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A Study on VR Game Interface based on Mobile HMD

-Focusing on FPS Game-

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Abstract
With the proliferation of HMD devices using the smartphone display, VR games based on mobile HMD are getting developed. However, since mobile HMD VR games are at an early stage, an apposite interface and inapposite one mixed, a user cannot feel reliably involved in the game. This study conducted analysis and patternization on the interface of mobile VR FPS game using an absorption graph, targeting “First Person Shooting Game”, which has rather high ratio among mobile HMD VR game and is evaluated as an apposite one for user’s experiencing a virtual space strongly involved. According to the navigation in the VR game, there appeared the following three types: park position, rail move, free move. In this study, the level of absorption in the VR FPS game was observed according to that of each manipulation. As FPS games enters mobile VR environment, it developed to use only HMD devices and smartphone without separate controller, which has made a new trend automate existing manipulation. This study shows two problems of mobile HMD VR FPS game interface. The first is the shrinkage of a player’s role resulted from a function omitted and automated. Second is that minimization of providing information confuses the users. Until mobile VR game establishes itself as a game genre, many problems need to be solved.

Keywords: Virtual Reality, FPS Game, Interface

1 Introduction
In late 2015, as some VR(Virtual Reality) devices using the smartphone display became more and more widespread, related industries have also developed. A variety of HMD VR devices are being used with various softwares developed. Especially the VR contents are expected to generate new flows in the mobile application market.

The games do represent the largest share of total VR contents, which is the most absorbing field. Various genres of games have been launched such as shooting, escaping, running, RPG, sports, shooting games having the largest proportion. However, mobile HMD VR games are still in the early stages, which has prevented the user from being stably absorbed in the games with apposite interfaces and inapposite ones mixed.

For the sake of helping the users enjoy those contents easily and accelerating advance in that field, several ones should be clearly defined such as the users’ behaviour to play the game and the feedback of system on it. This study conducted analysis and patternization on the interface of mobile VR FPS game using an absorption graph, targeting “First Person Shooting Game”, which has rather high ratio among mobile HMD VR game and is evaluated as an apposite one for user’s experiencing a virtual space strongly involved.

2 A study on the factors of VR game

2-1 VR game
A virtual reality is an absorbing media technology which realizes disappearance of a media the most, which is intended to enhance the users’ sense of presence.[1] The virtual reality could be defined to as an experience for a kind of space where the users recognize it as the reality, provided with a environment which is same as real one.

Recently, VR contents has developed into the form of using mobile HMD devices, publicized by spread of a smartphone. VR is a kind of non-linking medium, which have the users forget the fact that they are wearing the HMD devices and accept VR as it is. Non-linking, the characteristic of VR, provides the users with an experience without any medium and it is maximized in the field of games. By playing the games, the players identify VR as the reality, transfer their spirit into VR, and become absorbed.[2]

The most important factors could be a virtual space and an interface. The virtual space is where the experience of VR happens and the very interface induce the trait of non-linking of VR. Both two factors are essential ones and play important roles in a game.
2-2 A character of space in game
For a game, space is a kind of fictional world. The players become more absorbed from the moment they start to concentrate on it. A game are developing toward higher level of absorption to today’s mobile VR.

Likewise, the space is an important factor in absorption. Thus, in this study, a definition of the game space needs to be established and some precedent study were conducted. Newman(2004) refers to process of a game as that of a game space. Also, through the process of the game space, the game reveals a totally new space. At this moment, playing a game means that the player is bound by the space and that it is a sort of tour which penetrates the space. Lee Jeongyeop(2003) argues that a games is a play “the structure of which is designed” and it should be understood as a form of culture which put an importance on a fictional structure of space rather than a stream of time. Jenkins(2007) demonstrates that a game is “a form of narration prioritizing a space.” That is, the space of a game is a fictional space in which a characteristic of fantasy and that of reality are mixed, while it is an essential condition and an important variable in that it affects the players’ level of absorption, and from the viewpoint of a theory of narration.[3]

Therefore, this study defines the game space as “a virtual world inducing a player outside the game to be absorbed in it” and regards it as one of the essential factors which attains absorption of the players. Furthermore, the study conducted the system of swimming in the space as well as a game space itself.

2-3 An interface of a VR game
In the process of playing games, there exists an interface between human and a content. An interface means the point where a person meet the non-existing fictional world. However, a virtual space seeks to have an “interfaceless” interface through which the users encounter media directly. feeling as if any interface disappeared. The interfaceless interface assimilate a game and a player together by giving the player a illusion that he or she come into the game inside. Moreover, the feeling of absorption would be maximized by being provided with a control inside the VR.[1] As mentioned above, swimming in the game space and mechanics manipulation of the game belong to the virtual ability of the player.

Under the VR environment, a game interface is divided into two: a physical interface and an internal one.[4] The former employs a physical activity intuitively, which is provided as a form of touching or staring. It takes in charge of direct manipulation, which makes it possible to swim in the game space or manipulate the avatar. Yi fu tuan(1995) suggests the three physical precondition to experience a space or a spatial characteristic: kinesthetic sight and touch senses. Those senses appear as the physical interface in VR games. On the other hand, an inner interface in a games means the two-dimensional picture presented in the game display, which shows the game mechanics such as maps, menu, information, system, and present situation visually in the form of windows. It acts as a layer triggering opacity and as a device to remind players of existing in the game.

However, as VR games going on mobile, it confronts a problem resulted from the change of the form of interface. In case of smartphone, the screen based on touch is used only as display of HMD, losing its former physical interface. So, the physical interface of a game exist in contracted way like an external button of HMD device or a separate controller.

In exchange for the minimized physical interface, gyro sensor of the smartphone measures the level of users’ slope and manipulates exploring the space using it. It made the area of interface shrink because under the environment, the transparency of interface is maximized and the player can manipulate the game without any separate device. Meanwhile, inner interface is given visually or omitted and in turn the area player can control in the game becomes more and more small. Under those limited environment, mobile VR game interface is realized and developed in various ways to overcome the limit.

3 The Typology of VR game interface based on HMD

3-1 An absorption graph of VR game
FLOW means the state that “people are extremely involved in what they are doing even enough not to be interested in any other stuff.”[5] According to Csikszentmihalyi(2004), the moment the skill, mental or physical ability to solve an assignment, and the Challenge which is a level of difficulty of the assignment and requirement needed to perform it become equal, FLOW, the state leading to a motive constantly, happens.[5]

Raverof(1995) suggests that three factors including navigation, manipulation, immersion consist of VR system. Navigation is an ability to explore and interact with a space, which makes the player feel as if it is a reality. Manipulation is a manipulative ability of a player such as knocking a door or shooting an virtual enemy. Depending on the player’s manipulation, VR responds properly like real object. Immersion is a kind of feeling that the player experience the alternative world from inside.[6] Navigation and Manipulation appear as a form of exploring space and interface in VR, inducing the player to be absorbed. Thus both can be thought of as requirement for immersion.

Although two studies explain the course to immersion in different term, they get the same results.[7] The immersion in the game makes its players play the game consistently. It
means that Raveroff’s immersion and Csikszentmihalyi’s FLOW could be used as the same concept in the game, and this study uses the unified term, immersion. Navigation which mean the level of freedom inside the space could be interpreted as similar with Challenge of Csikszentmihalyi. According to degree to which a player explore the space, the level of the game is set and the ability of the player inside is also suggested. Skill, mental or physical ability for solving an assignment could be defined as an action such as moving or attacking of player in the game.

Figure 1 reconstructed the absorption graph

Combing each factors, the absorption graph of Csikszentmihalyi is reconstructed to Figure 1. Through the exploration and manipulation of VR, the players could experience a variety of experience and depending on it, diverse interfaces are provided to be optimized on the absorption. Looking on the level of absorption of VR game using the graph on Figure 1, the standards of example analysis are established.

3-2 A study on FPS game and selecting the examples
The first person narrative in the game induces concentration on the game by evoking an illusion that human’s physical experience is reconnected and the player experience it in person. VR game based on mobile HMD are produced, using first person narrative which is effective in absorption. Under that narrative, the process of identification occurs twice. The first identification is that a player identifies his or her avatar sharing its point of view.[4] In turn, until second identification the players became strongly absorbed in the game, reflecting him or her on the avatar through Goal and interface inside, which is arranged on Figure 2.

FPS game is a shooting game of the first person narrative, providing its users with strong involvement throughout the play. FPS game offers a great sense of reality, by projecting the images moving depending on the player’s sight and the hands grabbing a weapon. A sense of unity through it induces a deep absorption of the player to the space. Also, FPS game has various advantages like easiness of applying a sense of space, a great intuition of manipulation, the low barriers to entry of hardwares because existing devices could be used in case of controller. Today, FPS game has the largest number among mobile HMD VR games. As examples, mobile HMD VR FPS game apps are selected from Google Play Store. Among them, the following four conditions are required: A player manipulates “human-like avatar,” uses “gun or knife,” aims and meets the “target,” and has “first person narrative.” Thus, the scope of examples analyzed is 28 FPS game application in Google Play Store. Overall UI of display is analyze limited only to in-play display except for the beginning and menu. Bringing it together, a distribution chart is made and based on the result of it, some types are deducted.

3-3 Typology of navigation type of VR FPS game
Navigation in mobile HMD VR game is the users’ level of freedom to exploration and means the extent to which the users’ could behavior in VR space. The users can explore mainly through physical interface while under mobile VR environment they make manipulation through separate controller or gyro sensor. Depending on the level of freedom to exploration, there could be found three navigations type in mobile VR FPS game: Position Fixing, Rail Moving, Free Moving.
### Table 1 Navigation type of VR FPS games

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<thead>
<tr>
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<th>Free Moving</th>
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#### Figure 3 Navigation in Position Fixing Type

The first type is a Position Fixing, in which a player is fixed on a point and unable to move, which means the level of freedom to exploration is lowest. (Figure 4) The player from his or her position could see around within 360° and the play is in progress within that scope. Although the player is not free for any movement, there is a case a special action to avoid an attack from his or her enemy is offered. Among the three types, it has the largest proportion because it is easy to develop for a limit on VR space and movement of the player.

#### Figure 4: Navigation in Rail Moving Type

In the second type, Rail Moving, the player moves within the space automatically along the route regardless of his or her intention. (Figure 4) It has intermediate level of freedom to exploration. The player also could see around within 360° from changing position, but he or she could play the game only within 270°. That is, the player sees around from his or her moving position and plays the game.

#### Figure 5: Navigation in Free Moving Type

The third type, Free Moving, in which the player could explore the space freely, which means it has the highest level of freedom to exploration. (Figure 5) The player moves around toward 360° and plays the game within the same scope. In exchange of free movement, mostly separate controller is needed. Among the three types, it has the highest level of freedom and has the role of a player maximized.

To match the three types of navigation mentioned above, the number of entries in each game is analyzed and interface distribution chart on it is also made. In navigation, every game is capable of space exploration. So, low degree of navigation is omitted from the chart. Figure 3 shows that there exists an optimal interface maximizing the absorption depending on the exploration of three types. However, some cases are found in which the mobile HMD VR game is not fixed with the optimal interface and rather with an interface of low absorption. Those mixed situation cannot give the player a deep absorption. If those situation maintain and have the players not concentrated on the game, the expectation to the game also fall a lot.
3-4 A study on interface of VR FPS game

The interface of FPS game could be divided into two types according to whether a player intervenes or not. Information interface means there is no direct intervene of the player and the player can use Manipulation interface.

Information interface provides some game information to player, a layer which shows the state of the player popping onto the game display. It visually shows many factors such a visual factor like avatar, Crosshairs, a vital force, time, the number of ammo or enemy, point or score, current stage, menu. In case of menu, it appears as a form assimilated with VR space unlike other information. The menu is given on the wall, the air, or the floor, which makes it possible for the player to choose a option to log out or change any setting. Information interface except for menu, is positioned differently depending on the three types of navigation, shown at Table 2. In the type of position fixing, inner interface is laid around Crosshairs in the center of display, in free moving, it is on outer display, and rail moving, it mixed the positions of those two types and it is placed in front. Those information interface play roles of reminding the players of their playing games.

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On the other hand, manipulation interface means the activities the players do in person inside the game. The representative manipulation involves movement, shooting, loading, choosing weapon, switching space in existing FPS games. As FPS games enters mobile VR environment, it developed to use only HMD devices and smartphone without separate controller, which has made a new trend automate existing manipulation. Regardless of the player’s intention, automatic shooting happens and ammo provided limitless, which omits action of loading. Although shooting or moving is still possible by using a button of HMD device or a separate controller, the rest manipulation is almost impossible. In this case, the weapon and ammo are provided as a kind of item and therefore, moving and changing weapon happens at the same time. The system of smartphone sensor using the mobile environment appears. A single choose is possible through the players’ staring in the game. For example, if a player stares at a door, he or she could move to other space filling the gauge, which is used for moving or choosing a weapon. However, it takes some times to fill the gauge, it mainly happens in the preparation space before starting the game.

Manipulation is generally similar regardless of the three types of navigation but there is a tiny difference between them. The majority of cases in position fixing and rail moving types are automated in shooting and loading and the players’ level of freedom is low, which in turn prevents him or her from being absorbed. On the other hand, even if most free moving type is set to automatically shoot, the player can sometimes control shooting freely, which means the level of freedom is highest and the role of players is the most enlarged.

4 Conclusion

Games are changing based on various medium. It is the present situation that existing VR games undergo trial and error entering under mobile VR environment. The quantitative research of this study could have low level of trust because of the small number of examples as it is a new field. Moreover, this study is conducted only by reviewing literature to measure the level of absorption in the mobile VR game, which put a limit that practical examination was not done. However, this study shows two problems of mobile HMD VR FPS game interface.

The first is the shrinkage of a player’s role resulted from a function omitted and automated. Shooting and moving becoming automatic, the player’s manipulation power disappears. Also, the factors consisting of a sense of realism in FPS game such as loading or choosing a weapon were omitted and other action cannot be taken except for aiming through staring. Besides, basic functions like menu inside the game or exiting game are not suggested. Shrinkage in role of player interrupt absorption.

Second is that minimization of providing information confuses the users. The minimal information such as the number of ammo or vital energy given, users explore the VR space. Not knowing the beginning and end, the player becomes confused without provided with any feedback on game clear. In case of free moving type, not given any map, the players hang around the space infinitely. Ignorance on his or her present position only interrupt the second identification and make it impossible to enter stage of absorption. Moreover, the crosshair, the aiming point is suggested very simply, which has the users unaware of their shooting direction.

Until mobile VR game establishes itself as a game genre, many problems need to be solved. The problem of interface mentioned above could be seen as a barrier of new field, which can be solved as times go on. The barrier to VR becomes low and the distance from us gets closer, as existing VR field is changed into mobile VR using smartphone. Without separate equipment, we explore the new VR world only by smartphone and HMD devices. However, because of minimizing equipment, diverse functions in VR also shrink. To stable settlement of VR field, it should be fixed with the interface which could provide the users with the optimal
Thus, this study could help designate a guideline for field of VR game in the future. Further, it also could suggest the baseline of the players’ manipulative ability.

Reference