A Study of Navigation Aids in Video Games

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Summary

As the hardware and technique develop, the game world becomes more real and complex. Navigation aids are considered as important components in video game making. The goal of this research is to study different navigation aids that are applied in video games.

Compass and map as common tools in real world, are applied in video games. In virtual game world, map is often implemented in two ways: world-oriented map and character-oriented map. Without the physical limitation, compass and map feature diverse functions and have various forms. Video games also provide various directional visual cues to players. This research divided them into explicit cues and implicit cues. Explicit cues include breadcrumbs and floating points, which tell players the way to their destination directly. Implicit cues refer to cues that are integrated into the environment of games, such as lighting and color. In addition, game levels are often designed to lead players move along the scripted route physically and visually. This research discussed this idea in terms of physical barrier, visual language, visual composition, and motion.

Not only for player's wayfinding, navigation aids can also provide valuable information for player's exploration or be a tool of communication among players. This research discussed navigation aids in open world and linear game respectively, and the mini map in RTS games as a communication tool.

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1 Introduction

In Fundamentals of Game Design, Ernest W. Adams(2014) defines a game as following:

“A game is a type of play activity, conducted in the context of a pretended reality, in which the participant(s) try to achieve at least one arbitrary, nontrivial goal by acting in accordance with rules.”

In terms of non-digital traditional games, he mentions that they derive from a mental ability of human: pretending, as an essential factor of playing games. It is a capacity of creating a notional reality that pretender can building, abandon or modify according with wishes. Meanwhile, pretender knows it is different from the real world (Adams 2014). A Dutch historian Johan Huizinga described the pretend reality created during play as a magic circle originally in his book Homo Ludens (Huizinga, Vácha, and Magincová 1971). While Ernest W. Adams (2014) points out that Johan Huizinga and his idea of magic circle did not refer to the virtual world. Instead, magic circle in his book was used to describe the physical space for playing, such as the stage, tennis court and so forth. This term was then expanded and interpreted in detail by theoreticians of game to identify the notional reality.

A game world is a fictional space. It could be a high fantasy world, cyberpunk city or ice age based on the theme of the game. Participants pretend they are the characters in a make-believe world (Adams 2014). As mentioned above, the story generally takes place in the players’ imagination in traditional non-digital games, based on their experience and their understanding of the story. Although conventional games are usually presented accompanying with cards, printed boards and text, everyone has unique game image.

With early video games, they are presented by moving 2D animated graphics on the screen, as images are able to simulate the coherent movement (Nitsche 2008). *Space War* (1962) and *Tennis For Two* (1958) are known as the earliest video game (Smith 2019). As the

technology develops, more elaborate animated 3D graphics come out and utilized in game making. Furthermore, with the dawn of new data storage methods, game developers start to establish a delicate and complicated game world (Nitsche 2008). Games are no longer only implemented on a game board, such as a chessboard. Instead, more and more games feature expansive virtual worlds with mountains, rivers, and other terrains. Meanwhile, navigation as a spatial practice in real world is engaged in video games.

The process of navigation within an environment is often called wayfinding, it is the practice including looking for the direction and arriving at a destination through an environment (Nisbet 2016). Its steps generally include identifying one's current location, mapping out a route from that location to a destination, adjusting or maintaining the route during travel, and understanding when one has arrived (Verdine 2011). Scholars suggest that the process of wayfinding can be considered as "spatial problem solving" (Arthur and Passini 1992: 25). They argue that the process includes three steps:

1. Making decision on navigation strategy.
2. Executing decision.
3. Processing information, which means integrating and processing the information from previous steps.

Essentially, the game world is an artificial world, it is different with real world. Nisbet (2016) points out that the digital world tends to reduce the "field of view". He argues that the digital world is the simulation of real space. While it is difficult to orient and navigate in such an environment, as there are less details and representations of space. For example, in the real world, we can attempt to guess our orientation via the position of the sun if we know the time of day. However, the environment of many early games does not have such a realistic presentation due to the limitation of hardware and technique. Therefore, game designers need to guide players via navigation aids. Indeed, game designers certainly don't want gamers to get lost in the game world and then give up the game halfway through.

Adams (2014) suggests that designer should avoid creating the challenges which can only be surmounted by trial and error. Therefore, games should provide adequate cues for player's wayfinding, unless it becomes the core gameplay.

Real world navigation aids are often represented in video games, such as map, compass, and GPS, and it is not that only games with wide three-dimensional terrains that require navigation aids. In fact, a map was applied in many early games. The arcade game *Defender (1981)* for instance, has a mini map at the top of the screen (see Figure 1). The mini map features a type of GPS, meaning that players can witness their location from the map. However, it could be argued that mini map in this game is used to provide extra information to players such as enemy's location, like a radar rather than a map for wayfinding.

Figure 1*: Defender,* there is a mini map at the top of the screen

Generally, such kinds of navigation aids are set up in the HUD. HUD means heads-up display, it is a way of visually giving feedback and information to players through user interface (Wilson 2006). The pattern of mini map and compass will be adjusted based on developer's ideas, as well as the genre and game's aesthetics. In other words, their presentations are flexible, they for example can be high fantasy or science fiction style. In addition, the functions of navigation aids can be changed following the demands of games.

For example, some can only tell players terrains of the game world, but others have extra manual functions like marking a point. Even in the same series of games, the map and compass may have diverse functions and patterns in different games (such as *Assassin's Creed* series), they are always referring to game developer's ideas. More details will be discussed in following sections.

As a digital space, the game world is able to achieve some special navigation strategies that cannot be implemented in real world, such as visual directional cues. For example, the game world can generate explicit visual cues like breadcrumbs and floating points without limitation. Those cues directly tell players which way they should go rather than interpreting map and compass. In additional, directional cues can be integrated into game's aesthetic design, implicitly lead players to move along scripted routes. Furthermore, games can take advantage of geographic features in the game world to restrict and adjust the player's movements, such as physical barriers and high ground. These navigation aids will be discussed elaborately in following sections and presented by taking examples from different video games.

As mentioned above, the mini map also tells enemy's location to players (in *Defender*). Not only for player's wayfinding, navigation aids serve various demands, including exploration and interaction among players. Video games can be divided into nine genres: 'Action', 'Strategy', 'Role-Playing', 'Sports', 'Vehicles-Simulations', 'Construction and-Management-Simulations', 'Adventure', 'Online-Games' and 'Artificial-Life Puzzle-games-and-others' (Zammitto 2008). Navigation aids play different roles in different genres, they offer various solutions for the game's requirements. For example, in role-playing games with open game worlds, a mini map often shows the player's surroundings to help the players predict what they will meet when exploring. In online games like RTS and MMORPG, players often share messages through a mini map and some manually engaged markers. Navigation aids in this way become a tool for games to give better experiences to players.

In terms of game design, immersion is a key element that deeply impacts on navigation aids strategies. Bitgood defines it as “the illusion of ‘feeling in a specific time and place’” (Bitgood 2013). It is the experience that players are completely drawn into the game world because the gameplay is compelling and absorbing, thus the real world seems to disappear (Bates and LaMothe 2004). The medium that players are immersed in presents a compelling artificial world to them which they can lose themselves (Nisbet 2016). Nisbet points out that the features of visibility of video games are unmatched, as the participants can directly control the avatars and the game worlds can be explored, affected and manipulated by participant’s actions (Nisbet 2016).

Leading players meanwhile creating an immersive aesthetic experience for game players is a challenge for game developers (Winters and Zhu 2014). Nisbet suggests that games should rely less on wayfinding features and use more visually consistent cues and environmentally appropriate visual cues (Nisbet 2016).

This research aims to study different navigation aids in video games. They are divided into five types in this research: compass, mini map, global map, visual directional cues, and visual communication. Next chapter discussed the properties of different navigation aids including how are they applied and presented in games. Then the following chapters discussed navigation aids in different genres, including opened world games, linear narrative games, and multiplayer games.

2 Types of Navigation Aid

The definition of wayfinding in video games includes that players navigate and find the way to novel destinations assisted with navigation aids (Verdine 2011). The navigation system will take different measures to give cues to players in different situation. For example, the system will guide players by using breadcrumbs if they try to find an NPC. While they may only obtain a simple map without too much information on it if they want to find the rare equipment, and they have to figure out the location by themselves. In addition, different games apply different wayfinding system. Some games only have compass and others may have powerful mini map which provides different functions to players. Generally, games tend to apply more than one navigation aid and build up a blended wayfinding system.

This chapter presents different navigation aids and discusses their patterns, functions, pros and cons in details. The reason why games apply certain navigation strategies will be discussed as well. Some examples from games are presented visually in order to clarify the properties of navigation aids.

2.1 Compass

As a common navigation and orientation instrument in real world, the compass is often applied in video games, especially in RPG games. For example, in the fantasy-themed RPG game *Gothic 3* (2008), the compass looks like a conventional compass which exists in real world (see Figure 2). It is placed in the lower left corner of the screen as a part of HUD. The only purpose of it is orientation. While Gothic 3 provides a very traditional compass, in compass design in games is not limited by reality. Instead, there are examples of game designers redesigning the compass and changing its representation while keep its functions. *Fallout 3* (2008) adopts the combination of compass and world map as its navigation system, and the compass is also placed at the lower left corner of screen. Unlike *Gothic 3*, the compass in *Fallout 3* looks like a dynamic ruler (see Figure

3). There are E, W, S, N four letters on it represent four directions. On the of the compass, there is a fixed arrow which always points the direction of avatar. When players move the camera, the scale on the compass will alter correspondingly.

Figure 2: Compass in *Gothic 3* (lower left corner)

Figure 3: Compass in *Fallout 3* (lower left corner, below Hit Points bar)

Many later games introduce compass in this form as the navigation system, and make a improvement on it from different perspectives. For example, in RPG games *The Elder Scrolls V* (2011) and *Horizon Zero Dawn* (2017) (see Figure 4), the compass is placed at the top of the screen and the fixed arrow is removed. In this way, players can be easier to

catch the information from compass as their sight overlap the avatar's sightline. They can focus on the objects in front of the avatar and glance at the compass at the simultaneously. In addition, in these games, the compass provides more information to players. For example, the direction of enemies, destinations, and treasures will be presented in the way of icons that are overlaid on the compass.

Even with overlaid icons, a compass is a very simple navigation aid and has some limitations. For example, if there are two objects in the same direction, their icons in the compass will overlap so that confuse players. In addition, the information provided in compass is limited. The distance between player's location and the target object, for instance, is not shown in the compass. In a massive open world games with complex terrain, players are unable to estimate how long they have to spend on the wayfinding. Therefore, compass is often applied accompanying with world map in video games.

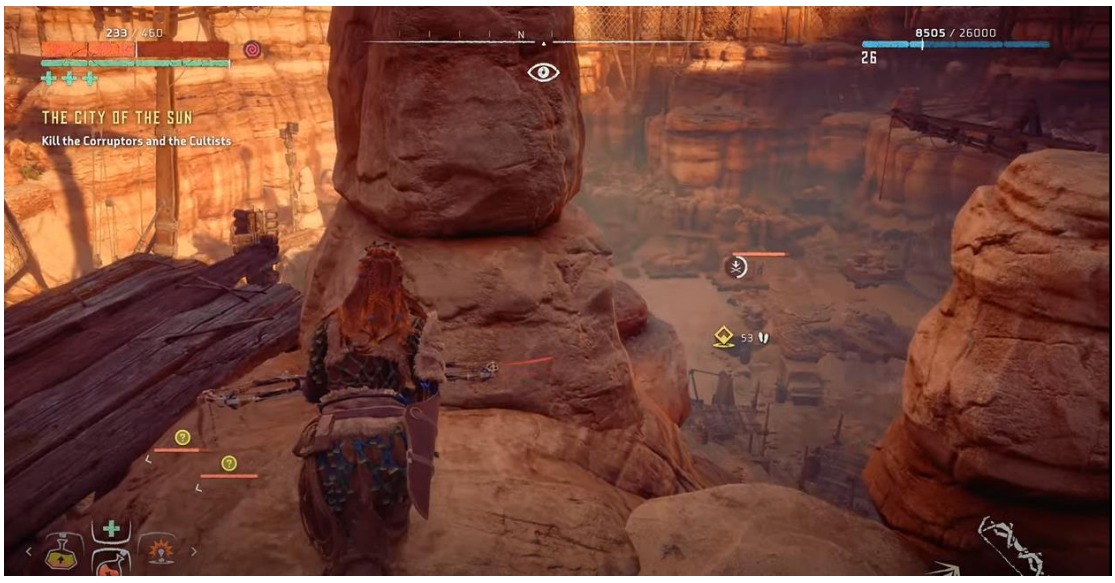

Figure 4: compass in *Horizon Zero Dawn*

2.2 Explicit Visual Cues and Implicit Visual Cues

Not only providing visual cues, games but also give information to players by sound and text. In *Red Dead Redemption 2* (2018), the NPC will tell players the location of their goals,

such as “the carriage is at the crossroads south of the town”. While, in a research of visual cues in digital space, scholars find that participants who are given the directional cues can reach the destination in the shortest time without relying on map or other navigation aids (Vembar et al. 2004). They argue that directional cues are the most effective measure for navigating. In modern games, many wayfinding cues are given as visual elements on the screen. For example, games will tell player that they should turn right or left through luminous arrows on the ground or lead players to reach their goals by showing trails of breadcrumbs, which is considered as the explicit visual cues. Some visual cues are integrated into the game world that implicitly tell players the correct direction, like lighting and color. The difference between these visual cues and compass is that they are not confined to the HUD area. In other words, they can appear anywhere on the screen.

Visual directional cues could be divided into two types: manually engaged dynamic directions and persistent dynamic directions (Nisbet 2016). With regard to the former, literally it means the navigation system is engaged by players. At the request of players, the dynamic UI cues will be generated and point toward their goals. This navigation aid is often applied in sandbox video games with a big open world. In such game world, the terrain is complex that players often lose their way and cannot find an NPC or some other game object, even though they are very close. The player can mark their goals in certain ways and the game will give the directional cues as the feedback.

Rather than being engaged by players, the visual cues provided by the persistent dynamic direction system is ever-present. Meanwhile, the information will constantly update based on player’s location and movement so that displays the most efficient route to the goal. The cues will normally be eliminated once the player reach the goal. Besides, these two visual cues can be shown in the game world or be placed in the player’s HUD.

The directional cues adopt different patterns to communicate information to players and take a varying amount of space on the screen. These patterns include floating point, light,

color, breadcrumbs and other situational cues (Nisbet 2016). While the available space on the screen is limited, including that within the HUD. This means the number of directional cues showing on the screen should be considered carefully. Game designers should be conscious of the cues that players received can be overwhelming, which will negatively impact on the gameplay experience.

2.2.1 Floating Point

The floating-point navigation aid is literally a system that marking player's goals through floating points. The points are not confined to the HUD area and float on the game world. They offer directional cues to players without considering the distance or obstacles. But in some games, they will indicate the direct distance to the goal. Based on the information, players can know the direction to the goal and how far it is. Furthermore, the floating-point can show in both player's HUD and game world. For example, in *Assassin's Creed Odyssey* (2017), when the player finds floating directional cues in the game world. Those locations will be marked in the mini map, meanwhile the compass will show their directions in the compass. This multiple cuing system guarantees that the player will not miss any important information.

The floating-point navigation system effectively provides a lot of information in various ways. Action-adventure game *Dead Rising 3* (2014) applies persistent dynamic navigation aids. With the progression of the story, the new locations or goals in the following mission will be marked by the system. Meanwhile, most of the floating points become faded in order to keep a legible screen and avoid bringing confusion to players, only the main goal will be highlighted (see Figure 5A). In addition, due to the limitation of the field of vision, the avatar cannot witness every object in their vision, as well as the player. In *Dead Rising 3*, when the floating points move out of the vision, they will hover over the edge of the screen (see Figure 5B). The points will float to the left of the screen as the object is to the left of the avatar, and vice versa.

Figure 5A: *Dead Rising 3,* most floating points are faded, only one is highlighted

Figure 5B: *Dead Rising 3,* floating points hover near the edge of the screen. Red skull represents enemy.

The action game *Dishonored* (2012) adopts this system as well. However, there is a clear difference between these two games. In *Dishonored*, the floating-point has the same pattern. While the representation of floating-point is varying in *Dead Rising 3*. The navigation system provides different markers based on the attribution of the object. For example, the red skull represents the enemy and the yellow square indicates a location. These mechanisms ensure that players know how many goals or enemies there are, thus they can adjust their game strategy.

However, the disadvantages of floating-point navigation system cannot be ignored. Firstly, game designers aim to create an elaborate game level and story that players can ideally

immerse into. But the information will be overwhelming if there are many points on the screen. Players may be attracted by other goals rather than focusing on current story. Secondly, whether the floating points are displayed in the compass or the game world, the cues may be useless even lead to misunderstanding. In some games, the floating points display the direct distance between player and goals. While it will be helpless when players are in an unexplored area with complex terrain. Besides, players may get lost such as being stuck by a cliff, if they are following the floating point directly.

For the floating-point in games mentioned above, they all adopt persistent dynamic directions system. In other words, the directional cues are provided by the game. In some games the floating-point is manually engaged. Especially in multiple player games, like *Call of Duty: War Zone* (2020), players can mark some objects or locations in the game world and mini map. Furthermore, other players can share the cues.

2.2.2 Lighting

Lighting can be an effective navigation aid. Ginthner (2002) argues that wayfinding towards a well-lit area is the human nature. Psychologist Yannick Joye also points out that the illuminated area will draw people's attention as well as trigger their explorative behaviors (Joye 2007: 312). In video games, strategic lighting is a widely used wayfinding aid. When the lighting is deployed elaborately, it can not only communicate the information of the surrounding areas, but also guide players on the right way. Nisbet (2016) points out that lighting navigation cues are the "preferred navigational tool" for players, especially for the "Achievers" and "Explorers" players of Bartle types. In addition, the contrast between light and dark has a strong narrative. Game developers can create a dark environment and highlight the elaborate landscapes and special items. It builds a mysterious vibe and may pique the player's interest.

Figure 6: *The Last of Us*, key lighting

Byrne categorizes lighting into two types: key lighting and fill lighting. With regard to the former, he suggests that the implementation of key lighting in games is crucial to players for their wayfinding through light (Byrne 2005: 262). For example, in a dim environment, this is the most important measure to illuminate and highlight items which are the triggers for the game progression (see Figure 6). Furthermore, it provides appropriate visibility while subtly drawing the player's attention to the items. Kremers also suggests that key lighting is a way of taking advantage of special lighting to highlight the location of game progression or environment exits. It ensures that the game communicates the final destination or exits of the region and that the players receive the information (Kremers 2009: 214-15).

The key lighting has different light sources. On the one hand, the game world is an artificial world, which means light sources in the space do not need to be logical. In other words, lighting in games may be situational or happen unnaturally. For example, the game will highlight a location or a rare item by unusual light in order to hint players. In *Diablo 3* (2012), the rare equipment will vertically emit a beam of light to the sky. In *Sekiro: Shadows Die Twice* (2019), players can find light from the floor. Players can trigger the game's progression when they approach the light. In addition, the key lighting can function as the

manually engaged dynamic directions, and players can manually highlight a location. In *The Legend of Zelda Breath of the Wild* (2017), players can mark a location such as a temple or a watchtower through a telescope. Then a beam of light will be emitted from the sky to point the object. Players can see it because the avatar has good eyesight. The light always exists until players cancel it, and players can only mark no more than seven locations.

On the other hand, Byrne suggests that the operation of key lighting can be subtle, by utilizing the light that occurs naturally within the environment, such as street lights and fire (Byrne 2005). Nisbet also suggests that providing a realistic source to key lighting consistently maintain the visual style of the environment, mean while giving important visual cues to players (Nisbet 2016). For example, the NPC who are standing under the streetlight may be the one that players are looking for. In addition, when players find a house with closed door, the lit window may indicate the real entrance to the building. Therefore, the key lighting is considered as an immersive navigation cues, and it has great potential and performance (Nisbet 2016). It improves player's visual experience, while communicate information implicitly to players.

As mentioned above, not all lighting in video games functions as the key lighting. Byrne refers to the lighting used to illuminate the entire environment as the fill lighting. It aims to maintain the luminance of the surrounding for players rather than highlighting some important features (Byrne 2005: 262-63). Instead of providing directional cues, fill lighting helps players to read the information from their surroundings so that they can make appropriate exploration decisions. In order to ensure the game progresses fluently, Nisbet suggests that the environment should give sufficient visibility to players for perceiving their surroundings (Nisbet 2016). While he also points out that adjusting lighting is able to depict certain atmospheres or create a sense of tension, thus design may restrict lighting in some games (Nisbet 2016), such as horror games. But in general, the game world should convey its contents clearly to players.

In addition, fill lighting needs to avoid interference with key lighting. It should create a condition that players are able to recognize the key lighting within the context. For example, moonlight can be the fill lighting on the street at night, and the only streetlight is the key lighting. By contrast, in a dark castle, fill lighting is the flame from the torches on the wall. The moonlight across the opened window can be the key lighting. Fill lighting does not need to be darker than key lighting. The point is that there should be contrasts between them, and not only in brightness. Nisbet suggests that players can distinguish two lightings by lighting properties, such as brightness, light source, light concentration, hue and physical isolation (Nisbet 2016).

Furthermore, the contrast in the environmental illumination can also be the directional cue. As discussed above, the streetlight in the dark street is appealing. Similarly, the shadow in the brightness may also inspire player's desire of exploring. Byrne asserts that "A brightly lit area at the end of a dark room will guide the player to that spot. Likewise, a shadowy corner of a well-lit room will almost always invite curiosity" (Byrne 2005: 101). Ginthner also suggests that viewer's attention is related to the contrast of lighting around the focal point, greater contrast brings larger attention (Ginthner 2002). Therefore, both shadow and lit areas can be directional cues for players. The point is that the level should create a noticeable contrast by using key lighting and fill lighting.

Figure 7: the example of squint test

Except for key lighting and fill lighting, path highlighting is another efficient wayfinding aid associated with lighting strategy. Especially in a complex environment with many

distractors, the key lighting cannot communicate sufficient clues of the exits to players (Kremers 2009). Unlike fill lighting and key lighting, the key point of path highlight is not creating contrast to draw player's attention. Nisbet points out that players tend to follow the brightest path when they are facing puzzling visual noise (Nisbet 2016). He mentioned that Naughty Dog, an American game developer, applies the "squint test" (see Figure 7) in their games to ensure that the main path is the brightest one on the screen, the *Uncharted* series and *The Last of Us* all show this feature. The "squint test" means when players squint their eyes, the brightest path they can see should be the primary path (Nisbet 2016). Generally, games applying path highlight strategy should have sufficient bright and dark areas in the environment to ensure players can visually distinguish the primary path and secondary path.

2.2.3 Color

Color is widely used in every part of game design. It is a fundamental element of the game aesthetic, and it can also be an immersive wayfinding cue. The game level can draw the attention of players to a certain object or area by using color in an elaborate way. Kopacz suggests that game developers can create "focus" by using color to highlight important features in a scene. The player's eyes are often caught by those objects that are in high contrast with the environment or consist of brightest colors (Kopacz 2004: 109). He also points out that when the color's frequency of appearance is higher, its capacity for drawing attention becomes lower (Kopacz 2004: 109). Therefore, for pulling the focus of players, the color should have a high brightness, be in contrast with the current context, and it cannot be used frequently. Game developers can choose a color, strategically restrict it appearing in a game level, then utilize the color in a pivotal area, object, or progression point within a scene. This can efficiently give wayfinding information to players.

In *Mirror's Edge* (2008), color is famously used as the main directional cue. This is an action-adventure game with first person perspective. Players control the avatar shuttle in buildings evading enemies. The game world has complex structures while there are not

compass, mini map or breadcrumbs for the player's wayfinding. The game utilizes bright red to tell players where they should go. For example, if the player must climb the rooftop, water pipes on the wall will be highlighted in red (see Figure 8). This gives the player a hint that they must use this water pipe to get to the rooftop; In a big hall with many white doors, a singular red door indicates the real exit. In *Mirror's Edge,* the bright red serves two purpose: it tells the player which direction they must go, and the object they need to utilize.

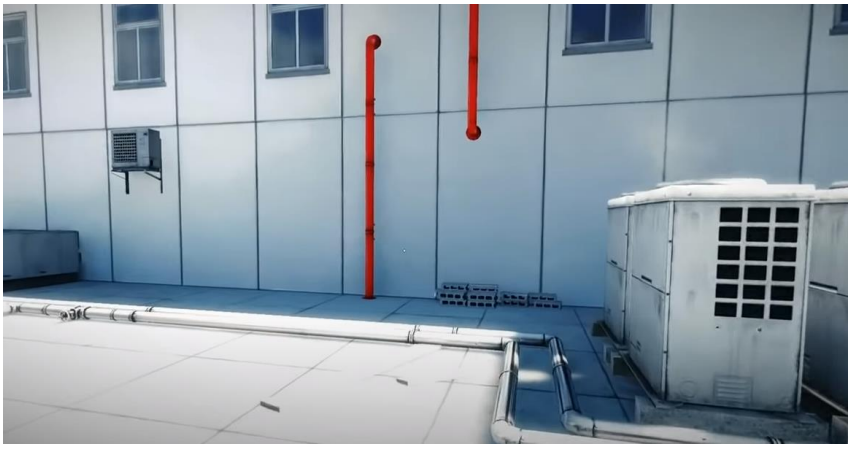

Figure 8: *Mirror's Edge,* water pipes are highlighted in red

In a scene, only the object that refers to player's next movement will be highlighted in red. While red is not the natural appearance of the object. It is intentionally rendered in red by the game designer to help the player's wayfinding. But this may bring some inconsistencies in general aesthetics to the game. In some games, the color will be integrated into game's aesthetic design, as a visual cue. Examples include *The Last of Us* in which the exit frequently involves yellow components (see Figure 9 and Figure 6 in chapter Lighting).

Apart from visual language and color, games often utilize visual composition to guide their players. Nisbet suggests that painting and photography often use visual strategies to lead audience's eyes to focus on a particular region or the focal point. Such techniques may also function in video games (Nisbet 2016). By using the scenic design of the game level, games can lead player's eyes toward important content in a scene, hence subtly communicate the directional cues to players.

Figure 9: *The Last of Us*, there is a yellow carpet at the exit

2.2.4 Breadcrumbs

Humans have weak skills of wayfinding, they tend to ignore details, forget the information, misunderstand maps, wayfinding cues and the architectural layouts (Arthur and Passini 1992: 5). As discussed above, floating-point and lighting are common navigation aids in video games, while they all have weaknesses that cannot be ignored. For example, players can know the direction of their goals through floating-point, but never know the terrain of their trips. Thus, they may be misguided by the cues. Additionally, rather than providing the directional cues, lighting only gives players hints which might be difficult to catch for some players. However, game developers need to ensure every player is able to reach their destination. Therefore, Byrne suggests that communicating abundant volume and quality of directional information is important for game progression (Byrne 2005). Breadcrumbs, a navigation aid that directly tells players the path, is often adopted in video games, especially in role-playing games with vast open world.

Breadcrumbs is a navigation aid that game level supplies a series of alluring “breadcrumbs” to players for leading them to their destination. The “breadcrumbs” can be light, voice, marker or other enticing forms. Players will be attracted and investigate them (Moore 2016:

5). Once a player approaches a breadcrumb physically, a new breadcrumb appears and marks the next point. The player will be stringed along by a series of signals thus towards the predetermined location (Bates and LaMothe 2004: 116). To sum up, breadcrumbs will be generated continuously, to ensure players can reach their destination. In addition, game level can tune the difficulty of navigation by adjusting the distribution, frequency, quantity, and strength of the breadcrumbs (Byrne 2005).

Figure 10: *Watch Dogs 2*, breadcrumbs in the game

Figure 11: *Fable 2*, breadcrumbs in the game

The most common pattern of the breadcrumb trail is using easily recognizable sign to clue players. In *Watch Dogs* (2014), When avatar is in the car, there will be serial arrows appear start from its position linking toward the destination (see Figure 10). They are fluorescent and noticeable. In *Fable 2* (2008), the game will generate a light path to guide players (see Figure 11). However, they take the form of navigation overlays which cannot integrate into the game world. They to some extent negatively impacts on player's visual experience. Taking advantage of environmental features as the breadcrumbs to guide players is way that maintains game consistency visually. For example, when players walk in a cave, they often follow the way that has torches on the wall. Torches become the breadcrumbs, as well as wood signs in forests and landmarks in wildness (Byrne 2005). Additionally, audio can also be the cue. In *Call of Duty: Modern Warfare* (2019), players will hear a dynamic alarm when they approach the treasure chest or their prey. The closer they are, the higher the sound frequency.

In addition, breadcrumbs navigation is blended into the gameplay or mechanism in some games in a way where wayfinding becomes a character's skill or ability such as tracking footprint. In *Monster Hunter World: Iceborne* (2019), players have capacity to track the monster by its footprints. In *the Witcher 3* (2015), it becomes a special ability of perception that character has. Players can detect the blood trail and footprint by using this ability (see Figure 12). These clues will be highlighted on the screen by read light. Meanwhile, this capacity is the key point for players to progress the game story, as players need to find out some props via the perception. Odor can also serve as breadcrumbs. In *Red Dead Redemption 2* (2018), every character and animal in games can emit a smell. Players can pursue the smell by using a special ability: dead eye. This will slow down time and allows players to see all the trajectory of smells. Players can choose one to follow, but the trace will disappear when players deviate from it.

Figure 12: *Witcher 3,* player uses special ability to detect footprints

Breadcrumbs are a most efficient navigation aid to directly guide players to their goal. However, Verdine argues that it negatively impacts on the immersion in media and destroys the gameplay experience (Verdine 2011). When the game gives the breadcrumbs to players, the only thing they need to do is to follow the directional cues without exploring and thinking. They may completely ignore the well-designed level and landscape in game world. Therefore, many games instead apply landmarks to lead players.

A landmark can be considered an implicit form of breadcrumbs. Rather than overlaid visual sign, landmarks are objects utilizing in game world for drawing attention, beautification and orientation (Carpman and Grant 2002). They are usually the focal points in an area, and often adopt the form of statues, distinct buildings, towers, fountains and so forth (Co 2006: 101). Landmarks can be set up in anywhere, but they should be unique in terms of appearance or the size relative to the surroundings (Richard 2004). The outstanding appearance gives them identifiability and memorability and makes them distinct points of reference and effective orientation for players (Nisbet 2016). As the focal point in the area, the landmark visually completes the scene hence provides a visual goal for way finders to focus on and reduce their anxiety (Nisbet 2016). In addition, Richard suggests that landmarks can be “worked into the story and setting of the level itself” (Richard 2004).

Unlike the luminous arrow generating unnaturally on the road, they do not need to be incongruous objects. The appearance and existence of landmarks can still be based on the game world, though they may contrast with their surroundings.

2.3 Mini Map

Different from other maps in the real world, mini map in games is a type of navigation aid that can provide most information to players, including their location, the objects near them, and the terrain around them (Nisbet 2016). Although scholars suggest that interpreting map is more difficult than receiving directional cues for players' wayfinding (Vembar et al. 2004), it still plays an important role in many games, especially in role-playing games with open worlds. It gives players ability to identify their location and orient themselves. Apart from wayfinding, the mini map typically also gives players access to a lot of information about the game world around the avatar (Adams 2014), such as the terrain of surrounding and the enemies out of vision. In some particular genres, such as real-time strategy games and race games, mini map often provides crucial information for player's decision making. As mentioned above, Adam categorizes mini map into two types: character-oriented map and world-oriented map (Adams 2014).

A mini map is generally constructed as a part of HUD on the screen, typically set up in a corner of the screen, takes up around 5 to 10 percent of the screen area (Adams 2014). In other words, the presentation of mini map is limited by the size of screen, thus some handheld games for Nintendo Switch and Sony PSP decide to hide the min-map on the screen. Besides, in some games where the core game play is to explore the game world, *Far Cry 2* (2008) for instance, the mini map is hidden as it may spoil the experience of gaming and immersion by taking the player's attention away from the game world. In addition, the UI design of a mini map tends to follow the aesthetics of the game and its HUD. For example, the story of *Grand Theft Auto V* (2013) happens in a modern city, thus the mini map is a digital map. While the theme of *Red Dead Redemption 2* (2018) is western, it set in 1899 of American Old West. Thus, the style of its mini map is hand drawing

as that period is not a digital age.

2.3.1 Character-oriented Map

A character-oriented mini map is sometimes called radar screen as it is often round in games (Adams 2014: 227), such as *Far Cry 3* and *Witcher 3.* While it can also be square, such as *Battlefield Vietnam* and *GTA 5.* Generally, it is positioned in a corner of the screen, and players can read it in any time. In addition, its formation depends on the aesthetics of game design. In a character-oriented mini map, the avatar is placed at the center of the map. Rather than displaying the entire game world, the map displays only the surrounding of avatar, and it integrates into the game world that updates in every moment along with the avatar movement (Verdine 2011). Furthermore, the landscape will be rotated in the mini map correspondingly if the player turns the perspective or the direction of avatar (Adams 2014). This aims to provide information and feedback to players in a timely manner.

In *Witcher 3,* the mini map is positioned in the upper right corner of the screen. Avatar is displayed on the center as a white arrow (see Figure 12 and 13), and the top of the arrow represents the orientation of avatar. There is an orange arrow at the edge of the mini map. It rotates automatically along the edge that can always points player's destination, no matter how the player turns the avatar. The map shows the details around the avatar, such as the terrain, some items which can be picked up (represented by green leave), and potential threats (represented by red points). It also indicates the distance between the avatar and the destination.

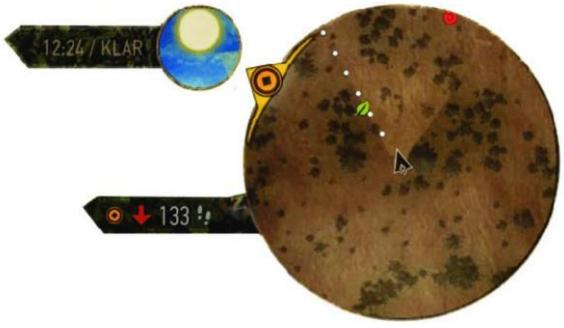

Figure 13: *Witcher 3,* character-oriented mini map

2.3.2 World-oriented Map

World-oriented map is also called global map, like a paper map in the real world. It shows the entire game world with north at the top, regardless of the orientation of avatar and player's perspective (Adams 2014: 227). The resemblance of world oriented-map and character-oriented map is that the position of avatar will be indicated on the map, though it cannot illustrate the precise position because of the scale. There are also some differences between them. For example, instead of integrating into HUD, the world-oriented map is generally hidden in games; player can call it out through the instruction, such as pressing key "M", means instruction "map". In addition, it is a static map that cannot rotate or update with avatar's movement. Literally, the world-oriented map displays the entire game world, including mountains, waters, towns and some noticeable objects, and potential threats. For example, in *Read Dead Redemption 2*, the border of an area will become turn into red line to warn players if they commit a crime in this area (see Figure 14). The red line means the character is wanted in the area.

Figure 14: *Red Dead Redemption 2*, red border means the player is wanted in this area

The contents of the mini map are not fixed. They depend on many factors including the requirement of level, the game design, genre, and so forth. This feature had been demonstrated in early games. In *Wizard of Wor,* an arcade game issued in 1980, player's characters called Worriors, the aim of the game is to kill all the monsters by shooting them. The game happens in a dungeon which consists of walls and corridors in different

formations, like a maze. There is a mini map in the HUD, at the bottom of the screen. It does not display the terrain and the location of avatars. Instead, players can only know the enemy's position and quantity from the map. The enemies are presented by pixels in different colors depending on the category, the pixel will update since enemies move. While in *Defender* (1981), shown in Figure 1, the mini map is placed on the top of the screen. Players can clearly recognize the spaceship they control, the information of all enemies in the space, as well as the terrain of current level. The mini map in this game can be considered as a world-oriented map. It illustrates the terrain, and all the items in the game space. Its indication range is wider than the space that players can observe.

As the game making develops, more and more gameplays are created and installed in video games, hence the cues that should be provided to players are increasing. The visual cues are generally set up in mini map. While the space in map is confined, overwhelming information will negatively impact on the readability of mini map. Players may be confused when they find there are cluttered visual cues in the map. For example, in *Battlefield Vietnam* (2004), the mini map displays every member in the same group by blue arrows. Due to the limited size of mini map, those arrows are overlapped with each other（see Figure 15）. Players cannot find their targets from it. In *Assassin's Creed IV: Black Flag* (2013), the mission cues are crowded floating on the edge of the mini map (see Figure 16). It is not easy for players to figure out which one is their target mission.

Figure 15 (left): *Battlefield Vietnam,* signs on the map are overlapped

Figure 16 (right): the mission cues are crowded floating on the edge of the mini map

Generally, the aim of character-oriented map is to provide information of player's surroundings. Due to the limitation of its size, it cannot contain too much details so that ensure it is readable. By contrast, the world-oriented map needs to give comprehensive clues of the game world to participants. Meanwhile, players do not need to spend too much time on interpreting it. Therefore, game developers start to install some interactive elements in mini map. For example, players can turn off the visual cues in the map or choose to only show a specified sign. In some games featuring large opened world, the world-oriented maps are able to zoom in and zoom out. When players zoom in the map, there will be more details show up, such as streets and stores in town. There details will be hidden when maps restore their scale.

There are some differences between mini map and other navigation aids. Unlike breadcrumbs that provide directional cues directly to players, a mini map gives detailed geographic information. Players need to make the wayfinding decision by themselves based on this, rather than following the directional instruction. Scholars argue that directional cue is the most efficient instruction, and it is more difficult for players to interpret a map than just receive visual cues (Vembar et al. 2004). While Verdine suggests that the player can find the safest and shortest route by using map (Verdine 2011), such as dodging powerful monsters on the main road. He also argues that many games with freely navigable world tend to reward explorers. They do not provide accurate navigation so that encourage players wander around and make wayfinding decision so that stumble across a particular place or rare items (Verdine 2011). If players always walk along the breadcrumbs, they may miss many elaborate stories.

Some of players may tend to progress the game as soon as they can, some of them may prefer exploring the fictitious world. In order to meet different demands, games usually have a variety of navigation aids to serve players. The performance of combining multiple tools is usually better than single aid. For example, in *Witcher 3*, there is a character-oriented map on the screen, players can also call out the world-oriented map which has

manual breadcrumbs function.

The element of map often engages in gameplay. The most common form is treasure hunting. The process of treasure hunt in video game is that participants follow a series of clues from games, which lead them to the treasure (Sprogis 2005). Treasure map is the way that integrate clues into the map. Usually, there will be some obstacles of finding the treasure, either the map is difficult to obtain, or the map is not easy to interpret. For example, the map may lose some key part or only roughly shows the geographic features surround the treasure. Hunters need to be familiar with the game world very well, otherwise they never find the accurate location. In *Red Dead Redemption 2*, players will stumble across treasure maps (see Figure 17). Generally, these maps only show the mountain, forest and river in minimal way without any textual clues, and there will be a red arrow representing the position of the treasure. It demands the player to stand in a proper angle to view the mountains and river so that find out the accurate location. If the terrain around the treasure is complex, the player often experience may failures.

Figure 17: *Red Dead Redemption 2*, treasure map with minimal details

2.4 Level Design as Navigational Aid

The game world can be designed to tell players the direction in which to go. By using geographic features, games can push players move forward, and encourage them to make

certain wayfinding decisions. In a large scale synthetic natural world, players may get lost if they are unfamiliar with it. A body of research suggests that players tend to take advantage of the objects from nature to acquire spatial understanding (Bidwell et al. 2007). Like a noticeable castle, the geographic traits of the game world can be the natural landmark for players to build their "cognitive spatial map" (Zammitto 2008). The waters and mountains near the town, players will leverage them to recognize their location.

In linear narrative games, geographic features do not just refer to the geographical features of the game world like cliffs, rivers, or mountains. They include the physical barriers or choke points in the scene, such as walls, locked doors, dead-end alleys and other physical objects. The terrains physically funnel the movement of players without they being aware of it, so that intentionally force players to move toward established location (Aarseth 2000), though the game world is visually expansive. These choke points also ensure that the game progress in a certain sequence, as well as strike a balance in the length of each game level. As Bates mentioned "the point is to ensure the player does not get too far too fast" (Bates 2004: 119). In addition, Nisbet suggests that these physical barriers should be used appropriately, the game should still allow the player to make decision and solve problem in wayfinding (Nisbet 2016).

Physical barriers can also be used to prevent the player from revisiting previous game levels or progression points that they have already activated. Once the player triggers a new point, the game level will spawn a physical barrier to block the player (Bates 2004: 113). They can be crumbling bridges, collapsed walls or imposing enemies. After the player passes by, the bridge will slump instantly. By blocking some areas of the game environment, the game can force the player to focus on the route forward and avoid the confusion of wayfinding from the backtracking options (Nisbet 2016). However, when the player has not fully searched for a section but reaches the next progression point. The player may permanently miss the treasures and events that were overlooked in previous sections, as the player can never backtrack.

High ground is another strategy of terrain design. Psychological theories (such as the Appleton's prospect-refuge theory) suggests that humans tend to look for positions that provide a good view such as elevated point, which is good for monitoring the surroundings (Nisbet 2016). They are inclined to search higher ground and ascend to it when it is available. Alex Galuzin also suggests that utilizing lighting and high ground in tandem can draw the player into a certain direction (Galuzin 2011). Game developers can take advantage of the nature of humans to design the environment of the level. For example, the trigger can be set up at an elevated point and exposed to the player. Thus, the player will pay attention to stairs, climbable ropes or other objects. The level design of *Dark Souls* series adopts this strategy. Especially the *Dark Souls 1* (2011), the environmental structure of the game is like a tower. Players have to move all the way up.

2.5 Visual Language, Visual Composition, and Motion

Scott Rogers suggests that the game should constantly keep visual communication with players and provide wayfinding cues to players by using environment features. This helps to establish the game's visual language (Rogers 2014: 236). For example, the rusty door is inaccessible, or players cannot ascend a high grade of hill. Once players learn the environment features, the visual communication between the game and players has been established. Players do not need to check the accessibility of every door. Thus, they can make exploration and wayfinding decision efficiently.

For establishing the visual communication, the game must ensure that the accessibility and inaccessibility of visual cues are used consistently throughout the game (Nisbet 2016). When an object or environmental feature is used to convey the accessibility of an area, the property of its feature should be maintained when it appears in following game levels. This rule can be broken, but it should be supported by a new game story or event, such as upgrading skill levels or a new ability that can be mastered, which can destroy the door. Nisbet suggests that players' experiences brought by environment features will impact on

their wayfinding decision making and expectation, the inconsistent of visual clues may interrupt players' immersion (Nisbet 2016).

The guiding line is one of the common strategies. Lines within a scene, no matter they are actual lines or implied lines, can lead player's eyes across a visual path, end up with the focal point (Nisbet 2016). For example, in the scene of *Uncharted 1* (2007)(see Figure 18), an action-adventure game without navigation aids in HUD, the pillars and wall create a frame, which is like a portal that grabs the player's eyes to whatever is inside. The intersection of the roof is considered as the guiding line implying that the player should go that way. These lines can be composed by any objects in the scene, including trees, walls, pillars and so forth. As long as these objects provide a path to follow down without interruption from their surroundings, they can produce the lines (Nisbet 2016). If there are multiple guiding lines in a scene, player's attention may be drawn and focus on the point of convergence (Nisbet 2016).

Figure 18: *Uncharted 1*, pillars and wall create a frame, the top of the roof is an implicit line towards the correct way

The last one is motion. Motion means dynamic elements in a scene. They can be visual elements or auditory elements. In a static scene, the dynamic element often becomes the

visual focus of player. By using this strategy, the game can catch the player's attention and lead them to a certain direction (Nisbet 2016). When the game level exposes players to an unexpected visual or auditory stimulus, it may alter player's sight and their following movements (Bitgood 2013: 6). The stimulus can be a flashing light, a wagging door and so forth. It can change the player's previous activity and lead the player to the source of stimulus.

Creating a visual communication is important. Unlike explicit directional cues, visual communication is a form of cue that is integrated into the game world. It visually conveys the functionality and implication of the environments of the game. A visual expression that is easy to understand, enhances the player's ability of wayfinding in an artificial world. Guiding players in games as well as creating an aesthetic experience for their gameplay is a difficult issue. The visual communication must be consistent. It not only maintains the coherence of the game aesthetics, but also enables players to identify the accessible pathway. Nisbet suggests that inconsistent visual experiences in directional cues may reduce the player's immersion and the enjoyment of the gameplay (Nisbet 2016).

3 Navigation Aids in Open World and Linear Games

Before developing the game environments, game developers need to make a decision on the overall environmental structure of a game for supporting the desired gameplay. Most games which adopt the first person perspective or the third person perspective usually apply either an open world environment or a linear environment, and some of them take both (Nisbet 2016). Game designer Scott Rogers refers to the open game world and linear environment as "island" and "alley", respectively (Rogers 2014: 219). The terms apply to different ideas of environmental structure design.

With respect to an "island" game level, it usually requires a flexible game camera to accommodate a wide range of widths and elevations. As the game cannot guarantee that

the player will look at the right direction, Rogers suggests that it is difficult to execute scripted events in such a game world; some key Combat encounters may be bypassed (Rogers 2014: 219). As discussed above, there are usually compass, mini map and other navigation aids in open game worlds for providing information, leading players in the right direction and hence push the game progression. Rogers asserts that the “island” level design gives vast space that player can freely choose the order of game level exploration as their preference (Rogers 2014: 219).

However, this does not mean that linear narrative games always happen in a narrow game space. The “alley” game design can be expansive and visually give the illusion of space and freedom to players (Rogers 2014: 219), as seen in *Battlefield 1 (*2016) and *Call of Duty: Modern Warfare 2* (2005). Linear games often feature a single route with larger areas or a main route with branching paths that end up with a single area of advancement (Nisbet 2016). This ensures that players reach every progression point in a certain order to push the game progression appropriately. As the game world in this case is not an open space, there is usually no compass or mini map. In a game with well-designed terrain, the player is like walking into an alley without walls and always move along the correct path.

3.1 Open World Games

Navigation aids take different forms, and multiple forms often coexist kin the same game. Generally, in an open game world, there will be a world-oriented map as the global map for player’s wayfinding, which will not be displayed in HUD. As discussed above, the navigation aids in HUD aim to quickly give information to players, and games tend to apply different navigation strategies in based on the idea of game design, such as character-oriented mini map (*Witcher 3, Red Dead Redemption 2*, *GTA5*) or compass (*Fallout 3, Gothic 3*, *Horizon Zero Dawn*). They do not require too much time to interpret, players can read the information from them speedily. Some games do not provide navigation aid in the HUD (*Far Cry 2, Far Cry 5*).

Figure 19: *Watch Dog 2*, breadcrumbs has digital style

Figure 20: *Witcher 3*, breadcrumbs on mini map

Apart from a mini map, games can also apply explicit visual cues to assist players. They can manually point to a location on the global map, and breadcrumbs can be generated correspondingly. However, the use of breadcrumbs in the game world may spoil the visual experience of the game and weaken player's immersion. Nisbet suggests that using visually consistent cues appropriate to the game's aesthetics and environment may enhance player's immersion (Nisbet 2016). However, breadcrumbs as unnaturally generated cues, often take the forms of fluorescent arrow or dotted line. Even if a breadcrumb trail's form is consistent with the aesthetics of the game, such as breadcrumbs in *Watch Dog 2* (See Figure 19), its generation is unnatural in a scene. Therefore, instead

of in the game world, those games which contain a mini map in HUD, often display the breadcrumbs on the mini map. In *Witcher 3*, when the player points a location on the global map, there will be a dotted line generating from avatar towards the destination on the mini map (see Figure 20).

The weakness of breadcrumbs is that its capacity of terrain identification is not intelligent enough. When the player marks a location on the global map, the game will recognize the terrain between avatar and the destination automatically, then generate breadcrumbs. This pathway is generally created basing on game roads and paths, i.e., it will avoid hills, forests, rivers, and other terrains that may impede the player's movement. In *Red Dead Redemption 2*, for instance, the breadcrumbs will be generated along the road displayed on the map, even though in this game, the player's actions will not be restricted by some terrains. When breadcrumbs prompt the player to move along the periphery of the forest, the player is often able to travel through the forest and reach the destination faster. When players are given a choice, they prefer the shorter route than the longer route, unless the shorter one is more complex (Vembar et al. 2004). Therefore, when the player has map to recognize the terrain of the trip, breadcrumbs sometimes will decrease the wayfinding efficiency.

Setting up mini map within HUD in an open world game may weaken the enjoyment of gameplay. As mentioned above, in *Witcher 3,* players can use the mini map to witness details out of sight, including terrains, potential threats, and collectable items (see Figure 20). Referring to gameplay, wayfinding usually is not a primary purpose, but the inevitable exploration during the wayfinding process (Bidwell et al. 2007). Rather than wandering between destinations relying on navigation aid, in Red Dead Redemption 2, players often meet unexpected events during the wayfinding, such as being robbed by gangsters, witnessing an NPC being attacked by wolves. Players can get involved in these events to trigger a new story line. These events enhance the game's realism and immersion. When players know what will happen next, the predictability will spoil the fun of games. A research

finds that if there is an arrow cue on the mini map, participants will spend most of time looking at the map during the wayfinding (Vembar et al. 2004). In this case, players are just blindly stumbling from waypoint to waypoint, which makes it hard for them to be immersed in the otherwise incredible artificial world.

Scholars suggest that game design should promote player's acquisition and reflection upon environmental information during their travelling (Bidwell et al. 2007). For this purpose, games should restrict the available information in navigation aids. *The legend of Zelda* series is a good example. Instead of understanding the game world through maps, the core gameplay of Zelda is exploring. The first Zelda was released in 1986, and despite its age, there are forest, rivers and wild monsters in this game. While these elements are not displayed on the mini map, in the original Zelda, the mini map is at the top left corner of the screen (see Figure 21). The content inside is minimized, the entire map is a gray square with only one pixel on the space representing the location of avatar. The player must explore every corner of the game world to find the way and kill the monsters

Figure 21: *The legend of Zelda* (1986), mini map is at the top left

This idea continues to this day, for example through a mechanism in *the Legend of Zelda: Breath of the Wild* (2017) (see Figure 22). The background is in vacuum, both terrain and enemies are not demonstrated in the map, like the original Zelda. The game world is

separated into several plates, each plate has a watchtower. When the player approaches the watchtower and triggers an event, then the maps (both the character-oriented map and the global map) will be activated. The manual icons (like floating points) are displayed on two maps, but players can only know the direction of the mark – they still need to figure out how to approach the point by themselves. In addition, even if the map is activated, it only shows watchtowers and the terrain of the game world, no icons for nearby activities, side quests, and collectibles on it. Players must explore the world without any directional cues. This also means that driving players' travel around the world is not by icons and waypoints, but through their curiosity and desire for exploring.

In *Breath of the Wild,* the terrain is a part of the game's navigation aid strategy. If in a game, players can approach to every destination through following the indication from mini map, the mountain and river are meaningless to the players. While in this game, the spatial structure of the world serves a function in the gameplay. Players may need to climb a mountain or a high place to observe the surroundings for reaching their destination. Meanwhile the details of the world are restricted on the map intentionally, players have to observe their surroundings carefully. In this case, the game world becomes more authentic and important for every participant.

Figure 22: *Breath of the Wild* (2017), mini map only displays towers and manual marks

Another measure of restricting information that players can receive is to replace the mini map with a compass. In some games, a compass can tell the player the direction of their goals, even when the player does not understand the terrain of the trip in advance and therefore cannot predict the events they may meet during the trip. To some extent, games applying compass rather than mini map in the HUD still maintain the unpredictability. Therefore, some games started to remove the mini map. For example, in the *Assassin's Creed* series, there is no mini map in the last two installments *Origins* (2017) and *Odyssey* (2018) (see Figure 23). Instead, a compass taking the form of dynamic ruler is installed at the top of the screen. Player's goals are represented in the compass by icons. Though both titles apply floating points to offer more assistance to players. Thus, it is difficult to judge that the immersive experiences they give are better than *Witcher 3*.

Figure 23: *Assassin's Creed: Odyssey,* apply compass and floating points.

By contrast, *The Elder Scrolls* series carry out this idea directly. In *Morrowind* (2002), there is still a mini map at the top right of the screen. But the next two series *Oblivion* (2006) and *Skyrim* (2011) only have a compass. There are no other explicit visual cues on the screen. Besides, the information that compass can provide, depends on the form of compass. For example, and as discussed above (chapter Compass), in *Gothic 3*, its compass can only be used to orient.

It is noticeable that some games do not feature any navigations aids on the screen. Players can only receive the information that they can see, everything out of their sight is unknown. Both *Far Cry 2* (2008) and *Far Cry 5* (2018) take this strategy. In *Far Cry 2*, the global map is integrated into the gameplay. Instead of generating a new window for the global map, the game presents the map in a form of handheld map. Players can only check the map when they are in a car (see Figure 24). This gives players an immersive experience that they are exploring a totally unknown world. The curiosity drives them to go to somewhere rather than the visual cues. As the lead writer of *Far Cry 5* Drew Holmes said, “We really wanted to focus on exploration with a sense of, ‘I’m not sure what to do or where to go’” (Warman 2017).

Figure 24: *Far Cry 2*, players can check a handheld map when they are driving

However, it does not mean that players can understand the terrain of the entire game world as long as they have a global map. Many games feature a mechanism which is similar to ants memorizing routes (Bidwell et al. 2007). Players must explore the world themselves as they do not have the “memory” of an area where they never visited. The unexplored area is vacuum on the map. It is like the global map in *the Legend of Zelda: Breath of the Wild* mentioned above. In *Breath of the Wild*, the map will be activated by utilizing the

watchtower. In some games, players must explore the game world like ants, for the "memory" of the area. *Red Dead Redemption 2*, for instance, only the explored area will be generated on the global map (see Figure 25). This mechanism may stimulate player's desire of exploration, especially for those who fall under the "explorer" and "achiever" in Bartle's player types.

Figure 25: *Red Dead Redemption 2*, unexplored area will not be displayed on the map

3.2 Linear Games

As discussed above, linear narrative games often feature "alley" structure and have no global map for players. They tend to minimize the navigation aid element in HUD in order to provide a better visual experience. In linear games, exploration is no longer part of the core gameplay, instead the game world is used to serve the story. The navigation system aims to lead players to find out the next narrative progression point. Meanwhile, Players need to decode their surroundings. If the game applies explicit visual cues, this streamlines the gameplay and reduces challenges. Players may be excessively reliant on cues to find out progression points and ignore the game itself. Therefore, linear games often utilize implicit visual cues to lead players, such as lighting, physical barrier, color and so forth. These cues generally fit in the game world and visually keep the aesthetics of the game consistent.

Game designers often develop navigation strategies in games to “nudge” players along the path that designers intend, while still leaving other options open (Winters and Zhu 2014). This gives a sense to players that they still have freedom to explore whichever they choose. Players always seem to stumble across new content, but they are not entirely aware that they are subconsciously persuaded to choose that path or enter that door, by implicit visual cues. They still believe other exits and doors will lead to new places. This creates an illusion for players that the world is visually bigger than it really is.

The Last of Us (2013) is a typical linear game, and implicit visual cues are widely used in this game. For example, one scene is the night that the plague breaks out (see Figure 26), and here the main character Joel is escaping away from the zombie with his daughter. In this scene, many NPCs are running in the same direction with the intention that the player will follow the people unconsciously. This is the strategy that utilizes motion to lead players. Besides, windows, eaves, and stripes on the road all create implicit lines toward the same direction, which refer to the strategy of visual composition. In the following scene, the player comes to a junction (see Figure 27). Some cars are out of control and collide, which form physical barriers and block the road. There is a distinct streetlamp lighting up a side path which is the next progression point. The streetlamp is the key lighting to tell the player to go that way. This is how game subtly nudges players through the game level and keep them on the carefully scripted path laid out by designers.

Figure 26: *The Last of Us,* example of motion and visual composition

Figure 27: *The Last of Us,* example of physical barrier and key lighting

4 Navigation Aids in Multiplayer Games

The virtual environment that multiplayer games provide is considered as appearing in a relation of mediation for the communication among players (Leino 2013). Navigation aids like mini maps, need to serve players in their interaction with other players. In multiplayer games with big open worlds, such as MMORPGs, the mini map is the most common navigation aid with the similar functions to single-player games. Player can pin a location on it and share the information with team members. The difference is that in MMORPG games, mini maps also display the locations of other players.

Figure 28: *Dota 2*, mini map shows the entire battlefield

Mini maps play a vital role in RTS games. In RTS games, the mini map represents the entire battlefield, as players have requirement of overviewing different locations at the same time (Zammitto 2008). In MOBA games for instance, the mini map briefly demonstrates everything happening in battlefield (see Figure 28). Players are able to know every participant's location immediately. It is highly valuable that players can collect information at a glance (Zammitto 2008). In addition, players can briefly communicate with team members through the mini map. When they "pin" a location, everyone in the same group will see the pin. As the mini map represents the entire battlefield, it should restrict the information displaying on it. If players can understand every enemy's location, the game

will lose its playability. Therefore, RTS games often apply a mechanism to limit player's view: fog of war.

Under the fog of war, everything is in dark. In MOBA games, the player's view is limited. Every avatar has a certain range of sight. The space out of their sight will be in fog of war. and it exists on both battlefield and mini map. When players witness an enemy, the enemy is also displayed on the mini map to every team member. To sum up, mini map functions as a tool for receiving and sharing information.

5 Conclusion

Navigation aids play an important role in video games. Not only for player's wayfinding, navigation aids serve various demands, including exploration and interaction among players. Based on this idea, the research studies different type of navigation aids respectively and presents examples from different games. In addition, games usually apply various navigation strategies to meet the requirement of game design, whether they are the same genre or not. By discussing several games, this research studies navigation strategies in open world games and linear games. Furthermore, navigation aids often feature different functions rather than only providing directional cues to players. This research discusses the mini map in multiplayer games, which is often used as a communication tool. The limitation of this research is that it does not involve data from players. As the game experience is a subjective feeling, player's feedback will be a valuable reference to judge the pros and cons of navigation aids.

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