Socially Relevant Simulation Games: A Design Study*

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ABSTRACT

Socially Relevant Simulation Games (SRSG), a new medium for social interaction, based on real-world skills and skill development, creates a single gaming framework that connects both serious and casual players. Through a detailed case study this paper presents a design process and framework for SRSG, in the context of mixed-reality golf swing simulations. The SRSG, entitled "World of Golf", utilizes a real-time expert system to capture, analyze, and evaluate golf swing metrics. The game combines swing data with players' backgrounds, e.g., handicaps, to form individual profiles. These profiles are then used to implement a golf simulation game using artificially controlled agents who inherit the skill levels of their corresponding human users. The simulation and assessment modules provide the serious player with tools to build golf skills while allowing casual players to engage within a simulated social world. A framework that incorporates simulated golf competitions among these social agents is presented and validated by comparing the usage statistics of 10 PGA Golf Management (PGM) students with 10 non-professional students.

Categories and Subject Descriptors

I.6.8 [**Simulation and Modeling**]: Types of Simulation/ Gaming

General Terms

Design

Keywords

Simulation, social gaming, golf swing analysis, real-time motion capture, background assessment

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1. INTRODUCTION

Game developers distinguish between realistic simulations, referred to as "serious games", and games intended to incorporate social networks and interaction, referred to as "social games". Most game designs fall into one category or the other. Consequently, each of these types of games tends to be adopted by a specific target audience. Despite the separate game development processes this distinction has created, the possibility exists to make a game socially relevant without losing the requirements of a simulation or serious game. This paper presents a design process; example title, the World of Golf; and in-depth case study, that effectively blends the two forms to create Socially Relevant Simulation Games (SRSG).

2. BACKGROUND

2.1 Serious Games

Serious games serve to educate, rather than entertain. Their primary purpose is to provide an interactive means by which a knowledge domain can be transferred to the player [9]. The audience for these games depends upon the subject matter present in the game. It consists of players who wish to train or learn a specific skill set, including experts and players who are already somewhat knowledgeable in the subject matter presented in the game, and often a serious game provides direct, visual means by which these players can assess themselves [12]. Many simulation games can thus be considered serious games[6].

Based on Moizer's work, we define a "serious game" as a game that:

1) Is intended to educate or train the player.

2) Contains a direct (usually visual) means of assessing skill or learning.

3) Employs a game interface which provides the above two features.

2.2 Social Games

The goal of "social gaming" is to incorporate, as seamlessly as possible, the social interactions and networks which occur in the real world in a virtual environment [11]. As such, the audience for social games includes players who wish to socialize and interact within this virtual environment[1][3]. Social games may provide little benefit for single-player gameplay, and some may not include single-player functionality at all. Also, since the focus of a social game is on the social interaction, the game itself becomes a platform to facilitate

this interaction [5], and thus the details of the game's subject matter are considered less significant. Facebook games are a modern example of this gaming category [4].

We define a "social game", or a game which is "socially relevant", as a game that:

1) Requires little or no knowledge about the game's subject domain in order for a player to enjoy the game.

2) Employs an interface, central to enjoyment of the game, that is designed to connect its player base through multiplayer gameplay.

3. A DESIGN FRAMEWORK FOR SOCIALLY RELEVANT SIMULATION GAMES

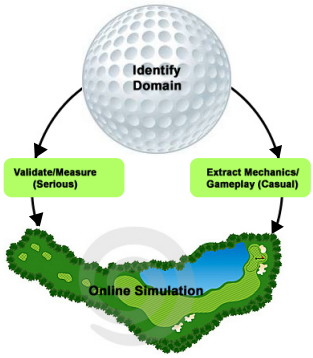

Figure 1: SRSG Design Flow Diagram

We have developed a framework for SRSG that includes a three-step design and development process, focusing on the design of the simulation, consistent interfaces for all users, and social hooks.

Step 1. *Simulation*: In this step the development team designs the simulation, or core serious game aspects, of the SRSG in a manner that ensures that it realistically and convincingly models the level of skill and domain knowledge of users.

Step 2. *Consistent Interfaces*: After completing Step 1, the development team must translate elements of the interface that has been developed to provide a consistent interface which is both informative and simple to understand for both casual and expert players.

Step 3. *Social Hooks*: Expand the completed simulation with social hooks and features to attract and entertain the casual audience.

Using the same process, games which are currently simulations can be modified and expanded into social simulations using steps 2 and 3. The design process is illustrated in Figure 1.

4. WORLD OF GOLF

To demonstrate the efficacy of the SRSG design process we employed it to create the World of Golf as a generalizable SRSG. It is a golf swing simulation that includes a simple, yet powerful method for facilitating online social gaming. We chose this subject domain because it includes easily measurable metrics of skill and performance and is an activity which facilitates social interaction among players.

4.1 Step 1: Design of a Simulation

In order to create an accurate simulation and to complete the first step of our design process, we begin by establishing metrics which can serve as criteria for assessment and training. This process is critical for any simulation to be considered "serious", and the amount and types of metrics depend on the subject matter taught by the simulation.

4.1.1 Golf Swing Metrics

In general, metrics for the first step of the SRSG design process should be chosen based on two requirements:

1) The metrics should be accurately measurable using the chosen method of input.

2) The metrics combined should form an accurate assessment of a player's skill level in the subject domain.

With these goals in mind, World of Golf's game engine uses five golf swing metrics to determine what to look for in a player's golf swing. They are as follows:

1. Club Speed - The vector representing the force acting upon the ball at time of collision, vimpact, is directly affected by the speed of forward motion with which the player swings [7].

2. Club Face - The angle of the club head's face - open, closed or square - affects the direction of travel and curvature of the shot [10].

3. Club Path - The path traveled by the club head during the swing influences direction of flight. This influence increases as club speed increases [8].

4. Centeredness at Contact - The distance travelled and direction of a ball are both influenced by how close the ball was to the club head's "sweet spot".

5. Angle of Approach - The steepness of the angle at which the club head approaches the ball during the swing affects how far the ball travels and how curved its path becomes [2].

These five metrics interact to form a near-precise measure [8] of the flight path of the ball after contact, and help World of Golf satisfy the first step of the social simulation design process.

4.1.2 Swing Assessment

The next step is to design an interface which brings the learning elements in the simulation to the player. In the general case, this includes both player input and feedback from the simulation. By establishing this interface, we complete step 1 of the design process. For this purpose, World of Golf utilizes real-time capture of 3-axis data from the Wiimote's accelerometer. The user holds the accelerometer with the y-axis pointing downward toward the ball and the z-axis facing in the direction opposite the shot. The x-axis represents the displacement of the club handle toward or away from the golfer.

The club then forms a "swing plane" which intersects a "ground plane" to represent a club path, as indicated in Figure 2. Deviations from this plane by the club head result in changes to the centeredness of contact, and a different club path results in a new swing plane altogether.

4.2 Step 2: Design of an Interface

Having completed the first step, we now arrive at the second part of the SRSG design process, the development of a uniform interface which includes features targeting both expert and casual audiences. In general, the interface for

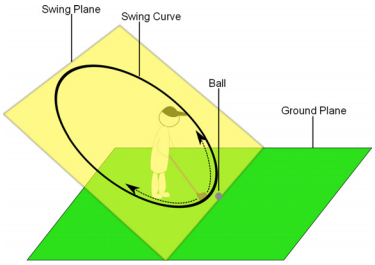

Figure 2: Planar Swing Model

a SRSG should be designed so that, while some elements target expert audiences and some focus on casual audiences, all elements are accessible, to a reasonable extent, by both audiences.

The interface displays a set of bars which represent the magnitude of movement of the golf club on the x, y, and z axis, along with the numeric values themselves. The bars are used as a form of visual feedback which is simplistic enough for casual players to determine how powerful and how steady their swing was, while at the same time providing the raw numeric values for use by experts to determine where improvement should be made in their swing. The goal of this design strategy is to satisfy the requirements in step 2 of the design process (to develop a uniform interface that engages both targeted audiences).

4.3 Step 3: Social Hooks and Attractive Features

The remaining task is to fulfill the requirement of a socially relevant game. Since at this point, we have already developed a complete game, the goal is to expand the game with social hooks and features which facilitate player interaction. In order to fulfill this third and final step of the SRSG design process, World of Golf includes a "golf world" module. This module was incorporated into the design to allow players to get visual feedback on their performance and skill level. Values for each metric are used to compose a virtual golf player, an artificial agent whose play style and swing depend directly upon these retrieved values.

This module serves as the social hook which connects players, both casual and expert, to other players through their avatars in the game world, creating interactions typical in a social network game [4]. When a casual player is matched against an expert player, the system automatically adjusts the performance requirements to keep the gameplay balanced, allowing for a fair match despite the difference in skill between the two players. This connection between the two audience groups completes the final step of the design process, making the game enjoyable for both groups.

5. EVALUATION

To demonstrate that World of Golf satisfies the requirements of the SRSG design process, we evaluate it as a simulation. While this evaluation is not a core part of the design process, it is useful in ensuring that one has met the requirements of both gaming categories. Since the "Golf World" interface is yet to be complete, we leave the evaluation of World of Golf as a social game for future work, and instead focus on the serious game elements of the prototype. In order to determine the validity of the real-time assessment performed by the software, the system was evaluated by comparing profile assessments of golf students against those of non-golf students. The goal of the evaluation was to ensure that the assessment rating scored by a golf player is consistently higher than the rating scored by a player who is a beginner or who does not play golf.

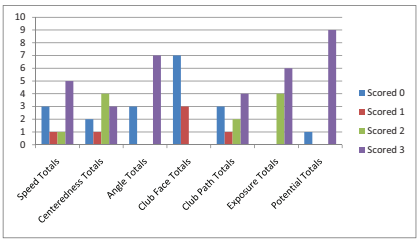

Figure 3: Swing Assessment Scores for PGM Students

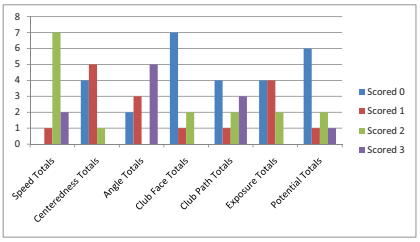

Figure 4: Swing Assessment Scores for Non PGM Students

5.1 Procedure

The study was performed at a driving range of a PGA Golf Management (PGM) program housed in a university. 10 PGM students and a control group of 10 non-PGM students anonymously participated in the evaluation. Each student was instructed to swing the Wii remote until he or she was satisfied with the last swing. Each student also completed the questionnaire along with his or her swing and an anonymous profile was created for that student.

Students were scored on each of the five metrics (club speed, club face, club path, centeredness at contact, angle of approach) as well as on level of exposure to the sport and level of potential. All students were given the same set of instructions and tested under the same condition. Number of attempts varied, and only the last swing attempt was given a score. The score represented the overall swing performance for each student.

5.2 Results

For the questionnaire module, the responses of PGM students indicated both high levels of exposure and high potential. Worth noting is that none of the PGM students tested scored below a "2" in exposure, as indicated in Figure 3. This indicates that the scaling on exposure should be increased to account for professional players, as the soft-

Averages	Speed	Centeredness	Angle	Club Face	Club Path	Exposure	Potential
PGM	1.8	1.8	2.1	0.3	1.7	2.6	2.7
Non-PGM	2.1	0.7	1.8	0.5	1.4	0.8	0.8

Figure 5: Swing Assessment Averages

ware in its current state did not differentiate well between the students themselves. The range of exposure levels for non-PGM students was slightly more evenly distributed, as shown in Figure 4, though no non-PGM student scored a "3" in exposure among those tested.

For the swing metrics, scores of PGM students tended toward extremes, whereas those of non-PGM students varied less. 5 indicates the averages of students tested in each of these metrics for both PGM and non-PGM students. Non-PGM averaged higher in speed, and their club faces were more likely to be open club faces. They scored an average of 2.1 in speed, beating the PGM students by 0.3, and 0.5 in club face, beating the PGM students by 0.2.

For centeredness, club angle, and club path, PGM students scored consistently better on average than non-PGM students. In centeredness, PGM students scored 1.8 on average, 0.7 higher than that of the control group. In angle, they averaged 2.1, beating the non-PGM testers by 0.3. In club path they held an 0.3 point advantage as well, scoring 1.7 in comparison to 1.4 for non-PGM.

5.3 Analysis

The advantage in speed and openness of club face in non-PGM students can be accounted for by the observation that these students, most likely as a result of inexperience, focused on swinging the club with as much force as possible, giving much less consideration to the accuracy of their swing or the steadiness at the point of impact. The reasoning might be that these students interpreted a "good" golf swing as one with the greatest speed at impact with the ball. Their grips on the Wii remote were less steady, causing the wrists to rotate significantly at impact and the club face to switch often to an open position.

While PGM students scored lower in speed and club face metrics, their swings were far more steady and precise on average. Based on similar reasoning, the PGM students would focus less on putting force in their shot and tended to focus more on maintaining proper shoulder, wrist and body positioning during the swing. This scored them almost an entire point higher on average in centeredness and gave them approach angles and club path scores which indicated a more experienced golf swing. Based on the scores output by the software, PGM students performed better overall and indicated far higher levels of experience and potential, a result which supports the validity of World of Gold as a simulation.

6. CONCLUSION

World of Golf demonstrates that through a framework for SRSG that applies a three- step design process, it is possible to create a game which satisfies the interests of both experts and casual players, and do so without isolating the gameplay experience of the two groups. This design study applies the SRSG design process to a physical simulation involving motion detection and synthesis; however the design process could theoretically be applied to any simulation whose subject matter involves some form of social interaction, using the criteria and requirements described. In addition to providing a strategy for the development of new, socially-aware simulations, the proposed design model encourages the expansion of pre-existing simulation games without modification of the core elements, allowing them to engage a larger audience.

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