Exploring Board Game Design Using Digital Technologies

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Figure 1: *Adding extensibility to games using modularized units fabricated by laser cutters*

1. Introduction

This talk presents results of a case study from a course called "History of Games" offered at the School of Art + Design at New Jersey Institute of Technology. After analyzing various traditional board games and their mechanics, students explore the possibility of producing their own original board games by altering various existing game structures through application of new technologies such as digital prototyping, including laser cutting and 3-D printing, and microcontroller technologies. In principle, we can fully emulate the playing of a board game such as Monopoly inside a computer, digitally. However, there is a certain quality of physicality with traditional board games that cannot be experienced through games in fully digital environments. The existence of tangible game pieces, boards, and real human players can produce cooperation, engagement, and tensions unlike those in video games and AR-based applications. Through this project-based course, students further explore how new technologies can help in developing new types of games.

2 Our Approach

Advantages in Digital Crafts

Figure 2: *Digital Crafts*

Applications of digital technologies have several obvious advantages for making physical board games. The use of digital prototyping tools such as laser cutters and 3-D printers can introduce a level of craft that cannot be achieved through traditional manual production by hand in terms of balance between speed and quality in design, three-dimensional complexities, and the number of variations that can be produced in a short time. Figure 2 shows game pieces printed directly from a 3-D printer based on 3-D models designed by a student, demonstrating a wider range of options for formal aesthetics.

Hybridizations:
Many traditional board games, such as chess, go, and checkers, possess characteristics of an abstract strategy game, having no hidden information, no non-deterministic elements, and two players taking a finite number of alternating turns. However, there are many physical games, such as the block stacking/removing game, Jenga, which possess random elements and real-time simultaneous engagement by players through the presence of their physical characteristics. Maintaining intellectual tensions that exist in classic abstract strategy games, while adding features from games that require physical skills to play, will create a completely new hybrid game. Figure 3 shows an example of a student game that asks players to strategically lay out 3-D roller coaster tracks toward an opponent's area, taking alternating turns, and in which physical movements of marbles rolling on tracks add dynamic results that rely also on players' physical skills and luck.

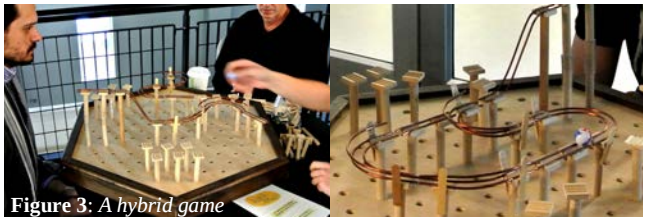

Figure 3: *A hybrid game*

Extensibility:
Another advantage explored by students is extensibility of games. Many traditional board games have fixed and predefined board layouts with limited play options. The use of digital prototyping tools allows us to quickly produce modularized units that can be reconfigured. These modularized units allow players not only to play a game, but also to create multiple game layout options and add extensibility to games (Figure 1).

3. Real-time Interactions and Future Work

Finally, sensors and microcontroller technologies can add real-time interaction to physical games that are traditionally turn-based and asynchronous, and potentials in this direction are currently being explored (Figure 4). The author will discuss how new technologies using prototyping and microcontroller platforms can produce new kinds of physical gaming experience that cannot be fully explored solely through traditional crafts.

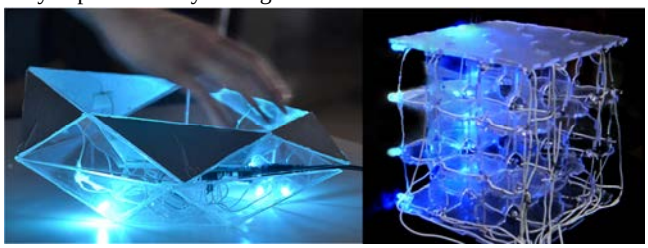

Figure 4: *Sample games that use sensor-based interaction, randomness represented by physical blinking of LED lights, and a light cube that changes its patterns based on its orientation, using an accelerometer.*

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