unforeseen situations in pre-programmed game-logic could introduce problems. Further, a game should always stay transparent to its players. Obscured technology can give rise to confusion among players. To conclude, selling prices will be higher, due to increased costs for development and production. The conclusions from our survey are consistent with recommendations by Lundgren [6].

### 3 The Self-Conscious Gameboard

Given the results of our research we propose a conceptual framework within which future development of electronically augmented board games can be discussed: the *self-conscious gameboard*. It should be able to recognize the state and composition of all its elements: game floor, field tiles, and game tokens. The gameboard controller can identify all elements and request, set and communicate the state of these elements. A short explication of its elements:

- The *controller* is the computational unit, computer or microcontroller placed in or nearby the gameboard. It serves as the central “brain” in which the state of the gameboard is registered, user input analyzed, rules of game applied, scores registered and feedback initiated.
- The *game floor* is a matrix (or other fixed pattern of cells) on top of which the playfield is constructed. On each cell a field tile can be positioned. When there are no individual field tiles, the game floor can be seen as one field tile.
- *Field tiles* form the first layer on top of the game floor. Together they form the playfield. A field tile can have one or more states, based on its orientation/rotation,

type of tile and game tokens placed on top of it. Examples are the natural resource hexagons in *Settlers of Catan*.

- *Game tokens* are placed on top of the field tiles. As far as its characteristics are concerned, a game token is similar to a field tile: it can have several states that may be registered and altered by the controller. Its state may for instance be determined by its ownership, such as with hotels in *Monopoly* or the pieces in a game of *Chess*.
- *Game control elements* provide additional ways to supply the controller with event triggers and data (e.g., dice, configuration switches), but also means to offer feedback to the players (e.g., LCD display, LED, speaker).

Obviously, to implement a self-conscious gameboard, some minimal electronic infrastructure is essential for the controller to register the state of the game and give appropriate feedback. Given the scope of this short paper it is not possible to explicate physical wiring and electronics issues. For this we refer to [5], in which we describe how the number of required electronic contact points can be limited to  $\lceil \sqrt{2 \log(n \cdot R + 1)} \rceil$  where  $n$  is the number of recognizable game tokens or field tiles, and  $R$  is the number of recognizable rotations of such elements. Once the hardware infrastructure is realized, more functionality can be added rather easily by extending the software in the controller. The state of the individual elements is changed appropriately in the controller and communicated to the players through the available channels of feedback.

## 4 Case Study with *Settlers of Catan*

To assess the weaknesses and strengths of our proposed concept of a self-conscious gameboard, a case study was undertaken. We chose to electronically augment an existing board game, as opposed to creating a new game. By this (1) we can compare the enhanced version to its original, (2) we ensure that the quality of the game itself is a proven fact, and (3) attention is focussed on the electronic enhancements, and not drawn away by a new board game.

*Settlers of Catan* [4] is a highly acclaimed multiplayer board game, and one of the best selling games of the last few years. The game presumes that its players are new settlers on the uninhabited island of Catan. During the game, settlers tap the land's natural resources to build roads, settlements, and cities. Resource production is controlled by two six-sided dice. A player's progress is recognized by victory points that are earned by building principalities and other. The first settler to declare that he has accumulated the required number of victory points wins.

In the traditional version of *Settlers of Catan* hexagonal field tiles represents one of six natural resources. A number between two and twelve is assigned to each tile indicating the dice value that must be tossed to earn that certain resource; their positions are unchanged during the game, after their (semi-)random initialization. In the electronically augmented prototype of *Catan*, each field tile has a seven-segment LED-display installed, showing its number. At the start of the game, the task of distributing the numbers on the board is automated. During a game the displayed numeric values may randomly change every ten minutes, or every ten turns. This results in a constantly changing gameboard and new opportunities for the players. Our

board is fitted with a digital dice function that tosses between 2 and 12 using a selectable chance distribution (double-diced or uniform). The tossed number is indicated with a LED on each field tile that lights up on payout. The “robber” game token of *Catan* connects to a slot on every field tile, enabling the controller to recognize its position and thus inhibiting payout of resources (indicated by a red LED instead of green).

Several test teams of experienced *Catan* players played games on the prototype. The general opinion of the subjects was that the introduced randomization of numbers gives a strong added value to the level of excitement and game pleasure. The regularly changing gameboard altered player’s opportunities, raised tension, and largely influenced player strategies. Although no real dice are used in the augmented version, their digital replacement was hardly mentioned by the testers, which points towards transparency of this technology. The choice between two chance distributions for the dice was deemed a unique feature. Because the original cardboard and wooden game elements were preserved in the prototype, the nostalgic feel of the game remained.

## 5 Discussion

The electronic augmentation of board games is still in its infancy. World leading board game manufacturers, although sceptic, are willing to invest resources in the development of such games. Important obstacles are the costs of development and production and the need for game designers to accumulate knowledge on modern technology. Our studies showed that for the consumer it is essential that the added technology is non-obtrusive and provides clear benefits in game pleasure, ease of use, and level of excitement. Through a case study in which *Settlers of Catan* was electronically enhanced, it was proved that the proposed concept of a self-conscious game board is viable and capable of heightening a board game’s appreciation, particularly through dynamic changing of the game board. The case study also showed player’s positive reception of the unexpected new possibilities to customize a game to their own likings. We trust that with the proposed concept of a self-conscious gameboard we contributed to future discussions regarding electronically augmented board games.

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