

## Eye-Movement Pattern by Playing Experience in Combat System of FPS Game

GyuHyeok Choi<sup>1</sup>, Mijin Kim<sup>2</sup>

<sup>1</sup> Department of Visual Contents, Dongseo University,  
47 Jurye-ro, Sasang-gu, Busan, 617-716, KOREA  
choi8603@hanmail.net

<sup>2</sup> Division of Digital Contents, Dongseo University,  
47 Jurye-ro, Sasang-gu, Busan, 617-716, KOREA  
Corresponding Author: mjkim@dongseo.ac.kr

**Abstract.** In playing FPS game, immediate perception of information on play situations and direct and indirect information gathering through a player's own past experience plays an important role. Visually perceived information is particularly a means for direct information gathering and it can be utilized as data to analyze user-oriented gameplay behavior. This study divides subjects into two groups (novice and expert) based on playing experience in FPS game and makes subject play a certain game level selected as the research target. We adopts Eye-tracking to trace player's eye movement and to collect and analyze visually perceived information (500 movie clips), which is to observe whether there is a certain pattern in a subject's eye movement. Through analyzing such characteristics, this study intends to confirm the need of concrete information gathering which is necessary for the structure setting of game levels.

**Keywords:** Game playing experience, Eye-tracking, Eye-Movement pattern

### 1 Introduction

FPS (First Person Shooter) game is of a play structure that the first person's viewpoint is focused on controlling a character to achieve a goal on a certain game level through combat against opposing characters (another player or AI\_Bot). Thus, the degree of interaction with game level is higher than other genres and gameplay behavior may vary through interaction [1, 2]. As it is possible to directly give significance to character's move controlled by player and play behavior, game developers have to give much consideration to adjusting balance of character and game level.

Game playing experience refers to controlling over genres with a similar game play structure or memories including information on similar geographic features. When faced with a similar circumstance or environment, a player compares it with his past experience and behaves in the light of optimized movement. One who lacks empirical information which may affect gameplay behavior is commonly called Novice and game developers offer tutorial to supplement their experience. On the other hand, one who has extensive and rich playing experience is called Expert and

their playing experience makes it easy to adapt to a new game or a game level when they are first exposed to it. Game playing experience, therefore, serves as a factor to help to adapt to a certain game and analysis on player's behavior depending on his experience level can give concrete information in order to set game levels [3, 4].

What matters in FPS games is information immediately perceived through player's eye. Therefore, data collecting and analysis on player's eye movement can tell which point or object is perceived by player on a certain game level and what kind of behavior is observed through his perception. Information obtained through this process enables proper response to setting for game level components and level of difficulty. Such behavior is required on testing phase of game development and it is recognized as one of methods to evaluate a certain game's Usability and Playfulness for players.

This study intends to examine eye-movement pattern depending on player's playing experience in FPS games. On a combat situation, the FPS game's main part, this study tries to examine what kind of patterns is observed respectively on novice's and expert's eye movement. Eye-movement pattern is classified on the basis of playing experience and before and after a combat situation. Through this process, this study has significance in that information is collected which can lead to player's increased absorption on the game level designing phase.

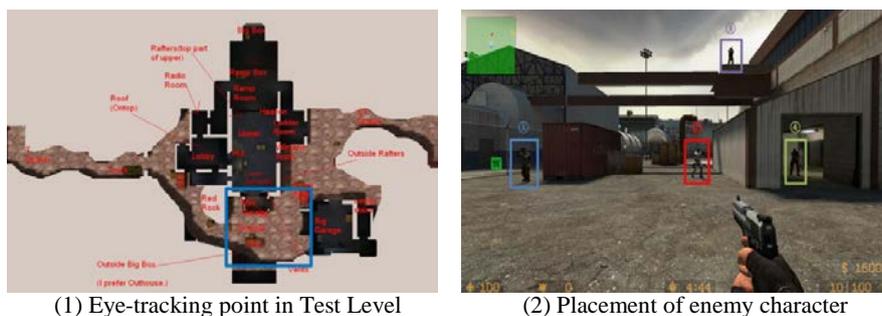
## **2 Eye-Tracking for User Experience**

Eye-tracking refers to tracing a subject's pupil to check optic information within a certain period of time. Eye-tracking has been mainly used for usability evaluation which aims for marketing information gathering. It is game field where UX is required the most. It is because a game is designed as intended by game developers but feedback on player's behavior has a direct impact on the game's life cycle. The impact is greater particularly in case of online games on which player's feedback information is updated in real time and so are the contents with frequency. Thus, observation and analysis process on points subject to player's visual perception can be utilized as a means to improve the game's playfulness.

## **3 Experiment**

The process to set such gameplay space is called game level design and its components are called Level Design Pattern (LDP hereafter) on FPS games [5]. Each LDP plays different roles and they are arranged to help or disturb the accomplishment of a goal, affecting a player's gameplay behavior [6, 7]. LDPs can be classified into ones that can be set as game level designer's intention and arbitrary ones that occur for player's gameplay. There are 7 items of LDP that can be set as game level designer's intention (Stronghold, Arena, Split Level, Gallery, Turret, Vehicle Section, Hidden Area) and 4 of them are frequently used (Stronghold, Arena, Split Level, Gallery) [8].

The Test Level (de\_nuke in Counter-Strike:Source) selected as the research target is a level on which the frequently used 4 items are included and a point where a player can simultaneously detect an opposing character on the 4 of LDP is chosen as the Eye-tracking spot.



**Fig. 1.** Test Level Setting

The Marked on Fig. 1.(1) is a position where all of 4 LDPs can be seen and it includes ①Gallery, ②Arena, ③Split Level and ④Stronghold of Fig. 1.(2). As a player should destroy all opposing characters arranged on different LDPs on the same screen, it is a point where both novice's and expert's eye movement can be clearly observed.

Criteria adopted to classify the novice and the expert is based on experience in FPS games. There are 10 participants in total (5 novices and 5 experts respectively). Subjects in the novice group have played less than 2 kinds of FPS games and spent 10 hours or less on game levels with 4 representative goals (destruction, explosion, occupation, and rescue). Ones in the expert group have played more than 3 kinds of FPS games and spent 10 hours or longer on game levels with the aforementioned representative goals and 1 hour or more every week.

### 3.1 Method

4 AI\_Bots are arranged as opposing characters on the point subject to Eye-tracking on the Test Level. AI\_Bots are put on 4 LDPs (Stronghold, Arena, Split Level and Gallery) and play situations are saved as movie clips by using Remote mode which occurring on the Eye-tracking point while playing the game. Test period is 5 days (10 times a day) and 250 data from each group is collected, which amounts to 500 movie clips both on play and on eye tracking. The play video is used to analyze gameplay compared to the Eye-tracking one.

### 3.2 Result

As a result of analyzing 500 Eye-tracking movie clips collected, participants in both groups demonstrate and form a certain eye movement pattern. Types of the pattern somewhat vary in each group.

**Table 1.** Eye-movement pattern

	Novice	Expert
Eye-Movement Pattern		①→②→④→③
		①→③→④→②
		②→③→①→④
	①→②→④→③	②→③→④→①
	②→③→①→④	②→④→③→①
	②→③→④→①	②→①→④→③
	②→④→①→③	③→②→①→④
	②→④→③→①	③→④→②→①
		④→②→③→①
		④→③→②→①
Count of Pattern	5	10

Novices demonstrate 1 pattern that they perceive ① first and 4 patterns that they perceive ② first. Considering the types of pattern, novices see ② first, the center of screen where enemies are located. In addition, after they initially perceive an enemy, the nearer an enemy is from the first one, the sooner they tend to see it. Experts, on the other hand, demonstrate 2 patterns that they perceive ① first, 4 patterns on ② and 2 patterns on each ③ and ④. Experts also see the center ② first the most and they show 2 types of pattern that they first perceive enemies located at each kind of LDP. This result shows that there are differences in types of pattern depending on one's experience, but players' first look at the center of screen and that novices and experts indicate 4 patterns in common. It also shows that experts seek for fun with unexpected behavior based on their past experience.

All players perceive the center of screen first. In other words, they have a habit of priorly perceiving a point where the cross hair, the attack point indicated to the first person's view, is heading. Novices are not of unexpected behavior while experts often perceive the center of screen the most but they highly seek for fun based on unexpectedness. These results show features in player's eye movement.

- Players demonstrate 8 types before shooting (4 on each novice and expert) that they first perceive the enemy number ② located at the center of screen. It suggests that players tend to first perceive the center of screen where the cross hair to deal with an enemy is located.

- Novices and experts have 5 eye-movement patterns in common, which can be regarded as main eye-movement pattern. Through this pattern, novices perceive enemies and shoot them in order of their recognition while experts seek for a way other than this main pattern to perceive and shoot their enemies.

## 4 Conclusion

Among LDPs that can be set as game level designer's intention on FPS games, this study selects frequently used 4 patterns to examine whether there is a certain pattern of eye movement depending on a player's level of experience. To do this, Eye-tracking system is adopted and 500 movie clips both on behavior and on eye tracking for 2 groups of 10 participants (novice and expert) are collected and compared each other. The results obtained are as follows. 1) There are 5 main eye-movement patterns and most players' first perceive an enemy located at the center of screen. 2) In addition to the main pattern that matches that of novice group, expert group demonstrates some unexpected patterns, which can be interpreted as seeking for fun through unexpectedness. In short, according to novice's eye-movement pattern, the distance between enemies around the center of screen matters while experts tend to seek unexpectedness for more fun on a game level by comparing with their experience. The result tells us the relationship between a player's level of experience and eye-movement pattern and it is expected to provide information applicable on the game level designing phase through frequency test in addition to eye movement patterns. It is necessary to build up empirical data on eye-movement pattern with concrete analysis on results obtained from Test Level adopted in this study.

## References

1. Cheon, Y., Kim, M.: "A Proposal of Level Design Guidelines through Attribute Analysis of Cover Pattern on FPS Game by Theme," *Journal of Korea Game Society*, Vol. 5, No. 12, pp.35-48 (2012)
2. Choi, S., Kim, D., Young-Ook Kim.: "A Study on the Placement of Game Objects using Space Syntax," *Journal of Korea Game Society*, Vol. 5, No. 12, pp.43-55, (2012)
3. Bernhaupt, R., Eckschlager, M., Tscheligi, M.: "Methods for evaluating games: how to measure usability and user experience in games?," In: *Proceedings of the international conference on Advances in computer entertainment technology*, pp.309-310. ACM (2007)
4. Bernhaupt, R., Ijsselsteijn, W., Mueller, F. F., Tscheligi, M., Wixon, D.: "Evaluating user experiences in games," In: *CHI'08 extended abstracts on Human factors in computing systems*, pp. 3905-3908. ACM (2008)
5. Hullett, K., Whitehead, J.: "Design Patterns in FPS Levels," In: *the Fifth International Conference on the Foundations of Digital Games*, pp.78-85. ACM Press, New York (2010)
6. Drachen, A., Canossa, A., and Yannakakis, G. N.: "Player Modeling using Self-Organization in Tomb Raider: Underworld," In: *IEEE Symposium on Computational Intelligence and Games*, pp.1-8. IEEE Press (2009)
7. Pedersen, C., Togelius, J., and Yannakakis, G. N., "Modeling Player Experience in Super Mario Bros," In: *IEEE Symposium on Computational Intelligence and Games*, pp.132-139, (2009)
8. Choi, G., Kim, M.: "Player Behavior Analytics on Planned Level Design Patterns in Multiplayer FPS," In: *Third International Conference on the Smart Media Applications*, pp.196-199, (2014)