ACSIJ Advances in Computer Science: an International Journal, Vol. 4, Issue 6, No.18 , November 2015
ISSN : 2322-5157
www.ACSIJ.org

ACSIJ
WWW.ACSIJ.ORG

Analysis of the "Heroes of the Storm"

Shuo XIONG[1], He ZHAI[2] , Long ZUO[3], Mingyang WU[4] and Hiroyuki Iida[5]

[1,2,3,4,5] School of Information Science, Japan Advanced Institute of Science and Technology, Nomi, Ishikawa, 923-1211, Japan
[1]xiongshuo@jaist.ac.jp
[2]zhaihe@gmail.com
[3]zuolong@jaist.ac.jp
[4]gawain513@jaist.ac.jp
[5]iida@jaist.ac.jp

Abstract

Game refinement is a unique theory that has been used as a reliable tool for measuring the attractiveness and sophistication of the games considered. The refinement measures were derived from game information progress model and have been applied in various types of games. This paper focuses on the game refinement theory and its application to a MOBA game "Heroes of the Storm" (HOS), which was produced by Blizzard Entertainment in 2014. Furthermore, we evaluate the measurement for different maps of HOS. Experimental results show that a game refinement value of HOS was between 0:08~0.1 for which previous works have confirmed.

Keywords: *Game refinement theory, Heroes of the Storm, MOBA.*

1. Introduction

1.1 MOBA game

Multi-player Online Battle Arena (MOBA) [1], also known as Action Real-Time Strategy (ARTS), in which a player controls a single character at one of two teams. The objective is to destroy the opponent team's main structure with the assistance of periodically spawned computer controlled units. Player characters typically have various abilities and advantages that improve over the course of a game and that contribute to a team's overall strategy. A fusion of action games and RTS games, players do not construct either buildings or units [4]. The genre traces its roots to Aeon of Strife (AOS), a custom map for StarCraft where four players each controlling a single powerful unit and aided by weak computer-controlled units were put against a stronger computer-controlled faction [5]. Defense of the Ancients or "DOTA" [2], a map based on Aeon of Strife for Warcraft III: Reign of Chaos and The Frozen Throne, was one of the first major titles of its genre and the first MOBA for which has been kept sponsored tournaments. It was followed by two spiritual successors: "League of Legends" (LOL) and "DOTA 2". Generally, the Original MOBA game map is shown in Figure 1. From the Figure 1, we can see that MOBA game has developed over 17 years. However, DOTA 2 and LOL are very hard to learn that makes a lot of new players jump away from the game. This situation greatly limits the development of the MOBA game. In this case, a subversive game called Heroes of Storm came out in 2015.

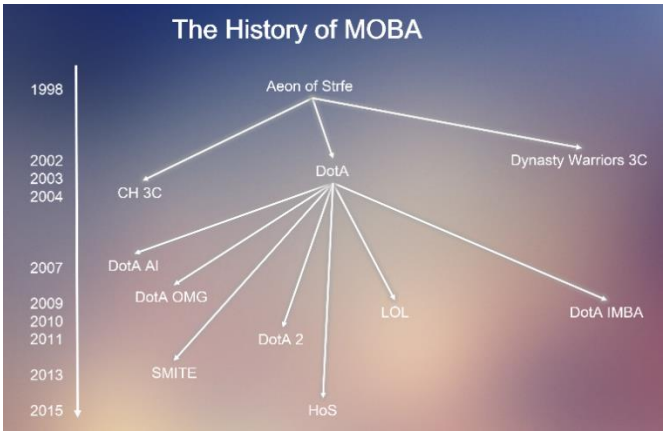

Fig 1. History of MOBA game

1.2 Research Object: Heroes of the Storm

Heroes of the Storm (originally titled Blizzard DOTA and later changed to Blizzard All-Stars) is a multiplayer online battle arena video game which has been developed by Blizzard Entertainment. The game features heroes from Blizzard's franchises including Series of Warcraft, Diablo, and StarCraft. [3].

In order to develop the game rhythm and make more interest for players, Blizzard has revised a lot of mechanisms to modify the traditional MOBA game. Heroes of the Storm revolves around online 5-versus-5 matches, operated through Blizzard's online gaming service Battle.net. Players can choose one among three game modes, which make the players play with/against computer-controlled heroes or other players. When players first start the game, they may play five heroes provided by the free hero rotation, a methodically selected list that changes weekly, but by using gold, the in-game source of wealth, or through micro transactions, they can gain permanent access to a hero. Two additional heroes are available to players who have reached level 15. As of July 2015, there are currently 39 heroes in the game divided into 4 separate roles. Of the currently released maps, 6 of the 8 have the standard 3 main lanes where players can fight, while the others have only two main lanes, but a separate objective-based area. Killing enemy/neutral units

and the opposing side's heroes grants experience points, which are shared with the entire team. When a certain experience threshold is reached for a team, each hero on that team levels up, acquiring slightly amplified status and gaining a talent point upon reaching levels 1, 4, 7, 10, 13, 16, and 20. Talent points allow players to customize their hero's abilities and generally result in large increase in power, especially for levels 10 and 20. This level-up system emphasizes the importance of teamwork, since a player's action can affect the whole team. Minions at neutral camps can be defeated to gain mercenaries that fight for the player. Each map has a different side-objective that will help either team deal significant damage to the other.

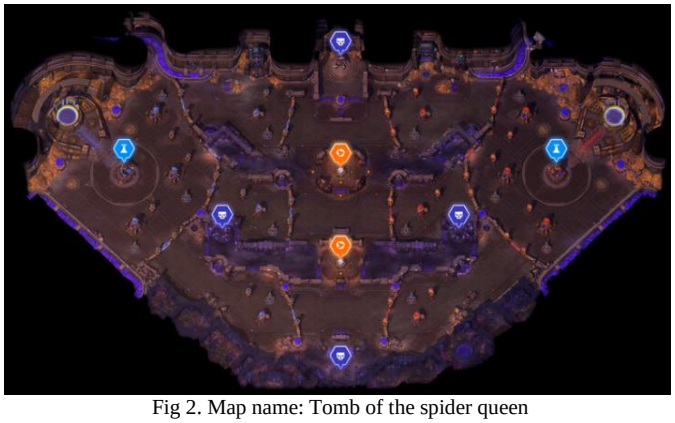

Fig 2. Map name: Tomb of the spider queen

Fig 3. Map name: Garden of Terror

There are many different maps existed in the Heroes of the Storm. For each map, players can choose the corresponding strategy to fight against each other, also the same hero can choose the different talent to fit the map environments as shown in Figure 2 and 3 [10].

2. Game Refinement Theory

2.1 Original game refinement theory

We give a short sketch of the basic idea of game refinement theory from [9]. The "game progress" is twofold. One is game speed or scoring rate, while another one is game information progress with focus on the game outcome. In sports games such as soccer and basketball, the scoring rate is calculated by two factors: (1) goal, i.e., total score and (2) time or steps to achieve the goal [6]. Thus, the game speed is given by average number of successful shoots divided by average number of shoot attempts. For other score-limited sports games such as Volleyball and Tennis in which the goal (i.e., score to win) is set in advance, the average number of total points per game may correspond to the steps to achieve the goal [10].

Game information progress presents how certain is the result of the game in a certain time or steps. Let G and T be the average number of successful shoots and the average number of shoots per game, respectively. If one knows the game information progress, for example after the game, the game progress x(t) will be given as a linear function of time t with $0 \leq t \leq T$ and $0 \leq x(t) \leq G$, as shown in Equation (1)

$$x(t) = \frac{G}{T}t \quad (1)$$

However, the game information progress given by Equation (1) is unknown during the in-game period. The presence of uncertainty during the game, often until the final moments of a game, renders exponential game progress. Hence, a realistic model of game information progress is given by Equation (2).

$$x(t) = G\left(\frac{t}{T}\right)^2 \quad (2)$$

Here n stands for a constant parameter which is given based on the perspective of an observer of the game considered. Then acceleration of game information progress is obtained by deriving Equation (2) twice. Solving it at t = T, the equation becomes

$$x''(T) = \frac{Gn(n-1)}{T^n}t^{n-2} = \frac{G}{T^2}n(n-1)$$

It is assumed in the current model that game information progress in any type of game is encoded and transported in our brains. We do not yet know about the physics of information in the brain, but it is likely that the acceleration of information progress is subject to the forces and laws of physics. Therefore, we expect that the larger the value $\frac{G}{T^2}$ is, the more the game becomes exciting, due in part to the uncertainty of game outcome. Thus, we use its root square $\frac{\sqrt{G}}{T}$, as a game refinement measure for the game under consideration. We can call it R-value for short.

2.2 Identify the Headings

Here we consider the gap between board games and sports games by deriving a formula to calculate the game information progress of board games. Let *B* and *D* be average branching factor (number of possible options) and game length (depth of whole game tree), respectively. One round in board games can be illustrated as decision tree. At each depth of the game tree, one will choose a move and the game will progress. Figure 1 illustrates one level of game tree. The distance *d*, which has been shown in Figure 1, can be found by using simple Pythagoras theorem, thus resulting in $d = \sqrt{\Delta l^2 + 1}$.

.

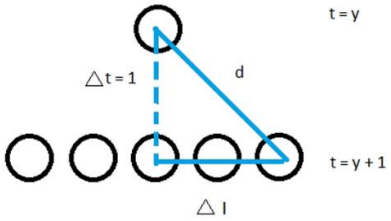

Fig.4 Illustration of one level of game tree

Assuming that the approximate value of horizontal difference between nodes is $\frac{B}{2}$, then we can make a substitution and get $d = \sqrt{(\frac{B}{2})^2 + 1}$. The game progress for one game is the total level of game tree times *d*. For the meantime, we do not consider Δt^2 because the value ($\Delta t^2 = 1$) is assumed to be much smaller compared to B. The game length will be normalized by the average game length *D*, then the game progress *x(t)* is given by $x(t) = \frac{t}{D} * d = \frac{t}{D} * \sqrt{(\frac{B}{2})^2} = \frac{Bt}{2D}$. Then, in general we have, $x(t) = c\frac{B}{D}t$, where *c* is a different constant which depends on the game considered. However, we manage to explain how to obtain the game information progress value itself. The game progress in the domain of board games forms a linear graph with the maximum value *x(t)* of *B*. Assuming $c = 1$, then we have a realistic game progress model for board games, which is given by

$$x(t) = B\left(\frac{t}{D}\right)^n \quad (3)$$

Equation (3) shows that the game progress in board games corresponds to that of sports games as shown in Equation (2).

In addition, the branching factor B can be defined as the number of possibility. For example in table tennis, each round of game could be regarded as one depth/length, for each round, there are only two possibility– win or lose. Therefore, another definition is a way to figure out the progress model of a target game using two factors: possibility result (say W) and total round of entire game (say T). R-value is given by $R = \frac{\sqrt{W}}{T}$. To support the effectiveness of proposed game refinement measures, some data of games such as Chess and Go [6] from board games and two sports games [9] are compared. We show, in Table I, a comparison of game refinement measures for various type of games. From Table I, we see that sophisticated games have a common factor (i.e., same degree of acceleration value) to feel engagement or excitement regardless of different type of games [8].

Table 1: Measures of game refinement for various game

Game	G or B	T or D	R-value
Chess	35	80	0.074
Go	250	208	0.076
Soccer	2.64	22	0.073
Basketball	36.38	82.01	0.073
DotA ver 6.48	69.2	110.8	0.075
DotA ver 6.64	68.4	110.4	0.075
DotA ver 6.80	68.6	106.2	0.078

3. Game Refinement Theory in HOS

We consider the game progress of Heroes of the Storm. It can be measured by two factors: kill heroes and destroy fortress. Let K and A be the average number of successful killing heroes and destroying fortress, and the average number of attempts per game, respectively [7]. If one knows the game information progress, for example after the game, the game progress *x(t)* will be given by Equation (4).

$$x(t) = \frac{K}{A}t \quad (4)$$

A model of Heroes of the Storm game information progress is given by Equation (5).

$$x(t) = K\left(\frac{t}{A}\right)^2 \quad (5)$$

Here n stands for a constant parameter which is given based on the perspective of an observer in the game considered. Then acceleration of game information progress is obtained by deriving Equation (5) twice. Solving it at t = A, the equation becomes

$$x''(T) = \frac{Kn(n-1)}{A^n}t^{n-2} = \frac{K}{A^2}n(n-1)$$

Therefore, the refinement value in Heroes of the Storm can be described as the Equation (6)

$$R = \frac{\sqrt{K}}{A} \quad (6)$$

As game players, the first thing they care about is how to develop themselves and limit the development of the enemy. Each player have different role in the game, therefore players have to choose the different kinds of heroes and their talent base on the corresponding map. In order to make the data more objective and reasonable, we choose the expert players' video to analyze data. The statistics was collected the data of killing and the destroyed fortress of each replay. As the Table 2 shows, the results of different map using game refinement measure by computer system, and one fortress equal to four defense force, then we have $K' = K + 4 * D$.

Table 2: Measures of game refinement for each map in Heroes of the Storm

Map	K	D	A	K'	R
Blackheart's bay	37.300	8.4	71.7	70.900	0.117
Sky temple	38.875	9.7	70.2	77.675	0.126
Dragon Shire	39.100	6.2	82.6	63.900	0.097
Tomb of the Spider queen	45.800	7.3	90.7	75.000	0.095
Infernal shrines	39.875	5.8	87.2	63.075	0.091
Cursed hollow	40.350	7.3	93.4	69.550	0.089
Battlefield of eternity	44.950	5.5	93.8	66.950	0.087
Garden of terror	37.225	7.9	81	68.825	0.102
Haunted mines	38.875	4.2	73.9	55.675	0.101

4. Discussion and Comparison

We collected data of Heroes of the Storm (HOS) for each map. Then, we applied game refinement theory application in Section II and Section III. In the previous studies, it is found that sophisticated R-value in each game between $0.07 - 0.08$. However, we see that the results show much higher values for HOS battle. It means this game will be too excited which is suitable for especial viewer such as boxing which is extremely

exciting sport. Compared with other MOBA game such as DOTA, we can summarize the conclusion as below:

- As a new game, HOS still has some insufficient aspects. In fact, until our research was done, only 43 heroes can be chosen, however, there are 112 heroes in DOTA. Many new heroes should be added and the current heroes' parameter should be changed.
- Generally, the R-value in HOS is too high even approach 0.1, and DOTA almost in the window value which between 0.07 and 0.08. It means DOTA fit to set as an e-sports competition item, but HOS is fit to do entertainment. DOTA has powerful skill and more visual impact for each hero, what cares more about management and running. Players need to make a stable and safe environment for carry and develop. Gank usually happens during the whole game. However in the HOS, the most important thing is large-scale team combat, therefore, the game rhythm is much higher than DOTA. Generally, a DOTA game may spend about 40 minutes but HOS usually within 20 minutes. HOS offers game players a new style of MOBA game that spends less time of each game and form a fast rhythm.
- According to the Table 2, the most interesting and exciting map are Sky temple and Blackheart's bay. Battlefield of eternity and Garden of terror are suitable for e-sports competition. In fact, DOTA can consider make more maps in the future to improve the fun level. The higher refinement value will be tenderer to the freshman players. DOTA is very unamiable to the new players.
- For the mechanism, DOTA focus on the anaphase period during the game, but the core mechanism in HOS is wild monster. For this reason, the game depth of HOS is less than DOTA and gets a larger R-value. Therefore, HOS cares more about teamwork not personal operation and game awareness.

Nevertheless, the fun of HOS is not derived only from battle. The various heroes and their talent can provide a lot of enjoyment for Blizzard fans. In addition, they can design maps that are more interesting. For example, control the map mechanism to keep the R-value between 0.07 and 0.08, what suitable for held e-sports use.

5. Conclusion

This paper we have extended game refinement theory to the field of HOS and builds a model of measurement for each map in HOS. The results of computer analysis confirmed HOS has the similarity of game entertainment impact like sports games and board games. It means that multi-player game also follow the principle of seesaw games. Compared with the other MOBA game such as DOTA, the game rhythm of HOS is much higher, it means player can feel more enjoyable from this game, on the other hand it shows HOS has lacked serious competition. HOS is trying to increase the amount of team play involved; this will absolutely lead to more fun than ever before. However, we need further investigation in collecting data and apply game refinement theory to another famous MOBA game such as LOL. Finally, further work may be considered the comparison of three popular MOBA games (DOTA, LOL and HOS).

References

[1] Multi player online battle arena,
http://en.wikipedia.org/wiki/Multiplayer online battle arena

[2] DotA, http://en.wikipedia.org/wiki/Dota
Heroes of the Storm, https://en.wikipedia.org/wiki/Heroes of the Storm

[3] C. Chambers, W.Feng, W.Feng, and D.Saha. (2005). Mitigating information exposure to cheaters in real-time strategy games, In Proceeding of NOSSDAV '05 Proceedings of the international workshop on Network and operating systems support for digital audio and video, pp.7–12.

[4] D.Cheng, R.Thawonmas. (2004). Case-based plan recognition for real-time strategy games. In Proceedings of the 5th Game-On International Conference, pp.36–40.

[5] H. Iida, N. Takeshita, and J. Yoshimura. (2003). A metric for entertainment of boardgames: Its implication for evolution of chess variants. Entertainment Computing Technologies and Applications, pages 65–72.

[6] H. Iida, K. Takahara, J. Nagashima, Y. Kajihara and T. Hashimoto.
(2004). An application of game-refinement theory to Mah Jong. In Entertainment Computing–ICEC2004, pp. 333–338. Springer.

[7] XIONG Shuo, ZUO Long and H. Iida (2014). Quantifying Engagement of Electronic Sports Game. Advances in Social and Behavioral Sciences,5, 37–42.

[8] A. P. Sutiono, A. Purwarianti, and H. Iida. (2014). A mathematical model of game refinement, in D. Reidsma et al. (Eds.): INTETAIN2014, LNICST 136, 148–151.

[9] J. Takeuchi, R. Ramadan, and H. Iida. (2014). Game refinement theory and its application to Volleyball, Research Report 2014-GI-31(3),Information Processing Society of Japan, 1–6.

[10] Heroes of the Storm Game guide. 2015 BLIZZARD ENTERTAINMENT, INC. ALL RIGHTS RESERVED. url: http://us.battle.net/heroes/e